Pandemic Outbreak

Real-time Monitoring

Of Reverse Logistic Network of Bio-medical Waste During Lockdown

Environment Surveillance Centre

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Contents

1. Preamble

The outbreak of an epidemic disease poses significant threat to the human beings globally. It not only causes a large number of deaths, but also severely affect the economic front of the affected nation. During last two decades, the outbreak of several infectious and deadly diseases, viz. Severe Acute Respiratory Syndrome (SARS) in 2003, H1N1 influenza in 2009, the Ebola virus in 2014, and the Middle East Respiratory Syndrome Corona virus (MERS-Cov) in 2014 have created panic across the globe. The management of Bio-medical wastes and reverse logistic network for managing it play prime role in times of epidemic or pandemic outbreak owing to the fast accumulation of quantity of waste within a short span of time.

Following the global emergency declared by the WHO on January 31, 2020 due to Corona Virus Disease – 2019 (COVID-19) the GoI kept a close watch on the situation and declared a total lockdown in the country from 25.03.2020 to 14.04.2020 which was later extended to 03.05. 2020. Owing to situational demand the lockdown was further extended till 17.05.2020 with relaxations in certain essential activities based on Red, Orange and Green zonation in various parts of the country. The lockdown was further extended from 18.05.20 to 31.05.20 with greater ease to different sectors to start functioning with all necessary precautions.

The implementation of lockdown policy restricted both inbound and outbound transportation from the country, including mobility of the people in the city. All the Government offices, business and other activities were barred, except the emergency and most essential services, for speedy control of the crisis. Looking to the severity of the crisis the National Disaster Management Act was also imposed across the country.

The use of plastic during Covid-19 pandemic has tremendous environmental consequences but owing to the urgent health priority has overshadowed this issue. The disposal of plastic waste is considered as environmental liability but it is unavoidable and the planners need to re-think over it. The sudden surge in demand of single use plastic products was experienced to protect the common masses and all the people who were engaged in tackling this crisis. The management of single use plastic is already a challenge for the environmentalists globally and the impending increase in volume of plastic waste during Covid pandemic time has further aggravated the problem of plastic waste management but it is still manageable scientifically. The new scenario during Covid pandemic is about the diverged sources of biomedical waste generation viz. Containment zones or red zones, quarantine centres, isolation homes or home quarantine places, health care facilities, hospitals, laboratories etc. Keeping a vigil on all these places for effective and foolproof management of infectious waste is a challenge but government and associated agencies are putting best efforts to tackle the situation.

2. The Scenario

The pandemic situation, which arose due to human-to-human transmission of Corona Virus Disease (COVID-19), could affect the large number of people through community transmission and exponentially increase quantity of infectious medical waste within a short span of time. The worst side is that there is no medical counter measures available to negate its effect. The prevention and control strategies are considered as the only way to deal with this crisis situation. Owing to this the Central Pollution Control Board (CPCB) issued the COVID-19 waste management guidelines on 18.03.2020, amended on 25.03.2020, to be followed by all the health care facilities (HCF), quarantine centres, isolation wards, sample collection centres, laboratories, ULBs and the common bio-medical wastes treatment facilities (CBWTF) for effective management of medical wastes. All the State Pollution Control Boards and Committees are to ensure proper management of infectious Covid waste under their jurisdiction in line with the Bio-medical Wastes Rules 2016 and the relevant guidelines.

3. Monitoring Mechanism for Covid Waste

The effect of pandemic crisis was prominent, amongst other States, in Madhya Pradesh State with significantly high escalation of COVID symptoms in four of its cities, viz. Indore, Bhopal, Ujjain and Khargone. This situation raised alarm due to probable multifold increase in the infectious medical waste with an unexpected volume which, if not handled effectively and timely, could culminate in secondary contagion by affecting larger number of people. This led to the immediate requirement to ensure that the wastes generated from medical facilities is collected properly and timely from the source and is transported to the disposal site in minimum possible time with utmost care. This called for an effective mechanism which could monitor operation of reverse logistic network for transportation of bio-medical waste.

In order to ensure uninterrupted operation and functioning of reverse logistic network of bio-medical wastes the Environment Surveillance Centre, M.P. Pollution Control Board kept a constant watch on quantum of daily generation of waste, especially from the facilities which were designated for the treatment of the COVID-19 affected patients. The waste generated from other places, which were put under ‘quarantine’ and ‘isolation’ category, was also collected by the common biomedical waste treatment facility (CBWTF) operators for safe and scientific disposal. A regular online real-time tracking of all the vehicles, deployed by CBWTF to pick the waste from the source and transportation of the same to the incineration site, was practiced during the entire lockdown period. This report, published on 10.08.2020, covers the study span from 05.04.2020 to 10.07.2020.

A total of 13 common biomedical wastes treatment facilities (CBWTFs), as listed in Tab. 1, are functional across the State for the management of Covid and Non Covid medical wastes. One of the facilities, i.e. M/s Davis Surgico, Sagar is yet to commission the incinerator system. Presently this facility is collecting the waste from HCFs and transporting the same to the nearby facility M/s Elite Engineers at Jabalpur for disposal.

Common Bio-medical Waste Treatment & Disposal Facilities (CBWTFs) in M. P.			
S.No.	**Name of Facility**	**District**	**Coordinates**
01	M/s. Bhopal Incinerators Pvt. Ltd.	Bhopal	23°04'48.3"N 77°32'21.2"E
02	M/s. Bio-Medical Waste Management System	Ratlam	23°20'27.1"N 75°02'50.4"E
03	M/s. BMW Solutions	Bhopal	23°27'34.3"N 77°24'10.4"E
04	M/s. Elite Engineers	Jabalpur	23°12'42.3"N 79°54'51.7"E
05	M/s. Environment Protection Corporation	Sehore	23°11'05.7"N 77°05'02.3"E
06	M/s. Hoswin Incinerator Pvt. Ltd.	Indore	22°46'43.7"N 75°51'06.0"E
07	M/s. Indo Water Management & Pollution Control Corporation	Satna	24°30'49.9"N 80°51'29.9"E
08	M/s. J K Medical Waste Management Disposal System	Ashoknagar	24°49'26.8"N 78°08'03.7"E
09	M/s. Krupa Wastages	Seoni	22°04'00.5"N 79°40'00.5"E
10	M/s. M.P. Bio-medical Wastes Disposal System	Umaria	23°21'40.5"N 81°19'03.2"E
11	M/s India Waste Management Pvt. Ltd., Mandideep	Raisen	23°17'47.5"N 77°25'18.4"E
12	M/s. Davis Surgico	Gwalior	26°03'49.3"N 78°13'35.6"E
13	M/s. Davis Surgico	Sagar	-

Tab.1 – Common biomedical waste treatment facilities in the State.

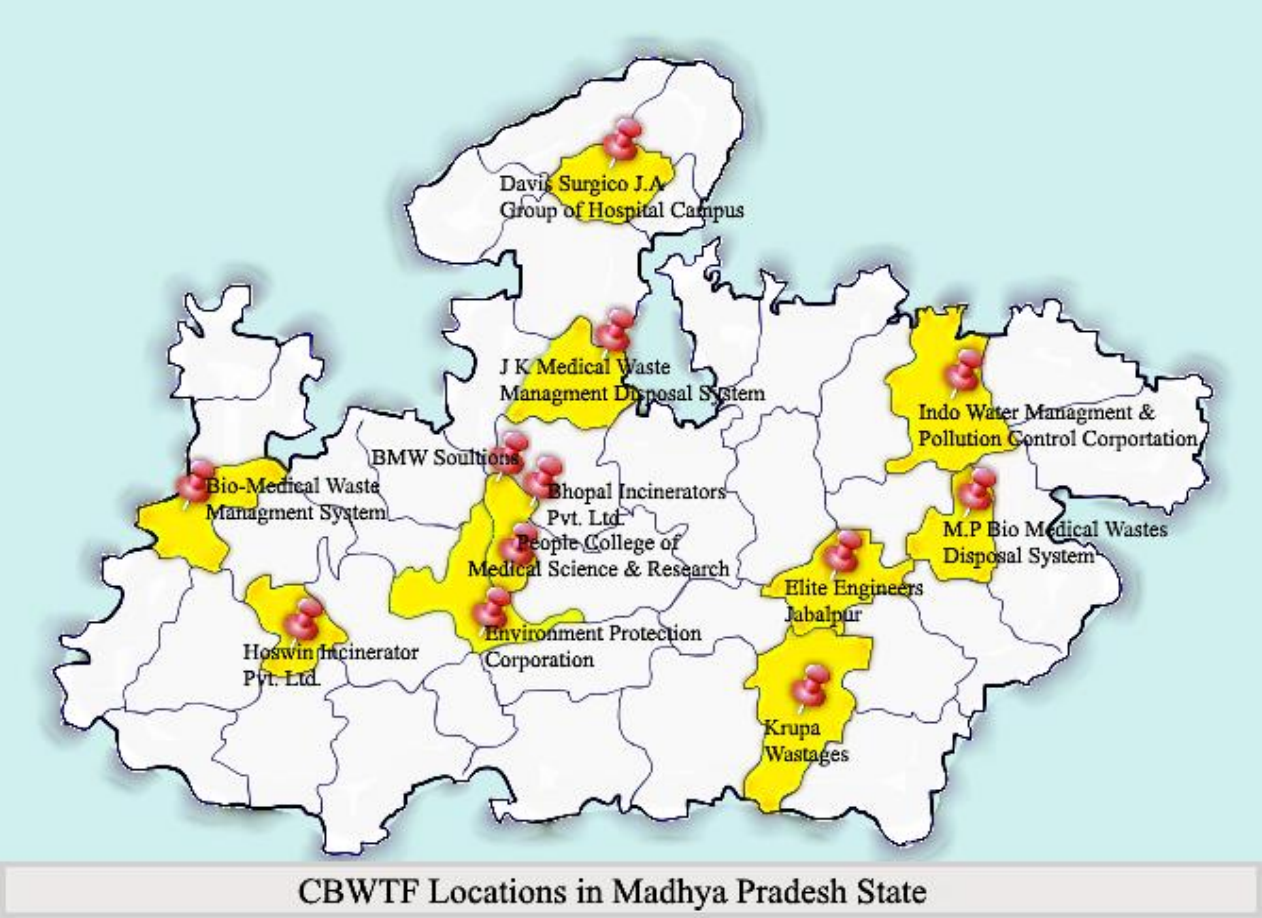


Fig.1- Map Showing Locations of CBWTFs in M.P. State

In addition to 13 CBWTFs the State has 02 captive bio-medical waste treatment & disposal facility. In addition to this 02 CBWTFs of adjoining State have been authorized for collection and transportation of bio-medical wastes from Madhya Pradesh State to Uttar Pradesh for treatment and disposal. Details are listed in Tab. 2 and Tab. 3.

Captive Bio-medical Waste Treatment & Disposal Facilities in M. P.			
S.No.	**Name of Facility**	**District**	**Coordinates**
01	M/s. People's College of Medical Sciences & Research Centre	Bhopal	23°17'47.5"N 77°25'18.4"E
02	M/s. Sanjay Gandhi Medical College,	Rewa	

Tab.2 – Captive biomedical waste treatment facilities in the State.

Authorized Facilities for Collection & Transportation of BMW from MP to other States			
S.No.	**Name of Facility**	**Districts covered**	**Coordinates**
01	M/s. JRR Waste Management Pvt. Ltd., Agra (U.P.)	Bhind, Morena	27°13'44.5"N 78°10'42.3"E
02	M/s. Labco Instruments, Indira Nagar, Lucknow (U.P.)	Singrauli (NTPC Hospital)	

Tab. 3 – Authorized CBWTF for interstate transportation of BMW.

The CBWTFs have three types of treatment facility, viz. Incineration, Autoclaving and Shredding. The existing CBWTFs are catering to the requirement of all the districts in the State ranging from 1 district to a maximum of 12 districts. The vehicles and their routes have been designated by CBWTFs to collect the wastes from the member health care facilities (HCFs) at regular intervals. The movement of vehicles and the geo-fenced track can be monitored online on realtime basis at any point of time. The area served by individual CBWTF to facilitate the Health Care Facilities and medical establishments for the management of Bio-medical waste, including Covid-19 waste, is shown in Table - 4.

S.No.	Name of CBWTF	No. of Districts	Name of Districts
01	M/s Bhopal incinerator Pvt. Ltd., Dist. Bhopal	2	Bhopal, Raisen
02	M/s Hoswin Incinerators Pvt. Limited, Dist. Indore	12	Alirajpur, Jhabua, Burhanpur, Dewas, Shajapur, Dhar, Indore, Khandwa, Khargone, Badwani, Ujjain, Aagar
03	M/s Elite Engineers, Dist. Jabalpur	3	Jabalpur, Katni, Narsinghpur
04	M/s J.K. Medical waste Management System, Dist. Ashoknagar	5	Ashoknagar, Shivpuri, Guna, Rajgarh, Tikamgarh
05	M/s Krupa Wastages, Dist. Seoni	5	Mandla, Seoni, Chhindwara, Balaghat, Dindori
06	M/s Environment Protection Corporation, Dist. Sehore	6	Sehore, Harda, Bhopal, Betul, Vidisha, Hoshangabad
07	M/s M.P. Biomedical Wastes Disposal System, Dist. Umaria	3	Umaria, Shahdol, Anuppur
08	M/s Davis Surgico, Dist. Gwalior	5	Gwalior, Datia, Sheopur, Sagar, Damoh
09	M/s Biomedical Wastes Management System, Dist. Ratlam	3	Ratlam, Mandsaur, Neemuch

10	M/s Indo water Management & Pollution Control Corpn., Dist. Satna	6	Singrauli, Satna, Chhatarpur, Panna, Rewa, Sidhi
11	M/s India Waste Management Pvt. Ltd., Mandideep	1	Bhopal, Raisen
12	M/s BMW Solutions, Berasia, Dist. Bhopal	1	Bhopal
13	M/s JRR Waste Management Pvt. Limited, Dist. Agra (U.P.)	2	Bhind, Morena

Tab. 4 – Districts being facilitated by individual CBWTF in the State.

All the vehicles deployed for the waste collection are fitted with Global Positioning System (GPS) for satellite navigation to track the actual ground position of vehicle. The vehicular information is shown in Table 5.

