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ދާދިވަގު ، ފ، ދިވެހިރާއްޖެ

ADDENDUM 1

1 ވަނަ ހިނގުން

ނަންބަރު No:	**TES/2020/G-006-R02**
ޕްރޮޖެކްޓް Project:	**Design, Supply and Installation of a Construction and Demolition waste processing plant - 2nd Retender**
ހުށަހެޅި ތާރީޚް Issued Date	**10th October 2021**

ސަފްޙާ ތަކެއް No. of Pages: -02	ބ.ބ.ލ Boq: -00	ޑްރޮއިންގ Drawings: -02

Please include this addendum when submitting the bid. ތިލަ ހުށަހަޅާ ލިޔުންތަކުގައި ބަލައި ހަމަ ކުރަންވާނެ ކަމަށް ދަންނަވަމެވ.

Please find attached;

- Addendum 01 for the project.
- Waste Processing Plant Drawing – Ground View.
- Waste Processing Plant Drawing – Cross Section.
- C&D Waste Survey report.

ނަން **Name: Aminath Naheen Ahmed**	ސޮއި **Signature:**

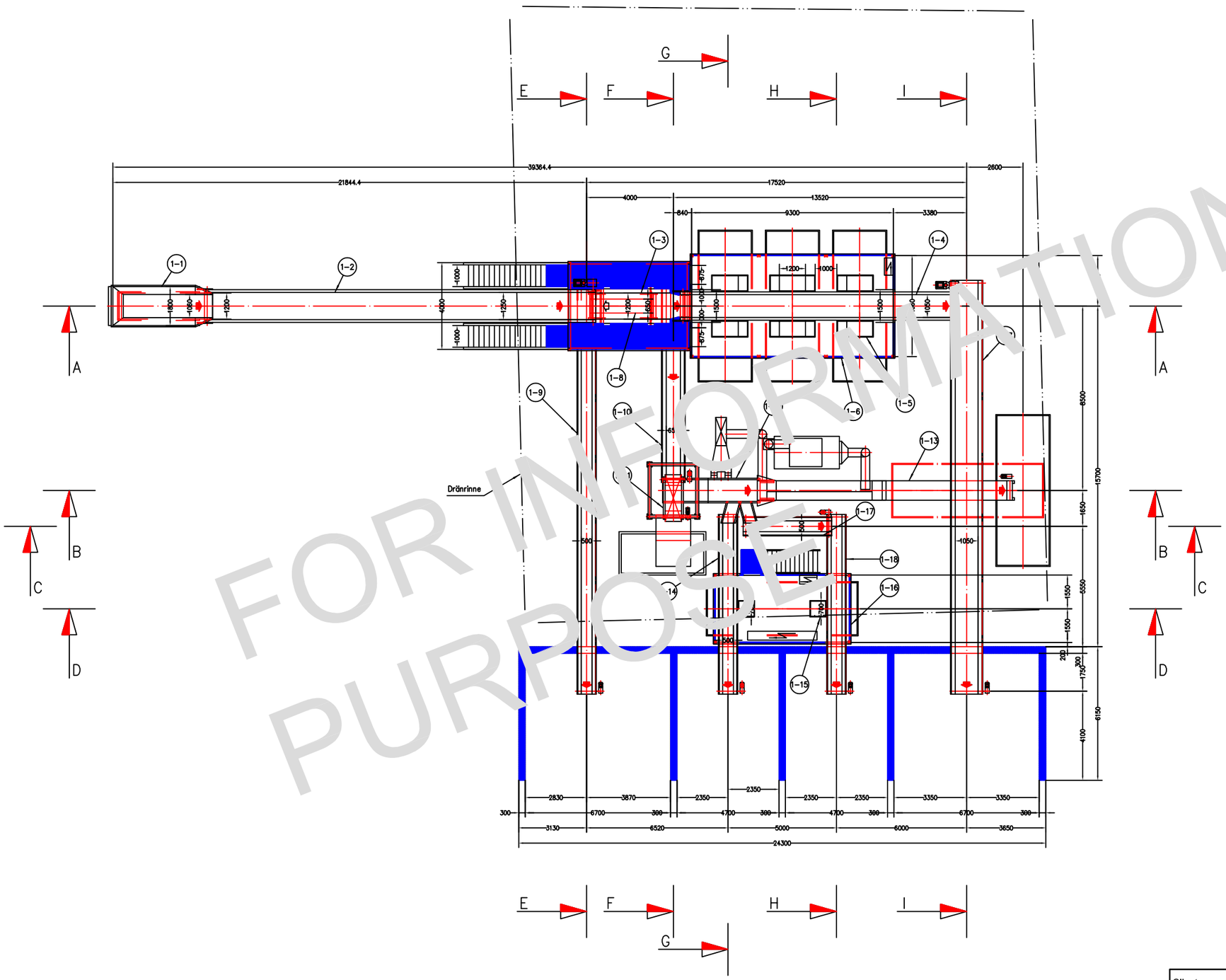
MINISTRY OF FINANCE
Male', Republic of Maldives

