

**For Public Consultation
Volume-I**

**Draft Environmental Impact Assessment Report
for**

**Expansion of Waste to Energy Plant from 24 MW to 60 MW at Integrated
Municipal Solid Waste Management Facility (MSWMF) at Sector 5,
Pocket N1, Bawana Industrial Area, Narela Bawana, District North West,
Delhi by M/s. Delhi MSW Solutions Ltd. (DMSWSL)**

(PROJECT OR ACTIVITY OF SCHEDULE 1(d), CATEGORY-A)

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Proponent

M/s. Delhi MSW Solutions Ltd. (DMSWSL)

**Sector 5, Pocket N1, Behind Pragati Power Plant, Bawana Industrial Area,
Bawana, District North West, Delhi.**

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Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

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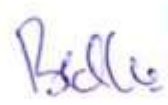
FOREWORD

M/s. Delhi MSW Solutions Ltd (DMSWSL) has developed the 2000 TPD MSW including 24 MW RDF Standalone Project with in the Integrated MSW Management Facility (IMSWMF) at the notified site by Municipal Corporation of Delhi for which EC was obtained from MoEF&CC with capacity 4000 TPD of MSW processing wide EC vide no. F. No.-67/2009-IA.III dt. 8th May 2012. Now DMSWSL proposed to expand the existing WTE capacity to 60 MW at the same site.

Total water requirement for Existing project is 313 KLD. Total water requirement for the proposed expansion project is 337 KLD. The same will be sourced from Delhi Jal Board and Industrial Waste Water of adjacent Pragati Power Plant. The total power required for operations is approximately 5.4 MW. The estimated capital cost for the proposed project is around Rs. 900.1 Crores. Total manpower requirement of both existing and proposed WTE site is 475. The capital cost allotted for EMP is around Rs. 134.5 Crores. To assessing the potential environmental impacts due to the proposed project, DMSWSL, retained M/s Re Sustainability Solutions Private Limited (ReSSPL), (formerly known as Ramky Enviro Services Private Limited) Hyderabad a NABET accredited consultant, to prepare Environmental Impact Assessment (EIA) report and technical assistance for obtaining Environmental clearance from Expert Appraisal Committee, MOEF&CC, New Delhi.

Environmental Impact Assessment report presents details of baseline data covering ambient air, noise, ground & surface water, soil, land, ecology & bio-diversity, and socio-economic components of the environment with a view to identify, predict and evaluate the potential impacts due to the proposed project with a detailed delineated EMP to mitigate the adverse impacts.

The co-operation and the assistance rendered by the officials of M/s. Delhi MSW Solutions Ltd. in preparation for this report, are greatly acknowledged.



Dr. B. Chakradhar
Head of the Department

Re Sustainability Solutions Private Limited
(formerly known as Ramky Enviro Services Private Limited)

Re Sustainability Solutions Private Limited
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Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Abbreviation	
AAQ	Ambient Air Quality
ACC	Air Cooled Condenser
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model.
AFA	Aquatic Flora
AFL	Aquatic Fauna
APC	Air Pollution Control
AQI	Air Quality Index
ASR's	Air pollution Sensitive Receivers
AWS	Automatic Weather Station
BDL	Below Detectable Limits
BMTPC	building materials & technology promotion council
BOD	Biochemical Oxygen Demand
BR	Biosphere Reserve
CBA	Cost Benefit Analysis
CER	Corporate Environmental Responsibility
CFE	Consent for Establish
CFO	Consent for Operate
CGWB	Central Ground Water Board
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health & Environmental Engineering Organization
CSR	Corporate Social Responsibility
CW	Crosswind
dB(A)	decibel
DCH	Direct contact heater
DCS	Distributed controlled system
DDA	Delhi Development Authority
DM	Disaster Management
DM Plant	Demineralization Plants
DMSWSL	Delhi MSW Solutions Limited
DO	Dissolved Oxygen
DPCC	Delhi Pollution Control Committee
DSIIDC	Delhi State Industrial and Infrastructure Development Corporation Ltd.
DW	Downwind
E	East
EAC	Expert Appraisal Committee
EBM	Environmental Baseline Monitoring
EC	Environmental Clearance
ECC	Emergency Control Centre
EIA	Environmental Impact Assessment

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

ELCB	Earth Leakage Circuit Breaker
EMP	Environmental Management Plan
ENE	East North East
EPA	Environment Protection Act
EPP	Emergency Preparedness Plan
ESE	East South East
FE&TI	Fire- Explosion and Toxicity Index
FGCS	Flue Gas Condensers
GCV	Gross calorific value
gm	Gram
GPH	General Process Hazard
GW	Ground Water
Ha	Hectare
HAZOP	Hazard and Operability Study
HCl	Hydrochloric acid
HSD	High Speed Diesel
HWMP	Hyderabad Waste Management Project
IBAs	Important bird areas
ILO	International Labour Organization
IMD	Indian Meteorological Department
IMSWMF	Integrated Municipal Solid Waste Management Facility
ISO	International Organization for Standardization
kcal/kg	kilocalorie/ Kilogram
KLD	kilo liters per day
LCV	Lower calorific value
LDO	Light Diesel Oil
LIZ	Likely Impact Zone
LOS	Level of Service
LTP	Leachate Treatment Plant
LULC	Land use Land Cover
m/s	Meter per second
MCD	Municipal Corporation of Delhi
MDR	Major District Road
MFA	Marine Fauna
MFL	Marine Flora
MOEFCC	Ministry of Environment, Forest and Climate Change
MSDS	Material Safety Data Sheet
MSIHC	Manufacture, Storage and Import of Hazardous Chemicals
MSW	Municipal Solid Waste
MT	Metric ton
MVR	Mechanical Vapour Recompression
MW	Megawatt
N	North
NAAQS	National Ambient Air Quality Standard

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

NABET	National Accreditation Board for Education and Training
NABL	National Accreditation Board for Testing and Calibration Laboratories
NaOCl	Sodium hypochlorite
NE	North East
NFPA	National Fire Protection Association
NNE	North North East
NNW	North North West
NOx	Oxides of Nitrogen
NP	National Park
NRSC	National Remote Sensing Centre
NW	North West
O&G	Oil & Gas
O&M	Operations & Maintenance
OBC	Other Backward Class
OHC	Occupational Health Centre
OM	Office Memorandum
OSHA	Occupational Safety and Health Administration
PCDD	Polychlorinated dibenzodioxins
PCDF	Polychlorinated dibenzofurans
PHC	Public Health Centre
PM	Particulate Matter
PPCL	Pragati Power Corporation Limited
PTFE	Polytetrafluoroethylene
PUC	Pollution Under Control
RCCB	Residual Current Circuit Breaker
RDF	Refuse Derived Fuel
ReSL	Re Sustainability Limited
S	South
SC	Soil Conservation
SCBA	Self-Contained Breathing Apparatus
SE	Socioeconomic
SEAC	State Level Expert Appraisal Committees
SLF	Secured Landfill
SO ₂	Sulfur Di-oxide
SOI	Survey of India
SPCB	State Pollution Control Board
SPH	Specific Process Hazard
Sq.m	Square meter
SRB	Sustainable Responsible Business
SRTM	shuttle radar topographic mission
SSE	South South East
ST	Schedule Tribe
SW	South West

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solid
TFA	Terrestrial Fauna
TFL	Terrestrial Flora
THE	Thermal
TOR	Terms of Reference
TPD	Ton per Day
TSS	Total Suspended Solids
USA	United States of America
UW	Upwind
VOC	Volatile organic compounds
W	West
WLS	Wildlife Sanctuary
WNW	West North West
WSW	West South West
WTE	Waste To Energy



Quality Council of India

National Accreditation Board for
Education & Training



CERTIFICATE OF ACCREDITATION

Ramky Enviro Services Private Limited

Ramky Grandiose, Ramky Towers Complex,
Gachibowli, Hyderabad – 500032, Telangana

Accredited as **Category - A** organization under the QCI-NABET Scheme for Accreditation of EIA
Consultant Organizations: Version 3 for preparing EIA-EMP reports in the following Sectors:

Sl. No.	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals including Open cast/ Underground mining	1	1 (a) (i)	A
2	Onshore Oil and gas exploration, development & production	2	1 (b)	A
3	Thermal power plants	4	1 (d)	A
4	Petrochemical based processing (processes other than cracking & reformation and not covered under the complexes)	20	5 (e)	A
5	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	21	5 (f)	A
6	Industrial estates/ parks/ complexes/ Areas, export processing zones (EPZs), Special economic zones (SEZs), Biotech parks, Leather complexes	31	7 (c)	A
7	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	32	7 (d)	A
8	Bio-medical waste treatment facilities	32A	7 (da)	B
9	Common effluent treatment plants (CETPs)	36	7 (h)	B
10	Common municipal solid waste management facility (CMSWMF)	37	7 (i)	B
11	Building and construction projects	38	8 (a)	B
12	Townships and Area Development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RA AC minutes dated July 26, 2019 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/19/1045 dated August 28, 2019. The accreditation needs to be renewed before the expiry date by Ramky Enviro Services Private Limited, Hyderabad, following due process of assessment.

Sr. Director, NABET
Dated: August 28, 2019

Certificate No.
NABET/ EIA/1922/ RA 0140

Valid till
21.05.2022

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.



QCI/NABET/ENV/ACO/22/2614

Dec 12, 2022

To

Re Sustainability Solutions Private Limited (formerly *Ramky Enviro Services Pvt Ltd*)
Level 11, Aurobindo Galaxy, Hyderabad Knowledge City,
Hitech City Road, Hyderabad 5000081 Telangana

Sub.: Extension of Validity of Accreditation till March 11, 2023 – regarding
Ref.. Certificate no. NABET/EIA/1922/RA0140

Dear Sir/Madam

This has reference to the accreditation of your organization under the QCI-NABET EIA Scheme, the validity of **Re Sustainability Solutions Private Limited** (formerly *Ramky Enviro Services Pvt Ltd*) is hereby extended till March 11, 2023 or completion of the assessment process, whichever is earlier.

The above extension is subject to the submitted documents/required information with respect to your application and timely submission and closure of NC/Obs during the process of assessment.

You are requested not to use this letter after expiry of the above stated date.

With best regards.

(A K Jha)
Sr. Director, NABET

NABET

No. Q-15018/49/2018-CPW
Government of India
Ministry of Environment, Forest and Climate Change
CP Division

Agni, Indira Paryavaran Bhawan,
Jor Bagh Road, New Delhi- 110003

Dated: 14th September, 2020

To

M/s Ramky Enviro Engineers Limited
Ramky Grandiose, Ramky Towers Complex
Gachibowli, Hyderabad-500032
Telangana

Ref: (i) MoEF&CC's letter No. Q-15018/49/2018-CPW dated 20.12.2019
(ii) M/s Ramky Enviro Engineers Limited, Hyderabad, Telangana Letter ref. no. REEL/MoEF&CC/renewal/2020-21/269 dated 08.07.2020.

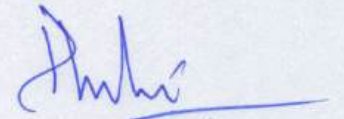
Subject: - Extension of validity of recognition of M/s Ramky Enviro Engineers Limited, Hyderabad Waste Management Project, Survey No. 684/1, Dundigal (V), Qutabullapur (M), Rangareddy District-500043, Telangana as Environmental Laboratory under the Environment (Protection) Act, 1986.

Sir,

With reference to the above, and in view of the current validity of mandatory certificates submitted, this Ministry hereby extends the validity of recognition of M/s Ramky Enviro Engineers Limited, Hyderabad under the Environment (Protection) Act, 1986 to 26.04.2023, as shall be notified in the Gazette of India.

2. This recognition is subject to all the terms and conditions detailed in this Ministry's letter under reference and these shall be strictly adhered to by the laboratory.

Yours faithfully,



(Dr. Ritesh Joshi)
Scientist 'E'

Copy to :

1. Member Secretary, Central Pollution Control Board, Parivesh Bhawan, East Arjun Nagar, New Delhi - 110032.
2. Member Secretary, Telangana State Pollution Control Board, A-3, Industrial Estate, Sanath Nagar, Hyderabad
3. Additional Principal Conservator of Forests (C), Ministry of Environment, Forest and Climate Change, Regional Office (SEZ), 1st and 2nd Floor, Handloom Export Promotion Council, 34, Cathedral Garden Road, Nungambakkam, Chennai-34.
4. Director, IT Division, MoEF&CC, New Delhi-110003: for uploading on MoEF&CC website

UNDERTAKING BY PROPONENT

As per the MOEFCC Office Memorandum No. J-11013/41/2006-IA.II(I) dated October 05, 2011, we, Delhi MSW Solutions Ltd., the proponent of the proposed **Expansion of Waste to Energy Plant from 24 MW to 60 MW at Integrated Municipal Solid Waste Management Facility (IMSWMF) at Pocket N1, Sector 5, Bawana Industrial Area, Narela Bawana, District North West (Delhi)** hereby declare that we have engaged M/s. Re Sustainability Solutions Private Limited (RSSPL) (Formerly M/s. Ramky Enviro Services Private Limited), a QCI/NABET accredited (Certificate No. NABET/EIA/1922/RA0140) EIA Consultant for the preparation of the Environmental Impact Assessment (EIA) Report. The EIA report has been prepared in compliance with the Terms of Reference received (vide File No. J-13012/01/2022-IA.I (T) and Proposal number IA/DL/THE/271398/2022) dated 29th June, 2022. We hereby certify that the data/information presented in the report is factually correct and that we own the contents (information and data) of the EIA report.

Proponent

Authorized Signatory,



For M.s. Delhi MSW Solutions Ltd. (DMSWSL)

Delhi MSW Solutions Limited [WTE]
(A Subsidiary of Re Sustainability Limited)

Site Address:

Sector-5, Pocket N-1, Bawana Industrial Area,
Behind Pragati Power Plant, Bawana,
New Delhi - 110039, India.
CIN : U90001TG2009PLC063708
GSTIN : 07AADCD1783F1ZS

Registered Office:

Level 11B, Aurobindo Galaxy,
Hyderabad Knowledge City,
HITECH City Road, Hyderabad-500081, India.

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info@resustainability.com
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UNDERTAKING BY CONSULTANT

We M/s. Re Sustainability Solutions Private Limited (Formerly M/s. Ramky Enviro Services Private Limited) accredited EIA consultant involved in the preparation of EIA/EMP report after accreditation by QCI-NABET (Certificate No. NABET/EIA/1922/RA 0140), hereby declare that we have prepared the EIA report for the “Expansion of Waste to Energy Plant from 24 MW to 60 MW at Integrated Municipal Solid Waste Management Facility (IMSWMF) at Pocket N1, Sector 5, Bawana Industrial Area, Narela Bawana, District North West (Delhi) by M/s. Delhi MSW Solutions Ltd. We hereby certify that the prescribed Terms of References (File No. J-13012/01/2022-IA.I (T) and Proposal number IA/DL/THE/271398/2022) received dated 29th June, 2022) has been complied. In this regard, we hereby certify that the EIA/EMP report prepared by us and data provided by the Laboratory including our status of approvals presented in the report is factually correct. The laboratory used for the analysis of samples is approved by NABL, MOEFCC and under EPA 1986 and Rules made there under.

We are also enclosing the letter issued from QCI-NABET vide letter no. QCI/NABET/ENV/ACO/22/2614 dated Dec. 12, 2022 for Extension of Validity of Accreditation till Mar. 11, 2023.




Dr. B. Chakradhar

Head of the Department

Re Sustainability Solutions Private Limited
(formerly known as Ramky Enviro Solutions Private Limited)

Re Sustainability Solutions Private Limited
(formerly known as Ramky Enviro Services Private Limited)
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Level 11B, Aurobindo Galaxy,
Hyderabad Knowledge City,
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CIN No. U90001TG2010PTC071974

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Declaration by Experts contributing to the EIA – “Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Limited (DMSWSL) at Tehsil Narela, District North West Delhi”.

I, hereby, certify that I was a part of the EIA team in the following capacity that developed this EIA report.

EIA Coordinator:

Name : **Mr. V. Vijay Kumar**

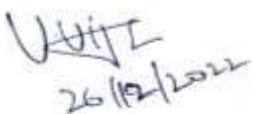
Sign & Date :

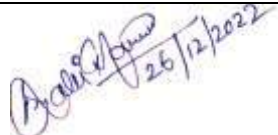
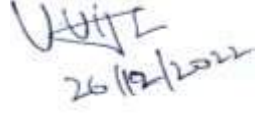
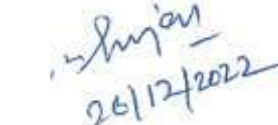

26/12/2022

Period of involvement : **June, 2022 – Till date**

Contact information : vvijaykumar@resustainability.com

Functional Area Experts:

S. No	Functional Area	Name of the Expert	Involvement		Sign & Date
			Period	Task	
1	AP	Mr. V. Vijay Kumar	June, 2022 – Till date	Provided the required inputs for AP during project period.	 26/12/2022
2	WP	Dr. B. Chakradhar	June, 2022 – Till date	Provided the required inputs for WP during project period.	
3	SHW	Dr. B. Chakradhar	June, 2022 – Till date	Provided the required inputs for SHW during project period.	
4	SE	Mr. Anil Kumar Vishwakarma	October, 2022 – Till date	Provided the required inputs for SE during project period.	
5	HG	Mr. B. Mallikarjuna Rao	June, 2022 – Till date	Provided the required inputs for HG during project period.	 26/12/2022

6	GEO	Mr. B. Mallikarjuna Rao	June, 2022 – Till date	Provided the required inputs for GEO during project period.	
7	EB	Dr. Manoj Kumar Vijaysing Pardeshi	June, 2022 – Till date	Provided the required inputs for EB during project period.	
8	AQ	Mr. V. Vijay Kumar	June, 2022 – Till date	Provided the required inputs for AQ during project period.	
9	NV	Dr. Hemanth Rajkumar	October, 2022 – Till date	Provided the required inputs for NV during project period.	
10	LU	Mr. Uttam Kumar	June, 2022 – Till date	Provided the required inputs for LU during project period.	
11	RH	Dr. B. Chakradhar	June, 2022 – Till date	Provided the required inputs for RH during project period.	
12	SC	Mr. V. Vijay Kumar	June 2022- Till date	Provided the required inputs for SC during project period.	
Note: The baseline data for the project was earlier collected during September, 2019 to November, 2019 and additional one month baseline data as per Office Memorandum F.No.IA3-22/10/2022-IA.III [E 177258] dated 08.06.2022 was carried out during September, 2022 to October 2022.					

Declaration by the Head of the accredited consultant organization/ authorized person:

I, **Dr. B. Chakradhar**, hereby, confirm that the above-mentioned experts prepared the EIA Report for the **“Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Limited (DMSWSL) at Tehsil Narela, District North West Delhi”**. I also confirm that the consultant organization shall be fully accountable for any misleading information mentioned in this statement.

Signature :

Name : Dr. B. Chakradhar
Designation : Head of the Division
Name of the EIA Consultant Organization : Re Sustainability Solutions Private Limited
(Formerly known as Ramky Enviro Services Private Limited)
NABET Certificate No. & Issue Date : NABET/EIA/1922/ RA 0140 & Aug 28, 2019

Annexure – IE

Format for information on Team Member

(only for in-house employees)

Name of project: **“Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi Municipal Solid Waste Solutions Limited (DMSWSL) at Tehsil Narela, District North West Delhi”.**

1. Name and address of EIA consultant organization

M/s. Re Sustainability Solutions Private Limited
(formerly known as Ramky Enviro Services Private Limited)
Level 11 B Aurobindo Galaxy, Hyderabad Knowledge City,
Hitech City Road, Gachibowli,
Hyderabad- 500081

a. Head Office : ✓

b. Branch Office/s :

2. Name of the head of the organization with designation

Dr. B. Chakradhar
Head of the Division

3. Contact details with name of the contact person

a. Name of Contact person	Dr. B. Chakradhar
Address	M/s. Re Sustainability Solutions Private Limited (formerly known as Ramky Enviro Services Private Limited) Level 11 B Aurobindo Galaxy, Hyderabad Knowledge City, Hitech City Road, Gachibowli, Hyderabad- 500081

b. Tel. No.	<u>040 24446000</u>	Mob. : <u>+91-9000604455</u>

c. Email:	drchakradhar@resustainability.com
Alt. Email :	vvijaykumar@resustainability.com

d. Website: resustainability.com

4. Team Members proposed

SI	Name	Qualification [#]	EC/ FAE	Sector/ FA	Approved Sr. Expert	Jobs to be assigned
With Environmental Coordinator						
1.	Mr. Bhasker Boge	M.Sc (Environmental Science & Technology) (Year of passing 2008) (Jawaharlal Nehru Technological University Hyderabad). B.Sc (Botany, Zoology, Chemistry) (Year of passing 2006) (Kakatiya University, Warangal).	EC	4	Mr. V. Vijay Kumar	Assisting the EC in preparation of draft EIA report. Collating the data given by respective functional area experts, assisting in complying TOR points and generic structure of the EIA. Compiling the PH minutes and including the same in final EIA report and preparing presentation.
With Functional Area Expert						
1.	Mr. Pawan Kumar Verma	M.Sc Environmental Science (Year of passing 2008) (APS University, Rewa Madhya Pradesh) B.Sc Botany: Honors Zoology: Subsidiary (Year of passing 2006) (TRS Collage, Rewa Madhya Pradesh).	FAE	EB	Dr. Manoj Kumar Vijaysing Pardeshi	Desk Based Survey involves review of existing literature, databases and site-specific information for the study area. Listing of potentially threatened flora and fauna species, along with land cover/vegetation map. Securing secondary information from Forest & Wildlife department. Visit to project site and study area for collecting flora and fauna species. Identification of Ecological sensitive area including identification of flora and fauna species. Assessing the impact on the ecology and biodiversity due to project

SI	Name	Qualification [#]	EC/ FAE	Sector/ FA	Approved Sr. Expert	Jobs to be assigned
						activities. Preparation of Green Belt development plan based applicable guidelines.
2.	Mrs. Arpita Podder Paka	M.Sc Geography (Year of passing 2011) (University of Calcutta) M.Plan (Urban and Regional planning, Public policy) (Year of passing 2014) (Center for Environmental Planning and Technology)	FAE	SE	Mr. Anil Kumar Vishwakarma	1. Assisting in identifying the project area and demarcate the study area based on the anticipated impact of the upcoming project on google earth. 2. Resource mapping in and around the project site on Google earth, for preliminary understanding before starting secondary analysis which includes no. of habitats, no. of hospitals, no. of educational institutes, no. of Administrative units, Road accessibilities etc. 3. Detailed data analysis from Secondary source (Census of India)- includes Demographic profile analysis, social Character analysis, Physical Infrastructure analysis (Educational centers, Medical Units etc) along with validation of data from other peer published documents. 4. Preparing an illustrated inference from the secondary source to derive into the existing situation in relation to the project. 5. Preparation for upcoming field visit, like

SI	Name	Qualification [#]	EC/ FAE	Sector/ FA	Approved Sr. Expert	Jobs to be assigned
						documentation of questionnaires for Village level survey, door to door survey, FGD format, if required PRA format.
						6. Once data is collected, organizing the raw data into excel format for further detailed analysis. Various techniques would be the part of data analysis. 7. An illustrated inference would be drawn from the analyzed data and would be incorporated in the EIA report based on the impact analysis gather from the environmental dynamics.
			FAE	LU	Mr. Uttam Kumar	1. Assisting in identifying toposheet, satellite imagery for the project site and the study area 2. Helping in land use and land cover verification during field visit 3. Preparing KML of the project site according to project layout 4. Assisting in data interpretation and digitization.
3	Mr. Anjaneyulu Kandimalla	M.A. Social Work (Year of Passing 1991) Andhra Loyola College, Nagarjuna University.	FAE	SE	Mr. Anil Kumar Vishwakarma	1. Basic secondary data analysis from authenticate source and related validation of data. 2. Detail understanding of the project site and its surrounding study area from authenticate secondary Image like

SI	Name	Qualification [#]	EC/ FAE	Sector/ FA	Approved Sr. Expert	Jobs to be assigned
						Google map for secondary analysis 3. Pre-field visit studies would be followed in respect to preparing survey forms 4. Data analysis and inference need to be prepared after visit
4	Mr. Athul S	B.Tech, Civil Engineering (Year of Passing 2017), Cochin University of Science and Technology (CUSAT)	FAE	SC	Mr. V. Vijay Kumar	Assisting in identifying the soil sampling locations and do a comparative study of soil quality for the study area.
			FAE	HG	Mr. B. Mallikarjuna Rao	Assisting FAE in preparation of HG report and contributing to the EIA report. Study of depth of water level, estimation of surface runoff.

[#] Qualification – Bachelor degree in Technical subjects and Master's degree in Science, Humanities and other subjects, year of passing and name of university

Declaration by the employer

We have carefully read the provisions in respect of 'Team Members' in the NABET's Scheme for accreditation of EIA Consultants organizations and commit to abide by the same. The conformity of eligibility of the candidates proposed as Team Member in respect of qualification and other aspects has been verified by us at our end. We confirm that the information provided in the application is correct to the best of our knowledge and belief.

We understand that in case the information provided is found wrong/mis-leading, it may result in cancellation of accreditation granted to the organization.



Signature

Name (authorized signatory)

Dr. B. Chakradhar

Designation

Head of the Division

Organization

M/s. Re Sustainability Solutions Private Limited
(formerly known as Ramky Enviro Services Private Limited)

Date

26/12/2022

Certificate of Plagiarism Check

Title of EIA Report	Expansion of Waste to Energy Plant from 24 MW to 60 MW at Integrated Municipal Solid Waste Management Facility (IMSWMF) at Pocket N1, Sector 5, Bawana Industrial Area, Narela Bawana, District North West (Delhi) by M/s. Delhi MSW Solutions Ltd.
Name of Accredited Organization	Re Sustainability Solutions Private Limited
Unique Identification Number	RSSPL/DMSWSL-WTE/D/4/2022/I/021/A
Name of EIA Co-Ordinator (EC)	Mr. V. Vijay Kumar
Name of the Software	Plagiarism Checker X
Date of Check	26-12-2022
Time of Check	05:45 PM

Declaration by the Head of the Accredited Consultant Organization (ACO)

I hereby certify that this EIA report has been evaluated using online/In-house software i.e. Plagiarism Checker X. The report produced has been analyzed by the system and based on it, I certify that the EIA report produced is in accordance with good scientific practice.

Date and sign of EIA Coordinator/Head of ACO




Name: Dr. B. Chakradhar

Designation: Head of the Department

Re Sustainability Solutions Private Limited

(Formerly Ramky Enviro Services Private Limited)

NABET Certificate No. & Issue Date: NABET/ EIA/ 1922/ RA 0140 dated July 12, 2021 and extension issued Vide Letter no. QCI/NABET/ENV/ACO/22/2614 dated Dec 12, 2022

Re Sustainability Solutions Private Limited
(formerly known as Ramky Enviro Services Private Limited)

Registered Office:

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T: 040 2301 5000

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TERMS OF REFERENCE (TOR)

F. No. J-13012/01/2022-IA.I (T)
Government of India
Ministry of Environment, Forest & Climate Change
(Impact Assessment Division)

Indira Paryavaran Bhavan
2nd Floor, Vayu Wing
Aliganj, Jor Bagh Road
New Delhi - 110003

Dated: 29th June, 2022

To,

M/s Delhi Municipal Solid Waste Solutions Ltd (DMSWSL)
13th Floor, Ramky Grandiose,
Ramky Towers, Gachibowli,
Hyderabad (Telangana)

Sub: Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi Municipal Solid Waste Solutions Ltd (DMSWSL) at Tehsil Narela, District North West (Delhi) - Terms of Reference - reg.

Sir,

This has reference to your online proposal no. IA/DL/THE/271398/2022 dated 5th May, 2022 submitted to the Ministry for grant of terms of reference to the project cited in the subject.

2. The Ministry of Environment, Forest and Climate Change has considered the application. It is noted that the proposal is for expansion of Waste to Energy Plant from 24 MW to 60 MW in an existing area of 40.46 Ha by M/s. Delhi Municipal Solid Waste Solutions Ltd (DMSWSL) at Tehsil Narela, District North West (Delhi).

3. Environment Clearance was granted by MoEF vide letter dated 8th May, 2012 to the project for Waste to energy Plant of capacity min 36 MW at Integrated Waste Management Facility located in the same premise. The unit is in operation at the capacity of 24 MW with valid CTO.

4. Thermal Power Plants are listed in S.N. 1(d) of Schedule of Environment Impact Assessment (EIA) Notification under Category 'A' and to be appraised at Central level in the Ministry.

5. There are no National Parks, Wildlife Sanctuaries, Biosphere Reserves, Tiger/Elephant Reserves, Wildlife Corridors etc within 10 km distance of the project site.

6. The proposed expansion of Waste to Energy plant will further strengthen the Solid Waste Management infrastructure in Delhi at the same time it will also contribute in energy recovery.

7. The proposal was considered by the Expert Appraisal Committee (EAC) for Thermal Power Projects in its 25th EAC meeting held on 31st May, 2022.



8. The details of the project submitted by project proponent and ascertained from the document submitted are mentioned below:

- (i) DMSWSL has developed the Integrated MSW Management Facility (IMSWF) at the identified site by Municipal Delhi Corporation. DMSWSL initially established IMSWF with the capacity of 4000 TPD. Further A standalone RDF based Waste to Energy Plant of 24 MW with 1200 TPD of RDF as fuel which will be drawn from the existing facility. Now DMSWSL has proposed to utilise the leftover 1800 TPD of RDF by installing another 36 MW WTE cumulatively 60 MW.
- (ii) The main objective of the project to collect 100% of MSW generated in the concessionary areas and to dispose-off the same through a most scientific and productive disposal through a combination of processes such as segregation units consisting of Composting plant for biodegradable material, Refuse Derived Fuel (RDF) plant and Waste to Energy for combustible material and secured Landfill for inert disposal.

(iii) Salient features of the project

S. No.	Parameters	Description
1	Name of the project	Expansion of Standalone RDF based Waste to Energy Power Plant from 24 MW to 60 MW at Integrated Municipal Solid Waste Management Facility (IMSWMF) – at Pocket N1, Sector 5, Bawana Industrial Area, Narela Bawana, North West Delhi, Delhi
2	Project proponent	M/s. Delhi Municipal Solid Waste Solutions Ltd (DMSWSL)
3	Plant capacity	Existing–24MWwith1200TPD; Proposed–36MWwith1800 TPD
4	Total plot area	100 Acres(40.46Ha)
	Land demarcated for WtE	69,750m ²
	WtE operation	34,875m ²

S. No.	Parameters	Description

	WtE Proposed	Approx.34.875m2
5	Net water requirement	350m3/day
6	Source of water	Delhi Jal Board and Industrial Waste Water of adjacent Pragati Power Plant
7	Man power requirement	250nos.
8	Power requirement	Approx.5.4 MW (15%oftotalpowergeneration)
9	Nearest Habitation	Sanothvillage-1.34km
10	Nearest WaterBody	YamunaCanal-AdjacenttoSite
10	Nearest Railway Station	HolambiKalan-3.2km
11	Nearest Airport	IndiraGandhiInternationalAirport-25km
11	Nearest Highway	NationalHighway1-6.5km
12	Total project cost	Rs848Crores

(iv) Earlier, the public hearing was conducted on 14.05.2010 for the activity of Integrated Municipal Solid waste management Facility.

(v) The raw material for the proposed project is municipal solid waste, which is having the certain calorific value suitable for power generation. The total MSW of the proposed project concessionary areas is getting scientifically segregated, treated and disposed at the site.

(vi) Regular water demand is estimated to be 350 KLD, source of the water is industrial Waste water of adjacent Pragati Power Plant and Delhi Jal Board Quantity of wastes to be generated (liquid and solid) and scheme for their management/disposal. The wastewater as liquid waste of 105 KLD will be generated which includes cooling tower blow down, boiler blow down and DM regeneration and Leachate. The generated leachate will be treated in the existing LTP, blow-down water from ancillary cooling tower, boiler blow down and WTP Rejects collection tank and utilised in the bottom ash quenching and in APCDs.

(vii) The proposed project is developing within the existing IMSWF and hence there is no rehabilitation and resettlement is envisaged.

9. The sectoral Expert Appraisal Committee considered the proposal in its 12th, 17th

and 25th EAC meetings held on 31st May, 2022. The EAC after detailed deliberation on the information submitted and as presented during the meeting recommended the proposal for grant of Standard ToR with public consultation (without public hearing) for conducting EIA study for expansion of Waste to Energy Plant from 24 MW to 60 MW in an existing area of 40.46 Ha by M/s. Delhi Municipal Solid Waste Solutions Ltd (DMSWSL) at Tehsil Narela, District North West, Delhi with under the provisions of EIA Notification, 2006, and as amended along with the certain additional/specific ToR.

10. Based on recommendation of EAC, the Ministry is hereby accords approval for Standard ToR with public consultation (without public hearing) for conducting EIA study to the project for expansion of Waste to Energy Plant from 24 MW to 60 MW in an existing area of 40.46 Ha by M/s. Delhi Municipal Solid Waste Solutions Ltd (DMSWSL) at Tehsil Narela, District North West (Delhi), under the provisions of EIA Notification, 2006 and as amended along with the following additional/specific ToR:

[A] Environmental Management and Biodiversity Conservation

- i. Baseline Study Heavy metals in Ground water, Surface water and soil to be carried out and incorporated in EIA/EMP report.
- ii. Details pertaining to water source discharge treatment should be provided.
- iii. Zero Liquid Discharge plan shall be submitted.
- iv. Status of green belt (33% of total project cover area) across the periphery of the project boundary shall be provided with a video clip.
- v. Status of Ash Utilization of last 5 years, action plan for 100% ash utilization along with timeline need to be submitted.
- vi. PP shall submit action plan for using treated Sewage/Domestic wastewater for its operations.
- vii. Project proponent to prepare Environmental Cost Benefit Analysis for the project in EIA/EMP Report.

[B] Disaster Management

- viii. Disaster Management Plan shall be prepared and incorporated in EIA/EMP report.

[C] Miscellaneous

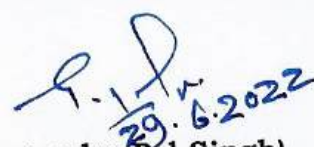
- ix. Public Consultation shall be carried out by uploading the draft EIA/EMP report on Pollution Control Board's website, District collector website/office and publishing notice in newspapers (both in Hindi and English) for seeking comments from the general public. The comments received so shall be addressed in the final EIA report along with time bound action plan and financial budget allocation.
- x. PP shall submit letter from State Pollution Control Board that the project area does not come under Critically or Severely Polluted Areas.
- xi. Certified compliance report of previous EC to be submitted certified by Regional office of the MoEF&CC.
- xii. PP shall submit details of court cases and its status for the project.
- xiii. The PP should submit the photograph of monitoring stations & sampling locations. The photograph should bear the date, time, latitude & longitude of the

monitoring station/sampling location. In addition to this PP should submit the original test reports and certificates of the labs which will analyze the samples.

xiv. Arial view video of project site shall be recorded and to be submit.

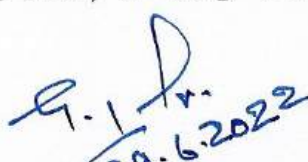
11. You are requested to kindly submit the final EIA/EMP prepared as per TORs to the Ministry for considering the proposal for environmental clearance within 4 years as per the extent rule of the Ministry notified time to time.

12. The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and data provided by other Organization(s)/Laboratories including their status of approvals etc.


(Yogendra Pal Singh)
Scientist 'E'

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi - 110 001.
2. The Chairman, Central Electricity Authority, Sewa Bhawan, R. K. Puram, New Delhi - 110 066.
3. The Chairman, Central Pollution Control Board, Parivesh Bhawan, East Arjun Nagar, Delhi - 110 032.
4. The Deputy Inspector General of Forests, Ministry of Environment, Forest and Climate Change, Integrated Regional Office, Jaipur, A-209 & 218, Aranya Bhawan, Mahatma Gandhi Road, Jhalana Institutional Area, Jaipur - 304 002, Rajasthan.
5. The Chairman, Delhi Pollution Control Committee, 6th floor, C wing, Delhi Secretariat, I P Estate, Delhi - 110 002.
6. Guard file/Monitoring file
7. Website of MoEF&CC.


(Yogendra Pal Singh)
Scientist 'E'

**1(d):STANDARD TERMS OF REFERENCE FOR CONDUCTING
ENVIRONMENT IMPACT ASSESSMENT STUDY FOR THERMAL
POWER PLANTS PROJECTS AND INFORMATION TO BE
INCLUDED IN EIA/EMP REPORT**

- 1) The proposed project shall be given a unique name in consonance with the name submitted to other Government Departments etc. for its better identification and reference.
- 2) Vision document specifying prospective long term plan of the project shall be formulated and submitted.
- 3) Latest compliance report duly certified by the Regional Office of MoEF&CC for the conditions stipulated in the environmental and CRZ clearances of the previous phase(s) for the expansion projects shall be submitted.
- 4) The project proponent needs to identify minimum three potential sites based on environmental, ecological and economic considerations, and choose one appropriate site having minimum impacts on ecology and environment. A detailed comparison of the sites in this regard shall be submitted.
- 5) Executive summary of the project indicating relevant details along with recent photographs of the proposed site (s) shall be provided. Response to the issues raised during Public Hearing and the written representations (if any), along with a time bound Action Plan and budgetary allocations to address the same, shall be provided in a tabular form, against each action proposed.
- 6) Harnessing solar power within the premises of the plant particularly at available roof tops and other available areas shall be formulated and for expansion projects, status of implementation shall also be submitted.
- 7) The geographical coordinates (WGS 84) of the proposed site (plant boundary), including location of ash pond along with topo sheet (1:50,000 scale) and IRS satellite map of the area, shall be submitted. Elevation of plant site and ash pond with respect to HFL of water body/nallah/River and high tide level from the sea shall be specified, if the site is located in proximity to them.
- 8) Layout plan indicating break-up of plant area, ash pond, green belt, infrastructure, roads etc. shall be provided.
- 9) Land requirement for the project shall be optimized and in any case not more than what has been specified by CEA from time to time. Item wise break up of land requirement shall be provided.
- 10) Present land use (including land class/kism) as per the revenue records and State Govt. records of the proposed site shall be furnished. Information on land to be acquired including coal transportation system, laying of pipeline, ROW, transmission lines etc. shall be specifically submitted. Status of land acquisition and litigation, if any, should be provided.
- 11) If the project involves forest land, details of application, including date of application, area applied for, and application registration number, for diversion under FCA and its status should be provided along with copies of relevant documents.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- 12) The land acquisition and R&R scheme with a time bound Action Plan should be formulated and addressed in the EIA report.
- 13) Satellite imagery and authenticated topo sheet indicating drainage, cropping pattern, water bodies (wetland, river system, stream, nallahs, ponds etc.), location of nearest habitations (villages), creeks, mangroves, rivers, reservoirs etc. in the study area shall be provided.
- 14) Location of any National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes / wildlife corridor, if any, within 10 km of the project site shall be specified and marked on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.
- 15) Topography of the study area supported by toposheet on 1:50,000 scale of Survey of India, along with a large scale map preferably of 1:25,000 scale and the specific information whether the site requires any filling shall be provided. In that case, details of filling, quantity of required fill material; its source, transportation etc. shall be submitted.
- 16) A detailed study on land use pattern in the study area shall be carried out including identification of common property resources (such as grazing and community land, water resources etc.) available and Action Plan for its protection and management shall be formulated. If acquisition of grazing land is involved, it shall be ensured that an equal area of grazing land be acquired and developed and detailed plan submitted.
- 17) A mineralogical map of the proposed site (including soil type) and information (if available) that the site is not located on potentially mineable mineral deposit shall be submitted.
- 18) Details of fly ash utilization plan as per the latest fly ash Utilization Notification of GOI along with firm agreements / MoU with contracting parties including other usages etc. shall be submitted. The plan shall also include disposal method / mechanism of bottom ash.
- 19) The water requirement shall be optimized (by adopting measures such as dry fly ash and dry bottom ash disposal system, air cooled condenser, concept of zero discharge) and in any case not more than that stipulated by CEA from time to time, to be submitted along with details of source of water and water balance diagram. Details of water balance calculated shall take into account reuse and re-circulation of effluents.
- 20) Water body/Nallah (if any) passing across the site should not be disturbed as far as possible. In case any Nallah / drain is proposed to be diverted, it shall be ensured that the diversion does not disturb the natural drainage pattern of the area. Details of proposed diversion shall be furnished duly approved by the concerned Department of the State.
- 21) It shall also be ensured that a minimum of 500 m distance of plant boundary is kept from the HFL of river system / streams etc. and the boundary of site should also be located 500 m away from railway track and National Highways.
- 22) Hydro-geological study of the area shall be carried out through an institute/ organization of repute to assess the impact on ground and surface water regimes. Specific mitigation measures shall be spelt out and time bound Action Plan for its implementation shall be submitted.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- 23) Detailed Studies on the impacts of the ecology including fisheries of the River/Estuary/Sea due to the proposed withdrawal of water / discharge of treated wastewater into the River/Sea etc shall be carried out and submitted along with the EIA Report. In case of requirement of marine impact assessment study, the location of intake and outfall shall be clearly specified along with depth of water drawl and discharge into open sea.
- 24) Source of water and its sustainability even in lean season shall be provided along with details of ecological impacts arising out of withdrawal of water and taking into account inter-state shares (if any). Information on other competing sources downstream of the proposed project and commitment regarding availability of requisite quantity of water from the Competent Authority shall be provided along with letter / document stating firm allocation of water.
- 25) Detailed plan for rainwater harvesting and its proposed utilization in the plant shall be furnished.
- 26) Feasibility of near zero discharge concept shall be critically examined and its details submitted.
- 27) Optimization of Cycles of Concentration (COC) along with other water conservation measures in the project shall be specified.
- 28) Plan for recirculation of ash pond water and its implementation shall be submitted.
- 29) Detailed plan for conducting monitoring of water quality regularly with proper maintenance of records shall be formulated. Detail of methodology and identification of monitoring points (between the plant and drainage in the direction of flow of surface / ground water) shall be submitted. It shall be ensured that parameter to be monitored also include heavy metals. A provision for long-term monitoring of ground water table using Piezometer shall be incorporated in EIA, particularly from the study area.
- 30) Socio-economic study of the study area comprising of 10 km from the plant site shall be carried out through a reputed institute / agency which shall consist of detail assessment of the impact on livelihood of the local communities.
- 31) Action Plan for identification of local employable youth for training in skills, relevant to the project, for eventual employment in the project itself shall be formulated and numbers specified during construction & operation phases of the Project.
- 32) If the area has tribal population it shall be ensured that the rights of tribals are well protected. The project proponent shall accordingly identify tribal issues under various provisions of the law of the land.
- 33) A detailed CSR plan along with activities wise break up of financial commitment shall be prepared. CSR component shall be identified considering need based assessment study and Public Hearing issues. Sustainable income generating measures which can help in upliftment of affected section of society, which is consistent with the traditional skills of the people shall be identified. Separate budget for community development activities and income generating programmes shall be specified.
- 34) While formulating CSR schemes it shall be ensured that an in-built monitoring mechanism for the schemes identified are in place and mechanism for conducting annual social audit from the nearest

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

government institute of repute in the region shall be prepared. The project proponent shall also provide Action Plan for the status of implementation of the scheme from time to time and dovetail the same with any Govt. scheme(s). CSR details done in the past should be clearly spelt out in case of expansion projects.

- 35) R&R plan, as applicable, shall be formulated wherein mechanism for protecting the rights and livelihood of the people in the region who are likely to be impacted, is taken into consideration. R&R plan shall be formulated after a detailed census of population based on socio economic surveys who were dependant on land falling in the project, as well as, population who were dependant on land not owned by them.
- 36) Assessment of occupational health and endemic diseases of environmental origin in the study area shall be carried out and Action Plan to mitigate the same shall be prepared.
- 37) Occupational health and safety measures for the workers including identification of work related health hazards shall be formulated. The company shall engage full time qualified doctors who are trained in occupational health. Health monitoring of the workers shall be conducted at periodic intervals and health records maintained. Awareness programme for workers due to likely adverse impact on their health due to working in non-conductive environment shall be carried out and precautionary measures like use of personal equipments etc. shall be provided. Review of impact of various health measures undertaken at intervals of two to three years shall be conducted with an excellent follow up plan of action wherever required.
- 38) One complete season site specific meteorological and AAQ data (except monsoon season) as per latest MoEF&CC Notification shall be collected and the dates of monitoring shall be recorded. The parameters to be covered for AAQ shall include PM₁₀, PM_{2.5}, SO₂, NO_x, CO and Hg. The location of the monitoring stations should be so decided so as to take into consideration the upwind direction, pre-dominant downwind direction, other dominant directions, habitation and sensitive receptors. There should be at least one monitoring station each in the upwind and in the pre - dominant downwind direction at a location where maximum ground level concentration is likely to occur.
- 39) In case of expansion project, air quality monitoring data of 104 observations a year for relevant parameters at air quality monitoring stations as identified/stipulated shall be submitted to assess for compliance of AAQ Standards (annual average as well as 24 hrs).
- 40) A list of industries existing and proposed in the study area shall be furnished.
- 41) Cumulative impacts of all sources of emissions including handling and transportation of existing and proposed projects on the environment of the area shall be assessed in detail. Details of the Model used and the input data used for modeling shall also be provided. The air quality contours should be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The windrose and isopleths should also be shown on the location map. The cumulative study should also include impacts on water, soil and socio-economics.
- 42) Radio activity and heavy metal contents of coal to be sourced shall be examined and submitted along with laboratory reports.

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- 43) Fuel analysis shall be provided. Details of auxiliary fuel, if any, including its quantity, quality, storage etc should also be furnished.
- 44) Quantity of fuel required, its source and characteristics and documentary evidence to substantiate confirmed fuel linkage shall be furnished. The Ministry's Notification dated 02.01.2014 regarding ash content in coal shall be complied. For the expansion projects, the compliance of the existing units to the said Notification shall also be submitted
- 45) Details of transportation of fuel from the source (including port handling) to the proposed plant and its impact on ambient AAQ shall be suitably assessed and submitted. If transportation entails a long distance it shall be ensured that rail transportation to the site shall be first assessed. Wagon loading at source shall preferably be through silo/conveyor belt.
- 46) For proposals based on imported coal, inland transportation and port handling and rail movement shall be examined and details furnished. The approval of the Port and Rail Authorities shall be submitted.
- 47) Details regarding infrastructure facilities such as sanitation, fuel, restrooms, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase should be adequately catered for and details furnished.
- 48) EMP to mitigate the adverse impacts due to the project along with item - wise cost of its implementation in a time bound manner shall be specified.
- 49) A Disaster Management Plan (DMP) along with risk assessment study including fire and explosion issues due to storage and use of fuel should be carried out. It should take into account the maximum inventory of storage at site at any point of time. The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be invariably provided. Mock drills shall be suitably carried out from time to time to check the efficiency of the plans drawn.
- 50) The DMP so formulated shall include measures against likely Fires/Tsunami/Cyclones/Storm Surges/ Earthquakes etc, as applicable. It shall be ensured that DMP consists of both On-site and Off-site plans, complete with details of containing likely disaster and shall specifically mention personnel identified for the task. Smaller version of the plan for different possible disasters shall be prepared both in English and local languages and circulated widely.
- 51) Detailed scheme for raising green belt of native species of appropriate width (50 to 100 m) and consisting of at least 3 tiers around plant boundary with tree density of 2000 to 2500 trees per ha with a good survival rate of around 80% shall be submitted. Photographic evidence must be created and submitted periodically including NRSA reports in case of expansion projects. A shrub layer beneath tree layer would serve as an effective sieve for dust and sink for CO₂ and other gaseous pollutants and hence a stratified green belt should be developed.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- 52) Over and above the green belt, as carbon sink, plan for additional plantation shall be drawn by identifying blocks of degraded forests, in close consultation with the District Forests Department. In pursuance to this the project proponent shall formulate time bound Action Plans along with financial allocation and shall submit status of implementation to the Ministry every six months.
- 53) Corporate Environment Policy
- Does the company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.
 - Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.
 - What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions. Details of this system may be given.
 - Does the company has compliance management system in place wherein compliance status along with compliances / violations of environmental norms are reported to the CMD and the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.

All the above details should be adequately brought out in the EIA report and in the presentation to the Committee.

- 54) Details of litigation pending or otherwise with respect to project in any Court, Tribunal etc. shall invariably be furnished.

Additional TOR for Coastal Based Thermal Power Plants Projects (TPPs):

Over and above the TOR mentioned in Thermal Power Plants Projects, the following shall be strictly followed (as applicable):

- Low lying areas fulfilling the definition wetland as per Ramsar Convention shall be identified and clearly demarcated w.r.t the proposed site.
- If the site includes or is located close to marshy areas and backwaters, these areas must be excluded from the site and the project boundary should be away from the CRZ line. Authenticated CRZ map from any of the authorized agencies shall be submitted.
- The soil leveling should be minimum with no or minimal disturbance to the natural drainage of the area. If the minor canals (if any) have to be diverted, the design for diversion should be such that the diverted canals not only drains the plant area but also collect the volume of flood water from the surrounding areas and discharge into marshy areas/major canals that enter into creek. Major canals should not be altered but their embankments should be strengthened and desilted.
- Additional soil required for leveling of the sites should as far as possible be generated within the site itself in such a manner that the natural drainage system of the area is protected and improved.

STANDARD TERMS OF REFERENCE (TOR) FOR EIA/EMP REPORT FOR PROJECTS/ACTIVITIES REQUIRING ENVIRONMENT CLEARANCE

- e) Marshy areas which hold large quantities of flood water to be identified and shall not be disturbed.
- f) No waste should be discharged into Creek, Canal systems, Backwaters, Marshy areas and seas without appropriate treatment. Wherever feasible, the outfall should be first treated in a Guard Pond and then only discharged into deep sea (10 to 15 m depth). Similarly, the Intake should be from deep sea to avoid aggregation of fish and in no case shall be from the estuarine zone. The brine that comes out from Desalinization Plants (if any) should not be discharged into sea without adequate dilution.
- g) Mangrove conservation and regeneration plan shall be formulated and Action Plan with details of time bound implementation shall be specified, if mangroves are present in Study Area.
- h) A common Green Endowment Fund should be created by the project proponents out of EMP budgets. The interest earned out of it should be used for the development and management of green cover of the area.
- i) Impact on fisheries at various socio economic level shall be assessed.
- j) An endowment Fishermen Welfare Fund should be created out of CSR grants not only to enhance their quality of life by creation of facilities for Fish Landing Platforms / Fishing Harbour / cold storage, but also to provide relief in case of emergency situations such as missing of fishermen on duty due to rough seas, tropical cyclones and storms etc.
- k) Tsunami Emergency Management Plan shall be prepared wherever applicable and Plan submitted prior to the commencement of construction work.
- l) There should not be any contamination of soil, ground and surface waters (canals & village pond) with sea water in and around the project sites. In other words necessary preventive measures for spillage from pipelines, such as lining of Guard Pond used for the treatment of outfall before discharging into the sea and surface RCC channels along the pipelines of outfall and intake should be adopted. This is just because the areas around the projects boundaries could be fertile agricultural land used for paddy cultivation.

TERMS OF REFERENCE (TOR) COMPLIANCE

Compliance to Terms of Reference

1.1 Additional TOR Compliance

S.No	Additional TOR points	Compliance status
A	Environmental Management and Biodiversity Conservation	
i.	Baseline Study Heavy metals in Ground water, Surface water and soil to be carried out and incorporated in EIA/EMP report.	Baseline environmental studies have been conducted for heavy metals in ground water, surface water, soil and results have been included in Chapter-3 Section 3.4 and 3.7 respectively in of Draft EIA/EMP Report.
ii.	Details pertaining to water source discharge treatment should be provided.	Water Source: Project has permission from Delhi Jal Board for 1000 KLD also has agreement with Pragati Power Corporation Limited (PPCL) for 350 KLD treated industrial water. The agreement with PPCL is expandable as per requirement. The total water required after expansion is 650 KLD (existing 313 + expansion 337 KLD). The industrial wastewater generation after expansion is 220 KLD (existing 105 + expansion 105 KLD). This will be treated in wastewater treatment plant and reused for quenching bottom ash. The leachate generation is around 200 KLD, which will be treated in Mechanical Vapour Recompression (MVR) based Low Temperature Evaporation (LTE) plant. The permeate/condensate from the MVR will be used for Flue gas conditioning, lime preparation and dust suppression. Concentrate from the MVR will be disposed in mixing with RDF or disposed in Secured landfill. The domestic water requirement is 15 KLD, which will be sourced from Delhi Jal

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

S.No	Additional TOR points	Compliance status
		Board (DJB). Domestic wastewater generation is 13 KLD, which treated in septic tank followed by soak pit through bio toilets. Entire treated wastewater will be reused and no discharge from the plant premises is envisaged. Zero Liquid Discharge (ZLD) concept will be followed. Details of the same is included in Chapter 4, Section 4.3.3 in Draft EIA/EMP Report.
iii.	Zero Liquid Discharge plan shall be submitted.	Entire treated wastewater (industrial, domestic and leachate) will be reused and no discharge from the plant premises is envisaged. Zero Liquid Discharge (ZLD) concept will be followed. Details of the same is included in Chapter 4, Section 4.3.3 in Draft EIA/EMP Report.
iv.	Status of green belt (33% of total project cover area) across the periphery of the project boundary shall be provided with a video clip.	The site measuring 100 Acre (40.46 Ha) of land was allocated for Integrated municipal solid waste management facilities including WTE plant. MSW management site is in operation since year 2012 and existing WTE plant is in operation since 2017. Total 33.2 Acre (13.5 Ha) of land has been allocated form greenbelt development. As the project is an existing facility adequate greenery has been developed in the site. Around 12365 saplings have been planted and grown within the premises of the facility. Around 3900 additional saplings are proposed during proposed expansion with an allotted budget of Rs 7.80 lakhs. Photos of the greenbelt are given in Chapter 10, Section 10.3.5 in Draft EIA/EMP Report.

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S.No	Additional TOR points	Compliance status
v.	Status of Ash Utilization of last 5 years, action plan for 100% ash utilization along with timeline need to be submitted.	Around 450 TPD of ash is generated after proposed expansion (existing 180 TPD + expansion 270 TPD). The fly ash collected from the bag filter hoppers, economizer hoppers and evaporator /super heater hoppers will be sent to adjacent TSDF for stabilization of hazardous waste. Bottom ash collected from the furnace bottom will be segregated in the ash recycling unit (capacity 30 TPH) into useful material, sent to cement plants, brick manufacturing units, NHAI for road making etc. Any non-usable or reject material will be disposed via secured landfilling.
vi	PP shall submit action plan for using treated Sewage/Domestic waste water for its operations.	Approximately 13 KLD of domestic wastewater will be generated, which will be sent to septic tank followed by soak pit through bio-toilets. No wastewater will be discharged outside the plant premises.
vii.	Project proponent to prepare Environmental Cost Benefit Analysis for the project in EIA/EMP Report.	Environmental Cost Benefit Analysis has been performed and included in Chapter-9 in the Draft EIA/EMP Report.
B	Disaster Management	
viii.	Disaster Management Plan shall be prepared and incorporated in EIA/EMP report.	Disaster Management Plan has been prepared and incorporated Chapter-7, Section 7.4 in Draft EIA/EMP Report.
C	Miscellaneous	
ix.	Public Consultation shall be carried out by uploading the draft EIA/EMP report on Pollution Control Board's website, District collector website/office and publishing notice in newspapers (both in Hindi and English) for seeking comments from the general public. The comments received so shall be addressed in the	Draft EIA/EMP Report will be uploaded on Delhi Pollution Control Board's website, District collector website/office and notice of the same will be published in newspapers (both in Hindi and English) for seeking comments from the general public. Details of comments and it's pointwise responses of the same will be included

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

S.No	Additional TOR points	Compliance status
	final EIA report along with time bound action plan and financial budget allocation.	Final EIA Report.
x.	PP shall submit letter from State Pollution Control Board that the project area does not come under Critically or Severely Polluted Areas.	A request letter dated 18.11.2022 is submitted to DPCC with respect to the condition “project area does not come under Critically or Severely Polluted Areas”. Acknowledgement from the DPCC enclosed as Annexure-8 . The letter from the DPCC will be included in the Final EIA Report.
xi.	Certified compliance report of previous EC to be submitted certified by Regional office of the MOEFCC.	As per MOEFCC Office Circular No. J-11011/618/2010-IA (II) (I) dated 30/05/2012; certified copy of Compliance from Regional Office of MOEFCC was secured and copy of the same dated 18.07.2022 is enclosed as Annexure-7
xii.	PP shall submit details of court cases and its status for the project	No court cases are pending for the project.
xiii.	The PP should submit the photograph of monitoring stations & sampling locations. The photograph should bear the date, time, latitude & longitude of the monitoring station/sampling location. In addition to this PP should submit the original test reports and certificates of the labs which will analyze the samples	Photographs has been collected while sampling/monitoring by using the Note Cam Application and GPS map camera application which represents date, time, latitude & longitude of the monitoring station/sampling location and the same are displayed in Chapter-3, Section 3.11 in Draft EIA/EMP Report. Original test reports and certificates of the labs are enclosed as Annexure-4 .
xiv.	Arial view video of project site shall be recorded and to be submit.	Arial view video videography has been recorded to capture the aerial view of project site and the same will be shown to the expert committee during EAC meeting.

1.2 Standard TOR Compliance

S. no.	TOR points	Compliance
1.	The proposed project shall be given a	The unique name of project is given

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S. no.	TOR points	Compliance
	unique name in consonance with the name submitted to other Government Department etc. for its better identification and reference.	below: Project Name: Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West (Delhi). The same is submitted to other Government Departments for its better identification and reference.
2.	Vision document specifying prospective long-term plan of the project shall be formulated and submitted.	A Vision document specifying prospective long-term plan is given in Annexure-9
3.	Latest compliance of report of duly certified by the Regional Office of MOEFCC for the conditions stipulated in the Environmental and CRZ clearances of the previous phase (s) for the expansion projects shall be submitted.	Current plant Environmental Clearance was secured on 8 th May, 2012. As per MOEFCC Office Circular No. J-11011/618/2010-IA (II) (I) dated 30/05/2012; certified copy of Compliance from Regional Office of MOEFCC was secured and copy of the same dated 18.07.2022 is enclosed as Annexure-7
4	The project proponent needs to identify minimum three potential sites based on environmental, ecological and economic considerations, and choose one appropriate site having minimum impacts on ecology and environment. A detailed comparison of the sites in this regard shall be submitted.	Not applicable as no alternate sites were considered. The expansion of proposed project is located within the existing IMSWMF site which is on total 100 Acres (40.46 ha) area. Out of total 100 Acres land; 17.24 Acre (6.97 Ha) land is allocated for WTE projects. Existing 24 MW WTE project was developed on 8.62 Acre (3.49 Ha) and same area of land is allocated for expansion of WTE project from 24 MW to 60 MW capacity. Hence no additional land to be acquired and there is no displacement involved.
5	Executive summary of the project indicating relevant details along with recent photographs of the proposed	Executive summary of project is attached separately with the Draft EIA/EMP Report.

S. no.	TOR points	Compliance
	site (s) shall be provided. Response to the issues raised during public hearing and the written representations (if any), along with a time bound Action Plan and budgetary allocations to address the same, shall be provided in a tabular form, against each action proposed.	Public consultation will be carried out as per recommendation in approved ToR Vide F. No. J-13012/01/2022-IA.I (T) dt 29.06. 2022. Details of the same will be included in the Final EIA Report once Public Consultation is completed.
6	Harnessing solar power within the premises of the plant particularly at available roof tops and other available areas shall be formulated and for expansion project, status of implementation shall also be submitted.	DMSWSL is proposing to harness solar energy through solar PV rooftop plant from the available roof surface within the site. Adequate area has been demarcated for installation of Solar Panels. Additionally, the panels will be installed all over the open to sky area, street poles, above admin building etc.
7	The geographical coordinates (WGS 84) of the proposed site (plant boundary), including location of ash pond along with toposheet (1:50000 scale) and IRS satellite map of the area, shall be submitted. Elevation of plant site and ash pond with respect to HFL of water body/nallah/River and high tide level from sea shall be specified, if the site is located in proximity to them.	The topographical map of the site with 10 km radius is given in Chapter 1, Figure 1.2. The geographical co-ordinates of WTE power plant are given in Chapter 1, Table 1.3 The satellite imagery of the 10 km radius is shown in Chapter 3, Figure 3.7. Being a WTE plant, there is no provision for ash pond within the proposed project site. The fly ash collected from the bag filter hoppers, economizer hoppers and evaporator /super heater hoppers will be sent to adjacent TSDF for stabilization of hazardous waste. Bottom ash collected from the furnace bottom will be segregated in the ash recycling unit (capacity 30 TPH) into useful material sent to cement plants, brick manufacturing units, NHAI for road making etc. Any non-usable or reject materials will be disposed via

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S. no.	TOR points	Compliance
		secured landfilling.
8	Layout plan indicating break-up of plant area, ash pond, greenbelt, infrastructure, roads etc. shall be provided.	Total plot area of IMSWMF is 100 Acre (40.46 Ha). Out of which land demarcated for WTE is 17.24 Acre (6.97 Ha). Existing WTE power plant was developed on 8.62 Acre (3.48 Ha) area and another 8.62 Acre (3.48 Ha) is allotted for expansion of WTE plant. The detailed layout of the project site showing all the facilities are shown in Chapter 2, Figure 2.6.
9	Land requirement for the project shall be optimized and, in any case, not more than what has been specified by CEA from time to time. Item wise break up of land requirement shall be provided.	As per CEA guidelines the area required for thermal power plant with pit head/load center stations using indigenous coal is 0.52 acres per MW (CEA Report 2017) which is around 18.72 acres for waste to energy plant. CEA has not prescribed norms for land requirement for WTE projects. The proposed project is required only 8.62 Acres (3.49 Ha) which is much lower than CEA norms for coal-based plant requirement. Land breakup details of WTE power plant are given in Chapter 2, Section 2.6.1, Table 2.6 and 2.7.
10	Present land use (including land class/kism) as per the revenue records and State Govt. records of the proposed site shall be furnished. Information on land to be acquired including coal transportation system, laying of pipeline, ROW, transmission lines etc. shall be specifically submitted. Status of land acquisition and litigation, if any, should be provided.	M/s. Delhi MSW Solutions Ltd (DMSWSL) has developed an 24 MW RDF based power plant within the integrated MSW Management Facility (IMSWMF) at the site notified by Municipal Corporation of Delhi. The present land use of the project site is municipal waste landfill, existing 24 MW WTE power plant. The land is owned and notified by Municipal Corporation Delhi (MCD). No additional land is required for the proposed project.
11	If the project involves forest land,	No forest land is involved in the project

S. no.	TOR points	Compliance
	details of application, including date of application, area applied for, and application registration number, for diversion under FCA and its status should be provided along with copies of relevant documents.	site. The site is owned and notified by Municipal Corporation Delhi (MCD).
12	The land acquisition and R&R scheme with a time bound Action Plan should be formulated and addressed in the EIA report.	There is no R&R plan required as total land is under possession of project proponent.
13	Satellite imagery and authenticated topo sheet indicating drainage, cropping pattern, water bodies (wetland, river system, stream, nallahs, ponds etc.), location of nearest habitations (villages), creeks, mangroves, rivers, reservoirs etc. in the study area shall be provided.	Satellite imagery of the site and study area is shown in Chapter 3, Figure 3.7 . Topographical map of the site and study area is given in Chapter 1, Figure 1.2 .
14	Location of any National Park, Sanctuary, Elephant/Tiger Reserve (existing as well as proposed), migratory routes / wildlife corridor, if any, within 10 km of the project site shall be specified and marked on the map duly authenticated by the Chief Wildlife Warden of the State or an officer authorized by him.	There is no National parks, Sanctuary, Elephant / Tiger reserve, and Migratory routes/wildlife corridor within 10 km radius of proposed project site. Bawana RF is at 1.5 km (N) direction, Shri Krishna Sultanpur RF at 5.0 km (SW) direction and Marmurpur PF located 7 km (NE) direction from the proposed project site. The sensitivity map of the project site with 15 km radius is given in Chapter 3, Figure 3.6 .
15	Topography of the study area supported by toposheet on 1:50,000 scale of Survey of India, along with a large-scale map preferably of 1:25,000 scale and the specific information whether the site	Details of topography of the study area are given in Chapter 7, Section 7.5 . Topographical map of the site and study area is given in Chapter 1, Figure 1.2 . There is no requirement of filling within the site. The site is located within the

S. no.	TOR points	Compliance
	requires any filling shall be provided. In that case, details of filling, quantity of required fill material; its source, transportation etc. shall be submitted	existing waste management unit. Nominal surface preparation will be required.
16	A detailed study on land use pattern in the study area shall be carried out including identification of common property resources (such as grazing and community land, water resources etc.) available and Action Plan for its protection and management shall be formulated. If acquisition of grazing land is involved, it shall be ensured that an equal area of grazing land be acquired and developed and detailed plan submitted.	Details of land use/Land Cover pattern in the study area is given in Chapter 3, Section 3.9 . No land acquisition involved in the project. No grazing land is present in the land parcel.
17	A mineralogical map of the proposed site (including soil type) and information (if available) that the site is not located on potentially mineable mineral deposit shall be submitted.	The land is under possession of project proponent. The project site is not located on potentially mineable mineral deposit area and there are no mineral deposits present within the study area. Geology and mineralogical map of the study area is shown in Chapter 7, Figure 7.6 .
18	Details of fly ash utilization plan as per the latest fly ash Utilization Notification of GOI along with firm agreements / MoU with contracting parties including other usages etc. shall be submitted. The plan shall also include disposal method / mechanism of bottom ash.	The fly ash generated from the proposed project will be sent to sanitary landfill or adjacent TSDF located adjacent to IMSWMF site and operated by M/s. Tamil Nadu Waste Management Limited (TNWML) an MoU will be executed between TNWML and DMSWMF for disposal of ash.
19	The water requirement shall be optimized (by adopting measures such as dry fly ash and dry bottom ash disposal system, air cooled	The water requirement is optimized by adopting air cooled condenser and zero discharge concept. The details of water requirement, source and water balance

S. no.	TOR points	Compliance
	condenser, concept of zero discharge) and in any case not more than that stipulated by CEA from time to time, to be submitted along with details of source of water and water balance diagram. Details of water balance calculated shall take into account reuse and recirculation of effluents.	diagram is given in Chapter 2, Section 2.6.3, Table 2.9, and Figure 2.7.
20	Water body/Nallah (if any) passing across the site should not be disturbed as far as possible. In case any Nallah / drain is proposed to be diverted, it shall be ensured that the diversion does not disturb the natural drainage pattern of the area. Details of proposed diversion shall be furnished duly approved by the concerned Department of the State.	No waterbody /Nallah is passing through the site identified and demarcated for expansion of WTE site. Hence, no diversion is envisaged.
21	It shall also be ensured that a minimum of 500 m distance of plant boundary is kept from the HFL of river system / streams etc. and the boundary of site should also be located 500 m away from railway track and National Highways.	There is no river HFL falling within the study area. Yamuna canal is located adjacent to site at 0.5 km (SW), Yamuna river located 13.6 km (E).
22	Hydro-geological study of the area shall be carried out through an institute/ organization of repute to assess the impact on ground and surface water regimes. Specific mitigation measures shall be spelt out and time bound Action Plan for its implementation shall be submitted.	The detailed hydro-geological study and drainage pattern details of the study area are given in Chapter 7, Section 7.5.
23	Detailed Studies on the impacts of the ecology including fisheries of the River/Estuary/Sea due to the proposed withdrawal of water /	The water required for the proposed project will be sourced from Delhi Jal Board and Pragati Power Corporation Limited (PPCL) and treated wastewater is

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S. no.	TOR points	Compliance
	discharge of treated wastewater into the River/Sea etc shall be carried out and submitted along with the EIA Report. In case of requirement of marine impact assessment study, the location of intake and outfall shall be clearly specified along with depth of water drawl and discharge into open sea.	reused within the plant premises. No treated wastewater will be discharged outside the boundary. Hence, there will not be any impact on any fisheries. As water is not taken or discharged into sea, hence marine impact assessment study is not required.
24	Source of water and its sustainability even in lean season shall be provided along with details of ecological impacts arising out of withdrawal of water and taking into account inter- state shares (if any). Information on other competing sources downstream of the proposed project and commitment regarding availability of requisite quantity of water from the Competent Authority shall be provided along with letter / document stating firm allocation of water.	The water required for the proposed project will be sourced from Delhi Jal Board and Pragati Power Corporation Limited (PPCL). Permission from Delhi Jal Board and agreement with Pragati Power Corporation Limited (PPCL) is enclosed as Annexure-3
25	Detailed plan for rainwater harvesting and its proposed utilization in the plant shall be furnished.	The detailed plan for rain water harvesting and its utilization details are given in Chapter 4, Section 4.3.3.2 and Chapter 7, Section 7.7.3
26	Feasibility of near zero discharge concept shall be critically examined and its details submitted.	The proposed project will follow zero discharge concept by recirculating the maximum blow down water from boilers, cooling towers and MVR (Leachate treatment plant) condensate will be utilized to the maximum level. Details are given in Chapter 2, Section 2.11.4.
27	Optimization of Cycles of Concentration (COC) along with other water conservation measures in the	The proposed Cycles of Concentration (COC) is five for minimizing water requirement of air-cooled condenser

S. no.	TOR points	Compliance
	project shall be specified.	system, recycle and reuse of various plant uses.
28	Plan for recirculation of ash pond water and its implementation shall be submitted.	There will be no provision for ash pond within the site. The fly ash generated from the proposed project will be sent to TSDF located adjacent to IMSWMF site and operated by M/s. Tamil Nadu Waste Management Limited (TNWML).
29	Detailed plan for conducting monitoring of water quality regularly with proper maintenance of records shall be formulated. Detail of methodology and identification of monitoring points (between the plant and drainage in the direction of flow of surface / ground water) shall be submitted. It shall be ensured that parameter to be monitored also include heavy metals. A provision for long-term monitoring of ground water table using Piezometer shall be incorporated in EIA, particularly from the study area.	The water quality in and around the site were regularly monitored and the recent monitoring reports were attached as Annexure-10 The details of ground water table in study area is given in Chapter 7, Section 7.7 and Table 7.16.
30	Socio-economic study of the study area comprising of 10 km from the plant site shall be carried out through a reputed institute / agency which shall consist of detail assessment of the impact on livelihood of the local communities.	Socio-economic study was carried out in the study area by QCI-NABET Accredited Consultant Organization i.e. Re Sustainability Solutions Pvt. Ltd. Detailed impact assessment survey and proposed mitigation measures along with demography and the prevailing socio- economic conditions are given in Chapter 3, Section 3.10 and Chapter 4, Section 4.3.6 in Draft EIA/EMP Report.
31	Action Plan for identification of local employable youth for training in skills, relevant to the project, for	Training in skills relevant to the project and CSR activities carried out by the project management and the same is given

S. no.	TOR points	Compliance
	eventual employment in the project itself shall be formulated and numbers specified during construction & operation phases of the Project.	in Chapter 8, Section 8.2. Photos of CSR activities undertaken is enclosed as Annexure-6
32	If the area has tribal population it shall be ensured that the rights of tribal are well protected. The project proponent shall accordingly identify tribal issues under various provisions of the law of the land.	The proposed project is within the existing IMSWMF facility by DMSWSL. No tribal population is present within the project site.
33	A detailed CSR plan along with activities wise break up of financial commitment shall be prepared. CSR component shall be identified considering need based assessment study and Public Hearing issues. Sustainable income generating measures which can help in upliftment of affected section of society, which is consistent with the traditional skills of the people shall be identified. Separate budget for community development activities and income generating programmes shall be specified.	The details of CSR/CER activities carried out by the company and details of the fund allocated in the past years along with the proposed future CSR/CER activities are given in is given in Chapter 8, Section 8.3.2. Photos of CSR activities undertaken is enclosed as Annexure-6
34	While formulating CSR schemes it shall be ensured that an in-built monitoring mechanism for the schemes identified are in place and mechanism for conducting annual social audit from the nearest government institute of repute in the region shall be prepared. The project proponent shall also provide Action Plan for the status of implementation of the scheme from time to time and dovetail the same with any Govt. scheme(s). CSR	The details of CSR/CER activities were given in Chapter 8, Section 8.3.2.