Vehicles Deployed by CBWTFs for BMW Management

S no	Name of Facility	Online /Offline		Vehicles	Covid -19
01	M/s. Bhopal Incinerators Pvt. Ltd., Bhopal (M.P.)	10	1	MP04 LD 3531 - TRACK	
			2	MP074 LD 3611 - TRACK	
			3	MP04 GA 8945 - TRACK	
			4	MP04 LC 8289 - TRACK	
			5	MP04 GB 4616 - TRACK	
			6	MP04 LD 0737 - TRACK	
			7	MP04 GA 8944 - TRACK	
			8	MP04 GB 8288 - TRACK	
			9	MP04 LC 8287 - TRACK	
			10	MP04 LD 0736 - TRACK	
02	M/s. Bio-Medical Waste Management System, Ratlam (M.P.)	1	1	MP43L1901_01	
03	M/s. BMW Solutions,Bhopal (M.P.)	5	1	MP04LD4571	
			2	MP04LD4572	
			3	New – 01	
			4	New Vehicles - 02	
			5	New Tata	
04	M/s. Elite Engineers, Jabalpur (M.P.)	9	1	MP20GB0578_01	
			2	MP20MB4357_02	
			3	MP20GB0487_03	
			4	MP20LB0633_04	
			5	MP20GB1370_05	
			6	MP20LA5134_06	
			7	MP20LA7292_07	

			8	MP20LA5576_08	
			9	MP20LB1714_09	
05	M/s. Environment Protection Corporation, Sehore (M.P.)	8/1	1	MP05LA0636 (Hoshangabad)	
			2	New Betul CHCs	
			3	MP04GA0729(Vidisha)	
			4	MP04GA7672(Betul)	
			5	MP04LC9886 (Harda)	
			6	MP04GA5957(Sehore)	
			7	MP04LC1305(Bhopal local)	
			8	MP04LC7757(Sehore)	
			Res	MP04GB4220	MP04GB4220
06	M/s. Hoswin Incinerator Pvt. Ltd., Indore (M.P.)	21	1	MP09GG0720	
			2	MP09GG0810	
			3	MP09GG3996	
			4	MP09GG5670	
			5	MP09GG6489	
			6	MP09GG8370	
			7	MP09GG8397	
			8	MP09GG8523	
			9	MP09GG8532	
			10	MP09GH1062	
			11	MP09GH1098	
			12	MP09GH1107	
			13	MP09HG2147	
			14	MP09LQ3081	
			15	MP09GH4968	
			16	MP09GF0441	
			17	MP09GG5679	
			18	MP09GG8073	
			19	MP09GH4923	
			20	RJ17GA5949	
			21	RJ17GA7867	
07	M/s. Indo Water Management & Pollution Control Corporation, Satna (M.P.)	12/1	1	Sadik REWA 1160	Sadik REWA 1160
			2	jawed sing-sidhi	jawed sing-sidhi
			3	Chhatarpur-santosh	Chhatarpur-santosh
			4	MP17B3206 मैहर रीवा	MP17B3206 मैहर रीवा
			5	chitrakut-jahir & sadik- sidhi	Chitrakut-Jahir & Sadik- Sidhi
			6	RIWA SIDHI -SADIK	Rewa-Sidhi-Sadik
			7	INDO CBWTF	INDO CBWTF
			8	Sadik- Rewa, Jahir- Chhatarpur	Sadik- Rewa, Jahir- Chhatarpur

			9	Singroli Baidhan	Singroli Baidhan
			10	Sidhi-Singroli	Sidhi-Singroli
			11	SATNA CITY 0638	Satna City
			12	Damoh Suresh	Damoh
			Res		
08	M/s. J K Medical Waste Management Disposal System, Chanderi, Dist. Ashoknagar (M.P.)	4	1	MP04GB1982	
			2	mp67g0705	
			3	MP67G1038	
			4	mpo4Gb4118	
09	M/s. Krupa Wastages, Seoni (M.P.)	3/1	1	MP22G-3741 (Mahindra Bolero Pickup)	
			2	MP22G-3924 (Eicher Truck)	
			3	MP22G-3984 (Mahindra Bolero)	
			Off		
10	M/s. M.P. Bio-medical Wastes Disposal System, Umaria (M.P.)	4	1	MP 18 L 0853 - Tata truck	
			2	MP 18 L 1084 - Tata Truck	
			3	MP 18 L 1085 - Tata Truck	
			4	MP 21 L 0559 - TATA TRUCK	
11	M/s India Waste Management Pvt. Ltd., Mandideep	*	*	*	
12	M/s. Davis Surgico, J.A.Group of Hospital Campus, Gwalior (M.P.)	10	1	MP 30 G 1351 - CAR	
			2	MP 09 15 G 4152 - Truck	
			3	MP 15 G 3641 - Truck	
			4	MP 15LA 1039 - Truck	
			5	MP07L2246 - Truck	MP07L2246 - Truck
			6	MP07L5588 - Truck	
			7	MP07L5589 - Truck	
			8	MP07L5591 - Truck	MP07L5591 - Truck
			9	MP07L5592 - Truck	
			10	MP07L5593 - Truck	
Total Online / (Offline/Rec) Vehicle »		88/3			

* M/s Bhopal Incineators Pvt. Limited is providing transportation facility.

Tab. 5 – Vehicles deployed by various CBWTFs for transportation of BMW

4. Tracking of CBWTF Vehicles

There was an alarming situation due to multifold increase in the quantum of infectious medical waste which, if not handled timely and effectively, could pose risk of secondary contagion. The only and the immediate way-out for this waste management was to ensure that the wastes generated from medical facilities is timely collected at the source and transported to the designated site for disposal in a scientific manner in minimum possible time with utmost care. An effective logistic network was needed to meet this requirement for timely management of bio-medical waste, including Covid-19 waste, during pandemic crisis time.

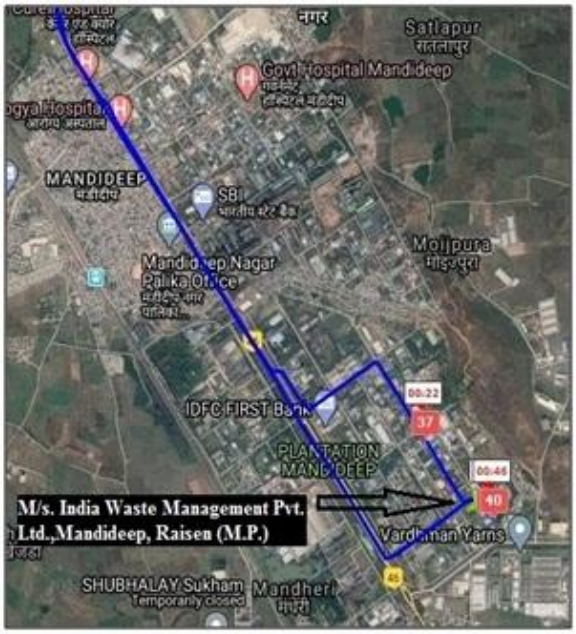
All the common biomedical waste treatment facilities (CBWTFs) in the Madhya Pradesh State were pressed into service and put on high alert to deal with the unexpected rise in the waste quantity. The vehicles deployed for the collection and transportation of wastes were geo-tagged for online real-time tracking purpose. Details of vehicles, put into service by individual CBWTF, are depicted in Tab. 5. Each vehicle had a designated route for collection of waste on daily basis from the health-care facilities and the other non-permanent sources of waste generation where Covid patients were being placed for observation and treatment purpose. The route map, geo-fence area, of CBWTF vehicles is shown at page 12 to 31 which indicates the area and the districts covered by each individual waste collection vehicle deployed by each CBWTF. The online tracking of vehicles was carried out remotely to get a truly candid picture of the vehicles movement in order to ensure that the logistic system operates and functions uninterruptedly and smoothly from waste pick-up source to the final disposal site.

All the vehicles deployed for the collection and transportation of bio-medical wastes were on the scanner of the M.P. Pollution Control Board and were monitored routinely by the Environment Surveillance Centre at Bhopal.

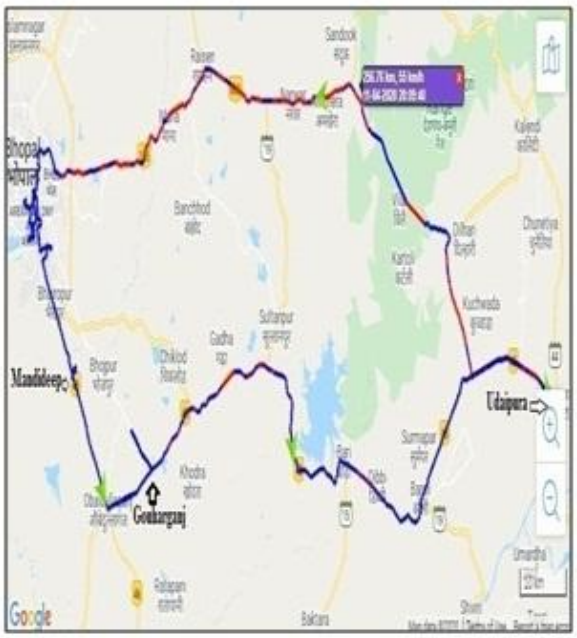
Fig 2 to 74 - Route map, geo-fence area, of CBWTF vehicles

CBWTF - M/s. India Waste Management Pvt. Ltd., Mandideep, Raisen (M.P.)

Location of CBWTF



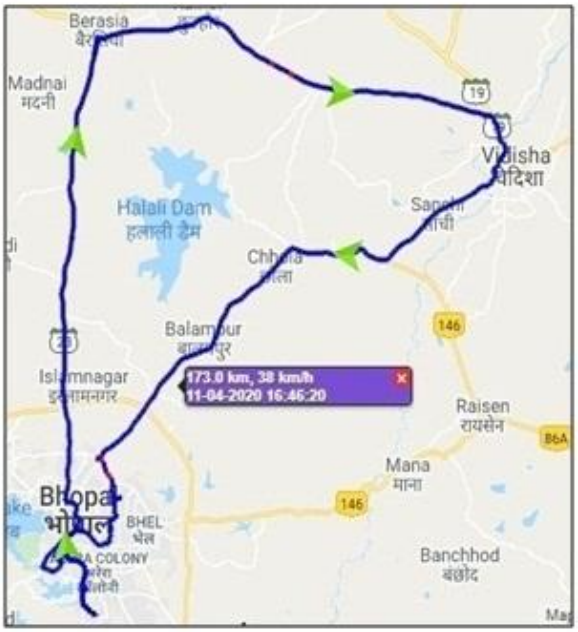
Surrounding details of CBWTF



Route map of CBWTF Vehicle for Bhopal & Raisen districts

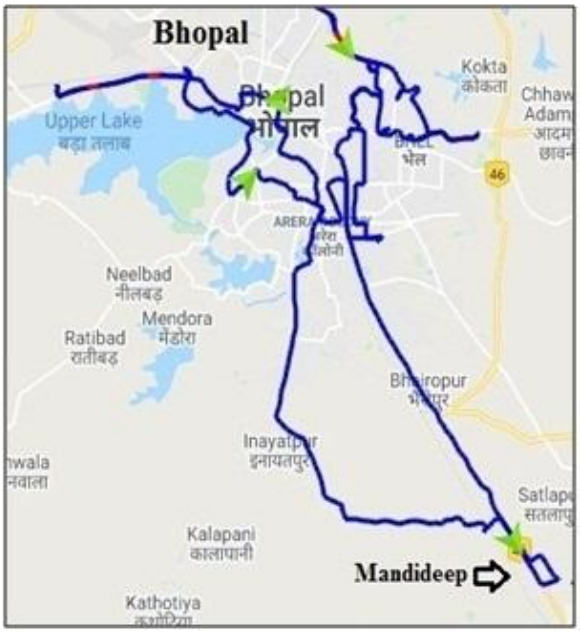
Route map of CBWTF Vehicle for Bhopal & Raisen districts

CBWTF - M/s. India Waste Management Pvt. Ltd., Mandideep, Raisen (M.P.)

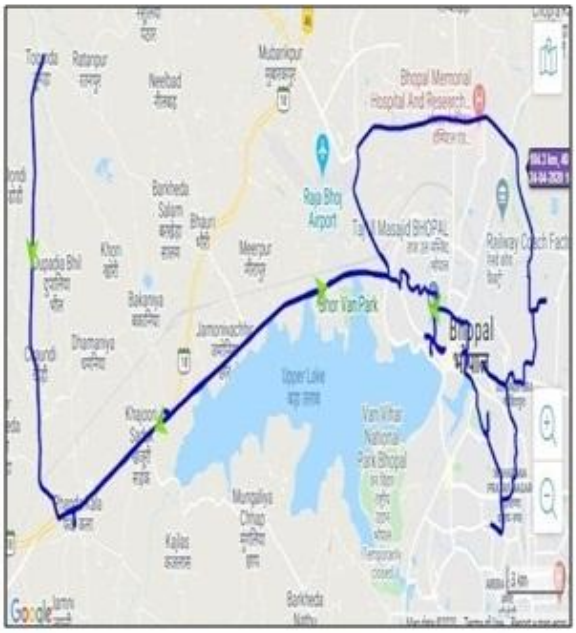


Route map of CBWTF Vehicle for Bhopal & Raisen districts

Route map of CBWTF Vehicle for Bhopal & Raisen districts



Route map of CBWTF Vehicle for Bhopal & Raisen districts



Route map of CBWTF Vehicle for Bhopal district

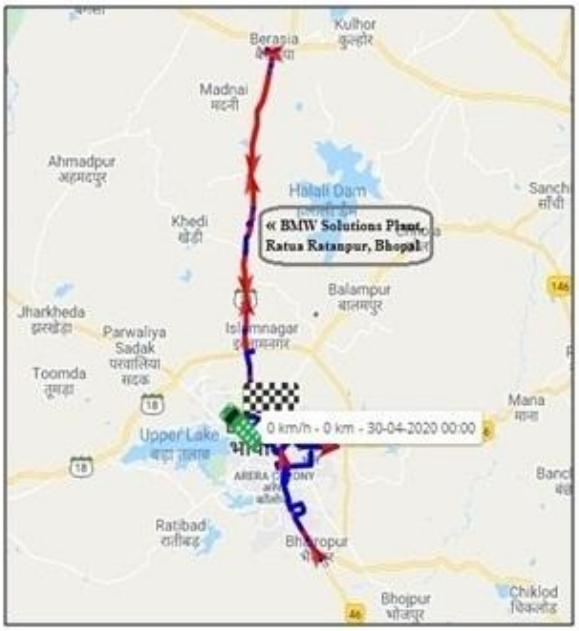
Route map of CBWTF Vehicle for Bhopal district

Route map of CBWTF Vehicle for Bhopal district

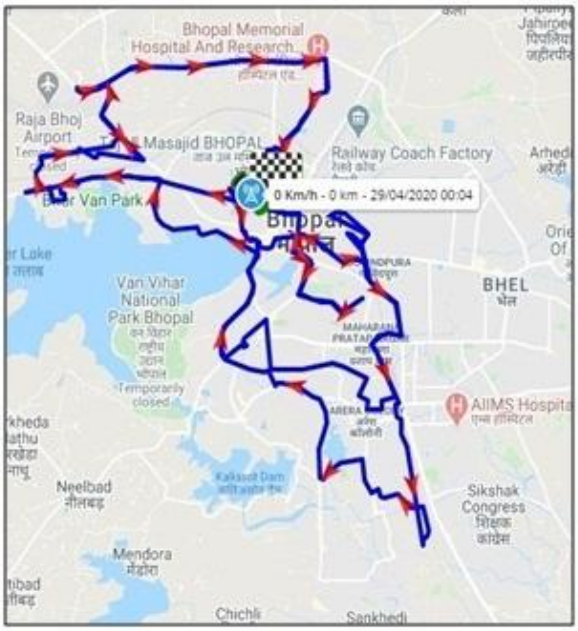
CBWTF - M/s. BMW Solutions,Bhopal (M.P.)