ADDENDUM 01

This Addendum 1 is issued in accordance with Sub-Clause No. 8.1 of Section 1 – Instructions to Bidders. The addendum forms part of the Bidding Document.

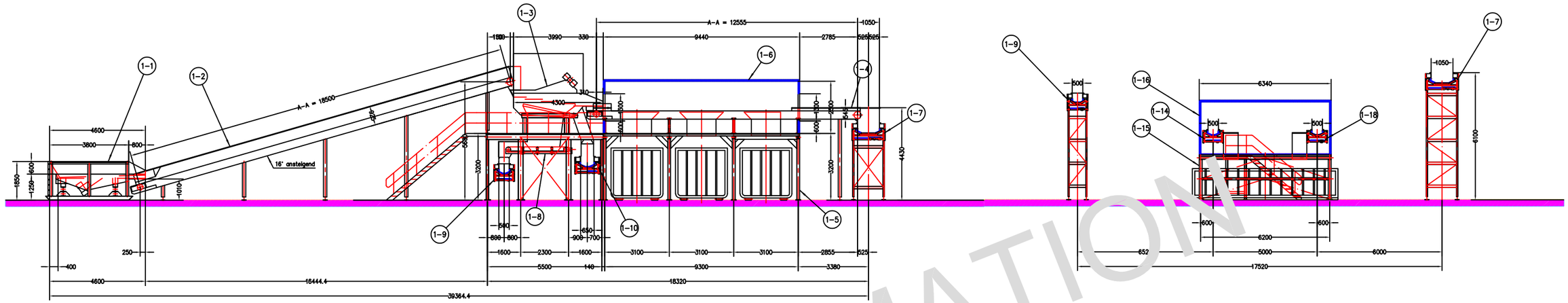
Section 6 - Drawings	Please find attached the drawings mentioned in annex.
Section 6 – Supplementary Information	Please find attached the C&D Waste Survey report.

MINISTRY OF FINANCE
Malé : Republic of Maldives



Client	**Ministry of Environment and Energy**		
Project Title	Consultancy Services for Feasibility Study for an Integrated Solid Waste Management System for Zone III (including Greater Malé) and Preparation of Engineering Design of the Regional Waste Management Facility at Thilafushi		
Design phase			
Contents	Waste Processing Plant - Ground view		
Scale	1:200000		
Drawing No.	01	Paper	A3

Schnitt A–A



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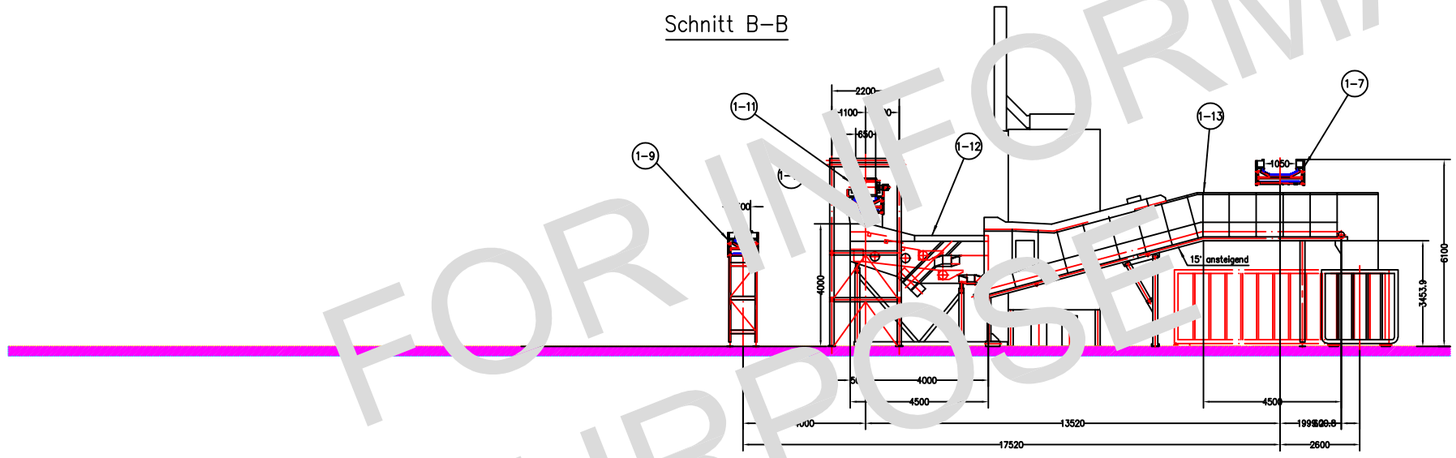