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S. no.	TOR points	Compliance
	details done in the past should be clearly spelt out in case of expansion projects	
35	R&R plan, as applicable, shall be formulated wherein mechanism for protecting the rights and livelihood of the people in the region who are likely to be impacted, is taken into consideration. R&R plan shall be formulated after a detailed census of population based on socio economic surveys who were dependent on land falling in the project, as well as, population who were dependent on land not owned by them.	No R&R is envisaged for the proposed project as total land is under procession of IMSWMF/MCD.
36	Assessment of occupational health and endemic diseases of environmental origin in the study area shall be carried out and Action Plan to mitigate the same shall be prepared.	Health assessment has been carried out as part of Socioeconomic survey. The study area has well developed medical centers, which include both private and government facilities. The Primary Health Centers, also known as Aam Aadmi Moholla Clinics, offers basic health care services along with medicines and diagnostics support across the villages. For major diseases and illness, they prefer to visit government/private hospitals like District Government Hospital, AIIMS, Safdarjung Hospital, Ganga Ram Hospital, Apollo Hospital, Fortis Hospital where multi specialty facilities are available. As per the survey conducted during the study period data reveal no prevalence of chronic diseases, some common diseases like malaria, typhoid and seasonal fever are prevalent in the study area. All villages have accredited social health activists (ASHA) to address

S. no.	TOR points	Compliance
		the community level health care needs. As a part of CER activities; Rs. 60.12 Lakhs has been proposed for health check-up for communities in the nearby villages and distribution of medicines to the needy and vaccination drives for children and needy. Health checkup of the workers is also being conducted on regular basis.
37	Occupational health and safety measures for the workers including identification of work-related health hazards shall be formulated. The company shall engage full time qualified doctors who are trained in occupational health. Health monitoring of the workers shall be conducted at periodic intervals and health records maintained. Awareness programme for workers due to likely adverse impact on their health due to working in non-conductive environment shall be carried out and precautionary measures like use of personal equipments etc. shall be provided. Review of impact of various health measures undertaken at intervals of two to three years shall be conducted with an excellent follow up plan of action wherever required.	Basic health care facilities like First-aid and ambulance facility will be made available to the workers during the construction and operation period. Company will engage qualified Doctors and conduct health camps for the workers. Required treatment and other facilities will be provided as per company policy. Workers will not be allowed to work without relevant Personal Protective Equipment's (PPE). Emergency Response plan were given in Chapter 7, Section 7.4.
38	One complete season site specific meteorological and AAQ data (except monsoon season) as per latest MoEF&CC Notification shall be collected and the dates of monitoring shall be recorded. The parameters to be covered for AAQ	Baseline Environmental studies was earlier carried out during September to November 2019. We have also conducted one-month fresh Monitoring at all the identified locations during 23 rd September, 2022 to 22 nd October, 2022. Comparative analysis of earlier baseline

S. no.	TOR points	Compliance
	shall include PM ₁₀ , PM _{2.5} , SO ₂ , NO _x , CO and Hg. The location of the monitoring stations should be so decided so as to take into consideration the upwind direction, pre-dominant downwind direction, other dominant directions, habitation and sensitive receptors. There should be at least one monitoring station each in the upwind and in the pre – dominant downwind direction at a location where maximum ground level concentration is likely to occur.	and fresh baseline is given in Chapter-3, Section 3.3.3.
39	In case of expansion project, air quality monitoring data of 104 observations a year for relevant parameters at air quality monitoring stations as identified/stipulated shall be submitted to assess for compliance of AAQ Standards (annual average as well as 24 hrs).	Ambient air quality monitoring data of last one year for relevant parameters at air quality monitoring station of existing plant is given in Annexure-11
40	A list of industries existing and proposed in the study area shall be furnished.	A list of major type of industries in the study area is enclosed as Annexure-12
41	Cumulative impacts of all sources of emissions including handling and transportation of existing and proposed projects on the environment of the area shall be assessed in detail. Details of the Model used and the input data used for modeling shall also be provided. The air quality contours should be plotted on a location map showing the location of project site, habitation nearby, sensitive receptors, if any. The windrose and isopleths should also be shown on	Cumulative impacts of all sources of emissions including handling and transportation of existing and proposed projects on the predicted maximum GLC of 24 hours average of PM ₁₀ , PM _{2.5} , SO ₂ & NO _x concentrations considering mean meteorological data of the study season are superimposed on the maximum baseline concentrations obtained during study period to estimate the project scenario, which would prevail at the post operational phase. Details are given in Chapter 4, Section 4.3.2.

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S. no.	TOR points	Compliance
	the location map. The cumulative study should also include impacts on water, soil and socio-economics.	
42	Radio activity and heavy metal contents of coal to be sourced shall be examined and submitted along with laboratory reports.	Coal is not used in the proposed project. This is a WTE project that uses RDF from MSW as fuel.
43	Fuel analysis shall be provided. Details of auxiliary fuel, if any, including its quantity, quality, storage etc. should also be furnished.	RDF is used as a fuel and detailed analysis is given in Chapter 2, Section 2.9 . Only Light Diesel Oil (LDO) will be used as auxiliary fuel in the initial stage of the plant commissioning of expansion plant
44	Quantity of fuel required, its source and characteristics and documentary evidence to substantiate confirmed fuel linkage shall be furnished. The Ministry's Notification dated 02.01.2014 regarding ash content in coal shall be complied. For the expansion projects, the compliance of the existing units to the said Notification shall also be submitted	The quantity of RDF is 1800 TPD. Total RDF for proposed expansion will be taken from the existing IMSWMF processing plant. Characteristics of MSW (RDF) are given in Chapter 2, Section 9.9 .
45	Details of transportation of fuel from the source (including port handling) to the proposed plant and its impact on ambient AAQ shall be suitably assessed and submitted. If transportation entails a long distance it shall be ensured that rail transportation to the site shall be first assessed. Wagon loading at source shall preferably be through silo/conveyor belt.	There is no requirement of transportation of the fuel (RDF) as the waste to energy power plant is located within the IMSWMF site.
46	For proposals based on imported coal, inland transportation and port handling and rail movement shall be	Not Applicable.

S. no.	TOR points	Compliance
	examined and details furnished. The approval of the Port and Rail Authorities shall be submitted.	
47	Details regarding infrastructure facilities such as sanitation, fuel, restrooms, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase should be adequately catered for and details furnished.	Basic infrastructure such as health care facilities like First-aid, sanitation, fuel, restrooms, medical facilities, safety will be provided to the workers during the construction period. Company will engage qualified doctors and conduct health camps for the workers. Required treatment and other facilities will be provided as per company policy. Workers will not be allowed to work without relevant Personal Protective Equipment's (PPE).
48	EMP to mitigate the adverse impacts due to the project along with item - wise cost of its implementation in a time bound manner shall be specified	The detailed EMP to mitigate the adverse impacts during construction and operation phases detailed in Chapter 10 . The item wise cost of its implementation is given in Chapter 10, Table, Section 10.6 & 10.7 .
49	A Disaster Management Plan (DMP) along with risk assessment study including fire and explosion issues due to storage and use of fuel should be carried out. It should take into account the maximum inventory of storage at site at any point of time. The risk contours should be plotted on the plant layout map clearly showing which of the proposed activities would be affected in case of an accident taking place. Based on the same, proposed safeguard measures should be provided. Measures to guard against fire hazards should also be invariably provided. Mock drills shall be suitably carried out from time to	Detailed disaster Management Plan along with risk assessment study is given in Chapter 7, Section 7.4 ALOHA source point on the layout map is given in Chapter 7, Figure 7.3.1

S. no.	TOR points	Compliance
	time to check the efficiency of the plans drawn.	
50	The DMP so formulated shall include measures against likely Fires/Tsunami/Cyclones/Storm urges/ Earthquakes etc., as applicable. It shall be ensured that DMP consists of both On-site and Off-site plans, complete with details of containing likely disaster and shall specifically mention personnel identified for the task. Smaller version of the plan for different possible disasters shall be prepared both in English and local languages and circulated widely.	Detailed disaster Management Plan is given in Chapter 7, Section 7.4.
51	Detailed scheme for raising green belt of native species of appropriate width (50 to 100 m) and consisting of at least 3 tiers around plant boundary with tree density of 2000 to 2500 trees per ha with a good survival rate of around 80% shall be submitted. Photographic evidence must be created and submitted periodically including NRSA reports in case of expansion projects. A shrub layer beneath tree layer would serve as an effective sieve for dust and sink for CO ₂ and other gaseous pollutants and hence a stratified green belt should be developed.	Detailed scheme of green belt development and action plan and no. of species for proposed expansion are given in Chapter 10, Section 10.3.5.
52	Over and above the green belt, as carbon sink, plan for additional plantation shall be drawn by identifying blocks of degraded forests, in close	As the project is an existing facility adequate greenery has been developed in the site. Around 12365 saplings have been planted and grown in the premises. Additionally, 3900 saplings are

S. no.	TOR points	Compliance
	consultation with the District Forests Department. In pursuance to this the project proponent shall formulate time bound Action Plans along with financial allocation and shall submit status of implementation to the Ministry every six months.	proposed to be planted within the project premises. Budgetary allocation & action plan for plantation drives is given in Chapter 10, Table 10.2.
53	Corporate Environment Policy	
	a. Does the company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be detailed in the EIA report.	The Project Proponent has well laid down vision & mission statement approved by Board of Directors with emphasis on environmental protection and health, safety and communication. Details of the vision and mission statement is given in Annexure-9
	b. Does the Environment Policy prescribe for standard operating process / procedures to bring into focus any infringement / deviation / violation of the environmental or forest norms / conditions? If so, it may be detailed in the EIA.	Environmental cell under the control of Project Head to monitor the issues and make necessary report to Directors. Environmental cell /department monitors implement the requisite measures to protect the environment as directed by the statutory authorities.
	c. What is the hierarchical system or Administrative order of the company to deal with the environmental issues and for ensuring compliance with the environmental clearance conditions. Details of this system may be given.	The hierarchical system/administrative setup of the company to deal the environmental related issues forensuring compliances with the environmental clearance conditions is given in Chapter 10, Section 10.5 Figure 10.3 in Draft EIA/EMP Report.
	d. Does the company has compliance management system in place wherein compliance status along with compliances / violations of environmental norms are reported to the CMD and the Board of Directors of the company and / or shareholders or	Yes, the company has compliance management system including an online Regulatory Compliance Tracker in place with environmental cell under the control of Project head to monitor the issues and make necessary report to Directors & CMD. Environmental cell / department monitors and

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S. no.	TOR points	Compliance
	stakeholders at large? This reporting mechanism should be detailed in the EIA report. All the above details should be adequately brought out in the EIA report and in the presentation to the Committee.	implement the requisite measures to protect the environment as directed by the statutory authorities.
54.	Details of litigation pending or otherwise with respect to project in any Court, Tribunal etc. shall invariably be furnished.	No litigations/court cases against the proposed project.

EXECUTIVE SUMMARY

Executive Summary

E.1. Introduction

M/s. Delhi MSW Solutions Ltd. (DMSWSL) has developed an existing 24 MW RDF based Power Plant within the integrated MSW Management Facility (IMSWMF) at the site notified by Municipal Corporation of Delhi (MCD) for which EC was obtained from MOEFCC with 4000 TPD capacity with minimum 36 MW WTE capacity of 3000 TPD wide EC vide no. F. No.-67/2009-IA.III dt. 8th May 2012. The plant was installed and is operating successfully after obtaining CFE and CFO from Delhi Pollution Control Committee (DPCC) vide letter No. DPCC/PLG/2016/36691 dated 10th Mar 2016 and vide letter no. DPCC/PLG/2017/39391 dated 20th Feb 2017. The expansion of the existing WTE project has been recommended by Mayor of Erstwhile North DMC, Hon'ble LG of Delhi for alleviating the mammoth task of MSW of Delhi Now DMSWSL has proposed to expand the capacity of WTE plant from 24 MW to 60 MW in the same premises. The existing IMSWMF has a processing capacity of 4000 TPD.

E.2. Details of project capacity

M/s. Delhi MSW Solutions Ltd. (DMSWSL) has developed the Integrated MSW Management Facility (IMSWMF) at the identified site by Municipal Corporation Delhi (MCD). DMSWSL initially established IMSWMF with the capacity of 4000 TPD and standalone WTE plant of 24 MW with 1200 TPD of RDF as fuel was developed. Now DMSWSL has proposed to utilize the leftover 1800 TPD of RDF by installing another 36 MW WTE Power plant cumulatively 60 MW. The proposed expansion of waste to energy power plant will be located within the existing facility of IMSWMF at Pocket N-1 Sector 5, Bawana Industrial Area, Tehsil Narela, District North West Delhi, Delhi.

E.3. Details of land area breakup

Total plot area of IMSWMF is 100 Acre (40.46 Ha) out of which land (built up area) demarcated for WTE is 17.24 Acre (6.97 Ha). Existing WTE power plant was developed on 8.62 Acre (3.48 Ha) area and total 8.62 Acre (3.48 Ha) is allotted for proposed expansion of WTE plant.

E.4. Water requirement

Total water requirement for existing project is 313 KLD and for the proposed expansion project it is 337 KLD. The same will be sourced from Delhi Jal Board and Industrial Waste Water of adjacent Pragati Power Plant. The wastewater as liquid waste of 105 KLD will be generated which includes cooling tower blow down, boiler blow down and DM regeneration and Leachate. The generated leachate (100 KLD) will be treated in an advanced MVR technology based LTP. Blow down water from ancillary cooling tower, boiler blow down and

WTP Rejects will be collected neutralization tank and neutralized by adding neutralized agents then utilized in the bottom ash quenching and in Air Pollution Control Devices. Thus, facility will achieve zero-liquid discharge (ZLD). Domestic water requirement is 15 KLD which is met by Municipal Water Supply. The domestic wastewater of 13 KLD will be treated in septic tank followed by soak pit /bio toilets.

E.5. Power and fuel requirement

The total power required for operations is approximately 5.4 MW and the same is met from existing WTE Plant of 24 MW capacity. Once the expansion power plant will be fully operational the power requirement will be met from the same plant and excess will be interconnected to sub-station of state grid.

E.6. Required manpower

Total manpower requirement of both existing and proposed WTE site is 475. Total 215 workers are appointed for existing WTE plant and additional 260 workers and technical staff will be required for expansion unit. Most of workers have appointed locally in the existing project. For expansion project also; preference will be given to the local population.

E.7. Baseline environmental status

The baseline data for the project was earlier collected from Sep 2019 to December 2019. Additional baseline data for the proposed expansion project was collected during 23rd Sep 2022 to 22nd Oct 2022. The data is collected with respect to meteorological conditions, air pollution levels, noise levels, water quality, soil quality, land use and socio-economic conditions during the study period. Summary of baseline is tabulated below:

E.7.1. Air quality

The ambient air quality was monitored at 10 locations. The minimum and maximum 98th percentile values of pollutants are shown in **Table 1**.

Table 1: Results of ambient air quality ($\mu\text{g}/\text{m}^3$)

Details	PM ₁₀	PM _{2.5}	SO ₂	NO _x	O ₃	CO	NH ₃	C ₆ H ₆
Minimum In 98 th Percentile	84.5	56.5	20.4	29.3	26.5	860	29.3	0.50
Maximum In 98 th Percentile	212	132	28.1	38.1	40.3	1482	47.2	0.95
NAAQ Standards 2009	100	60	80	80	100 (8 hourly)	2000 (8 hourly)	400	5 (Annual)

E.7.2. Ground and surface water quality

Water samples in the study area were collected from 10 ground water and 4 surface water sources respectively. The samples were analyzed for various physical and chemical characteristics, the results of which are given in **Table 2** and **Table 3** respectively.

Table 2: Results of ground water analysis

Parameters	Units	Minimum	Maximum	Drinking water Standards IS: 10500:2012	
				Acceptable	Permissible
pH	-	7.4	8.4	6.5-8.5	No Relaxation
TDS	mg/l	680	2373	500	2000
Chlorides	mg/l	98.3	685	250	1000
Hardness	mg/l	198	886	200	600
Fluorides	mg/l	1.13	1.79	1.0	1.5

Table 3: Results of surface water analysis

Parameters	Units	Min	Max	CPCB water quality criteria as updated on 11 th September, 2017				
				A	B	C	D	E
pH	-	7.4	8.5	6.5-8.5		6-9	6.5-8.5	6-8.5
EC	μS/cm	486	1912	-	-	-	-	2250
DO	mg/l	1.5	4.8	6	5	4	4	-
BOD	mg/l	<4	70	2	3	3	-	-
Total coliform	MPN/100ml	920	1600	50	500	5000	-	-

E.7.3. Noise quality

Baseline noise levels have been monitored at 9 locations within the study zone, using a continuous noise measurement device. The day equivalents during the study period ranged between 53.9 to 68.2 dB (A) whereas the night equivalents were in the range 43.9 to 54.6 dB (A). It was observed that the night equivalents were within the AAQ standards in respect of Noise SO 123 (E) dt 14th Feb 2000 for Residential and Commercial area. However, the day equivalents are above the specified standards in some locations.

E.7.4. Traffic study

The traffic survey was carried out on the major district road (MDR) near the project site during site visit (Oct 2022) of the baseline study period. From MDR, we observed that the highest peak was 2171 PCU/hr during 09 to 10 am. It was observed that the existing Level of Service (LOS) is good on both MDR and site access road. The traffic study was compared with previous baseline locations at MDR. Comparing from 2019 to 2022 the traffic volume at MDR was increased from peak hours 1672 to 2171 PCU's per hour due to ongoing urbanization and increase in population. The LOS during 2019 and as well as during 2022 are in "good" (C) performance.

E.7.5. Soil quality

To determine the impact of proposed activity on soil and agricultural productivity soil samples were collected from 9 locations. The results of important parameters are summarized in **Table 4**.

Table 4: Soil quality in the study area

Parameters	Minimum	Maximum	Standard Soil Classification – (Indian Council of Agricultural Research, New Delhi)
pH	7.7	8.3	Acidic<6.0, Normal to Saline 6.0-8.5, Tending to become Alkaline 8.6 to 9.0, Alkaline above 9.
EC (µS/cm)	133	537	Normal<1000, Critical for germination 1000-2000, Critical for growing 2000 - 4000, Injurious to most crops>4000
Organic carbon (%)	0.26	1.50	Low < 0.5, Medium 0.5 – 0.75, High > 0.75
Nitrogen (kg/Ha)	107	196	Low below 280, Medium 280-560, High above 560
Phosphorous (kg/Ha)	13	20	Low below 10, Medium 10-25, High above 25
Potassium (kg/Ha)	102	399	Low below 110, Medium 110-280 High above 280

E.7.6. Ecology & Biodiversity

There is no National Parks / Wildlife Sanctuary / Forests / Tiger reserve / Wetlands / Biosphere Reserve/ Tiger Reserves and Elephant corridor etc. present within 10 km radius from project site. The reserve forests (RF) include Bawana RF at 1.5 km (N), Shri Krishna Sultanpur RF at 5.0 km (SW) and Marmurpur PF located 7 km (NE) identified in the study area. There is no forest land present within the project site. No any kind of forest diversion is involved in the project.

There are no perennial water bodies such as rivers and reservoirs, pools, ponds, drains, and canals. Village water tanks and paddy fields are the common aquatic and semi aquatic ecosystems found in the proposed project area.

E.7.7. Socioeconomic Study

The study area comprises Narela Tehsil of North West Delhi (NCT Delhi) covering majority of the study area and a part of Sonipat Tehsil of Haryana, consisting of 6,74,439 and 44,184 population as per Census of India, respectively. Output of the study is given below:

- Men and women in Narela Tehsil of North West Delhi (NCT Delhi) constitute about 54.2% and 45.8% in the study area respectively. Whereas, the gender diversity, as percentage of men and women in the parts of Sonipat Tehsil of Haryana accounted to be about 54.9% and 45.1% respectively.

- Average family size in the study area is 5 persons per household.
- Male and female constitute 54.2% and 45.8% respectively and number of females per 1000 males is low at 846.
- Average density of population of the study area is 272 persons per km².
- The Socio-Economic study observed that 20.7% of total population in the study area which includes Narela Tehsil of North West Delhi (NCT Delhi) belongs to Scheduled Caste (SC) category. Whereas, a part of Sonipat Tehsil which is coming within the study area evidences 20.9% of total population belongs to Scheduled Caste category.
- The analysis of the literacy levels in selected villages of Narela Tehsil of North West Delhi (NCT Delhi) reveals an average literacy rate of 69.5% as per available census data. However, the male literacy rate of the study area is 58.7%, whereas the literacy rate among women is estimated to be as low as 41%. Literacy levels in selected villages of Sonipat Tehsil of Haryana indicate an average rate of about 69.4% as per census 2011 data. The male literacy rate of the selected villages is 60%, and the literacy rate among women is estimated to be around 40%.
- Well-developed medical and health care center, which includes both private and government facilities, are available in the study area.
- Study area accounted for 29 % of the main working class of the total population. Whereas, marginal workers and non-workers constitute 2% and 69% of the total population, respectively. However, the selected villages of Sonipat Tehsil within a 5-10km radius have 28% of the total population's main workers, followed by marginal workers and non-workers, who account for 6% and 65% of the total population, respectively.

E.7.8. Anticipated impacts

The impacts due to project on the environment are classified into two phases and the possible impacts are assessed.

- During Construction phase
- During Operation phase

The impact of the above activities would be temporary and will be confined within the project boundary.

E.7.9. Impacts during Construction phase

Construction phase works include site clearance, site formation, building works, infrastructure provision and other infrastructure activities. However, this project is

expansion of existing WTE plant, the impact during construction phase is not much envisaged.

E.7.10. Impacts during Operation phase

E.7.10.1 Impact on air quality

The proposed project is expansion of existing waste to energy power plant and the major source of pollution would be the emissions from the stack. The main raw materials required for the project is Refused Derived Fuel (RDF) for producing the energy by combustion/incineration. The important air pollutants generated from the power plant are particulate matter (PM), sulfur di-oxide (SO₂), oxides of nitrogen (NO_x), dioxins and furans (PCDDs & PCDFs). High Speed Diesel (HSD) is used for DG set and Light Diesel Oil (LDO) is used only for power plant start-up activity, heat transfer furnace. The major air pollutants generated from the proposed operation are:

- Dust particulates in flue gas from chimney
- SO₂, NO_x, dioxins and furans in flue gas
- Fly ash dust particles from ash silos and ash disposal areas

To estimate the ground level concentration of air pollutants released from 60 m height of the stack provided for the power plant, a study state dispersion model based on Gaussian Plume (AERMOD Version 7.0.3) software is used to calculate the concentrations for PM, SO₂ and NO_x.

E.7.10.2. The proposed mitigation measures

- Bag filter with an efficiency of more than 99.5% to limit PM in outlet to less 30 mg/Nm³.
- To minimize the SO₂ and NO_x emissions a semidry flue gas cleaning system consist of spray reactor with lime slurry and activated carbon is used.
- The chimney is selected considering sulphur dioxide emissions and to meet central pollution control board norms. The height of chimney has been selected as 65 m for the power plant.
- To control NO_x emission from the power plant boiler over fire air system and low NO_x burners is used.
- Semi dry type gas cleaning system is envisaged for this plant. The acid gas emissions are controlled by dozing lime slurry into the gas steam.
- The furnace and the flue gas residence time (minimum 2 seconds with a minimum flue gas temperature of 950°C) in the furnace are designed such that, the dioxins and furans (PCDDs & PCDFs) emissions are mitigated.
- The flue gas is further treated with activated carbon which ensures the PCDDs & PCDFs are limited to less than 0.1 ng/TEQ/Nm³ of flue gas.
- Semi-dry type gas cleaning system with lime dozing is envisaged for reduction of acid gases and activated carbon injection is envisaged for reducing the dioxins/ furans and

heavy metal emissions.

- The RDF storage has been envisaged in a completely closed shed in the tipping / storage area. This measure will reduce the dust nuisance in the power plant area. Also the forced draught fan takes suction from the storage pit there by maintaining slightly negative pressure in the RDF storage pit. This will eliminate odour in the RDF storage pit area.
- As RDF will be stored in a covered shed, no bird menace is envisaged. Arrangement will be made for suitable spray on the RDF to overcome the nuisance of bird menace, mosquito and fly nuisance and odour.
- Internal roads are concreted / asphalted to reduce fugitive emissions
- Greenbelt will be provided around the power plant, along the internal roads and along the plant boundary and wherever required.

E.7.10.3. Impact on water quality and Management

Total water requirement for existing project is 313 KLD. Total water requirement for the proposed expansion project is 337 KLD. The same will be sourced from Delhi Jal Board and recycled Industrial Waste Water of adjacent Pragati Power Plant. The wastewater as liquid waste of 105 KLD will be generated which includes cooling tower blow down, boiler blow down and DM regeneration and Leachate. The generated leachate (100 KLD) will be treated in the existing LTP, blow down water from ancillary cooling tower, boiler blow down and WTP Rejects will be collected neutralization tank and neutralised by adding neutralized agents then utilized in the bottom ash quenching and in Air Pollution Control Devices. Thus, facility will achieve the zero-liquid discharge (ZLD). Domestic water requirement is 15 KLD which is met by Municipal Water Supply. The domestic wastewater of 13 KLD will be treated in septic tank followed by soak pit / bio toilets.

E.7.10.4. Impact on noise levels

Any activity in general, consists of several sources of noise pollution. The different sources of noise pollution are mentioned below:

- Boiler feed pumps
- Turbo generator
- Cooling tower
- Diesel generator
- Frequent vehicular movement

E.7.10.5. The proposed mitigation measures are

- Noise level specification of various equipment as per the Occupational Safety and Health Association (OSHA) standards.
- Providing suitable enclosures (adequate insulation) to minimize the impact of high noise generating sources.
- Employees will be provided with PPE like ear plugs, helmets, safety shoes etc.

- Development of greenbelt all along the boundary and along the roads within the project site.

E.8. Environmental monitoring plan

The main spirit of environmental monitoring plan is aimed such that there is not much of time lag between commencements of damage to environment mitigation measures to various environmental parameters that are being affected. Environmental monitoring program has been prepared for assessing the efficiency of implementation of Environment Management Plan and details of the same are given in **Table 5**.

Table 5: Environmental monitoring plan during operational phase

S. No	Potential Impact	Detailed actions to be followed as per EMP	Parameters/Points to be monitored	Frequency of Monitoring
1.	Air Emissions	Stack emissions from boiler	Stack emissions from boiler for PM ₁₀ , HCl, SO ₂ , NO _x , CO, TOC, HF, Total dioxins & furans, Cd+Th+ their compounds, Hg & its compounds, heavy metals (Sb+As+Pb+Cr+Co+Cu +Mn+Ni+V+ their compounds),	As per CFE conditions/Emission standards as per SWM rules 2016 / once in month for regular parameters.
		DG sets, etc.	DG sets for PM, SO ₂ & NO _x	As per MOEFCC/CPCB guidelines once in a Month.
		AAQ shall be monitored within the project premises and nearby habitations (minimum 3 places). All vehicles shall have Pollution Under Control (PUC) certificate.	PM, SO ₂ , NO _x VOC etc.) Vehicle logbooks shall be maintained. Greenbelt will be developed for minimizing dust propagation	
		Meteorological data	Wind speed, direction, temperature, relative humidity and rainfall.	As per CFE condition
2.	Noise	Noise generated during operation of boiler, cooling towers, DG sets etc. shall be monitored	Spot Noise Level will be recorded and shall meet the limits set by relevant legislation	Periodic during operation phase. As per CFE condition
3.	Wastewater Discharge	Wastewater must be treated and must Comply to wastewater discharge standards and achieve zero	pH, TSS, TDS, BOD, COD, Oil & Grease and other parameters as mentioned in the CFE	Daily at regular intervals and Once in a month by third party

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		liquid discharge.		
4.	Solid waste/ Haz. waste	During operational phase, waste should be handled according to the waste management plan as per Hazardous and other waste (Management and Transboundary Movement) Rules, 2016 its amendments till date. Solid waste should handle as per SWM rules, 2016	Logbook shall be maintained to record the amounts of wastes generated, transportation routes and final reuse/disposal. Solid and Hazardous waste quantities and destination (final disposal) will be documented and kept to ensure proper handling and disposal.	Periodically and as per CFE condition
5.	Ground Water Quality and Water Levels	Ground water quality and ground water levels must be monitored. Ground water monitoring during operation phase shall form part of the continuous QA/QC procedures for the plant subject to ongoing inspection.	Comprehensive monitoring of ground water quality and ground water levels as per IS 10500-2012 (important major, minor ions, heavy metals)	Periodically or once in a year
6.	Flora and fauna	Vegetation, Greenbelt/ Green cover development	Number and type of plant species will be recorded	Once a year
7.	Soil quality	Checking & Maintenance of good soil quality around	Soil quality will be analysed for Physico-chemical parameters and presence of metals.	Every quarter
8.	Health Conditions Accidents	A baseline health check-up of all employees and migrant labour shall be carried out. The	Follow-up medical Check-up shall be carried out and results must be documented. Safety records and	Regular check-up as per factories act.

		Emergency Response Plan will be monitored and tested frequently to ensure its effective in the event of an emergency.	monitoring of plant safety rules.	

E.9. Risk analysis

The principal objective of the risk assessment study is to identify and quantify the major hazards and the risk associated with various operations of the project, which may lead to emergency consequences (disasters) affecting the public safety and health. All necessary measures to minimize the risk due to the project are taken viz, Fire & safety control measures, Emergency preparedness plan, Disaster Management plan, etc.

E.10. Project benefits

The contribution of the power plant on local social infrastructure is expected to be significant. The proposed expansion of power plant will stimulate the growth of industrial and commercial activities in and around the district, by improving the availability of the power. This project will provide a significant amount of direct and indirect employment opportunities to the local people with different skills and trades.

The physical infrastructure and socio-economic status of the surrounding areas will be benefited as follows:

- Road transport facilities which improve accessibility
- Improvement in education, housing, and banking facilities
- Improvement in postal & communication services
- Recreation facilities
- Improvement in power supply, water supply and sanitation
- Improvement in economic conditions
- Proper training to the local people will be given to improve the employment potential within the plant
- Increase in revenue to the state in the form of taxes and duties from the development of local businesses
- Local markets with food and non-food commodities will be improved due to the increase inflow of human residents within the district.
- Waste to Energy facilities provide a safe, technologically advanced means of waste disposal that reduces greenhouse gases, generates clean energy and recycles metal.
- Waste to Energy facilities will save space and significantly reduce landfill volume.
- In terms of CO₂ emissions, waste to energy saves one ton of CO₂ per ton of waste, when compared to landfills that do recover their landfill gases, it saves about half a ton of CO₂ per ton of waste.

E.11. Cost estimate of the project

The Environmental Management Plan (EMP) is required to ensure a sustainable development of the plant area and the surrounding areas of the plant. The EMP will be integrated in all the major activities of the project, with clearly defined policies, to ensure that the ecological balance of the area is maintained and the adverse effects are minimized. EMP requires multidisciplinary approach with mitigation, management, monitoring and institutional measures to be taken during implementation and operation, to eliminate adverse environmental impacts or reduce them to acceptable levels. In order to ensure sustainable development in the study area, it needs to be an all-encompassing plan for which the plant authorities, government, regulating agencies, and the population of the study area need to extend their cooperation and contribution.

The mitigation measures are planned for construction and operation phases and the overall management plan helps to improve the supportive capacity of the receiving bodies. The EMP aims to control pollution at the source level to the possible extent with the available and affordable technology followed by the standard treatments before getting discharged. The recommended mitigation measures will synchronize the economic development of the study area with the environmental protection of the region.

The budget proposed for implementation of EMP measures in operation phase is Rs. 134.5 Crores is capital cost and Rs. 20.5 crores /annum is recurring cost.

E.12. Conclusions

The municipal solid waste generation is increasing day by day with the increase in the urban population and thereby causing the need for sustainable management or disposal of the generated solid waste. The waste to energy plant is now a more sustainable option for solid waste management as there is a shortage of land area for scientific landfill and also the demand for electricity has been steadily increasing. Expansion of power plant in this area will benefit the society by providing better infrastructural, educational and medical facilities in the area also improvement in indirect employment and economic growth of the area. The project provides job opportunities to around 260 persons will get direct employment and around 150 people will get indirect employment.

कार्यकारी सारांश

इ.1 परिचय

मैसर्स दिल्ली एम. एस. डब्ल्यू. सॉल्यूशन्स लिमिटेड (DMSWSL) द्वारा दिल्ली नगर निगम (MCD) द्वारा अधिसूचित साइट पर एकीकृत शहरी ठोस अपशिष्ट प्रबंधन सुविधा (IMSWMF) क्षेत्र के भीतर एक 24 मेगावाट RDF आधारित पावर प्लांट विकसित किया है, जिसके लिए पर्यावरणीय स्वीकृति पर्यावरण वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार द्वारा फाइल नं.- 67/2009-आई.ए.।।। दिनांक 8 मई 2012 को प्राप्त की गई। यह स्वीकृति 4000 टन प्रति दिन (TPD) क्षमता के साथ न्यूनतम 36 मेगावाट अपशिष्ट से ऊर्जा (WTE) उत्तपन्न करने के लिए दी गई थी। दिल्ली के एमएसडब्ल्यू के विशाल कार्य को कम करने के लिए तत्कालीन उत्तरी डीएमसी के महापौर, दिल्ली के माननीय एलजी द्वारा मौजूदा डब्ल्यूटीई परियोजना के विस्तार की सिफारिश की गई है। इस परियोजना का निर्माण एवं संचालन दिल्ली प्रदूषण नियंत्रण समिति (DPCC) द्वारा स्थापना के लिए सहमति (CFE) पत्र संख्या DPCC/PLG/2016/36691 दिनांक 10 मार्च 2016 एवं संचालन के लिए सहमति (CFO) पत्र संख्या डीपीसीसी/पीएलजी/2017/39391 दिनांक 20 फरवरी 2017 के अनुसार किया गया। अब DMSWSL उसी परिसर में WTE प्लांट की क्षमता 24 MW से बढ़ाकर 60 MW तक बढ़ाने का प्रस्ताव किया है। एकीकृत शहरी ठोस अपशिष्ट प्रबंधन सुविधा (IMSWMF) की प्रसंस्करण क्षमता 4000 टन प्रति दिन है।

इ. 2. परियोजना क्षमता का विवरण

DMSWSL द्वारा दिल्ली नगर निगम (MCD) द्वारा अधिसूचित साइट पर एकीकृत शहरी ठोस अपशिष्ट प्रबंधन सुविधा (IMSWMF) के भीतर एक 24 MW RDF आधारित पावर प्लांट एवं ईंधन के रूप में 1200 टीपीडी आरडीएफ के साथ विकसित किया है

अब DMSWSL बचे हुए 1800 TPD आरडीएफ को उपयोग में लाकर 36 मेगावाट पावर प्लांट के निर्माण का प्रस्ताव किया है जिससे कुल मिला का 60 मेगावाट बिजली का निर्माण होगा। यह परियोजना पॉकेट एन-1 सेक्टर 5, बवाना औद्योगिक क्षेत्र, तहसील नरेला, जिला उत्तर पश्चिम दिल्ली, दिल्ली में मौजूदा IMSWMF सुविधा के भीतर विकसित की जाएगी।

इ. 3. भूमि क्षेत्र का विवरण

शहरी ठोस अपशिष्ट प्रबंधन सुविधा (IMSWMF) का कुल क्षेत्र 100 एकड़ (40.46 हेक्टेयर) है जिसमें से 17.24 एकड़ (6.97 हेक्टेयर- निर्माण क्षेत्र) क्षेत्र अपशिष्ट से ऊर्जा (WTE) प्लांट के लिए आवंटित किया गया है मौजूदा अपशिष्ट से ऊर्जा (WTE) प्लांट 8.62 एकड़ (3.48 हेक्टेयर) क्षेत्र में विकसित किया गया है एवं 8.62 एकड़ (3.48 हेक्टेयर) क्षेत्र परियोजना विस्तार के लिए आवंटित किया गया है।

इ.4 पानी की आवश्यकता

मौजूदा परियोजना के लिए कुल पानी की आवश्यकता 313 केएलडी है और प्रस्तावित विस्तार परियोजना के लिए यह 337 केएलडी है। जिसकी आपूर्ति दिल्ली जल बोर्ड और निकटवर्ती प्रगति पावर प्लांट के उपचारित औद्योगिक अपशिष्ट जल से पूरी होगी। लगभग 105 केएलडी अपशिष्ट जल उत्पन्न होगा जिसमें कूलिंग टॉवर ब्लो डाउन, बॉयलर ब्लो डाउन और डीएम पुनर्जनन और लीचेट शामिल हैं। उत्पन्न लीचेट (100 केएलडी) उन्नत एम.वी.आर. प्रौद्योगिकी आधारित एल.टी.पी. में उपचारित किया जाएगा। एंसिलरी कूलिंग टॉवर से

उत्पन्न ब्लो डाउन वॉटर, बाँयलर ब्लो डाउन और डब्ल्यू.टी.पी. रिजेक्ट्स को न्यूट्रलाइजेशन टैंक में एकत्रित किया जाएगा एवं न्यूट्रलाइजिंग एजेंट द्वारा उपचारित करने के बाद इसका उपयोग बॉटम ऐश शमन और वायु प्रदूषण नियंत्रण उपकरणों में किया जाएगा। इसलिए यह प्रोजेक्ट जीरो लिक्विड डिस्चार्ज (ZLD) संकल्पना पर आधारित होगी। घरेलू पानी की आवश्यकता 15 के.एल.डी. है जिसकी आपूर्ति नगरपालिका द्वारा पूरी की जाती है। 13 केएलडी के घरेलू अपशिष्ट जल को सेप्टिक टैंक में उपचारित किया जाएगा और उसके बाद सोक पिट/जैव शौचालयों (Bio-toilets) में उपचारित किया जाएगा।

इ.5 बिजली और ईंधन की आवश्यकता

संचालन के लिए आवश्यक कुल बिजली लगभग 5.4 मेगावाट है और इसे 24 मेगावाट क्षमता के मौजूदा डब्ल्यू.टी.ई. (WTE) संयंत्र से पूरा किया जाता है। एक बार विस्तार पावर प्लांट के पूरी तरह से चालू हो जाने के बाद बिजली की आवश्यकता उसी प्लांट से पूरी की जाएगी और अतिरिक्त बिजली को स्टेट ग्रिड के सब-स्टेशन से जोड़ा जाएगा।

इ.6 आवश्यक जनशक्ति

मौजूदा और प्रस्तावित डब्ल्यू.टी.ई. साइट दोनों के लिए कुल जनशक्ति की आवश्यकता 475 है। कुल 215 श्रमिकों को मौजूदा डब्ल्यू.टी.ई. संयंत्र के लिए नियुक्त किया गया है और अतिरिक्त 260 श्रमिकों और तकनीकी कर्मचारियों की आवश्यकता विस्तार इकाई के लिए होगी। मौजूदा परियोजना में अधिकांश श्रमिकों को स्थानीय स्तर पर नियुक्त किया गया है। विस्तार परियोजना के लिए भी स्थानीय श्रमिकों को वरीयता दी जाएगी।

इ.7 आधारभूत पर्यावरणीय स्थिति

परियोजना के लिए बेसलाइन डेटा सितंबर 2019 से दिसंबर 2019 तक एकत्र किया गया था। प्रस्तावित विस्तार परियोजना के लिए अतिरिक्त बेसलाइन डेटा 23 सितंबर 2022 से 22 अक्टूबर 2022 के दौरान एकत्र किया गया। जिसमें मौसम संबंधी स्थिति, वायु प्रदूषण के स्तर में विस्तार, शोर का स्तर, भूजल एवं सतहीय जल की गुणवत्ता, मिट्टी की गुणवत्ता, भूमि उपयोग एवं भूमि आवरण, जैविक और सामाजिक-आर्थिक स्थिति का अध्ययन किया गया जिसका सारांश नीचे दिया गया है।

इ.7.1 वायु की गुणवत्ता

कुल 10 स्थानों पर वायु गुणवत्ता की निगरानी की गई। प्रदूषकों के न्यूनतम और अधिकतम 98% मान तालिका 1 में दर्शाए गए हैं।

तालिका 1: वायु गुणवत्ता के परिणाम ($\mu\text{g}/\text{m}^3$)

विवरण	PM ₁₀	PM _{2.5}	SO ₂	NO _x	O ₃	CO	NH ₃	C ₆ H ₆
न्यूनतम (98% मान)	84.5	56.5	20.4	29.3	26.5	860	29.3	0.50
अधिकतम (98% मान)	212	132	28.1	38.1	40.3	1482	47.2	0.95
NAAQ मानक, 2009	100	60	80	80	100 (8 hourly)	2000 (8 hourly)	400	5 (Annual)

मैसर्स दिल्ली एम. एस. डब्ल्यू. सॉल्यूशन्स लिमिटेड (DMSWSL) द्वारा तहसील नरेला, जिला उत्तर पश्चिम, दिल्ली में प्रस्तावित अपशिष्ट द्वारा ऊर्जा संयंत्र का 24 मेगावाट से 60 मेगावाट तक क्षमता विस्तार का प्रस्ताव

इ.7.2. भूजल और सतही जल की गुणवत्ता

अध्ययन क्षेत्र में पानी के नमूने क्रमशः 10 भूजल और 4 सतही जल स्रोतों से एकत्र किए गए। विभिन्न भौतिक और रासायनिक विशेषताओं के लिए नमूनों का विश्लेषण किया गया, जिसके परिणाम क्रमशः तालिका 2 और तालिका 3 में दिए गए हैं।

तालिका 2: भूजल विश्लेषण के परिणाम

पैरामीटर	यूनिट	न्यूनतम	अधिकतम	पेयजल मानक आईएस: 10500:2012	
				स्वीकार्य	अनुमेय
पीएच	-	7.4	8.4	6.5-8.5	नो रिलैक्स
टी.डी.एस.	मिलीग्राम/ली	680	2373	500	2000
क्लोराइड	मिलीग्राम/ली	98.3	685	250	1000
कठोरता (हार्डनेस)	मिलीग्राम/ली	198	886	200	600
फ्लोराइड	मिलीग्राम/ली	1.13	1.79	1.0	1.5

तालिका 3: सतही जल विश्लेषण के परिणाम

पैरामीटर	यूनिट	न्यूनतम	अधिकतम	सीपीसीबी जल गुणवत्ता मानदंड 11 सितंबर, 2017 को अद्यतन किया गया				
				A	B	C	D	E
पीएच	-	7.4	8.5	6.5-8.5		6-9	6.5-8.5	6-8.5
ई.सी.	μS / सेमी	486	1912	-	-	-	-	2250
डी.ओ.	मिलीग्राम/ली	1.5	4.8	6	5	4	4	-
बी.ओ.डी.	मिलीग्राम/ली	<4	70	2	3	3	-	-
टोटल कॉलीफॉर्म	एम.पी.एन./100 मिली	920	1600	50	500	5000	-	-

इ.7.3. शोर की गुणवत्ता

अध्ययन क्षेत्र के भीतर 9 स्थानों पर निरंतर शोर माप उपकरण का उपयोग करके शोर के स्तरों की निगरानी की गई। अध्ययन अवधि के दौरान शोर की स्थिति दिन के समय 53.9 से 68.2 डीबी (ए) के बीच थी जबकि रात के समय 43.9 से 54.6 डीबी (ए) के बीच थी। यह देखा गया कि रात के समय शोर की स्थिति आवासीय और वाणिज्यिक क्षेत्र के लिए एस.ओ. 123 (ई) दिनांक 14 फरवरी 2000 के मानकों के भीतर थी। हालांकि, कुछ स्थानों पर दिन के समय शोर की स्थिति निर्देशित मानकों से ऊपर पाई गई।

इ.7.4 यातायात अध्ययन

बेसलाइन अध्ययन अवधि (अक्टूबर 2022) के दौरान परियोजना स्थल के पास प्रमुख जिला सड़क पर यातायात सर्वेक्षण किया गया और पाया गया कि सुबह 09 से 10 बजे के दौरान यातायात का उच्चतम स्तर 2171 पीसीयू/घंटा था। यह देखा गया कि एम.डी.आर. और साइट एक्सेस रोड दोनों पर मौजूदा स्तर (एल.ओ.एस.) अच्छा है। पिछले बेसलाइन परिणामों से वर्तमान परिणामों की तुलना की गई थी और पाया गया कि २०१९ से २०२२ के दौरान PUC 1672 से 2171 प्रति घंटा बढ़ी है पर LOS में कोई बदलाव नहीं है

इ.7.5. मिट्टी की गुणवत्ता

मिट्टी और कृषि उत्पादकता पर प्रस्तावित गतिविधि के प्रभाव को निर्धारित करने के लिए 9 स्थानों से मिट्टी के नमूने एकत्र किए गए। महत्वपूर्ण मापदंडों के परिणामों को तालिका 4 में संक्षेपित किया गया है।

तालिका 4: अध्ययन क्षेत्र में मिट्टी की गुणवत्ता

पैरामीटर	न्यूनतम	अधिकतम	मानक मृदा वर्गीकरण - (भारतीय कृषि अनुसंधान परिषद, नई दिल्ली)
पीएच	7.7	8.3	<6.0: अम्लीय, 6.0-8.5: सामान्य से लवणीय, 8.6 से 9.0 बनने की प्रवृत्ति: क्षारीय, 9 से ऊपर: क्षारीय।
ईसी (μS/सेमी)	133	537	<1000: सामान्य, 1000-2000: अंकुरण के लिए गंभीर, 2000 – 4000: फसल उगाने के लिए गंभीर, >4000: अधिकांश फसलों के लिए हानिकारक
जैविक कार्बन (%)	0.26	1.50	<0.5: निम्न, 0.5 - 0.75: मध्यम, > 0.75: उच्च
नाइट्रोजन (किलो/हेक्टेयर)	107	196	<280: कम, 280-560: मध्यम, >560: उच्च
फॉस्फोरस (किलो/हेक्टेयर)	13	20	<10: निम्न, 10-25: मध्यम, >25: उच्च
पोटेशियम (किलो/हेक्टेयर)	102	399	<110: कम, 110-280: मध्यम, >280: उच्च

इ.7.6. पारिस्थितिकी और जैव विविधता

परियोजना स्थल से 10 किमी के दायरे में कोई राष्ट्रीय उद्यान/वन्यजीव अभयारण्य/वन/टाइगर रिजर्व/आर्द्रभूमि/बायोस्फीयर रिजर्व/टाइगर रिजर्व और एलीफेंट कॉरिडोर आदि मौजूद नहीं है। आरक्षित वन (आरएफ) एवं बवाना आरएफ 1.5 किमी (उत्तर) श्री कृष्ण सुल्तानपुर आरएफ 5.0 किमी (दक्षिण पश्चिम), और मर्मुरपुर पीएफ 7 किमी (उत्तर पूर्व) दिशा पर हैं। परियोजना स्थल के भीतर कोई वन भूमि मौजूद नहीं है। परियोजना में किसी भी प्रकार का वन डायवर्सन शामिल नहीं है।

नदियों और जलाशयों, तालों, तालाबों, नालों और नहरों जैसे बारहमासी जल निकाय नहीं हैं। प्रस्तावित परियोजना क्षेत्र में गाँव के पानी के टैंक और धान के खेत आम जलीय और अर्ध जलीय पारिस्थितिक तंत्र हैं।

इ.7.7 सामाजिक आर्थिक अध्ययन

अध्ययन क्षेत्र में उत्तर पश्चिम दिल्ली (एनसीटी दिल्ली) की नरेला तहसील शामिल है, जो अध्ययन क्षेत्र के अधिकांश हिस्से को कवर करती है और हरियाणा की सोनीपत तहसील का एक हिस्सा है, जिसमें क्रमशः भारत की जनगणना के अनुसार 6,74,439 और 44,184 आबादी शामिल है। अध्ययन का परिणाम नीचे दिया गया है:

- उत्तर पश्चिम दिल्ली (एनसीटी दिल्ली) की नरेला तहसील में पुरुष और महिलाएं अध्ययन क्षेत्र में क्रमशः लगभग 54.2% और 45.8% हैं। जबकि, हरियाणा की सोनीपत तहसील के कुछ हिस्सों में पुरुषों और महिलाओं के प्रतिशत क्रमशः लगभग 54.9% और 45.1% है

- अध्ययन क्षेत्र में परिवार का औसत आकार प्रति परिवार 5 व्यक्ति है।
- पुरुष और महिला क्रमशः 54.2% और 45.8% हैं और प्रति 1000 पुरुषों पर महिलाओं की संख्या 846 है।
- अध्ययन क्षेत्र की जनसंख्या का औसत घनत्व 272 व्यक्ति प्रति किमी² है।
- सामाजिक-आर्थिक अध्ययन में पाया गया कि अध्ययन क्षेत्र में कुल आबादी का 20.7% जिसमें उत्तर पश्चिम दिल्ली (एनसीटी दिल्ली) की नरेला तहसील शामिल है, अनुसूचित जाति (एससी) श्रेणी से संबंधित है। जबकि, सोनीपत तहसील का एक हिस्सा जो अध्ययन क्षेत्र के भीतर आता है, कुल आबादी का 20.9% अनुसूचित जाति वर्ग से संबंधित है।
- उत्तर पश्चिम दिल्ली (एनसीटी दिल्ली) की नरेला तहसील के चयनित गांवों में साक्षरता के स्तर के विश्लेषण से उपलब्ध जनगणना के आंकड़ों के अनुसार औसत साक्षरता दर 69.5% है। हालाँकि, अध्ययन क्षेत्र की पुरुष साक्षरता दर 58.7% है, जबकि महिलाओं में साक्षरता दर 41% तक कम होने का अनुमान है। हरियाणा की सोनीपत तहसील के चयनित गांवों में साक्षरता का स्तर 2011 की जनगणना के आंकड़ों के अनुसार लगभग 69.4% की औसत दर दर्शाता है। चयनित गांवों की पुरुष साक्षरता दर 60% है, और महिलाओं के बीच साक्षरता दर लगभग 40% होने का अनुमान है।
- अच्छी तरह से विकसित चिकित्सा और स्वास्थ्य देखभाल केंद्र, जिसमें निजी और सरकारी दोनों सुविधाएं शामिल हैं, अध्ययन क्षेत्र में उपलब्ध हैं।
- अध्ययन क्षेत्र कुल आबादी का 29% मुख्य श्रमिक वर्ग है। जबकि, सीमांत श्रमिक और गैर-श्रमिक कुल जनसंख्या का क्रमशः 2% और 69% हैं। हालाँकि, 5-10 कि.मी. के दायरे में सोनीपत तहसील के चयनित गांवों में कुल जनसंख्या के मुख्य श्रमिकों का 28% है, इसके बाद सीमांत श्रमिक और गैर-श्रमिक हैं, जो क्रमशः कुल जनसंख्या का 6% और 65% हैं।

इ.7.8 अनुमानित प्रभाव

- पर्यावरण पर परियोजना के कारण पड़ने वाले प्रभावों को दो चरणों में वर्गीकृत किया गया है और संभावित प्रभावों का आकलन किया गया है।
 - निर्माण चरण के दौरान
 - ऑपरेशन चरण के दौरान

उपरोक्त गतिविधियों का प्रभाव अस्थायी होगा और परियोजना सीमा के भीतर ही सीमित होगा।

इ.7.9.

निर्माण चरण के दौरान प्रभाव

निर्माण चरण के कार्यों में साइट क्लीयरेंस, साइट फॉर्मेशन, बिल्डिंग वर्क, इंफ्रास्ट्रक्चर निर्माण और अन्य गतिविधियां शामिल हैं। हालांकि, यह परियोजना मौजूदा डब्ल्यूटीई संयंत्र का विस्तार है, इसलिए निर्माण चरण के दौरान प्रभाव की ज्यादा परिकल्पना नहीं की गई है।

इ.7.10.