Location of CBWTF

Surrounding details of CBWTF



Route map of CBWTF Vehicle for Bhopal district

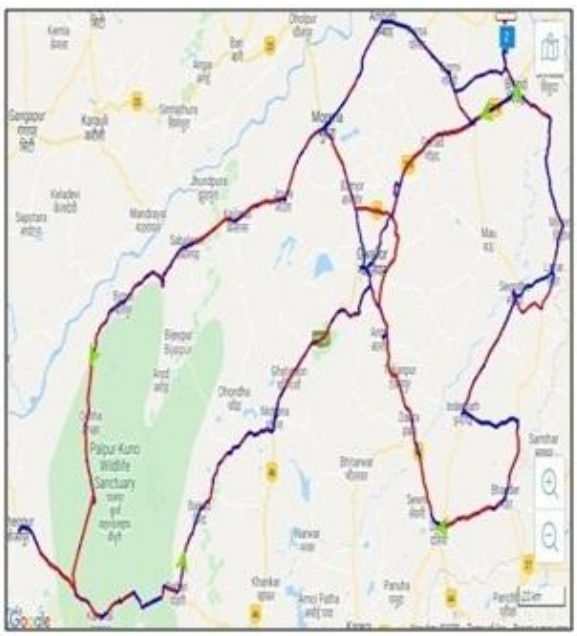


Route map of CBWTF Vehicle for Bhopal district

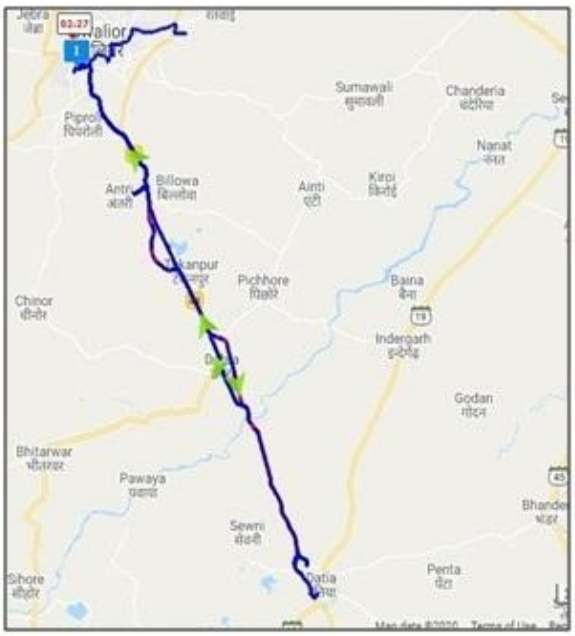
CBWTF - M/s. Davis Surgico, J.A.Group of Hospital Campus, Gwalior (M.P.)

Location of CBWTF

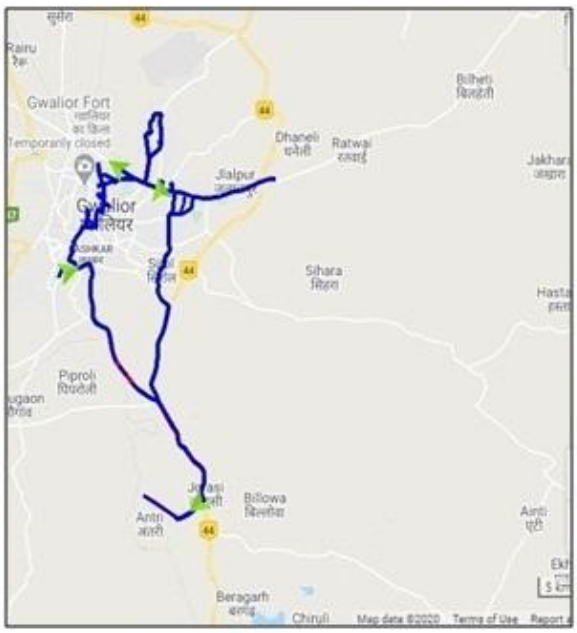
Surrounding details of CBWTF



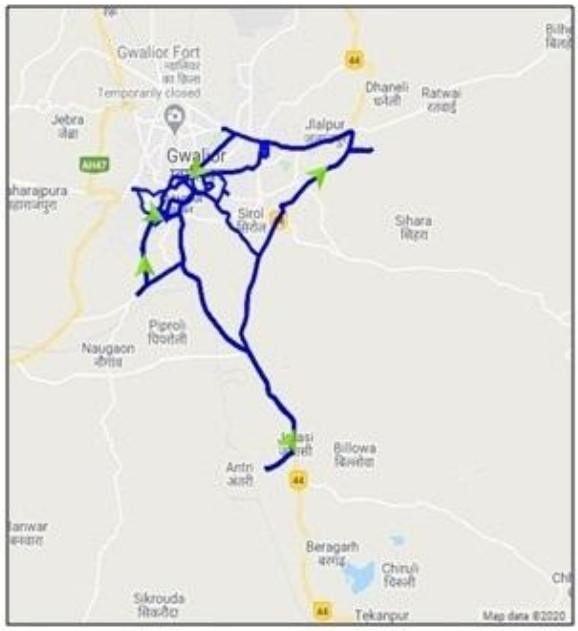
Route map of CBWTF Vehicle for Gwalior, Morena, Bhind, Datia, Sheopur & Shivpuri



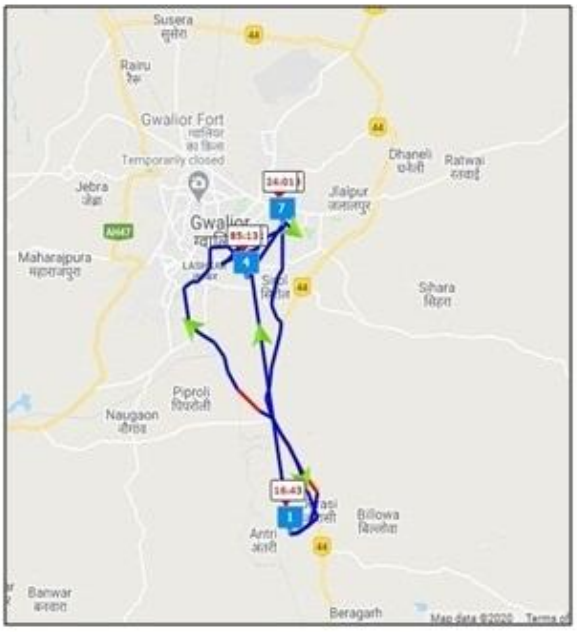
Route map of CBWTF Vehicle for Gwalior & Datia districts



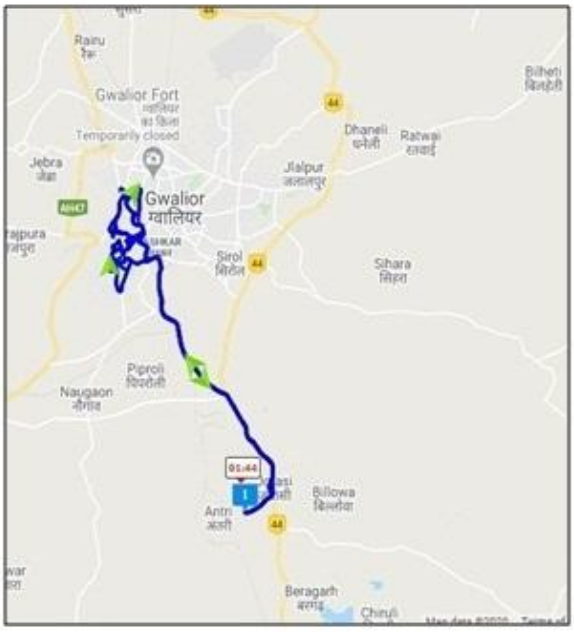
Route map of CBWTF Vehicle for Gwalior district



Route map of CBWTF Vehicle for Gwalior district



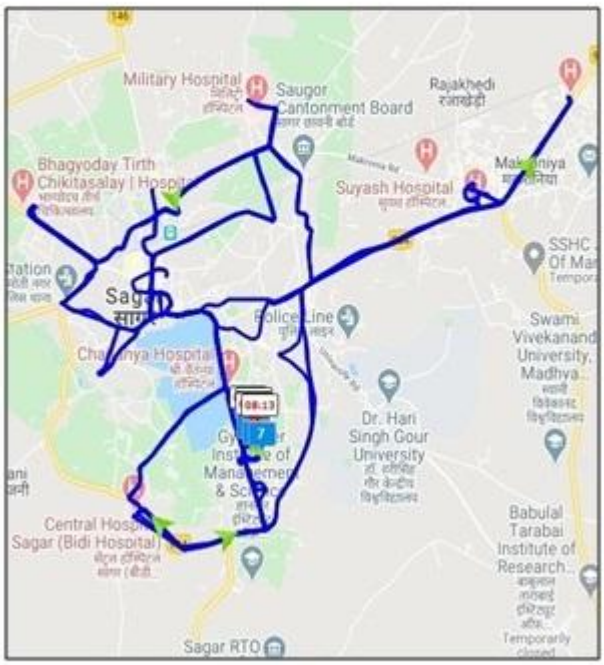
Route map of CBWTF Vehicle for Gwalior district



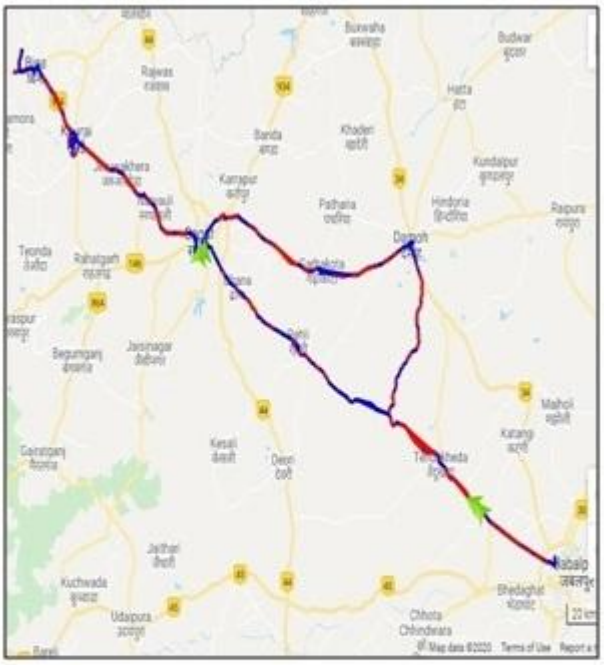
Route map of CBWTF Vehicle for Gwalior district

CBWTF - M/s. Davis Surgico, Bundelkhand Medical College Campus, Tili road, Sagar (M.P.)

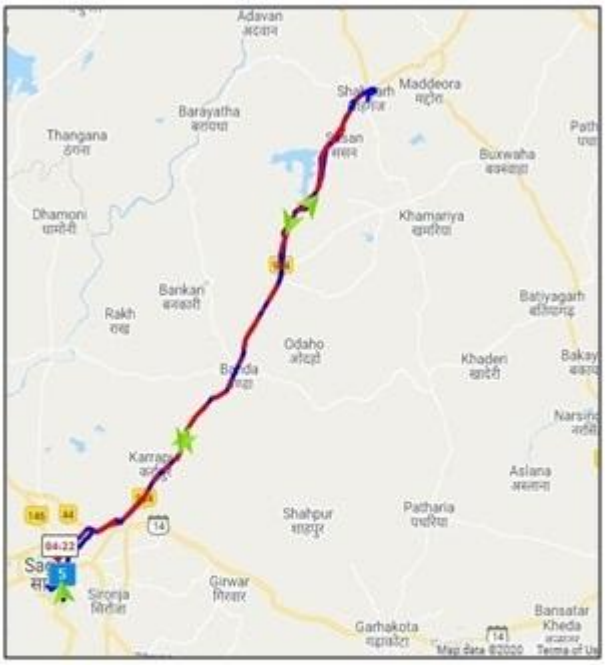
Surrounding details of CBWTF



Route map of CBWTF Vehicle for Sagar district



Route map of CBWTF Vehicle for Sagar, Damoh & Jabalpur

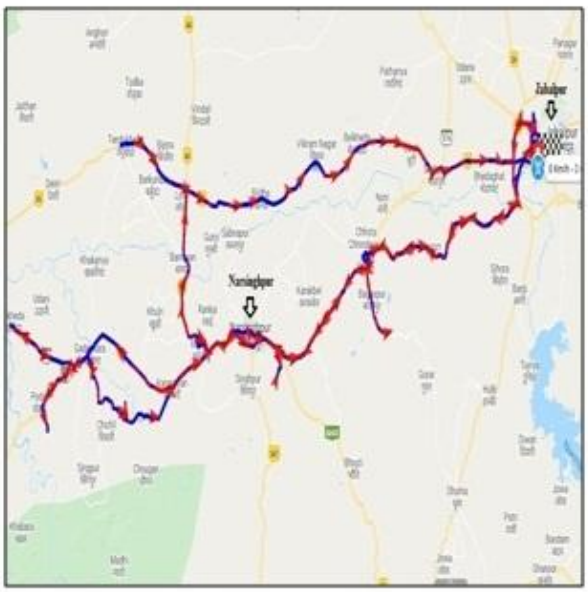


Route map of CBWTF Vehicle for Sagar district

CBWTF - M/s. Elite Engineers, Jabalpur (M.P.)

Location of CBWTF

Surrounding details of CBWTF



Route map of CBWTF Vehicle for Jabalpur & Narsinghpur

Route map of CBWTF Vehicle for Jabalpur & Katin districts

Route map of CBWTF Vehicle for Jabalpur district

Route map of CBWTF Vehicle for Jabalpur district

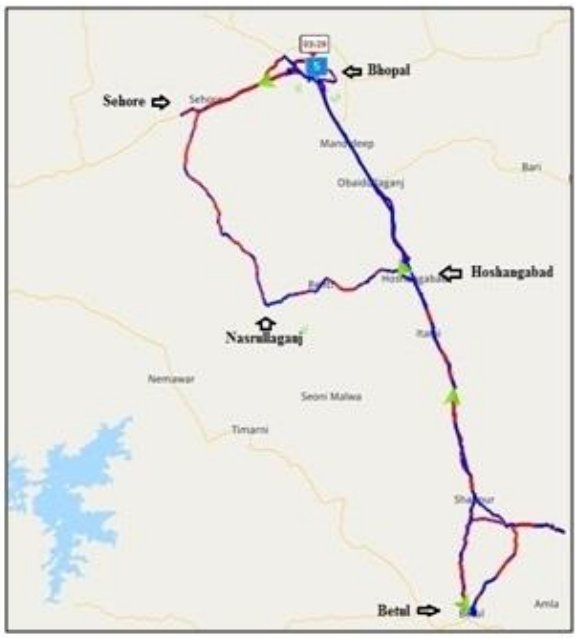
Route map of CBWTF Vehicle for Jabalpur district

Route map of CBWTF Vehicle for Katni district

CBWTF - M/s. Environment Protection Corporation, Sehore (M.P.)