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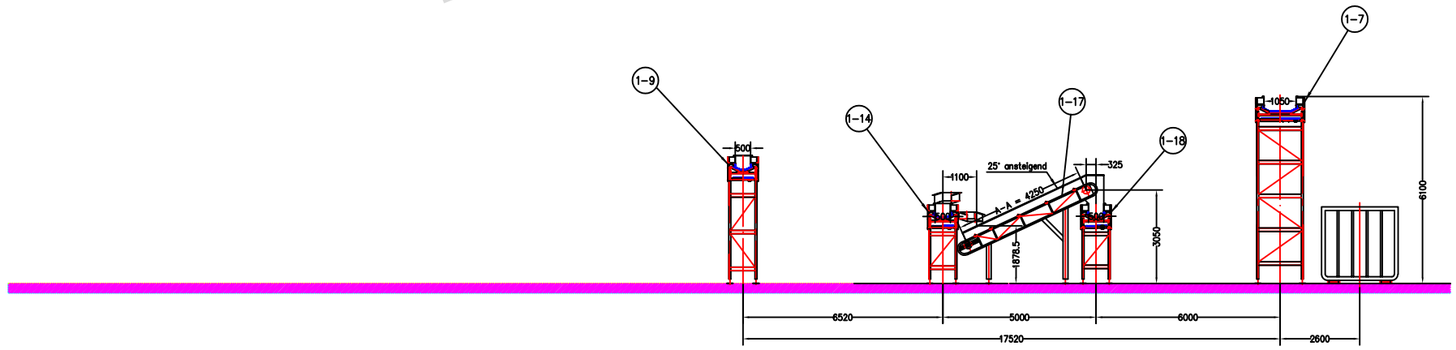

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Construction and Demolition (C&D) waste;

Construction and Demolition (C&D) waste is generated by activities such as construction, demolition and maintenance of civil infrastructure and facilities. The local authorities do not have accurate data on C&D waste, despite the fact that there is a dedicated service for collection and removal of this waste stream under implementation, there are no separate collection points and there is lack of infrastructure.

Removal is made based on occurring needs and not on proper planning. Therefore this specific stream is reported by all stakeholders as a growing problematic in terms of the high expenditures that collection and transportation services require. Due to the lack of specific locations and suitable containers for the removal of this specific stream, the risk that citizens and private businesses deposit their C&D waste (small non-industrial quantities) in a centralized collection place or mix it with common household waste. It is not a seldom practice to encounter piles of C&D waste that is illegally disposed at by the sides of road axes. A special on demand pick-up service for bulky and C&D waste is installed by WAMCO, and some of the industries might bring bigger quantities to the transfer station site in Male.

C&D waste is identified as a priority stream because of the high recycling and reusing potentials. Special C&D elements can be used for road construction and maintenance, draining projects, etc. In addition to this, the current technologies for segregation and recovery of these fractions have advanced. The C&D stream can be easily accessed and is relatively cheap.

Construction and Demolition waste has been estimated from the observation and asset of previous docking station dedicated exclusively for Industrial and C&D waste (October/November 2016).

A series of surveys on estimating amount of construction and demolition waste generated in Male' were conducted 1 year later, to estimate the average composition and amount of the construction and demolition waste brought to the Male' transfer station. The waste transfer station is opened to incoming vehicles from 06.00 am to 02.00 am. Construction and demolition waste, Household and other waste is the loaded onto a vessel and taken to Thilafushi. The size of vehicles that carry C&D waste varies from 350kg to 5T.