संचालन चरण के दौरान प्रभाव

इ.7.10.1 वायु गुणवत्ता पर प्रभाव

प्रस्तावित परियोजना मौजूदा अपशिष्ट से ऊर्जा (WTE) संयंत्र का क्षमता विस्तार है जिसमें प्रदूषण का प्रमुख स्रोत स्टैक से उत्सर्जन होगा। दहन/भस्मीकरण द्वारा ऊर्जा का उत्पादन करने के लिए परियोजना के लिए आवश्यक मुख्य कच्चा माल रिफ्यूज्ड डेराइव्ड फ्यूल (आरडीएफ) है। पावर प्लांट से उत्पन्न होने वाले महत्वपूर्ण वायु प्रदूषक पार्टिकुलेट मैटर (PM), सल्फर डाइ-ऑक्साइड (SO₂), नाइट्रोजन के ऑक्साइड (NO_x), डाइऑक्सीन और फ्यूरोन (PCDDs और PCDFs) हैं। हाई स्पीड डीजल (HSD) का उपयोग DG सेट के लिए किया जाता है और लाइट डीजल ऑयल (LDO) का उपयोग केवल पावर प्लांट स्टार्ट-अप गतिविधि, हीट ट्रांसफर फर्नेस के लिए किया जाता है। प्रस्तावित संचालन से उत्पन्न प्रमुख वायु प्रदूषक निम्नलिखित हैं

- चिमनी से निकलने वाली फ्लू गैस में धूल के कण
- फ्लू गैस में SO₂, NO_x, डाइऑक्सीन और फ्यूरोन
- राख साइलो और राख निपटान (disposal) क्षेत्रों से फ्लाई ऐश धूल के कण

पावर प्लांट में लगाई गई स्टैक की ऊंचाई 65 मीटर से जारी वायु प्रदूषकों की जमीनी स्तर की सांद्रता (Ground Level Concentration) का अनुमान लगाने के लिए, गॉसियन प्लूम (AERMOD संस्करण 7.0.3) सॉफ्टवेयर पर आधारित अध्ययन डिस्पर्सन मॉडल का उपयोग किया गया जिसमें पी.एम., SO₂, NO_x के संभावित बढ़े हुए स्तर का अध्ययन किया गया।

इ.7.10.2. प्रस्तावित शमन उपाय

- आउटलेट में PM को 30 mg/Nm³ से कम करने के लिए 99.5% से अधिक दक्षता वाला बैग फ़िल्टर लगाया जायेगा।
- SO₂ और NO_x उत्सर्जन को कम करने के लिए एक अर्धशुष्क फ्लू गैस क्लीनिंग प्रणाली में चूने के घोल के साथ स्प्रे रिएक्टर और एक्टिव कार्बन का उपयोग किया जाता है।
- चिमनी का चयन सल्फर डाइऑक्साइड उत्सर्जन को ध्यान में रखते हुए और केंद्रीय प्रदूषण नियंत्रण बोर्ड के मानदंडों को पूरा करने के लिए किया जाता है। पावर प्लांट के लिए चिमनी की ऊंचाई 65 मीटर चुनी गई है।
- बिजली संयंत्र बॉयलर से एन.ओ.एक्स. उत्सर्जन को नियंत्रित करने के लिए अग्नि वायु प्रणाली (फायर एयर सिस्टम) और लो नॉक्स बर्नर का उपयोग किया जाता है।
- इस संयंत्र के लिए सेमी ड्राई टाइप गैस क्लीनिंग सिस्टम की प्रस्तावित है। एसिड गैस के उत्सर्जन को कम करने के लिए गैस की भाप में चूना घोल डालकर नियंत्रित किया जाता है।
- भट्ठी में फ्लू गैस रेसिडेंट टाइम (न्यूनतम 2 सेकंड, 950 डिग्री सेल्सियस तापमान पर) को इस तरह से डिजाइन किया गया है कि, डाइऑक्सीन और फ्यूरोन (पी.सी.डी.डी. और पी.सी.डी.एफ.) उत्सर्जन कम हो जाते हैं।
- फ्लू गैस को आगे एक्टिव कार्बन के साथ उपचारित किया जाता है जो सुनिश्चित करता है कि PCDDs और PCDFs फ्लू गैस के 0.1 ng/TEQ/Nm³ से कम तक सीमित हैं।
- एसिड गैसों को कम करने के लिए लाइम डोजिंग के साथ सेमी-ड्राई टाइप गैस क्लीनिंग सिस्टम प्रस्तावित है और डाइऑक्सीन/फ्यूरोन और भारी धातु उत्सर्जन को कम करने के लिए एक्टिव कार्बन इंजेक्शन प्रस्तावित है।

- आर.डी.एफ. का भंडारण बंद/कवर्ड शेड में किया जायेगा। इस उपाय से बिजली संयंत्र क्षेत्र में धूल की परेशानी कम होगी। साथ ही फोर्स ड्राफ्ट फैन आर.डी.एफ. स्टोरेज पिट में थोड़ा निगेटिव दबाव बनाए रखता है जिससे आर.डी.एफ. स्टोरेज एरिया में दुर्गंध खत्म हो जाएगी।
- चूंकि आर.डी.एफ. को एक ढके हुए शेड में रखा जाएगा, इसलिए किसी पक्षी के खतरे की सम्भावना नहीं है। पक्षियों के प्रकोप, मच्छर व मक्खी के उपद्रव व दुर्गंध से निपटने के लिए आर.डी.एफ. पर उपयुक्त छिड़काव की व्यवस्था की जाएगी।
- अस्थायी उत्सर्जन को कम करने के लिए आंतरिक सड़कों को पक्का/डामरीकृत किया जाता है।
- पावर प्लांट के आसपास, आंतरिक सड़कों के किनारे और प्लांट की सीमा के साथ और जहां भी आवश्यक हो, ग्रीनबेल्ट प्रदान किया जाएगा।

इ.7.10.3. पानी की गुणवत्ता पर प्रभाव और प्रबंधन

मौजूदा परियोजना के लिए कुल पानी की आवश्यकता 313 केएलडी है और प्रस्तावित विस्तार परियोजना के लिए यह 337 केएलडी है। जिसकी आपूर्ति दिल्ली जल बोर्ड और निकटवर्ती प्रगति पावर प्लांट के औद्योगिक अपशिष्ट जल से प्राप्त किया जाएगा। लगभग 105 केएलडी अपशिष्ट जल उत्पन्न होगा जिसमें कूलिंग टॉवर ब्लो डाउन, बॉयलर ब्लो डाउन और डीएम पुनर्जनन और लीचेट शामिल हैं। उत्पन्न लीचेट (100 केएलडी) उन्नत एमवीआर प्रौद्योगिकी आधारित एलटीपी में उपचारित किया जाएगा। एंसिलरी कूलिंग टॉवर से उत्पन्न ब्लो डाउन वॉटर, बॉयलर ब्लो डाउन और डब्ल्यूटीपी रिजेक्ट्स को न्यूट्रलाइजेशन टैंक में एकत्रित किया जाएगा एवं न्यूट्रलाइजिंग एजेंट द्वारा उपचारित करने के बाद इसका उपयोग बॉटम ऐश शमन और वायु प्रदूषण नियंत्रण उपकरणों में किया जाएगा। इसलिए यह प्रोजेक्ट जीरो लिक्विड डिस्चार्ज (ZLD) संकल्पना पर आधारित होगी। घरेलू पानी की आवश्यकता 15 केएलडी है जिसकी आपूर्ति नगरपालिका द्वारा पूरी की जाती है। 13 केएलडी के घरेलू अपशिष्ट जल को सेप्टिक टैंक में उपचारित किया जाएगा और उसके बाद सोक पिट/जैव शौचालयों (Bio-toilets) में उपचारित किया जाएगा।

इ.7.10.4. शोर के स्तर पर प्रभाव

सामान्य रूप से किसी भी गतिविधि में ध्वनि प्रदूषण के कई स्रोत होते हैं। ध्वनि प्रदूषण के विभिन्न स्रोतों का उल्लेख नीचे किया गया है:

- बॉयलर फीड पंप
- टर्बो जनरेटर
- कूलिंग टॉवर
- डीजल जनरेटर
- लगातार वाहनों की आवाजाही

इ 7.10.5. प्रस्तावित शमन उपाय हैं

- सभी उपकरणों के शोर के स्तर को व्यावसायिक सुरक्षा और स्वास्थ्य संघ (OSHA) मानकों के अनुसार रखा जायेगा
- उच्च ध्वनि उत्पन्न करने वाले स्रोतों के प्रभाव को कम करने के लिए पर्याप्त इन्सुलेशन प्रदान किया जायेगा
- कर्मचारियों को पी.पी.ई. जैसे ईयर प्लग, हेलमेट, सुरक्षा जूते आदि प्रदान किए जाएंगे।
- परियोजना स्थल के भीतर सभी सीमाओं और सड़कों के किनारे ग्रीनबेल्ट का विकास किया जायेगा।

इ. 8. पर्यावरण निगरानी योजना

पर्यावरण निगरानी योजना की मुख्य भावना इस तरह है कि पर्यावरण को होने वाले नुकसान को कम करने के लिए कम से कम समय लिया जाये। प्रबंधन योजना के कार्यान्वयन की दक्षता का आकलन करने के लिए पर्यावरण निगरानी कार्यक्रम तैयार किया गया है और इसका विवरण तालिका 5 में दिया गया है।

तालिका 5: परिचालन चरण के दौरान पर्यावरण निगरानी योजना

क्र. सं.	संभावित प्रभाव	ईएमपी के अनुसार पालन की जाने वाली विस्तृत कार्रवाई	निगरानी के लिए पैरामीटर / स्थान
1.	वायु उत्सर्जन	बॉयलर चिमनी से उत्सर्जन	बॉयलर स्टैक उत्सर्जन, PM ₁₀ , HCl, SO ₂ , NO _x , CO, TOC, HF, कुल डाइऑक्साइड और फ्यूरान, Cd+Th+ उनके यौगिक, Hg और इसके यौगिक, भारी धातु (Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V+ उनके यौगिक)
		डी.जी. सेट आदि	PM, SO ₂ & NO _x
		AAQ की निगरानी परियोजना परिसर और आस-पास की बस्तियों (न्यूनतम 3 स्थानों) के भीतर की जाएगी। सभी वाहनों के पास पॉल्यूशन अंडर कंट्रोल (पीयूसी) सर्टिफिकेट होना चाहिए।	PM, SO ₂ , NO _x VOC वाहन का रखरखाव किया जाएगा। धूल के प्रसार को कम करने के लिए ग्रीनबेल्ट का विकास किया जाएगा
		मौसम संबंधी डेटा	हवा की गति, दिशा, तापमान, सापेक्ष आर्द्रता और वर्षा।
2.	शोर	बॉयलर, कूलिंग टावर, डीजी सेट आदि के संचालन के दौरान उत्पन्न शोर की निगरानी की जाएगी	स्थानीय शोर स्तर दर्ज किया जाएगा और निर्धारित मानकों के भीतर रखा जायेगा
3.	अपशिष्ट पानी	अपशिष्ट पानी का उपचार किया जाएगा अपशिष्ट जल निर्वहन मानकों का पालन किया जाएगा शून्य तरल निर्वहन (ZLD) सुनिश्चित किया जायेगा	सीएफई (CFE) में उल्लिखित पीएच, टीएसएस, टीडीएस, बीओडी, सीओडी, तेल और ग्रीस और अन्य पैरामीटर
4.	ठोस अपशिष्ट/ हानिकारक अपशिष्ट	परिचालन चरण के दौरान, अपशिष्ट को हजारडस एंड अदर	उत्पन्न कचरे की मात्रा, परिवहन मार्गों और अंतिम पुनः उपयोग/निपटान को रिकॉर्ड करने

		वेस्ट्स (मैनेजमेंट एंड ट्रांस बाउंड्री मूवमेंट) रूल्स, 2016 एवं आज तक के संशोधनों के अनुसार अपशिष्ट प्रबंधन योजना के अनुसार प्रबंधित किया जाना चाहिए। ठोस कचरे का निपटान एसडब्ल्यूएम नियम, 2016 के अनुसार किया जाना चाहिए।	के लिए लॉगबुक रखी जाएगी। ठोस और हानिकारक कचरे की मात्रा और डिस्पोजल (अंतिम निपटान) को रिकॉर्ड किया जाएगा
5.	भूजल गुणवत्ता और जल स्तर	भूजल गुणवत्ता और भूजल स्तर की निगरानी की जानी चाहिए। संचालन चरण के दौरान भूजल निगरानी संयंत्र के लिए निरंतर क्यूए/क्यूसी प्रक्रियाओं का हिस्सा होगी	आईएस 10500-2012 (महत्वपूर्ण प्रमुख, लघु आयन, भारी धातु) के अनुसार भूजल गुणवत्ता और भूजल स्तर की व्यापक निगरानी की जाएगी
6.	वनस्पति और जीव	वनस्पति, हरित पट्टी /हरित आवरण विकास	पौधों की प्रजातियों की संख्या और प्रकार दर्ज किया जाएगा
7.	मिट्टी की गुणवत्ता	चारों ओर अच्छी मिट्टी की गुणवत्ता की जाँच और रखरखाव	भौतिक-रासायनिक मापदंडों और धातुओं की उपस्थिति के लिए मिट्टी की गुणवत्ता का विश्लेषण किया जाएगा।
8.	स्वास्थ्य की स्थिति, दुर्घटनाएं	सभी कर्मचारियों और प्रवासी श्रमिकों का प्राथमिक स्वास्थ्य परीक्षण किया जाएगा। आपातकाल की स्थिति में इसके प्रभावी होने को सुनिश्चित करने के लिए आपातकालीन प्रतिक्रिया योजना की अक्सर निगरानी और परीक्षण किया जाएगा।	निर्धारित समय अंतराल में चिकित्सा जांच की जाएगी और परिणामों का रिकॉर्ड रखा जाना चाहिए।

E.9 जोखिम विश्लेषण

जोखिम विश्लेषण अध्ययन का मुख्य उद्देश्य परियोजना के विभिन्न संचालनों से जुड़े प्रमुख खतरों और जोखिमों की पहचान करना और उनकी मात्रा/स्तर निर्धारित करना है, जिससे आपदा के समय सार्वजनिक सुरक्षा और स्वास्थ्य को सुनिश्चित किया जा सके हैं। परियोजना के कारण होने वाले जोखिम को कम करने के लिए सभी आवश्यक उपाय किए गए हैं, जैसे आग और सुरक्षा नियंत्रण उपाय, आपातकालीन तैयारी योजना, आपदा प्रबंधन योजना, आदि।

E.10 परियोजना लाभ

स्थानीय सामाजिक बुनियादी ढांचे पर परियोजना का योगदान महत्वपूर्ण होने की उम्मीद है। बिजली संयंत्र का प्रस्तावित विस्तार बिजली की उपलब्धता में सुधार करके जिले में और आसपास औद्योगिक और वाणिज्यिक गतिविधियों के विकास को प्रोत्साहित करेगा। यह परियोजना स्थानीय लोगों को विभिन्न कौशल और व्यापार के साथ प्रत्यक्ष और अप्रत्यक्ष रोजगार के महत्वपूर्ण अवसर प्रदान करेगी।

आसपास के क्षेत्रों की भौतिक संरचना एवं सामाजिक-आर्थिक स्थिति को निम्न प्रकार से लाभ होगा:

- सड़क परिवहन सुविधाएं में सुधार लाएंगी
- शिक्षा, आवास और बैंकिंग सुविधाओं में सुधार होगा
- डाक और संचार सेवाओं में सुधार होगा
- मनोरंजन सुविधाएं बढ़ेंगी
- बिजली आपूर्ति, जल आपूर्ति और स्वच्छता में सुधार होगा
- आर्थिक स्थिति में सुधार होगा
- संयंत्र के भीतर रोजगार और क्षमता में सुधार के लिए स्थानीय लोगों को उचित प्रशिक्षण दिया जाएगा
- स्थानीय व्यवसायों के विकास से करें और शुल्कों के रूप में राज्य के राजस्व में वृद्धि होगी
- जिले के भीतर निवासियों के बढ़ने के कारण खाद्य और गैर-खाद्य वस्तुओं के साथ स्थानीय बाजारों में सुधार होगा।
- अपशिष्ट से ऊर्जा सुविधाएं (WTE) अपशिष्ट निपटान का एक सुरक्षित, तकनीकी रूप से उन्नत साधन प्रदान करती हैं जो ग्रीनहाउस गैसों को कम करता है, स्वच्छ ऊर्जा उत्पन्न करता है और धातु का पुनर्चक्रण करता है।
- अपशिष्ट से ऊर्जा (WTE) सुविधाएं क्षेत्र को बचाएंगी और लैंडफिल की मात्रा को काफी कम कर देंगी।
- कार्बन डाइऑक्साइड उत्सर्जन के संदर्भ में, अपशिष्ट से ऊर्जा एक टन कार्बन डाइऑक्साइड प्रति टन अपशिष्ट की बचत करती है, लैंडफिल की तुलना में जो अपनी लैंडफिल गैसों को पुनर्प्राप्त करते हैं, यह लगभग आधा टन कार्बन डाइऑक्साइड प्रति टन अपशिष्ट बचाता है।

E. 11 परियोजना की लागत का अनुमान

संयंत्र क्षेत्र और संयंत्र के आसपास के क्षेत्रों के सतत विकास को सुनिश्चित करने के लिए पर्यावरण प्रबंधन योजना (ईएमपी) की आवश्यकता है। ईएमपी को स्पष्ट रूप से परिभाषित नीतियों के साथ परियोजना की सभी प्रमुख गतिविधियों में एकीकृत किया जाएगा, ताकि यह सुनिश्चित किया जा सके कि क्षेत्र का पारिस्थितिक संतुलन बना रहे और प्रतिकूल प्रभाव कम से कम हो। ईएमपी को प्रतिकूल पर्यावरणीय प्रभावों को खत्म करने या उन्हें स्वीकार्य स्तर तक कम करने के लिए कार्यान्वयन और संचालन के दौरान शमन, प्रबंधन, निगरानी और संस्थागत उपायों के साथ बहु-विषयक दृष्टिकोण की आवश्यकता होती है। अध्ययन क्षेत्र में सतत विकास सुनिश्चित करने के लिए, इसे समावेशी बनाने की आवश्यकता है। योजना

जिसके लिए संयंत्र अधिकारियों, सरकार, नियामक एजेंसियों और अध्ययन क्षेत्र की आबादी को अपना सहयोग और योगदान देने की आवश्यकता है।

निर्माण और संचालन चरणों और समग्र प्रबंधन योजना के लिए नियंत्रण उपायों की योजना बनाई गई है ईएमपी का उद्देश्य उपलब्ध और किफायती तकनीक के साथ संभावित सीमा तक स्रोत स्तर पर प्रदूषण को नियंत्रित करना है अनुशंसित शमन उपाय क्षेत्र के पर्यावरण संरक्षण के साथ अध्ययन क्षेत्र के आर्थिक विकास को सिंक्रनाइज़ करेंगे। संचालन चरण में ईएमपी उपायों के कार्यान्वयन के लिए प्रस्तावित बजट 134.5 करोड़ रुपये पूंजीगत लागत है और 20.5 करोड़/वर्ष आवर्ती लागत है।

E12 निष्कर्ष

शहरी आबादी में वृद्धि के साथ नगरपालिका क्षेत्र में ठोस अपशिष्ट उत्पादन दिन-प्रतिदिन बढ़ रहा है और इस प्रकार उत्पन्न ठोस कचरे के स्थायी प्रबंधन या निपटान की आवश्यकता पैदा हो रही है। ठोस अपशिष्ट प्रबंधन के लिए अपशिष्ट से ऊर्जा संयंत्र (WTE) अब अधिक टिकाऊ विकल्प है क्योंकि वैज्ञानिक लैंडफिल के लिए भूमि क्षेत्र की कमी है और बिजली की मांग भी लगातार बढ़ रही है। इस क्षेत्र में पावर प्लांट के विस्तार से क्षेत्र में बेहतर आधारभूत, शैक्षिक और चिकित्सा सुविधाएं उपलब्ध कराकर समाज को लाभ प्राप्त होगा और अप्रत्यक्ष रोजगार में सुधार और क्षेत्र की आर्थिक वृद्धि भी होगी। इस परियोजना से लगभग 260 लोगों को प्रत्यक्ष रोजगार मिलेगा और लगभग 150 लोगों को अप्रत्यक्ष रोजगार मिलेगा।

CHAPTER 1

INTRODUCTION

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Introduction

1.1 Introduction

Waste to Energy (WTE) is the sum of processes that produce electric energy using waste as fuel in the power plant. Nowadays it has also become a safe and favorable form of energy recovery from the environmental point of view. As such, it is currently regarded as an essential element in the mechanism of integrated waste management, in all industrialized countries. Waste to energy provides the fourth "R" in a comprehensive solid waste management program: Reduction, Reuse, Recycling, and energy Recovery.

M/s. Delhi MSW Solutions Ltd. (DMSWSL) has developed an existing 24 MW RDF based Power Plant within the integrated MSW Management Facility (IMSWMF) at the site notified by Municipal Corporation of Delhi (MCD) for which EC was obtained from MOEFCC with 4000 TPD capacity with minimum 36 MW WTE capacity of 3000 TPD wide EC vide no. F. No.- 67/2009-IA.III dt. 8th May 2012 (**copy enclosed as Annexure-1**).

DMSWSL has installed 24 MW Waste to Energy power plant and operating successfully after obtaining CFE and CFO from Delhi Pollution Control Committee (DPCC) vide letter **No. DPCC/PLG/2016/36691** dated 10.03.2016 and vide letter no. **DPCC/PLG/2017/39391** dated 20.02.2017 respectively (**copy enclosed as Annexure-2**). Now DMSWSL proposed to expand this standalone WTE plant from 24 MW to 60 MW by installing one more 36 MW WTE adjacent to the existing WTE plant.

The Environmental Impact Assessment (EIA) report has been prepared for the proposed expansion project in accordance with EIA notification S.O. 1533, issued on 14th September, 2006 and its subsequent amendments. As per said notification the proposed expansion project falls under Project / Activity 1 (d) - Thermal Power Plants (≥ 25 MW (based on biomass or non-hazardous municipal solid waste as fuel). The proposed expansion project is coming under Category – A since it is more than 25 MW and requires Environmental Clearance (EC) from the Expert Appraisal Committee (EAC), Ministry of Environment Forest & Climate Change (MOEFCC), New Delhi. ToR has been issued from sectoral Expert Appraisal Committee of Thermal Power Plants **Vide F. No. J-13012/01/2022-IA.I (T)** dated 29th June, 2022.

1.2 Purpose of the report

The proposed expansion of RDF from Municipal Solid Waste (MSW) to Energy generating project is one of the most efficient and environmentally friendly solution for tackling the

municipal solid waste problem of Delhi. The expansion of the existing WTE project has been recommended by Mayor of Erstwhile North DMC, Hon'ble LG of Delhi for alleviating the mammoth task of MSW of Delhi. Paper statement of the same is attached as **Annexure 2a**.

DMSWSL has submitted Application (Form 1 with pre-feasibility report) for obtaining Terms of Reference (ToR) to MOEFCC through online proposal no. **IA/DL/THE/271398/2022** dated 5th May, 2022. The proposal was considered by the EAC for Thermal Power Projects, New Delhi in the 25th EAC meeting held on 31st May, 2022 and has issued ToR vide its File No. J-13012/01/2022-IA. I (T) dated 29th June, 2022 for conducting baseline environmental studies and preparation of EIA/EMP report.

1.3 Identification of project and project proponent

1.3.1 Project

DMSWSL has developed the Integrated MSW Management Facility (IMSWMF) at the identified site by Municipal Corporation Delhi. DMSWSL initially established IMSWMF with the capacity of 4000 TPD. Further A standalone RDF based WTE Plant of 24 MW with 1200 TPD of RDF as fuel which will be drawn from the existing facility. Now DMSWSL has proposed to utilise the leftover 1800 TPD of RDF by installing another 36 MW WTE cumulatively 60 MW.

The details of the statutory clearances obtained for the existing unit are given in **Table 1.1**. The project details such as land area, expansion cost and total production before and after expansion, its categorization as MOEFCC notification are given **Table 1.2**.

Table 1.1: Details of statutory clearances of existing WTE Project

Statutory clearances	Date	Remarks
TOR obtained from MOEFCC	26.11.2009	MSW processing and disposal of 4000 TPD (activities involving segregation, composting, RDF & SLF with leachate collection & Treatment of wastes)
Public hearing	14.05.2010	
Environmental Clearance of IMSWMF by MOEFCC	25.10.2010	
CFE for IMSWMF by DPCC	18.01.2011	WTE power plant of min 36 MW having MSW processing capacity up to 3000 TPD
Environmental Clearance of Waste to Energy MOEFCC	08.05.2012	
CFE for WTE by DPCC	10.03.2016	WTE power plant of 24 MW. Valid till 04.05.2026
First CFO for WTE by DPCC	20.02.2017	

Table 1.2: Details of Project and site

EIA Notification – 14.09.2006 No.S.O.1533 & Subsequent Amendments	
Project activity	Project or Activity – 1(d) Thermal Power Plants ($\geq$ 25 MW (based on biomass or non-hazardous municipal solid waste as

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

	fuel)
Category	Category 'A' (>25 MW)
Location	at Integrated Municipal Solid Waste Management Facility, Pocket N-1, Sector 5, Bawana Industrial Area, Narela Bawana, North West Delhi, Delhi
Project proponent	M/s. Delhi MSW Solutions Ltd. (DMSWSL)
Plant capacity	Existing: 2 x 600 TPD = 1200 TPD 24 MW Expansion: 3 x 600TPD = 1800 TPD 36 MW Cumulatively: 5 x 600 = 3000 TPD 60 MW
Land area	Total plot area of IMSWMF: 100 Acre (40.46 Ha) Land demarcated for WTE: 17.24 Acre (6.97 Ha) Existing: WTE plant under operation: 8.62 Acre (3.48 Ha) Proposed WTE Expansion: 8.62 Acre (3.48 Ha)
Water requirement & source	Existing: 313 KLD Proposed: 337 KLD Total 650 KLD Source: Permission from Delhi Jal Board for 1000 KLD and plant having agreement with PPCL for 350 KLD and the agreement with Pragati Power Corporation Limited (PPCL) is expandable as per requirement.
Manpower requirement	Existing – 215 nos Proposed - 260 nos Total manpower – 475 nos Source: Local has been hired in existing facility. For expansion additional manpower will be hired locally.
Power requirement	Approximately 9.0 MW (15% of total power generation) Existing: 3.6 MW Proposed: 5.4 MW
Estimated Cost of the Project	Existing: 378.0 Crore Proposed: 900. 1 Crores

1.3.2 Project proponent

M/s. Delhi MSW Solutions Ltd. (DMSWSL), has developed the Integrated MSW Management Facility (IMSWMF) along with WTE at Pocket N1, Sector 5, Bawana Industrial Area, Bawana, District North West Delhi, Delhi to handle MSW in compliance with MSW Rules 2000 and SWM rules 2016. The main objective of the project is to collect 100% of MSW generated in the concessionary areas and to dispose-off the same through a most scientific and productive disposal through a combination of processes such as segregation units consisting

of composting plant for biodegradable material, Refuse Derived Fuel (RDF) plant and Waste to Energy plant for combustible material and secured Landfill for inert disposal.

Re Sustainability Limited (ReSL) is a reputed waste management company in the country with vast experience in the Solid waste, Hazardous waste, Biomedical waste and E-waste management sector. It has established itself in the leadership position in the country in the field of environment and infrastructure. It is an India's leading provider of comprehensive environment management services offering a whole gamut of best-in-class services under various categories such as waste management - hazardous, municipal, biomedical & e-waste; recycling - waste water, paper, plastic and integrated waste. In addition, they also offer renewable energy, consultancy and integrated environment services.

1.4 Brief description of nature, size, location of the project and its importance to the country and region

M/s. Delhi MSW Solutions Ltd. (DMSWSL) has developed the Integrated MSW Management Facility (IMSWMF) at the identified site by Municipal Corporation Delhi (MCD). DMSWSL initially established IMSWMF with the capacity of 4000 TPD and a standalone WTE plant of 24 MW with 1200 TPD of RDF as fuel was developed. Now DMSWSL has proposed to utilize the leftover 1800 TPD of RDF by installing another 36 MW WTE Power plant cumulatively 60 MW. The proposed expansion of WTE power plant will be located within the existing facility of IMSWMF at Pocket N-1 Sector 5, Bawana Industrial Area, Tehsil Narela, District North West Delhi, Delhi.

The details of the project site are given in **Table 1.3**. The location map of the project site is given as **Figure 1.1**. Toposheet maps of 10 km, 5 Km and 3 Km are given as **Figure 1.2, 1.3 and 1.4** respectively. The plant layout of existing and proposed project is given as **Figure 1.5** below.

Table 1.3: Features of the proposed project site

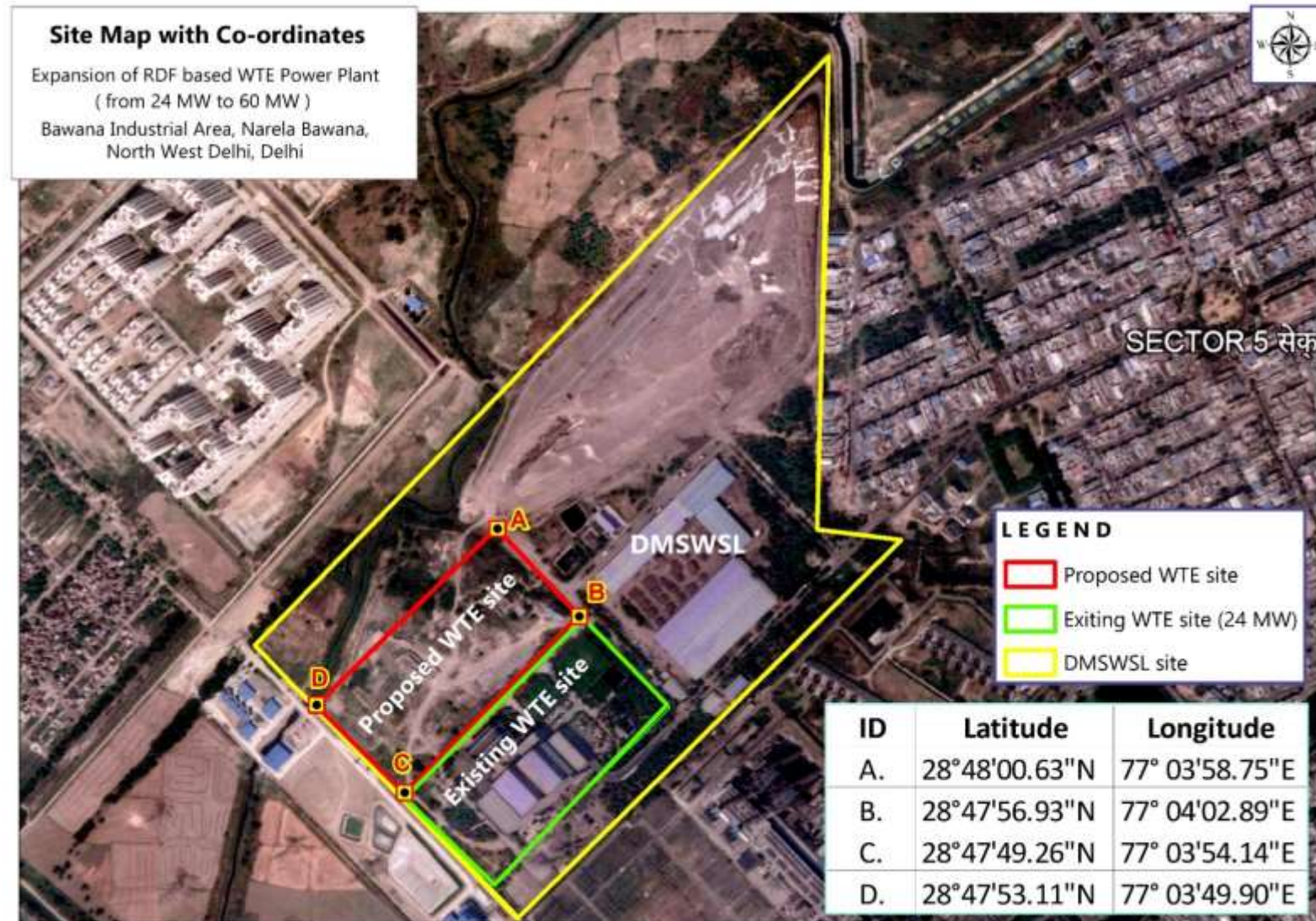
Location	Pocket N-1 Sector 5, Bawana Industrial Area, Tehsil Narela, District North West Delhi, Delhi.			
Project schedule	Project or Activity – 1 (d) Thermal Power Plants (≥ 25 MW (based on biomass or non-hazardous municipal solid waste as fuel)			
Land coordinates	S. No.	Latitude	Longitude	
	1	28°48'00.63"N	77° 03'58.75"E	
	2	28°47'56.93"N	77° 04'2.89"E	
	3	28°47'49.26"N	77° 03'54.14"E	
	4	28°47'53.11"N	77° 03'49.90"E	
Elevation	Site elevation is around 216-220 m above MSL			
Nearest railway station	Holambi Kalan Railway station – 3.2 km (E)			
Nearest habitation	Sanoth Village 1.35 km			

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Nearest town	Narela Bawana– adjacent
National highway	NH-1 is located 6.5 km (E)
Nearest airport	Indira Gandhi International Airport at 25 km (SE).
Nearest water bodies	Yamuna canal located adjacent to site 0.5 km (SW), Yamuna river located 13.6 km (E)
Nearest forest	Bawana RF at 1.5 km (N) Shri Krishna Sultanpur RF at 5.0 km (SW) Marmurpur PF located 7 km (NE)
Eco-sensitive zone (NP, WLS, BR within study area)	Not within 10 km radius study area

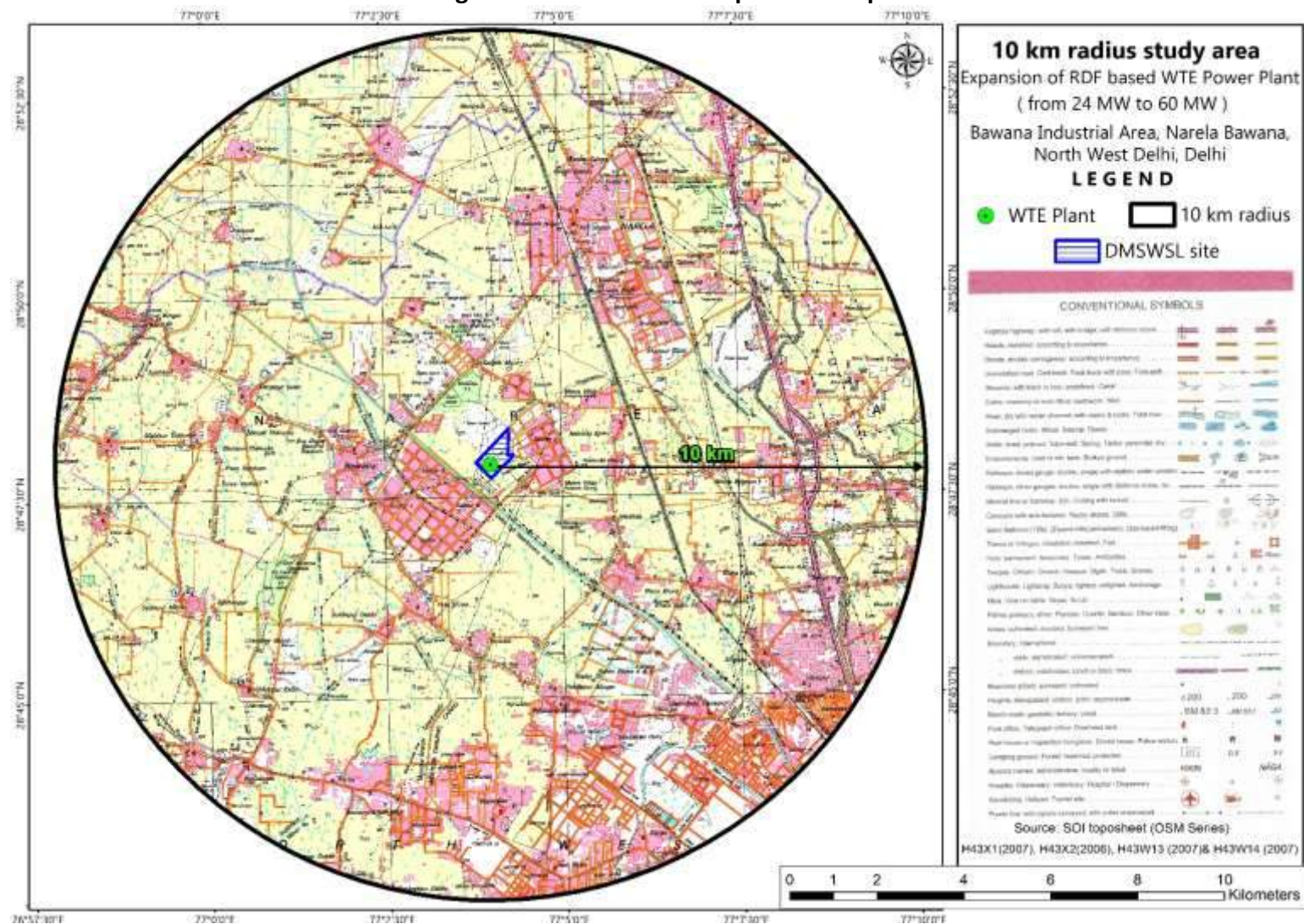
Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd.
(DMSWSL) at Tehsil Narela, District North West, Delhi

Figure 1.1: Location map of the site



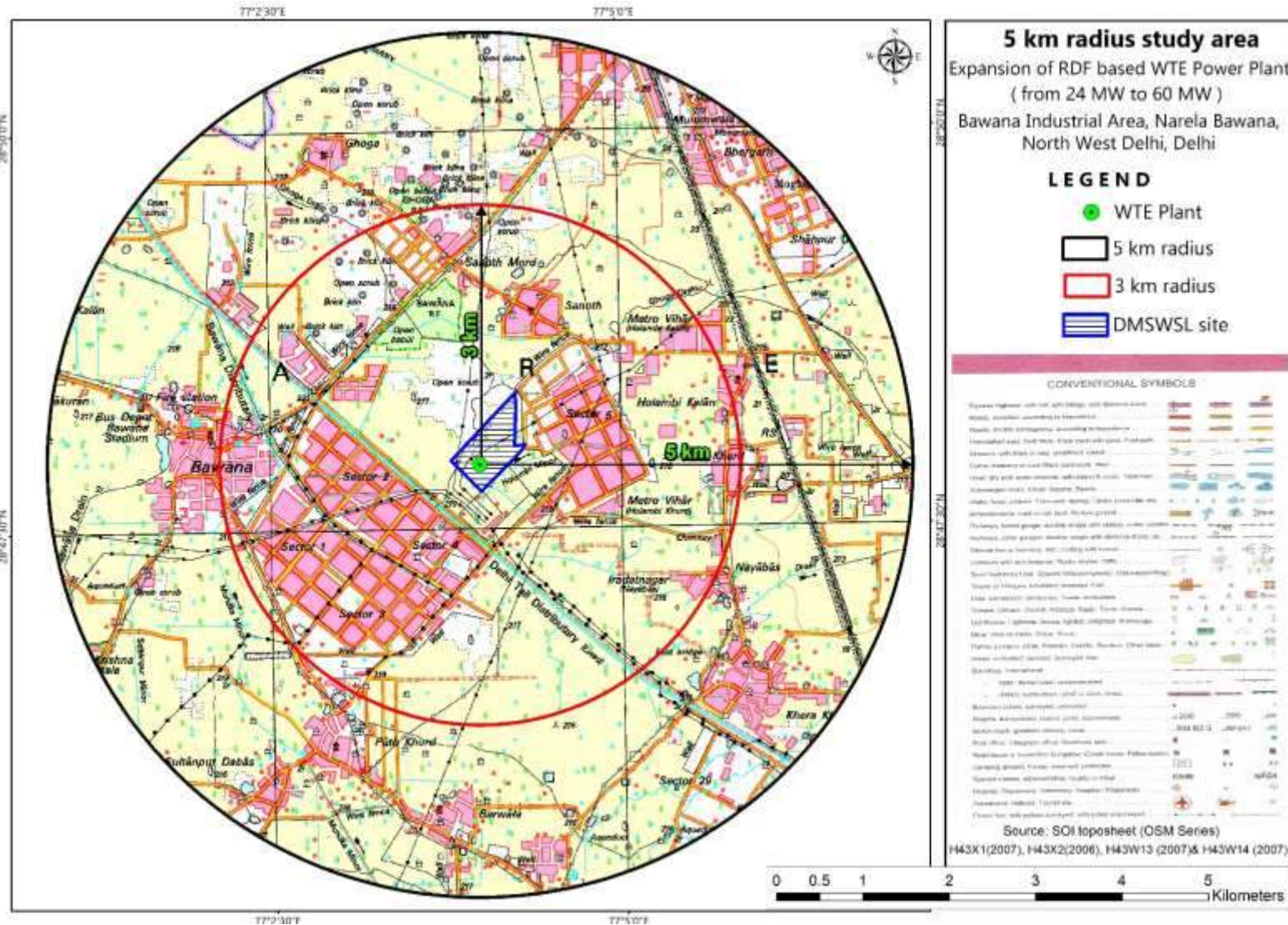
Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd.
(DMSWSL) at Tehsil Narela, District North West, Delhi

Figure 1.2: 10 km radius toposheet map



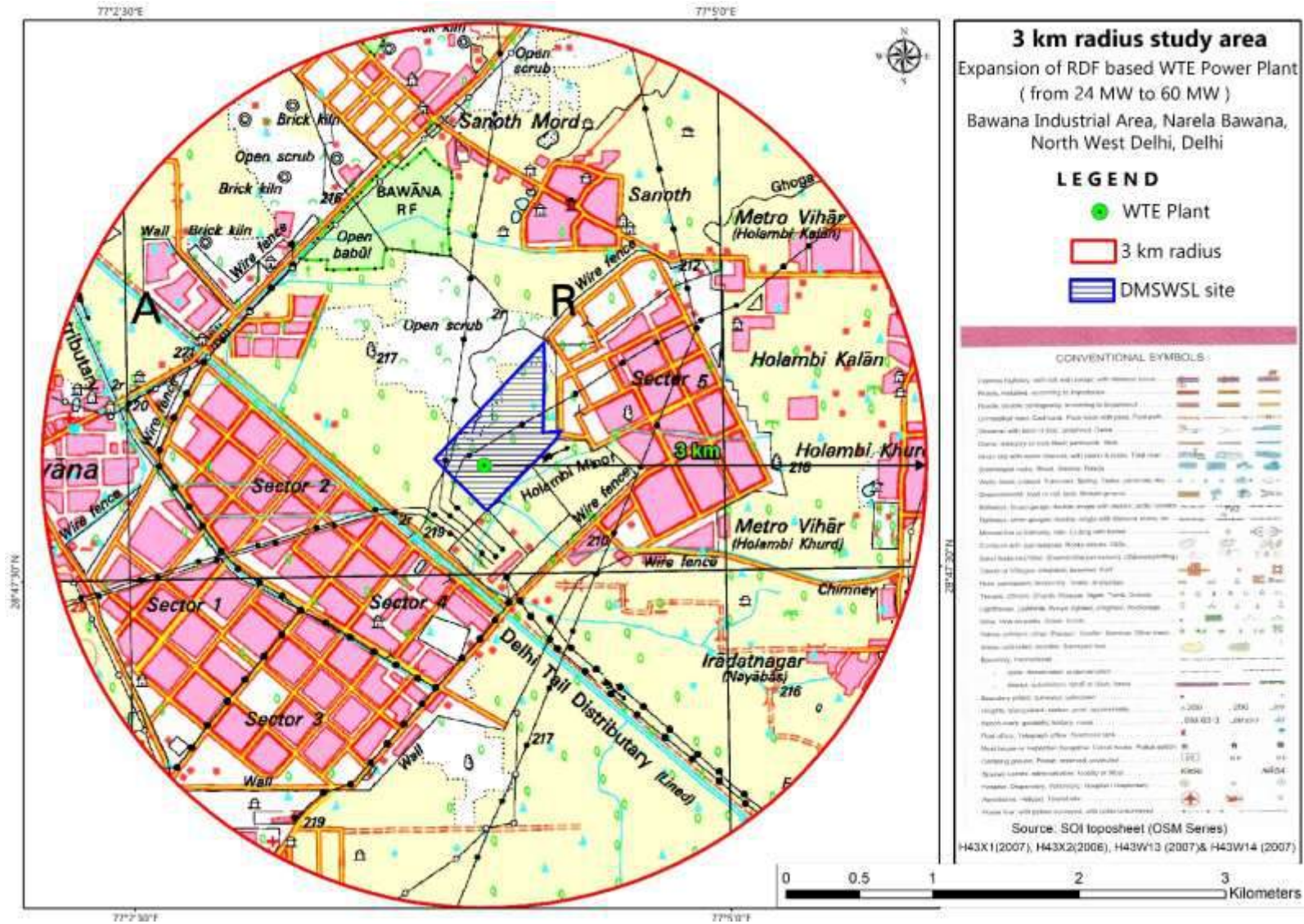
Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Figure 1.3: 5 km radius toposheet map



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Figure 1.4: 3 km radius toposheet map



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd.
(DMSWSL) at Tehsil Narela, District North West, Delhi

Figure 1.5: Plant layout showing Existing and proposed expansion of WTE



1.5 Scope of the study

The scope of the study is to carry out the environmental baseline studies to identify, predict and evaluate potential environmental and socio-economic impacts, which may result from establishing the proposed expansion of WTE plant and to develop suitable Environment Management Plan (EMP) to mitigate the undesirable effects. Study will also include to assess the implementation of existing environmental management measures at existing site.

The study is aimed at:

- Establishing the existing environmental conditions, identifying potential environmental impacts and identifying areas of significant environmental concerns due to the proposed expansion project
- Prediction of impacts on environment, socio-economic conditions of the people residing close to and within the proposed project area.
- Preparation of environmental management plan
- Development of post project environmental monitoring program.

The EIA study shall be conducted as per the applicable rules/guidelines of MOEFCC, Govt. of India including the general/sectoral provisions. The EIA study will necessarily include but not get restricted to the following:

- (a) Literatures review
- (b) Field studies
- (c) Impact assessment and preparation of the EIA/EMP report

The generic approach for accomplishing EIA studies is shown in **Figure 1.6**.

Stage A: Environmental baseline monitoring (EBM)

Assessment of relevant features of the project those are likely to have an impact on environment during construction and operation phases.

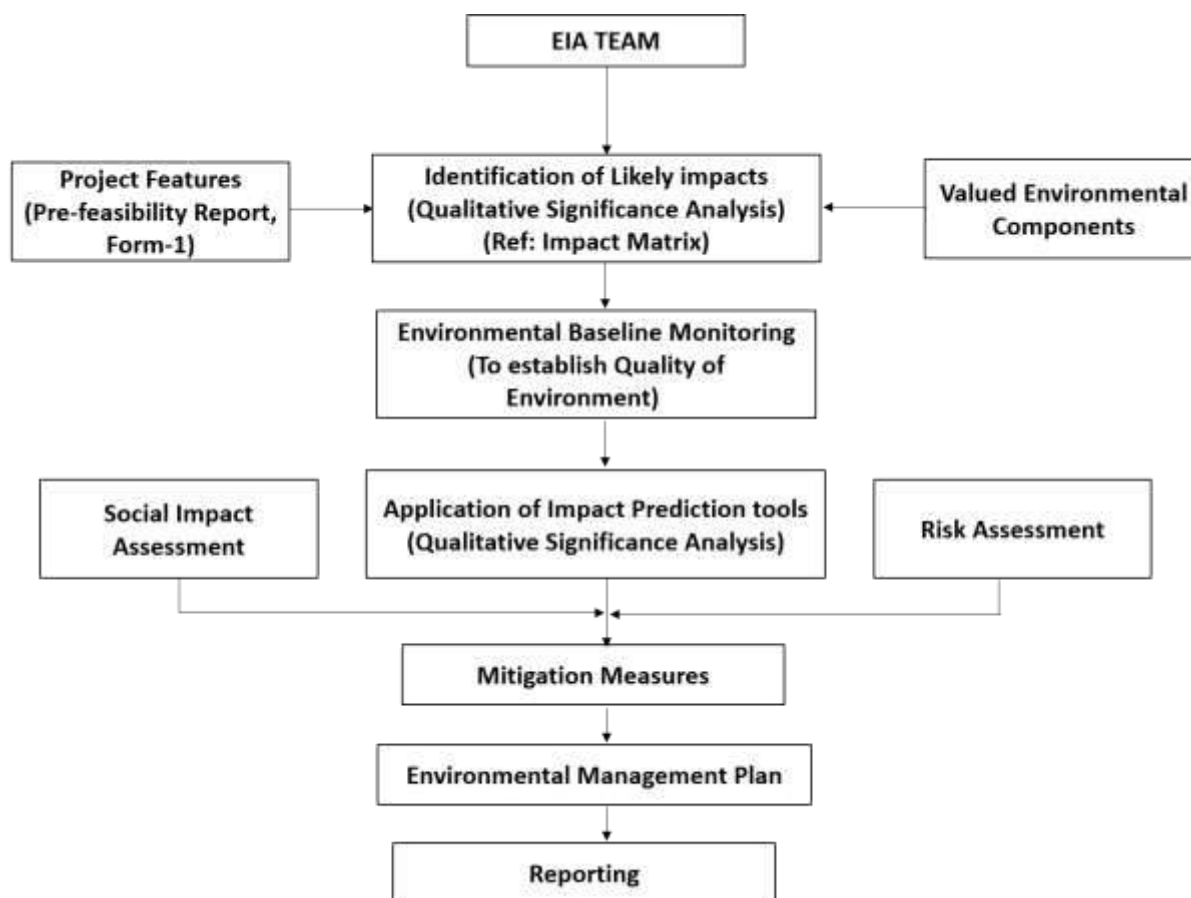
Stage B: Impact prediction

Assessment of likely emissions from the proposed facility and assessment of impacts using scientific tools to delineate post project scenario.

Stage C: Environmental monitoring and management plan

Suggesting adequate pollution control measures to offset adverse impacts if any; Preparation of EIA and EMP documents and defending the study findings before the regulatory authorities.

Figure 1.6: Flow sheet for EIA studies



An outline of the activities carried out in stages A, B, C are briefly described below:

Stage A: Environmental baseline monitoring (EBM)

EIA Notification, 2006 specifies that an EIA report should contain detailed description of the existing environment that would be or might be affected directly or indirectly by the proposed expansion of existing project. Environmental Baseline Monitoring (EBM) is a very important stage of EIA. On one hand, EBM plays a very vital role in EIA and on the other hand it provides feedback about the actual environmental impacts of a project.

List of important physical-environmental components and indicators of environmental baseline monitoring is given in **Table 1.4**.

Table 1.4: Environmental Baseline Monitoring parameters

Environment Component	Environmental Indicators
Climatic variables	➤ Rainfall patterns ➤ Temperature patterns ➤ Extreme events ➤ Climate change projections ➤ Prevailing wind – direction & speed

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

	➤ Relative humidity ➤ Stability conditions and mixing height etc.
Topography	➤ Slope form ➤ Landform and terrain analysis ➤ Specific landform types etc.
Drainage	➤ Surface hydrological condition ➤ Natural drainage pattern and network ➤ Rainfall runoff relationships ➤ Hydrogeological condition
Soil	➤ Type and characteristics (Physical & Chemical) ➤ Run-off rate ➤ Infiltration capacity ➤ Effective depth (in/cm) ➤ Suitability for method of sewage disposal etc.
Geology	➤ Underlying rock type, texture ➤ Surgical material ➤ Geologic structures (faults, shear zones etc.) ➤ Geologic resources (minerals etc.) etc.
Water quality	➤ Raw water availability ➤ Water quality ➤ Surface waters (rivers, lakes etc.) – quality, water depths, flooding areas etc. ➤ Ground water – water table, local aquifer storage capacity, water level depths and fluctuations etc.
Air quality	➤ Ambient ➤ Respirable ➤ Air shed importance ➤ Odor levels etc.
Noise	➤ Identifying sources of noise ➤ Noise due to traffic/transportation of vehicles ➤ Noise due to heavy equipment operations ➤ Duration and variations in noise over time etc.
Biology	➤ General species composition of flora and fauna ➤ Reporting presence of Eco-sensitive area like NP, WLS, Biosphere Reserve, Elephant/Tiger Reserve (Existing as well as proposed), migratory route/ wildlife corridors ➤ Wild Life Conservation Plan for Schedule-I species
Land use	➤ Land use pattern etc.

The EBM program for EIA can at best address temporal and/or spatial variations limited to a limited extent because of cost implications and time limitations. Therefore analysis of all available information or data is essential to establish the regional profiles. So, all the relevant secondary data available for different environmental components should be collated and analyzed.

Stage B: Assessment of environmental impacts of proposed project

The scientific and technical credibility of an EIA relies on the ability of EIA practitioners to estimate the nature, extent, and magnitude of change in environmental components that may result from project activities. Information about predicted changes is needed for assigning impact significance, prescribing mitigation measures, and designing & developing EMPs and monitoring programs. The more accurate the predictions, the more confident the EIA practitioner will be in prescribing specific measures to eliminate or minimize the adverse impacts of development project. Accordingly, with the knowledge of baseline conditions in the study area and proposed expansion project activities, impact on the environment shall be discussed in detail covering air emissions, discharge of liquid effluents and particulates emission during construction, noise & solid waste generation etc. Detailed projections shall be made to reflect influence of the proposed expansion project on different environmental components.

Assessment of potential damage to terrestrial and aquatic flora and fauna due to air emissions, discharge of effluents, noise pollution, ash disposal, and change in land use pattern, habitat degradation and fragmentation, anthropogenic activities from the proposed expansion project and delineation of guidelines to minimize adverse impacts were done. Assessment of economic benefits arising out of the project has been carried out. The component of existing unit was also considered for assess the overall impact cumulatively by existing and proposed unit.

Stage C: Environmental Management Plan (EMP)

The mitigation measures necessary to offset the impacts from the proposed expansion project were discussed. Environmental management plan and pollution control measures necessary to meet the requirements of the regulatory agencies have been suggested.

Environmental management plan consists of mitigation measures for item-wise activity to be undertaken for construction and operation of the facility for its entire life cycle to minimize adverse environmental impacts. It also delineates the environmental monitoring plan for compliance of various environmental regulations.

1.6 Important Environment Legislations

Important applicable environmental legislations related to EC for new, expansion & modernisation activities are given in **Table 1.5**.

Table 1.5: Applicable environmental legislations

Legislation	Responsible Ministries/ Bodies	Objective of Legislation
The Environment (Protection) Acts 1986/ Rules 1986. The Environmental Impact Assessment (EIA) Notification, 2006	MOEFCC, CPCB, SPCC	Protection and Improvement of the Environment
The Water (Prevention & Control of Pollution) Acts 1974/ Rules 1975	CPCB, SPCC	The prevention, control and abatement of air pollution
The Air (Prevention & Control of Pollution) Acts 1981/ Rules 1982	CPCB, SPCC	The prevention and control of water pollution and also maintaining or restoring the wholesomeness of water
The Solid Waste Management Rules, 2016	CPCB, SPCC	To manage/ utilize the generated solid waste without damaging the environment and surroundings
Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016	CPCB, SPCC	Prevention, control and safe handling of hazardous wastes
E-Waste (Management) Rules, 2016,	CPCB, SPCC	Ensure to reduce, reuse, and recycle of e-waste
Factories Act, 1948 (as amended till 1987)	Ministry of Labour, DGFASLI and Directorate of Industrial Safety and Health/ Factories Inspectorate	Control of workplace environment, and providing for good health and safety of workers
The Central Motor Vehicle Rules, 1989	Ministry of Shipping, Road Transport and Highways	To consolidate and amend the law relating to motor vehicles including to regulate the transportation of dangerous goods with a view to prevent loss of life or damage to the environment
Noise Pollution (Regulation and Control) Rules, 2000 and its amendments	CPCB, SPCC, MOEFCC	To maintain the noise levels with respect to the place/equipment/ industry
The Indian Boilers Act- 1923 Delhi Boilers Rules- 1927 Delhi Boilers Attendant Rules-1953 Bombay Smoke Nuisances Act-1912,	Labour Commissioner, Government of NCT of Delhi	To provide mainly for the safety of life and Property of persons from the danger of explosions of steam boilers and for

Legislation	Responsible Ministries/ Bodies	Objective of Legislation
as extended to UT of Delhi. Delhi Smoke Nuisances Rules-1975. Indian Boilers Regulations-1950		achieving uniformity in registration and inspection during operation and maintenance of boilers in India.

1.7 Structure of EIA Report

The report is structured as per Appendix III of EIA Notification, 2006 and its subsequent amendments

- Chapter 1: Introduction
- Chapter 2: Project Description
- Chapter 3: Description of the Environment
- Chapter 4: Environmental Impacts and Mitigation Measures
- Chapter 5: Analysis of Alternatives (Site & Technology)
- Chapter 6: Environmental Monitoring Program
- Chapter 7: Additional Studies
- Chapter 8: Project Benefits
- Chapter 9: Environmental Cost Benefit Analysis
- Chapter 10: Environment Management Plan
- Chapter 11: Summary and Conclusion
- Chapter 12: Disclosure of Consultants Engaged

CHAPTER 2

PROJECT DESCRIPTION

Chapter 2

Project description

2.1 Background Information

M/s. Delhi MSW Solutions Ltd. (DMSWSL) has developed the 24 MW RDF based Standalone Waste To Energy (WTE) Project with in the integrated MSW Management Facility (IMSWMF) at the notified site by Municipal Corporation of Delhi for which EC was obtained for the same from MOEFCC with capacity of minimum 36 MW with the MSW Processing capacity of (4000 TPD) vide EC no. **F. No.- 67/2009-IA.III dt. 8th May 2012**. Now DMSWSL has proposed to expand this WTE plant from 24 MW to 60 MW by installing one more 36 MW Waste to Energy Plant adjacent to the existing WTE plant. Total cost of the project is Rs 900.1 Crore.

DMSWSL has installed 24 MW Waste to Energy power plant and operating successfully after obtaining CFE and CFO from Delhi Pollution Control Committee (DPCC) vide letter **No. DPCC/PLG/2016/36691** dated 10.03.2016 and vide letter no. **DPCC/PLG/2017/39391** dated 20.02.2017 respectively. The performance of Existing unit with receipt of RDF and Power generation is given below in **Table 2.1**.

Table 2.1: Year wise waste receipt and power generation

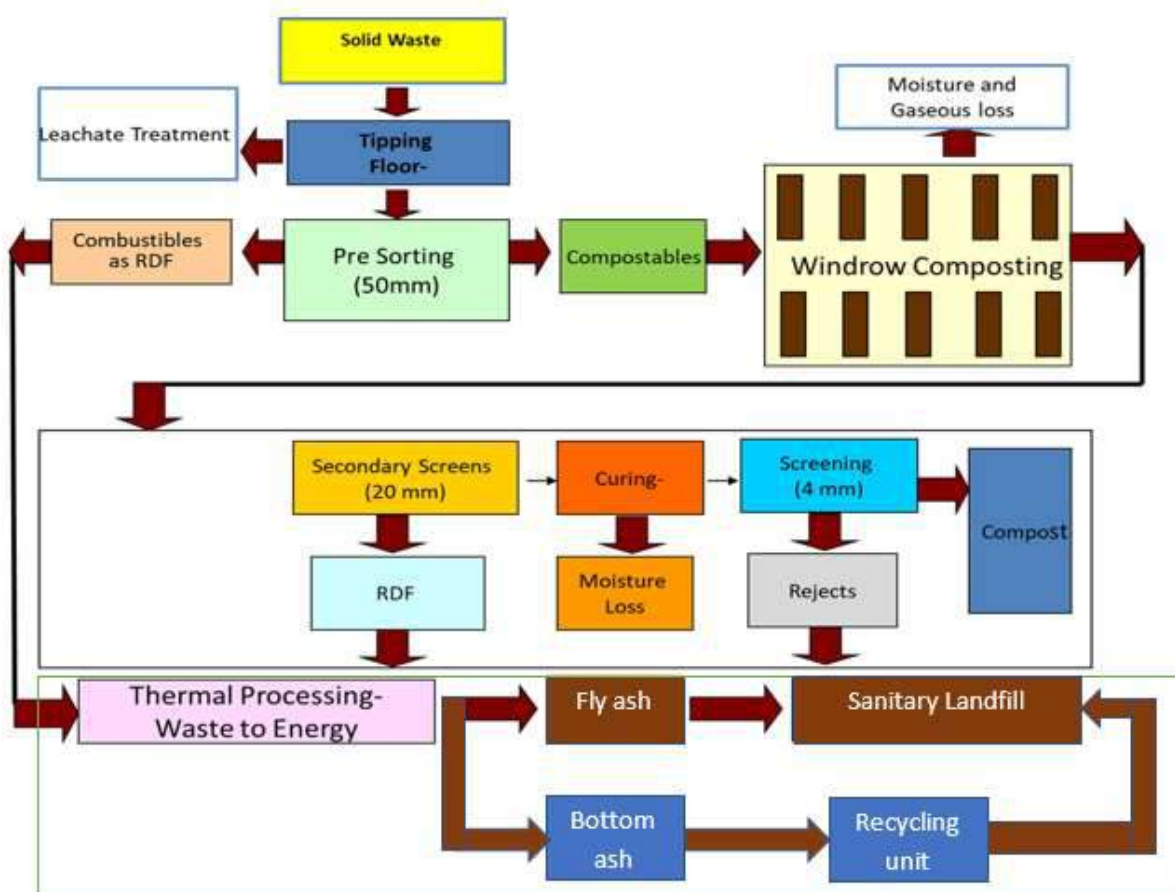
Year	Waste Receipt (Mt)	Power Generation (MU)
2016-17	706456.35	22.66
2017-18	720116.46	107.19
2018-19	678123.60	135.86
2019-20	734872.30	145.63
2020-21	754546.90	159.62
2021-22	835820.00	163.26

2.2 Type of project

The proposed expansion project is a Refused Derived Fuel (RDF) based WTE power plant which is a part of the integrated municipal solid waste management project located at Bawana Industrial Area, Narela Bawana, Delhi. Total plot area of IMSWMF is 100 Acre (40.46 Ha). Out of which total land demarcated for WTE is 17.24 Acre (6.9 Ha). Existing WTE power plant was developed on 8.62 Acre (3.48 Ha) area and another 8.62 Acre (3.48 Ha) is allotted for expansion of WTE plant.

As per EIA Notification 2006 as amended; the project is listed under Project or Activity – 1 (d) Thermal Power Plants (≥ 25 MW (based on biomass or non-hazardous municipal solid waste as fuel)). The project categorized under “A” category project for which Environmental Clearance. The schematic representation of MSW processing and Process flowchart of waste to energy are shown in **Figure 2.1** and **Figure 2.2**.

Figure 2.1: Schematic representation of MSW Processing



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

The expansion of the existing WTE project has been recommended by Mayor of Erstwhile North DMC, Hon'ble LG of Delhi for alleviating the mammoth task of MSW of Delhi. Considering the above facts M/s. DMSWSL has proposed expansion of existing 24 MW RDF based power plant, is one of the most efficient and environmentally friendly solution for tackling the municipal solid waste problem of Delhi.

This standalone RDF based WTE Plant of 24 MW with 1200 TPD of RDF as fuel. Now DMSWSL has proposed to utilise the leftover 1800 TPD of RDF by installing another 36 MW WTE cumulatively 60 MW.

2.4 Demand Supply gap

Rapid growth of industries and commerce in India necessitates uninterrupted power supply. Therefore, all options need to be explored to generate power from conventional and non-conventional sources. MSW provides an opportunity of tapping potential energy to meet part of the energy demand of the country. At present there are no plans of importing the MSW, only indigenously produced MSW will be used for proposed expansion of WTE power plant. However, in future if any MSW is taken from long distance the same will be informed to the concerned authorities.

2.5 Location (Map showing general location, specific location, project boundary and project site layout)

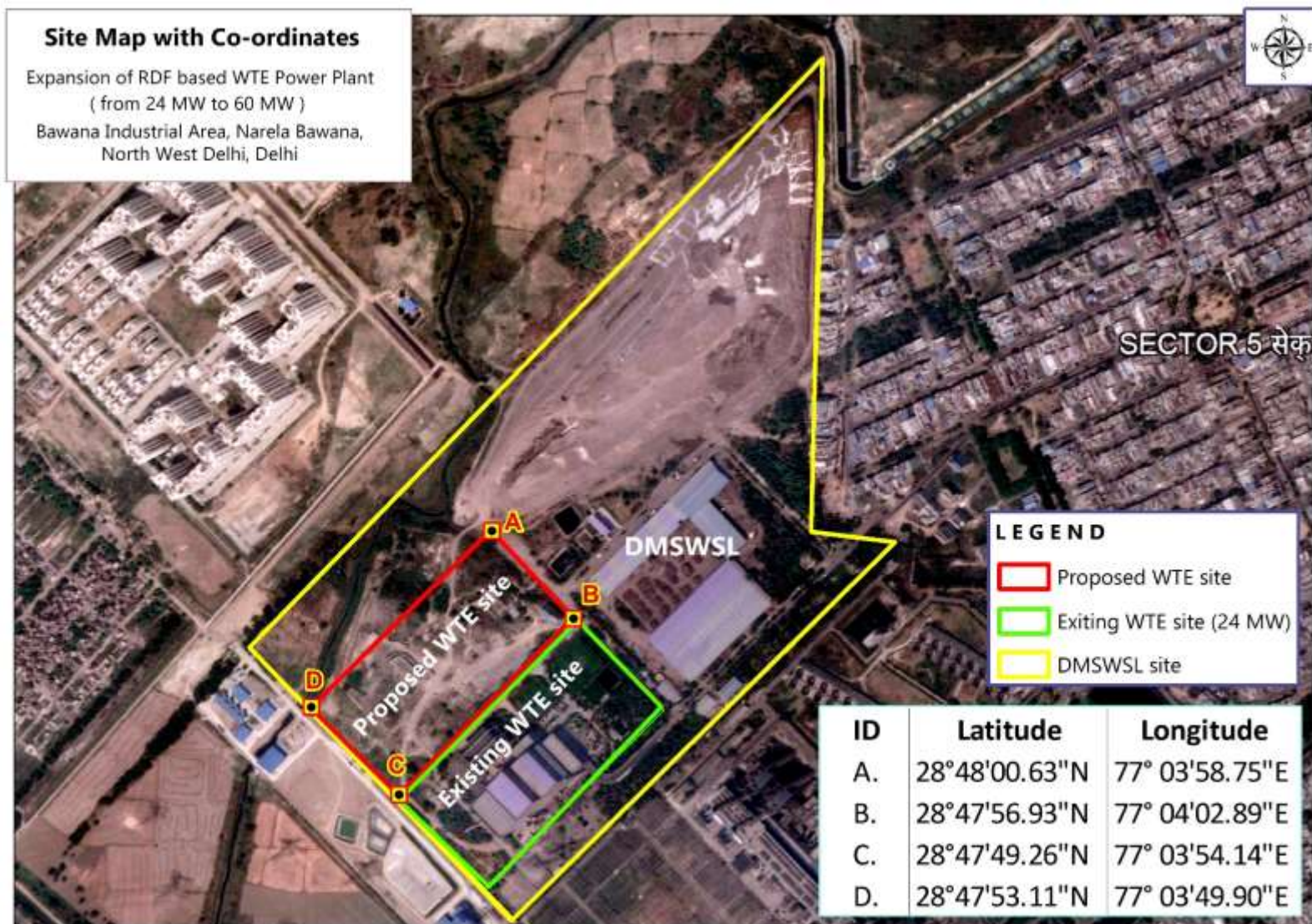
The project site is located at Pocket N1, Sector 5, Bawana Industrial Area, Bawana, North West Delhi, Delhi (Within the premises of Integrated MSW Management Facility at Notified site by Municipal Corporation of Delhi). Proposed expansion project will be developed within the existing IMSWF and hence there is no rehabilitation and resettlement are required. Major co-ordinates of the project site boundary are given in **Table 2.3**. The Google map of the site is shown in **Figure 2.3** and Google image (10 km radius) are shown in **Figure 2.4** and existing and proposed waste to energy site layout is shown in **Figure 2.5**.

Table 2.3: Project site co-ordinates of waste to energy plant

S. No.	Latitude	Longitude
1	28°48'00.63"N	77° 03'58.75"E
2	28°47'56.93"N	77° 04'02.89"E
3	28°47'49.26"N	77° 03'54.14"E
4	28°47'53.11"N	77° 03'49.90"E

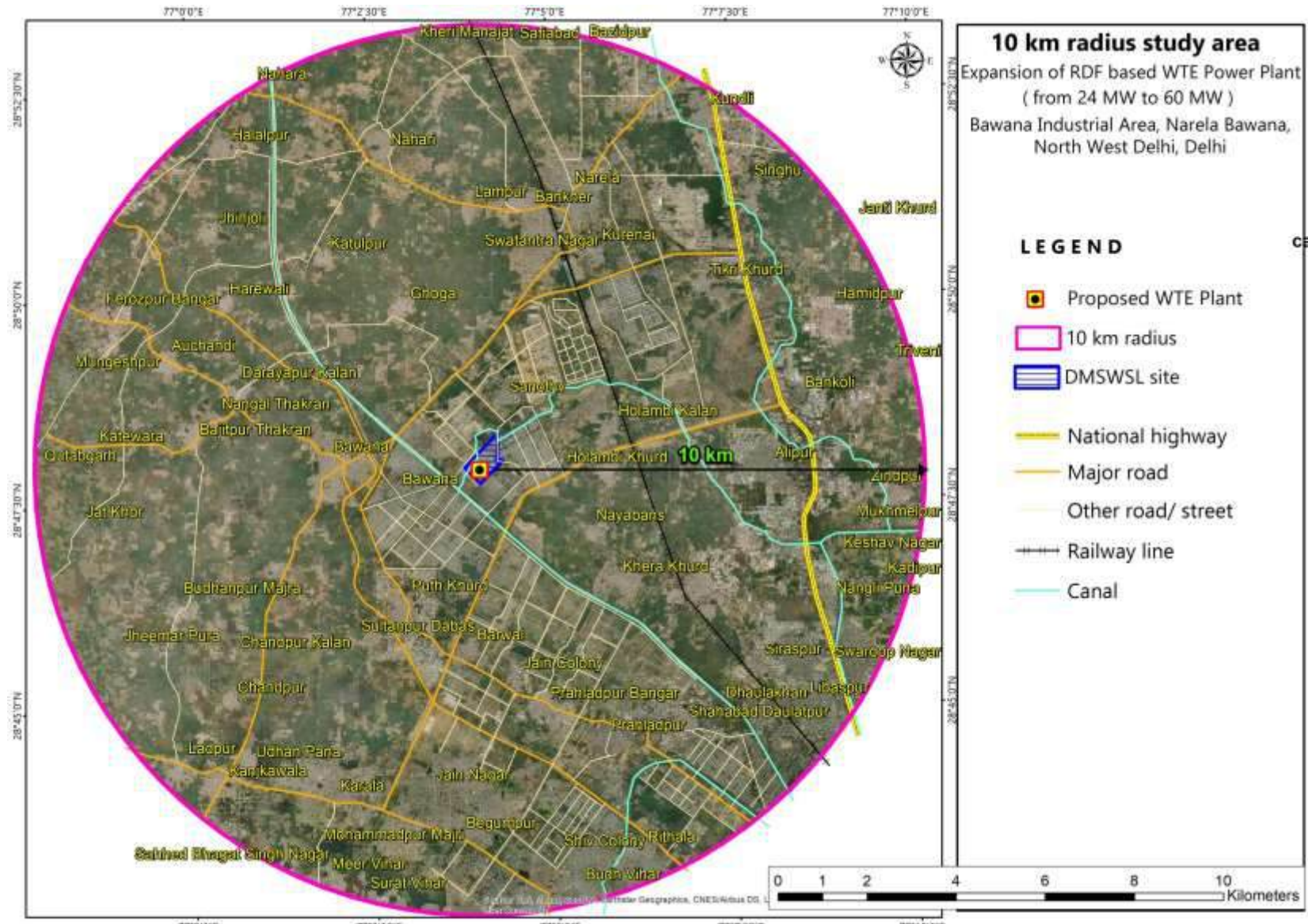
Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Figure 2.3: Location map of the site



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Figure 2.4: Google image (10 km radius)



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Figure 2.5: Layout of waste to energy plant



2.6 Size or magnitude of operation (incl. associated activities required by or for the project)

The proposal is for expansion of Existing Waste to Energy power plant. The existing capacity of the operating power plant is 24 MW (**CFO obtained on 20.02.2017**) to proposed expansion to 60 MW by adding another 36 MW WTE power plant adjacent to the existing unit.

The proposed standalone expansion of WTE plant scheme for the DMSWSL, consists of three number of steam generators boilers with cumulative capacity of 190 TPH and capable to burn 1800 TPD of Segregated MSW, with steam outlet parameters of 46 kg/cm² (a), 400 °C to 410 °C and one 36 MW extraction cum condensing turbo generator followed by Air Cooled Condenser (ACC).

The details about the waste to energy power plant are given in **Table 2.4** and RDF composition details is given in **Table 2.5**.

Table 2.4: Power Plant Details

RDF Power Plant capacity and Power output	Setting up of another unit 36 MW adjacent to the present 24 MW unit cumulatively totalling to 60 MW
Plant load factor (PLF)	75% to 85%
Number of Boiler to be installed	Three
Cumulative capacity of boiler	195 TPH and capable to burn 1800 TPD of Segregated MSW with reciprocating/step Grate type boiler
Operating Parameters of Boilers	Steam Temperature 410+/-5 °C Steam pressure:46 kg/Sq.m
Number of Steam Turbine Generators	One 36 MW turbo generator, (to be decided in detailed engineering)
Type and Capacity of STG	Bleed cum condensing extraction type
Total Power Generation (MW)- Installed	Existing 24 MW Proposed 36 MW Cumulatively 60 MW
Condenser	Air Cooled Condenser
Auxiliary power consumption (15%)	15% of the total power generation (3.6 MW + 5.4 MW = 9.0 MW)
Saleable Power to Grid	51 MW
Main Fuel used in the power plant	Pre-sorted MSW/RDF
Auxiliary fuel used in the plant	During commissioning 300 KL of LDO will be used. No auxiliary fuel will be used in the normal plant operations.

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Water requirement in Kl/day (Onetime demand)	Existing: 313 KLD, Proposed: 337 KLD Total: 650 KLD
Total Cost	Rs 900.1 Crore
*Note: The Project cost is increased due to GST Slab.	

Table 2.5: RDF Composition

S. No	Particulars	Values
1	Shape	Irregular
2	Size	>50mm
3	Bulk density	200 kg/m ³ - 350 kg/m ³
4	Moisture	Up to 40 %
5	Calorific value	1100 - 3400 kcal/kg
6	Ash	20 to 25%

2.6.1 Land Details of the Project

The area allocated for RDF based WTE power plant is 27.19 Acre (11.00 ha) out of the total area available for 100 Acre (40.46 ha) of IMSWMF. The detailed land breakup of IMSWMF facility total area 100 Acre (40.46 Ha) is given in **Table 2.6** with Land area of waste to energy plant area 27.19 Acre (11.00 Ha) is given in **Table 2.7**.

Table 2.6: Land Breakup (IMSWMF Facility)

Component	Land Area		
	Acres	Ha	%
MSW Processing facility (Landfill, storage area, treatment plant, etc.)	29.60	11.98	29.61
RDF based waste to energy power plant	27.19	11.00	27.19
Peripheral and internal roads	9.89	4.00	9.89
Greenbelt	33.32	13.48	33.31
Total	100.00	40.46	100

Table 2.7: Built-up area (Waste to Energy Power Plant)

Description	Land Area Acre	
	Existing	Proposed
Land demarcated for WTE	17.24 (6.97 Ha)	
WTE built up area	8.62 (3.49 Ha)	8.62 (3.49 Ha)
Greenbelt	Around 33 % of the (33.3 Acres/13.48 Ha) area in 100 Acres (40.46 Ha) of the total area of IMSWMF is developed as greenbelt	
Note: Total land area of WTE plant is 27.19 Acre (11.0 Ha)		

2.6.2 Manpower Requirement

Total manpower requirement of both existing and proposed WTE site is 475. Total 215 workers are appointed for existing WTE plant and additional 260 workers and technical staff will be required for expansion unit. Most of workers have appointed locally in the existing project. For expansion project also; preference will be given to local public. Manpower power bifurcation is tabulated below in **Table 2.8**.