Location of CBWTF

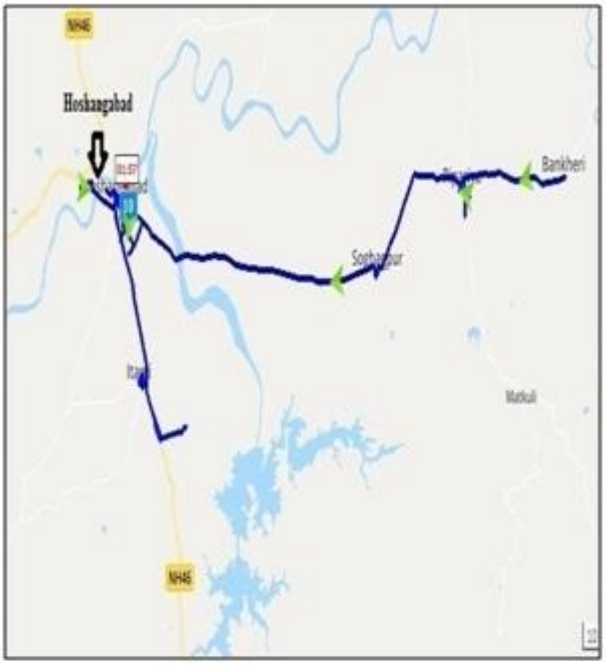
Surrounding details of CBWTF



Route map of CBWTF Vehicle for Sehore, Bhopal, Raisen, Hoshangabad & Betul districts

Route map of CBWTF Vehicle for Sehore & Bhopal districts

Route map of CBWTF Vehicle for Betul district



Route map of CBWTF Vehicle for Hoshangabad district

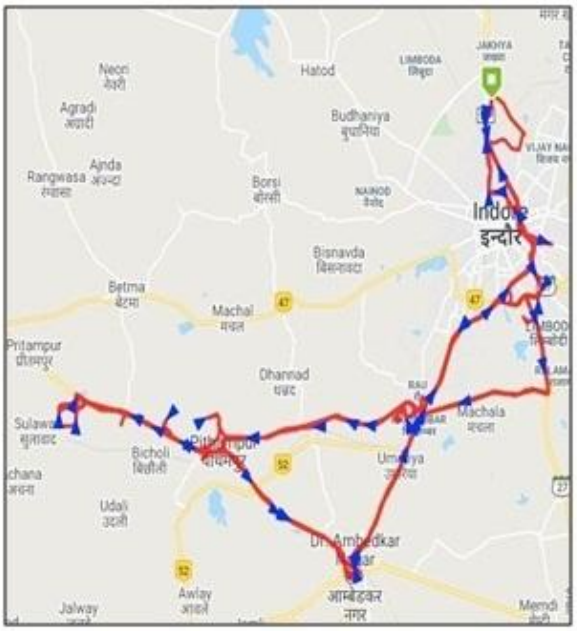
Route map of CBWTF Vehicle for Harda district

Route map of CBWTF Vehicle for Vidisha district

CBWTF - M/s. Hoswin Incinerator Pvt. Ltd., Indore (M.P.)

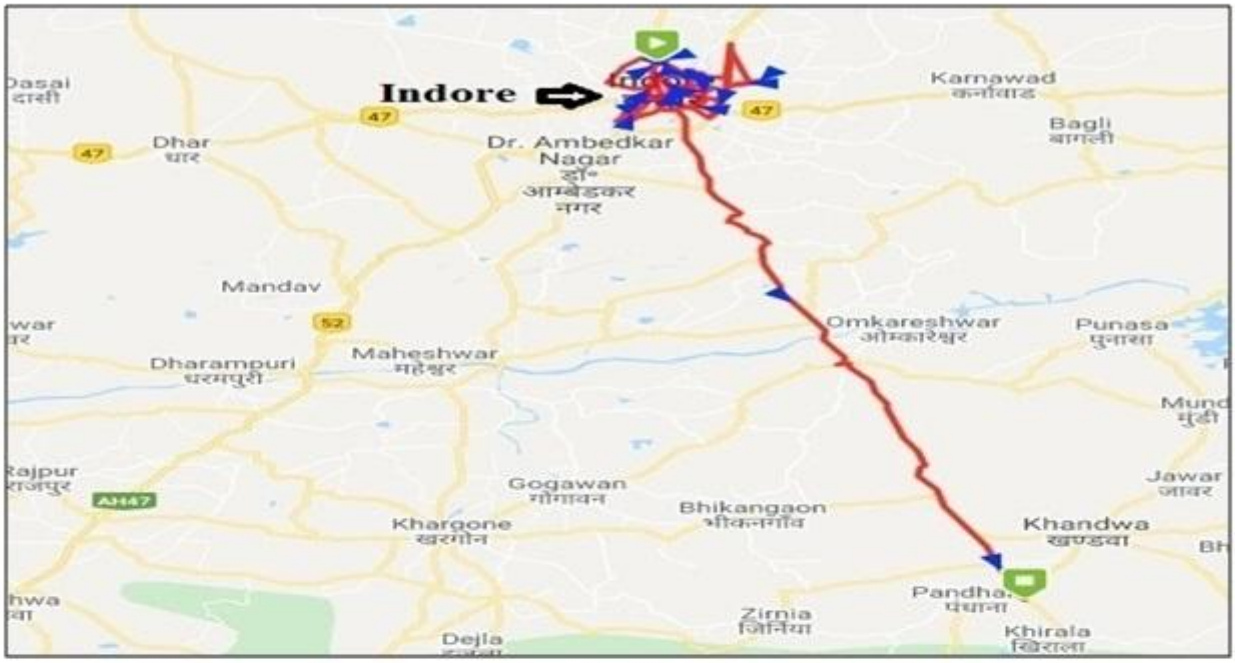
Location of CBWTF

Surrounding details of CBWTF

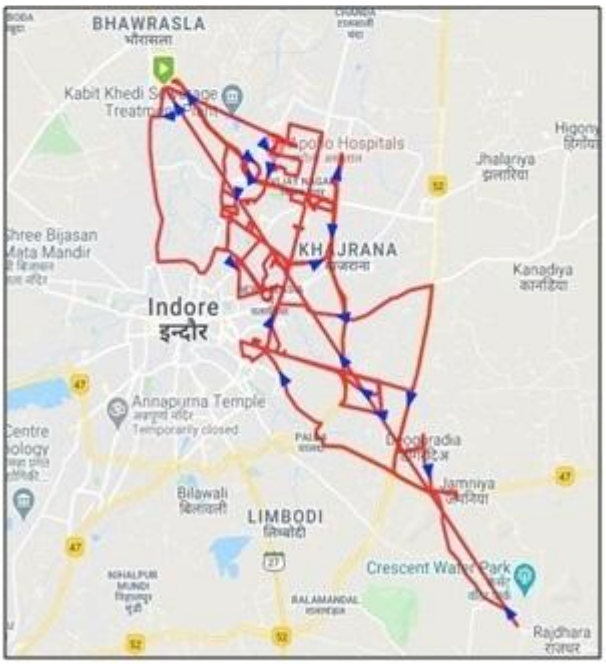


Route map of CBWTF Vehicle for Indore & Dhar districts

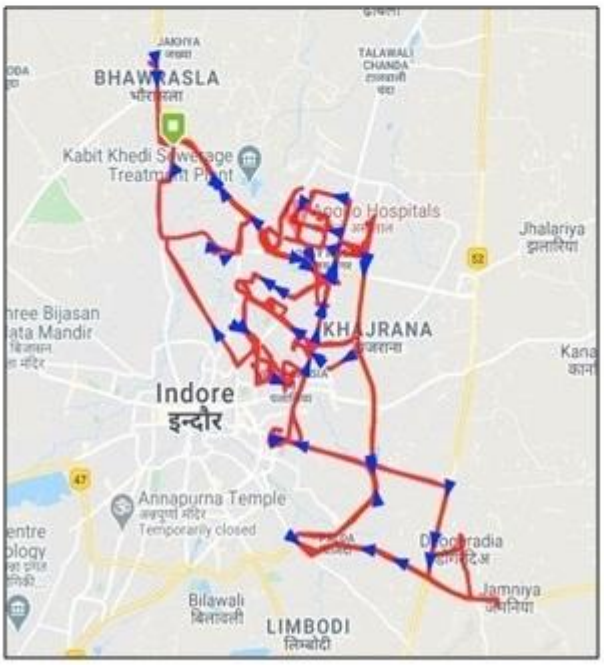
Route map of CBWTF Vehicle for Indore, Ujjain & Agar Malwa



Route map of CBWTF Vehicle for Indore, Khandwa & Khargone districts



Route map of CBWTF Vehicle for Indore district

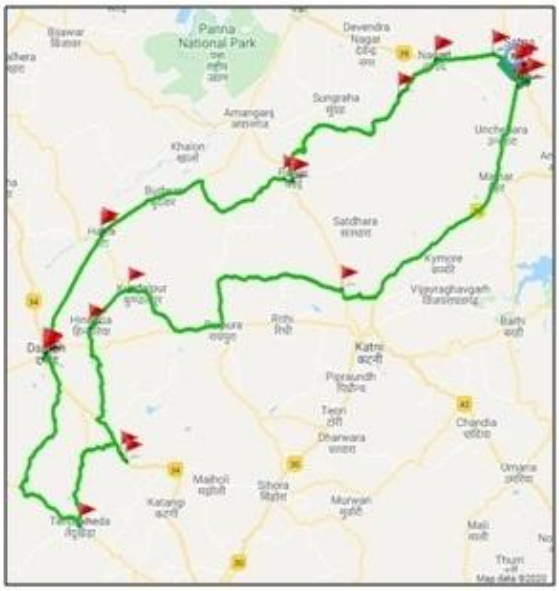


Route map of CBWTF Vehicle for Indore district

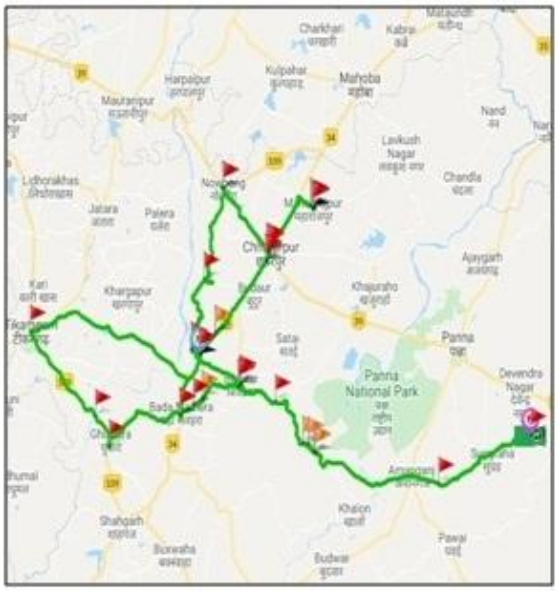
CBWTF - M/s. Indo Water Management & Pollution Control Corporation, Satna (M.P.)

Location of CBWTF

Surrounding details of CBWTF

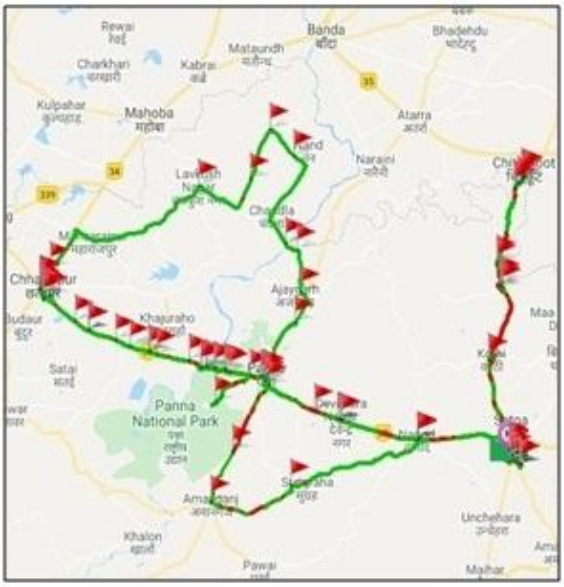


Route map of CBWTF Vehicle for Satna, Katni, Damoh & Panna districts

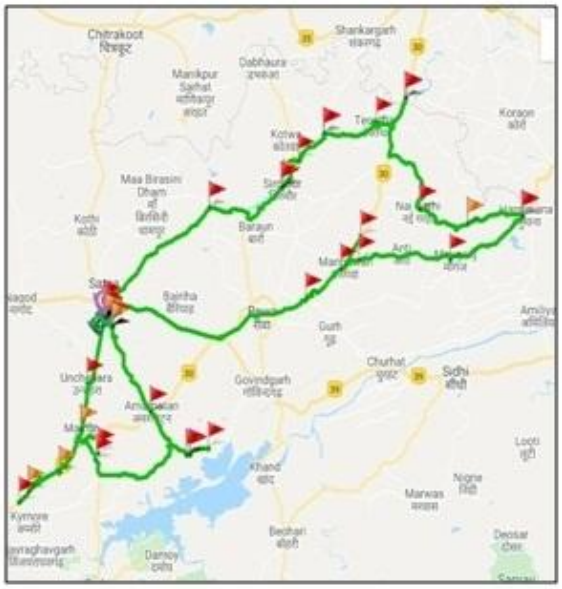


Route map of CBWTF Vehicle for Tikamgarh, Chhatarpur & Panna districts

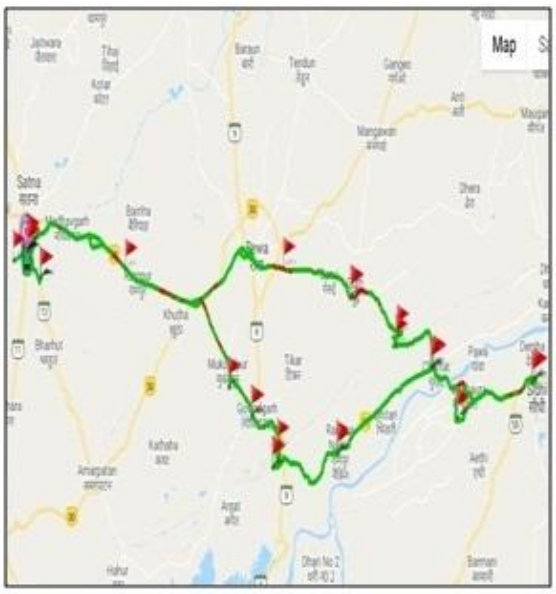
CBWTF - M/s. Indo Water Management & Pollution Control Corporation, Satna (M.P.)