Survey 1 was conducted on 29th October 2017 at Male' transfer site by 5 members from Water Solutions. A total of 41 vehicles containing C&D waste were surveyed and its content were recorded.

A method of visual characterization of disposed waste from construction and demolition activities produced for the State of California in October 2006 was used as a model in this survey to estimate the composition of C&D waste. This generally involves measuring the volume of the waste loads and visually characterizing the waste to a set of materials which were categorized by this method. The volumes measure were converted to mass using industry-accepted density values. The volume was measured when the trucks arrive and stop to make the entrance payment. The length and width of the loading section of the truck was recorded and an average from two readings for the height of the waste pile was taken to calculate the volume. An excel tool was also provided with the instructions for said method. This was used to estimate the percentage composition of the different materials.

The following estimates in *figure 35* were generated by the aforementioned excel tool. About 92% of the C&D waste was aggregates and dirt, which is mainly concrete from houses that have been demolished, sand and rocks after excavations from foundation works. Most of the plastic was from polypropylene woven sacks that contained sand, rocks and small pieces of concrete. The wood materials were mostly pallets and lumber beams; however, sawdust and wood shavings from carpentries were also included. Paper materials were mostly just cardboard boxes.

Estimated Composition by Weight for All Loads

Paper	**0.5%**	**Roofing**	**0.0%**
Unwaxed OCC	0.5%	Roofing	0.0%
RC Paper	0.0%	RC Roofing	0.0%
Plastic	**0.5%**	**Insulation**	**0.0%**
Non-bag Film	0.5%	Insulation	0.0%
Polystyrene Packaging	0.0%	RC Insulation	0.0%
Rigid Plastic	0.0%	**Wood**	**7.1%**
RC Plastic	0.0%	Clean Recyclable Lumber, Pallets, Crates	7.1%
Metal	**0.2%**	Other Untreated & Recyclable Wood	0.0%
Major Appliances	0.0%	Painted, Stained, Treated Wood	0.0%
HVAC Ducting	0.0%	RC Wood	0.0%
Other Ferrous & Non-Ferrous	0.0%	**Gypsum**	**0.0%**
RC Metal	0.2%	Clean Gypsum Board	0.0%
Organic	**0.0%**	Painted Gypsum Board	0.0%
Prunings, Trimmings, Branches, Stumps	0.0%	RC Gypsum	0.0%
RC Organic	0.0%	**Misc. C&D**	**0.0%**
Carpet	**0.0%**	**Glass**	**0.0%**
Carpet	0.0%	**Electronics**	**0.0%**
Carpet Padding	0.0%	**HHW**	**0.0%**
RC Carpet	0.0%	**Special**	**0.0%**
Aggregates & Dirt	**91.8%**	**Mixed Residue**	**0.0%**
Dirt, Sand, Soil	41.0%		
Concrete	42.6%		
Asphalt Paving	0.0%		
Brick, Ceramic, Porcelain	0.0%		
Rock, Gravel	8.1%		
RC Aggregates & Dirt	0.0%	**TOTAL**	**100.0%**

Figure 1 Estimated composition of C&D waste from Male' Transfer Station

Figure 2: Barge at Male' TS that contains a mixture of C&D waste and household waste

The mass of the waste load was calculated for individual materials by using their density values.

Sample no	Materials	Volume (m^3)	Mass (kg)	MAM of Vehicle (kg)	Difference
6	Aggregate and Dirt-Concrete	5.02	4,300	2,000	2,300
8	Aggregate and Dirt- sand	4.3	3,900	2,000	1,900
11	Aggregate and dirt, Wood	6.1	4700	1,500	3,200
17	Dirt, Wood, Plastic	7.68	5,820	1,500	4,320
19	Dirt Wood plastic	3	2,900	350	2,550
23	Aggregate & dirt	7.14	6,100	2,000	4,100
28	Wood, metal	3.9	645	350	295
31	Aggregate & Dirt	6.2	5,300	5,000	300
36	Plastic, cardboard, wood	1.49	340	350	-10
39	Aggregate and dirt	5.8	5,400	5,000	400

Table 1: Mass of waste and MAM for randomly selected trucks.