Table 2.8: Manpower requirement

Sr. No.	Particular	Existing unit	Proposed Expansion unit
1	Plant Head	1	1
2	In charge-Operation	1	1
3	Shift In charge-	4	4
4	In charge- Account	3	3
5	Boiler Operators First and second class	16	22
6	FGCS operator	16	22
7	Ash Handling	16	22
8	Fuel Management	10	10
9	Grab operator	12	14
10	Incharge Electrical and Engineers	17	22
11	Incharge Mechanical and Engineers	17	22
12	Incharge C&I and engineers	17	22
13	All other technician and support staff (Chemists, and HR Admin)	45	45
14	Skilled manpower	40	50
Total		215	260

2.6.3 Water Requirement

Total water requirement for Existing project is 313 KLD. Total water requirement for the proposed expansion project is 337 KLD. The same will be sourced from Delhi Jal Board and Industrial Waste Water of adjacent Pragati Power Plant (**Agreement enclosed as Annexure-3**). The wastewater as liquid waste of 105 KLD will be generated which includes cooling tower blow down, boiler blow down and DM regeneration and Leachate. The generated leachate will be treated in the existing LTP, blow down water from ancillary cooling tower, boiler blow down and WTP Rejects will be collected neutralization tank and nutralised by adding neutralized agents then utilized in the bottom ash quenching and in Air Pollution Control Devices. Thus, facility will

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

achieve the zero-liquid discharge. Domestic water requirement is 15 KLD which is achieved by Municipal Water Supply. The domestic waste water generated from the proposed project will be sent to bio toilets and septic tank followed by soak pit. The detailed water requirement and wastewater generation breakup is given in **Table 2.9**. Water balance is shown in **Figure 2.6**.

Table 2.9: Water Requirement and Wastewater Generation

Utility	Water Requirement (KLD)			Wastewater generation (KLD)		Remarks
	Existing	Expansion	Total			
				Existing	Expansion	
Power Plant						
Boiler (WTP+DM plant)	183	257	440	95	95	Recycle / reuse for ash quenching, Flue gas cleaning
Auxiliary Cooling Tower	80	80	160	10	10	
Green Belt	50	-	50	-	-	-
Sub Total	313	337	650	105	105	-

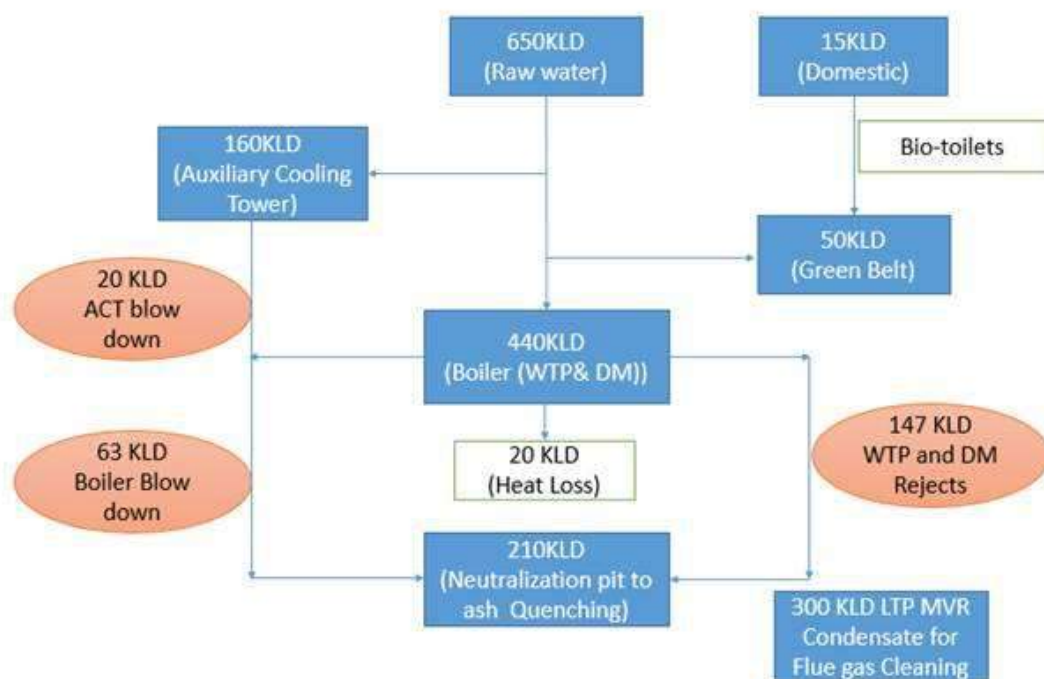
Source: Having agreement with PPCL for 350 KLD and permission from Delhi Jal board 1000 KLD

Note: PPCL agreement is expandable

Note: 1) Drinking water requirement is 15 KLD (source Municipal Supply), wastewater 13 KLD sent to bio toilets and septic tank followed by soak pit.

2) Leachate quantity is around 200 KLD treated in MVR

Figure 2.6: Water Balance



2.6.4 Power Requirement & Supply/ Source

The total power required for operations is approximately 5.4 MW and the same is met from existing WTE Plant of 24 MW capacity. Once the expansion power plant will be fully operational the power requirement will be met from the same plant and excess will be interconnected to substation of state grid.

2.6.5 Solar Power Generation

DMSWSL is proposing to harness solar energy through solar PV rooftop plant from the available roof surface within the site. Adequate area has been demarcated for installation of Solar Panel. Additionally; the panels will be installed all over the open to sky area, Street poles, above admin building etc.

2.6.6 Transport and Parking facilities

For efficient movement of vehicles inside the facility roads will be developed with required width of smooth turning as per NBC 2016. Efficient parking facilities will be provided inside the plant premises to avoid the traffic congestion. As this is expansion project of WTE plant within the integrated waste management facility; common parking has been also project for easy movement of vehicles.

2.7 MSW segregation, characterization and the process description

The RDF for the proposed expansion is received from the Existing MSW Processing Facility which has the capacity of 4000 TPD. The segregation process as follows. The normal municipal waste after coming from weighbridge unloaded at receiving platform called Tipping Floor and manually sorted the recyclables and boulders. After the manually shorting, the MSW is sent to pre-sorting trommels (which the trammel has 50 mm sieve size) where recyclables are handpicked and the rest of the waste segregated in to Compostable and Combustibles. Compostable waste sent to windrow management for aerobic composting, Combustibles are being carted to WTE Plant through trucks. The photograph of weigh-bridge is shown as **Figure 2.7**.

Figure 2.7: View of weigh-bridge

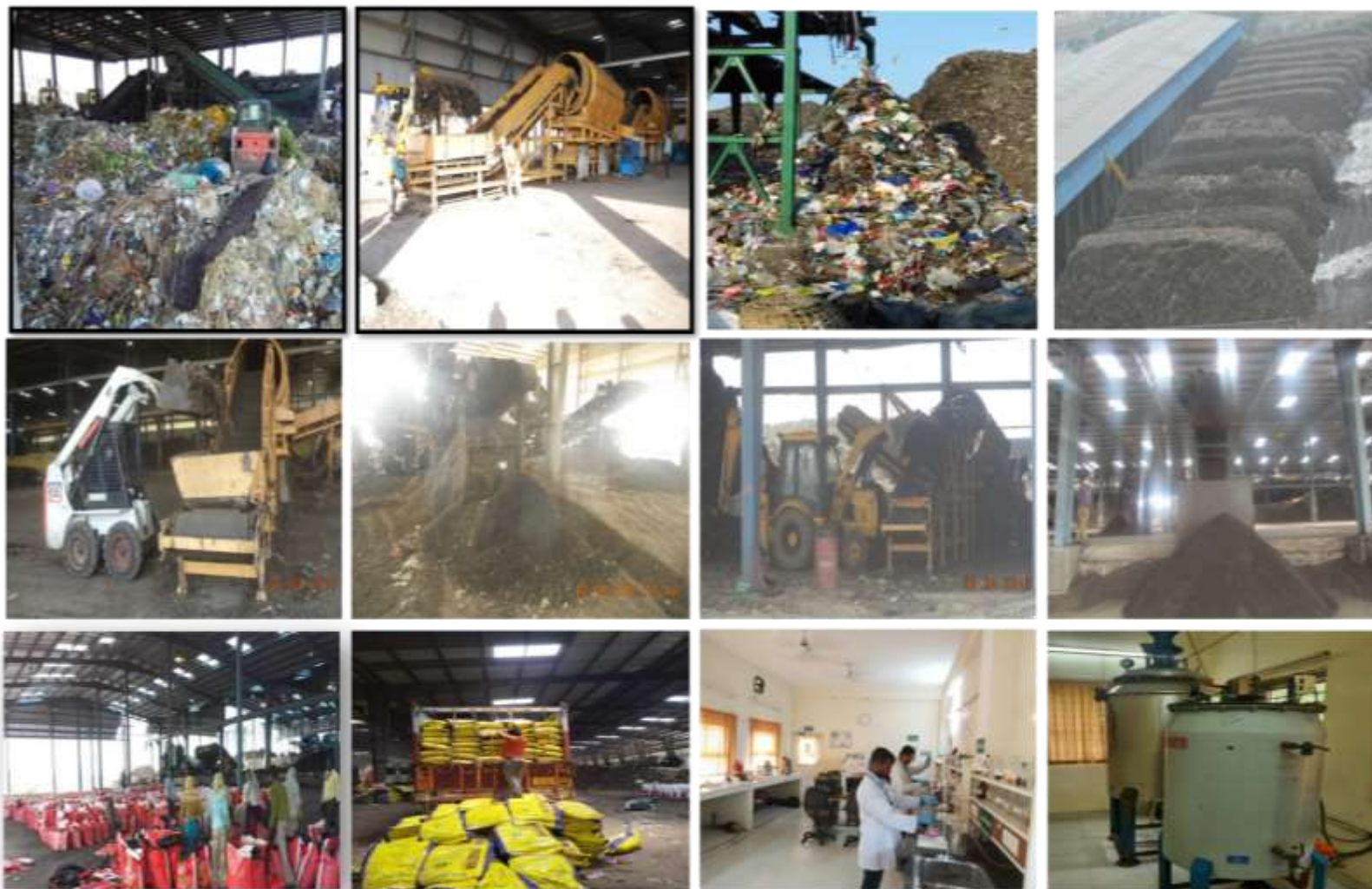


The recyclable (viz. plastic, paper, cloth, metals, rubber, glass, etc.) are segregated into saleable/recyclable and the same are sent to recyclable complex for further treatment to convert into value added product or disposed. The waste received at compost plant is sent to windrow platform where it is converted into manure by adding the bio enzymes to enhance the aerobic composting. After the degradation of the compostable material sent to second course segregation section. Here, the trommel have 20 mm sieve size. The compostable mater will pass through the <20 mm size material will be sent to further segregation process called fine segregation, >20 mm size material is a reject material which have more inert content and not suitable for further process and same is disposed in the secured landfill.

Material >20 mm from the course segregation unit is sent to fine segregation units, here, the trommel have 4 mm size sieve, which is the standard of Fertilizer Control Order 1985. 4 mm material is the final product called as Organic Manure. The final product is blended with additive and packed for marketing. The stage wise processing images are shown in the **Figure: 2.8**

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Figure 2.8: Stagewise processeing of MSW



2.8 Laboratory

DMSWSL has developed a State of Art Laboratory to quality control laboratory. The following work is being carried out in the laboratory. Analysis of air samples for ambient air quality and from industrial sources for both routine and industry specific pollutants; Water and waste water analysis for all parameters as per standard methods including pesticides and poly hydro carbons; Solid and hazardous waste analysis including TCLP tests; Monitoring of noise levels at source and in ambient air; Development of new methods and quality assurances of results obtained; Design and settings of analytical laboratories; the Photos of the laboratory are already shown above.

2.9 MSW characteristics

Domestic solid waste management is one of the essential obligatory functions of the institution and urban local bodies. The municipal solid waste mainly contains recyclable (Paper, plastic, glass, Wood, Metals etc.) toxic substances (Paints, Pesticides, used batteries, Medicines) Compostable organic matter (Fruits and vegetable peels, food waste) and other waste (Blood strained cotton, sanitary napkins, disposable syringes).

The sampling procedure followed were as per the guidelines described in ASTM ii – D523L92 sample from vehicles unloading solid waste form the commercial and households and dump sites are collected for detailed characterization. The samples were collected using Quartile method to understand the waste composition.

2.9.1 Physical characterization of municipal solid waste

Determination of the physical composition of MSW is important to identify the suitable technology for implementation of effective waste management system. The MSW samples collected were analyzed on wet-weight basis and segregated into their components. The segregated components include Paper, Polythene, Plastic, Clothes, Rags, Textiles, Organic/Vegetables/Plant waste, Rubber material, Glass, Other mixed constituents like Clothing, Toys, Sanitary items, Metals, Inert, etc.

The composition of solid waste from Municipal Corporation Delhi (MCD) area varies from zone to zone due to different activities in each zone. In general, the MSW waste composition received in DMSWSL site are mainly Food waste, Paper and Cardboard, Plastic, Wood and rest will be Metal and Other garden trimming etc. including dust. The biodegradable waste mainly from the residential area in commercial residence above as the non- biodegradable waste mainly comprises of Plastic, Glass, Leather, Wood and Metals. The typical characterization of municipal solid waste received at IMSWMF and as per CPHEEO is given in **Table 2.10**.

Table 2.10: MSW composition

S. No	Description of the content	At IMSWMF#	As per CPHEEO##
		Weight (%)	
1	Easy to degrade garden waste	55.90	47.4
	Food waste + vegetables waste	1.88	
2	Paper	2.14	8.1
3	Wooden material (hard to degrade)	1.63	4.0
4	Coconuts	7.62	
5	Cloths	7.44	4.4
6	Leather	0.47	
7	Plastic: PP	0.53	9.2
	PET	0.18	
	Low grade plastic covers	16.56	
	HDPE	0.86	
	LDPE	1.90	
8	Iron (metal)	0.14	0.5
9	Stones	1.97	25.1
10	Ceramic glass	0.83	1.0
	Total	100	
Note: # As per actuals ## Swachh Bharat Mission, Municipal Solid Waste Management Manual, Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development, 2016			

2.9.2 RDF characteristics

The ultimate analysis of municipal solid waste generated in MCD region is typically involves the determination of percentage of C (Carbon), H (Hydrogen), O (Oxygen), N (Nitrogen), S (Sulphur) and Ash. The ultimate analysis of the waste received at the site are performed based on the relative composition of various components at the source for waste generation areas. The ultimate analysis of MSW (RDF) such as CHONS composition details are given in **Table 2.11**.

In view of the past operational experience, increase in the population, awareness among the people about Swachh Bharat, improved collection efficiency and expansion of the municipality by incorporating nearby villages, there will be increase in municipal solid waste generation. The waste composition is fast changing and the combustible is increasing with recovery of high RDF with greater potential for WTE generation.

Table 2.11: Ultimate analysis of processed MSW (RDF) – CHONS

Ultimate Analysis of MSW (%) at IMSWMF		
Parameter	June 2022	July 2022
Carbon	32.78 – 35.24	29.54 – 30.32
Hydrogen	7.48 – 9.62	7.58 – 9.28
Oxygen	11.25 – 15.91	11.18 – 14.64
Moisture	21.18 – 21.53	20.58 – 22.34
Sulphur	0.24 - 0.35	0.27 - 0.32
Ash	28.62 – 31.77	28.48 – 31.35
Nitrogen	1.49 – 1.94	1.34 – 1.86

2.10 Waste to Energy (WTE) Process description

Waste-to-energy (WTE) or energy-from-waste (EFW) in its strictest sense refers to any waste treatment that creates energy in the form of electricity or heat from a waste source that would have been disposed of in landfill. In a WTE plant, biodegradable as well as non –biodegradable components of MSW are combusted at high temperatures. The heat of combustion is used to produce steam that drives a generator of electricity. A WTE plant that provides net electricity output to utilities is equivalent to a saving of fossil fuels.

The proposed expansion of RDF based power plant consists of two to three number of steam generators cumulatively capable to burn 1800 TPD of segregated MSW with super heater steam outlet parameters of 46 kg/cm², 400°C and one 36 MW extraction cum condensing turbo generator.

The turbo generator capacity is arrived based on the actual steam quantity available to generate power, with required margins to take care of the Valve Wide Open (VWO) conditions of the turbo generator and to meet various operating and upset conditions of the power plant. The steam generator is equipped with complete required system like air and flue gas system, fuel and ash system, feed water and steam system, dust collection system, soot blower system, steam and water analysis system, boiler draft system, instrument air system, electrical system, instrumentation and control system, etc.

Each turbine will be a single bleed cum condensing machine. The steam required for the de-aerator is taken from the bleed of the turbine. Air cooled condenser (ACC) is identified as the condensing equipment. Steam required for the ejector and gland sealing is about 350 kg/h at 10.0 kg/cm², is taken from live steam line through pressure reducing & de-super heating station (PRDS).

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

The power plant cycle will be provided with a de-aerator serving the dual purpose of de-aerating the feed water as well as heating the feed water with the bleed steam drawn through the turbine. The de-aerator considered is a floating pressure type. The feed water management program shall ensure the supply of good quality makeup water to the system. In the proposed power cycle, from the steam supplied to the turbine, about 98% will come back as the condensate from the ACC to the steam generator, through the feed water heating system (de-aerator). The complete make up water required for the plant operation will be obtained from Delhi Jal Board and Pragati Power Corporation Limited (PPCL).

Makeup water of required quality is considered from the water treatment plant. The makeup for the cycle will be added in the condensate hot well and the quantity of makeup will be controlled by the hot well level control system. Well-engineered Fuel feeding and ash handling system is considered for this project.

The power generation will be at 11 kV level and exporting at 66 kV level. After meeting the power plant internal consumption, the remaining power will be stepped up by a step-up transformer and exported to the state grid. The complete plant instrumentation and control system for power plant shall be based on distributed controlled system (DCS) philosophy, covering the total functioning requirements of measuring, monitoring, alarming and controlling, logging, sequence interlocks and equipment protection etc.

2.10.1 Fuel, its properties and technology selection

RDF is highly heterogeneous and percentage of its constituents varies widely depending on the source. Further seasonal changes also contribute to the higher level of heterogeneity in MSW. To assess the suitability of any technology for processing MSW, it is very important to broadly analyze the composition and the weight fraction of each of the constituents with reference to different sources of its generation.

The MSW includes, garbage-organic material discarded or waste generated as a result of the storage, preparation and consumption of food, rubbish, paper, wood, glass, metal, leaves, and debris-construction and demolition of structures mainly generated from vegetable markets, hotels, community halls, street sweepings and residential areas. Composition of MSW differs widely from place to place.

The difference in organic content in MSW which is much higher in the low-income areas than the high income, while the paper and plastic content is much higher in high income areas than low income areas. This reflects the difference in consumption pattern, cultural and educational differences.

During the last 10 years, life and consumption styles have remarkably modified the composition of MSW. The quantity of organic waste has decreased, while packaging-related waste has increased (as of now it is about 40 % of the total). Such a massive presence of packaging material, like plastic, paper, cardboard – all of which have high energy contents – has progressively raised the overall heating value of MSW.

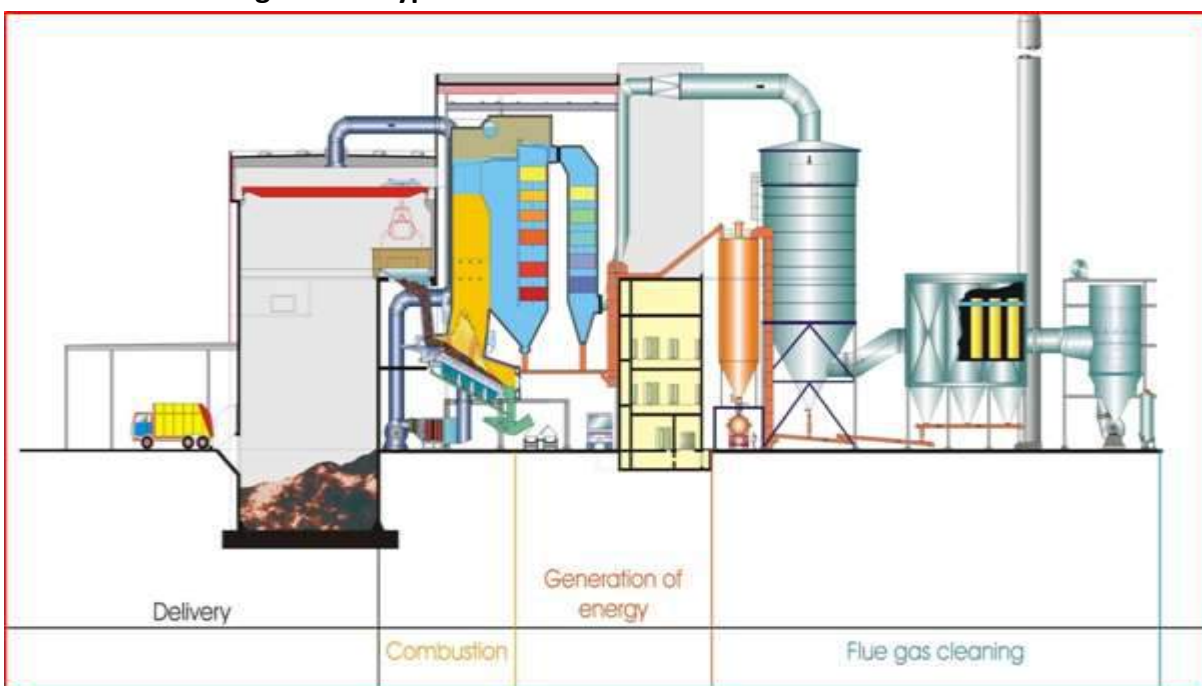
MSW collected from different sources has different Gross Calorific Values (GCV). The GCV varies from 1500 to 2800 kcal/kg (the corresponding Lower Calorific Value (LCV) varies from 1200 to 2250 kcal/kg). However, after mixing in the MSW pit, the MSW possesses an average lower calorific value of 1724 kcal/kg.

2.10.2 Combustion

Combustion technology is the controlled combustion of RDF with the recovery of heat to produce steam that in turn produces power through steam turbines. Combustion process needs sufficient quantity of air for complete combustion of the incoming RDF to generate heat energy. Incineration of RDF allows huge savings at the landfill as the volume of RDF is reduced almost to 20% in the form of ashes and slag as compared to the original RDF volume.

In waste to energy (WTE) plants based on combustion, the entire energy contents of RDF is recovered, except the unavoidable fraction that is lost through the flue gas, cooling devices, boiler walls and ash. The direct combustion of RDF releases more available energy compared to pyrolysis and gasification. In view of worldwide experience of WTE plants, European Union (EU) has 400 units, Japan has 100 units, USA has 87 units and China has around 400 units. From the above it is evident that the energy recovery from RDF through Combustion is a proven technology. Most importantly, RDF combustors have to be designed for a higher value than present in order to achieve the objective of disposal of MSW. Considering all the above, combustion of RDF to produce power will be the option for this project. The typical view of an RDF fired boiler & auxiliaries is shown in **Figure 2.9**.

Figure 2.9: Typical view of a RDF fired boiler & Auxiliaries



2.11 The Power Plant Scheme

2.11.1 Steam cycle for the power plant and selection of boiler

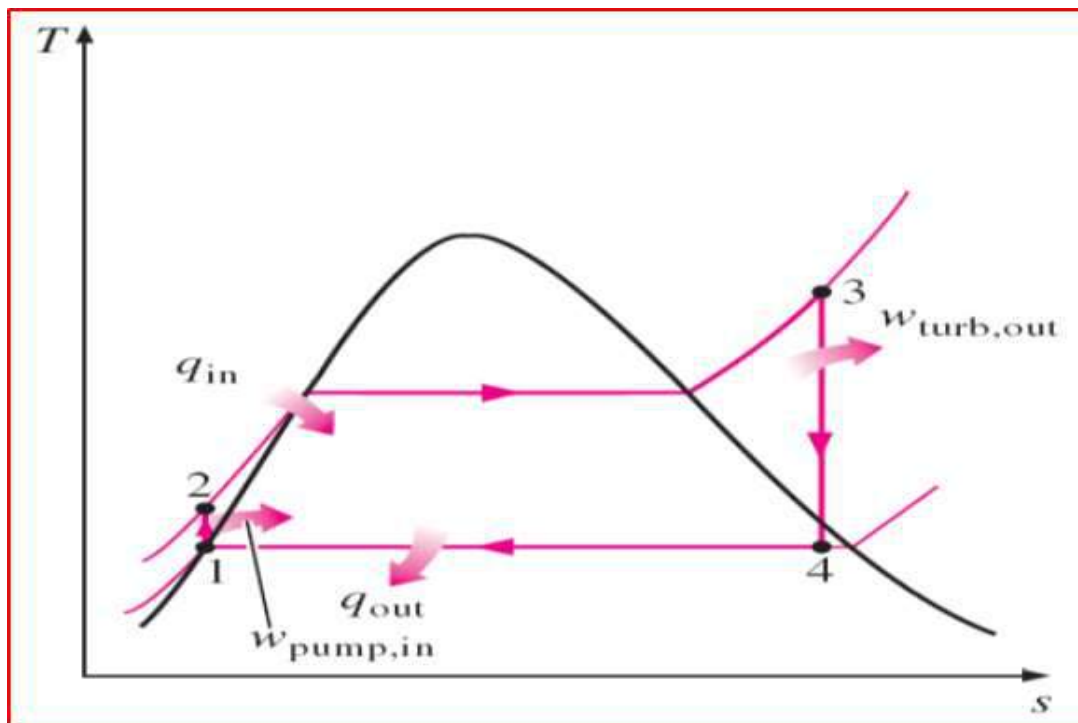
The steam cycle defines the transformation of the heat energy to the mechanical energy at the turbine shaft, through the various thermodynamic processes that is capable of producing the net heat flow or work when placed between the energy source and energy sink. The heat energy is derived from burning of some fuels or using heat energy already available in the hot waste gases. The cycle needs a working fluid and steam is considered for the same. Steam is viewed as the most favoured working fluid mainly because of its unique combination of high thermal capacity, high critical temperature, high latent heat, excellent heat transfer characteristics, and wide availability at cheaper cost, non-toxic and non-corrosive nature.

All the steam-based power plants operate under the Rankine Cycle. In simple terms the Rankine Cycle is described as the combination of the various processes like the isentropic compression of water in the boiler feed water pumps (1 to 2), reversible heat addition to the working fluid (2 to 3) through the liquid, two phase and super heat states, isentropic expansion of the working medium in the turbine (3 to 4) and the constant pressure heat rejection to the atmosphere (4 to 1) through the condenser. Simple Rankine Cycle is shown as **Figure 2.10**.

The cycle to be adopted for this project will be a modified Rankine Cycle with the addition of a Regenerative feed water heating. Reciprocating step grate is widely used in various countries and is a proven technology for burning pre-sorted MSW. The proposed MSW based power plant

shall be designed to burn the pre-sorted MSW in the boiler. Bulky objects present in the MSW are removed during the pre-sorting process.

Figure 2.10: Simple Rankine Cycle



2.11.2 Selection of turbo-generator for the power plant

Steam turbines are broadly classified in to condensing steam turbines and non-condensing steam turbines. The non-condensing steam turbines are also called as back pressure turbines. In the power generation application, generally condensing steam turbines are widely used. The condensing steam turbine is designed to operate with the exhaust pressure below the atmospheric pressure (Vacuum pressure).

The high-pressure condensing steam turbines for power generation application are broadly classified as Regenerative type steam turbine and Reheat type steam turbines. Regenerative turbines are widely used and well proven in the power and process industries for the capacity ranging from 10 MW to 100 MW. Reheat turbines are generally used for a capacity more than 100 MW range.

For the capacity under consideration, and the experience of the turbine vendors in the Indian market, Regenerative type steam turbine is selected for this project. The turbine selected will be double bleed cum condensing machine. The steam required for the de-aerator and SCAP will be taken from the bleed of the turbine.

Figure 2.11: Typical Arrangement of Steam Turbine



2.11.3 Air Pollution Control System

Flue gas treatment system

Flue gas treatment, a process designed to reduce the amount of pollutants emitted from the burning of fossil fuels at an industrial facility, a power plant, or another source. Flue gas the emitted material produced when fossil fuels such as coal, oil, natural gas, or wood are burned for heat or power may contain pollutants such as particulates, sulphur dioxide, mercury, and carbon dioxide. Most flue gas, however, consists of nitrogen oxides. If left untreated, flue gas from power plants, industrial facilities, and other sources can substantially affect local and regional air quality.

The flue gas treatment system is an integral and crucial component of a modern municipal waste combustable plant. The state-of-the-art technology being installed by DMSWSL in the expansion of WTE unit for flue gas treatment covers the absorption of acidic components such as HCl, HF and SO_x and removal of dioxins, furans and heavy metals by adsorption. The filtration of dust particles is also part of this process through a bag filter. The bag filters elements are mechanical barriers for the dust and so they ensure the lowest possible emissions.

Process schemes of flue gas treatment systems

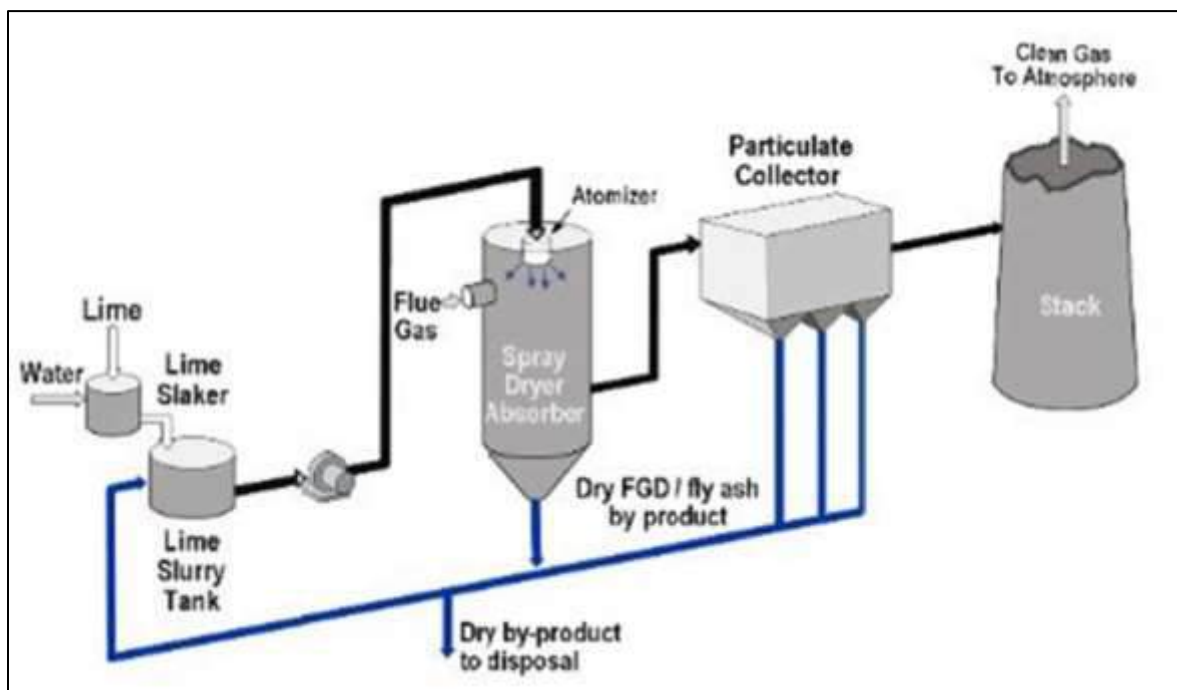
The flue gas shall be led into reaction tower through spiral-cased flue duct (also called flue gas distributor). The best de-acidification temperature is about $210\sim 220^{\circ}\text{C}$. This temperature could be lower down to $180\sim 240^{\circ}\text{C}$ which is the best de-acidification temperature by means of flue gas duct. Therefore, the best de-acidification efficiency could be reached. This de-acidification reaction tower shall adopt semi-dry type rotation atomizer, the design philosophy is using absorbent to neutralize acid gases in flue gases.

After the neutralization reaction and evaporation drying, reaction products shall settle to the bottom of tower for discharging out, the fine dust particles shall flow out of absorbing tower along with flue gas. The temperature of flue gas shall drop down to $150\text{-}160^{\circ}\text{C}$ then be exhausted. The design of de-acidification tower shall ensure the reaction covers overall tower section. The designed residence time of flue gas inside tower shall be adequate for the reaction between flue gas and absorbent / serous fluid. Due to the working temperature of de-acidification reaction tower is 240°C and the stay time of flue gas inside tower is very short, there will be no corrosion on tower structure. The upper part of reaction tower is cylindrical and the lower part is invert cone structure. The diameter of shell is approx.10000 mm, the height is approx.13000 mm and the cone angle of invert cone is above 55°C . In order to ensure the deposited fly ash to be dry particulate matter, two sets of electric heating system shall be equipped at the bottom of reaction tower. The whole outer surface of tower shall be insulated. There are pneumatic hammer and crusher at the bottom of reaction tower to avoid the bonding and blocking of reaction products/fly ash. The rotating ash discharge valve and scratch board conveyer which located at the bottom of reaction tower used for ash discharging and collecting shall be also equipped with electric heating system. A set of drainage and blow down filter device shall be mounted on the top platform of reaction tower.

These solid products along with excess lime carried by gases from the reactor into the bag house at reduced temp. A certain amount of the chemical reactions that take place happen in the dust layer that builds up on the filter fabric called the filter cake, so the filter media is, of course, a key component. The performance of the filter media influences the function of the entire plant, as it is the only barrier for solid particles in the gas stream. At the injection point (e.g. for hydrated lime) the particles are accelerated by the flue gas. During this acceleration the absorption rate is high. This increases the speed of neutralization reactions. Depending on turbulence the rate of reaction can go back until the particle ends up in the filter cake of the filter media. There it forms a kind of fixed bed reactor, and again the rate of reaction is increased as the entire gas flow is forced to pass this fixed bed of reactive particles. As these are usually fine dust particles they have to be collected by using a bag filter unit. By using mixture of hydrated lime and activated carbon, not just absorption but also removal of dioxins, furans and

heavy metals by adsorption takes place on the filter media. View of Flue Gas Treatment System is shown below in **Figure 2.12**.

Figure 2.12: Flue Gas Treatment System



2.11.4 Effluent Treatment Plan

Mechanical Vapour low temperature evaporator (LTE) is essentially an evaporation process designed to reduce water volumes by recovering most of the water in the solution. The recovered water is of good quality and can be recycled and reused in plant. Waste water treatment through MVR is based on evaporation without use of steam. On progressive lowering of pressure in LTE, water starts boiling and subsequently generation of vapours. Generated vapours compressed through MVR technique and recycled as heating medium. It is based on principal of heat recycling without any addition or blowdown of heat. Over time, the concentrated waste/product reaches a saturation point and must be discharged for waste disposal. Dehydration of solution in low temperature evaporator is a very efficient process. In this technology mechanical vapour recompressions raises the vapour temperature and pressure, recirculate it as heating medium.

Mechanical vapor recompression (MVR) is an energy recovery process. It involves taking vapor (usually water vapor) at certain pressure and adding energy to it by compression. The result is a smaller volume of vapor, at a higher temperature and pressure, which can be used to do useful work. During mechanical vapor recompression, the vapor of an evaporator is recompressed to

a higher pressure by means of a mechanically driven compressor. The recompression, therefore also operates as heat pump. A full assembly of Spray low temperature evaporator consists of LTE chambers, plate type heat exchanger (PHE), direct contact heater (DCH) and a concentrator. The efficiency and performance of this system has a major impact on environment. Initially start the vacuum pump and maintain a required vacuum in calandria of evaporator. Solution from PHE is fed into the DCH and then from DCH to evaporator by distributor. Now, system will start to generate vapor and this vapor will send to the MVR booster/fan which is mounted on the top of the concentrator. After certain level of condensate in condensate tank, pass it through the PHE with the help of pump where condensate transfers sensible heat to inlet solution. In this way, solution temperature rises. NCG from concentrator sent through DCH to vacuum pump so that NCG losses its sensible heat to incoming feed in DCH and also many volatiles got removed from the DCH. So, there is no heat wastage, system uses its own heat and serving its purpose very well.

Benefit of MVR process

The main benefit of vapor compression is that it allows for significant energy savings. Mechanical vapor compression, unlike the alternative thermal vapor compression, does not require an additional steam supply. And since no fluid mixing occurs, all of the available vapor can be compressed for energy recovery. This method is ideally suited for systems operating on a low temperature difference such as many evaporation plants; in these applications, heat exchangers with a large heat transfer area can be employed to maximize energy recovery. The energy-saving potential of mechanical vapor recompression is especially significant when compared to the energy required to generate new steam. In fact, it is not uncommon for multi-effect evaporators to be fitted with mechanical vapor recompression processes. Even for multi-effect systems in which the vapor from the last effect is condensed in the first-effect heat exchanger, mechanical vapor recompression can be very economical.

Working Principle

Mechanical vapor compression is positive displacement compressors, single stage or multi stage centrifugal compressors used to raise the pressure and temperature of the generated vapour and recirculate it as heating media to the evaporator system. Compression ratio must be seen from commercial perspective. Increase of energy costs must justify on comparing prevalent alternatives of evaporation along with user and environment friendly.

The principle is simple. Vapor from an evaporator is compressed (with a positive-displacement, centrifugal or axial-flow compressor) to a higher pressure (upgradation of heat value) so that it can be condensed in the heat exchanger of same evaporator which has generated. Mechanical

recompression works best in a system with low boiling point elevation and where larger heat transfer surfaces can be used to lower the differential temperatures in the heat exchanger. MVR evaporator operates on a “heat pump” principle. The evaporated water vapor is recompressed with a simple, low speed centrifugal fan or compressor. The fan increases the saturation temperature of the vapour. After the fan, vapor can be used as heating media in the same unit. The recompressed vapor condenses and releases its latent heat through the heat transfer surface for further evaporation of the effluent. An MVR evaporator is also called a Vapor Compression Evaporator (VCE). Process of MVR evaporator is shown in **Figure 2.13** and photos of MVR evaporator unit is shown in **Figure 2.14**.

Process description

- Process wastewater is fed by the feed pump through the feedstock heat exchanger and into the circulating stream. The feedstock heat exchanger is used to heat the wastewater by transferring sensible heat from the hot condensate to the cooler feed.
- The recirculation pump circulates wastewater from the separation tank through the main heat exchanger, to the orifice plate, and back into the separation tank. The latent heat from the compressed vapor is transferred to the wastewater via the main heat exchanger.
- An orifice plate is used to reduce the pressure of the circulating stream. The downstream pressure is low enough to allow flashing of the circulating stream into liquid and vapor components.
- The liquid and vapor then flow to the separation tank where they are separated. The liquid steam exits the tank at the bottom and flows back to the recirculation pump. The vapor stream exits the tank at the top and flows to the vapor compressor(s).
- A mist pad is provided at the top of the separation tank to remove small droplets of liquid from the vapor.
- The vapor compressor compresses the vapor (raising the temperature and pressure), and sends the vapor to the main heat exchanger, where it transfers its latent heat to the wastewater in the recirculation loop.
- High temperature condensate exits the main heat exchanger and flows to the condensate tank, where any remaining vapor is separated. The hot condensate is then pumped to the feedstock heat exchanger, where it transfers sensible heat to the incoming feed wastewater.
- Upon reaching steady-state at the target concentration, the concentrated wastewater is purged from the recirculation loop, using the residue valve. Depending on the energy balance, energy can be added to the system by electric heaters / process steam or excess energy can be removed from the system by the steam relief valve.

Figure 2.13: Process flow of MVR evaporator (Vapor Compression Evaporator)

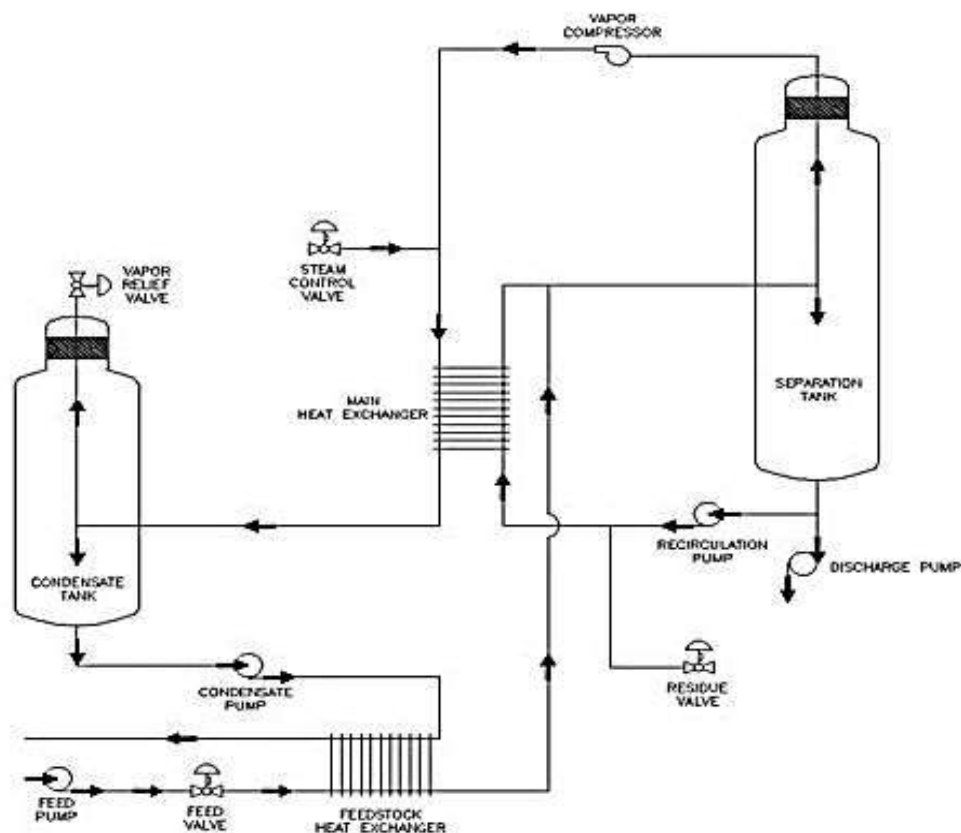


Figure 2.14: Photos of the MVR



2.12 Ash Recycling Unit

About 450 TPD of Ash will be cumulatively generated from Existing and Proposed Waste to Energy Plant. To recycle these ash DMSWSL has established a state of art ash recycling plant with capacity of 30 TPH. The output of the products are as follows:

- Aggregate (8-20 mm)
- Coarse sand (3-8 mm)
- Fine sand (1-3 mm)
- Silt
- Large objects (> 40 mm, rags)

2.12.1 Process and flowchart

Generated bottom ash will be carted to the receiving platform of the ash recycling unit. The material will be feeded in to the primary segregation unit which has grizzly screen whereas the material will be crushed into different sizes. Here the large objects also be removed. The crushed material goes in to further segregation, i.e. 20-40 mm size, 8-20mm size and >8 mm size. The 20-40 mm material goes to cone crushing unit to come down to 8 -20 mm size. Below 8mm material will be washed with water to making it to slurry, that slurry goes in to sand washer. After washing the 8mm material will be collected as coarse and fine sand as per market requirement. The leftover silt will be used as landfill cover. The process flow chart is shown in **Figure 2.15**. Washing of crushed output using spay jets and screening using two-part screening. Dewatering screening for +3 mm separation and secondary screening through Hydro cyclone for recovery of -3mm fraction and removal of slurry (0.75 mm) overflow. The overflow slurry is taken into clarifier to recover water and then to sludge tank after dosing of polymer for easy settling of sludge. The output of the product is shown in **Figure 2.16**.

Figure 2.15: Process flow of Ash recycling plant

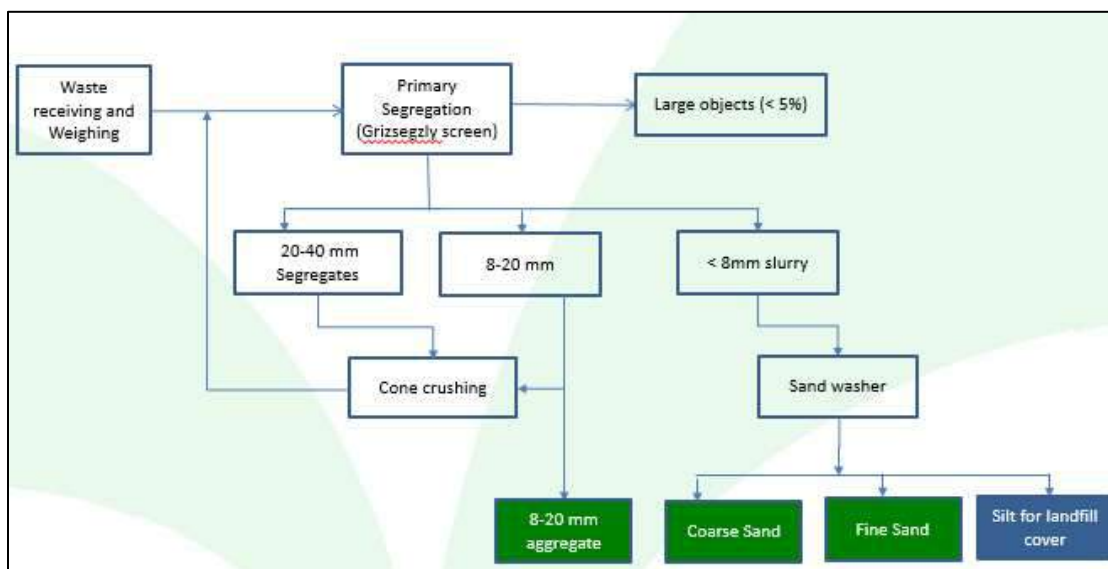


Figure 2.16: Output of Ash recycling plant



CHAPTER 3

DESCRIPTION OF THE ENVIRONMENT

Chapter 3

Description of the Environment

3.1 Introduction

Baseline environmental status in and around the proposed expansion of WTE project site depicts the existing environmental conditions of Air, Noise, Water, Soil, Biological and Socio-economic environment. Considering the proposed expansion project as the centre, a radial distance of 10 km is deemed as 'study area' for baseline data collection and environmental monitoring. Baseline data was collected for various environmental attributes so as to compute the impacts that are likely to arise due to the proposed expansion project.

The main aim of the baseline study is to identify the critical environmental attributes which will be affected due to the proposed expansion project and have adverse impacts on the surroundings. This study is carried out during the project planning stage itself, so that proper mitigation measures can be implemented in a technically, financially, and environmentally sound manner for sustainability on a long-term basis.

The study depends mainly on two factors. One is the estimation of the impact of proposed expansion project on the environment and the second is the assessment of the baseline environmental conditions. Both of these are key factors to arrive at the post project scenario. The scope of the baseline studies includes detailed characterization of the following environmental components, which are most likely to be influenced by setting up the proposed facility:

- Meteorological Conditions
- Ambient Air Quality
- Noise Levels
- Water Quality (Ground & Surface water)
- Soil Quality
- Biological Environment
- Land Environment
- Socio-Economic Environment
- Traffic movement and
- Other studies as per approved ToR

Study period

The baseline data for the project was earlier collected from Sep. 2019 to Nov. 2019 (Considering one non-monsoon season). Detailed analysis results of earlier data are enclosed as **Annexure-4**. Additional one-month baseline data (as per MOEFCC OM dated 08.06.2022) for the proposed expansion project was carried out during 23rd Sep. 2022 to 22nd Oct. 2022 from all the locations

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

selected during earlier monitoring for revalidation of the earlier data. The data is collected with respect to meteorological conditions, air pollution levels, noise levels, water quality, soil quality, land use, socio-economic conditions and ecology and biodiversity during the study period. Earlier data and recent data collected were compared to assess the variation and changes in environmental quality with due course of time.

3.2 Micrometeorology

The study of micrometeorological conditions of a particular region is of utmost importance to understand the variations in ambient air quality status in that region. The prevailing micrometeorology at project site plays a crucial role in transport and dispersion of air pollutants released from the project site. The persistence of predominant wind direction and wind speed will decide the direction and extent of air pollution impact zone. The principal variables which affect the micrometeorology are horizontal transport and dispersion (average wind speed and directions), convective transport and vertical mixing (atmospheric stability) and topography of the area towards local influences.

The micrometeorological data recorded in the study region as well as surface meteorological data procured from IMD corresponding to nearest available observatories are appropriately used in this study. Automatic Weather Station (AWS) is already installed at site. The hourly record of wind speed and wind direction during the study period was used for computing the relative percentage frequencies of wind occurrences in various directions. Secondary meteorological data from 1981 to 2010 is given in **Table 3.1** and from 2011 to 2021 is given in **Table 3.2**. The nearest IMD station of New Delhi Palam [Distance from site is 25 km (S)].

Table 3.1: IMD data of Delhi (1981-2010)

Nearest IMD Station is Delhi 25 Kms S from the site										
Month	Temperature °C				Humidity %		Rainfall		Mean Wind speed (m/s)	1 st pre-dominant direction
	Mean Min	Mean Max	Lowest	Highest	in	Max	Monthly mm	No of rainy Days		
Jan	7.3	20.4	3.6	25.8	53	86	18.4	1.4	1.43	W
Feb	10.2	24.1	5.7	29.4	44	79	20.0	1.7	1.68	W
Mar	15.1	29.9	9.3	36	34	66	13.2	1.4	1.93	W
Apr	21.4	37.1	15.1	42.5	23	45	9.1	1.0	2.13	W
May	26.0	40.3	20.4	45.0	26	44	37.7	2.6	2.27	W
Jun	27.7	39.9	22.1	44.9	40	56	82.1	4.0	2.35	W
Jul	27.0	35.9	23.5	40.8	61	75	174.4	8.6	1.96	E
Aug	26.2	34.4	23.2	38.3	66	79	188.7	8.3	1.71	W
Sep	24.7	34.7	21.3	38.2	56	74	106.3	4.6	1.65	W
Oct	19.5	33.4	14.9	36.7	41	65	13.7	0.9	1.23	NW
Nov	13.6	28.5	8.8	32.7	42	68	6.1	0.5	1.04	W
Dec	8.8	22.8	4.6	27.0	52	80	6.9	0.7	1.12	W

Source: GoI, Ministry of Earth Sciences, IMD, Climatological Tables 1981-2010

Table 3.2: Meteorological data (from 2011 to 2021)

Station: Delhi					
Month	Average Temperature (°C)		Average Humidity	Average Rain fall	No of rainy days
	Min	Max	(%)	mm	
Jan	12	23	52	19.5	1
Feb	14	26	49	21.5	2
Mar	20	34	33	17.6	1
Apr	28	40	19	13.5	1
May	33	44	18	15.6	1
Jun	34	43	27	47.5	2
Jul	31	38	53	187.1	7
Aug	29	36	61	181.5	9
Sep	28	36	57	122.1	5
Oct	27	36	35	5.5	0.6
Nov	21	31	31	4.4	0.4
Dec	15	25	36	4.9	0.5
<i>Source: World weather: Monthly average weather data for 2011 to 2021</i>					

During the study period, the winds were predominantly recorded from W to E. This was closely followed by WNW and NW directions. Calm conditions prevailed for 22.21 % of the total time and the average wind speed for the season was 2.26 m/s. A comparison between the observed meteorological data during study period and that obtained from the secondary meteorological data of IMD New Delhi Palam in terms of maximum and minimum temperature as well as relative humidity revealed that the data is consistent. The maximum and minimum temperatures, relative humidity recorded and predominant wind direction observed are given in **Table 3.3**. The frequency distribution table for the study period is given in **Table 3.4**. Monthly Wind rose diagrams and season diagrams are given in **Figure 3.1**.

Table 3.3: Observed meteorological data onsite

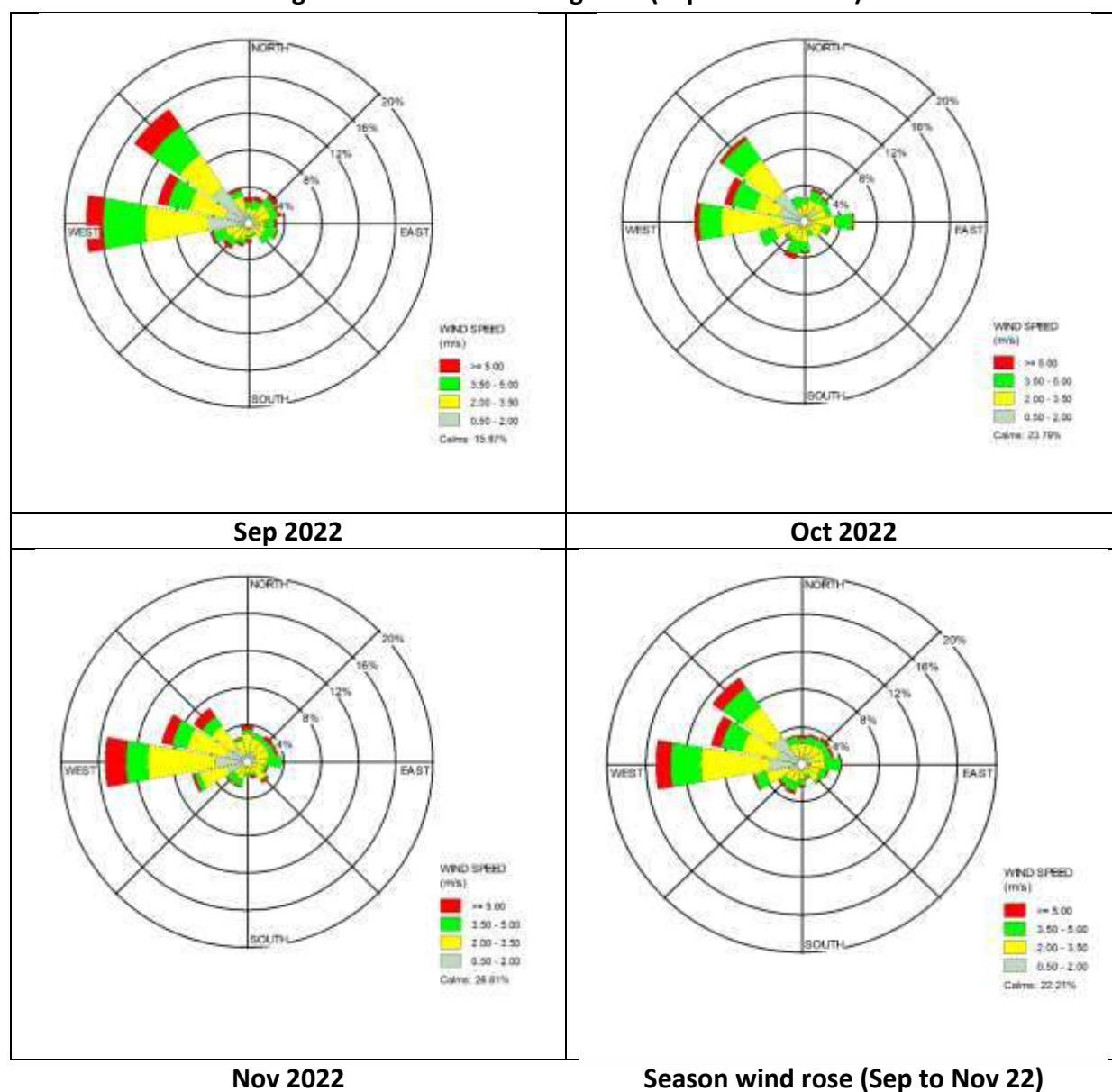
Period	Temp (°C)		Relative Humidity (%)		Predominant wind Direction
	Min	Max	Min	Max	
September 2022	20.3	37.8	52	85	W to E
October 2022	16.4	36.5	49	80	W to E
November 2022	12.1	34.9	50	82	W to E

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Table 3.4: Frequency distribution table (Sep to Oct 2022)

Wind directions	Wind classes (m/s)				Total
	0.5 - 2.0	2.0 - 3.5	3.5 - 5.0	> 5.0	
N	0.96	1.28	0.60	0.32	3.16
NNE	0.96	1.28	0.87	0.23	3.34
NE	1.33	1.19	0.73	0.32	3.57
ENE	0.73	1.79	0.69	0.23	3.43
E	0.96	1.47	1.60	0.14	4.17
ESE	0.82	1.19	0.73	0.14	2.88
SE	0.60	1.60	0.32	0.09	2.61
SSE	0.60	0.69	0.37	0.09	1.74
S	0.64	1.05	0.60	0.18	2.47
SSW	0.64	1.37	0.96	0.32	3.30
SW	0.73	1.33	0.73	0.23	3.02
WSW	1.47	2.34	1.19	0.18	5.17
W	3.43	6.91	3.11	1.51	14.97
WNW	2.66	3.66	2.20	1.01	9.52
NW	3.62	3.80	2.56	1.24	11.22
NNW	0.92	1.42	0.73	0.14	3.21
Sub-Total	21.06	32.37	17.99	6.36	77.79
Calms (<0.5 m/s)					22.21
Total					100
Note: 1. Average Wind Speed is 2.26 m/s 2. All values are in percentage					

Figure 3.1: Wind rose diagrams (Sep to Nov 2022)



3.3 Ambient air quality

The ambient air quality in the study area was monitored as per MOEFCC guidelines. The prime objective of the baseline air quality study is to assess the existing ambient air quality of the area with reference to conventional air pollutants.

3.3.1 Methodology adopted for the study

The baseline status of the ambient air quality has been assessed through a scientifically designed ambient air quality network. The design of monitoring network in the air quality surveillance programme has been made based on the following considerations:

- Topography of the study area
- Representation of regional background
- Populated and sensitive areas
- Screening of maximum ground level concentrations and distances of their likely occurrences as per climatologically normal
- Representation of valid cross-sectional distribution in downwind direction

Ambient air quality monitoring (AAQ) stations were installed at 8 different locations with due consideration to the above-mentioned points. AAQ locations were selected in downwind, cross wind and upwind direction of the proposed project location. The details of air quality monitoring stations are given in **Table 3.5**. The map showing ambient air quality monitoring locations is given in **Figure 3.2**.

Table 3.5: Details of ambient air quality monitoring stations

Code	Locations	W.R.T. Site		Latitude (N)	Longitude (E)	Criteria
		Distance (km)	Direction			
A1	Site	0.0	Core	28°47'54.9"	77° 03'46.8"	Core
A2	Bawana	1.0	W	28°47'56.9"	77°04'44.5"	Nearest village & Upwind
A3	Holambi khurd	3.0	E	28°47'49.4"	77°05'46.5"	DW
A4	Khera khurd	3.8	SE	28°46'26.3"	77°05'32.5"	DW
A5	Barwala	3.8	S	28°45'39.4"	77°03'38.5"	CW
A6	Ghoga	4.0	NW	28°49'41.1"	77°02'46.8"	CW
A7	Narela	5.8	NE	28°51'19.7"	77°05'40.5"	CW
A8	Chandpur khurd	6.8	SW	28°45'40.7"	77°00'32.8"	UW

Note: DW: Downwind, CW: Crosswind, UW: Upwind

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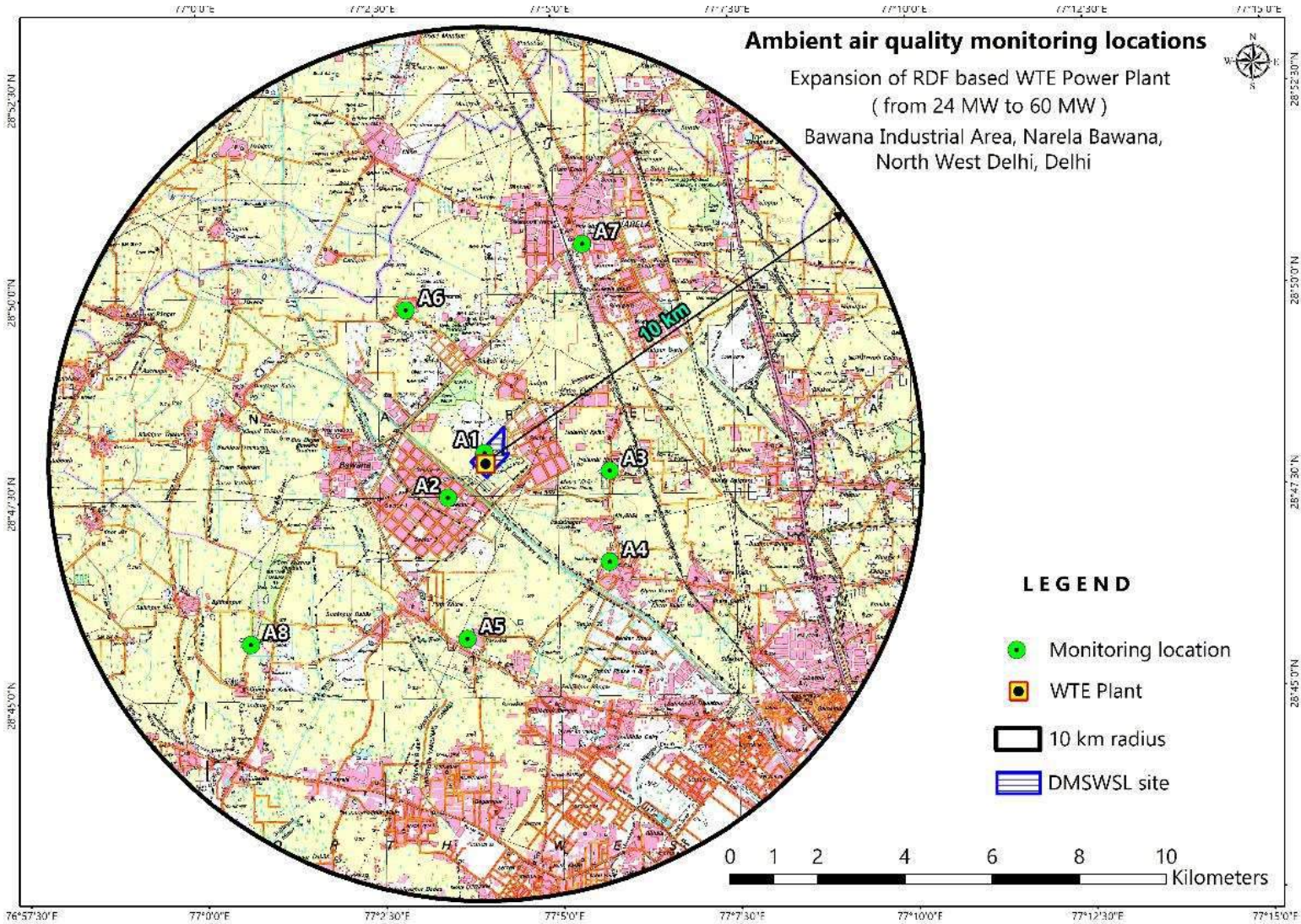


Figure 3.2: Ambient air quality monitoring stations

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Ambient air quality monitoring stations were selected on the basis of surface influence, demographic influence and meteorological influence. During the study period, monitoring was carried out for a frequency of 2 days per week for 4 weeks at each sampling station. The common air pollutants namely Particulate Matter (PM_{<2.5µm}, PM_{<10µm}), Sulfur dioxide (SO₂), Oxides of nitrogen (NO_x) and Ozone (O₃) were sampled on 8/24 hourly basis and the results were averaged to 24 hours. Carbon monoxide (CO), Benzene (C₆H₆) and Ammonia (NH₃) were monitored 2 days per week for 4 weeks during the study period to meet the requirements of MOEFCC and compared with the standards stipulated by CPCB. Other trace elements such as lead, arsenic, nickel and benzo(a)pyrene were also monitored. The log sheet of raw data for the above-mentioned parameters has been enclosed as **Annexure 4**. The ambient air quality results for all these pollutants during 23rd Sep 2022 to 22nd Oct, 2022 are presented in **Tables 3.6 to Table 3.10**.

Table 3.6: AAQ quality results for PM₁₀ & PM_{2.5} (µg/m³) - 23rd Sep to 22nd Oct, 2022

Location	PM10			PM2.5		
	Min	Max	98 th Percentile	Min	Max	98 th Percentile
Site	74.3	84.5	84.5	48.3	56.5	56.5
Bawana	168	212	212	104	132	132
Holambi khurd	140	162	162	75.7	110	110
Khera khurd	158	178	178	101	120	120
Barwala	150	168	168	78.3	104	104
Ghoga	105	132	132	62.3	78.4	78.4
Narela	115	170	170	76.5	98.6	98.6
Chandpur khurd	78.5	115	115	49.8	72.1	72.1
98th Percentile	84.5 to 212			56.5 to 132		
NAAQ Standards 2009(24 hr)	100			60		

Table 3.7: AAQ results for SO₂, NO_x (µg/m³) - 23rd Sep to 22nd Oct, 2022

Location	SO2			NOx		
	Min	Max	98 th Percentile	Min	Max	98 th Percentile
Site	16.9	23.5	23.5	26.5	30.1	30.1
Bawana	21.4	28.1	28.1	31.2	38.1	38.1
Holambi khurd	20.8	23.4	23.4	28.8	32.4	32.4
Khera khurd	21.2	24.2	24.2	29.7	33.2	33.2
Barwala	20.6	25.3	25.3	31.2	35.3	35.3
Ghoga	19.8	23.2	23.2	28.4	32.1	32.1
Narela	21.2	25.4	25.4	30.4	34.8	34.8
Chandpur khurd	17.3	20.4	20.4	24.8	29.3	29.3

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98th Percentile	20.4 to 28.1	29.3 to 38.1
NAAQ Standards 2009 (24 hr)	80	80

Table 3.8: AAQ results for O₃ and CO (µg/m³) - 23rd Sep to 22nd Oct, 2022

Location	O ₃			CO		
	Min	Max	98 th Percentile	Min	Max	98 th Percentile
Site	23.8	29.9	29.9	810	860	860
Bawana	32.3	40.3	40.3	1250	1482	1482
Holambi khurd	26.5	33.2	33.2	1080	1220	1220
Khera khurd	27.6	34.2	34.2	1025	1290	1290
Barwala	31.3	37.5	37.5	1140	1345	1345
Ghoga	26.8	30.4	30.4	1080	1175	1175
Narela	28.7	31.5	31.5	980	1220	1220
Chandpur khurd	20.6	26.5	26.5	820	955	955
98th Percentile	26.5 to 40.3			860 to 1482		
NAAQ Standards 2009 (8 hr)	100			2000		

Table 3.9: AAQ results for NH₃ and C₆H₆ (µg/m³) - 23rd Sep to 22nd Oct, 2022

Location	NH ₃			C ₆ H ₆		
	Min	Max	98 th Percentile	Min	Max	98 th Percentile
Site	38.3	45.4	45.4	0.39	0.52	0.52
Bawana	41.8	47.2	47.2	0.62	0.78	0.78
Holambi khurd	25.8	30.4	30.4	0.56	0.68	0.68
Khera khurd	30.5	36.2	36.2	0.54	0.62	0.62
Barwala	32.2	35.4	35.4	0.55	0.64	0.64
Ghoga	22.8	30.8	30.8	0.48	0.58	0.58
Narela	26.4	29.3	29.3	0.46	0.56	0.56
Chandpur khurd	27.6	32.2	32.2	0.38	0.50	0.50
98th Percentile	29.3 to 47.2			0.50 to 0.78		
NAAQ Standards 2009	400 (24 hr)			5 (Annual)		

Table 3.10: AAQ results for trace elements, benzo(a)pyrene - 23rd Sep to 22nd Oct, 2022

Parameters	Lead (µg/m ³)	Arsenic (ng/m ³)	Nickel (ng/m ³)	Benzo(a)Pyrene (ng/m ³)
BDL Value	< 1	< 1	< 0.5 µg/m ³	0.01
NAAQ Standards 2009	1	6	20	1
	24 hr	Annual		

3.3.2 Ambient air quality scenario in the study area

a) Particulate matter <2.5 µm and <10 µm

Particulate Matter (PM) is the term used for a mixture of solid particles and liquid droplets suspended in the air. These particles originate from a variety of sources, such as power plants, industrial processes, and diesel trucks and they are formed in the atmosphere by transformation of gaseous emissions. Their chemical and physical compositions depend on location and time of year and composed of both coarse and fine particles.