Route map of CBWTF Vehicle for Satna, Chhatarpur & Panna districts



Route map of CBWTF Vehicle for Satna, Rewa & Katni districts

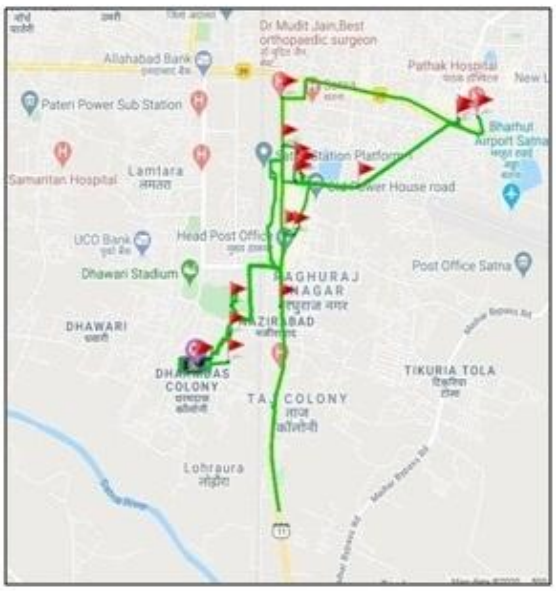


Route map of CBWTF Vehicle for Satna, Rewa & Sidhi districts

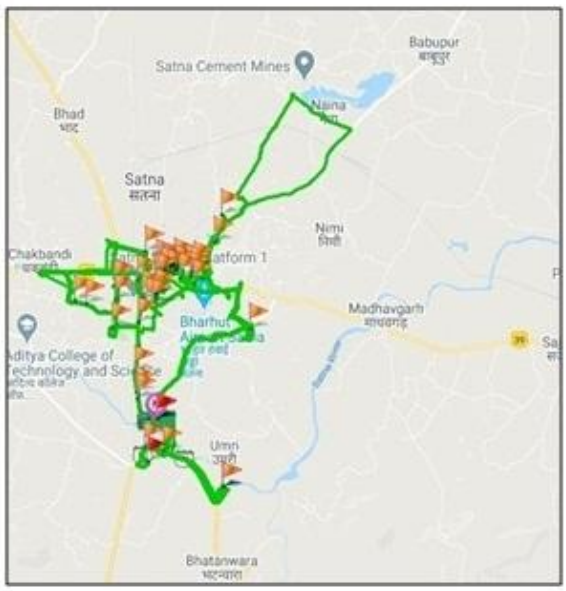
Route map of CBWTF Vehicle for Satna & Rewa districts

CBWTF - M/s. Indo Water Management & Pollution Control Corporation, Satna (M.P.)

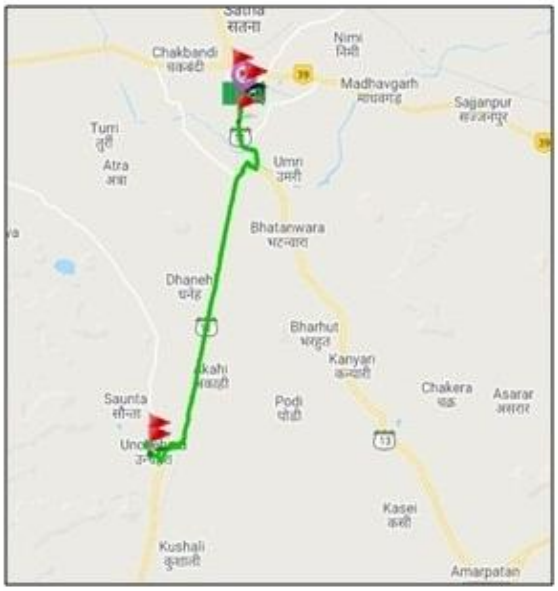
Route map of CBWTF Vehicle for Sidhi & Singrauli districts



Route map of CBWTF Vehicle for Satna district



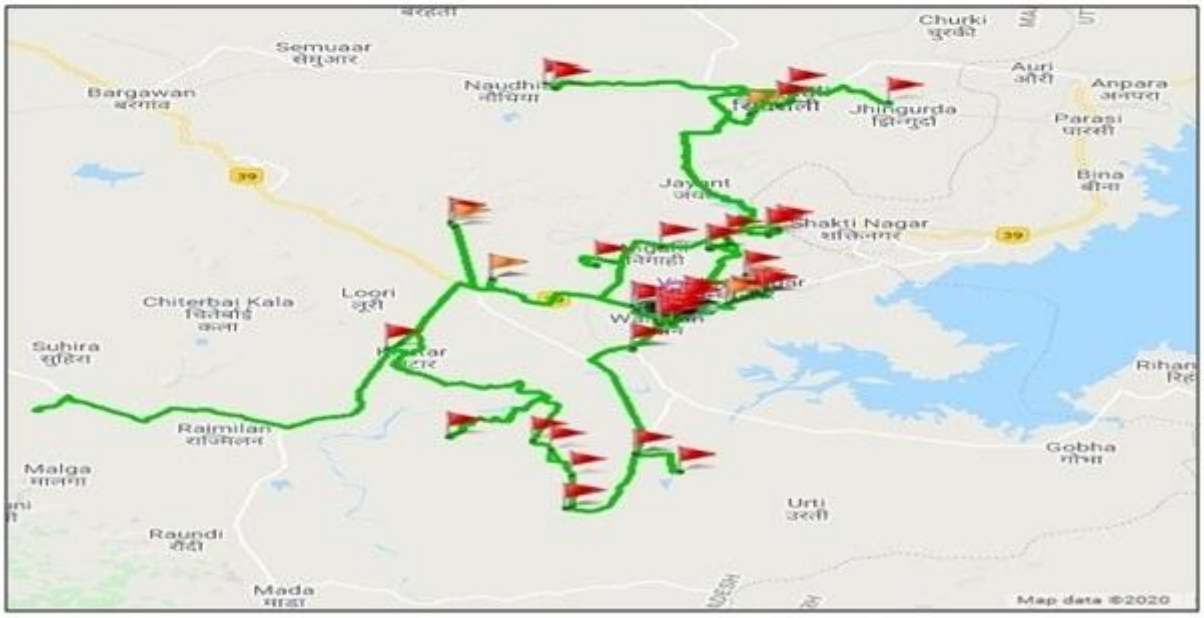
Route map of CBWTF Vehicle for Satna district



Route map of CBWTF Vehicle for Satna district

CBWTF - M/s. Indo Water Management & Pollution Control Corporation, Satna (M.P.)

Route map of CBWTF Vehicle for Damoh district

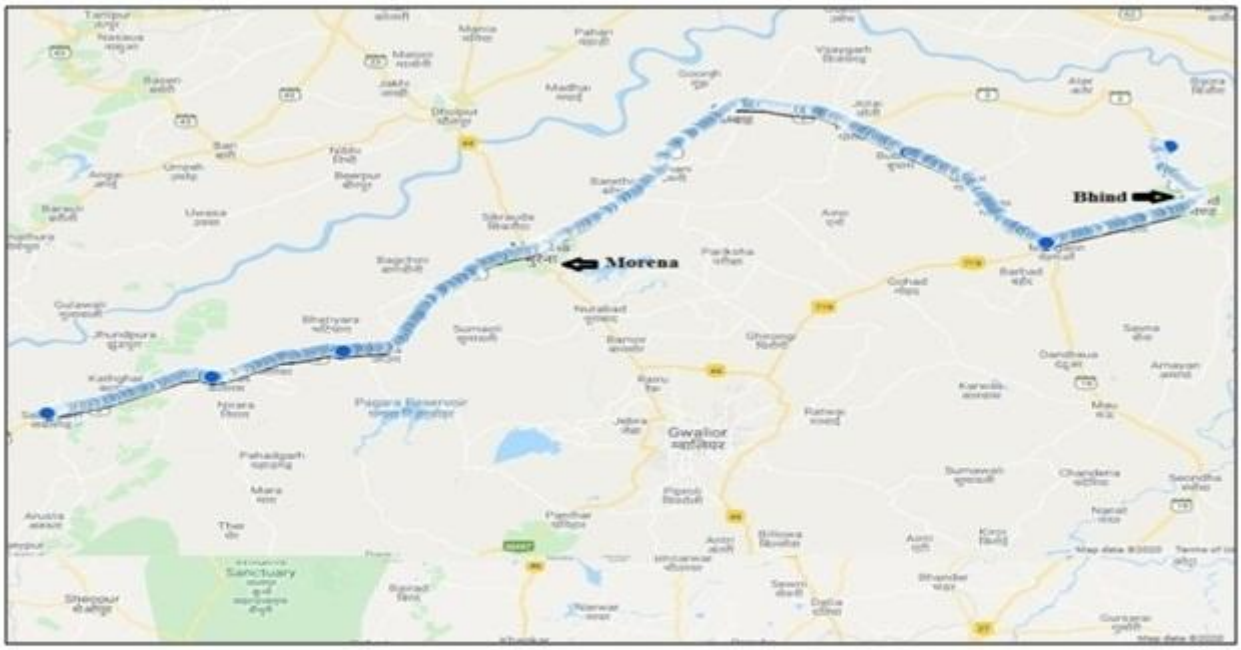


Route map of CBWTF Vehicle for Singrauli district

CBWTF - M/s. JRR Waste Management Pvt. Ltd., Agra (U.P.)

Location of CBWTF

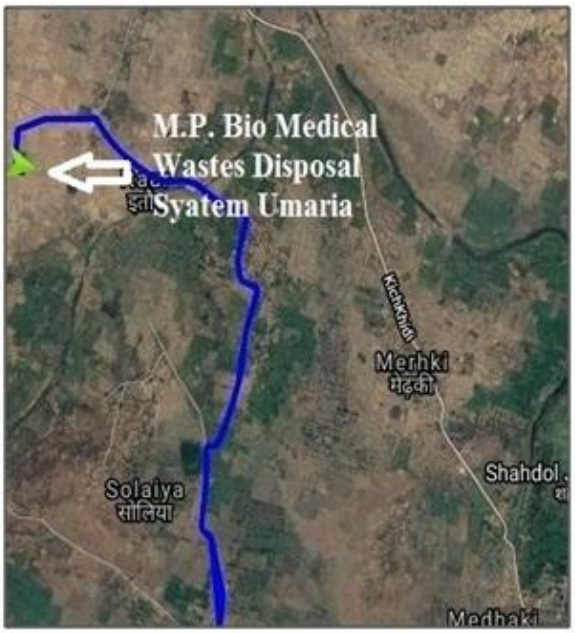
Surrounding details of CBWTF



Route map of CBWTF Vehicle for Bhind & Morena districts

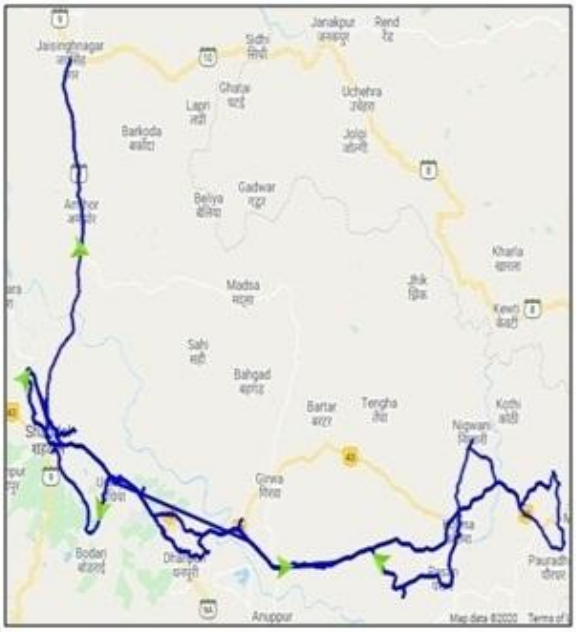
CBWTF - M/s. M.P. Bio-medical Wastes Disposal System, Umaria (M.P.)

Location of CBWTF



Surrounding details of CBWTF

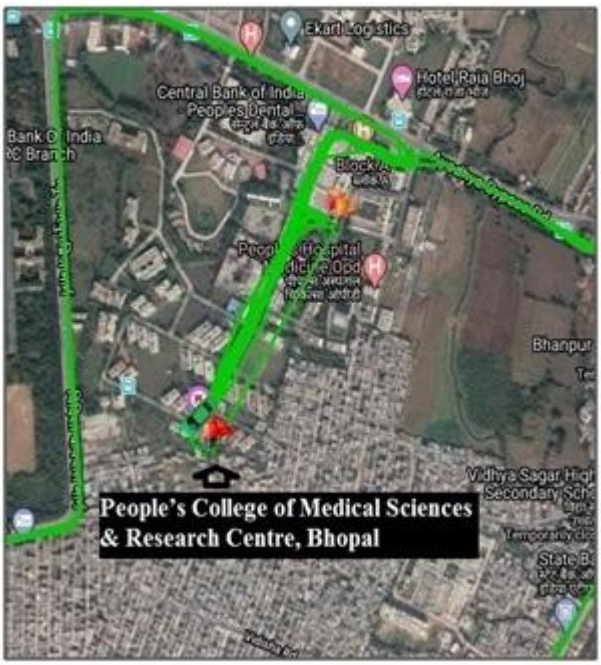
Route map of CBWTF Vehicle for Shahdol & Umaria districts



Route map of CBWTF Vehicle for Shahdol & Anuppur districts

CBWTF - M/s. People's College of Medical Sciences & Research Centre, Bhopal (M.P.)

Location of CBWTF



Surrounding details of CBWTF

Route map of CBWTF Vehicle for Bhopal district

5. Management of Bio-medical wastes

A strict monitoring mechanism was established to ensure foolproof process for the management of waste. The challenge was basically to deal with the unestimated amount of BMW exclusively from the dedicated Covid hospitals, isolation and quarantine centres, sample collection centres etc. The quantification of Covid and non-Covid waste was done on daily basis at the source as well as at the disposal facility. The day-wise details of quantity of Covid and non-Covid waste is given in Tab. 6 . The non-covid waste include different categories of wastes, viz. Red, Yellow, Blue and White, as defined under BMW Rules 1989. The cumulative quantity of covid linked BMW generated in the State during the first phase of study from 05.04.2020 to 10.07.2020 was 512.77 MT and the non-covid waste was 918.53 MT. The fractional quantity of non-covid was recorded to be 686.55 MT under Yellow category, 122.02 tonnes under Red category, 102.70 MT under Blue category and 7.24 MT under White category.