The calculated mass for the waste was observed to be much higher than the Maximum Authorized Mass (MAM) of the vehicles. A vehicle could carry more than the MAM, but some reading showed values that were more than twice, even thrice of the amount. Hence, these results are not reliable. These overestimated values maybe due to the empty areas in volume that was not accounted for when converting to mass.

Figure 3: (a) Aerial view of a 2T truck containing concrete waste (b) Truck containing sand and rocks in polypropylene woven sacks with wooden pellets on top (c) Aerial view of a 2T truck containing concrete waste (d) Truck containing soil.

Date	No. of trucks carrying Concrete							No. of trucks carrying Wood					No. of trucks carrying Sand			
	350 KG	1.5 Ton	2 Ton	3 Ton	4 Ton	5 Ton	Total (Ton)	350 KG	1.5 Ton	2 Ton	4 Ton	Total (ton)	1.5 Ton	2 Ton	4 Ton	Total (ton)
27/10/17	6	4	25	6	1		80.1	11	1	4		13.35				0
28/10/17	8	12	71		3	2	184.8	6		3		8.1		6		12
29/10/17	9	15	59			14	213.7	4	2	3	1	14.4	1	14	1	33.5

Table 2 Number of different sized trucks carrying concrete waste, wood, and sand, and their total tonnage from MAM of the trucks

The entrance posts at the transfer station keep logs of the time, plate number, MAM and the type of waste. The three types of waste that were considered to be C&D waste in these logs were concrete, wood and sand. *Table 10* shows the number of truck of each size that carried a certain material of waste. By adding up the frequency and capacity of these trucks we get 93.45T for 27th (Friday), 204.9 for 18th (Saturday) and 261.6 for 29th (Sunday) of C&D waste.

About 92% of the C&D waste was comprised of 'Aggregates and dirt', which refers to the demolished concrete waste, rock, and sand from excavation works. However, most of the loads that contain sand, rocks, and even smaller concrete that have been smashed to smaller pieces are packed into polypropylene woven sacks and then transferred. This obstructed us to see exactly what was in these sacks and if all the sacks has the same content. We also asked the drivers about the contents and if its demolition waste, they would say it is either wood, Gaakundi (Dhivehi word for demolition waste and similar material) or sand.

Figure 4: (a) Soil and rock in polypropylene sacks (b) truck overflowing with wooden pellets and other mixed waste (c) Large pieces of demolished concrete (d) Truck overflowing with mostly wooden pellets with some metal containers on top.

A lot of the trucks also carried mixed waste of C&D. The individual percentage composition of these trucks were harder to get as waste is loaded as an overflowing pile and we cannot see very well what is underneath. *Figure 38 (b) and (c)* are examples of such vehicles. However, the regular shape of the loading section of the truck made it easier to estimate the percentage of the material.

As mentioned before, the large overestimation of the mass of the load compared to the MAM of the vehicle was due to the empty spaces that were not accounted for. Trucks carrying large

concrete slabs and columns on top of each other would have many empty spaces and would have an irregular shape but we calculated volume with the assumption that the load was a regular cuboid. *Figure 38 (c)* shows the width of the waste load being taken and the empty areas within the volume measured. Therefore sand, concrete and rock material that have high densities would give a much higher value for mass than the actual value if the empty is not taken in to consideration.

Although a daily amount of C&D was found from the log sheets acquired from WAMCO, these values only reflect the MAM of the trucks and not the actual value. It is seen that these trucks usually load more than they can carry and some vehicles even have thin plywood attached to the sides to load high piles of waste. The purpose of this survey was to find a value closer to the actual and not just rely on the vehicles capacity. Therefore, a second survey was conducted that estimated a percentage empty space along with the types of material.

The second survey was conducted on 2nd of November and recorded a total amount of 20 trucks. The main purpose of this survey was to account for the empty space of the measured volume for load.

The same method was used to measure the volume and visually characterize the type of C&D wastes, except this survey includes a percentage for empty space. By doing so, a value closer to the actual mass of the load can be estimated. However, it would not be possible to use the excel tool to assess the composition of the waste as empty space is not an option given in the tool and the total percentage for materials need to add up to 100 for every sample. So this survey would only look into the amount of C&D waste brought into Male' transfer station.

Mass for each sample was calculated using the percentage volume and the industry-accepted density values for the specific materials in that load.