Coarse particles (PM₁₀) have an aerodynamic diameter between 2.5 µm and 10 µm. They are formed by mechanical disruption (e.g. crushing, grinding, and abrasion of surfaces) evaporation of sprays, and suspension of dust. PM₁₀ is composed of alumina silicate and other oxides of crustal elements, and major sources including fugitive dust from roads, industries, agriculture, construction & demolition and fly ash from fossil fuel combustion. The lifetime of PM₁₀ is from minutes to hours and its travel distance varies from <1 km to 10 km. Fine particles have an aerodynamic diameter less than 2.5 µm (PM_{2.5}). They differ from PM₁₀ in origin and chemistry. These particles are formed from gas and condensation of high temperature vapors during combustion and they are composed of various combinations of Sulfate compounds, Nitrate compounds, Carbon compounds, Ammonium, Hydrogen ion, organic compounds, metals (Pb, Cd, V, Ni, Cu, Zn, Mn and Fe) and particle bound water. The major sources of PM_{2.5} are fossil fuel combustion, vegetation burning, the smelting and processing of metals. Their lifetime is from days to weeks and travel distance ranging from hundreds to thousands of kilometers.

The 98th percentile of Particulate Matter <2.5 µm recorded within the study area were in the range of 56.5 to 132 µg/m³. The 98th percentile of Particulate Matter <10 µm recorded within the study area were in the range of 84.5 to 212 µg/m³.

The 98th percentile values of PM 2.5µm (60 µg/m³) and 10µm (100 µg/m³) were compared with the national ambient air quality standards (NAAQS) and found that the PM values for all the samples in the study area were exceeding except project site. At the project site due to well-developed greenbelt, presence of all required pollution controlling equipment and other pollution controlling measures; the air quality within the project site is gradually improving. The facility has provided good transportation services, concreated roads as well as regular maintenance of vehicles and PUC which helped to reduce the concentration level. All the measures adopted in existing unit will be ensured in expansion unit so as to improve the air quality of the area gradually. Whereas the main reason of increasing the PM values at other locations are due to heavy transportation within the industrial area and villages area, industrial area and ongoing construction and other commercial activities.

b) Sulfur Dioxide

Sulfur dioxide (SO₂) gas is an inorganic gaseous pollutant. SO₂ emissions are expected to be emitted wherever combustion of any fuel containing sulfur takes place. The Sulfur in the fuel will combine with oxygen to form SO₂. Sulfur trioxide and Sulfuric acid mist are the other important pollutants in the Sulfur group. In general, some of the important sources of SO₂ are power stations, Sulfuric acid plants, oil refining, boilers in utilities in any industry and domestic use of coal. The following sources of Sulfur dioxide in the study area are identified:

- Emissions from domestic fuel (coal, diesel, etc.)
- Emissions from DG sets used by industries and local residents

SO₂ in atmosphere is significant because of its toxicity. SO₂ is capable of producing illness and lung injury. Further it can combine with water in the air to form toxic acid. Aerosols can corrode metal surfaces, fabrics and the leaves of plants. SO₂ is irritating to the eyes and respiratory system. Excessive exposure to SO₂ causes bronchial asthma and other respiratory related diseases as it affects the lungs.

The 98th percentile of SO₂ recorded within the study area was in the range of 20.4 to 28.1 µg/m³. The 98th percentile values of SO₂ were compared with the national ambient air quality standards and it was found that the recorded values for samples collected in sampling locations were much lower than the applicable limit of 80 µg/m³ prescribed for residential and rural areas. As far as project site is concerned; there is no use of coal for burning within the site which can increase the SO₂ level into the environment.

c) Oxides of Nitrogen

Oxides of nitrogen are also inorganic gaseous pollutants like SO₂. Oxides of nitrogen are expected to be emitted wherever combustion at high temperatures takes place. Nitrous oxide and Nitric acid mist are the other important pollutants in the inorganic nitrogen group. In general, some of the important sources of Oxides of nitrogen are boilers (utilities) in any industry and auto exhaust. In a metropolitan town NO_x levels are predominantly due to automobile emissions. The following sources of oxides of nitrogen in the study area are identified:

- Emissions from industrial and domestic burning of coal.
- Emissions from automobiles.

Oxides of nitrogen have far greater significance in photochemical smog reaction than any of the other inorganic gaseous contaminants. NO_x in the presence of sunlight will undergo reactions with a number of organic compounds to produce all the effects associated with photochemical smog. NO_x has inherent ability to produce deleterious effects by themselves like toxicity. It acts as asphyxiate when in concentrations great enough to reduce the normal oxygen supply from the air. The 98th percentile of NO_x recorded within the study area was in the range of 29.3 to 38.1 µg/m³.

The 98th percentile values of NO_x were compared with the national ambient air quality standards and it was found that the recorded values for samples collected in sampling locations were much lower than the applicable limit of 80 µg/m³ prescribed for residential and rural area.

d) Ammonia (NH₃)

Ammonia (NH₃) in the atmosphere results primarily from the decomposition and volatilization of animal wastes. As such it is in principle a natural trace gas. Other sources of ammonia include direct volatilization from mineral fertilizers (particularly urea), agricultural crops and a wide range of non-agricultural sources including sewage, catalytic converters, wild animals, seabirds and industrial processes.

Atmospheric ammonia has impacts on both local and international (transboundary) scales. In the atmosphere, ammonia reacts with acid pollutants such as the products of SO₂ and NO_x emissions to produce fine ammonium (NH₄⁺) containing aerosol. While the lifetime of NH₃ is relatively short (<10-100 km), NH₄⁺ may be transferred to much longer distances (100 - >1000 km). In addition to the transboundary effects, NH₃ has substantial impacts at a local level: emissions occur at ground level in the rural environment and NH₃ is rapidly deposited). As a result, some of the most acute problems of NH₃ deposition are for small relict nature reserves located in intensive agricultural landscapes. The 98th percentile of NH₃ recorded within the study area was in the range of 29.3 to 47.2 µg/m³.

e) Ozone (O₃)

Ozone (O₃) or Trioxygen, is a triatomic molecule, consisting of three oxygen atoms. It is an allotrope of oxygen that is much less stable than the diatomic allotrope (O₂). Ozone in the lower atmosphere is an air pollutant with harmful effects on the respiratory systems of animals and will burn sensitive plants; however, the ozone layer in the stratospheric layer is beneficial, preventing potentially damaging ultraviolet light rays from reaching the earth's surface. Ozone is present in low concentrations throughout the earth's atmosphere.

The 98th percentile of ozone recorded within the study area was in the range of 26.5 to 40.3 µg/m³. The 8-hour average values of ozone compared with the national ambient air quality standards revealed that the recorded values were within the applicable limits of residential and rural areas for all the locations in study area.

f) Carbon monoxide (CO)

It is a colorless, odourless and tasteless gas that is slightly less dense than air. It is toxic to humans and animals when encountered in higher concentrations, although it is also produced in normal animal metabolism in low quantities, and is thought to have some normal biological functions. In the atmosphere, it is spatially variable and short lived, having a role in the formation of ground-level ozone. Along with aldehydes it is part of series of reactions that forms photochemical smog. Carbon monoxide is present in small amounts in the atmosphere,

chiefly as a product of volcanic activity but also from natural and man-made fires (such as forest and bush fires, burning of crop residues and sugarcane fire-cleaning). Carbon monoxide is a temporary atmospheric pollutant in some urban areas, mainly from the exhaust of internal combustion engines (including vehicles, portable and back-up generators, lawn mowers, power washers, etc.), but also from incomplete combustion of various other fuels (including wood, coal, charcoal, oil, paraffin, propane, natural gas, and trash).

The 8 hourly average values of CO were compared with the national ambient air quality standards and it was found that all the sampling stations recorded values much lower than the applicable limit of 2000 µg/m³ or residential and rural areas. The 98th percentile of CO recorded within the study area was in the range of 860 to 1482 µg/m³.

g) Benzene (C₆H₆)

Benzene is a clear, colorless, highly flammable and volatile, liquid aromatic hydrocarbon with a gasoline-like odour. Benzene is found in crude oils and as a by-product of oil- refining process. Benzene is found in the air from emissions from burning coal and oil, gasoline service stations, and motor vehicle exhaust. Acute (short-term) inhalation exposure of humans to benzene may cause drowsiness, dizziness, headaches, as well as eye, skin and respiratory tract irritation.

The 98th percentile of Benzene recorded within the study area was in the range of 0.50 to 0.78 µg/m³. Other parameters such as lead, arsenic, nickel and benzo(a)pyrene are below detectable limits (BDL).

h) Air quality index

At site the AQI is found to be 85 and at Narela industrial area the AQI is observed to be 147. The AQI reveals the status of air quality in the study region varies between satisfactory to moderate. Detailed AQI of all the locations are given in **Table 3.11**.

Table 3.11: Air Quality Index (AQI) of study area

Sr. No.	Location	AQI
1	Site	85
2	Bawana	175
3	Holambi khurd	141
4	Khera khurd	152
5	Barwala	145
6	Ghoga	121
7	Narela	147
8	Chandpur khurd	110
Range of AQI		85 to 175
Reference range		

Good (0-50)	Minimal Impact
Satisfactory (51-100)	Minor breathing discomfort to sensitive people
Moderate (101-200)	Breathing discomfort to the people with lung, heart disease, children and older adults
Poor (201-300)	Breathing discomfort to people on prolonged exposure
Very Poor (301-400)	Respiratory illness to the people on prolonged exposure
Severe >400	Respiratory effects even on healthy people

3.3.3 Comparative study of ambient air quality from the 2019 & 2022

The baseline study was conducted in the Sep 2019 to Nov 2019 (post monsoon season) and additional one-month data from 23rd Sep 2022 to 22nd Oct 2022 for the project and study area. The baseline results have been compared with present scenario and previous environmental baseline scenario to know the impact due to the existing and proposed expansion project.

The following observations are made regarding PM₁₀, PM_{2.5}, SO₂, NO_x, O₃, CO, NH₃ from the comparison of AAQ monitoring results shown in **Table 3.6 to 3.9** and with earlier results of monitoring conducted during Sep 2019 to Nov 2019.

- The PM₁₀ and PM_{2.5} values of the year 2022 are higher when compared to 2019 due to regular construction and developmental activities in the study area. However, the value of PM₁₀ and PM_{2.5} are within the limit in project site area.
- The SO₂ values of the year 2022 are higher when compared to 2019 due to regular growth of commercial and industrial activities. However, the value of SO₂ are within the limit at all the monitoring location.
- The NO_x values of the year 2022 are higher when compared to 2019 due to regular growth of commercial and industrial activities. However, the value of NO_x is within the limit at all the monitoring location.
- The values of O₃ also observed higher in year 2022 when we compared with values received in the year of 2022 but within the limit of CPCB.
- The CO values of the year 2019 are observed lesser when compared to 2022 but within limit of CPCB.
- the values of NH₃ in the year 2019 are observed lesser when compared to 2022 but within limit of CPCB.

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Table 3.12: Comparison of Particulate matter results in the study area - ($\mu\text{g}/\text{m}^3$)

Location	PM ₁₀				PM _{2.5}			
	2019		2022		2019		2022	
	Min	Max	Min	Max	min	max	min	Max
Site	70.0	81.1	74.3	84.5	41.4	53.5	48.3	56.5
Bawana	152	171	168	212	78.3	84.3	104	132
Holambi khurd	132	150	140	162	66.2	79.8	75.7	110
Khera khurd	133	155	158	178	69.8	82.9	101	120
Barwala	148	160	150	168	64.2	81.1	78.3	104
Ghoga	93.7	125	105	132	50.4	67.3	62.3	78.4
Narela	126	164	115	170	48.7	60.3	76.5	98.6
Chandpur khurd	80.3	105	78.5	115	66.2	80.9	49.8	72.1
Range	70.0 to 171		74.3 to 212		41.4 to 84.3		48.3 to 132	
NAAQ Standards 2009 (24 hr)	100				60			

Table 3.13: Comparison of SO₂ and NO_x results in the study area - ($\mu\text{g}/\text{m}^3$)

Location	SO ₂ ($\mu\text{g}/\text{m}^3$)				NO _x ($\mu\text{g}/\text{m}^3$)			
	2019		2022		2019		2022	
	Min	Max	Min	Max	min	max	min	Max
Site	17.8	22.8	16.9	23.5	24.3	29.3	26.5	30.1
Bawana	20.2	25.5	21.4	28.1	29.1	36.3	31.2	38.1
Holambi khurd	19.2	22.3	20.8	23.4	28.4	31.5	28.8	32.4
Khera khurd	18.5	21.5	21.2	24.2	27.9	30.9	29.7	33.2
Barwala	21.1	24.1	20.6	25.3	30.5	33.8	31.2	35.3
Ghoga	17.6	22.5	19.8	23.2	25.6	30.4	28.4	32.1

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Narela	20.1	23.7	21.2	25.4	28.8	32.1	30.4	34.8
Chandpur khurd	15.8	19.8	17.3	20.4	22.5	28.9	24.8	29.3
Range	15.8 to 25.5		16.9 to 28.1		22.5 to 36.3		24.8 to 38.1	
NAAQ Standards 2009 (24 hr)	80				80			

Table 3.14: Comparison of O₃ and CO results in the study area - (µg/m³)

Location	O ₃ (µg/m ³)				CO (µg/m ³)			
	2019		2022		2019		2022	
	Min	Max	Min	Max	min	max	min	Max
Site	25.4	31.8	23.8	29.9	850	980	810	860
Bawana	31.7	44.5	32.3	40.3	1140	1354	1250	1482
Holambi khurd	28.8	35.4	26.5	33.2	1015	1180	1080	1220
Khera khurd	25.8	32.2	27.6	34.2	960	1178	1025	1290
Barwala	30.5	36.5	31.3	37.5	1045	1250	1140	1345
Ghoga	25.4	29.3	26.8	30.4	1024	1154	1080	1175
Narela	31.2	42.3	28.7	31.5	1150	1280	980	1220
Chandpur khurd	23.5	28.8	20.6	26.5	880	1010	820	955
Range	23.5 to 44.5		20.6 to 40.3		850 to 1354		810 to 1482	
NAAQ Standards 2009 (8 hr)	100				2000			

Table 3.15: Comparison of NH₃ results in the study area - (µg/m³)

Location	NH ₃ (µg/m ³)			
	2019		2022	
	Min	Max	Min	Max
Site	28.7	31.7	38.3	45.4
Bawana	35.4	41.2	41.8	47.2
Holambi khurd	27.4	32.4	25.8	30.4
Khera khurd	29.4	34.2	30.5	36.2
Barwala	31.7	36.5	32.2	35.4
Ghoga	24.3	28.5	22.8	30.8
Narela	34.5	38.4	26.4	29.3
Chandpur khurd	22.3	26.5	27.6	32.2
Range	22.3 to 41.2		27.6 to 47.2	
NAAQ Standards 2009 (24 hr)	400			

3.4 Water quality

Surface water and ground water samples were collected from different sources within the study area and analyzed for some important physical and chemical parameters including heavy metals for depicting the baseline status of the study area.

3.4.1 Water quality assessment

During the study period (Oct 2022), a total of 10 ground water samples and 4 surface water samples were collected from the study area in order to assess the water quality. Ground water samples were drawn from hand pumps and bore wells used by the villagers for their domestic needs. Surface water sampling was carried out from the river/nallas and ponds in the study area. Details of the sampling locations are given in **Table 3.16**. The analytical results were compared with IS: 10500-2012 drinking water standards as shown in **Table 3.17**. Surface water results were compared with CPCB water quality criteria as updated on 11th Sep, 2017 and shown in **Table 3.18**. Sampling location map for SW/GW is given in **Figure 3.3**.

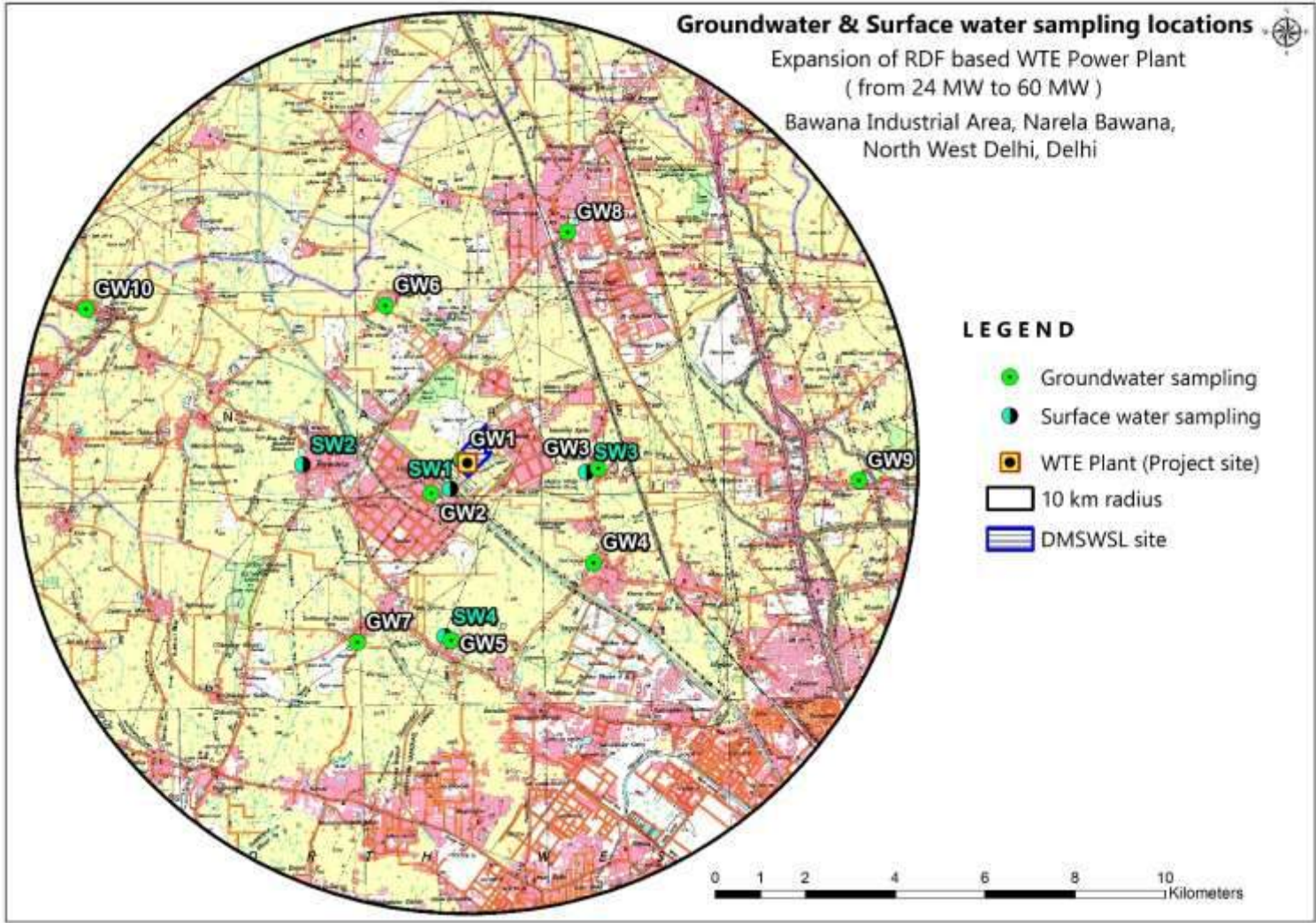
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Table 3.16: Water sampling locations

Code	Locations	W.R.T. Site		Latitude	Longitude
		Distance (km)	Direction		
Ground water					
GW1	Site	0.0	Core	28° 47' 59.6"	77° 04' 16.6"
GW2	Bawana	1.0	W	28° 47' 52.4"	77° 01' 43.7"
GW3	Holambi Khurd	3.0	E	28° 47' 44.2"	77° 05' 51.6"
GW4	Khera khurd	3.7	SE	28° 46' 36.1"	77° 05' 51.2"
GW5	Barwala	3.8	S	28° 45' 47.8"	77° 03' 43.5"
GW6	Ghoga	4.0	NW	28° 49' 45.5"	77° 02' 46.0"
GW7	Sultanpur Dabas	4.3	SW	28° 50' 31.3"	77° 05' 35.4"
GW8	Narela	5.8	NE	28° 50' 37.7"	77° 05' 27.0"
GW9	Zindpur	8.7	E	28° 47' 34.3"	77° 09' 17.0"
GW10	Ferozpur Bangar	8.9	NW	28° 49' 46.0"	76° 58' 54.5"
Surface water					
SW1	Canal	0.4	SW	28° 47' 23.0"	77° 04' 04.4"
SW2	Bawana	3.5	W	28° 47' 55.5"	77° 01' 43.7"
SW3	Johad pond	2.77	E	28° 47' 45.9"	77° 05' 36.8"
SW4	Barwala pond	3.86	S	28° 45' 47.8"	77° 03' 42.9"

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Figure 3.3: Map showing locations of ground and surface water sampling



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Table 3.17: Results of ground water sample analysis (Oct. 2022)

S. No	Parameter	Unit	Analysis results										Standard as per IS -10500:2012	
			GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	GW-9	GW-10	Acceptable Limit	Permissible Limit
1	pH Value	--	7.5	7.8	8.0	7.9	7.6	7.4	7.7	8.2	8.4	7.9	6.5-8.5	No Relaxation
2	TSS		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	-
3	Electrical Conductivity	µS/cm	1081	1680	1866	1710	1155	1265	3630	3925	3504	3345	--	--
4	TDS	mg/L	680	1031	1150	1020	712	795	2162	2373	2040	1984	500	2000
5	Turbidity	NTU	<0.1	<0.1	0.3	0.1	1.3	0.1	0.1	0.2	0.3	0.2	1	5
6	Alkalinity as CaCO ₃	mg/L	245	340	393	372	265	240	350	439	428	392	200	600
7	Chloride as Cl	mg/L	98.3	201	244	152	184	250	685	560	605	509	250	1000
8	Sulphate as SO ₄	mg/L	71.2	141	210	160	36.4	32.1	364	591	346	464	200	400
9	Nitrate as NO ₃	mg/L	34.1	22.2	11.1	43.3	5.6	8.4	43.0	40.2	43.8	26.8	45	No Relaxation
10	Phosphate	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-
11	Hardness as CaCO ₃	mg/L	198	436	658	399	299	345	735	849	886	723	200	600
12	Calcium as Ca	mg/L	43.6	80.4	99.1	83.3	75.4	84.5	135	188	186	126	75	200
13	Magnesium as Mg	mg/L	21.6	56.4	50.5	45.7	26.4	32.2	95.4	91.2	101	98.2	30	100
14	Sodium as Na	mg/L	162	182	192	204	120	140	490	510	402	410	--	--
15	Potassium as K	mg/L	10.1	14.4	22.2	28.4	18.4	5.2	38.1	28.2	21.6	30.2	--	--
16	Fluoride as F	mg/L	1.24	1.16	1.23	1.33	1.13	1.21	1.62	1.79	1.58	1.20	1.0	1.5
17	Iron as Fe	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	No Relaxation
18	Lead as Pb	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	
19	Cadmium as Cd	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.003	
20	Chromium as Cr	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	
21	Copper as Cu	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	1.5
22	Arsenic as As	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.01	0.05
23	Boron as B	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	1
24	Zinc as Zn	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	5	15

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Table 3.18: Results of surface water sample analysis (Oct 2022)

Parameter	Units	SW1	SW2	SW3	SW4	CPCB water quality criteria as updated on 11 th Oct, 2019				
						A	B	C	D	E
pH Value	---	7.8	7.4	8.5	8.1	6.5-8.5	6.5-8.5	6.0-9.0	6.5-8.5	6.5-8.5
Total Suspended Solids	mg/L	30	15	35	40	-	-	-	-	2250
Electrical Conductivity	µS/cm	486	693	1912	681	-	-	-	-	-
Total Dissolved Solids	mg/L	314	436	1145	429	-	-	-	-	-
Turbidity	NTU	0.6	0.4	1.2	2.4	-	-	-	-	-
Alkalinity as CaCO ₃	mg/L	91.0	88.0	296	148	-	-	-	-	-
Chloride as Cl	mg/L	69.0	68.0	308	80.2	-	-	-	-	-
Sulphate as SO ₄	mg/L	38.7	92.0	243	70.0	-	-	-	-	-
Nitrates as NO ₃	mg/L	1.4	7.5	4.7	4.2	-	-	-	-	-
Phosphate as PO ₄	mg/L	<1	1.2	<1	<1	-	-	-	-	-
Total Hardness as CaCO ₃	mg/L	161	228	472	198	-	-	-	-	-
Calcium as Ca	mg/L	39.6	67.4	108	55.7	-	-	-	-	-
Magnesium as Mg	mg/L	14.8	14.4	48.4	14.2	-	-	-	-	-
Sodium as Na	mg/L	18.0	38.0	188	64.5	-	-	-	-	-
Potassium as K	mg/L	5.1	5.8	9.6	5.2	-	-	-	-	-
Fluoride as F	mg/L	1.18	1.42	1.52	1.32	-	-	-	-	-
Iron as Fe	mg/L	0.34	0.41	0.25	0.34	-	-	-	-	-
Lead as Pb	mg/L	<0.01	<0.01	<0.01	<0.01	-	-	-	-	—
Cadmium as Cd	mg/L	<0.003	<0.003	<0.003	<0.003	-	-	—	—	—
Arsenic as As	mg/L	<0.05	<0.05	<0.05	<0.05	-	-	-	-	—
Copper as Cu	mg/L	<0.05	<0.05	<0.05	<0.05	-	-	-	-	—
Boron as B	mg/L	<0.1	<0.1	<0.1	<0.1	-	-	-	-	2
Chromium as Cr	mg/L	<0.05	<0.05	<0.05	<0.05	-	-	-	-	—
Zinc as Zn	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	-	-	-	-	—
DO	mg/L	4.6	2.4	1.5	2.1	6	5	4	4	-
COD	mg/L	15.0	69.0	157	78.0	-	-	-	-	-
BOD	mg/L	<4	27	70	33	2	3	3	-	-
Total Coliform	MPN/100ml	>1600	>1600	1600	920	50	500	5000	-	-

Note:

Class A: Drinking water source without conventional treatment; **Class B:** Outdoor bathing; **Class C:** Drinking water source with conventional treatment followed by disinfection; **Class D:** Fish culture and wild life population; **Class E:** Irrigation, Industrial cooling, controlled waste disposal.

3.4.2 Regional scenario

Groundwater quality

- The pH limit fixed for drinking water samples as per IS: 10500-2012 Standards is 6.5 to 8.5. Beyond this range, water will affect the mucus membrane and water supply system. pH in the study area varied from 7.4 to 8.4, showing that values are within the acceptable range.
- The acceptable limit for Total Dissolved Solids as per IS: 10500-2012 Standards is 500 mg/L whereas the permissible limits in absence of alternate source are 2000 mg/L. Beyond this, palatability decreases and may cause gastro intestinal irritation. In the ground water

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samples collected from the study area, the Total Dissolved Solids varied from 680 mg/L to 2373 mg/L. In three locations i.e. GW7 (Sultanpur Dabas), GW8 (Narela) and GW9 (Zindpur) the TDS values were above the permissible limits and rest of the samples the TDS values were above acceptable limits but within permissible limits.

- The acceptable limit for Chloride is 250 mg/L as per IS: 10500-2012 Standards whereas the permissible limit of the same is 1000 mg/L. Beyond this limit, taste, corrosion and palatability are affected. The Chloride levels in the ground water samples collected in the study area ranged from 98.3 mg/L to a maximum of 685 mg/L. In six samples the Chloride value was within the acceptable including project site. In the rest of the samples the value was above the acceptable limits but within the permissible limits.
- The acceptable limit of Hardness as CaCO_3 according to IS:10500-2012 Standards is 200 mg/L whereas the permissible limit for the same is 600 mg/L. Beyond this limit, encrustation in water supply structures and adverse effects on domestic use will be observed. The Hardness values for the ground water samples collected from the study area varied from 198 mg/L to 886 mg/L. For Hardness only one sample is below the acceptable limit and other samples are above acceptable. Hardness value found within the Permissible limit at five samples locations and at rest of five locations the hardness value found exceeding permissible limit.
- Fluoride is another important parameter, which has an acceptable limit of 1 mg/L and permissible limit of 1.5 mg/L. However, the optimum content of Fluoride in the drinking water is <0.6 to 1.5 mg/L. If the Fluoride content is less than 0.6 mg/L it causes dental carries, above 1.5 mg/L it causes staining of tooth enamel, higher concentration in range of 3 - 10 mg/L causes Fluorosis. In the ground water samples of study area, the Fluoride value was in the range of 1.13 to 1.79 mg/L. In seven samples the Fluoride value was within the permissible limit, where as in three locations the Fluoride value was above the permissible limit

Surface water quality

- pH of the surface water collected in the study area ranges between 7.4 to 8.5. As per CPCB designated best use water quality criteria as updated on 11th September, 2017 Class A, B and D waters PH values are 6.5 to 8.5, Class C waters PH value is 6.0 to 9.0 and Class E is 6.0 to 8.5.
- Electrical conductivity values of collected water samples were varies between 486 to 1912 $\mu\text{S}/\text{cm}$. As per CPCB designated best use water quality criteria as updated on 11th September, 2017 the EC value for Class E waters should be less than 2500 $\mu\text{S}/\text{cm}$, for rest of the Classes there is not limit specified.
- The DO values for all the samples collected in the study area during study period were in the range of 1.5 to 4.8 mg/L. As per CPCB designated best use water quality criteria as updated on 11th September, 2017 Class C and D waters DO values should be >4 mg/L, for Class A and

Class B, the DO values should be > 6 mg/L and >5 mg/L respectively, for Class E the limit is not specified.

- The BOD values for all the samples collected in the study area during study period were in the range of <4 to 70 mg/L. As per CPCB designated best use water quality criteria as updated on 11th September, 2017 Class B and C waters BOD values should be <3 mg/L, for Class A the BOD values should be <2 mg/L, for Class D and E the limit is not specified.

3.4.3 Comparative study of water quality from the year 2019 & 2022

The water sampling locations were majorly identified with same locations in the previous baseline studies except two new SW locations. The samples were analyzed for physico- chemical characteristics and compared with present and previous water quality. Comparison of ground water and surface water results are given in **Table 19a & 19b** and **Table 20**.

The observation of the concentrations of pH, TDS, Fluoride, Chlorides and Total Hardness during the previous monitoring and present project baseline data are as follows:

- The pH values of all ground water samples are within acceptable limits.
- There is reduction of concentration of TDS levels observed Bawana, Holambi Khurd, Khera Khurd, Barwala, Ghogha. Whereas concentration of TDS level are increased at Project site, Sultanpur Dabas, Narela, Zindpur and Ferozpur Bangar.
- Chloride level found decreasing at Bawana, Holambi Khurd and Barwala but found increasing rest of locations.
- Fluoride level found decreasing at two location whereas found increasing at remaining locations. All the samples found exceeding the Acceptable limit but not exceeding the permissible limit except three locations i.e. Sultan Dabas, Narela and Zindpur as the value of these three locations found exceeding the permissible limit also.
- Surface water analysis was compared with two existing locations most of the parameters (TDS, Cl, SO₄, NO₃, Na, K, Mg, etc.) found to be lesser in year 2022 when compared to year 2019, however few parameters like F, Ca, Fe, etc increased.

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Table 3.19a: Comparison of ground water results for the year 2019 and 2022

Parameter	Unit	Analysis results										Standard as per IS -10500:2012	
		Site		Bawana		Holambi Khurd		Khera khurd		Barwala		Acceptable Limit	Permissible Limit
		2019	2022	2019	2022	2019	2022	2019	2022	2019	2022		
pH Value	--	7.4	7.5	7.7	7.8	7.6	8.0	7.7	7.9	7.6	7.6	6.5-8.5	No Relaxation
TSS		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	-
Electrical Conductivity	µS/cm	910	1081	2460	1680	1895	1866	2264	1710	1780	1155	--	--
TDS	mg/L	560	680	1505	1031	1220	1150	1425	1020	1105	712	500	2000
Turbidity	NTU	0.5	<0.1	0.8	<0.1	1.1	0.3	0.5	0.1	0.5	1.3	1	5
Alkalinity as CaCO ₃	mg/L	196	245	312	340	285	393	324	372	320	265	200	600
Chloride as Cl	mg/L	68	98.3	480	201	324	244	423	152	332	184	250	1000
Sulphate as SO ₄	mg/L	92	71.2	122	141	134	210	143	160	82	36.4	200	400
Nitrate as NO ₃	mg/L	14.0	34.1	32	22.2	40	11.1	25	43.3	20	5.6	45	No Relaxation
Phosphate as PO ₄	mg/L	1.1	<1	1.4	<1	1.6	<1	1.3	<1	1.2	<1	-	-
Hardness as CaCO ₃	mg/L	193	198	468	436	353	458	455	399	397	299	200	600
Calcium as Ca	mg/L	32.0	43.6	112	80.4	88.0	99.1	102	83.3	92	75.4	75	200
Magnesium as Mg	mg/L	27.0	21.6	45.0	56.4	32.0	50.5	48.0	45.7	40.0	26.4	30	100
Sodium as Na	mg/L	98.0	162	275	182	265	192	280	204	190	120	--	--
Potassium as K	mg/L	12.0	10.1	112	14.4	75	22.2	85	28.4	58	18.4	--	--
Fluoride as F	mg/L	1.22	1.24	1.43	1.16	1.12	1.23	1.25	1.33	1.05	1.13	1.0	1.5
Iron as Fe	mg/L	0.26	<0.2	0.32	7.8	0.65	<0.2	0.93	<0.2	1.12	<0.2	0.3	No Relaxation

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Table 3.19b: Comparison of ground water results for the year 2019 and 2022

Parameter	Unit	Analysis results										Standard as per IS -10500:2012	
		Ghoga		Sultanpur Dabas		Narela		Zindpur		Ferozpur Bangar		Acceptable Limit	Permissible Limit
		2019	2022	2019	2022	2019	2022	2019	2022	2019	2022		
pH Value	--	7.9	7.4	8.4	7.7	8.2	8.2	8.1	8.4	7.2	7.9	6.5-8.5	No Relaxation
TSS		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	-
Electrical Conductivity	µS/cm	1975	1265	2254	3630	2420	3925	2312	3504	1634	3345	--	--
TDS	mg/L	1210	795	1345	2162	1444	2373	1405	2040	1020	1984	500	2000
Turbidity	NTU	0.5	0.1	1.2	0.1	0.5	0.2	0.8	0.3	0.5	0.2	1	5
Alkalinity as CaCO ₃	mg/L	345	240	412	350	382	439	360	428	232	392	200	600
Chloride as Cl	mg/L	365	250	380	685	412	560	395	605	305	509	250	1000
Sulphate as SO ₄	mg/L	85	32.1	122	364	143	591	152	346	110	464	200	400
Nitrate as NO ₃	mg/L	22	8.4	28	43.0	32	40.2	40	43.8	20	26.8	45	No Relaxation
Phosphate as PO ₄	mg/L	1.2	<1	1.3	<1	1.4	<1	1.6	<1	1.4	<1	-	-
Total Hardness as CaCO ₃	mg/L	472	345	545	735	581	849	535	886	400	723	200	600
Calcium as Ca	mg/L	102	84.5	118	135	124	188	114	186	85	126	75	200
Magnesium as Mg	mg/L	52	32.2	60	95.4	65	91.2	60	101	45	98.2	30	100
Sodium as Na	mg/L	230	140	240	490	260	510	245	402	165	410	--	--
Potassium as K	mg/L	60	5.2	65	38.1	80	28.2	65	21.6	54	30.2	--	--
Fluoride as F	mg/L	1.24	1.21	1.08	1.62	1.02	1.79	1.04	1.58	0.98	1.20	1.0	1.5
Iron as Fe	mg/L	0.56	<0.2	0.65	<0.2	0.82	<0.2	0.26	<0.2	0.23	<0.2	0.3	No Relaxation

Table 3.20: Comparison of surface water results for the year 2019 and 2022

Parameter	Units	SW1		SW2		CPCB standards updated on 11 th Oct 2019				
		2019	2022	2019	2022	A	B	C	D	E
pH	---	8.2	7.8	7.5	7.4	6.5-8.5	6.5-8.5	6.0-9	6.5-8.5	6.5-8.5
EC	μS/cm	1375	486	886	693	-	-	-	-	2250
TSS	mg/L	34	30	22	15	-	-	-	-	0
TDS	mg/L	858	314	565	436	-	-	-	-	-
Turbidity	NTU	6.2	0.6	4.4	0.4	-	-	-	-	-
Alkalinity as CaCO ₃	mg/L	275	91.0	142	88.0	-	-	-	-	-
Chloride as Cl	mg/L	163	69.0	120	68.0	-	-	-	-	-
Sulphate as SO ₄	mg/L	118	38.7	62	92.0	-	-	-	-	-
Nitrates as NO ₃	mg/L	12	1.4	22	7.5	-	-	-	-	-
Phosphate as PO ₄	mg/L	1.2	<1	2.4	1.2	-	-	-	-	-
Total Hardness as CaCO ₃	mg/L	297	161	177	228	-	-	-	-	-
Calcium as Ca	mg/L	72	39.6	34	67.4	-	-	-	-	-
Magnesium as Mg	mg/L	28	14.8	22	14.4	-	-	-	-	-
Sodium as Na	mg/L	154	18.0	112	38.0	-	-	-	-	-
Potassium as K	mg/L	43	5.1	22	5.8	-	-	-	-	-
Fluoride as F	mg/L	1.15	1.18	1.34	1.42	-	-	-	-	-
Iron as Fe	mg/L	0.23	0.34	0.28	0.41	-	-	-	-	-
DO	mg/L	2.8	4.6	5.2	2.4	-	-	-	-	—
COD	mg/l	74	15.0	52	69.0	6	5	4	4	-
BOD	mg/l	26	<4	18	27	-	-	-	-	-
Total Coliform	MPN/100ml	>1600	>1600	>1600	>1600	2	3	3	-	-

3.5 Noise environment

Noise can be defined as any undesirable sound that interferes with speech and hearing and is intense enough to damage hearing or is otherwise annoying. Noise can also disturb natural wildlife and ecological systems. Noise impacts can be a major concern during the construction and the operational phases of the project. Noise should also be considered in relation to present and future land use zoning and policies.

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Construction noise can be a significant source of community noise. The impacts are felt on the people near the construction site, who are totally unrelated to construction activities (e.g. area residents, office workers, school children, staff, etc.). Factors which are important in determining noise levels that will potentially impact such populations include- distance from the noise source, natural or man-made barriers between the source and the impacted population, weather conditions which could potentially absorb, reflect or focus sound (such as wind speed, direction, temperature inversions), the scale and intensity of the particular construction phase (excavation, erection, or finishing). The Environment/ health impacts of noise can vary from Noise Induced Hearing Loss (NIHL) to annoyance depending on loudness of noise levels and tolerance levels of individuals.

3.5.1 Source of noise

The main sources of noise in the study area are domestic activities, industrial activities and vehicular traffic, operational noise of existing WTE plant, MSW plant and CHWTSDF plant adjacent to the facility.

3.5.2 Noise levels in the study area

Noise levels were monitored at 9 locations within the study zone, using a noise measurement device during study period (Oct. 2022). Random noise level measurements at various locations were carried out for assessment of existing noise levels. Keeping in view the land use pattern, residential areas, schools, bus stands, etc., the day levels of noise have been monitored during 6 am to 10 pm and the night levels during 10 pm to 6 am. The noise monitoring stations are shown in **Table 3.21** and **Figure 3.4**. The results are presented in **Table 3.22**.

Table 3.21: Noise monitoring locations

Code	Locations	W.R.T. Site		Latitude	Longitude
		Distance (km)	Direction		
N1	Site	0.0	Core	28° 47' 52.2"	77° 03' 55.1"
N2	Bawana	0.9	W	28° 47' 54.1"	77° 04' 43.2"
N3	Sanoth Mord	2.0	NNE	28° 48' 42.91	77° 04' 13.3"
N4	Holambi Khurd	3.3	E	28° 47' 49.1"	77° 05' 57.2"
N5	Barwala	3.7	S	28° 45' 38.5"	77° 03' 39.1"
N6	Khera kurd	3.9	SE	28° 46' 26.2"	77° 05' 32.1"
N7	Ghoga	4.0	NW	28° 49' 48.1"	77° 02' 57.2"
N8	Sultanpur Dabas	4.0	SW	28° 45' 58.1"	77° 02' 33.0"
N9	Narela	6.2	NE	28° 51' 20.7"	77° 05' 42.9"

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Table 3.22: Results of noise quality monitoring dB(A)

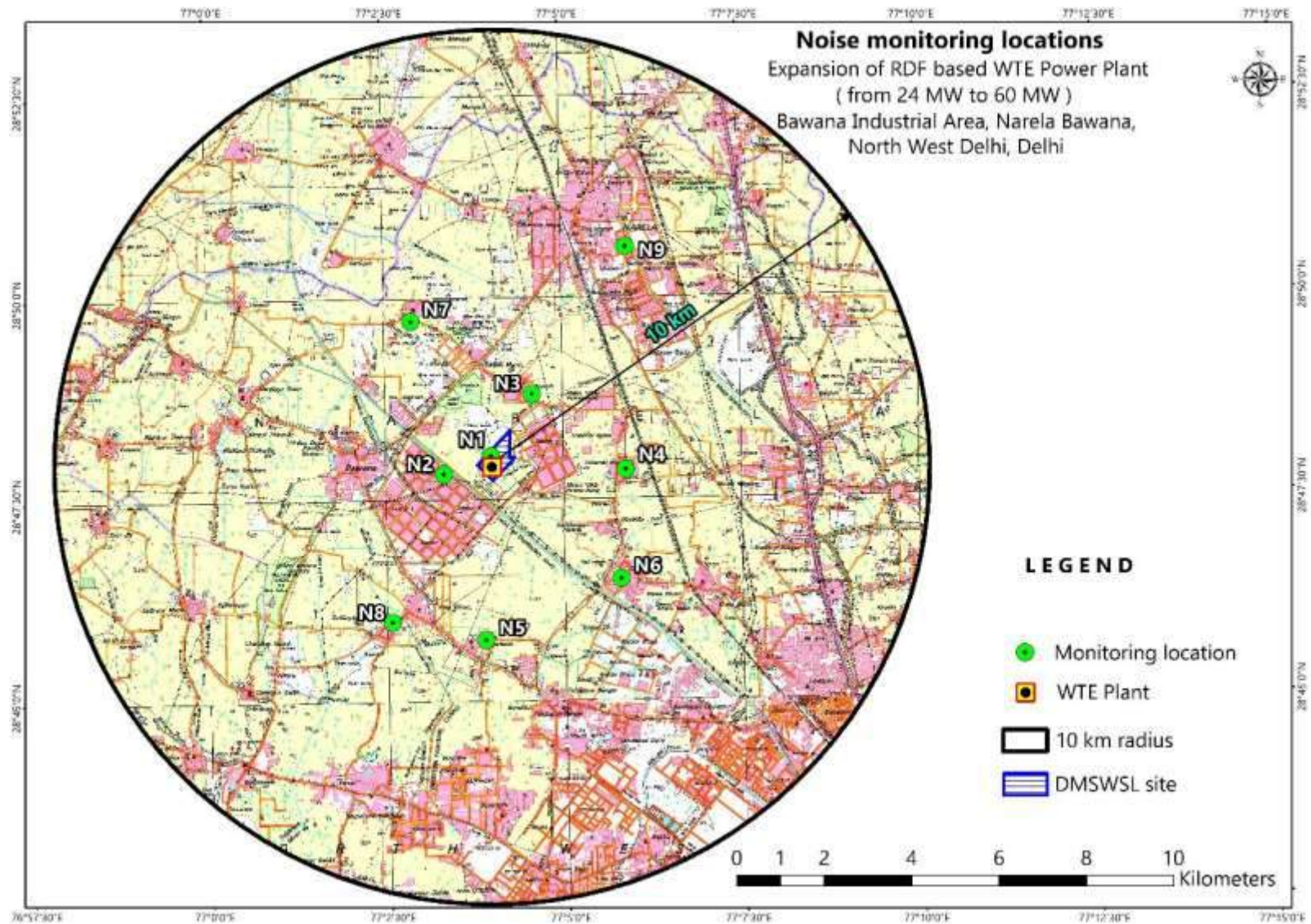
Code	Locations	Day		Night		Leq dB (A)	
		Min	Max	Min	Max	L _{day}	L _{night}
N1	Site	47.9	66.5	44.3	49.1	63.6	45.9
N2	Bawana (Residential)	47.1	57.6	43.1	47.6	54.1	44.3
	Bawana (Industrial)	58.9	73.6	50.8	57.1	68.2	54.6
N3	Sanoth (Residential)	52.8	69.1	46.1	52.1	63.5	48.2
N4	Holambi Khurd (Commercial)	46.8	57.2	42.7	46.9	53.9	44.1
N5	Barwala (Commercial)	51.8	67.9	46.1	51.6	62.6	48.2
N6	Khera khurd (Commercial)	52.9	68.9	46.5	51.4	62.9	48.6
N7	Ghoga (Commercial)	54.1	69.1	48.1	54.2	62.9	50.3
N8	Sulthanpur (Residential)	52.2	68.7	47.6	53.1	63.5	49.3
N9	Narela (Commercial)	47.1	57.6	42.3	48.5	54.5	43.9
Range						53.9 to 68.2	43.9 to 54.6

AAQ Standards in respect of Noise SO 123 (E) dt 14th Feb 2000

Area Code	Category of Area	Limits in dB(A) Leq	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Note: Day Time is recorded in between 6 a.m. and 10 p.m. Night time is recorded in between 10 p.m. to 6 a.m.

Figure 3.4: Map showing locations of noise samples



3.5.3 Regional scenario

High noise levels observed in some of the rural areas are primarily because of vehicular traffic and other anthropogenic activities. The day equivalents during the study period ranged between 53.9 to 68.2 dB (A) whereas the night equivalents were in the range of 43.9 to 54.6 dB (A). The results are compared with Ambient Noise standards in respect of Noise SO 123 (E) dt 14th Feb 2000. From the results it can be seen that the day equivalents and night equivalents at two residential areas are exceeding the limit, whereas all other locations the results are within the respective standards.

3.5.4 Comparative study of noise levels from the year 2019 & 2022

With reference to noise baseline values, the noise levels during the day equivalent are in the range of 46.5 to 70.3 dB (A) (2019), 46.8 to 73.6 dB (A) (2022) and during the night equivalent monitoring the noise values are in the range of 42.1 to 56.8 (2019), and 42.3 to 57.1 dB (A) (2022) indicating marginal variation. The comparison of noise level monitoring is given in **Table 3.23**.

Table 3.23: Comparison of noise monitoring results for the year 2019 & 2022 – dB (A)

S. No	Location	Day values				Night values			
		2019		2022		2019		2022	
		Min	Max	Min	Max	Min	Max	Min	Max
1	Site	47.8	65.7	47.9	66.5	43.2	48.4	44.3	49.1
2	Bawana (Residential)	46.7	58.4	47.1	57.6	42.1	47.8	43.1	47.6
	Bawana (Industrial)	58.7	74.3	58.9	73.6	50.3	56.8	50.8	57.1
3	Sanoth (Residential)	46.5	56.3	46.8	57.2	42.1	46.8	42.7	46.9
4	Holambi Khurd (Commercial)	52.3	68.4	51.8	67.9	45.3	51.2	46.1	51.6
5	Barwala (Commercial)	52.3	68.8	52.9	68.9	46.1	51.2	46.5	51.4
6	Khera khurd (Commercial)	53.2	68.5	54.1	69.1	47.2	53.8	48.1	54.2
7	Ghoga (Commercial)	53.2	70.1	52.2	68.7	48.3	52.8	47.6	53.1
8	Sulthanpur (Residential)	46.5	56.4	47.1	57.6	42.1	48.1	42.3	48.5
9	Narela (Commercial)	53.1	70.3	53.5	70.5	47.8	54.7	48.1	55.1
Range		46.5 to 70.3		46.8 to 73.6		42.1 to 56.8		42.3 to 57.1	

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3.6 Traffic study

Traffic studies are required to assess the traffic density pattern of the region and to assist the proponent in planning vehicular movement during the project activity. The methodology adopted for carrying out the traffic study was to select the major district road around the project site and count the various categories of vehicles moving on these roads.

The traffic survey was carried out on the major district road (MDR) near the project site during site visit (Oct 2022) of the baseline study period, the details of the same are given in **Table 3.24**. From MDR, we observed that the highest peak was 2171 PCU/hr during 09 to 10 am. It was observed that the existing Level of Service (LOS) is good on both MDR and site access road.

Table 3.24: Traffic survey at major district road (To & Fro)

Hours	Two-wheeler		Three-wheeler		Passenger cars & pick-up vans		Heavy commercial vehicles (HCV)		Total vehicles	
	v/hr	PCU/hr	v/hr	PCU/hr	v/hr	PCU/hr	v/hr	PCU/hr	Total	Total PCU/hr
06-07 am	205	154	48	96	345	345	88	326	686	920
07-08 am	254	191	52	104	522	522	154	570	982	1386
08-09 am	345	259	65	130	543	543	232	858	1185	1790
09-10 am	540	405	75	150	654	654	260	962	1529	2171
10-11 am	522	392	68	136	634	634	266	984	1490	2146
11-12 pm	512	384	52	104	620	620	245	907	1429	2015
12-01 pm	480	360	48	96	534	534	212	784	1274	1774
01-02 pm	460	345	46	92	485	485	156	577	1147	1499
02-03 pm	455	341	43	86	434	434	143	529	1075	1390
03-04 pm	435	326	42	84	422	422	135	500	1034	1332
04-05 pm	345	259	46	92	488	488	165	611	1044	1449
05-06 pm	365	274	60	120	565	565	191	707	1181	1665
06-07 pm	320	240	62	124	634	634	186	688	1202	1686
07-08 pm	232	174	56	112	522	522	172	636	982	1444
08-09pm	180	135	47	94	432	432	143	529	802	1190
09-10pm	154	116	38	76	355	355	132	488	679	1035
10-11pm	123	92	33	66	265	265	112	414	533	838
The highest peak observed is 2171 PCU/hr during 09 to 10 am										
Total width of the Road in meters (Arterial Road)										20 m
Carrying capacity of the road (the road is 4-Lane 2-Way), As per IRC:106-1990 (PCU's per hour)										3600
Existing V/C Ratio										0.60
LOS=Level of Service (Existing)										"C"
Indicators for LOS										
V/C		LOS		Performance						
0.00 - 0.2		A		Excellent						
0.20—0.4		B		Very good						
0.40-0.60		C		Good						
0.60-0.80		D		Fair/Average						
0.80-1.00		E		Poor						
>1.00		F		Very poor						

3.6.1 Comparative study of traffic from the year 2019 & 2022

The traffic study was compared with previous baseline locations at MDR. Comparing from 2019 to 2022 the traffic volume at MDR was increased from peak hours 1672 to 2171 PCU's per hour due to ongoing urbanization and increase in population. The LOS during 2019 and as well as during 2022 are in "good" (C) performance. The comparison of traffic study is given in **Table 3.25**.

Table 3.25: Comparison of traffic data (LOS) for the year 2019 & 2022 at MDR

Road	Year	Towards	Volume (V) PCU's/hr (worst case) Existing	Capacity of road PCU's/hr	Existing (V/C)	Level of Service (LOS)
MDR	2019	To & Fro	1672	3600	0.46	"C"
	2022	To & Fro	2171	3600	0.60	"C"
Indicators for Level of service (LOS)						
V/C			LOS	Performance		
0.00 - 0.2			A	Excellent		
0.20 - 0.4			B	Very good		
0.40 - 0.60			C	Good		
0.60 - 0.80			D	Fair/Average		
0.80 - 1.00			E	Poor		
> 1.00			F	Very poor		

3.7. Soil Environment

The study on soil quality establishes the baseline characteristics in the study area surrounding the project site. The study has been addressed with the following objectives to determine:

- The base line characteristics.
- The soil characteristics of proposed project site.
- The impact of industrialization/ urbanization on soil characteristics.
- The impacts on soils from agricultural productivity point of view.

3.7.1 Criteria adopted for selection of sampling locations

For studying the soil types and soil characteristics, 9 sampling locations were selected to assess the existing soil conditions representing various land use conditions and geological features. Homogenized soil samples collected at different locations during study period (Oct 2022) which were packed in a polyethylene plastic bag and sealed. The sealed samples were sent to laboratory for analysis. Important physical and chemical parameters were determined for all samples.

3.7.2 Soil sampling locations

Details of the soil sampling locations are given in **Table 3.26** and the soil sampling location map

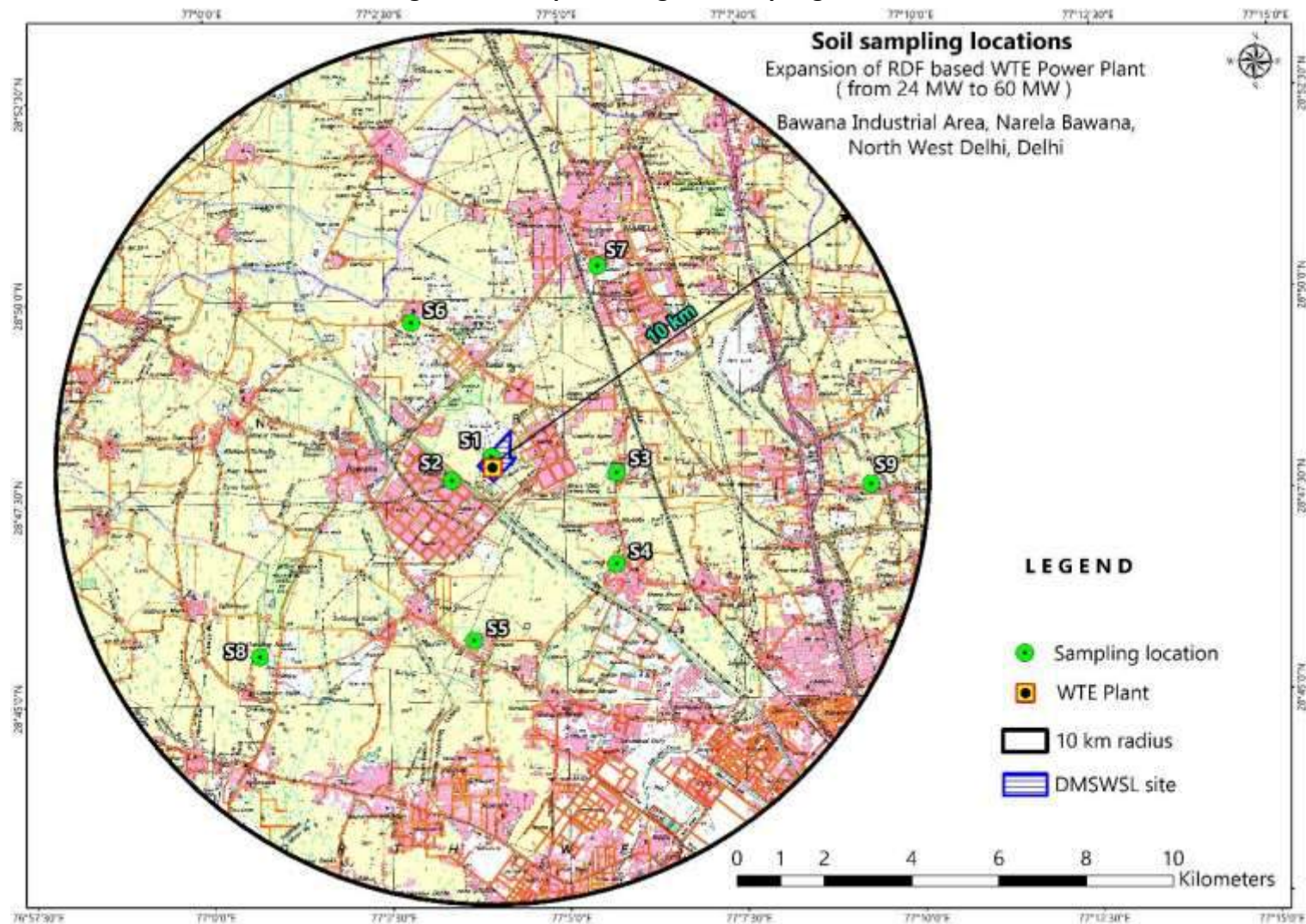
Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

is given in **Figure 3.5**. The analytical results of the soil samples collected during the study period are summarized in above **Table 3.27**.

Table 3.26: Soil sampling locations

Code	Locations	W.R.T. Site		Latitude (N)	Longitude (E)
		Distance (Km)	Direction		
S1	Site	0.0	Core	28° 47' 53.7"	77° 03' 59.2"
S2	Bawana	1	W	28° 47' 58.2"	77° 01' 35.1"
S3	Holambi Khurd	3.4	E	28° 47' 45.8"	77° 05' 55.6"
S4	Khera Khurd	3.8	SE	28° 46' 41.7"	77° 05' 59.1"
S5	Barwala	3.8	S	28° 45' 45.3"	77° 03' 57.5"
S6	Ghoga	3.9	NW	28° 49' 43.7"	77° 02' 46.6"
S7	Narela	5.7	NE	28° 51' 28.3"	77° 06' 53.4"
S8	Chandpur Khurd	6.7	SW	28° 46' 08.1"	77° 00' 13.3"
S9	Zindpur	8.8	E	28° 47' 35.5"	77° 09' 18.4"

Figure 3.5: Map showing soil sampling locations



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Table 3.27: Results of soil analysis

Parameter	Unit	S1	S2	S3	S4	S5	S6	S7	S8	S9	Standard Soil Classification – Indian Council of Agricultural Research, New Delhi
Texture	-	Sandy loam					Sandy loam				
Color	-	Brown	Light brown					Dark brown			
pH (1:5 extract)	--	7.8	8.1	8.3	7.8	7.9	7.7	8.2	8.1	8.3	• Acidic <6.0 • Normal to saline 6.0 – 8.5 • Tending to become alkaline 8.6-9.0 - Alkaline > 9.0
EC (1:5 extract)	µS/cm	303	234	195	133	235	200	537	146	165	• Normal <1000 • Critical for germination 1000 – 2000 • Critical for growth 2000- 4000 • Injurious to most crops > 4000
Bulk Density	g/cc	1.28	1.23	1.32	1.25	1.54	1.22	1.34	1.46	1.24	
Total organic Carbon	%	0.50	0.79	0.49	0.40	0.26	1.50	0.63	0.30	0.57	Low <0.5%, Medium 0.5-0.75%, High >0.75%
Calcium as Ca	mg/Kg	554	298	536	270	347	466	378	221	299	
Magnesium as Mg	mg/Kg	60.0	50.1	64.3	64.4	33.3	64.4	50.5	37.8	44.5	
Available Potassium as K	Kg/Ha	222	336	235	207	399	318	102	224	235	Low below 110; Medium 110 to 280; High above 280
Available Nitrogen as N	Kg/Ha	132	115	184	133	196	114	171	107	120	Low below 280; Medium 280 to 560; High above 560
Available Phosphorus as P	Kg/Ha	20	15	14	17	19	14	17	16	13	Low below 10; Medium 10 to 25; High above 25
Copper as Cu	mg/Kg	24.2	11.7	15.1	7.2	13.4	13.2	11.6	15.7	11.3	-
Boron as B	mg/Kg	10.7	12.2	16.8	8.8	20.2	28.4	32.3	12.2	20.4	-
Manganese as Mn	mg/Kg	326	539	294	199	228	296	286	236	186	-
Sulphur as S	%	0.62	0.25	0.21	0.20	0.18	0.57	0.52	0.42	0.65	-
Zinc as Zn	mg/Kg	117	46.7	78.1	35.9	55.7	51.3	55.3	50.8	35.8	-
Lead as Pb	mg/Kg	24.8	11.1	13.2	9.8	13.7	11.9	14.2	15.3	8.1	-
Arsenic as As	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	-
Cadmium as Cd	mg/kg	0.79	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
Total Chromium as Cr	mg/kg	86.9	47.9	42.1	33.6	37.8	55.2	43.7	41.8	33.5	-

3.7.3 Regional scenario

The pH of soil is an important property as plants cannot grow in low and high pH soils. The pH of soils in the range 6.0 to 8.5 is called normal to saline soils. Most of the essential nutrients like N, P, K, Cl and SO_4 are available for plants at neutral pH, except for Fe, Mn and Al which are available at low pH range. Soils having pH below 7 are considered to be acidic from the practical standpoint, those with pH less than 5.5 and which respond to liming may be considered as acid soils. On the basis of pH measurements, the degree of soil acidity may be indicated. The pH values in the study area varied from 7.7 to 8.3 pH for all samples fall under normal to saline category. Based on the electrical conductivity, the soils are classified into 4 groups (Normal, Critical for germination, Critical for growth of the sensitive crops, Injurious to most crops). The electrical conductivity in the study area varied from 133 to 537 $\mu S/cm$ indicating that the soils fall under normal category.

The total organic carbon in the study area varied from 0.26 to 1.50 % indicating that four samples are in low level, three samples are in medium level and all two samples are in high level. Other important parameters for characterization of soil for irrigation are Nitrogen, Phosphorus and Potassium which are known as primary nutrients whereas Calcium, Magnesium and Sulphur are known as secondary nutrients. The primary and secondary nutrient elements are known as major elements. This classification is based on their relative abundance and not on their relative importance.

Nitrogen encourages the vegetative development of plants by imparting a healthy green colour to the leaves. It also controls, to some extent, the efficient utilization of phosphorus and potassium. Its deficiency retards growth and root development, turns the foliage yellowish or pale green, hastens maturity, causes the shriveling of grains and lowers crop yield. The older leaves are affected first. An excess of nitrogen produces leathery (and sometimes crinkled) dark green leaves and succulent growth. It also delays the maturation of plants, impairs the quality of crops like barley, potato, tobacco, sugarcane and fruits increases susceptibility to diseases and causes "lodging" of cereal crops by inducing an undue lengthening of the stem internodes. The available nitrogen as N in the study area varies from 107 to 196 kg/Ha indicating that all samples are falling under low category.

Phosphorus influences the vigor of plants and improves the quality of crops. It encourages the formation of new cells, promotes root growth (particularly the development of fibrous roots) and hastens leaf development, the emergence of ears, and the formation of grains and maturation of crops. It also increases resistance to disease and strengthens the stems of cereal plants, thus reducing their tendency to lodge. It offsets the harmful effects of excess nitrogen in the plant. When applied to leguminous crops it hastens and encourages the development of nitrogen fixing bacteria. If phosphorus is deficient in the soil, plants fail to make a quick start, do not develop a satisfactory root-system, remain stunted, and sometimes develop a tendency to show a reddish or purplish de-colouration of stem and foliage owing to an abnormal increase

in the sugar content and the formation of anthocyanin. However, the deficiency of this element is not so easily recognized as that of nitrogen. It has also been observed that cattle feeding on the produce of phosphorus deficient soils become dwarfed, develop stiff joints and lose the velvety feel of the skin. Such animals show an abnormal craving for eating bones and even soil itself. In the study area available phosphorus varies from 13 to 20 kg/Ha indicating that all samples are falling under medium category.

Potassium enhances the ability of the plants to resist diseases, insect attacks, cold and other adverse conditions. It also plays an essential part in the formation of starch and production and translocation of sugars. It is of special value to carbohydrate rich crops e.g. sugarcane, potato and sugar beet. The increased production of starch and sugar in legumes fertilized with potash benefits the symbiotic bacteria and thus enhances nitrogen fixation. It also improves the quality of tobacco, citrus etc. With an adequate supply of potash, cereals produce plump grains and strong straw. But excess of elements tends to delay maturity, though not to the same extent as nitrogen. Plants can take up and store potassium in much larger quantities than what is needed for optimum growth and this excess uptake is known as luxury consumption. With the maturity or death of plants, potassium is washed out from the plant readily.

Vegetables and legumes are particularly heavy consumers of potassium. The deficiency of potassium produces the characteristic ringing of alfalfa leaves with rows of small white spots, reddish brown discoloration of cotton leaves, drying, scorching and curbing of leaf margins of potato, intra-venal chlorosis and flaring along the edges of maize leaves. The older leaves are affected first. The available potassium in the study area is varies between 102 to 399 kg/Ha indicating one sample is falling under low category, five samples are falling under medium category and three samples under high category.

3.7.4 Comparative study of soil quality from the year 2019 & 2022

Total 9 samples were analyzed and also compared with results of soil analysis from same locations collected during 2019. The comparison of soil quality is given **Table 28a & 28b**.

- The pH of all the samples were falling in Normal to Saline category
- Electrical Conductivity of all the samples are falling in Normal category
- Total Organic Carbon of all the samples are falling in Low, Medium and High category, in majority of locations the Total Organic Carbon was increasing except in two samples
- Available Nitrogen of all the samples are falling in Low category during both years, with minimum changes in the values.
- Available Phosphorous of all the samples are falling in Low to Medium category during both the years, how ever the values observed during year 2022 were more than year 2019.
- Available Potassium of all the samples are falling Medium to High during both the years, in four locations the values were less during the year 2022 when compared to year 2019.