Date	COVID BMW Generation quantity (Kg)		Non-COVID BMW Generation quantity (Kg)					
	Generation	Disposed	Yellow	Red	Blue	White	Generation	Disposed
05-04-2020	500.00	500.00	4621.35	584.84	674.71	43.83	5924.73	5929.30
06-04-2020	757.37	757.37	6161.05	1394.19	1030.85	95.76	8681.84	8683.36
07-04-2020	944.73	944.73	5540.16	1160.00	1093.11	74.89	7868.16	7868.16
08-04-2020	920.52	920.52	5536.50	974.42	991.79	61.78	7564.48	7564.48
09-04-2020	1104.09	1104.09	5087.47	1115.78	1007.16	63.34	7273.75	7273.75
10-04-2020	1585.89	1585.89	5864.65	1108.63	1056.47	70.36	8100.10	8100.10
11-04-2020	1822.93	1822.93	5679.55	1082.12	1022.16	66.43	7850.25	7850.25
12-04-2020	1720.66	1720.66	5581.62	799.39	775.85	43.85	7200.72	7200.72
13-04-2020	1984.39	1984.39	6617.74	1165.16	1237.15	81.74	9101.79	9101.79
14-04-2020	2149.63	2149.63	6736.90	1186.68	1199.54	63.60	9186.72	9186.72
15-04-2020	2287.21	2287.21	6478.49	1165.13	1041.70	73.84	8759.15	8759.15
16-04-2020	2659.36	2659.36	6811.62	1113.65	943.92	59.87	8929.06	8929.06
17-04-2020	3139.90	3139.90	5934.38	1014.42	976.21	37.43	7962.43	7962.43
18-04-2020	4251.47	4251.47	6694.19	1081.00	911.31	60.79	8747.29	8747.29
19-04-2020	4225.53	4225.53	5110.17	656.26	735.60	44.34	6546.37	6546.37
20-04-2020	3582.69	3582.69	6393.86	1208.14	1254.46	70.40	8926.85	8926.85
21-04-2020	3822.70	3822.70	6496.22	1399.76	1262.14	74.42	9232.54	9232.54
22-04-2020	4370.98	4370.98	6705.88	1389.42	918.27	68.30	9081.87	9081.87
23-04-2020	5032.04	5032.04	6958.00	1325.27	1123.56	67.14	9473.96	9473.96
24-04-2020	4178.25	4178.25	6976.18	1349.01	1214.01	64.47	9603.67	9603.67
25-04-2020	5185.89	5185.89	6381.70	1468.80	1101.40	63.67	9015.57	9015.57
26-04-2020	4552.39	4552.39	5417.71	705.32	816.68	44.09	6983.79	6983.79
27-04-2020	5379.31	5379.31	6684.45	1266.54	1078.26	69.53	9098.78	9098.78
28-04-2020	5590.24	5590.24	6667.56	1291.88	1044.25	72.18	9075.87	9075.87
29-04-2020	5535.28	5535.28	6438.25	1046.19	903.80	67.19	8455.43	8455.43
30-04-2020	5095.27	5095.27	6901.73	1284.74	1074.04	69.36	9329.87	9329.87

01-05-2020	5623.60	5623.60	6409.93	1359.49	1024.47	69.99	8863.87	8863.87
02-05-2020	5244.95	5244.95	6389.22	1143.77	863.32	65.80	8462.11	8462.11
03-05-2020	5946.89	5946.89	5064.86	701.64	724.99	45.14	6536.62	6536.62
04-05-2020	5785.44	5785.44	6199.53	1255.94	857.81	72.64	8385.92	8385.92
05-05-2020	5729.84	5729.84	6242.74	1169.87	893.38	78.44	8384.43	8384.43
06-05-2020	5994.61	5994.61	6223.99	1266.81	914.13	71.83	8476.75	8476.75
07-05-2020	5845.27	5845.27	6365.51	1357.68	1018.60	76.54	8818.33	8818.33
08-05-2020	4416.93	4416.93	6359.86	757.65	782.87	32.10	7932.49	7932.49
09-05-2020	6941.74	6941.74	6204.23	1364.72	985.26	69.91	8624.11	8624.11
10-05-2020	6538.16	6538.16	5331.40	738.50	704.74	42.17	6816.80	6816.80
11-05-2020	6206.00	6206.00	6908.99	1274.90	1000.49	72.33	9256.71	9256.71
12-05-2020	7195.62	7195.62	7159.32	1361.00	1087.92	72.72	9680.95	9680.95
13-05-2020	6330.35	6330.35	5677.41	1106.51	859.50	62.11	7705.53	7705.53
14-05-2020	7421.44	7421.44	6983.74	1214.82	1230.93	71.97	9501.45	9501.45
15-05-2020	6629.36	6629.36	6754.78	1208.67	998.71	82.29	9044.46	9044.46
16-05-2020	7078.97	7078.97	6655.36	1138.53	906.28	69.79	8769.96	8769.96
17-05-2020	7057.35	7057.35	5187.15	630.20	592.71	44.15	6454.21	6454.21
18-05-2020	6920.18	6920.18	7107.45	1366.89	1038.58	83.08	9596.00	9596.00
19-05-2020	8745.03	8745.03	6668.52	1357.18	1010.98	76.81	9113.48	9114.48
20-05-2020	8494.25	8494.25	6857.58	1396.96	1094.51	83.11	9432.16	9432.16
21-05-2020	7965.44	7965.44	6883.23	1344.09	1097.78	69.11	9394.20	9394.20
22-05-2020	7677.85	7677.85	6999.39	1177.03	1003.97	68.76	9249.14	9249.14
23-05-2020	6878.23	6878.23	5767.92	1051.42	871.82	64.69	7755.85	7755.85
24-05-2020	7682.49	7682.49	5482.52	610.09	579.42	43.07	6715.09	6715.09
25-05-2020	7346.22	7346.22	6946.52	1230.52	990.90	49.19	9217.13	9217.13
26-05-2020	7555.90	7555.90	7249.78	1220.14	1066.11	66.25	9602.27	9602.27
27-05-2020	7434.66	7434.66	6843.71	1281.26	982.54	77.88	9185.39	9185.39
28-05-2020	7223.27	7223.27	7575.34	1309.35	1120.01	78.20	10082.90	10082.90
29-05-2020	7393.31	7393.31	7256.61	1506.31	1409.93	69.56	10242.41	10242.41
30-05-2020	6741.43	6741.43	7019.50	1405.86	1012.18	90.55	9528.09	9528.09
31-05-2020	7486.36	7486.36	5305.57	725.16	686.53	42.25	6759.51	6759.51
01-06-2020	6796.51	6796.51	7719.89	1525.92	1220.88	81.28	10547.98	10547.98
02-06-2020	6790.81	6790.81	7525.96	1524.60	1123.17	97.46	10271.18	10271.18
03-06-2020	6918.88	6918.88	7816.60	1342.25	1165.70	69.96	10394.51	10394.51
04-06-2020	7008.23	7008.23	7558.45	1454.63	1179.28	80.04	10272.40	10272.40
05-06-2020	6532.82	6532.82	7096.94	1316.63	1065.53	81.20	9560.30	9560.30
06-06-2020	6046.76	6046.76	6815.46	1194.34	1026.24	81.17	9117.20	9117.20
07-06-2020	5164.07	5164.07	7250.70	817.82	797.13	43.46	8909.11	8909.11
08-06-2020	5588.75	5588.75	8979.43	1825.94	1425.45	92.65	12323.47	12323.47
09-06-2020	6439.15	6439.15	8582.33	1597.31	1195.97	78.09	11453.69	11453.69
10-06-2020	5312.10	5312.10	7636.12	1506.67	1238.24	80.71	10461.74	10461.44
11-06-2020	5407.73	5407.73	8541.04	1551.15	1189.42	85.98	11367.59	11367.59
12-06-2020	6008.26	6008.26	8228.64	1402.37	1156.79	83.63	10871.43	10871.43
13-06-2020	5832.67	5832.67	7908.01	1312.93	1053.88	71.28	10346.10	10346.10
14-06-2020	4976.53	4976.53	6596.82	783.06	702.68	49.78	8132.34	8132.34
15-06-2020	5504.68	5504.68	7583.60	1406.27	1071.49	99.63	10160.98	10160.98

16-06-2020	5622.23	5622.23	9343.60	1569.48	1371.61	103.58	12388.27	12388.27
17-06-2020	5845.36	5845.36	8231.20	1783.91	1446.63	91.24	11552.98	11552.98
18-06-2020	4839.59	4839.59	8660.10	1479.32	1255.31	91.09	11485.82	11485.82
19-06-2020	6263.47	6263.47	8686.11	1547.49	1305.85	88.36	11627.81	11627.81
20-06-2020	4903.59	4903.59	7774.48	1351.76	1218.20	95.35	10439.79	10439.79
21-06-2020	4629.48	4629.48	6620.44	761.05	763.91	51.13	8196.53	8196.53
22-06-2020	4869.01	4869.01	8414.92	1371.24	1271.87	84.05	11142.08	11142.08
23-06-2020	5343.58	5343.58	7773.39	1444.61	1262.69	90.31	10571.00	10571.00
24-06-2020	5432.80	5432.80	8382.34	1538.96	1294.89	99.58	11315.77	11315.77
25-06-2020	5090.11	5090.11	7755.97	1466.93	1148.74	103.52	10475.16	10475.16
26-06-2020	5101.96	5101.96	8917.27	1632.67	1312.32	88.23	11950.49	11950.49
27-06-2020	4713.64	4713.64	8516.57	1629.02	1305.61	97.05	11548.25	11548.25
28-06-2020	4519.89	4519.89	7675.18	904.07	931.73	66.64	9577.62	9577.62
29-06-2020	4952.99	4952.99	8561.84	1556.42	1325.10	97.87	11541.23	11541.23
30-06-2020	5773.17	5773.17	7968.60	1494.41	1228.79	94.33	10786.13	10786.13
01-07-2020	5643.93	5643.93	8845.59	1327.20	1085.17	91.48	11349.44	11349.44
02-07-2020	5100.06	5100.06	9245.20	1457.64	1054.36	99.58	11856.78	11856.78
03-07-2020	4215.55	4215.55	8314.44	1470.89	1129.41	87.66	11002.40	11002.40
04-07-2020	4281.72	4281.72	8207.32	1497.43	1080.41	99.38	10884.54	10884.54
05-07-2020	3964.44	3964.44	6991.22	778.18	808.30	60.93	8638.63	8638.63
06-07-2020	5372.06	5372.06	8817.00	1557.14	1224.97	120.42	11719.53	11719.53
07-07-2020	5708.00	5708.00	8888.40	1467.25	1406.15	99.87	11861.67	11861.67
08-07-2020	5296.32	5296.32	8993.10	1615.87	1280.31	97.68	11986.96	11986.96
09-07-2020	5610.10	5610.10	9208.47	1679.25	1384.29	126.33	12398.34	12398.34
10-07-2020	5445.47	5445.47	9361.60	1710.41	1297.51	111.24	12480.76	12480.76
Total	**512776.18**	**512776.18**	**686553.33**	**122024.12**	**102705.68**	**7248.18**	**918531.31**	**918538.10**

Tab. 6 : Day-wise quantity of Covid & Non-Covid Wate during study period

During the study period maximum quantity of Covid-BMW, i.e. 296.37 MT, was recorded in area under jurisdiction of Regional office Indore. The quantum of non-covid BMW in Indore region was 342.28 MT during the study period. This was followed by Bhopal region with covid-BMW to be 134.60MT and non-covid BMW 165.13 MT. The Ujjain region also observed high generation of covid-BMW to the tune of 29.05 MT and non-covid BMW to the tune of 64.40 MT. The generation of BMW in other regions was comparatively low and the same is depicted in Fig. 75.

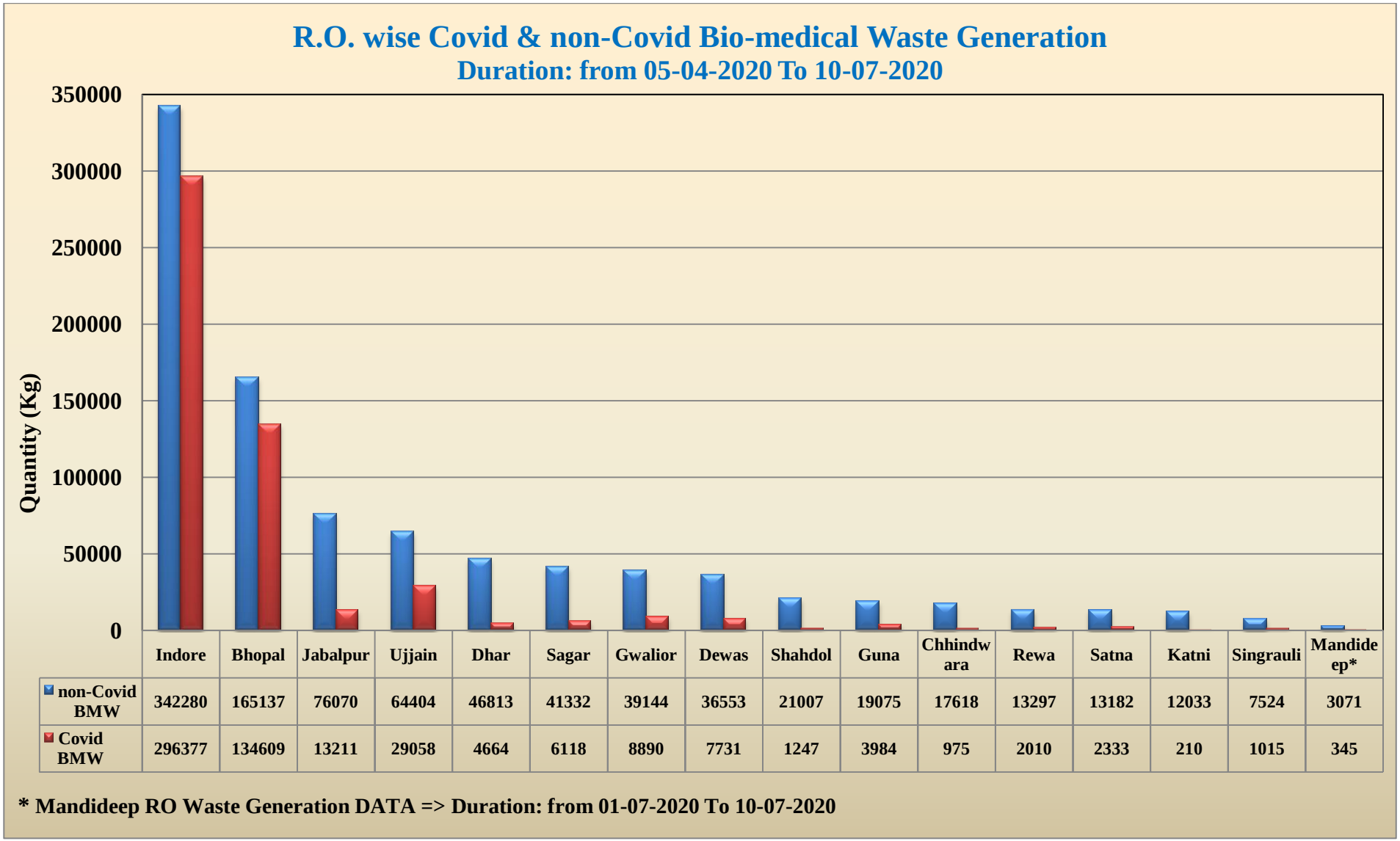

R.O. wise Covid & non-Covid Bio-medical Waste Generation
Duration: from 05-04-2020 To 10-07-2020
Quantity (Kg)
350000
300000
250000
200000
150000
100000
50000
0
Indore
Bhopal
Jabalpur
Ujjain
Dhar
Sagar
Gwalior
Dewas
Shahdol
Guna
Chhindwara
Rewa
Satna
Katni
Singrauli
Mandideep*
non-Covid BMW
342280
165137
76070
64404
46813
41332
39144
36553
21007
19075
17618
13297
13182
12033
7524
3071
Covid BMW
296377
134609
13211
29058
4664
6118
8890
7731
1247
3984
975
2010
2333
210
1015
345
* Mandideep RO Waste Generation DATA => Duration: from 01-07-2020 To 10-07-2020