To find the total mass of C&D waste brought in the Male' TS on a day, the average difference between the MAM and mass was calculated as a percentage for 2T trucks containing most of 'aggregates and dirt' material. This percentage increment was added to the total mass of 'concrete' and 'sand' materials logged by the WAMCO staff at the entrance post. The MAM were used for trucks containing wood because percentage composition of wood is significantly lower than aggregate and dirt. This also has a much higher density than wood, therefore contributing more to the discrepancies in mass calculated.

Table 11 shows the Volume, percentage empty space estimate for each load, mass calculated for each sample, MAM of the truck and the difference between the MAM and the mass calculated. Rows that have been highlighted in light green shows the samples that contained a majority composition of 'aggregates and Dirt' material. The maximum difference between MAM and mass calculated was 2,711.8kg and the average difference was 1,181.75 kg which is 59.1% of the MAM.

Table 12 shows the total daily mass of C&D waste brought in to Male' TS after the percentage increment of the average difference between MAM and the calculated mass.

Table 3: Volume, percentage empty space and Mass for the 20 samples

No.	Volume (m^3)	% Empty	Mass (kg)	MAM (kg)	Difference
1	6.944	15	3654.15	2000	1654.15
2	8.1	70	2089.8	2000	89.8
3	6	20	4711.8	2000	2711.8
4	8.1	60	2786.4	2000	786.4
5	6.786	65	2042.59	2000	42.59
6	3.906	10	3506.5	1500	2006.5
7	4.59	30	2921.1	2000	921.1
8	4.86	40	2845.53	2000	845.53
9	4.96	27	3182	2000	1182
10	4.08	25	2698.94	2000	698.94
11	6.72	22	4706	2000	2706
12	5.28	18	3952	2000	1952
13	2.2185	23	1534.8	2000	-465.2
14	1.116	42	317.88	350	-32.12
15	6.72	30	3035.81	1500	1535.81
16	4.8	15	3447.6	2000	1447.6
17	4.464	25	3971.77	2000	1971.77
18	5.1	25	2625.49	2000	625.49
19	6.12	45	215	2000	-1785
20	5.27	35	222.12	1500	-1277.88

Table 4 Total daily mass with percentage increments of 59.1

Date	Concrete		Wood	Sand		TOTAL (ton)
	Total (ton)	% increase of 59.1	Total (ton)	Total (ton)	% increase of 59.1	
27/10/2017	80.1	127.4	13.3	0	0	140.7
28/10/2017	184.8	294.0	8.1	12	19.0	321.2
29/10/2017	213.7	339.9	14.4	33.5	53.2	407.6

The deviations of the calculated mass from MAM can be more acceptable here compared to the first survey. Most of these trucks were observed to be carrying overflowing amount of C&D waste and could be carrying more that it's authorized mass.

As the station is opened from 06.00 am to 02.00 am, conducting a survey to record all the vehicles would be very challenging. For that reason, log sheets from WAMCO were obtained to have a sense of the capacity and number of vehicles coming in. It was also helpful that they noted the general materials in the trucks. Although some of the trucks contain mixed C&D waste, these forms only have one general material recorded. This data could have been used to find the daily mass brought in to Male' TS using the deviation from the MAM of different trucks containing different materials. Unfortunately, 16/20 trucks recorded during the second survey were of 2T and these values could not be generated for 350kg and 1.5T trucks. Similarly, most of the materials were also concrete and sand and an average increment for wood and other materials could not be found. For wood, this was not even necessary as the calculated mass of these trucks did not deviate too much from the MAM and some of these were negative as well as seen from *Table 11.*

According to WAMCO staff, Friday is the day the station get the least amount of C&D waste and is higher is Saturdays and weekdays (Sunday to Thursday are weekdays in Maldives).

And so, Male' TS receives an estimated amount of 321 T to 408 T of C&D waste on an average day and about 140 T on Fridays.

Additional recent pictures (2020-2021)

The following figure shows the waste collected at the Hulhumale Waste Transfer Station on the barge to be transported to Thilafushi Waste Management Facility.

Figure 5: Waste collected on the barge to be transported to Thilafushi (21st February 2021)

The C&D waste pile located in Male' was observed for the duration of two days. It was informed that the C&D waste was only transported to Thilafushi when the pile accumulated enough. The following figures shows photographs taken of the waste pile on the 22nd and 23rd of February 2021.

Figure 5: Waste pile at the Male' transfer station (22nd February 2021)

Figure 6: Waste pile at the Male' Transfer station (23rd February 2021)