Table 3.28a: Comparison of soil quality results for the year 2019 & 2022

Parameter	Unit	Analysis results										Standard Soil Classification – IndianCouncil of Agricultural Research, New Delhi
		Site		Bawana		Holambi Khurd		Khera khurd		Barwala		
		2019	2022	2019	2022	2019	2022	2019	2022	2019	2022	
Texture	-	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	
Color	-	Brown	Brown	Light brown	Light brown	Light brown	Light brown	Light brown	Light brown	Light brown	Light brown	
pH (1:5 extract)	--	8.1	7.8	8.3	8.1	7.9	8.3	7.7	7.8	7.9	7.9	• Acidic <6.0 • Normal to saline 6.0 – 8.5 • Tending to become alkaline 8.6-9.0Alkaline > 9.0
EC (1:5 extract)	µS/cm	386	303	456	234	465	195	480	133	395	235	• Normal <1000 • Critical for germination 1000 – 2000 • Critical for growth 2000- 4000 • Injurious to most crops > 4000
Bulk Density	g/cc	1.05	1.28	1.22	1.23	1.13	1.32	1.21	1.25	1.32	1.54	
Total organic Carbon	%	0.32	0.50	0.25	0.79	0.15	0.49	0.55	0.40	0.35	0.26	Low <0.5%, Medium 0.5-0.75%, High >0.75%
Calcium as Ca	mg/Kg	146	554	223	298	280	536	245	270	165	347	
Magnesium as Mg	mg/Kg	44	60.0	58	50.1	68	64.3	60	64.4	52	33.3	
Available Potassium as K	Kg/Ha	161	222	213	336	229	235	251	207	276	399	Low < 110; Medium 110 to 280; High > 280
Available Nitrogen as N	Kg/Ha	101	132	166	115	152	184	175	133	125	196	Low <280; Medium 280 to 560; High > 560
Available Phosphorus as P	Kg/Ha	8	20	9	15	13	14	12	17	6	19	Low <10; Medium 10 to 25; High > 25
Copper as Cu	mg/Kg	5.4	24.2	11.2	11.7	8.5	15.1	6.6	7.2	4.8	13.4	
Boron as B	mg/Kg	18	10.7	22	12.2	25	16.8	32	8.8	28	20.2	
Manganese as Mn	mg/Kg	123	326	234	539	214	294	185	199	245	228	
Sulphur	%	0.56	0.62	0.42	0.25	0.32	0.21	0.25	0.20	0.15	0.18	-
Zinc as Zn	mg/Kg	26	117	43	46.7	48	78.1	52	35.9	35	55.7	-

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Table 3.28b: Comparison of soil quality results for the year 2019 & 2022

Parameter	Unit	Analysis results								Standard Soil Classification – IndianCouncil of Agricultural Research, New Delhi
		Gh oga		Narela		Chandpur khurd		Zindpur		
		2019	2022	2019	2022	2019	2022	2019	2022	
Texture	-	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	
Color	-	reddish brown	Reddish brown	Dark brown	Dark brown	Dark brown	Dark brown	Dark brown	Dark brown	
pH (1:5 extract)	--	8.4	7.7	7.8	8.2	7.5	8.1	7.7	8.3	• Acidic <6.0 • Normal to saline 6.0 – 8.5 • Tending to become alkaline 8.6-9.0Alkaline > 9.0
EC (1:5 extract)	µS/cm	412	200	405	537	425	146	393	165	• Normal <1000 • Critical for germination 1000 – 2000 • Critical for growth 2000- 4000 • Injurious to most crops > 4000
Bulk Density	g/cc	1.55	1.22	1.22	1.34	1.08	1.46	1.01	1.24	
Total organic Carbon	%	0.18	1.50	0.21	0.63	0.22	0.30	0.24	0.57	Low <0.5%, Medium 0.5-0.75%, High >0.75%
Calcium as Ca	mg/Kg	205	466	134	378	175	221	158	299	
Magnesium as Mg	mg/Kg	75	64.4	38	50.5	65	37.8	48	44.5	
Available Potassium as K	Kg/Ha	264	318	296	102	318	224	325	235	Low < 110; Medium 110 to 280; High > 280
Available Nitrogen as N	Kg/Ha	116	114	143	171	161	107	150	120	Low <280; Medium 280 to 560; High > 560
Available Phosphorus as P	Kg/Ha	11	14	8	17	14	16	12	13	Low <10; Medium 10 to 25; High > 25
Copper as Cu	mg/Kg	10.5	13.2	7.8	11.6	7.2	15.7	6.8	11.3	
Boron as B	mg/Kg	35	28.4	28	32.3	22	12.2	32	20.4	
Manganese as Mn	mg/Kg	160	296	192	286	202	236	175	186	
Sulphur	%	0.18	0.57	0.48	0.52	0.18	0.42	0.28	0.65	-
Zinc as Zn	mg/Kg	42	51.3	28	55.3	36	50.8	40	35.8	-

3.8 Biological environment

3.8.1 Introduction

The project site is referred to hereafter as the core area while its surroundings extending up to 10 km radius is referred as the buffer zone. Post monsoon season during study period (Oct 2022) considered for the flora and fauna study.

3.8.2 Terrestrial vegetation and flora of the core zone

The proposed project site is covered with sparse vegetation of common, wild and other grass species. Common species in the site namely Neem (*Azadirachta indica*), Peepal (*Ficus religiosa*), Scholar tree (*Alstonia scholaris*), Pongam tree (*Pongamia pinnata*) etc., Wild plant species occupied in the site namely Lantana (*Lantana camara*), Prickly chaff flower (*Achyranthes aspera*), Indian Mallow (*Abutilon indicum*), Congress grass (*Parthenium hysterophorus*), Coffee Senna (*Senna occidentalis*) etc., and Poaceae species like Indian Crowfoot Grass (*Eleusine indica*), Kans Grass (*Saccharum spontaneum*), Bermuda grass (*Cynodon dactylon*) etc., List of Flora found in the Core zone is given in **Table 2.29**.

Table 3.29 List of Flora found in the Core zone

S. No.	Habit	Scientific Name	Common/ Local Name	Family Name
1	Tree	<i>Azadirachta indica</i>	Neem	Meliaceae
2	Tree	<i>Ziziphus mauritiana</i>	Ber	Rhamnaceae
3	Tree	<i>Morus alba</i>	Shahtoot	Moraceae
4	Tree	<i>Dalbergia sissoo</i>	Shisam	Legumes
5	Grass	<i>Tripidium ravennae</i>	Italian Sugarcane, Dholu	Poaceae
6	Grass	<i>Cenchrus ciliaris</i>	Buffel Grass, Anjan, Dhaman	Poaceae
7	Grass	<i>Panicum antidotale</i>	Giant Panic, Gobra ghas	Poaceae
8	Grass	<i>Setaria viridis</i>	Green Foxtail	Poaceae
9	Grass	<i>Cynodon dactylon</i>	Bermuda grass	Poaceae
10	Grass	<i>Eleusine indica</i>	Indian Crowfoot Grass	Poaceae
11	Herb	<i>Chenopodium sp.</i>	Goosefoot, Wild Spinach	Amaranthaceae
12	Herb	<i>Digera muricata</i>	Chanchali,	Amaranthaceae
13	Herb	<i>Cleome viscosa</i>	Elbow Spider Flower	Capparaceae
14	Herb	<i>Croton bonplandianus</i>	Ban Tulsi, Kala Bhangra	Euphorbiaceae
15	Herb	<i>Withania somnifera</i>	Ashwagandha	Solanaceae
16	Herb	<i>Tribulus terrestris</i>	Puncture Vine, Gokhru	Zygophyllaceae
17	Herb	<i>Tridax procumbens</i>	Tridax Daisy	Asteraceae
18	Shrub	<i>Calotropis procera</i>	Aak, Mudar	Apocynaceae
19	Shrub	<i>Parthenium hysterophorus</i>	Wild Carrot weed, Gajar Ghas	Asteraceae
20	Shrub	<i>Ricinus communis</i>	Castor Oil Plant, Arandi	Euphorbiaceae
21	Shrub	<i>Datura metel</i>	Safed Dhatura	Solanaceae
22	Shrub	<i>Prosopis juliflora</i>	Mesquite	Mimosaceae

Tree Girth Size Recorded in Core Zone

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S. No.	Habit	Scientific Name	Local Name	Girth Size of Tree	No of Trees
1	Tree	<i>Azadirachta indica</i>	Neem	>10 cm. up to 45 cm.	2
2	Tree	<i>Ziziphus mauritiana</i>	Ber	27 cm.	1
3	Tree	<i>Morus alba</i>	Shahtoot	36 cm.	1
4	Tree	<i>Dalbergia sissoo</i>	Shisam	>10 cm. to 40 cm.	10
Total Trees					14

Source: Data collected during primary survey

3.8.3 Vegetation and flora of the buffer zone

Land use and land cover of the buffer zone reveals the absence of any National Parks or Wildlife Sanctuaries or Biosphere reserves or important bird areas (IBAs) or Protected Wetlands within 10 Km radius of the project site. Forests in the study area (10 km radius) are namely Bawana Reserved forest (RF)- 1.5 km North direction, Sultanpur RF - 5.0 km SW direction and Marmurpur Protected Forest – 7.0 km NE direction. These forests were occupied with *Acacia* and *Capparis decidua* species and in terms of fauna monkeys were also observed.

Buffer zone consists of buildup area, crop land, fallow land, rural and industrial areas etc., major crops observed namely Wheat (*Triticum aestivum*); vegetables like Cauliflower (*Brassica oleracea* var. *botrytis*), Pea (*Pisum sativum*), Spinach (*Spinacia oleracea*), Fenugreek (*Trigonella foenum-graecum*), Radish (*Raphanus sativus*), Carrot (*Daucus carota*) etc., among the fruits Banana (*Musa x paradisiaca*) and Guava (*Psidium guajava*) etc., were grown in the study area.

There are many open lands covered with floral species viz. Ear leaf Acacia (*Acacia auriculiformis*), Gum Arabic (*Acacia nilotica*), Kair (*Capparis decidua*), Java plum (*Syzygium cumini*), Banyan tree (*Ficus benghalensis*), Peepal (*Ficus religiosa*), Forest Red Gum (*Eucalyptus tereticornis*), Devil tree (*Alstonia scholaris*), Golden shower tree (*Cassia fistula*), Blue Jacaranda (*Jacaranda mimosifolia*), Wild tamarind (*Leucaena leucocephala*) and other wild plants like Indian jujube (*Ziziphus mauritiana*), Lantana (*Lantana camara*), White bark Acacia (*Acacia leucophloea*), Crown flower (*Calotropis gigantea*), Rubberbush (*Calotropis procera*) etc. List of Flora (trees, shrubs and Herbs) found in the buffer zone is given in **Table 3.30**.

Table 3.30: List of Flora present in the Buffer zone

S. No.	Habit	Scientific Name	Common Name
1	Tree	<i>Acacia arabica</i>	Kikar
2	Tree	<i>Acacia auriculiformis</i>	Earleaf Acacia
3	Tree	<i>Acacia nilotica</i>	Desi Babool
4	Tree	<i>Aegle marmelos</i>	Bel
5	Tree	<i>Albizia lebbek</i>	Siris
6	Tree	<i>Alstonia scholaris</i>	Devil tree, Chitvan
7	Tree	<i>Azadirachta indica</i>	Neem, Neemdo
8	Tree	<i>Balanites aegyptica</i>	Hingota
9	Tree	<i>Bauhinia purpurea</i>	Butterfly tree
10	Tree	<i>Butea monosperma</i>	Flame of the Forest, Palas, Tendu
11	Tree	<i>Callistemon</i>	Bottle brush

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		<i>lanceolatus</i>	
12	Tree	<i>Carica papaya</i>	Papita
13	Tree	<i>Cassia fistula</i>	Golden shower tree, Amaltas
14	Tree	<i>Dalbergia sissoo</i>	Sisham
15	Tree	<i>Embllica officinalis</i>	Amla
16	Tree	<i>Eucalyptus hybrid</i>	Safeda
17	Tree	<i>Ficus benghalensis</i>	Banyan tree, Bargad
18	Tree	<i>Ficus racemosa</i>	Cluster fig
19	Tree	<i>Ficus religiosa</i>	Peepal
20	Tree	<i>Ficus virens</i>	White Fig
21	Tree	<i>Hardwickia binata</i>	Anjan
22	Tree	<i>Jacaranda mimosifolia</i>	Blue Jacaranda
23	Tree	<i>Leucaena leucocephala</i>	Wild tamarind
24	Tree	<i>Mangifera indica</i>	Mango, Aam
25	Tree	<i>Maytenus emarginata</i>	Kenkero
26	Tree	<i>Melia azedarach</i>	Chinaberry tree
27	Tree	<i>Moringa oleifera</i>	Drumstick Tree, Sahjan
28	Tree	<i>Morus alba</i>	Shatoot
29	Tree	<i>Neolamarckia cadamba</i>	Kadam
30	Tree	<i>Phoenix acaulis</i>	Khajur
31	Tree	<i>Pithecellobium dulce</i>	Manilla Tamarind
32	Tree	<i>Polyalthia longifolia</i>	Ashok
33	Tree	<i>Prosopis cineraria</i>	Khejari, Jhanti
34	Tree	<i>Psidium guajava</i>	Guava
35	Tree	<i>Salvadora oleoides</i>	Pilu, Jal
36	Tree	<i>Syzygium cumini</i>	Jamun
37	Tree	<i>Tamarindus indica</i>	Imli
38	Tree	<i>Tectona grandis</i>	Teak, Sagon
39	Tree	<i>Ziziphus mauritiana</i>	Ber
40	Tree	<i>Ziziphus nummularia</i>	Ber
41	Grass	<i>Cenchrus biflorus</i>	Bhurut
42	Grass	<i>Cenchrus ciliaris</i>	Buffel Grass, Anjan, Dhaman
43	Grass	<i>Cynodon dactylon</i>	Bermuda grass, Dab
44	Grass	<i>Cyperus rotundus</i>	Motho
45	Grass	<i>Dactyloctenium aegyptium</i>	Ghantaria
46	Grass	<i>Desmostachya bipinnata</i>	Dab
47	Grass	<i>Eleusine indica</i>	Indian Crowfoot Grass
48	Grass	<i>Panicum antidotale</i>	Giant Panic, Gobra ghas, Ghamor
49	Grass	<i>Saccharum Spontaneum</i>	Kans
50	Grass	<i>Setaria viridis</i>	Green Foxtail
51	Grass	<i>Tripidium ravennae</i>	Italian Sugarcane, Dholu

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52	Herb	<i>Achyranthes aspera</i>	Apamarga, Chichida
53	Herb	<i>Adhatoda vasica</i>	Arusa, Ardu
54	Herb	<i>Aerva persica</i>	Bui, Buvado
55	Herb	<i>Aloe vera</i>	Gawarpatha
56	Herb	<i>Amaranthus spinosus</i>	Chandalio-chatio
57	Herb	<i>Argemone mexicana</i>	Satyanasi
58	Herb	<i>Blepharis indica</i>	Cinawari, Bhangari
59	Herb	<i>Blumea obliqua</i>	Chotari Jal-Bhangaro
60	Herb	<i>Boerhavia diffusa</i>	Punarnava
61	Herb	<i>Chenopodium album</i>	Bathuwa
62	Herb	<i>Chenopodium sp.</i>	Goosefoot, Wild Spinach
63	Herb	<i>Cleome viscosa</i>	Elbow Spider Flower, Cleome, Bagra
64	Herb	<i>Corchorus tridens</i>	Chamkas, Kurand
65	Herb	<i>Cressa cretica</i>	Rudravanti
66	Herb	<i>Croton bonplandianus</i>	Ban Tulsi, Kala Bhangra
67	Herb	<i>Digera muricata</i>	Vajardanti
68	Herb	<i>Echinochloa colonum</i>	Small barnyard grass, Jangli jhangora, Jharwa,
69	Herb	<i>Echinops echinatus</i>	Looth, Gokaru
70	Herb	<i>Leucas aspera</i>	Panihari
71	Herb	<i>senna occidentalis</i>	coffeeweed, Kasunda, Bari kasondi
72	Herb	<i>Sida acuta</i>	Kala Beej Bandh
73	Herb	<i>Solanum nigrum</i>	Makoi
74	Herb	<i>Solanum xanthocarpum</i>	Kateli
75	Herb	<i>Trianthema monogyna</i>	Desert Horse Purslane, Sabuni, Salsabuni,
76	Herb	<i>Tribulus terrestris</i>	Puncture Vine, Gokhru
77	Herb	<i>Tridax procumbens</i>	Tridax Daisy
78	Herb	<i>Withania somnifera</i>	Indian Ginseng, Ashwagandha
79	Shrub	<i>Abutilon indicum</i>	Kangni
80	Shrub	<i>Caesalpinia pulcherrima</i>	Morpushp
81	Shrub	<i>Calotropis procera</i>	Aak, Aakdo, Mudar
82	Shrub	<i>Capparis decidua</i>	Ker, Kerdo, Karira
83	Shrub	<i>Cassia Tora</i>	Panwar
84	Shrub	<i>Clerodendrum indicum</i>	Bharangi
85	Shrub	<i>Coccinia indica</i>	Gol, Golan
86	Shrub	<i>Datura metel</i>	Devil's Trumpet, Safed Dhatura
87	Shrub	<i>Euphorbia caducifolia</i>	Thor, Danda Thor
88	Shrub	<i>Nerium indicum</i>	Kaner
89	Shrub	<i>Nyctanthes arbor-tristis</i>	Har singar
90	Shrub	<i>Opuntia elatior</i>	Thor, Hatha Thor
91	Shrub	<i>Parthenium hysterophorus</i>	Congress Ghas
92	Shrub	<i>Prosopis juliflora</i>	Mesquite, Vilayati Babul, Kikar
93	Shrub	<i>Ricinus communis</i>	Castor Oil Plant, Arandi

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94	Climber	<i>Asparagus racemosus</i>	Satawar
95	Climber	<i>Bougainvillea glabra</i>	Booganbel
96	Climber	<i>Cuscuta reflexa</i>	Amarbel
97	Climber	<i>Tinospora cordifolia</i>	Gilo, Giloya

Source: - data collected during primary survey. Ref: Floristic diversity of Delhi, India: a checklist, Int J herbal medicine 2015.

3.8.4 Terrestrial fauna of the core area and the buffer zone

As the animals, especially vertebrates and the winged invertebrates move from place to place in search of food, shelter, mate or other biological needs, separate lists for core and buffer areas are not feasible. There are no wildlife habitats, wetlands or IBAs within the study area (10km radius).

Primary survey carried out through physical observations, information gathered from surrounding villagers and nearby forest department. Faunal species observed in the study area were among mammals only squirrels, mongoose, rats, bandicoots, monkeys etc.; among reptiles, Lizards, Garden lizards were very common and the amphibians were also seen near the water bodies in the buffer zone. Avifauna was observed during active period of the day early morning and evening hours. Among the bird's crows, eagle, crane bird, pigeons etc. The list of fauna observed during primary survey and based on secondary sources is given in **Table 3.31**. It is apparent from the list that none of the species either spotted or reported is included in Schedule I of the Wildlife Protection Act.

Table 3.31 Fauna Recorded from Buffer zone

S. No.	Scientific Name	Common English Name	Threat Status as per IWPA-1972 & IUCN
Reptiles			
1	<i>Bungarus caeruleus*</i>	Common Indian Krait	IV
2	<i>Calotes versicolor</i>	Garden lizard	IV
3	<i>Chameleon zeylanicus*</i>	Chameleon	IV
4	<i>Hemidactylus flaviviridis</i>	Indian wall lizard	IV
5	<i>Naja naja*</i>	Cobra	II
6	<i>Ptyas mucosa*</i>	Rat snake	IV
7	<i>Varanus bengalensis</i>	Indian Monitor Lizard	I
Amphibians			
8	<i>Bufo melonosticatus</i>	Common Indian Toad	IV
9	<i>Euphlyctis hexadactylus / Rana hexadactyla</i>	Green Pond Frog	IV
Avifauna			
1	<i>Acridotheres tristis</i>	Common Myna	IV, Lc
2	<i>Alcedo atthis</i>	Common Kingfisher	IV, Lc
3	<i>Apus affinis</i>	House swift	IV, Lc

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4	<i>Ardeola grayii</i>	Indian pond heron	IV, Lc
5	<i>Bubulcus ibis</i>	Cattle Egret	IV, Lc
6	<i>Columba livia</i>	Pigeon	IV, Lc
7	<i>Coracias benghalensis</i>	Indian Roller	IV, Lc
8	<i>Corvus splendens</i>	House Crow	IV, Lc
9	<i>Cuculus micropterus</i>	Indian cuckoo	IV, Lc
10	<i>Dicrurus macrocercus</i>	Black drongo	IV, Lc
11	<i>Egretta garzetta</i>	Little egret	IV, Lc
12	<i>Eudynamys scolopaceus</i>	Asian koel	IV, Lc
13	<i>Francolinus pondicerianus</i>	Grey francolin	IV, Lc
14	<i>Halcyon smyrnensis</i>	White-throated kingfisher	IV, Lc
15	<i>Himantopus himantopus</i>	Blackwinged Stilt	IV, Lc
16	<i>Hirundo smithii</i>	Wire-tailed swallow	IV, Lc
17	<i>Merops orientalis</i>	Green Bee eater	IV, Lc
18	<i>Mesophoyx intermedia</i>	Intermediate egret	IV, Lc
19	<i>Passer domesticus</i>	House Sparrow	IV, Lc
20	<i>Pavo cristatus</i>	Indian Peafowl	I, Lc
21	<i>Psittacula krameri</i>	Parrot	IV, Lc
22	<i>Pycnonotus cafer</i>	Red-vented Bulbul	IV, Lc
23	<i>Saxicoloided fulicata</i>	Indian Robin	IV, Lc
24	<i>Streptopelia tranquebarica</i>	Red Collared dove	IV, Lc
25	<i>Turdoides caudatus</i>	Common Babbler	IV, Lc
26	<i>Turdoides striatus</i>	Jungle babbler	IV, Lc
27	<i>Vanellus cinereus</i>	Red-wattled lapwing	IV, Lc
Mammals			
1	<i>Bandicota indica*</i>	Large bandicoot rat	IV, Lc
2	<i>Funambulus pennanti</i>	Five stripped palm squirrel	IV, Lc
3	<i>Herpestes edwardsii</i>	Indian grey mongoose	II (Part I), Lc
4	<i>Hystrix indica*</i>	Indian crested porcupine	IV, Lc
5	<i>Macaca mulatta</i>	Rhesus macaque	II, Lc
6	<i>Rattus rattus</i>	Common Indian rat	IV, Lc
* Included in the list on the basis of the secondary evidences i.e. as informed by local people.			

Source: Both primary and secondary data (includes Zoogeographical information system, forest department, local villagers)

Ref: Fauna of Delhi, state fauna series 6 by Zoological survey of India 1997. Avibase- The world bird database, website.

3.8.5 Aquatic flora and fauna

A list of aquatic macrophytes found near the water bodies is given in **Table 3.32**.

Table 3.32: List of semi aquatic macrophytes and aquatic fauna

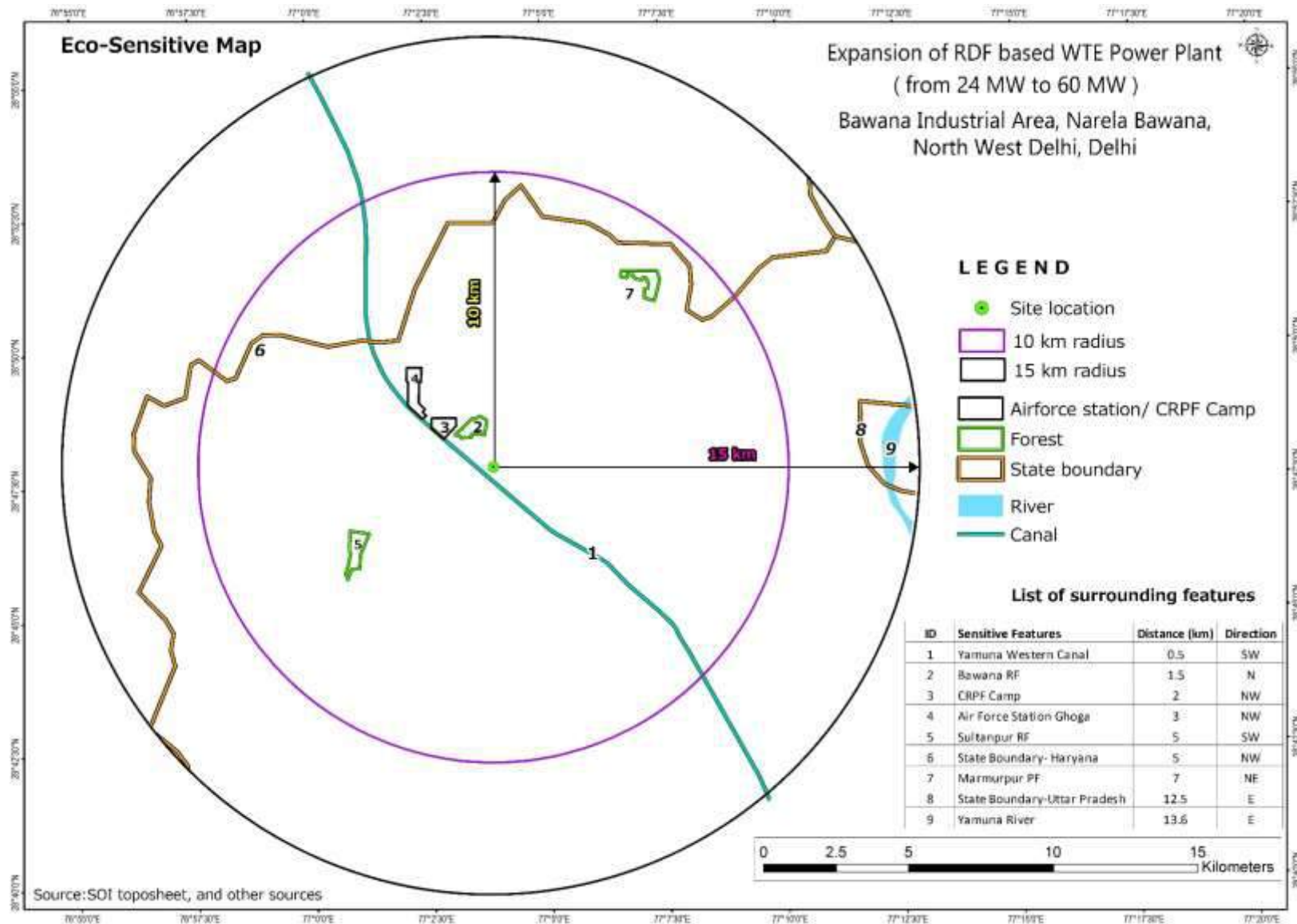
S.No	Latin name	Local / Common name	Family
1	<i>Ipomoea aquatica</i>	Water spinach	Convolvulaceae
2	<i>Ipomoea carnea</i>	Bush Morning Glory	Convolvulaceae
3	<i>Oxalis corniculata</i>	Indian Sorrel	Oxalidaceae
4	<i>Eichhornia crassipes</i>	Common water hyacinth	Pontederiaceae
5	<i>Alternanthera philoxeroides</i>	Alligator weed	Solanaceae
6	<i>Typha angustata</i>	Cattail	Typhaceae

3.8.6 Details regarding the project boundary passing through any eco-sensitive area and within 10 km from eco-sensitive area.

As stated above, there are no ecologically sensitive areas such as the Wildlife Sanctuaries, National Parks, Biosphere Reserves, Important Bird Areas (IBAs), Wetlands or any other protected area either in the project site or in the buffer zone except the above-mentioned forests. There are three blocks of open dry deciduous reserve forests in the buffer zone. Eco-sensitive map is shown in **Figure 3.6**.

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Figure 3.6: Eco-sensitive map of the study area



3.9 Land use/ land cover study

The satellite based remote sensing is a sustainable global information system which has the potential to meet the needs and demands of the present and future. The synoptic coverage which provides capability for integration of real time information on regional and global scales is a unique characteristic of this information system. Its versatility lies in its inherent capability to conceptualize situation to give clear perceptions for defining short term and long-term objectives. A very small activity could bring about changes in the land use and land cover in the vicinity. A data base on land use and land cover indicates ecosystems existing in and around the center of an economic activity, to safeguard and to allow comparison at a future date to draw conclusions on the nature. The study on land use and land cover is carried out within about 10 km radius of the proposed project.

3.9.1 Methodology for LULC mapping

Methodology

Land use\Land cover mapping involves primary and secondary data collection. High resolution satellite images IRS LISS-IV has been used to map the land use features. SOI Toposheets were used as secondary source for geographic reference of the study area and for geo-referencing the satellite images.

Land use features have been digitized using ARC GIS-10 application tools and categorized as per standard NRSC land use classes. Ground truth forms an important and integral part of the interpretation methodology of remotely sensed data. After creation of draft LULC, the same has been verified by Remote Sensing expert on field for preparation of final LULC. This increases the interpretation accuracy as well as accuracy of LULC. This also enables to verify details which cannot be obtained from satellite imagery. The base map information such as major roads, railways network and drainage networks were extracted from the available survey of India (SOI) Toposheets on 1:50,000 scale vectorized using “ARC/INFO” (Geographic Information System) Software.

The satellite map of the study area (10 km radius of the project site) is provided in **Figure 3.7**. The land utilization pattern of 10 km radius area is given in **Table 3.33** whereas land use comparison is given in **Table 3.34**. Land utilization maps of year 2010-2020 and year 2022 are given in **Figure 3.8 and 3.9**.

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Figure 3.7: Satellite map of the 10 km radius of the study area

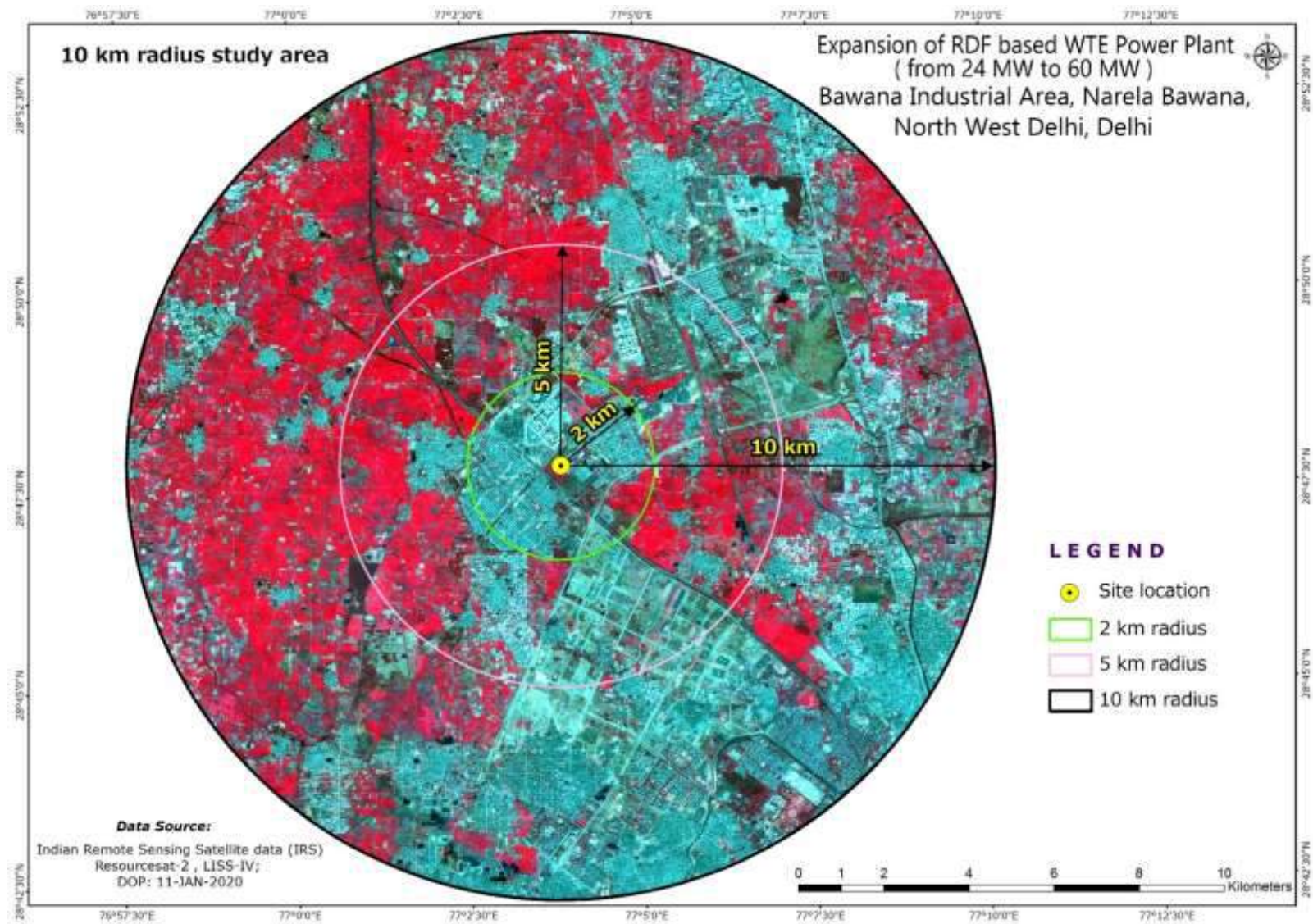


Table 3.33: Land utilization pattern of 10 km radius of study area in Year 2019-20 & 2022

Year-2022					
10 km radius					
L1			L2		
Class	Area (ha.)	% of area	Class	Area (ha.)	% of area
Built-Up	14638	44.7	Urban	8195	25.1
			Rural	2569	7.9
			Industrial Area	3874	11.9
Agriculture	16433	50.3	Crop Land	14114	43.2
			Fallow Land	2319	7.1
Waterbodies	702	2.2	Canal/ Nala	390	1.2
			Pond/ Lake	312	1
Forest	306	0.9	Forest Plantation	306	0.9
Wasteland	608	1.9	Scrub Land	608	1.9
Year-2019-20					
10 km radius					
L1			L2		
Class	Area (ha.)	% of area	Class	Area (ha.)	% of area
Built-Up	13729	42	Urban	8164	25
			Rural	2360	7.2
			Industrial Area	3205	9.8
Agriculture	17249	52.8	Crop Land	15323	46.9
			Fallow Land	1926	5.9
Waterbodies	512	1.6	Canal/ Nala	390	1.2
			Pond/ Lake	122	0.4
Forest	274	0.8	Forest Plantation	274	0.8
Wasteland	923	2.8	Scrub Land	923	2.8

Table 3.34: Land use pattern comparison

Land use-Classes	2019-20		2022	
	Area (ha.)	% of area	Area (ha.)	% of area
Built-Up	13729	42	14638	44.7
Agriculture	17249	52.8	16623	50.3
Waterbodies	512	1.6	702	2.2
Forest	274	0.8	306	0.9
Wasteland	923	2.8	608	1.9
Total		100		100

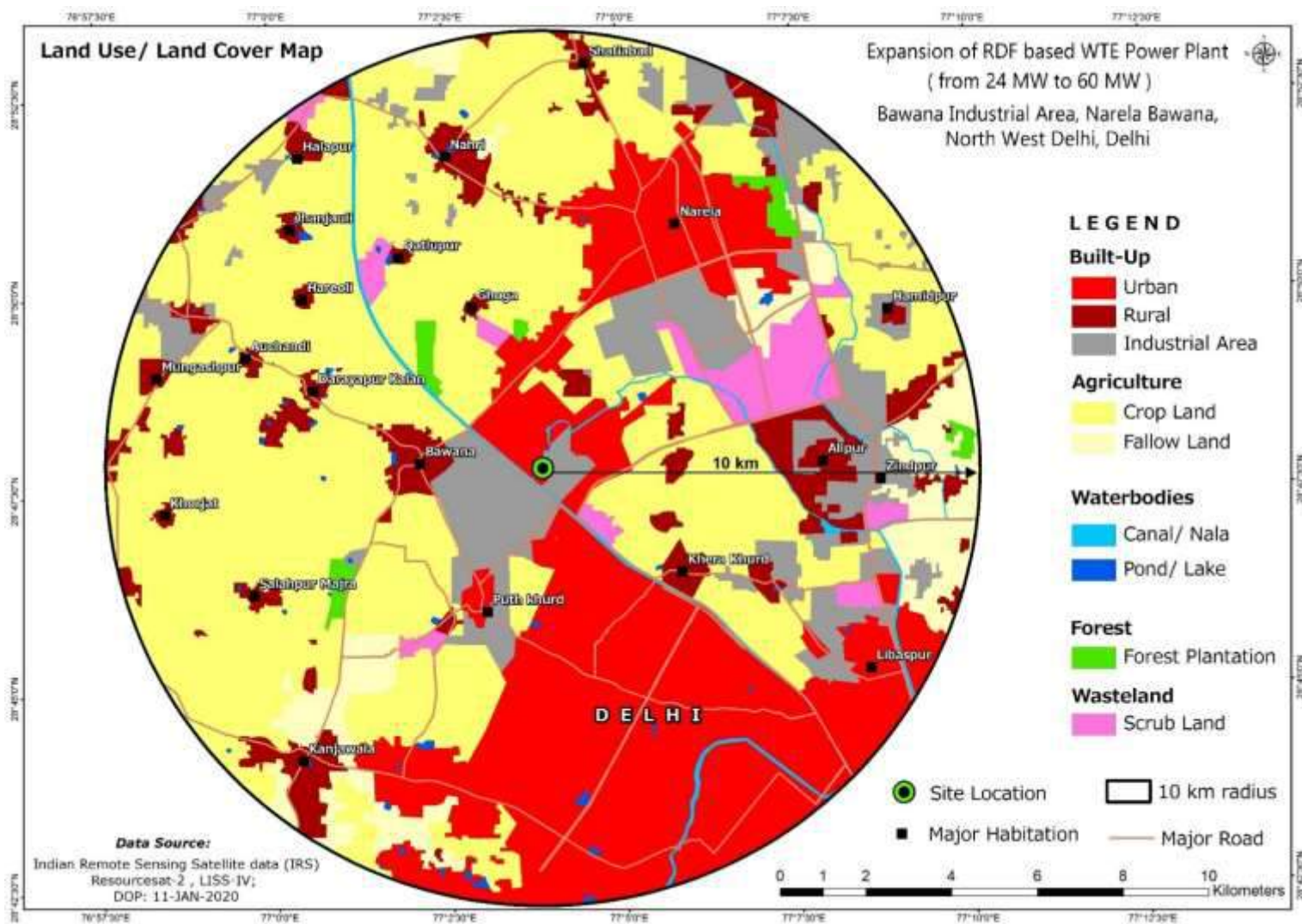
According to comparison analysis, it is observed that there is a significant development of built-up area which includes industrial, urban and rural area, due to rapid urbanization along with development industrial area caused increases of overall built area in present scenario. At the same time reduction in the agriculture land seen because of industrial development as

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due not profitable yield from crop land which kept as fallow land and followed by fallow getting barren and further used for industrial development, which are giving more yield than agriculture. Meanwhile waterbodies are and forest area has been increased due to it is post monsoon season where dried pond and few low-lying areas are filled with rain water which may not be visible during summer and significant forest plantation leads to increases forest area compare to old data. No significant changes observed in wasteland area.

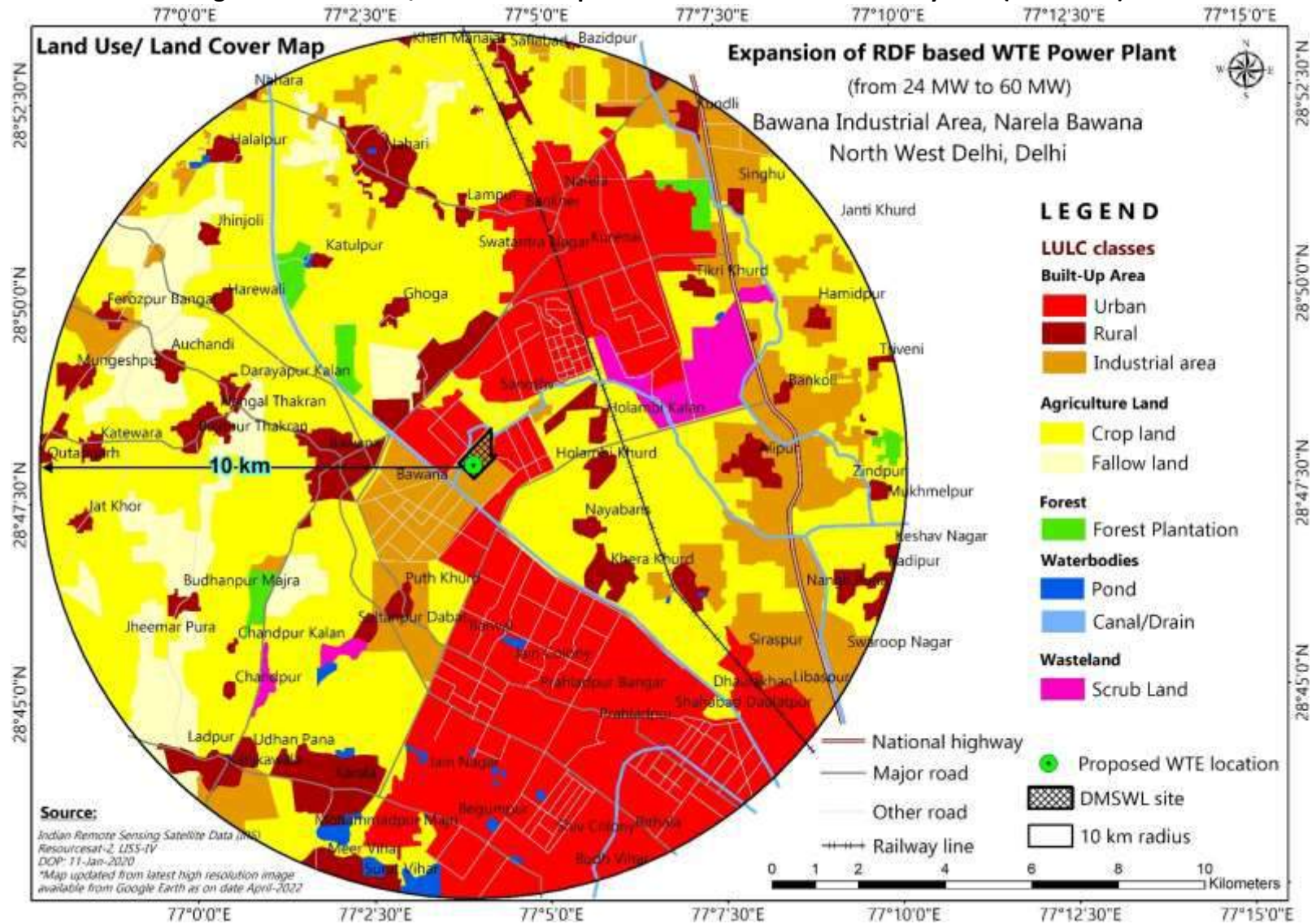
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Figure 3.8: Land use/Land cover map of the 10 km radius of the study area Year 2019-20



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Figure 3.9: Land use/Land cover map of the 10 km radius of the study area (Year 2022)



3.10 Socio-economics environment

Socioeconomic environmental circumstances examine a wide range of interrelated and diverse aspects and variables relating to an amalgamation of social and economic factors. In the context of the proposed expansion project, a socioeconomic assessment would aid in understanding how the proposed development will improve the lives of current and future members of the local community. Evidently, any developmental activity includes community life as well as social and cultural attributes, which includes the understanding of quality of life, concerned with requirements for public services such as housing, water, sanitation, communications, safety and security facilities, solid waste disposal, as well as health and educational services, etc. Thus, the socio-economic assessment is considered to be one of the primary parameters that helps to get an idea of the existing and possible impacts on social and economic conditions due to the proposed facility.

The below section deals with the prevailing socio-economic conditions of villages located in the radius of 0–10 kms of the study area. The following section describes the impactful developmental interventions required for the people and villages existing in the project area, along with a detailed analysis of the demographic scenario.

3.10.1 Methodology adopted for the study

The Socio-Economic study categorizes the study area into 3 zones, namely the Core Zone (0 to 2 km radius), the Buffer Zone (2 to 5 km radius) and other villages which are within a 5 to 10 km radius of the proposed project site. The SE data is collected from various census towns, DMC Wards, and villages located in Narela Tehsil of North West Delhi District of NCT Delhi and the villages coming under Sonipat Tehsil of Haryana. Details of study area is given below in **Table 3.35**.

Table 3.35: Details of the Study Area

S. No	Category	No. of villages/towns	Total Population
Narela Tehsil of North West Delhi District			
1	Core zone 0-2 km	4	1,27,502
2	2 - 5 km radius	8	51,654
3	5-10 km radius	35	4,95,283
Total		47	6,74,439
Few villages of Sonipat Tehsil of Haryana			
4	5-10 km radius	9	44,184

The study adopts a two-fold methodology for data collection, namely, review of published secondary data and analysis of primary data. The secondary source of information includes materials; statistics, research work, and study reports that may provide data and information about conditions in the study site, which have to be reviewed. This includes available data and information about various socioeconomic aspects, environmental quality, as well as

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current development schemes. Considering, Census data is relatively highly reliable and represents one of the main secondary sources of data and information.

The implementation of the socioeconomic study also involves a number of fieldwork activities, which include field surveys to acquire data and information from primary sources. This data and information are mainly collected through observation, personal or focus group discussions to illustrate any pre-existing concerns or future perspectives of the study area. The Random Sample Survey method is used to collect the primary data from the people and villages located in the proposed project study area.

3.10.2 Demographic aspects

3.10.2.1 Distribution of population

The study area shares two state boundaries which comprises Narela Tehsil of North West Delhi covering majority of the study area and a part of Sonipat Tehsil of Haryana, consisting of 6,74,439 and 44,184 population as per Census of India respectively. A detailed distribution of population in the study area are given in **Tables 3.36 and 37**.

Table 3.36: Distribution of population -Narela Tehsil of North West Delhi-NCT Delhi

Particulars	0-2km	2-5km	5-10km	Total (0-10 km)
Number of households	23,410	9,892	97,952	1,31,254
Male population	69,443	28,001	2,67,946	3,65,390
Female population	58,059	23,653	2,27,337	3,09,049
Total population	1,27,502	51,654	4,95,283	6,74,439
SC population	25,764	11,450	1,02,095	1,39,309
ST population	0	0	0	0
Total population (0-6 years)	18,620	7,021	67,462	93,103
Average household size	5.4	5.2	5.1	5.1
% of males to the total population	54.5	54.2	54.1	54.2
% of females to the total population	45.5	45.8	45.9	45.8
Sex ratio (number of females per 1000 males)	836	845	848	846

Source: District Primary Census statistics of NCT Delhi -2011

A detailed distribution of population in the study area (5-10 km) part of Sonipat Tehsil of Haryana is given in the Table below:

Table 3.37 Distribution of population of selected villages of Sonipat Tehsil, Haryana

Particulars	5-10 km
Number of households	9,359
Male population	24,268
Female population	19,916
Total population	44,184
SC population	9,224
ST population	0
Total population (0-6 years)	6,443
Average household size	4.7
% of males to the total population	54.9
% of females to the total population	45.1
Sex ratio (number of females per 1000 males)	821

Source: District Primary Census statistics of Haryana -2011

As illustrated in the above tables, the gender diversity, as percentage of men and women in Narela Tehsil of North West Delhi (NCT Delhi) constitute about 54.2 % and 45.8 % in the study area respectively. Whereas, the gender diversity, as percentage of men and women in the parts of Sonipat Tehsil of Haryana accounted to be about 54.9 % and 45.1 % respectively.

3.10.2.2 Average household size

According to the Census of India data of Yr. 2011, study area had an average family size of 5 people per household. This represents majorly nuclear family size and also in similarity with other parts of the district.

3.10.3 Social Profile

Sex ratio

To reiterate; the male and female population constitute 54.2 % and 45.8 % respectively and number of females per 1000 males is low as 846 as compared to National Sex Ratio 943 females per 1000 male. The gap in sex ratio reveals certain sociological aspects with regards female birth rate in rural areas. This is a result of growing infant mortality among female children, single child family structure and also migration of industrial workers.

Population projections and density

It is estimated that the average density of population of the study area is 272 persons per km². The population projections in the project area is given below in **Table 3.38**.

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Table 3.38: Details of the Population Projection

Annual population projections in the project area				
Percentage Decadal Variation in North West Delhi District (2001-11)	Year	Population	Male	Female
Decadal Population growth rate 73.85 Total Annual Percentage Growth Rate 7.38 Male Annual Percentage Growth Rate 6.9 Female Annual Percentage Growth Rate 7.9	1991	2,14,636	1,19,039	95,597
	2001	3,87,944	2,15,426	1,72,518
	2011	6,74,439	3,65,390	3,09,049
	2012	7,24,066	3,90,602	3,33,464
	2013	7,77,361	4,17,553	3,59,808
	2014	8,34,597	4,46,365	3,88,232
	2015	8,96,066	4,77,164	4,18,903
	2016	9,62,084	5,10,088	4,51,996
	2017	10,32,988	5,45,284	4,87,704
	2018	11,09,141	5,82,909	5,26,232
	2019	11,90,934	6,23,129	5,67,805
	2020	12,78,787	6,66,125	6,12,661
	2021	13,73,149	7,12,088	6,61,061
	2022	14,74,507	7,61,222	7,13,285
	2023	15,83,381	8,13,746	7,69,635
	2024	17,00,331	8,69,895	8,30,436
	2025	18,25,958	9,29,918	8,96,040
	2026	19,60,910	9,94,082	9,66,828
	2027	21,05,881	10,62,674	10,43,207
	2028	22,61,618	11,35,998	11,25,620
	2029	24,28,926	12,14,382	12,14,544
	2030	26,08,668	12,98,174	13,10,493
	2031	28,01,771	13,87,748	14,14,022

Source: District Primary Census statistics of NCT Delhi -2011

Social Characteristic

The Socio-Economic study observed that 20.7 % of total population in the study area which includes Narela Tehsil of North West Delhi (NCT Delhi) belongs to Scheduled Caste (SC) category. Whereas, a part of Sonipat Tehsil which is coming within the study area evidences 20.9 % of total population belongs to Scheduled Caste. No Schedule Tribe (ST) population recorded in the study area. The distribution of population in the study area by social structure are illustrated in **Tables 3.39 and 3.40**.

Table 3.39: Population distribution by social structure-Narela Tehsil of North West Delhi-NCT Delhi

Particulars	0-2 km	2-5 km	5-10 km	Total (0-10 km)
SC population	25,764	11,450	1,02,095	1,39,309
ST population	0	0	0	0
% of SC to the total population	20.21	22.17	20.61	20.66
% of ST to the total population	0	0	0	0
Total SC & ST population	25,764	11,450	1,02,095	1,39,309
Percentage to the total population	20.21	22.17	20.61	20.66
Total population	1,27,502	51,654	4,95,283	6,74,439

Source: District primary census statistics of NCT Delhi,2011

Table 3.40: Population distribution by social structure of selected villages of Sonipat Tehsil, Haryana

Particulars	5-10km
SC population	9,224
ST population	0
% of SC to the total population	20.88
% of ST to the total population	0
Total SC & ST population	9,224
Percentage to the total population	20.88
Total population	44,184

Source: District primary census statistics of Haryana, 2011

3.10.4 Basic Infrastructural Facilities

Literacy levels

The analysis of the literacy levels in selected villages of Narela Tehsil of North West Delhi (NCT Delhi) reveals an average literacy rate of 69.5 % as per available census data. However, the male literacy rate of the study area is 58.7 %, whereas the literacy rate among women, which is an important indicator for social change, is estimated to be as low as 41.0 % of the total literate. Details of the literacy distribution have been given below in Table

Moreover, literacy levels in selected villages of Sonipat Tehsil of Haryana indicate an average rate of about 69.4% as per census 2011 data. The male literacy rate of the selected villages is 60%, and the literacy rate among women is estimated to be around 40% of the total literate. The distribution of literates and literacy rates in the study area are illustrated in **Table 3.41 and 3.42.**

Table 3.41: Distribution of literate and literacy rates- Narela Tehsil of North West Delhi- NCT Delhi

Particulars	0-2 km	2-5 km	5-10 km	Total (0-10 km)
Male population	69,443	28,001	2,67,946	3,65,390
Female population	58,059	23,653	2,27,337	3,09,049
Total population	1,27,502	51,654	4,95,283	6,74,439
Male literates	46,245	21,959	2,07,106	2,75,310
Female literates	30,037	15,632	1,47,649	1,93,318
Total literates	76,282	37,591	3,54,755	4,68,628
% of Male literates	60.62	58.42	58.38	58.75
% of Female literates	39.38	41.58	41.62	41.25
% of Male literates to the Male population	66.59	78.42	77.29	75.35
% of Female literates to the Female population	51.74	66.09	64.95	62.55
Total literacy rate (%)	59.83	72.77	71.63	69.48

Source: District primary census statistics of NCT Delhi, 2011

Table 3.42: Distribution of literate and literacy rates of selected villages of Sonipat Tehsil, Haryana

Particulars	5-10km
Male population	24,268
Female population	19,916
Total population	44,184
Male literates	18,422
Female literates	12,242
Total literates	30,664
% of Male literates	60.08
% of Female literates	39.92
% of Male literates to the Male population	75.91
% of Female literates to the Female population	61.47
Total literacy rate (%)	69.40

Source: District primary census statistics of Haryana, 2011

Details of village-wise educational centres within the study area, excluding colleges and university level facilities have been shown in **Table 3.43**.

Table 3.43: village-wise educational centres

Villages	School	Class	Type
Narela	Narela, SBV	Nur. to XII	Boys
	No.1-SKV	Nur. to XII	Girls
	Narela-GBSSS (Mussadi Lal)	VI to XII	Boys
	Narela, No.2-SKV	Nur. to XII	Girls
	Narela, Pocket 5 & 6-GGSSS	VI to XII	Girls
	Narela, A-10 Pocket-5, RPVV	Nur. to XII	Co-ed
	Narela Sector B-4, SV-131040	Nur. to XII	Co-ed
	Narela, Sect. A-6, Pkt-2 -SBV	Nur. to XII	Boys
Bawana	GBSSS	VI to XII	Boys
	SKV (Ravi Shankar)	Nur. to XII	Girls
	Bawana J. J. Colony No.1 GGSSS	VI to XII	Girls
	Bawana J. J. Colony No.2 GBSSS	VI to XII	Boys
	Bawana, J.J Colony- GGSS	VI to X	Girls
Sannoth	SV	Nur. to XII	Co-ed
Holambi Khurd	GSS		Co-ed
Holambi Kalan	B-Block GBSSS	VI to XII	Boys
	Metro Vihar, C-Block- G (Co-ed) SSS	VI to XII	Co-ed
	METRO VIHAR, A-BLK G (Co-ed) SSS	VI to XII	Co-ed
	B-Block GGSSS	VI to XII	Girls
	G(Co-ed) SSS	VI to XII	Co-ed
Tikri Khurd	SKV	Nur. to XII	Girls

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	SBV	Nur. to XII	Boys
Pooth Khurd	GBSSS	Nur. to XII	Boys
	SKV	Nur. to XII	Girls
Alipur	Gbsss	VI to XII	Boys
	SKV	Nur. to XII	Girls
Bhorghar	GBSSS	VI to XII	Boys
Nargal Tharan	SBV	Nur. to XII	Boys
Barwala	G-(Co-ed) SSS	VI to XII	Co-ed
Auchandi	SV	Nur. to XII	Co-ed
ShahbadDaulatpur	GGSSS	VI to XII	Girls
	GBSSS	VI to XII	Boys
	Dairy-GBSSS	VI to XII	Boys
Ghoga	G (Co-ed) SSS	VI to XII	Co-ed
Prahaladpur	Prahaladpur-SBV	Nur. to XII	Boys

Source:http://web.delhi.gov.in/wps/wcm/connect/doiit_education/Education/Home/School+Inormations/

Source of Drinking Water

As per census (2011), the primary sources of drinking water come from tap facilities, tube wells/boreholes and hand pumps. The majority of the households in the study area have portable water access within or nearby, their residential premises.

Medical and Health Facilities

The study area has witnessed well developed medical centres, which includes both private and government facilities. The secondary analysis indicates that the Primary Health centres, also known as Aam Aadmi Moholla Clinic, offers basic health care services along with medicines and diagnostic support across villages. The Narela sub division is well facilitated with more than 15 Govt. Hospitals, dispensaries and polyclinics services along with other private clinics.

3.10.5 Economic Profile

Occupational Pattern

A detailed analysis of 2011 census data indicates that the study area accounted for 29% of the main working class of the total population. Whereas, marginal workers and non-workers constitute 2 % and 69 % of the total population, respectively. The distribution of workers by occupation indicates that non-workers are the predominant population. The occupational structure of the study area is given in the **Table 44**.

Table 3.44: Occupational structure- Narela Tehsil of North West Delhi-NCT Delhi

Particulars	0-2 km	2-5 km	5-10 km	Total (0-10 km)
Total population	1,27,502	51,654	4,95,283	6,74,439
Total workers	40,640	15,677	1,51,811	2,08,128

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Work participation rate (%)	31.87	30.35	30.65	30.86
Main workers	37,077	14,685	1,42,858	1,94,620
Percentage of main workers to total population	29.08	28.43	28.84	28.86
Marginal workers	3,563	992	8,953	13,508
Percentage of marginal workers to total population	2.79	1.92	1.81	2.00
Non-workers	86,862	35,977	3,43,472	4,66,311
Percentage of non-workers to total population	68.13	69.65	69.35	69.14
Dependency ratio	2.14	2.29	2.26	2.24

Source: District primary census statistics of NCT Delhi, 2011

However, the selected villages of Sonipat Tehsil within a 5-10 km radius have 28 % of the total population's main workers, followed by marginal workers and non-workers, who account for 6 % and 65 % of the total population, respectively. The distribution of workers by occupation indicates that non-workers are the predominant population. The occupational structure of the Sonipat area is given in **Table 3.45**.

Table 3.45: Occupational structure of selected villages of Sonipat Tehsil, Haryana

Particulars	5-10km
Total population	44,184
Total workers	15,503
Work participation rate (%)	35.09
Main workers	12,650
Percentage of main workers to total population	28.63
Marginal workers	2,853
Percentage of marginal workers to total population	6.46
Non-workers	28,681
Percentage of non-workers to total population	64.91
Dependency ratio	1.85

Source: District primary census statistics of Haryana, 2011

Likewise, the Socio-Economic data illustrated that cultivators and agriculture labour are predominant among the main working population in the study area. However, the study also revealed significant numbers of main other workers, who have been engaged in household industry, construction, trade and commerce, transport and communication and other services. The typology of main working population is illustrated below in the **Table 3.46 and 3.47**.

Dependency ratio

Based on the occupational structure of the study area the dependency rate of non-workers on the workers category has been estimated at 1:2. which indicates that majority of the

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educated youth are also part of the non-working population as they have limited employment opportunities in the area. The study also noted that work participation rate is 30.5% in the project area.

Table 3.46: Typology of main working population Narela Tehsil of North West Delhi-NCT Delhi

Particulars	0-2km	2-5km	5-10km	Total (0-10 km)
Population of main Cultivators	557	975	3,492	5,024
Agricultural Labour Population	794	736	2,490	4,020
Main Household Workers	918	347	3,758	5,023
Main Other working population	34808	12627	133118	1,80,553
Total Main Working population	37077	14685	142858	1,94,620
Total Population	1,27,502	51,654	4,95,283	6,74,439

Source: District primary census statistics of NCT Delhi, 2011

Table 3.47: Typology of main working population of selected villages of Sonipat Tehsil, Haryana

Particulars	5-10km
Population of main Cultivators	1,730
Agricultural Labour Population	1,045
Main Household Workers	349
Main Other working population	9,526
Total Main Working population	12,650
Total Population	44,184

Source: District primary census statistics of Haryana, 2011

3.10.6 Public utilities and Quality of Living

While illustrating the socio-economic structure of the study area, one should prioritize the physical amenities of the area, which induces the dynamics in the social fabric and focuses on the quality of life. Thus, this section highlights the details of the basic amenities identified from the Census record 2011. A detailed secondary analysis of the physical amenities of the study area indicates that the region is well facilitated with necessary basic amenities like a source of drinking water, a source of lighting, better housing services, drainage and sewage network etc.

The majority of the settlements in the study area have evidenced a proper source of drinking water within or nearby premises. Most of the houses in the villages and urban centers are in good and liveable condition, with concrete roofs and burnt brick walls. Quite a good number of settlements have proper latrine facilities within their residing premises, whereas there are few habitations that are still reliant on open defecation. A small number of scattered settlements have been observed within the radius of 0-3 km from the project site. The dwelling houses in this area are predominantly made of grass, thatch, bamboo, wood, mud, etc. As the Bawana Industrial area forms a part of the study area, majority of the working

population in the Industrial area comes from nearby villages and they are engaged in construction, trade and commerce, transport and communication activities.

3.10.7 Primary observations

In order to prepare a comprehensive report, villages in the project area and core and buffer zones, i.e. 0-10 km radius of the proposed WTE, were visited for conducting village level and household level survey activities along with focus group discussions. The surveys were conducted through a semi-structured/open-ended questionnaire about socio-economic aspects, including questions on the aspirations and requirements of the people for a better life. The village level formats were filled in order to capture the overall condition of the village with respect to community land, availability of potential earning opportunities in the vicinity, community institutions (schools, Anganwadi centers, health sub-centers, community centers, places of worship, etc.), availability of electricity, provision of drainage and toilet facilities etc. The village visits, surveys, and discussions were carried out from September 29th September to 10th October of 2022. As part of the survey activity, 15 villages in Narela tehsil of North West Delhi (NCT) Delhi were selected.

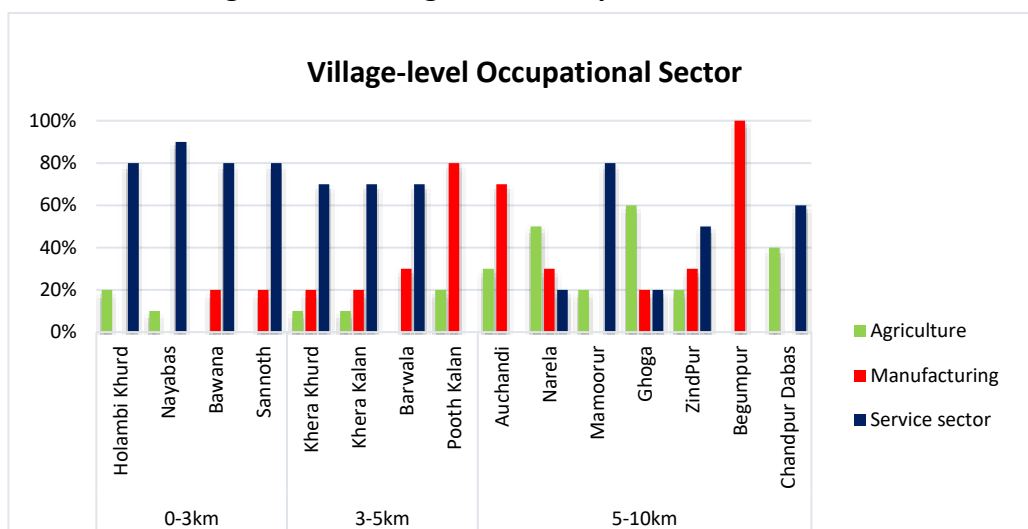
Observed conditions at the proposed project site and its surroundings

At the proposed expansion of Waste to Energy (WTE) project, villages within a radius of nearly 10 kms have been inhabited by a mix of social structures. The majority of these villages are facilitated with proper infrastructure services. The study area witnessed proper drainage and sewage network, adequate supply of power and portable drinking water facilities.

A majority of people in the area are engaged in the secondary and tertiary sectors. Some work as daily wage labourers in the Bawana Industrial Area. Some are also employed in government and private sectors, and a very few are engaged as agriculture labourers on local farms. Those who are not employed are involved in petty business activities.

The major source of income but subsistence to the extent of supporting household needs comes from the secondary sector. A large number of locals depend on the Bawana industrial area and are engaged in industries like electrical goods and appliances, auto parts, light engineering and service, plastics, polymers, textiles and apparel, etc. As the villages lie within the fringe area of the Delhi region, most of the villages are well equipped with both social and physical infrastructure facilities. In the local villages' basic facilities like education, transportation, roads and infrastructure are well developed, but to some extent, needs for further improvements still exist. The local people are expecting facilities like professional training centers, self-employment schemes for women and unemployed educated youth. Village level occupational sector is shown as **Figure 3.10**.

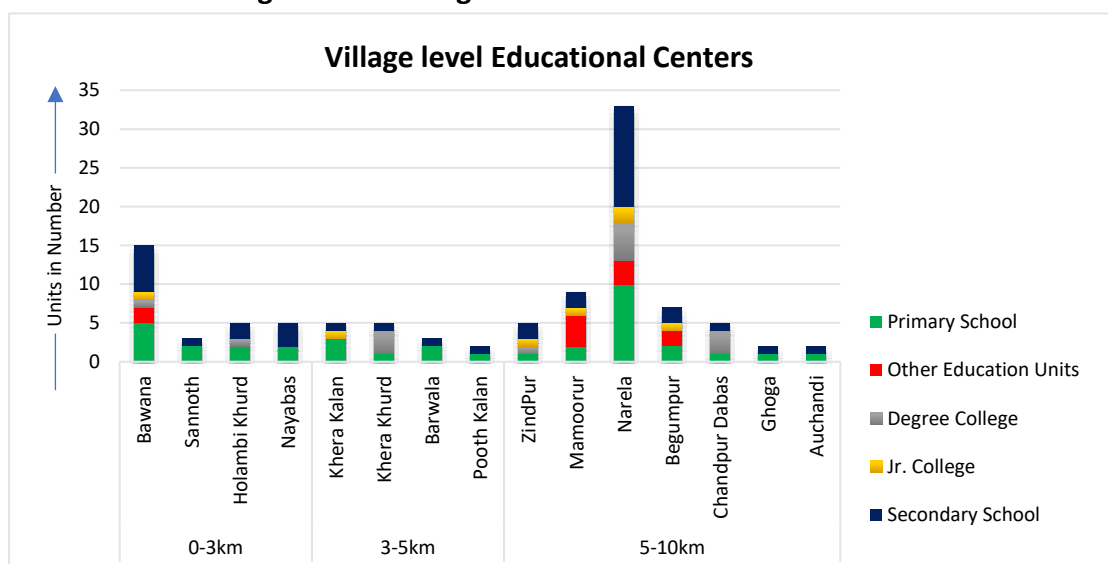
Figure 3.10: Village level Occupational Sector



Educational Infrastructure

The educational infrastructure has been observed to be very basic and preliminary in the local villages. The majority of the villages have anganwadi primary schools followed by middle schools and the basic infrastructure of schools are in fair condition. The FGDs revealed that villages depend on Narela town and Bawana town for senior secondary schools, higher education, graduate programs, ITI colleges, and vocational training institutes. Graphical representation of village level educational centres is shown as **Figure 3.11**.