Fig. 75

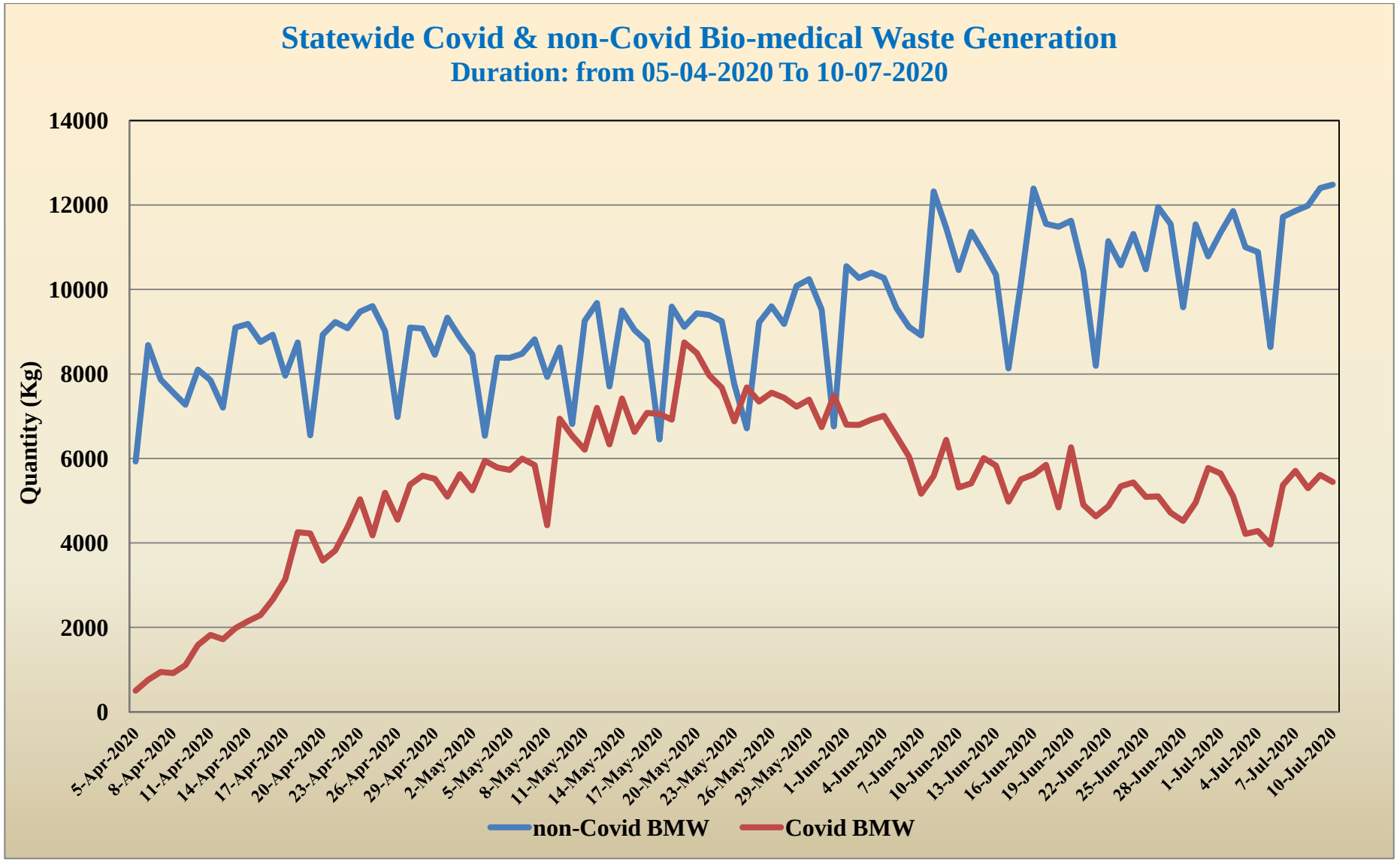

Statewide Covid & non-Covid Bio-medical Waste Generation
Duration: from 05-04-2020 To 10-07-2020
Quantity (Kg)
14000
12000
10000
8000
6000
4000
2000
0
5-Apr-2020
8-Apr-2020
11-Apr-2020
14-Apr-2020
17-Apr-2020
20-Apr-2020
23-Apr-2020
26-Apr-2020
29-Apr-2020
2-May-2020
5-May-2020
8-May-2020
11-May-2020
14-May-2020
17-May-2020
20-May-2020
23-May-2020
26-May-2020
29-May-2020
1-Jun-2020
4-Jun-2020
7-Jun-2020
10-Jun-2020
13-Jun-2020
16-Jun-2020
19-Jun-2020
22-Jun-2020
25-Jun-2020
28-Jun-2020
1-Jul-2020
4-Jul-2020
7-Jul-2020
10-Jul-2020
non-Covid BMW
Covid BMW

Fig. 76

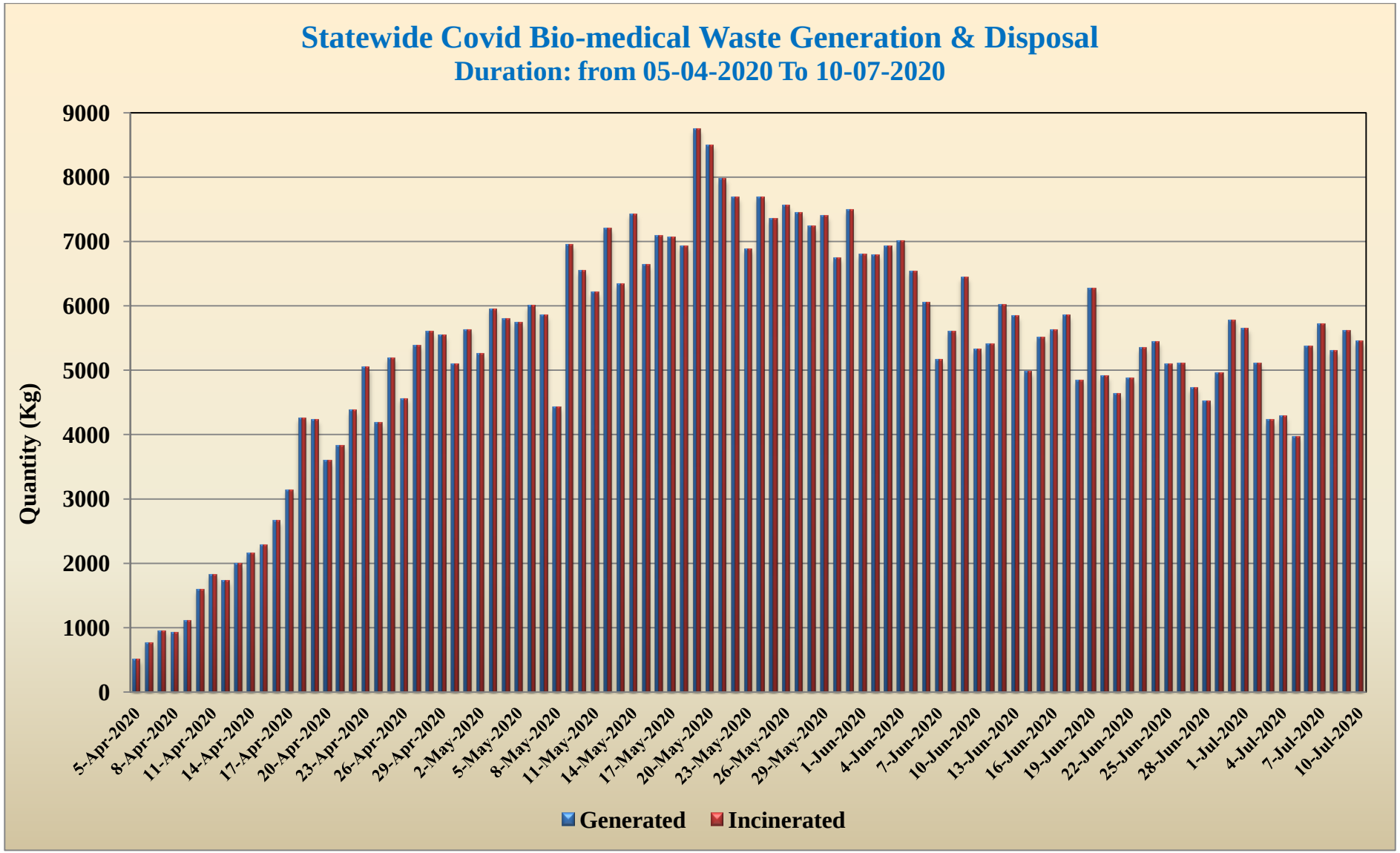

Statewide Covid Bio-medical Waste Generation & Disposal
Duration: from 05-04-2020 To 10-07-2020
Quantity (Kg)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
5-Apr-2020
8-Apr-2020
11-Apr-2020
14-Apr-2020
17-Apr-2020
20-Apr-2020
23-Apr-2020
26-Apr-2020
29-Apr-2020
2-May-2020
5-May-2020
8-May-2020
11-May-2020
14-May-2020
17-May-2020
20-May-2020
23-May-2020
26-May-2020
29-May-2020
1-Jun-2020
4-Jun-2020
7-Jun-2020
10-Jun-2020
13-Jun-2020
16-Jun-2020
19-Jun-2020
22-Jun-2020
25-Jun-2020
28-Jun-2020
1-Jul-2020
4-Jul-2020
7-Jul-2020
10-Jul-2020
Generated
Incinerated

Fig. 77

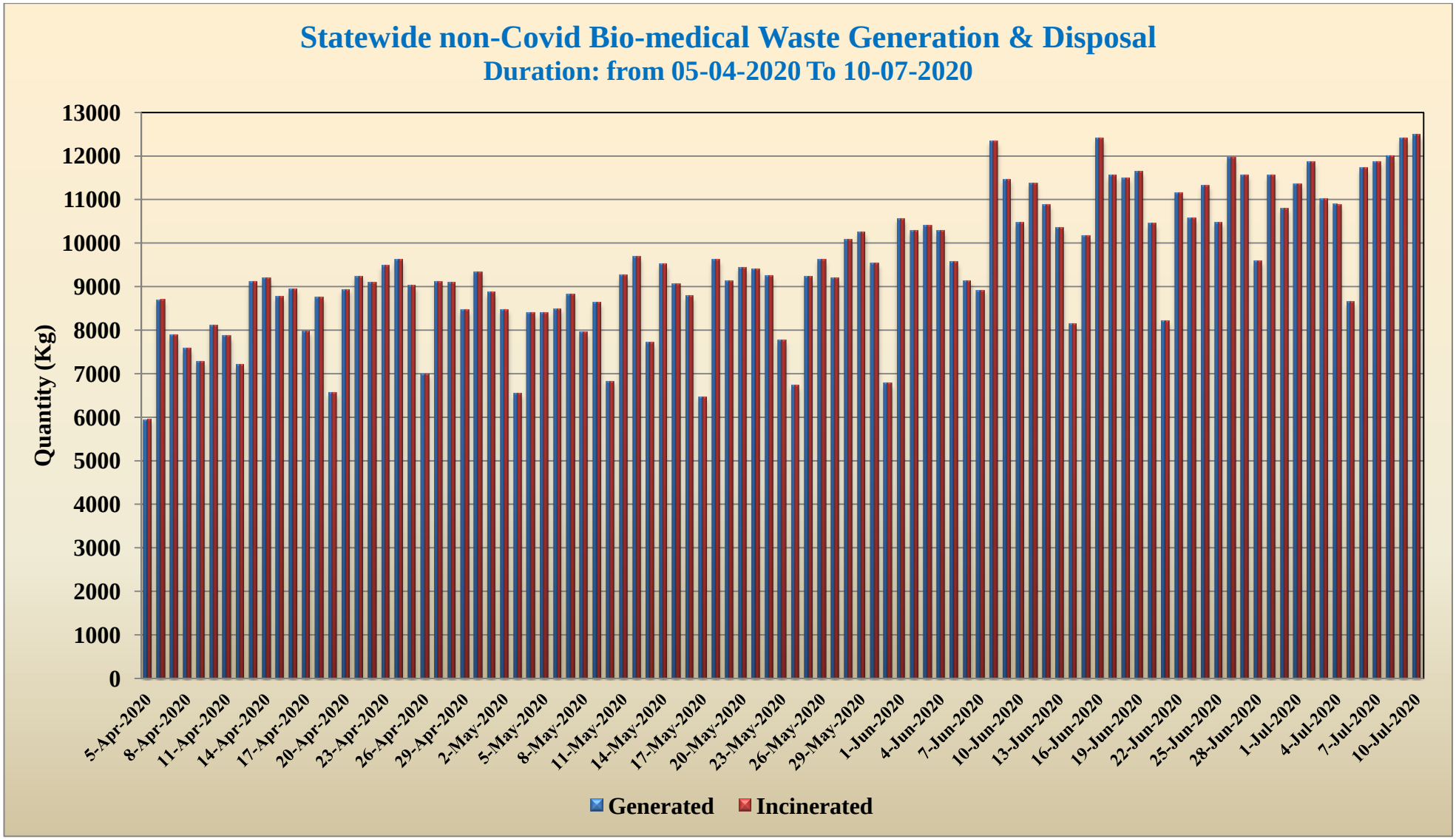

Statewide non-Covid Bio-medical Waste Generation & Disposal
Duration: from 05-04-2020 To 10-07-2020
Quantity (Kg)
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
5-Apr-2020
8-Apr-2020
11-Apr-2020
14-Apr-2020
17-Apr-2020
20-Apr-2020
23-Apr-2020
26-Apr-2020
29-Apr-2020
2-May-2020
5-May-2020
8-May-2020
11-May-2020
14-May-2020
17-May-2020
20-May-2020
23-May-2020
26-May-2020
29-May-2020
1-Jun-2020
4-Jun-2020
7-Jun-2020
10-Jun-2020
13-Jun-2020
16-Jun-2020
19-Jun-2020
22-Jun-2020
25-Jun-2020
28-Jun-2020
1-Jul-2020
4-Jul-2020
7-Jul-2020
10-Jul-2020
Generated
Incinerated