Figure 3.11: Village level Educational Centers



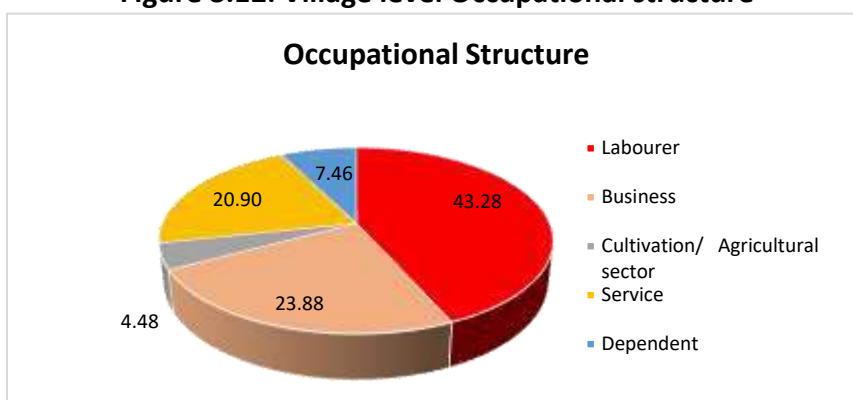
Occupational Structure

The primary data collected from the surveyed villages indicates that nearly 43% of the working population belongs to a labour class involved in small and medium-scale manufacturing sectors, followed by people engaged in small businesses (24%), people working as private and government servants (21%), whereas, nearly 8% of the respondents are dependent

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population, and the remaining 4% are local farms. Graphical representation of village level occupational structure is shown as **Figure 3.12**.

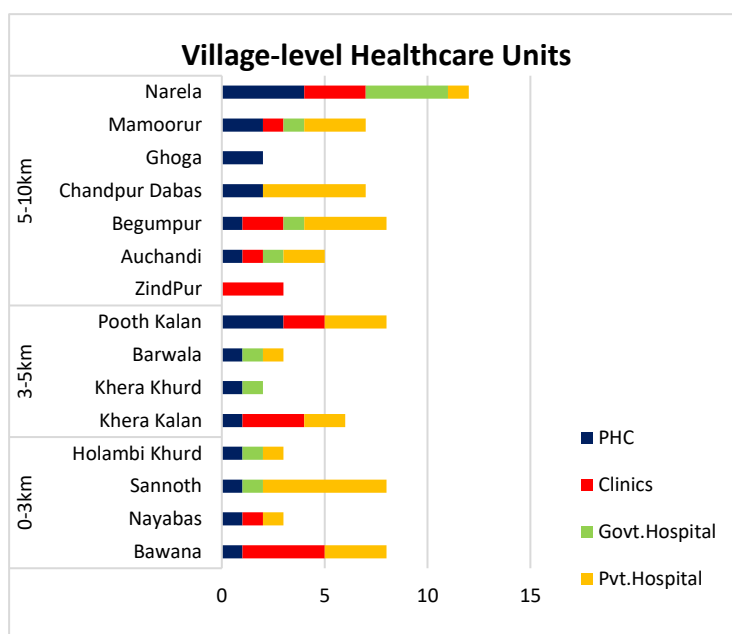
Figure 3.12: Village level Occupational structure



Health care Facilities

Health care facilities are well developed within the study area. As per the survey conducted in the 15 villages, all the villages have primary health centers and sub-centers (PHCs), along with private hospitals/clinics and dispensaries. The studies indicate that in order to avail medical facilities from government hospitals, the locals have to visit Narela, Sannoth. Graphical representation of village level healthcare facilities is shown as **Figure 3.13**.

Figure 3.13: Village level Healthcare units

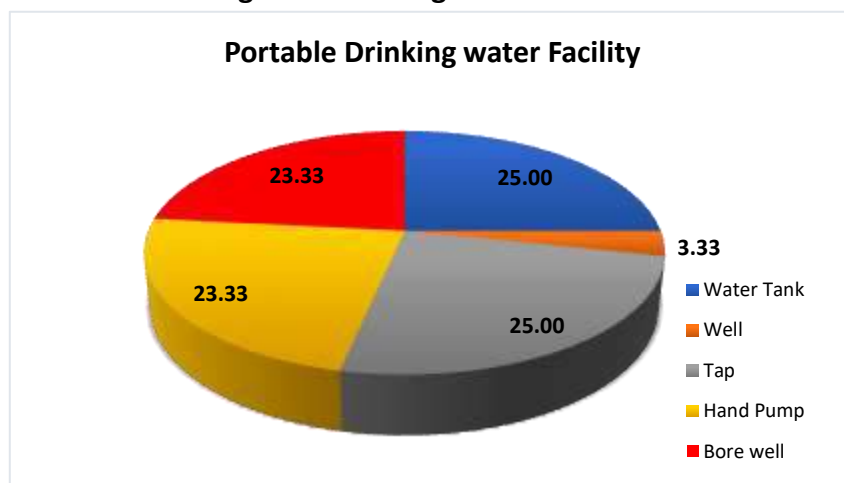


Holambi Khurd, Barwala, Khera Khurd, and Begumpur etc. The data reveal no prevalence of chronic diseases and some common diseases like malaria, typhoid, and seasonal fever are prevalent in the study area. However, all villages have accredited social health activists, or ASHA, to address the community's healthcare needs.

Water and Sanitation Facilities

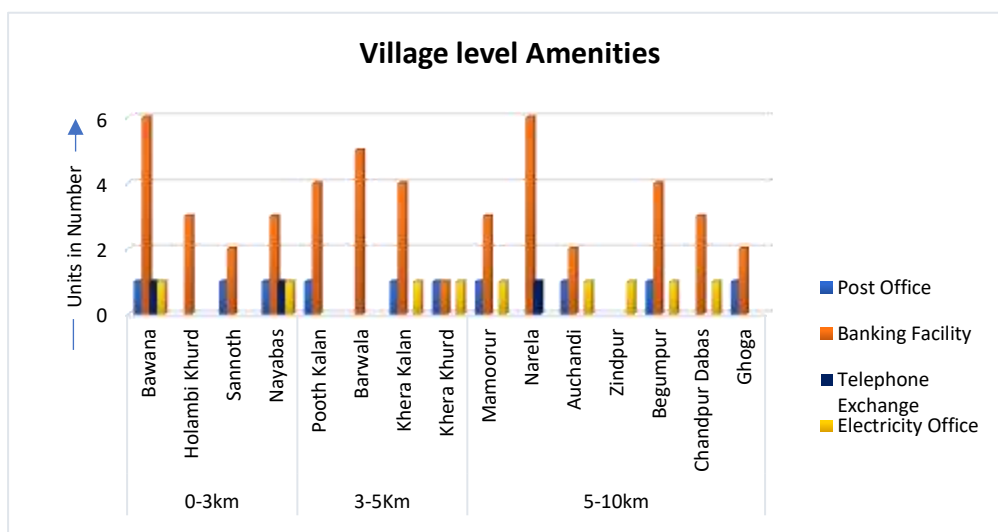
Regarding water facilities in the studied villages, indicates that the main sources of drinking water come from tap facilities (25%), water tankers (25%), and bore wells (23%). The studies reveal that Delhi Jal Board provides portable drinking water facilities across villages within the study area. Graphical representation of drinking water facilities is shown as **Figure 3.14**.

Fig 3.14: Drinking water facilities



Similarly, a few parts of the study area primarily the area near Bawana Industrial area, present a gloomy picture when it comes to sanitation. Most of the villages have community toilets, and even the percentage of households with access to private toilets is fairly adequate. Graphical representation of village level amenities is shown as **Figure 3.15**.

Fig 3.15: Details of the village level Amenities



Infrastructure Facilities in the Surveyed Villages

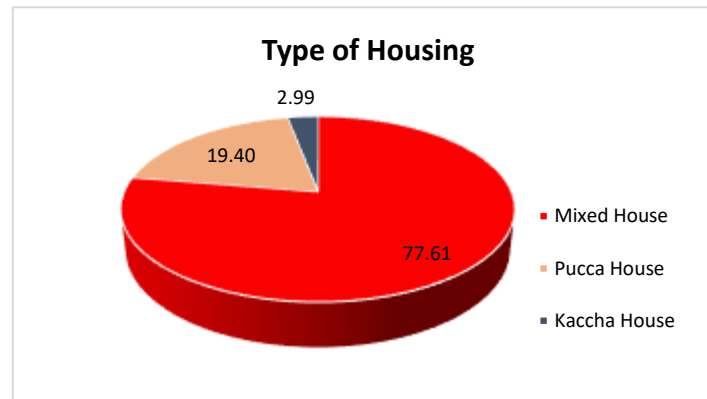
The primary data and village level focus group discussions also revealed that nearly 14% of villages have sub-post offices and all villages have community centers. Most of the villages have both private and government banking facilities. Similarly, as many as 60% of villages have play

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

grounds or sheds for sports and recreation purposes. It is also noted that all these villages have access to mobile networks and coverage. The studies reveal that majority of villages have good accessibility to banking facilities.

Moreover, the majority of the habitation witnessed mixed housing facilities (78%), followed by Pucca housing (20%) and the Kaccha housing type (3%), which is quite low in proportion. Graphical representation of house types is shown as **Figure 3.16**.

Figure 3.16: Percentage of the Housing typology



Transport facilities

The studied villages have good road connectivity. A large majority of the project villages have access to bus service, with pucca roads connecting to major towns and state highways. Almost all villages have all-weather road connectivity.

Other observations

A socio-economic study reveals that youth in the project area are devoid of employment opportunities. They can be a potential source of workers with minimum handholding, skill development, and vocational education skills. Apart from this, the study also highlighted the need for improved health care services. Despite the presence of well-equipped medical facilities, most of the villages have demanded a quality check-up and an increase in the frequency of doctor's visits. Moreover, the detailed analysis indicates that though the villages are well connected with road networks, there is still a need for an increase in modes of transportation.

The overall village level analysis across the surveyed villages focused on the quality of living aspects, which indicated the majority of the villages are well facilitated with power supply, drainage facilities, portable drinking water etc.

Few suggestions for improvement of socio-economic status

Through CSR and targeted community development interventions, the socioeconomic status of the population in the project area will be improved. Some of the salient activities are illustrated below:

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

- Periodical health check-up camps need to be conducted along with mobile health services to meet the health care needs of the villages.
- Training for capacity building trainings and strengthening of SHG activities.
- Youth empowerment programmes through awareness creation about various government schemes, providing appropriate opportunities with relevance to their qualifications and skills; conducting skills inculcating programmes etc.

Furthermore, public participation shall ensure spending on CSR activities in each fiscal year in accordance with existing State and Central Government guidelines (applicability of CSR under Section 135 (I) of the Companies Act, 2013). Based on discussions with the locals and government officials, in public consultation CSR initiatives should be proposed to ensure socio-economic development, which would include community development activities, skill development, income-generating programs, etc. in and around the project site.

Demographical details of study area are given in **Table 3.48**

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Table 3.48: Demographic details of project area

Delhi	Name	TRU	No_HH	TOT_P	TOT_M	TOT_F	P_06	P_SC	P_ST	P_LIT	M_LIT	F_LIT	TOT_WORK_P	NON_WORK_P
0-2KMS	Holambi Khurd	Rural	1,596	7,630	4,209	3,421	1,086	1,677	-	4,922	3,018	1,904	2,581	5,049
	Holambi Kalan	Rural	8,157	42,392	22,933	19,459	6,091	12,761	-	24,503	15,014	9,489	14,285	28,107
	Sanoth	Rural	696	3,800	2,043	1,757	497	1,513	-	2,778	1,611	1,167	1,077	2,723
	Bawana (CT)	Urban	12,961	73,680	40,258	33,422	10,946	9,813	-	44,079	26,602	17,477	22,697	50,983
2-5KMS	Shah Pur Garhi	Rural	624	2,642	1,601	1,041	378	198	-	1,857	1,233	624	1,091	1,551
	Ghoga	Rural	677	3,884	2,091	1,793	526	758	-	2,861	1,684	1,177	1,232	2,652
	Sultan Pur Dabas	Rural	799	4,399	2,330	2,069	598	1,384	-	3,206	1,845	1,361	1,252	3,147
	Iradat Nagar alias Naya Bans	Rural	496	2,723	1,463	1,260	381	692	-	2,075	1,181	894	763	1,960
	Bhor Garh (CT)	Urban	1,765	8,627	4,815	3,812	1,276	1,236	-	5,870	3,526	2,344	2,689	5,938
	Khera Khurd (CT)	Urban	1,753	9,777	5,177	4,600	1,159	2,965	-	7,477	4,266	3,211	2,858	6,919
	Barwala (CT)	Urban	1,748	8,948	4,783	4,165	1,199	2,013	-	6,616	3,798	2,818	2,686	6,262
	Pooth Khurd (CT)	Urban	2,030	10,654	5,741	4,913	1,504	2,204	-	7,629	4,426	3,203	3,106	7,548
	Lam Pur	Rural	474	2,653	1,405	1,248	315	643	-	1,944	1,121	823	743	1,910
5 TO 10KMS	Mamoor Pur	Rural	3,808	18,937	10,237	8,700	2,710	3,399	-	13,337	7,687	5,650	5,856	13,081
	Singhu	Rural	950	4,564	2,564	2,000	680	911	-	3,242	1,987	1,255	1,440	3,124
	Singhola	Rural	482	2,418	1,321	1,097	294	489	-	1,841	1,085	756	900	1,518
	Hamid Pur	Rural	644	3,469	1,849	1,620	467	784	-	2,502	1,437	1,065	1,069	2,400
	Kham Pur	Rural	358	1,983	1,035	948	232	636	-	1,516	857	659	558	1,425
	Ochandi	Rural	838	4,687	2,546	2,141	571	1,227	-	3,574	2,092	1,482	1,478	3,209
	Mungesh Pur	Rural	673	3,398	1,891	1,507	443	551	-	2,562	1,510	1,052	1,062	2,336
	Katewara	Rural	641	3,493	1,873	1,620	420	535	-	2,715	1,543	1,172	1,022	2,471
	Bazid Pur Thakran	Rural	783	4,456	2,412	2,044	544	1,722	-	3,425	1,984	1,441	1,211	3,245
	Nangal Thakran	Rural	722	4,202	2,264	1,938	513	1,322	-	3,131	1,821	1,310	1,335	2,867
	Zind Pur	Rural	576	2,753	1,513	1,240	399	475	-	1,991	1,199	792	874	1,879
	Nangli Poona	Rural	819	3,840	2,150	1,690	524	912	-	2,757	1,665	1,092	1,279	2,561
	Kankar Khera	Rural	25	116	63	53	10	-	-	74	45	29	53	63
	Bankner (CT)	Urban	2,683	14,788	8,042	6,746	2,011	4,100	-	10,360	6,085	4,275	4,446	10,342
	Tikri Khurd (CT)	Urban	2,768	13,772	7,635	6,137	1,981	4,067	-	8,967	5,590	3,377	4,632	9,140
	Bankauli (CT)	Urban	1,104	5,339	2,953	2,386	689	827	-	3,890	2,321	1,569	1,691	3,648
	Ali Pur (CT)	Urban	3,984	20,332	11,217	9,115	2,656	2,867	-	15,285	9,005	6,280	5,904	14,428
	Mukhmel Pur (CT)	Urban	910	4,931	2,649	2,282	584	2,128	-	3,684	2,127	1,557	1,347	3,584
	Libas Pur (CT)	Urban	8,799	44,375	24,059	20,316	6,112	5,062	-	32,473	18,864	13,609	13,919	30,456
	Khera Kalan (CT)	Urban	1,539	8,252	4,397	3,855	1,095	1,807	-	6,261	3,595	2,666	2,487	5,765
	Sahibabad Daulat Pur (CT)	Urban	11,720	54,773	30,402	24,371	8,241	18,364	-	34,004	21,287	12,717	17,189	37,584
	Pehlad Pur Bangar (CT)	Urban	4,628	22,968	12,612	10,356	3,388	4,313	-	15,236	9,107	6,129	7,104	15,864

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	Darya Pur Kalan (CT)	Urban	1,143	6,310	3,342	2,968	825	1,443	-	4,584	2,634	1,950	1,790	4,520
	Jat Khor	Rural	357	2,046	1,092	954	240	350	-	1,540	886	654	514	1,532
	Salah Pur Majra	Rural	370	2,127	1,138	989	279	429	-	1,615	948	667	624	1,503
	Budhan Pur	Rural	324	1,709	888	821	203	401	-	1,313	740	573	487	1,222
	Chand Pur	Rural	325	1,813	964	849	229	493	-	1,365	773	592	505	1,308
	Lad Pur (CT)	Urban	991	5,529	2,971	2,558	687	1,170	-	4,305	2,453	1,852	1,732	3,797
	Kanjhawala (CT)	Urban	1,991	10,331	5,529	4,802	1,344	1,509	-	7,434	4,317	3,117	3,131	7,200
	Mubarak Pur Dabas (CT)	Urban	2,228	12,043	6,441	5,602	1,730	2,162	-	8,420	4,899	3,521	3,477	8,566
	Mohammad Pur Majri (CT)	Urban	3,463	17,462	9,305	8,157	2,319	2,490	-	13,076	7,369	5,707	5,506	11,956
	Karala (CT)	Urban	6,870	35,730	19,085	16,645	4,635	5,701	-	26,860	15,325	11,535	10,379	25,351
	Begum Pur (CT)	Urban	10,446	53,682	29,039	24,643	7,751	9,531	-	37,244	22,052	15,192	15,797	37,885
	Pooth Kalan (CT)	Urban	19,516	96,002	51,063	44,939	12,341	19,275	-	72,228	40,696	31,532	30,270	65,732
Total			1,31,254	6,74,439	3,65,390	3,09,049	93,103	1,39,309	-	4,68,628	2,75,310	1,93,318	2,08,128	4,66,311
HARYANA	Name	TRU	No_HH	TOT_P	TOT_M	TOT_F	P_06	P_SC	P_ST	P_LIT	M_LIT	F_LIT	TOT_WORK_P	NON_WORK_P
5-10km	Munirpur (59)	Rural	56	337	179	158	39	-	-	257	147	110	283	54
	Dheki(231)	Rural	1	8	8	0	0	-	-	8	8	-	8	-
	Halalpur(235)	Rural	891	4650	2531	2119	527	1,003	-	3,335	1,978	1,357	1,970	2,680
	Nahri(232)	Rural	1572	8170	4439	3731	936	1,316	-	5,946	3,530	2,416	2,578	5,592
	Kundli (55) (CT)	Urban	5001	21633	12035	9598	3719	5,009	-	14,297	8,757	5,540	7,466	14,167
	Katlupur(233)	Rural	372	2102	1123	979	253	241	-	1,624	949	675	592	1,510
	Jhinjauli (234)	Rural	423	2040	1115	925	247	363	-	1,475	875	600	734	1,306
	Jataula (236)	Rural	426	2197	1199	998	289	499	-	1,588	940	648	980	1,217
	Ferozepur Bangar (237)	Rural	617	3047	1639	1408	433	793	-	2,134	1,238	896	892	2,155
Total			9,359	44,184	24,268	19,916	6443	9,224		30,664	18,422	12,242	15,503	28,681

Source: District Primary Census Abstract of Delhi NCT (Narela) & Haryana (Sonipat)-2011

3.17 Photographs of Environmental Baseline Studies

Air Monitoring



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Air Monitoring



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Ground water sampling



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Ground water sampling



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Ground water sampling



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Surface Water Sampling



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Soil sampling



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Soil sampling



Soil sampling



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Noise Monitoring



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

Noise Monitoring



Noise Monitoring



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

SE Survey



Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

SE Survey



Ecology & Biodiversity Survey



Ecology & Biodiversity Survey



CHAPTER 4

ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

Chapter 4

Anticipated Environmental Impacts and Mitigation Measures

4.1 Identification of impacts

This chapter presents identification and appraisal of various impacts from project in the study area. Prediction of impacts is the most important component in the Environmental Impact Assessment studies and it helps in minimizing the adverse impacts on environmental quality during pre and post project execution. The impact on various environmental components due to the project has been studied using scientific tools. Such predictions are superimposed over the baseline (pre-project) status of environmental quality to derive the ultimate (post-project) scenario of environmental conditions. The impacts on environment due to project are classified into two phases and the possible impacts are assessed.

- **During Construction phase**
- **During Operation phase**

The environmental impacts arising from the construction phase and operation phase on air, water, soil, noise, traffic and socio-economic conditions are systematically examined and evaluated. The details on impact of the project activity on each of the above environmental attributes are discussed below.

4.2 Impact during construction phase

Construction phase works include site clearance, site formation, building works, infrastructure provision and any other infrastructure activities. However, this project is expansion of existing waste to energy plant, the impact during construction phase is not much envisaged.

4.2.1 Impact on air quality

The principal potential impact on air quality is due to the fugitive dust generated during construction activities of the project. The dust, measurable as particulate matter and respirable particulates would be generated as a result of construction activities. The construction program of the project shall commence immediately after obtaining statutory clearances. The potential dust sources associated with construction activities are loading and unloading of the materials, top soil removal, travel over unpaved roads. The construction works associated with the proposed development are broadly mentioned below.

- Site development and foundation works
- Dust generation due to vehicles transporting the raw materials
- Unloading of raw materials, removal of unwanted waste material from site
- Civil constructions and provision of infrastructure required for various activities proposed

Among all the construction activities, site formation has the highest potential for causing dust nuisance to the nearby air sensitive locations, but in this project the power plant is adjacent to the existing waste processing facilities, hence the impacts will be negligible. Exhaust emissions from vehicles and equipment deployed during the construction are also likely to result in marginal increase in the levels of SO₂, NO_x, PM, CO and un-burnt hydrocarbons. The impact of such activities would be temporary and restricted to the construction phase. The impact is generally confined to the project area and is expected to be negligible outside the plant boundaries.

4.2.1.1 Mitigation measures proposed – air quality

For the expansion project, site levelling and grading will be minimum and wherever possible to maintain the natural elevations will be maintained but will not be disturbed. Levelling activity will be carried out for providing roads, sewage network, storm water system and for places which require for providing plant shed erection. According to the engineering assessment, most of the excavated material shall be reused within the project boundary. The movement of cut and fill material will be limited.

Most of the dust from construction activities will be generated from the movement of construction vehicles on unpaved roads, however the project is present within the already existing unit, all the roads are paved and hence no much generation of dust. Unloading and removal of soil material shall also act as a potential source for dust nuisance. The control measures proposed to be taken up are given below.

- 1 Regular water sprinkling on main haul roads in the project area. This activity will be carried out at least twice a day and if the need arises the frequency of watering will be increased likely on windy days. In this way, around 50 % reduction in the dust generation from the exposed surface could be achieved.
- 2 The duration of stockpiling will be kept as short as possible. This is because most of the material will be used as backfill material for the open cut trenches for road development.
- 3 Temporary tin sheets of sufficient height (3 m) will be erected around the site of dust generation or all around the project site as barrier for dust control.
- 4 To reduce the dust movement from civil construction site to the neighborhood the external part of the construction places will be covered by plastic sheets/green net.

With the implementation of above-mentioned control measures for dust suppression, no major adverse impacts are expected and compliance with the Ambient Air Quality is achieved at Air Pollution Sensitive Receivers (ASR's) at all time.

4.2.2 Impact on Water quality

The project will involve minor construction activities. The following section summarizes the activities likely to be undertaken during the proposed development and describes the potential impacts on water quality from each activity.

1. Site modification

Preparation of designated area of existing land for subsequent development activities involves levelling off the ground surface, removal of vegetation if any, stockpiling which leads to the generation of construction waste. Construction of temporary infrastructure such as drainage culverts may be required. The site formation may produce minor quantities of runoff with high suspended solids loading in the absence of appropriate mitigation measures. This potential problem may be aggravated during rainy season.

2. Construction of production blocks

Due to construction of various civil structures, site runoff results in significant pollution of the receiving water bodies especially in rainy season. Washing of all the equipment during construction will also result in water pollution.

3. Presence of workers

During construction, impacts from the workers include waste and wastewater generation from eating areas and sewage from temporary sanitary facilities respectively. Significant water quality impact will happen only if the sewage is discharged directly into the receiving waters without any prior treatment.

4.2.2.1 Mitigation measures – water quality

During site development necessary precautions will be taken, so that the runoff water from the site gets collected into working pit and the over flow will be diverted to nearby greenbelt/plantation area. During the construction activity, all the wastewater generated due to the equipment washing will be diverted to working pit to arrest the suspended solids if any and the settled water will be reused for construction purposes and for sprinkling on roads to control the dust emission.

The waste generated from the site workshop will be segregated like used oil, lubricants, etc. and disposed to authorized recyclers whereas the waste like soiled cotton, paper, etc. will be disposed to existing MSW processing facility. The domestic wastewater generated from toilets used by the work force will be diverted to existing septic tank followed by soak pit

through bio-toilets or toilets of the existing facility. Therefore, impact on water quality due to proposed units would be insignificant.

4.2.3 Impact on noise levels

The major activities, which produce periodic noise, during construction phase, are as follows:

- Foundation works
- Fabrication of structures
- Plant erection
- Operation of construction equipment
- Movement of vehicles
- Material loading and unloading activities

4.2.3.1 Mitigation measures – noise quality

All noise generating equipment will be used during day time for a short period. Proper enclosures will be used for reduction of noise levels, wherever possible and all the noise generating equipment will be kept away from the human habitation. Therefore, impact on noise environment due to project would be insignificant. All vehicles entering into the project site will be informed to maintain speed limits and will be suggested to avoid blowing horns unless it is required.

4.2.4 Impacts due to solid waste generation

This category of waste generation in the project site is due to different types of raw materials being used during construction stage, in general may comprise of the following:

- Cement concrete
- Bricks, tiles
- Cement plaster
- Steel (RCC, door/ window frames, roofing support, railings of staircase etc.)
- Rubble, sand, stone (marble, granite, sand stone)
- Timber/wood
- Paints/varnishes
- Municipal solid waste

Besides above there are some major and minor components namely conduits, pipes, electrical fixtures, panels and others also constitutes the solid waste.

4.2.4.1 Mitigation measures – solid waste

The solid waste generated during this period being predominantly inert in nature, maximum efforts would be made to reuse and recycle them. Most of the solid waste material can be

used for filling/ levelling of low-laying areas. All attempts should be made to stick to the following measures.

1. All construction waste shall be stored within the site itself. Proper screen will be provided so that the waste does not get scattered.
2. Attempts will be made to keep the waste segregated into different heaps as far as possible so that their further degradation and reuse is facilitated.
3. Plastics, broken glass, scrap metal etc. will be sent for recycling in the industries.
4. Rubble/ brick bats can be used for building activity, such as levelling, under coat of lanes where the traffic does not constitute heavy moving loads.
5. Larger unusable pieces can be sent for filling up low laying areas.
6. Fine material such as sand, dust, etc. can be used as cover material.
7. The unearthed soil can be used for levelling as well as for lawn development
8. The broken pieces of the flooring material can be used for levelling in the building or can be disposed of.
9. The unused or remaining paints/ varnishes/ wood can either be reused or can be disposed off
10. The generated municipal and packaged material will be sent to existing MSW processing facility for segregation.

4.2.5 Impact on land use

The proposed project is expansion of existing waste to energy power plant as per the Solid Waste Management Rules 2016 and subsequent amendments, therefore there is no major expected impact on land use. There shall be minimum clearance of vegetation like bushes, shrubs etc. The existing greenbelt will be improved along with the proposed greenbelt all around the facility. The tree available at site will be retained as it is under greenbelt development plan.

4.2.6 Demography and socio-economics

The expansion unit would have a positive impact on demographic and socio-economic conditions of the nearby areas. Some of which would be as follows:

1. Increase of floating population.
2. Additional strain on civic amenities like road, transport, communication, drinking water, sanitation & other facilities to meet the work force requirement
3. Increase in demand for services like hotels, lodges, public transport etc.
4. Employment opportunities for construction labourers, skilled and unskilled workers etc.
5. Economic upliftment of the area.
6. Rise in home rents and land prices and increase in labour rates.

7. Rapid growth of service sector will result in increase of incomes in the area.
8. More work to the civil construction and transportation companies.
9. Expansion of services like retail shops, banks, automobile workshops, schools, hospitals etc. in nearby areas of the project
10. Increase in literacy rate

4.3 Impacts during operation

4.3.1 Impact on topography and climate

The minor topographical changes envisaged would be manmade structures like erection of plant and machinery, raw material storage space, civil structures, water storage tanks, etc. However, it will also invite some positive benefits in the form of land leveling, tree plantation/greenbelt development, etc., in the plant vicinity. The impact on the climate from the proposed expansion project due to the exhaust gas temperature utilities such as boiler, DG set, etc., will be envisaged. To minimize the impacts on nearby areas, stack will be provided with stack height meeting the MOEFCC standards and air pollution control measures will be adopted. Impact on the climatic conditions from the plant will be marginal which can be nullified/ reduced by implementing greenbelt.

4.3.2 Impact on air quality

The proposed project is expansion of existing waste to energy power plant and the major source of pollution would be the emissions from the stack. The main raw materials required for the project is Refused Derived Fuel (RDF) for producing the energy by combustion/incineration. High Speed Diesel (HSD) is used for DG set and Light Diesel Oil (LDO) is used for power plant start-up activity and for heat transfer in the furnace. The major air pollutants generated from the proposed operation are:

- Dust particulates (particulate matter) in flue gas from chimney
- SO₂, NO_x, VOC, dioxins and furans in flue gas
- Fly ash dust particles from ash silos and ash disposal areas

4.3.2.1 Emission details

Combustion of waste in grate furnace results in the formation of exhaust gases that contain various pollutants. Atmospheric emissions arise primarily from the by-products of the combustion process SO₂, NO_x, Particulates, Volatile Organic Compounds (VOC) and some trace quantities of other materials and are exhausted from the stack. The other source of air emissions is the cooling tower and the associated thermal rise plume which contains heat and some trace materials along with the water vapour.

4.3.2.2 Prediction of impacts on the air environment

Prediction of impacts from the expansion project on the ambient air quality was carried out using air quality simulation models. The main sources of air pollution are as follows.

1. Line source emissions from vehicular movement
2. Point source emissions from Boiler and DG sets.

4.3.2.3 Atmospheric dispersion of stack emissions

In order to estimate the ground level concentrations due to the emissions from the proposed project, EPA approved American Meteorological Society/Environmental Protection Agency Regulatory Model - AERMOD 7.0.3 dispersion model has been used. AERMOD dispersion model provides option to model emissions from a wide range of sources that are present at a typical industrial source complex. The model considers the sources and receptors in undulated terrain as well as plain terrain and the combination of both. The basis of the model is the straight-line steady state Gaussian Plume Equation, with modifications to model simple point source emissions from stacks that experience the effect of aerodynamic down wash due to nearby buildings, isolated vents, multiple vents, storage piles etc.

AERMOD dispersion model with the following options has been used to predict the cumulative ground level concentrations due to the proposed emissions. The dispersion parameters are considered as below:

- Predictions have been carried out to estimate concentration values over radial distance of 10 km around the sources
- A combination of cartesian and polar receptor network has been considered
- Emission rates from the sources were considered as constant during the entire period
- The ground level concentrations computed were as is basis without any consideration of decay coefficient
- Calm winds recorded during the study period were also taken into consideration
- 24-hour mean meteorological data, extracted from the meteorological data collected during the study period as per guidelines of IMD/CPCB has been used to compute the mean ground level concentrations to study the impact of proposed activity.

4.3.2.4 Pollution sources

The main air pollutant expected from line sources are fugitive dust generation from the movement incoming & outgoing vehicle. To minimize the impact from line source, black carpeted road will be maintained properly to reduce the dust generation. All vehicles will be maintained properly to meet emission standard of respective vehicles. Green belt will be provided along the boundary and along the road and open areas.

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

The point source emissions considered for the project are boiler and DG set. The DG set will be used only during power failure for emergency requirements. Hence the impacts from the DG set will be felt only during power failure. The inputs used to run the model are stack details, emissions details are given in **Table 4.1** and twenty-four hours mean meteorological data is given in **Table 4.2**.

The predicted maximum ground level concentration of PM, SO₂ and NO_x concentrations considering 24 hours mean meteorological data of study season are superimposed on the maximum baseline concentrations obtained during the study period to estimate the post project scenario, which would prevail at the post operational phase. The overall scenario with predicted concentrations over the maximum baseline concentrations without control measures and with controlling measures is given in **Table 4.3**. Isopleths are shown in the **Figure 4.1 to 4.4**. Predicted Impact at AAQ (Baseline) monitoring locations is given in **Table 4.4**.

The outlet emissions standards as per MOEFCC Notification SWM Rules, 2006 S.O. 1357 (E), dated 08.04.2016 is PM is 50 mg/Nm³, SO₂ is 200 mg/Nm³ & NO_x is 400 mg/Nm³. But as DPCC is implementing stringent emission standards in Delhi for existing Waste to Energy plant has issued Consent to Operate with outlet emission standards as PM is 30 mg/Nm³, SO₂ is 100 mg/Nm³ and NO_x is 350 mg/Nm³. Hence for modelling the above mentioned DPCC emissions standards have been considered.

Table 4.1: Stack emissions details of WTE (Sep to Nov 2022)

	Existing		Expansion		Existing	Expansion
Details	Boilers – 2 No’s		Boilers – 3 No’s		DG Sets	DG Sets
Capacity (Steam)	2*65 TPH		3*65 TPH		600 kVA	600 kVA
Type of fuel	MSW (RDF)/LDO (initial start-up)				HSD	HSD
Fuel consumption	600TPD/boiler		600TPD/boiler		100 l/hr	100 l/hr
Height of the stack (m)	60		60		12	12
Temp of flue gas (°C)	150		150		360	360
Internal Dia. of stack (m)	3.2		3.2		0.3	0.3
Velocity of flue gas (m/s)	18.0		18.0		18.0	18.0
Volumetric Flow rate (m³/s)	145		145		1.27	1.27
Bag filter efficiency (%) PM	99.5				-	--
Flue gas cleaning (%) SO ₂	75				-	-
Low NOx burner	-				-	-
Pollutants	1.MSW Composition /boiler	2.Outlet Standard /boiler	1.MSW Composition /boiler	2.Outlet Standard/ boiler	--	-
PM Emissions (g/s) with control measures	2.4	3.1	2.4	3.1	0.003	0.003

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

	Existing		Expansion		Existing	Expansion
Details	Boilers – 2 No's		Boilers – 3 No's		DG Sets	DG Sets
SO ₂ Emissions (g/s) with control measures	0.011	10.2	0.011	10.4	0.0023	0.0023
NO _x Emissions (g/s)	-	35.7	-	35.7	0.05	0.05
PM Emissions (g/s) without control measures	473	-	473	-	-	-
SO ₂ Emissions (g/s) without control measures	0.042	-	0.042	-	-	-

Note 1: Emissions Calculations:

Boiler: Analysis Results: Ash in RDF 22.7 % (Fly ash 30%, bottom ash 70%), Sulphur in RDF 3.02 mg/kg.

Outlet Standard (MOEFCC Notification SWM Rules, S.O. 1357(E), dated: 08.04.2016)

Based on outlet emission standard PM is 50 mg/Nm³ SO₂ is 200 mg/Nm³ & NO_x is 400 mg/Nm³.

As per CFO. Emission standard PM is 30 mg/Nm³ SO₂ is 100 mg/Nm³ & NO_x is 350 mg/Nm³.

DG Sets: Stack height (H) = h+0.2 vkVA.

H= Total height of the Stack, h= height of the building (m) where DG set is installed,

kVA Generator capacity, height of the building assumed 3 m.

Total Sulphur max 50 mg/Kg as per BS-IV HSD Standards (IS 1460: 2017).

NO_x emission limit 0.4 g/kWh & PM emission limit 0.02 g/kWh (56 kW up to 560 kW) as per Gazette of India -G.S.R .804(E) Environment (Protection) Amended Rules dated 3rd November 2022.

Table 4.2: 24 Hours mean meteorological data for post monsoon season (Sep – Nov 2022)

Hour	Temperature (°C)	Relative humidity (%)	Wind direction (Degree)	Wind speed (m/s)	Stability class
1	20.1	77	270	1.04	6
2	18.9	78	315	1.57	6
3	18.2	79	315	1.23	6
4	16.9	81	270	1.65	6
5	16.1	82	270	1.08	6
6	17.2	80	245	1.05	6
7	19.7	76	270	2.02	5
8	24.3	75	315	2.15	4
9	27.4	73	270	2.34	4
10	28.5	68	315	2.63	3
11	32.6	65	290	2.84	2
12	34.5	54	270	3.22	1
13	36.2	50	270	3.25	1
14	35.9	52	270	3.34	1
15	33.5	56	270	3.03	1
16	30.4	59	315	2.78	2
17	28.2	62	270	2.56	3
18	26.5	64	290	2.32	4

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

19	25.5	66	270	2.04	5
20	24.3	68	315	1.98	5
21	22.9	70	290	1.72	6
22	22.3	73	245	1.63	6
23	21.8	75	200	1.55	6
24	20.7	76	290	1.43	6

Table 4.3: Post Project Scenario ($\mu\text{g}/\text{m}^3$) (Sep – Nov 2022)

Particulars	Particulate Matter (PM_{10})		Particulate Matter ($\text{PM}_{2.5}$)		Sulphur dioxide (SO_2)		Oxides of Nitrogen (NO_x)
	1	2	1	2	1	2	2
Predicted GLC (Max)with control	0.7	0.9	0.4	0.5	0.003	2.9	10.4
Baseline Scenario (Max)	212		132		28.1		38.1
Future predicted with control	212.7	212.9	132.4	132.5	28.103	31.0	48.5
NAAQ Standards 2009	100		60		80		80
Predicted GLC without control	137	-	-	-	0.012	-	-
Future predicted without control	349	-	-	-	28.112	-	-
Cumulative							
Baseline Scenario (Max)	212		132		28.1		38.1
Predicted GLC from existing & Proposed with control	1.2	1.5	0.7	0.9	0.005	4.8	17.3
Future predicted GLC (Cumulative) with control	213.2	213.5	132.7	132.9	28.105	32.9	55.4
NAAQ Standards 2009	100		60		80		80
Predicted GLC from existing & Proposed without control	230	-	-	-	0.018	-	17.3
Note: 1. Input Composition, 2. Outlet Standards							
Maximum GLC in 0.8 km in E direction							

Table 4.4a: Predicted Impact at AAQ(Baseline) monitoring locations - ($\mu\text{g}/\text{m}^3$)

Locations	Wind	W.R.T. Site	Baseline value 98 th percentile ($\mu\text{g}/\text{m}^3$)			Predicted Increment ($\mu\text{g}/\text{m}^3$)			Post-Predicted(Final status) ($\mu\text{g}/\text{m}^3$)		
		Direction	PM	SO ₂	NO _x	PM	SO ₂	NO _x	PM	SO ₂	Nox
Site	-	—	84.5	23.5	30.1	0.3	1.1	5.0	84.8	24.6	35.1
Bawana	¹ UW	W	212	28.1	38.1	0.1	0.1	1.0	212.1	28.2	39.1
Holambi khurd	¹ DW	E	162	23.4	32.4	0.3	1.1	5.0	162.3	24.5	37.4
Khera khurd	² DW	SE	178	24.2	33.2	0.1	0.1	1.0	178.1	24.3	34.2
Barwala	CW	S	168	25.3	35.3	0.0	0.0	0.0	168	25.3	35.3
Ghoga	² UW	NW	132	23.2	32.1	0.0	0.0	0.0	132	23.2	32.1
Narela	CW	NE	170	25.4	34.8	0.0	0.0	0.0	170	25.4	34.8
Chandpur khurd	CW	SW	115	20.4	29.3	0.0	0.0	0.0	115	20.4	29.3
NAAQ Standards 2009(24 hr)									100	80	80
Note: cw; crosswind, up; upwind & dw; downwind											

Table 4.4b: Stack Results data during Feb 2021 to Jun 2022

Sl. No.	Parameters	UoM	Method of testing	CTO Limits	20.02. 21	21.06. 21	24.07. 21	30.10. 21	16.11. 21	07.01. 22	09.02. 22	09.03. 22	27.06. 22	Max	Min	Average
1	Carbon Di-Oxide	%	Flue Gas Analyzer	-	9.6	12.4	12.8	11.8	13.4	11.9	10.7	11.9	9.9	13.4	9.60	11.60
2	Carbon Monoxide	mg/ Nm3	Flue Gas Analyzer	100	4.0	10.0	13.2	78.8	82.7	91.3	92.5	95.7	67.5	95.7	4.00	59.52
3	Hydrogen Fluoride	mg/ Nm3	USEPA method - 13	0.5	0.009	0.24	0.28	0.43	0.37	0.42	0.31	0.25	0.18	0.43	0.01	0.28
4	Particulate Matter	mg/ Nm3	USEPA method - 05	30	23.5	26.1	24.8	21.8	23.4	19.7	23.1	26.7	25.4	26.7	19.7	23.8
5	Oxides of Nitrogen	mg/ Nm3	USEPA method - 07	350	336	192.7	213.2	231.7	246.5	272.1	266.5	283.1	268.4	336.0	192.7	256.7
6	Sulphur Dioxide	mg/ Nm3	USEPA method - 06	100	102.4	96.4	86	71.5	67.8	72.3	60.1	74.2	62.7	102.4	60.1	77.0
7	Hydrogen Chloride	mg/ Nm3	USEPA method - 26	50	4.65	14.08	17.03	19.1	22.4	24.1	18.7	16.9	14.7	24.1	4.7	16.8
8	Total Organic Carbon	mg/ Nm3	USEPA method - 40 & MM5(10)	20	7.56	4.6	6.5	4.6	4	4.3	3.7	4.3	5.6	7.6	3.7	5.0
9	Hg and its compounds	mg/ Nm3	USEPA method - 29	0.02	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00	0.00	0.00
10	Cd + Th + their compounds			0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.00	0.00	0.00
11	Pb + Their Compounds				0.001	0.017	0.014	0.021	0.023	0.027	0.019	0.014	0.011	0.03	0.00	0.02
12	Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V + their compounds			0.5	0.439	0.439	0.35	0.334	0.339	0.253	0.179	0.149	0.136	0.44	0.14	0.29
13	Total Dioxins & Furans	ng TEQ/ Nm3	USEPA 23 A & 8290	0.1	0.009	0.0315	0.0307	0.0476	0.0501	0.0481	0.0426	0.0303	0.0549	0.05	0.01	0.04

Figure 4.1: Predicted 24 hourly average GLC's of PM ($\mu\text{g}/\text{m}^3$)

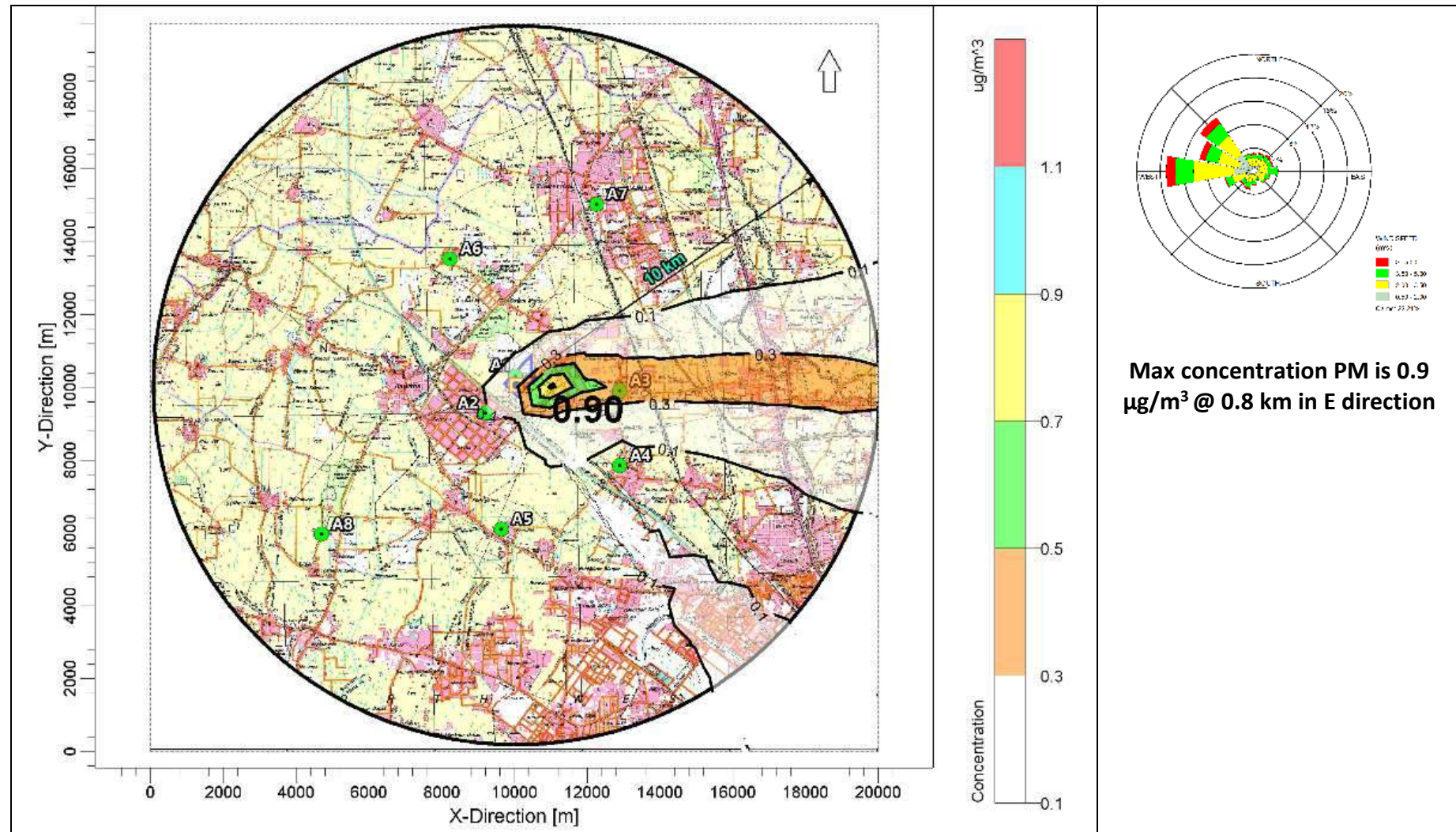


Figure 4.2: Predicted 24 hourly average GLC's of SO₂ (µg/m³)

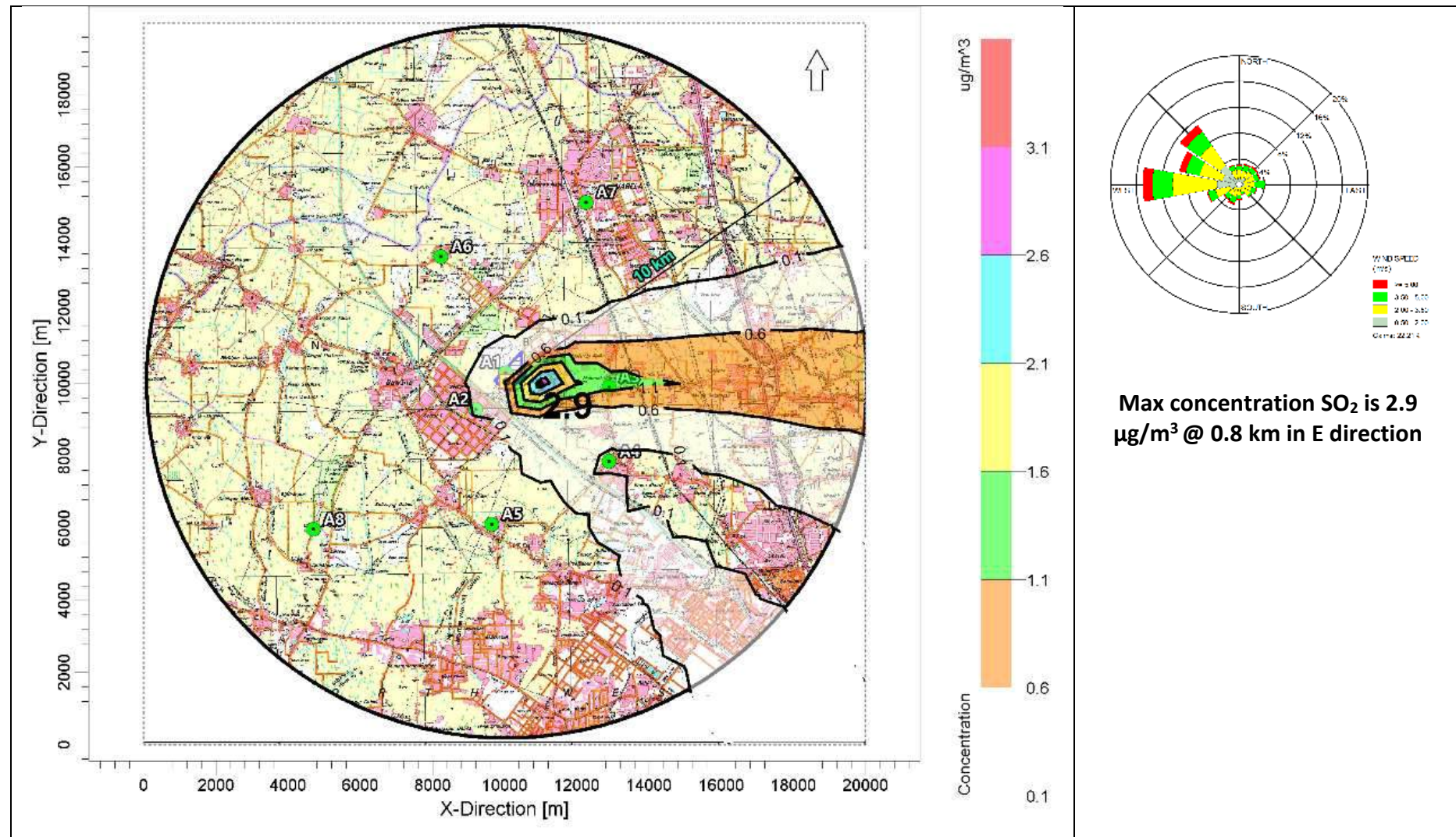
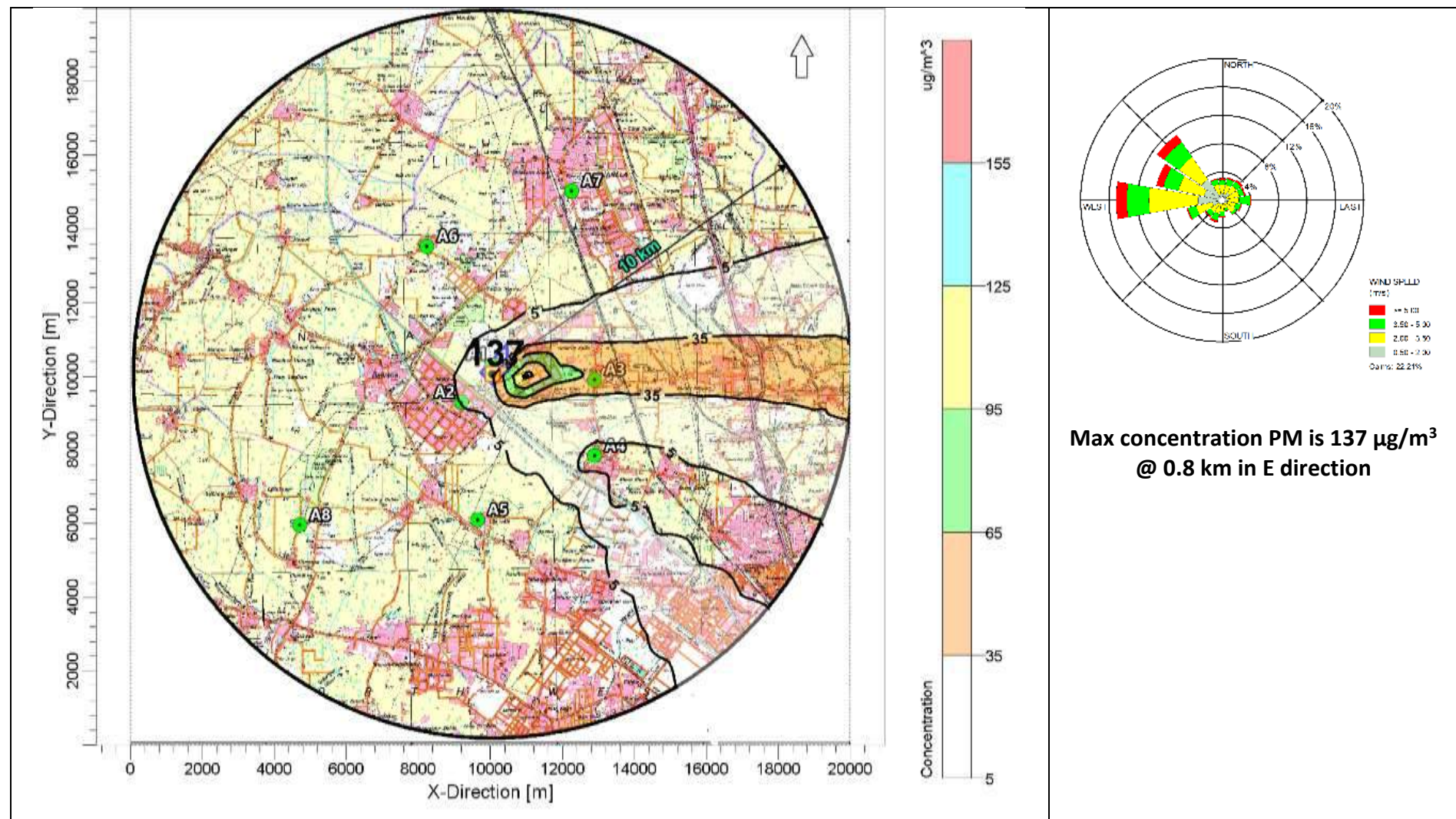


Figure 4.4: Predicted 24 hourly average GLC's of PM ($\mu\text{g}/\text{m}^3$) (without control)



4.3.2.5 Air pollution mitigation measures

Combustion of waste in grate furnace results in the formation of exhaust gases that contain various pollutants. These pollutants include particulate matter and gaseous flue gas constituents. Substances found in the flue gas of WTE plants (before treatment) can be classified into three groups.

- **Macro-pollutants:** Substances present in gaseous form, inorganic gases, such as CO, HCl, SO₂, HF, and nitrogen oxides (NO_x).
- **Micro-pollutants:** Substances present in very low concentrations, such as heavy metals (lead, cadmium, copper & zinc, etc.), organic chlorinated compounds like chlorophenols, polychlorobiphenils, dioxins, furans and aromatic polycyclic hydrocarbons (PAH).
- **Dust:** Solid-state particles upon which dioxins and other condensable micro-pollutants tend to fix.

Prior to the emission of flue gases into the atmosphere, concentrations of the pollutants mentioned must be reduced by providing control measures.

Reduction of acid gases (HCl, HF & SO₂) will be carried out by semi dry flue gas cleaning system in which the adsorption agent added to the flue-gas flow is aqueous lime slurry i.e. an aqueous suspension of calcium hydrate is used to neutralize the acid potential in the flue gas. Calcium hydrate is effective on all gases but nitrogen oxides. The water solution evaporates and the reaction products are dry. The residue may be re-circulated to improve reagent utilization.

Reduction of Nitrogen oxides

Nitrogen oxides in the flue gas of a waste incineration plant are formed largely from the nitrogen contained in the fuel. NO_x production can be reduced by boiler over fire air system and low NO_x burners.

Reduction of Dioxins/Heavy metal

Dioxins are usually the principal contaminants due to the presence of plastics in the waste. Heavy metals may also be present as a secondary contaminant. The temperature at the point of injection has been reduced to 130°C to minimize the volatility of the contaminants, which consequently optimizes the adsorption efficiency. Activated carbon is injected into the gas flow. The carbon is filtered from the gas flow using bag filters. The activated carbon shows a high absorption efficiency for heavy metals as well as for PCDD/PCDF. Different types of activated carbon have different adsorption efficiencies. The performance of activated carbon systems depends primarily on the carbon injection rate, carbon injection method, carbon properties, flue gas temperature, and PM control method.

Dust Removal:

To separate dust particles from the flue gas bag filters are installed. The selection of gas cleaning equipment for particulates from the flue-gas is mainly determined by:

- particle load in the gas stream
- the average particle sizes
- particle size distribution
- flow rate of gas
- flue-gas temperature
- compatibility with other components of the entire FGT system
- Required outlet concentrations.

Dust Removal:

Bag filters are filtering separators operating as surface filters. Separation of the particles takes place mainly on the surface of the filter medium, which is passed by the gas flow. On the surface of the filter medium, the particles retained form a layer, the dust cake, which causes an increasing pressure loss with increasing layer thickness. For this reason, the dust cake has to be removed regularly. By the construction of the filters and selection of filter media, these separators may be adapted optimally to the operation conditions and properties of the dusts, such that they can be used in various industrial sectors. Materials serving as filter media are fiber layers, membrane like materials, sintered metals or ceramics. For dedusting flue gas, for instance, PTFE membrane filter hoses are applied. The filter areas can be cleaned by shaking or compressed air. In case of compressed-air cleaning, the filter elements are usually passed by an air flow from outside to inside and cleaned by a jet pulse (0.1 to 1 second) that is blown into the filter element. The setup and functioning of a fabric filter with jet-pulse cleaning are shown schematically in the **Figure 4.5**.

Figure 4.5: Schematic view of flue gas cleaning system



The flue gas cleaning system envisaged for this project consists of semi dry process with bag filters. Semi dry flue gas cleaning system includes reaction tower, lime slurry making with pumping system & high-speed atomizer. The acid gas is reacted with lime slurry and heavy metal and dioxins are absorbed by active carbon.

4.3.3 Impact on water quality

Total water requirement for existing project is 313 KLD. Total water requirement for the proposed expansion project is 337 KLD. Hence total water requirement is 650 KLD. The same will be sourced from Delhi Jal Board and Industrial Waste Water of adjacent Pragati Power Plant. The wastewater as liquid waste of 105 KLD will be generated which includes cooling tower blow down, boiler blow down and DM regeneration and Leachate. The generated leachate will be treated in the existing LTP, blow down water from ancillary cooling tower, boiler blow down and WTP Rejects will be collected neutralization tank and neutralized by adding neutralized agents then utilized in the bottom ash quenching and in Air Pollution Control Devices. Thus, facility will achieve the zero-liquid discharge. Domestic water requirement is 15 KLD which is achieved by Municipal Water Supply. Water requirement and wastewater generation is given in **Table 4.5**.

Table 4.5: Water requirement and wastewater generation (KLD)

Utility	Water Requirement			Wastewater generation		Remarks
	Existing	Expansion	Total	Existing	Expansion	
Boiler (WTP+DM plant)	183	257	440	95	95	Treated & Reused for ash quenching, Flue gas cleaning
Auxiliary Cooling Tower	80	80	160	10	10	
Green Belt	50	-	50	-	-	-
Total	313	337	650	105	105	

Source: Having agreement with PPCL for 350 KLD and permission from Delhi Jal board 1000 KLD

Note: PPCL agreement is expandable

Note: 1) Drinking water requirement is 15 KLD (source Municipal Supply), wastewater 13 KLD sent to bio toilets and septic tank followed by soak pit.

2) Leachate quantity is around 200 KLD treated in MVR

Following water saving options can be provided in the facility.

- Improve energy efficiency of operations
- Installation of flow restrictors on tap water supply line
- Dry sweeping of all areas before hosing
- Eliminate leaks of the pipelines

- Using of water efficient nozzles for spray rinsing/hosing
- Storm water harvesting
- Rain water holding tanks
- Recycling of water etc.

4.3.3.1 Mechanical Vapour Recompression (MVR) technology

Process description

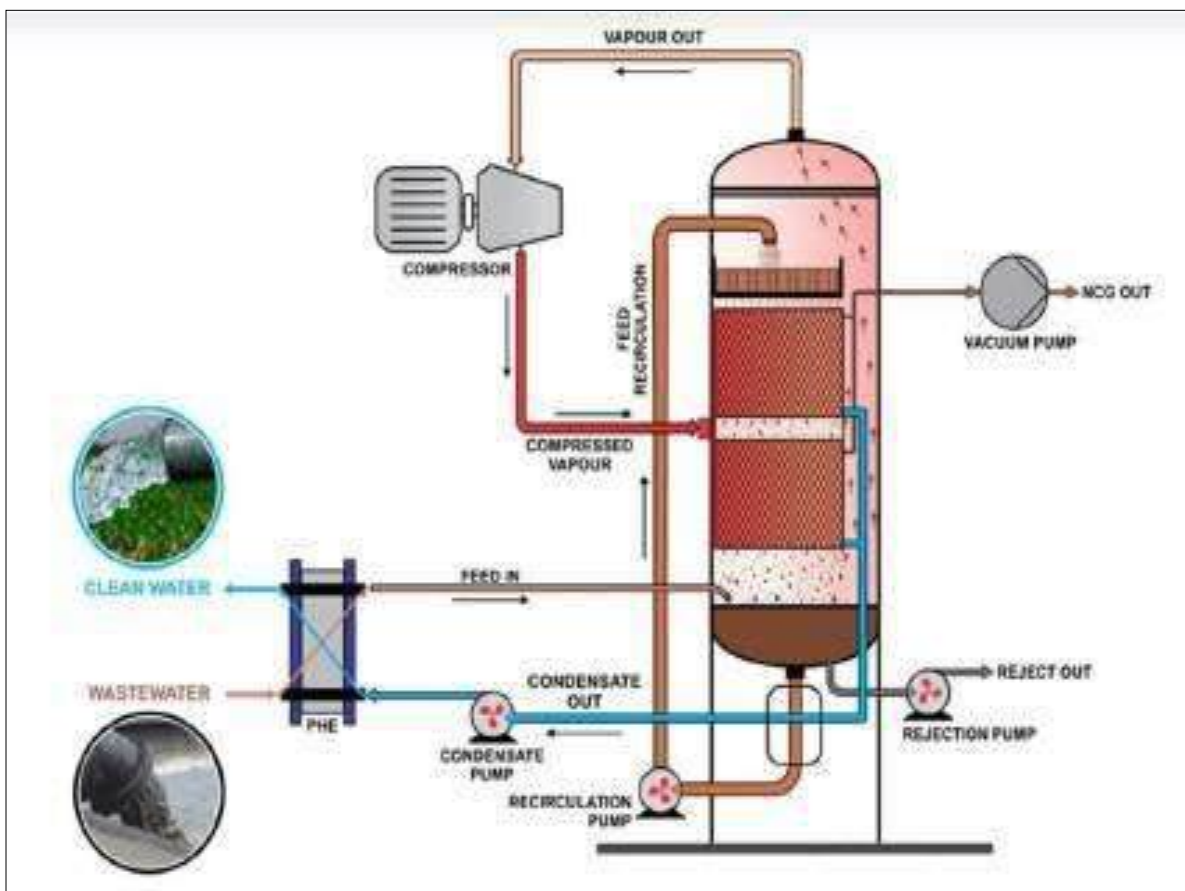
- Wastewater is fed by the feed pump through the feedstock heat exchanger and into the circulating stream. The feedstock heat exchanger is used to heat the wastewater by transferring sensible heat from the hot condensate to the cooler feed.
- The recirculation pump circulates wastewater from the separation tank through the main heat exchanger, to the orifice plate, and back into the separation tank. The latent heat from the compressed vapor is transferred to the wastewater via the main heat exchanger.
- An orifice plate is used to reduce the pressure of the circulating stream. The downstream pressure is low enough to allow flashing of the circulating stream into liquid and vapor components.
- The liquid and vapor then flow to the separation tank where they are separated. The liquid steam exits the tank at the bottom and flows back to the recirculation pump. The vapor stream exits the tank at the top and flows to the vapor compressor(s).
- A mist pad is provided at the top of the separation tank to remove small droplets of liquid from the vapor.
- The vapor compressor compresses the vapor (raising the temperature and pressure), and sends the vapor to the main heat exchanger, where it transfers its latent heat to the wastewater in the recirculation loop.
- High temperature condensate exits the main heat exchanger and flows to the condensate tank, where any remaining vapor is separated. The hot condensate is then pumped to the feedstock heat exchanger, where it transfers sensible heat to the incoming feed wastewater.
- Upon reaching steady-state at the target concentration, the concentrated wastewater is purged from the recirculation loop, using the residue valve. Depending on the energy balance, energy can be added to the system by electric heaters / process steam or excess energy can be removed from the system by the steam relief valve.

Benefits of MVR

The benefits of the MVR technology are mentioned below. The process flow chart of MVR technology is shown in **Figure 4.6**.

- No External Heat sources
- No heat rejection unit
- No chemical treatment
- No RO/No Membrane
- No ground water extraction
- 100% clean water recovery and recycling
- Minimal electrical power demand
- Lowest foot print area
- High Quality product
- Automated operation
- Low capital cost
- Minimum operation and maintenance cost
- Eco friendly
- Wide applicability

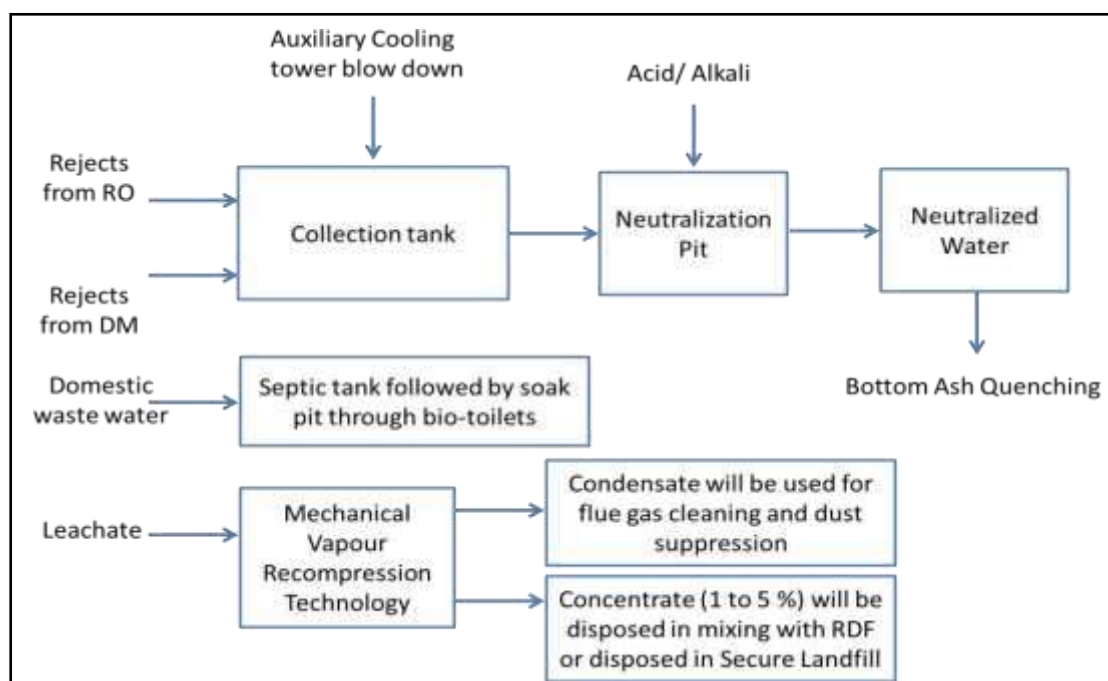
Figure 4.6: The process flow chart of MVR technology



4.3.3.2 Water impacts mitigation measures

The wastewater generated from rejects of the RO plant, DM plant and Auxiliary cooling tower blow down will be collected in the neutralization pit, after the neutralization this water will be used Bottom ash quenching. The leachate generated from the RDF storage bunker will be treated through Mechanical Vapour Recompression (MVR) technology. The permeate/condensate from the MVR will be used for Flue gas cleaning, lime and dust suppression, concentrate from the MVR will be disposed in mixing with RDF or disposed in secured landfill. The domestic waste water will be sent to septic tank followed by soak pit through bio-toilets. There will be no wastewater discharge to any nearby water body and adopts the zero-wastewater discharge concept. Schematic diagram of Wastewater generation, treatment and reuse is shown in **Figure 4.7**.