Fig. 78

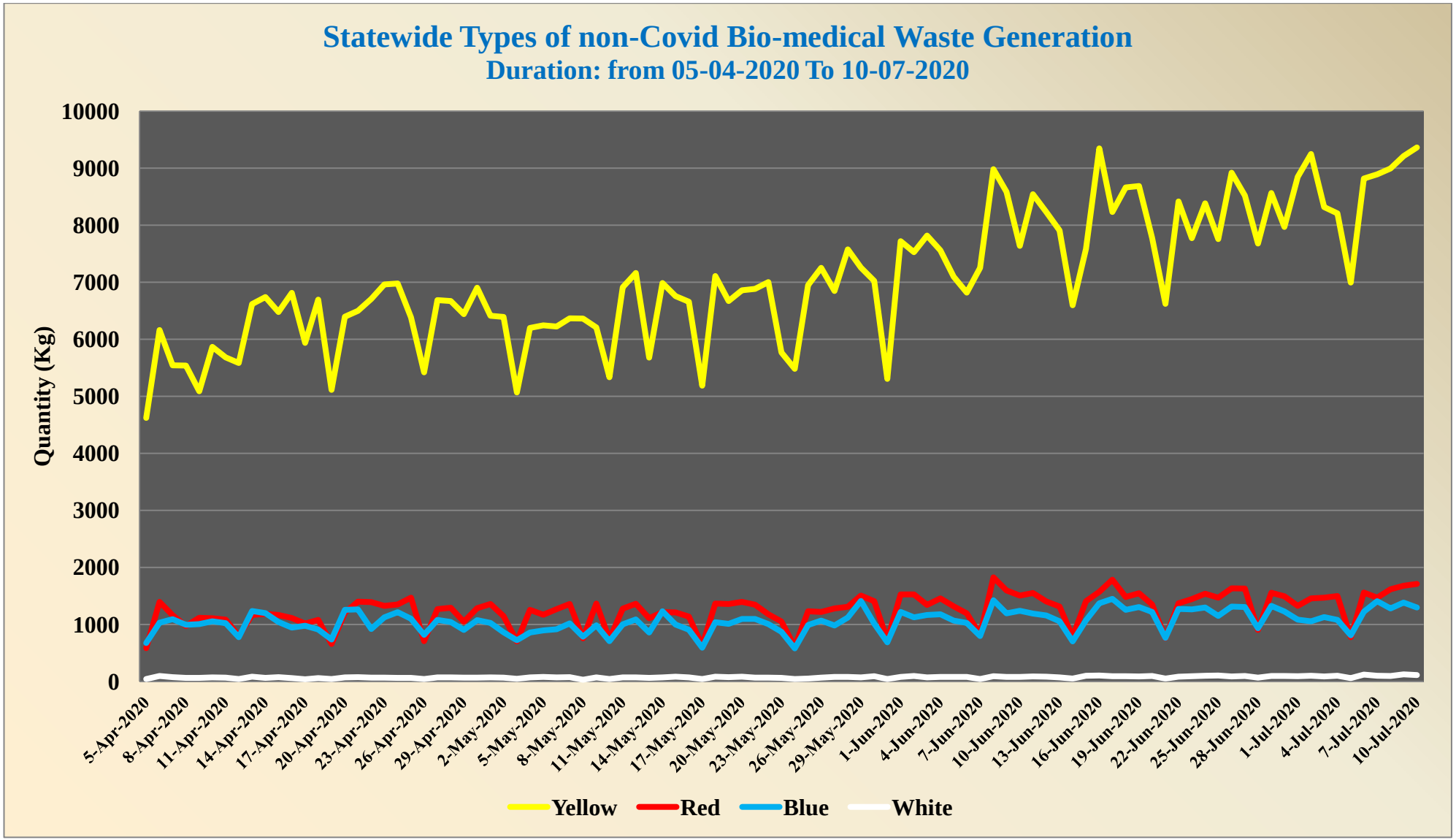

Statewide Types of non-Covid Bio-medical Waste Generation
Duration: from 05-04-2020 To 10-07-2020
Quantity (Kg)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
5-Apr-2020
8-Apr-2020
11-Apr-2020
14-Apr-2020
17-Apr-2020
20-Apr-2020
23-Apr-2020
26-Apr-2020
29-Apr-2020
2-May-2020
5-May-2020
8-May-2020
11-May-2020
14-May-2020
17-May-2020
20-May-2020
23-May-2020
26-May-2020
29-May-2020
1-Jun-2020
4-Jun-2020
7-Jun-2020
10-Jun-2020
13-Jun-2020
16-Jun-2020
19-Jun-2020
22-Jun-2020
25-Jun-2020
28-Jun-2020
1-Jul-2020
4-Jul-2020
7-Jul-2020
10-Jul-2020
Yellow
Red
Blue
White

Fig. 79

The day-wise quantum of Covid and Non-covid waste generation is shown in Fig. 76. The quantum of generation of Covid-BMW and non-Covid-BMW, and disposal of the same, are shown in Fig. 77 and 78. The study reveals that the quantity of generation of Yellow BMW was over 5.0 MT per day throughout the study period except on the first day. The generation of Red BMW and Blue BMW was around 1 MT per day during entire course. Details are depicted in Fig. 79.

6. Real-time Emission Monitoring of CBWTFs

The State has 13 common biomedical wastes treatment facilities (CBWTFs) equipped with incineration system. All the CBWTFs, except two, have controlled air type incinerators which works in two-stages of temperature. The CBWTF facility at Indore and Mandideep in District Raisen have Rotary Kiln type incinerator. There is no excess air type incinerator in the State. The incineration of bio-medical wastes can emit significant quantity of pollutants to the atmosphere including particulate matter, acid gases, oxides of nitrogen, carbon monoxide, toxic metals etc. The temperature in the primary chamber and the secondary chamber plays a significant role in destruction of wastes. The minimum temperature in the primary chamber is maintained to 800 ^{0}C and the secondary chamber has a minimum temperature of 1050 ^{0}C. The combustion efficiency is required to be maintained at 99% for proper and efficient combustion. Presently the CBWTFs are required to maintain the recommended temperature in both the combustion chambers and monitor the emission of carbon monoxide and carbon dioxide parameters only.

The emission from CBWTFs is monitored continuously by Environment Surveillance Centre through Central Server Application. The screen-shots of real-time monitoring are depicted in Fig. 80 & 81.

Madhya Pradesh Pollution Control Board

Environmental Surveillance Center

Paryavaran Parisar, E-5, Arera Colony, Bhopal - 462016 (M.P.)

Ph : 0755-2469180, **Fax** : 0755-2463742, **E-mail** : ercmppcb@nic.in, **Web** : www.erc.mp.gov.in

Real Time Data Acquisition And Monitoring

Average Report

Industry Name : Hoswin Incinerators Pvt Ltd
City : Indore
R.O. : Indore
Time Criteria : 15 min
Period : From Date: 2020-05-25 14:30 To Date: 2020-05-26 14:30

Description	Stack_1-CO(mg/Nm3)	Stack_1-CO2(%)	Stack_1-Primay_Temp(Celsius)	Stack_1-Seconday_Temp(Celsius)
Prescribed Standards	0 - 100	7 - 11	0 - 750	0 - 1000
Maximum Data	27.32	0.78	896.02	986.38
Minimum Data	14.87	0.53	882.79	972.84
Geometric Mean	20.9	0.65	890.34	981.77
Median	20.59	0.66	890.58	982.22
Standard Deviation	2.85	0.06	2.96	2.25
Maximum Value At Time	2020-05-25 16:00:00	2020-05-26 01:00:00	2020-05-25 16:30:00	2020-05-26 09:30:00
Minimum Value At Time	2020-05-26 06:30:00	2020-05-25 14:30:00	2020-05-25 23:15:00	2020-05-26 06:15:00
Valid Data Points	97	97	97	97
Total Data Points	97	97	97	97
Data Availability %	100.0%	100.0%	100.0%	100.0%

Time	Stack_1-CO(mg/Nm3)	Stack_1-CO2(%)	Stack_1-Primay_Temp(Celsius)	Stack_1-Seconday_Temp(Celsius)
2020-05-25 14:30:00	20.58	0.53	887.40	984.59
2020-05-25 14:45:00	22.30	0.61	893.67	982.15
2020-05-25 15:00:00	20.84	0.74	888.86	982.38
2020-05-25 15:15:00	19.79	0.61	883.70	981.05
2020-05-25 15:30:00	25.45	0.63	890.58	982.45
2020-05-25 15:45:00	16.78	0.71	890.62	982.46
2020-05-25 16:00:00	27.32	0.58	888.48	981.55
2020-05-25 16:15:00	23.89	0.63	886.82	978.29

Fig. 80

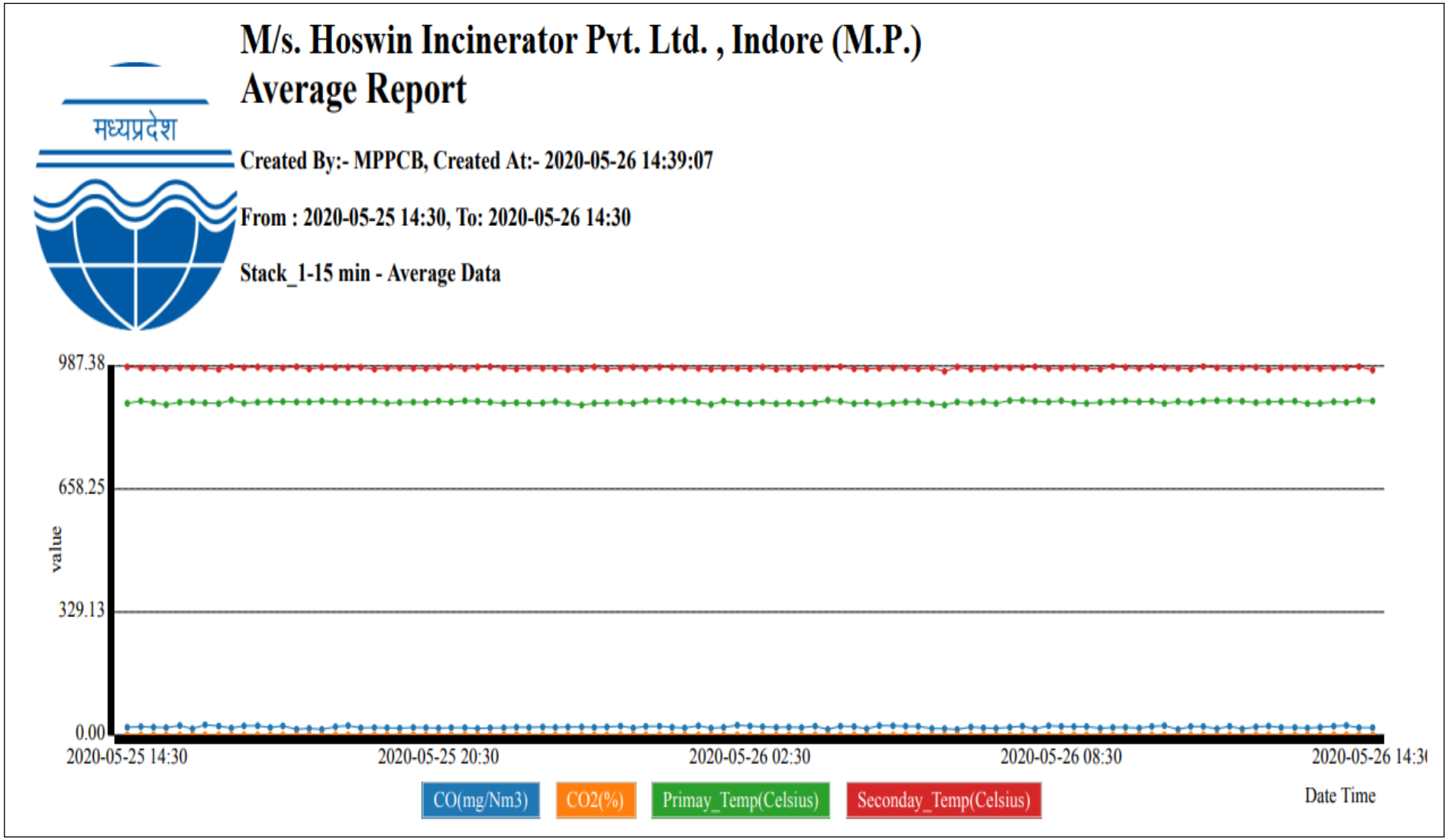

M/s. Hoswin Incinerator Pvt. Ltd. , Indore (M.P.)
Average Report
मध्यप्रदेश
Created By:- MPPCB, Created At:- 2020-05-26 14:39:07
From : 2020-05-25 14:30, To: 2020-05-26 14:30
Stack_1-15 min - Average Data
987.38
658.25
329.13
0.00
value
2020-05-25 14:30
2020-05-25 20:30
2020-05-26 02:30
2020-05-26 08:30
2020-05-26 14:3
CO(mg/Nm3)
CO2(%)
Primay_Temp(Celsius)
Seconday_Temp(Celsius)
Date Time

Fig. 81

7. Conclusion and the Way Forward

The use of plastic during Covid-19 pandemic has tremendous environmental consequences but owing to the urgent health priority has overshadowed this issue. The disposal of plastic waste is considered as environmental liability but it is unavoidable and the planners need to re-think over it. The sudden surge in demand of single use plastic products was observed to protect the common masses and all the entire committed warriors engaged in tacking this crisis. The management of single use plastic is already a challenge for the environmentalists globally and the impending increase in volume of plastic waste during pandemic time has further threatened the problem of plastic waste management. The need to assess the potential impact of plastic products, that are essentially required for personal protection during such pandemic situations, is now a new area and we need to pay attention to it. The sudden change in biomedical waste quantum and its composition calls for a strategic planning and study on Plastic Waste Footprint.

The existing medical waste treatment facilities in the State, which are based on thermal process, i.e. incineration of waste at high temperature, also need to be given a thought which have been installed based on predictable waste flow and composition. The sudden surge in waste quantity is likely to upset the functioning of incinerator system. A thought may be given to couple the incinerator systems with heat recovery system owing to the fact that the plastic waste has a high chemical energy content which can be recovered for useful purposes, subject to social acceptability.

The quantum of plastic waste generated during pandemic crisis was compensated to some extent because there was reduction in quantum of municipal/domestic waste which too contains plastic waste.

The generation of pathogen laden infectious waste was experienced not only from the medical establishments and health care facilities but the quarantine centres, isolation areas, home quarantine places were the other vulnerable source of waste generation. Transportation of waste from these scattered places to the disposal site was also a challenging task.

A thought may be given to own mobile incinerator systems to avoid transportation of infectious waste and immediate disposal of the same near or at the site of generation.

There is need to have a foolproof web enabled automated waste management system for tracking of quantity at the source of generation of bio-medical waste, at its storage, during transportation and disposal. The system should have remote operation provision.