Figure 4.7: Schematic diagram of Wastewater generation, treatment and reuse



4.3.3.1 Storm water management

Based on the rainfall intensity of the plant area, storm water drainage system has been designed. Storm water drainage system consists of well-designed network of open surface drains and rainwater harvesting pits along the drains so that all the storm water is efficiently drained off without any water logging.

Rain water harvesting system

Project management will make proper utilization of rainwater by harvesting through appropriate rain water harvesting mechanism. Rooftop water will be collected by adopting

proper treatment (O&G Trap), the collected water will be used for various uses (cooling tower make up, boiler make up, etc.). Rainwater from surface areas will be harvested by construction of harvesting pits all along the storm water drainage network at a definite pitch. Necessary expert advice has been obtained in this regard. Artificial recharge measures like rain water-harvesting helps in reducing the urban run-off, decrease pollution of ground water and improve the ground water table, which augments the /yields of bore wells.

4.3.4. Impact on noise quality

Any activity in general, consists of several sources of noise pollution. The different sources of noise pollution are mentioned below:

- Boiler feed pumps
- Turbo generators
- Cooling Tower
- Diesel generators
- Frequent vehicular movement

Table 4.6: Noise generating equipment

S.no	Sources	Noise level dB(A)	Area
1	ID & FD Fans	100	Near boiler stack areas
2	Boilers & feed pumps	78	Near boiler house
3	Turbines generator	92	Near monitoring room
4	Cooling towers	85	Near Cooling tower area
5	DM plant	70	Near DM plant
6	Bag Filter	80	Near Bag Filter proposed for both plants
7	DG sets Generator	90	Near DG set area

4.3.4.1 Prediction of noise quality impacts

Noise modelling was done using Custic software version 3.2 to estimate dispersion of noise levels in study area. The Isopleths generated by software are shown in **Figure 4.8** and noise levels predicted during operation phases of the project is given in **Table 4.7**.

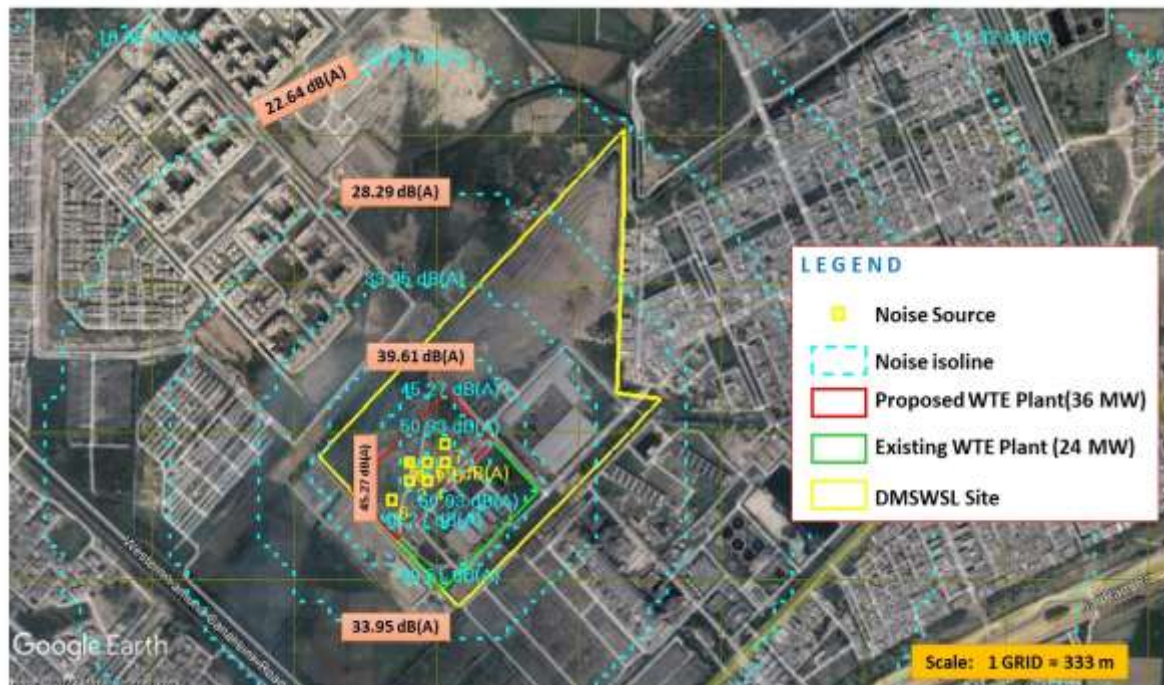
Table 4.7: Noise levels at project boundaries – dB (A)

Site boundary	Latitude (N)	Longitude (E)	Baseline	Predicted	Post Project	Standard dB (A)
North	28°48'20.8"	77° 4'14.7"	54.3	22.6	54.3	Industrial Area Day Eq 75 Night Eq 70
East	28°47'59.9"	77° 4'18.2"	68.5	28.3	68.5	
South	28°47'43.9"	77° 3'59.7"	56.8	33.9	56.8	
West	28°47'55.6"	77° 3'47.1"	60.5	39.6	60.5	

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Maximum noise level predicted near plant boundary is about 68.5 dB (A) which is within the Noise pollution rules, 2000 for industrial area. Hence there will be no impact due to plant operation in the vicinity of plant boundary.

Figure 4.8: Noise level Isoleths at project site



Noise mitigation measures

Adequate measures for noise control, at the design stage shall be taken such as keeping high noise generating equipment's like pumps, motors etc., on anti-vibration pads, closed rooms and regular maintenance as suggested by the manufacturer. The mitigation measures proposed are as follows:

- Noise level specification of various equipment's as per the Occupational Safety and Health Association (OSHA) standards.
- Providing suitable enclosures (adequate insulation) to minimize the impact of high noise generating sources.
- Employees will be provided with PPE like ear plugs, helmets, safety shoes etc.
- Development of greenbelt all along the boundary and along the roads within the project.
- Regular operation & maintenance of equipment as per suppliers instructions.

4.3.5 Solid waste management

Domestic solid waste generated will be sent to the composting plant after proper segregation. The ash generated from existing and proposed expansion plant will be around 450 TPD. Dry fly ash collected from the bag filter hoppers, economizer hoppers and ash collected from the furnace bottom, evaporator /super heater bottom hoppers is used for

landfilling, cement or brick manufacturing. Quantification of Solid Waste generation and respective disposal plan is given in **Table 4.8**.

Table 4.8: Solid Waste quantification and disposal

Sr. No	Type of Waste	Quantity	Disposal/management plan
1	Boiler Ash	450 TPD	Landfilling/cement or brick manufacturing
2	Domestic Solid Waste	100 Kg/day	Sent to IMSWMF

4.3.5.1 Ash Recycling Unit

About 450 TPD of Ash will be cumulatively generated from Existing and Proposed Waste to Energy Plant. To recycle these ash DMSWSL has established a state of art ash recycling plant with capacity of 30 TPH. The output of the products are as follows:

- Aggregate (8-20 mm)
- Coarse sand (3-8 mm)
- Fine sand (1-3 mm)
- Silt
- Large objects (> 40 mm, rags)

4.3.6 Demography and socio-economics

The impacts of the expansion project during operation on demography and socioeconomic conditions would be both positive and negative some of them are as follows.

- Increase in employment opportunities, reduction in migration for employment.
- Growth in industrial sector of local area
- Increase in consumer prices of indigenous produce and services, land prices, house rent rates and labour prices.
- Improvement in socio cultural environment of the study area.
- Improvement in transport, communication, health and educational services.
- Increase in employment due to increased business, trade, commerce and service sector.
- Increase in traffic on connecting roads

4.3.7 Impact on ecology and biodiversity

Biological impact assessment methodology

Impacts on biological components were identified by following various steps as explained in following different sections. All biological impacts have been assessed considering that, all operational / engineering control suggested in EMP will be properly implemented.

Identification of extent of Likely Impact Zone (LIZ) area

Extent of LIZ area can be mapped through superimposing air pollution dispersion model, noise dispersion model, drainage pattern on the project study area:

Identification of likely impacts

Likely impacts on the biological components have been identified on the basis of activities and associated aspects involved in the different phases of project cycle and various ecosystems or habitats falling in the identified LIZ area.

4.3.7.1 Scoring of biological consequences

The consequences due to impacts on various biological components have been categorized into 5 levels ranging from insignificant to severe consequence and are given in **Table 4.9**. It consists of flora, fauna and habitat / ecosystem level impacts.

Table 4.9: Biological consequences scoring scheme

Consequences Score (CS)	Likely Impact Receiving Components (Ecosystem, habitat and Species Level)
Insignificant Consequence - 1 Score	Site specific clearing (removal) of common flora i.e. herbs, shrubs, grasses, climbers.
	Vegetation composition does not form a habitat character for any species of conservation significance.
	No short term or long-term impacts are likely to adversely affect the surrounding habitat / ecosystem.
	Site specific disturbance to common / generalist faunal species (e.g. movement pattern, displacement etc.).
	No negative impacts on surrounding ecosystem functioning or habitat ecology.
Minor Consequence - 2 Score	Site specific loss (removal) of some common species of regenerating tree saplings.
	Minor temporary impacts on ecosystem functioning or habitat ecology of common / generalist species.
	Minor short term / long term impacts on surrounding / immediate / adjacent habitats but are resilient to changes in habitat structure or condition.
	Impact on surrounding agro-ecosystem / agriculture when environmental data / parameters are within permissible limits.
Moderate	Site specific clearing (removal) of some common well grown tree / trees

Consequence - 3 Score	Site specific loss of nesting / breeding habitat of common / generalist species of flora-fauna but will not result in permanent loss of habitat.
	Short term or long-term impacts having potential to affect adversely the surrounding habitat character/ habitat ecology/ functioning of ecosystem.
	Impact on surrounding agro-ecosystem / agriculture when physical parameters with marginal increase but can be mitigated. Or likely cumulative impact.
Major Consequence - 4 points	Site specific impact on threatened species but impacted species is widely distributed outside the project site. Short term impacts may lead to loss of abundance or extent, but unlikely to cause local population extinction.
	Site specific habitat loss of fauna listed in IUCN, WCMC, Birdlife, International, or any other international literature - secondary information.
	Impacts on habitats / ecosystems of international importance.
Severe Consequence - 5 points	Impact on Notified areas / species having legal protection under various acts / notifications including proposed areas / species or under consideration. Species mentioned in BSI, Red Data Book, ZSI, or literature published by any State Govt. Institute, University or Collage etc.

4.3.7.2 Likely impacts on biological environment

Identification of extent of likely impact zone (LIZ) area

Though the concentrations of the emitted pollutants will be kept within permissible levels through the various engineering controls, it is essential to have eco-management in the Likely Impact Zone (LIZ) for safeguard and enhanced of ecological environment of the project area. So, accordingly, nearby village areas, Bawana RF, Shri Krishna Sultanpur RF, Marmurpur PF, agriculture area / plantation, nearby pond, and other habitats like open scrub vegetation, and associated biodiversity are falling in the LIZ area.

Identification of likely impacts

Following impacts have been determined on the basis of the various project activities, associated aspects involved in various stages of the project cycle, and ecological setting / condition of the LIZ area. Activity based determination of impacting ecological components are given in the **Table 4.10** and Likely Impacts on biological components is given in **Table 4.11**.

Table 4.10: Activity-aspect based determination of impacting ecological components

S. No.	Activity	Aspect	Ecological Components					
			TFL	TFA	AFL	AFA	MFL	MFA
1. Pre- Construction Phase								
1.1	Site preparation	Removal of top soil and vegetation	√	--	--	--	--	--
1.2	Movement of Earth movers and other Vehicles	Generation of noise and dust	√	√	--	--	--	--
2. Construction Phase								
2.1	Movement of Earth movers, DG sets and other vehicles	Generation of noise and dust	√	√	--	--	--	--
2.2	Emissions from combustion of fossil fuels from stationary or mobile Sources	PM, SO ₂ and NO _x from DG sets	√	√	--	--	--	--
2.3	Handling of materials including construction materials, sewage and waste	Generation of dust or odours	√	√	--	--	--	--
3. Project operation Phase								
3.1	Emissions from combustion of fossil fuels from stationary or mobile Sources	PM, SO ₂ and NO _x , Fly Ash from WTE power plant and DG sets	√	--	√	--	--	--
3.1	operation of equipment e.g. engines, ventilation plant, crushers, steam blowout for the cleaning of the steam header	Generation of noise	--	√	--	--	--	--
TFL – Terrestrial Flora, TFA – Terrestrial Fauna, AFL – Aquatic Flora, AFA – Aquatic Fauna, MFL – Marine Flora, MFA – Marine Fauna								

Table 4.11: Likely Impacts on biological components

S. No.	Project Aspect Description	Likely Impacts on Ecology and Biodiversity (EB)
1. Site Preparation Phase		
1.1	Removal of site vegetation like herbs, shrubs and grasses (except trees)	Impact-1: Site specific loss of common floral diversity Impact-2: Site specific loss of associated faunal diversity Impact-3: Site specific loss of habitat / habitat diversity
1.2	Generation of dust and noise due to movement of Earth movers and other vehicles	Impact-4: Site specific impact (dust deposition) on the site flora & disturbance fauna
2. Construction Phase		
2.1	Generation of noise due to movement of Earth movers, DG sets and other vehicles	Impact-5: Site specific impact (dust deposition) on the site flora & disturbance fauna
2.2	Generation of PM, SO ₂ and NO _x from DG sets	Impact-6: Site specific impact on the site flora & fauna
2.3	Generation of dust or odours due to Handling of materials including construction materials, sewage and waste	Impact-7: Site specific impact on the site fauna
3. Project operation Phase		
3.1	Emissions of PM, SO ₂ and NO _x , Fly Ash from WTE power plant and DG sets combustion of fossil fuels from stationary or mobile sources	Impact-8: Impact on surrounding vegetation including buffer zone area and associated biodiversity.
3.2	Generation of noise due to operation of equipment e.g. engines, ventilation plant, crushers, steam blowout for the cleaning of the steam header	Impact-9: Site specific disturbance on the site fauna

Quantifying biological impact

Impacts on the flora, fauna and habitats have assessed in the **Table 4.12** on the basis of multiplication of Consequence Score (CS) and the Occurrence Frequency Score (OFS) together.

Table 4.12: Biological impact scoring

Impact S. No.	Likely Impact Description	Impact Scoring			Remarks
		CS	OFS	BIS	
1. Site Preparation Phase					
1.	Loss of floral diversity: Site possesses common floral species (herbs, shrubs and grasses; clearing of same will not result in loss of flora in true sense. This will be site specific impact.	1	5	5	Less severe
2.	Loss of habitat and associated faunal diversity: Faunal species reported from site are common / generalist species which uses wide variety of habitats of the local environment so there is no threat of loss of faunal diversity.	1	5	5	Less Severe
3.	Disturbance to the fauna / faunal movement: there will be short term impact on movement of common / generalist species. Project site forms common habitat structure which is very common component of the buffer zone habitats.	1	5	5	Less Severe
4.	Site specific impact (dust deposition) on the site flora & disturbance fauna: this will be short term impact during site preparation phase.	1	5	5	Less Severe
2. Construction Phase / Plant erection					
5	Site specific impact (dust deposition) on the site flora & disturbance fauna – Disturbance to the fauna / faunal movement: Project site is recorded with movement of common / generalist species. These species are adapted to routine general / normal human activities. However, site specific short term impacts are expected.	1	5	5	Less Severe
6	Site specific impact on the site flora & fauna due to Generation of PM, SO ₂ and NO _x from DG sets – proper engineering controls will be required. However, site-specific short-term impacts are expected.	1	5	5	Less Severe
7	Site specific impact on the site fauna due to generation of dust or odours due to Handling of materials including construction materials, sewage and waste – proper engineering controls will be required. However, site specific short term impacts	1	5	5	Less Severe

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

	are expected.				
3. Operation Phase					
8	Impact on surrounding vegetation including buffer zone and associated biodiversity due to emissions from PM, SO ₂ and NO _x from WTE power plant and DG sets combustion of fossil fuels from stationary or mobile sources.	2	5	10	Moderate Severe
9	Site specific disturbance on the site fauna due to generation of noise due to operation of equipment e.g. engines, ventilation plant, crushers, steam blowout for the cleaning of the steam header – this will be site specific impact on the common generalist species.	1	5	5	Less Severe

Mitigation measures

Considering above various impacts, apart from various operational / engineering controls following mitigation measures will be implemented to improve / maintain biological conditions of the project area environ. Detail description is given in the **Table 4.13**.

Table 4.13: Likely impacts and mitigation measures

S. No.	Likely Impact Description	Impact Justification and Mitigation Measures
1. Pre-construction Phase		
1.	Loss of floral diversity	- Common species of grass, herbs and shrubs (not trees) will be uprooted during the site clearing. - Core zone is not a critical / unique habitat for any species
2.	Loss of habitat and associated faunal diversity	Considering above facts there will no loss of flora, fauna and habitat diversity in true sense. However, 33 % of the site area will be developed as a greenbelt. Greenbelt with the suitable species will compensate floral loss as well as provide habitat for local faunal species.
3.	Disturbance to the fauna / faunal movement	All recorded species are generalist and adapted to routine human activity so no specific mitigation is required.

direct discharge in the canal or in the river is anticipated. Plant having permission from Delhi Jal Board for 1000 KLD and agreement with Pragati Power Corporation Limited (PPCL) for 350 KLD (expandable as per requirement). No water will be extracted from the canal or from the river. Further the power plant is designed to achieve zero liquid discharge (ZLD) hence, there will be no effluents released to surrounding water bodies. Hence, there will be no or minimal impact on aquatic life of water bodies in study area.

Terrestrial ecology

Major air pollutants from the waste to energy power plant are SO₂, NO_x and Particulate Matter. Impact on terrestrial ecosystem is due to deposition and absorption of these air pollutants on flora and soil surfaces. Deposition of fly ash on leaves may interrupt gaseous exchange through stomata clogging, thereby affecting plant growth. Since most of the tree species occurring in the study area are northern ravine throne forest and some mass plantation with different species, they have high Air Pollution Tolerance Index (APTI), and therefore, impact of SO₂ will be kept at minimum.

There are no National Parks / Wildlife Sanctuary / Forests / Tiger reserve / Wetlands / Biosphere Reserve/ Tiger Reserves and Elephant corridor etc. within 10 km. radius from project site.

To minimize the impacts and improve the environmental quality of surrounding area it is proposed to develop green belt of 33% of the project area and also large-scale plantation in Industrial area, nearby village, on agriculture hedges and other places of the village like around the schools, temple premises of LIZ to improve habitat status of the project area. Plantation will be done in the degraded Reserved Forest area with consultation of forest department.

4.	Site specific impact (dust deposition) on the site flora & disturbance fauna	Proper measures like water sprinkling will be done to suppress the dust during site preparation
2. Construction Phase / Plant erection		
5.	Site specific impact (dust deposition) on the site flora & disturbance fauna	No specific mitigation is required since all species are generalists and well adapted to routine human activities. However, regulatory norms will be followed.
6.	Site specific impact on the site flora & fauna due to Generation of PM, SO ₂ and NO _x from DG sets	Proper engineering controls will be required to meet the regulatory norms.
7.	Site specific impact on the site fauna due to generation of dust or odours due to Handling of materials including construction materials, sewage and waste	Proper engineering controls will be required to meet the regulatory norms. However, this will be a short-term impact. Plantation of fragrance species are recommended for greenbelt development.
3. Operation Phase		
8.	Impact on surrounding vegetation including buffer zone and associated biodiversity due to emissions from PM, SO ₂ and NO _x from WTE power plant and DG sets combustion of fossil fuels from stationary or mobile sources	Considering the various habitats like agriculture area, orchards, ponds and Reserved Forest area of the buffer zone, this impact is rated as a moderate sever. Greenbelt with the suitable species will be developed in the core zone / site and in the surrounding areas including degraded forest area to mitigate the likely impacts. Regulatory norms will be also followed on the disposal of fly ash.
9.	Site specific disturbance on the site fauna due to generation of noise due to operation of equipment e.g. engines, ventilation plant, crushers, steam blowout for the cleaning of the steam header	This will be site specific impact on the common generalist species and requires engineering control. Regulatory norms have to be followed. However, greenbelt will be developed as per norms.

4.3.7.3 Impacts on existing water bodies, reserve forest and other ecologically sensitive areas within 10 km radius of project site.

Aquatic ecology

There is no water body present within the project site or adjacent to the project site. Yamuna canal located adjacent to site at 0.5 km (SW), Yamuna river located 13.6 km (E). There is no

CHAPTER 5

ANALYSIS OF ALTERNATIVES (SITE & TECHNOLOGY)

Chapter 5

Analysis of Alternatives (Site & Technology)

5.1 Site Alternatives

Alternative analysis is the process of examining the proposed location for appropriateness for basic necessities to operate the plant safely; analysis also present the alternative technology towards environmental aspect of pollution prevention, and improvement in quality of life nearby the project vicinity. This chapter includes the reasoning for the selection of the project site from environmental point of view as well as from economic point of view that the technology will be affordable. As well it provides the alternatives for the proposed expansion project in terms of technology and site which are discussed with particular emphasis on environmental considerations.

The proposed project is an expansion of the existing Waste to Energy (WTE) power plant. The project involves increasing the present capacity of 24 MW to 60 MW within the plant premises of Integrated Municipal Solid Waste Management Project (IMSWMF) by constructing a 36 MW WTE module adjacent to the present operating plant.

No alternate sites were considered because the land required for proposed expansion project is within the existing IMSWMF Project area of 40.46 Ha (100 Acres) which notified Solid Waste Disposal site of Municipal Corporation of Delhi. No additional land to be acquired and there is no rehabilitation & resettlement involved. The land is within the Bawana Industrial Area, Narela Bawana, North West Delhi.

5.1.1 Compliance of the Site with Site Selection Criteria

In order to help the concerned authorities and the entrepreneurs, Ministry of Environment, Forest & Climate Change, Government of India has framed certain broad guidelines for establishment of an industry in India. The broad environmental guidelines recommended for siting of industries to ensure optimum use of natural and man-made resources in sustainable manner with minimal depletion, degradation and or destruction of environment are given in **Table 5.1**. The site is also meeting the Swatch Bharath Mission guidelines for site selection.

In siting power plant, care should be taken to minimise the adverse impact of the power plant on the immediate neighbourhood as well as distant places. Some of the natural life sustaining systems and some specific land uses are sensitive to power plant impacts because

of the nature and extent of fragility. With a view to protecting such an industrial site shall maintain the above-mentioned distances.

Table 5.1: Site Selection Criteria – Areas to be avoided

Land Procurement	Sufficient land to meet the demand of greenbelt development, reuse of treated water, storing of solid waste before final disposal	Sufficient land is available for expansion of the proposed project from 24 MW to 60 MW including greenbelt within IMSWMF
Coastal areas	At least 500 m from high tide line	Not in CRZ area, no sea coast nearby
Estuaries	At least 200 m away from the estuary boundaries	No estuaries nearby
Flood plains of the Riverine system	At least 500 m from flood plain or modified flood plain, or by flood control systems	No river flood plain in 500 m, Yamuna river is around 13.6 km (E), Yamuna canal at 0.5 km SW of the site
Transport/communications system	At least 500 m from highway and railway	NH-1 is around 6.5 km (E), Holambi Kalan Railway station is around 3.2 km (E)
Major settlements	At least 25 km from the project growth boundary of the settlement (3 lakh population)	The site is within Bawana Industrial area, Narela Bawana. Bawana residential area is around 500 m from the site
Ecologically and or otherwise sensitive area	At least 25 km (Archaeological monuments, National parks & Sanctuaries, Biosphere reserves, Hill resorts, Scenic areas, etc.	Bawana RF located at 1.5 km (N), Shri Krishna Sultanpur RF located at 4.5 km (SW), Marmurpur PF located 7 km (NE).
Ecologically and / or otherwise sensitive areas include: 1) Religious & historic places, 2) Archaeological monuments, 3) scenic areas, 4) Hills resorts, 5) Beach resorts 6) Health resorts 7) Coastal areas rich in coral, mangroves, breeding grounds of specific species, 8) Estuaries rich in mangroves, breeding ground of specific species, 9) Gulf areas, 10) Biosphere reserves, 11) National parks and sanctuaries, 12) Natural lakes, swamps, 13) seismic zones, 14) Tribal settlements, 15) Areas of scientific and geological interest, 16) Defence installations, specifically those of security importance and sensitive to pollution 17) Border areas (International), 18) Airports, 19) Tiger reserves/ elephant reserves/ turtle nestling grounds 20) Habitat for migratory birds 21) Lakes/ reservoirs/ dams.		

No alternative sites are considered as it is and expansion of the existing operation power plant. The proposed project site is located within the area identified by Delhi Development Authority (DDA) & DSIIDC for establishment of waste management facilities in waste

management complex and the land allocated at Bawana Industrial Area, Narela Bawana, North West Delhi, Delhi, hence no alternative sites have been identified. The Master Plan for Delhi (MPD 2020-21) has mentioned that 'the area required for solid waste disposal through various technologies including sanitary landfill sites shall be reserved in the Zonal Plans. This shall also include buffer zone of 'no development' around landfill sites'.

5.2 Analysis of Alternative Technologies

WTE is a very broad term that covers any process that converts waste into energy, or an energy-carrying product, such as a gas or oil into energy. Despite the existence of many different technologies, the aims of all WTE processes are essentially the same:

- Reduce the volume of waste and hence it reduces the volume/land requiring for disposal of waste in secured landfill
- Reduce the biodegradable fraction of waste to almost zero in the landfillable waste in the secured landfill, and
- Produce a useful commodity (typically electricity and/or heat) from non-recyclable waste.

WTE can be split into two main categories:

Thermal - includes combustion, gasification and pyrolysis, related processes all of which subject waste to high temperatures but with varying oxygen concentrations.

Biological - Anaerobic digestion (AD) used to recover energy from wet, biodegradable waste streams (such as food waste, vegetable/fruit market waste and farm slurry). AD uses micro-organisms in carefully controlled conditions to convert biomass into biogas consisting primarily of methane and carbon dioxide and a stabilized residue known as digestate.

5.2.1 Direct Combustion (Incineration)

Combustion (incineration) of waste is achieved by heating waste in an excess of oxygen. 'Mass burn' refers to a process that accepts raw or post recycling MSW without any additional pre-treatment (e.g. no shredding or Refuse Derived Fuel (RDF) production). The process can best be explained by examination of the combustion of waste in grate furnaces, where the fuel forms a bed on top of the grate and the combustion air is injected through the grate. The different local temperatures and oxygen concentrations cause a succession of reactions from drying through pyrolysis and gasification to final combustion.

Combustion is actually a sequence of close-coupled physical and chemical reactions; initially the waste dries, then pyrolysis and gasification reactions occur as volatile compounds are heated and de-volatilize from the solid phase into the gaseous phase and are then combusted. As this process occurs an ash comprised mainly of inorganic components is left behind. Combustion usually takes place with an excess of air (which is provided from below

the grate as under fire air and via secondary and tertiary injection as over fire air), in order to ensure the proportion of fuel reacting with the oxygen is maximized.

Combustion of RDF is a very well-established technology with many hundreds of operational plants worldwide. Energy recovery is invariably in the form of a steam boiler which recovers heat from the hot flue gases to generate superheated steam. A steam turbine is used to generate electricity, except in cases where the steam can be used directly in a co-located industrial process for distinct heating or desalination.

5.2.1.1 Grate Systems

A grate furnace is capable of burning untreated waste. In a grate furnace, the waste is fed via a feeding chute and then pushed into the combustion chamber by a hydraulic ram or a travelling grate. There are number of different grate designs in operation but their prime function is controlled transport of the waste through the combustion chamber. The design has to guarantee efficient mixing of the fuel bed and permanent coverage of the metal parts to protect them against over-heating. In all grates the primary air is injected from below, through the grate. As the waste is dried and combusted the remaining volatiles are further combusted above the grate assisted by proper mixing of the gases with the over fire air. The combustion grate is designed to have sufficient length to allow the remaining waste to fully combust prior to the ash being discharged out of the furnace. There are four main types of grate, forward reciprocating, reverse reciprocating, roller and horizontal.

The hot flue gases produced in the combustion furnace pass into a water tube boiler where the energy is recovered via heat transfer to form superheated steam inside the tubes. The gases then pass through the air pollution control (APC) system to be cleaned where pollutants such as acid gases, oxides of nitrogen (NO_x), heavy metals and dioxins/furans are removed before the cooled flue gas is emitted to atmosphere via a chimney. The superheated steam is used within a steam turbine to generate electrical power.

Two types of solid residues are generated by the combustion process, bottom ash (BA) and air pollution control (APC) residues incorporating fly ash from the abatement equipment. Bottom ash is usually classified as non-hazardous waste. It is initially processed to remove metals for recycling and can then be further treated to produce an approved aggregate material with applications for road building and construction and ash from the particulate filtration system is generated as fly ash and APC residues and usually classified as hazardous waste due to the residual alkalinity and eco-toxicity (attributed to chemicals removed from the flue gases). These residues are usually treated, neutralized and then sent for storage in underground mines or disposal in an appropriately permitted secured landfill.

5.2.1.2 Fluidised Bed Systems

Fluidization is the term applied to the process whereby a fixed bed of fine solids is transformed into a liquid-like state through contact with an upward flowing gas, usually air. The technology for fluidized bed (FB) combustion is a well-established and proven process for energy conversion. The technology was originally developed for power generation from the combustion of coal but it has been applied to a much wider range of fuels in recent years, such as sewage sludge, biomass and solid wastes.

FB furnaces consist of a rectangular or cylindrical combustion chamber where wastes with a relatively small particle size are burned in a fluidized sand bed, sometimes with the addition of dolomite for the capture of acid gases. All FB furnaces have the advantage of establishing a uniform distribution of the waste in the fluidized fuel bed, which enables homogeneous and stable combustion. Another advantage is the wide range of calorific value fuels that can be burnt in this type of furnace. The energy density in the fuel bed can be varied by controlling the share of fuel in the bed. FB technology is sometimes chosen due to the need to minimize plant floor area. A vertical furnace design can result in a higher combustion capacity per unit area than typical grate-fired units; there is however the potential for an increased height profile with FB technology to raise concerns over their visual impact in certain locations. In order to establish fluidization, the particle size has to be limited; therefore pre-treatment (i.e. shredding, chipping etc.) of the fuel is required. Another limitation is the fuel bed temperature, which is typically kept $< 850^{\circ}\text{C}$ to avoid melting and agglomeration of ash components and the collapse of the fluidized bed.

There are three types of FB reactor: 1. Bubbling (BFB), 2. Circulating (CFB) and 3. Revolving (internally recirculating FB). As for moving grate systems, the hot flue gases formed in the FB combustors pass through a waste heat recovery boiler to produce steam for use in a steam turbine to generate electricity. The flue gases are then cleaned in the APC process before being discharged to atmosphere. Residues (bed ash and fly ash) are removed from the plant for recycling or disposal.

5.2.2 Gasification

Gasification is a partial oxidation process, in which the majority of the carbon and hydrogen in the waste is converted into the gaseous form (syngas), comprising mainly carbon monoxide (CO) and hydrogen (H_2), and leaving a solid residue consisting of inert ash and a char consisting of the inorganic compounds that entered with the waste and fixed carbon rejected by the gasification process. Gasification converts about 80% of the chemical energy in the waste fuel into chemical energy in the gas phase. The gas can be combusted immediately, cleaned and used directly in gas engines or upgraded to higher fuels or chemicals.

There are a number of different gasification processes and process configurations that have been marketed as alternatives to combustion for treating MSW and RDF. These include different designs of the core gasification reactor such as fluidized bed, rotary kiln, updraft and downdraft reactors, each of which is tailored to give certain benefits when gasifying various types of wastes. This technology evaluation will only focus on those designs that are close to reaching commercial application using MSW or similar feedstock. Fluidized bed plants require feedstock to be shredded to reduce the particle size to a suitable level for the gasifier to accept. Gasification offers a number of potential advantages over direct combustion of the RDF, depending on how the process is configured. The resulting syngas can be utilized in a range of applications, including gas engines for conversion to heat and electricity with potentially increased efficiency over conventional steam cycle. There is potential for improved combustion control and reduced emissions at source associated with combustion of a gaseous fuel rather than a heterogeneous solid fuel and there is potential for the flue gas clean up system to be substantially scaled down when gas engines are used, due to much lower volumes of flue gas and reduced formation of certain pollutants.

5.2.2.1 Gasification with Steam Cycle ('Close-Coupled' Gasification)

Most commercially available waste gasification processes use a steam turbine to generate electricity in the same way as conventional combustion plants. The syngas produced by the gasifier is immediately combusted (in the same vessel or in a separate reactor). The heat produced by combustion is carried by flue gases and passes through a heat recovery boiler in order to raise steam to power a steam turbine. This is referred to as 'close-coupled' gasification.

Gasification in combination with combustion has a number of advantages over 'advanced' gasification (where syngas is used in gas engines or a gas turbine, or in high pressure boilers):

- Syngas does not require any treatment
- The energy from the tars and volatile organics are recovered;
- More conventional and proven steam boiler/steam turbine systems can be used for energy recovery;
- Tried and tested flue gas cleaning methods can be used to abate potentially harmful pollutants, and
- As a result of the above, it is seen as a lower risk, more bankable technology and financing can be more straightforward.

There are also however a number of significant disadvantages with this approach:

- The efficiency of a steam turbine generator is inherently lower than a gas engine or gas turbine.

- At small scale a close-coupled gasification process may generate electricity with an efficiency of around 20%, whereas gas engine or gas turbine systems could theoretically achieve efficiencies of 30 - 40%;
- The process is likely to have a larger plant profile than those configurations that produce a syngas because of the high flue gas volumes that require a gas clean-up system and stack similar to that required by a moving grate combustion plant, and
- The plant will require a much larger stack than an 'advanced' gasification plant.

5.2.2.2 Gasification with Syngas to Gas Engines or Turbine

Higher electrical efficiencies can be achieved when the syngas is used in gas engines. However, there are few plants operating in this manner due to the requirement to clean the gas to a standard appropriate for use in gas engines. Few systems have been proven technically at commercial scale, with JFE's Thermo select process being a notable exception that is currently operating at seven plants in Japan with five of them cleaning the syngas and using gas engines. However, we understand JFE are no longer offering this technology due to the costs of the process.

5.2.3 Slagging Gasification

Slagging gasification processes are designed to combine gasification of the waste with melting of the inorganic material (ash and metals) present in the waste. This practice is particularly prevalent in Japan where the main objective of waste management is volume minimization and maximized recycling. The resulting melted ash, a type of vitrified slag, is physically stable, environmentally inert and is predominantly recycled as a construction material in Japan. Total residues requiring disposal to landfill from a slagging gasification plant can be very low when outlets can be found for the slag. Metals can also be separated. To melt the inorganic ash, high temperatures are required and, in some processes, the required temperatures are facilitated by the use of oxygen rather than air for gasification and/or the use of plasma processes to provide the necessary input of heat energy. High-energy supplementary fuels such as coke are often also added to the waste stream to boost the temperature in the melting zone of the reactor to temperatures in the range of 1600°C required for melting to occur. The production of oxygen is costly and usually energy intensive although Pressure Swing Adsorption (PSA) oxygen generation systems are being used in Japan, which produces oxygen enriched air flow, which is much more cost effective than cryogenic air separation systems.

5.2.4 Pyrolysis

Pyrolysis is the thermal degradation of carbon-based materials through the use of an indirect, external source of heat, typically at temperatures of 450°C to 750°C, in the absence or almost complete absence of free oxygen. This drives off the volatile portions of the

organic materials, resulting in a syngas composed primarily of H_2 , CO, CO_2 , CH_4 and complex hydrocarbons. The syngas can be utilized in boilers, gas turbines or internal combustion engines to generate electricity. The balance of the organic materials that are not volatile are left as char material. Inorganic materials form bottom ash that requires disposal, although some pyrolysis ash can be used for manufacturing brick materials. Pyrolysis involves the thermal degradation of organic waste in the absence of free oxygen to produce a carbonaceous char, oils and combustible gases.

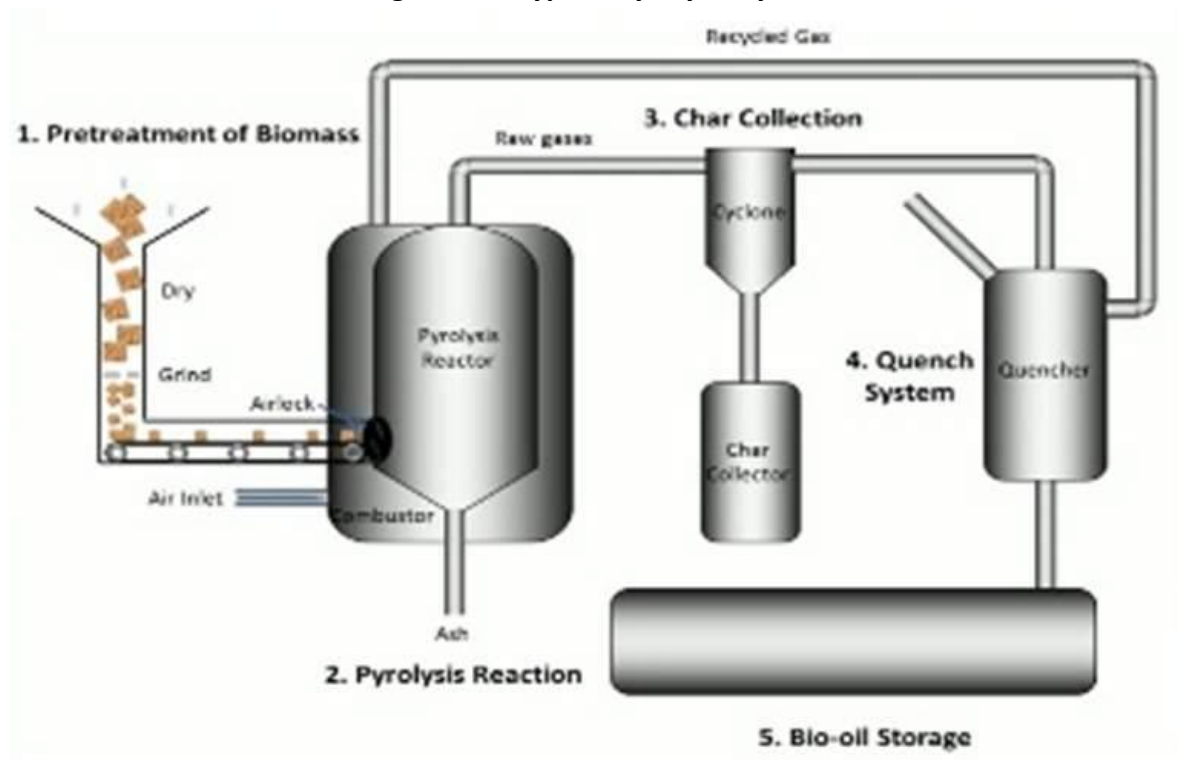
Although pyrolysis is an age-old technology, its application to biomass and waste materials is a relatively recent development. An alternative term for pyrolysis is thermolysis, which is technically more accurate for biomass energy processes because these systems are usually starved-air rather than the total absence of oxygen. Although all the products of pyrolysis may be useful, the main fuel for power generation is the pyrolysis oil. Depending on the process, this oil may be used as liquid fuel for burning in a boiler or as a substitute for diesel fuel in reciprocating engines, although this normally requires further processing. Typical pyrolysis system is shown in **Figure 5.1**.

Typical Pyrolysis Facility:

In a typical pyrolysis facility, the following are taking place:

- Drying of solid waste (100-200°C).
- Initial decomposition of substances, initiation of decomposition of H_2S & CO_2 (250°C).
- Break of the bonds of aliphatic substances – Start of the separation of CH_4 and other aliphatic substances (340°C).
- Enrichment of the produced material in Carbon (380°C).
- Break of the bonds C – O and C - N (400°C).
- Conversion of coal tar materials into fuel material and tar (400 - 600°C).
- Decomposition to materials resistant to heat – Formation of aromatic substances (600°C).
- Production of aromatic substances, processes for hydrogen removal from organics like Butadiene, etc. (>600°C).

Figure 5.1: Typical Pyrolysis System

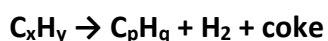


Reaction Process:

The reactions taking place initially are decomposition ones, where organic components of low volatility are converted into other more volatile ones:



Moreover, at the early stages of pyrolysis process, reactions occurring include condensation, hydrogen removal and ring formation reactions that lead to the formation of solid residue from organic substances of low volatility:



In the case of existence of oxygen, CO and CO₂ are produced or the interaction with water is possible. The produced coke can be vaporized into O₂ and CO₂.

The pyrolysis products can be liquid, solid and gaseous. The majority of the organic substances in waste are subjected to pyrolysis by 75 – 90 % into volatile substances and by 10 – 25 % to solid residue (coke). However, due to the existence of humidity and inorganic substances, the quantity of volatile substances varies from 60 to 70% and the coke between 30 and 40%.

In order to achieve the successful operation of a pyrolysis facility, continuous control is required due to the complex processes taking place during the method development. Moreover, solid waste with no major composition variation that does not include metals

and glass has to be fed on continuous basis (use of waste after successful implementation of separation at source or mechanical separation).

The products produced from pyrolysing materials are a solid residue and a synthetic gas (syngas), while some of the volatile components form tars and oils can be removed and reused. The solid residue (sometimes described as a char) is a combination of noncombustible materials and carbon. The syngas is a mixture of gases (combustible constituents include Carbon monoxide, Hydrogen, methane and a broad range of other VOCs). A proportion of these can be condensed to produce oils, waxes and tars. The syngas typically has a net calorific value of between 10 and 20 MJ/Nm³. If required, the condensable fraction can be collected by cooling the syngas, potentially for use as liquid fuel.

Disadvantages of pyrolysis:

The big problem of this technique is that pre-treatment is required including cutting and separation of waste prior to pyrolysis which can increase the cost for the installation and operation of such units substantially. The pyrolysis products cannot be disposed without further treatment. The facilities for cleaning the gases and wastewater require extremely high cost. At present, the application of the method at large scale is limited. Nevertheless, the prospects for reactors of average temperature with the form of rotary drum or fluidized bed seem to be better.

In developed countries, paper, plastics etc. form more than 50% of the waste resulting in a large proportion of gaseous as well as liquid products which have a heating value and can be easily used. However, the Indian MSW has a low projection of paper, plastics, etc. hence its successful adoption is difficult. In developed countries a substantial proportion of the total cost is often spent on processing. Unfortunately, more than 80% of the total cost of MSW Management in India is spent on collection and transportation, and the expenditure on processing is meager. Hence Pyrolysis and gasification are not proposed in the present project.

5.2.5 Plasma Arc Gasification

Plasma Arc Gasification is a multi-stage process which can break waste down to 1/300th of its original size by using ionized gases to produce temperatures greater than 3 times the surface temperature of the sun.

This process can safely deal with almost all forms of wastes by breaking down the matter into component molecules and producing a synthesis gas (syngas) which can be used as an industrial feedstock to produce biofuels, synthetic fuels or to produce hydrogen, or simply as a fuel (replacing fossil fuels) to generate steam or electricity.

Working of Plasma Arc Gasifier

Plasma Arc Gasification process has 4 stages as shown in **Figure 5.2**.

Figure 5.2 Flow Diagram of Process Stages of Plasma Arc Gasifier



Stage 1: Feed Handling

The waste is delivered into the feed system. One of the unique characteristics of the plasma assisted gasification type waste to energy technology is its waste processing flexibility. The system can handle any combination of solid, liquid and gaseous wastes. Solid waste is then passed through a pre-treatment process where it is shredded into smaller pieces to prevent blockages in the feed nozzle.

Stage 2: Gasification

The waste then is passed through an airlock which prevents gases from escaping into the atmosphere. The plasma gasifier is an insulated air-tight container with plasma torches at the base to provide the heat required to gasify the waste feed. The plasma torches consume a very small portion of the total energy available from the feedstock (2-5% of total energy input) in providing part of the heat required to drive the endothermic gasification process. Partial combustion provides the balance of heat required. Torch power is controlled by an automatic control system, which adjusts the gasification conditions to accommodate the potentially highly variable nature of the feedstock. The plasma arc is contained within the body of the plasma torch, and therefore, the waste material is not directly subjected to the plasma arc. Nonetheless, the plasma torches facilitate operating temperatures above typical flame temperatures associated with combustion of the waste feed stocks and also in excess of the melting points of metals and inorganic materials. Either air or oxygen and/or steam is injected above the torches to provide a source of oxygen for the gasification process and control the H_2 : CO ratio. Importantly, the gasification occurs in an oxygen starved environment, such that a combustible syngas product is produced, rather than a non-combustible flue gas, which would be the case if all the feed material was combusted.

Stage 3: Gas Cooling

After leaving the gasifier chamber the syngas passes through a series of filtration systems where it is cooled by using water injection. The cooling process acts to prevent the formation of dioxins and furans as these undesirable compounds are known to form within a specific temperature range. The gas will then be reheated to create a series of catalytic reductions to reduce the amount of NO_x and convert it into atmospheric nitrogen and

water. A series of scrubbers will then remove any acids, chlorides, fluorides, sulphates, phosphates, sodium and calcium.

Stage 4: Syngas Cleanup

A series of scrubbers will then remove any acids, chlorides, fluorides, sulphates, phosphates, sodium and calcium. Synthesis gas (syngas), the main output of the plasma gasifier, can be used as a fuel source in power plants, or treated further to generate hydrogen. It can also be used in the rural and industrial sector in the production of a wide range of polymers, chemicals, biofuels (including ethanol), fertilizers, pressure agents and more.

Limitations of Plasma Arc Gasification

- Waste gasification and combustion ultimately releases carbon dioxide to the atmosphere instead of sequestering a large fraction of the carbon in a landfill;
- Large capital costs relative to current landfills;
- Requires large electrical energy input if the waste stream does not contain a large fraction of unoxidized hydrocarbons;
- The highly corrosive plasma flame may lead to frequent maintenance and component replacement with associated facility down time;
- The filters and gas treatment systems are themselves sources of toxic waste, some of which (e.g. acidified water) are poor candidates for plasma processing.

CHAPTER 6

ENVIRONMENTAL MONITORING PLAN

Chapter 6

Environmental Monitoring Program

6.1 Environmental Monitoring Program

The main purpose of environmental monitoring program is to check the efficacy of the Environmental Management Plan (EMP) which is prepared for the proposed expansion project implementation and to take corrective action if needed. The regular monitoring of environmental parameters is of immense importance to assess the status of environment during project operation.

With the knowledge of baseline conditions, the monitoring programme will serve as an indicator for any deterioration in environmental conditions due to operation of the project and will enable to take up suitable mitigation steps in time to safeguard the environment. A well-defined environmental monitoring program is being followed in the existing unit, the same would be followed for the proposed expansion project. It would be ensured that trained and qualified employees supervise the monitoring of ambient air quality, stack gases, effluents, noise etc., to see that prescribed standards laid down are achieved. As a part of this, the project management has employed full time Environment, Health and Safety (EHS) Manager. The key responsibilities of the EHS manager are mentioned below which he has to implement in the existing unit and the same will be extended in the proposed expansion plant. In addition, he has to ensure that the monitoring program is properly implemented.

1. Detailed emergency response plan
2. Environmental, social management and monitoring plan
3. Community impacts monitoring plan
4. Occupational health and safety plans

6.2 Monitoring Plan Phases

The environmental monitoring for the proposed expansion project will be carried out in both phases **a) Construction phase and b) Operation phase**

6.2.1 Construction Phase

The proposed project is an expansion of the existing waste to energy (WTE) plant by constructing a new 36 MW WTE module adjacent to the present operating 24 MW WTE plant. As this is an expansion project, construction activities will be involved like erecting of plant, boilers machinery, air cooled condenser and other ancillary facilities required other than the facilities provided within the existing unit. The proposed additional construction

activities do not require clearing of vegetation; however, there will be mobilization of construction material and equipment for short period of few months.

The basic environmental measures that need to be undertaken during construction phase are given in the following **Table 6.1**.

Table 6.1: Environmental Monitoring Plan during Construction Phase

S. No	Potential Impact	Detailed actions to be followed as per EMP	Parameters/ Points to be monitored	Frequency of Monitoring
1.	Air Emissions	All equipment's shall be operated within specified design parameters.	Random checks of equipment's, logbooks/ manuals	Periodically
		Vehicle trips to be minimized to the possible extent	Vehicle logbooks will be checked	Periodic during site clearance & construction activities
		Any dry, dusty materials shall be stored in sealed containers or will be prevented from blowing.	Stockpiles or open containers of dusty materials will be monitored	Periodic during construction activities
		Compaction of soil during various construction activities	Logbooks for construction activities will be checked	
		Maintenance of DG sets during construction phase to meet stipulated standards	Gaseous emissions will be monitored for SO ₂ , HC, CO, NO _x	Periodic emission monitoring
		Ambient air quality to be monitored within the premises & in the adjacent villages of the proposed site.	Ambient air quality will be monitored for PM ₁₀ , PM _{2.5} , SO ₂ , NO _x and CO	As per CPCB/ SPCC requirement (project site, down wind and up wind)
2.	Noise	List of all noise generating machinery at the facility site during construction phase will be prepared.	Equipment log books, noise level monitoring	Periodic monitoring
		Working at night hours shall be minimized.	Working hour records shall be monitored	

		Vehicular movement with respect to time will be monitored	Trucks and machinery will be continuously monitored to limit unnecessary/ avoidable journeys	
		Implementing good working practices (such as equipment selection and proper sitting) to minimize noise pollution and propose adaptation of ear muffs, safe distances, and safety enclosures to reduce its impact on human health. No machinery should run when not required.	Site working practices records, Noise levels readings/records	Periodic during construction activities
		Acoustic mufflers / enclosures to be provided in noise generating equipment	Check that mufflers/ enclosures shall be in place.	Prior to use of equipment
		Noise levels to be monitored in the ambient air within the plant premises.	Instant noise levels recording	As per CPCB/SPCC requirement
		All equipment's must be operated within the specified design parameters.	Random checks of equipment logbooks/manuals	Periodic check During construction activities
3.	Wastewater Discharge	Wastewater should not be discharged directly on to surface water, groundwater or soil	Water courses must be checked to confirm no discharge hoses in the vicinity	Periodic check during construction activities
		Discharge point shall be selected properly and treated water shall be sampled and analysed prior to discharge	Discharged water must comply with the standard norms	
		Wastewater generated		

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

		shall be treated prior to discharge		
4.	Soil Erosion	Minimize the area of site clearance by staying within the defined boundaries	Site boundaries must not be extended/ breached as per plan document.	Periodic check during construction activities
		Protect topsoil stockpile	Effective cover in place.	
5.	Drainage and Effluent Management	Ensure drainage system and Effluent treatment system is working effectively. The design/pattern incorporated for the existing drainage system shall not be disturbed.	Visual inspection of the drainage system and continuous check of records	Periodic check during construction activities
6.	Solid Waste Management	Implement waste management plan that identifies and characterizes every solid waste associated with proposed activities and also identifies the procedures for the collection, handling & disposal of each waste generated. It must be compliance with MSW Rules, 2016; Hazardous and other waste rules, 2016; Construction & demolition rules 2016, BMW Rules 2016, Plastic waste management rules 2016 and its subsequent amendments and Battery Waste Management Rules, 2022.	Comprehensive waste management plan shall be incorporated and must be available on-site for inspection. Solid waste quantities and destination must be documented. Logbook must be kept and maintained to record the quantities of any excavated material waste exported from the project site, transportation routes and final reuse/disposal	Periodic check during construction activities. Logbooks must be reviewed regularly to check the chemicals consumption
7.	Non-routine events and	Plan will be drawn considering likely	Mock drills and records of all workplace	Periodic check during

	accidental releases	emergencies and steps required to prevent/ limit consequences.	accidents will be documented and archived	construction activities
8.	Health	Health check-ups of all employees & migrant labour (before they commence work) should be carried out	All relevant health check-ups must be monitored routinely	Check-up will be done as per Factories Act 1948.

6.2.2 Operational Phase

During operational phase, air emissions from boilers, DG sets, wastewater generation from water treatment process & Boiler blowdowns and other auxiliary facilities, solid (hazardous and non-hazardous) waste generation is expected. The following attributes which must be regularly monitored based on the environmental concern and nature of project activities are listed below.

- Point source emissions from industrial activities
- Ambient air quality in nearby villages (project site, downwind, upwind and cross wind directions)
- Groundwater levels, ground water quality in surrounding bore wells
- Surface water quality of nearby water bodies.
- Quality & quantity of wastewater generated
- Hazardous and solid waste characterization (process waste, ash, used /waste oil, etc.)
- Noise levels (equipment and machinery noise levels, occupational exposures and ambient noise levels)
- Ecological preservation and afforestation

Environmental monitoring plan for operational phase is given in **Table 6.2**.

Table 6.2: Environmental Monitoring Plan during Operational Phase

S. No	Potential Impact	Detailed actions to be followed as per EMP	Parameters/Points to be monitored	Frequency of Monitoring
1.	Air Emissions	Stack emissions from boiler	Stack emissions from boiler for PM ₁₀ , HCl, SO ₂ , NO _x , CO, TOC, HF, Total dioxins & furans, Cd+Th+ their compounds, Hg & its compounds, heavy metals (Sb+As+Pb+Cr+Co+Cu +Mn+Ni+V+ their compounds),	As per CFE conditions/Emission standards as per SWM rules 2016 / once in month for regular parameters.
		DG sets, etc.	DG sets for PM, SO ₂ & NO _x	As per MOEFCC/CPCB guidelines once in a Month.
		AAQ shall be monitored within the project premises and nearby habitations (minimum 3 places). All vehicles shall have Pollution Under Control (PUC) certificate.	PM, SO ₂ , NO _x VOC etc.) Vehicle logbooks shall be maintained. Greenbelt must be developed for minimizing dust propagation	
		Meteorological data	Wind speed, direction, temperature, relative humidity and rainfall.	As per CFE condition
2.	Noise	Noise generated during operation of boiler, cooling towers, DG sets etc. shall be monitored	Spot Noise Level must be recorded and shall meet the limits set by relevant legislation	As per CFE condition. Periodic during operation phase.
3.	Wastewater Discharge	Wastewater must be treated and must Comply with wastewater discharge standards and achieve zero liquid discharge.	pH, TSS, TDS, BOD, COD, Oil & Grease and other parameters as mentioned in the CFE	Daily at regular intervals and Once in a month by third party

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

		However, the proposed expansion will be designed for ZLD.		
4.	Solid waste/ Haz. waste	During operational phase, waste should be handled according to the waste management plan as per Hazardous and other waste (Management and Transboundary Movement) Rules, 2016 its amendments till date. Solid waste should handle as per SWM rules, 2016	Logbook shall be maintained to record the amounts of wastes generated, transportation routes and final reuse/disposal. Solid and Hazardous waste quantities and destination (final disposal) must be documented and kept to ensure proper handling and disposal.	As per CFE condition, periodically in operations phase.
5.	Ground Water Quality and Water Levels	Ground water quality and ground water levels must be monitored. Ground water monitoring during operation phase shall form part of the continuous QA/QC procedures for the plant subject to ongoing inspection.	Comprehensive monitoring of ground water quality and ground water levels as per IS 10500-2012 (important major, minor ions, heavy metals)	Periodically or once in a year
6.	Flora and fauna	Vegetation, Greenbelt/ Green cover development	Number and type of plant species must be recorded	Once a year
7.	Soil quality	Checking & Maintenance of good soil quality around	Soil quality must be analysed for Physico-chemical parameters and presence of metals.	Every quarter
8.	Health Conditions Accidents	A baseline health check-up of all employees and migrant labour shall be	Follow-up medical Check-up shall be carried out and results	Regular check-up as per factories act.

		carried out. The Emergency Response Plan will be monitored and tested frequently to ensure its effective in the event of an emergency.	must be documented. Safety records and monitoring of plant safety rules.	

6.3 Pollution monitoring facilities

The boilers stack, DG set stack will be provided with all the required facilities like spiral ladder around the chimney from ground level to sampling location, platform at sampling location along with sampling ports with necessary power points meeting the MOEFCC sampling standards and CFE conditiations. All the sampling ports will be easily accessible for carrying out proper sampling by the external monitoring team of the approved third-party environmental laboratory.

CHAPTER 7

ADDITIONAL STUDIES

Chapter 7

Additional Studies

7.1 Introduction

It is important to identify associated safety hazards and carry out a basic risk assessment. Mechanical and electrical hazards pertaining to heavy lift equipment, electrical fires/shocks, trips and falls and other standard hazards in different facilities constitute in the overall hazard profile of the project. In spite of the safety measures, possibility of accidents either due to human errors and/or due to equipment/system failure cannot be ruled out. The imperative need of a disaster management and response plan is to minimize the adverse impacts due to an unfortunate incident. Basic emergency response actions for the identified scenarios, disaster management aspects are described in this chapter..

7.1.1 Risk analysis

Risk analysis includes an estimate of the probability or likelihood that an event will occur. Estimation of random incidents totally uncorrected with plant activities may also be taken in to account. Risk can be characterized in qualitative terms as high, medium or low or in quantitative terms using numerical estimates and statistical calculations. Diminishing the likelihood of an accident or minimizing the consequences will reduce overall risk.

The Objectives for carrying out the Risk Assessment Study are:

- Identify hazards associated with operation and handling of hazardous chemical in the facility.
- Estimate the risks associated with the project facility by combining consequences of undesired events like fire, explosion, toxic and frequency of occurrence of such events.
- Benchmark the risk against PNGRB risk acceptance criteria and demonstrate that the risk is within ALARP or broadly acceptable region or whichever the case may be.
- Conclude and Suggest Risk Mitigation Measures/Recommendations
- Disaster Management Plan

The Risk Assessment study involves following aspects:

- Hazard Identification: Study of all critical areas with a view to identify potential hazards which could trigger loss causing events such as release of hazardous material, fire, vapor cloud explosions, toxic exposure etc. resulting in damages outside and/ or inside the facility.
- Scenario Selection: Identification of Maximum Credible Loss Accident Scenarios leading to undesired events such as fire, VCE, toxicity exposure etc.

- Consequence Modeling: Consequence modeling of the identified failure scenarios using PHAST software. This involves calculating the impact distances for fires, explosions, etc. and contour mapping of the impact zone on the plant layout.
- Frequency Estimation: Estimation of frequency of occurrence of the identified Maximum Credible Loss Case Scenarios using various databases
- Risk Assessment: Assessment of Risk based on consequence analysis and frequency of occurrence of MCA (Maximum Credible Accident) and comparing the risk with against risk acceptance Criteria
- Conclusion & Recommendation: Based on the study, conclusions are drawn and recommendations are made with a view to minimize risks associated with the facility.
- Disaster Management Plan and Emergency response system.

7.2 Evaluating hazards

The need for sophisticated techniques for evaluating hazards depends on the result of preliminary hazard analysis. Various techniques for evaluating hazards are as follows:

- Hazard and Operability Study (HAZOP)
- Accident Consequence Analysis
- Event Tree Analysis
- Fault Tree Analysis
- Failure Modes, Effects and Criticality Analysis

In order to be in a state of readiness to face the adverse effects of accidents, an Emergency Preparedness Plan (EPP) has to be prepared. Such a plan must cover the possible hazardous situations in the locality and the causes, areas most likely to be affected, on-site and off-site emergency plans, establishment of Emergency Control Centre (ECC), location of emergency services and duties of officers/staff during an emergency.

The EPP protocol should be designed to provide measures to control the incident and minimizing the effects due to fire, explosives, release or escape of toxic gas, spillage of hazardous substances during storage, processing or transportation. The necessary preventive and protective steps required to be taken before, during and after an accident need to be worked out in operational terms and detailed in the document.

7.3 Hazard identification

Identification of hazards is the primary task for planning for risk assessment in the analysis, quantification and cost-effective control of accidents involving chemicals and processes. A classical definition of hazard states that, it is the characteristic of system/process that presents potential for an accident. Hence, all the components of a system/process need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident. The methods

employed for hazard identification in this study are given below and list of hazards and mitigation measures are given in **Table 7.1**.

- Identification of major hazards based on Manufacture, Storage and Import of Hazardous Chemicals (MSIHC) amendment rules, 2000 and
- Identification of hazardous units and segments of plants and units based on relative ranking technique. Example: Fire- Explosion and Toxicity Index (FE&TI)
- Quantification of risk in terms of damage to property, environment or personnel

Table 7.1: List of hazards and mitigation

S. No.	Hazard Type		Mitigation measures
1	Geo-hazard	Earthquake	➤ Emergency response kits which consist of equipment and supplies like PPE, communications, first aid, flashlights, sanitation etc. should be stored in sizeable numbers. ➤ Escape procedures, emergency escape routes, congregation points should be demarcated and included in the response plan. ➤ Conduct mock drills to practice and improve the emergency preparedness response to make it foolproof.
		Flood	➤ Proper drainage system with adequate storm water drains shall be provided to prevent water logging ➤ Prior to monsoon season, de-silting and inspection of storm water drainage system shall be undertaken to remove any choke up/bottlenecks ➤ Greenbelt development shall be undertaken as much as possible to prevent soil erosion and water run-off.
2	Chemical	HSD (High Speed Diesel)	➤ Adequate firefighting equipment shall be provided in the storage area ➤ Personal protective equipment (PPE) i.e., boots, safety goggles, gloves etc. will be made available and worn at all occasions ➤ Hand washing facilities will be made available at all appropriate locations
		Fire, pressurized explosion	

3	Electrical	Fire in control room	➤ Flexible cords connected to appliance should be wired to conform to the international colour code
		Transformer blast/fire	➤ Electrical wiring, rewiring or extension work must be carried out properly ➤ Proper warning signs to be placed around such areas

7.3.1 Preliminary Health Analysis (PHA)

PHA is based on the philosophy "prevention is better than cure". Safety is relative and implies freedom from danger or injury. But there is always some element of danger or risk associated with anything we do or build and this calls for identification of hazards, quantification of risk and further suggests hazard-mitigating measures, if necessary. This analysis fortifies the proposed process design by incorporating additional safety factors into the design criteria.

An assessment of the conceptual design has to be conducted for the purpose of identifying and examining hazards related to feed stock materials, major process components, utility and support systems, environmental factors, proposed operations, facilities, and safeguards. Type of hazards during construction and operation phases and based on the areas and unit operations involved in generation of power, various hazards and risks are identified which are given in **Table 7.2** and **Table 7.3** respectively.

Table 7.2: Type of hazards during construction and operation phases

Type of hazard	Line of activity	Type of associated risk
Natural	Construction & Operation phase	Earthquake, flooding, cyclone, etc.
Electrical	Construction & Operation phase	Electrical cables, machinery/equipment, loose wiring, maintenance work etc.
Mechanical	Construction & Operation phase	Associated with power-driven machines operated manually, hand held tools, failure of slip falls and traps at workplace, activities such as cutting, lifting, crushing etc.
Physical	Construction & Operation phase	Noise and vibrations generated within site and its surroundings
Transportation	Construction & Operation phase	Movement of heavy vehicles, transport of construction material & raw material for operations, vehicle collision etc.
Storage and handling of flammable	Operation phase	Proposed project deal with RDF which is generally flammable in nature by virtue of their intrinsic physical properties. Hazards in this case are

Type of hazard	Line of activity	Type of associated risk
materials		associated with accidental fire/explosion or gas accumulation.
Others	Construction	Civil construction works, other hot jobs done at height

Table 7.3: Potential risks areas

Blocks/Areas	Hazards Identified
Control room	Fire in cable galleries and switchgear/control room
Boiler	Fire, explosions, etc.
Fire	Fire in RDF pit, fire on LDO tank, fire in switch yard, etc.
Building/structure collapse	Personnel injury, material damage
Feed materials storage	Fire, dust explosion and toxic gas formation
HSD/LDO storage tank	External fire, pressurized explosion
Medical emergencies	Food poisoning, snake bites, chemical spillage on body/floor
Natural disasters	Cyclone, flood, earthquake
Odour	Foul odour generated due to the waste/RDF

7.3.1.1 Maximum Credible Accident Analysis (MCA)

Identification of hazardous chemicals is done in accordance with MSIHC amendment rules, 2000. The rule provides a list of toxic and hazardous chemicals and the flammable chemicals. It defines flammable chemicals based on flash point, boiling point and melting point

The detail of threshold storage of the fuel as per MSIHC amendment rules, 2000 and quantity of the chemical to be stored in the facility are given in **Table 7.4** and **Table 7.5**. HSD is mainly used for DG sets, LDO is used for power plant start-up activity and acetylene for welding purpose. The current facility (existing WTE) is already operating and generating electricity, some of the electricity generated is consumed for running the facility while the rest of the electricity is exported to electricity department via power grid. Hence, the usage of DG sets is envisaged to be minimal. LDO is used only for power plant start up, in the initial commissioning phase and the existing tank shall be used to facilitate for the same. HCl (Hydrochloric acid)/NaOCl (Sodium hypochlorite), commonly referred to as bleach, is an excellent disinfectant/antimicrobial agent and is used primarily in auxiliary cooling tower and wastewater treatment plant. Physical properties of the above-mentioned chemicals are given in **Table 7.6**.

Table 7.4: Details of chemicals and applicability of MSIHC rules

Chemicals	Storage Type	Listed in	Threshold Quantity (Tons) as per Rules

		Scheduled	4,5,7-9,13-15	10-12
HSD	Tank	1 (part I)	2500	20000
LDO	Tank	1 (part I)	2500	25000
Acetylene	Cylinder	1 (part II)	1000	5000
HCl/NaOCl	Tank with dyke	-	-	-

Table 7.5: Chemicals storage at project site

Chemical	Use	Nature of Chemical	Type of Storage	No of tanks /Storage Quantity	
				Existing	Proposed
HSD	Fuel for DG set	Flammable	Vertical	1x 1 KL	1x 1 KL
LDO	Power plant start-up	Flammable	Vertical	1x40 KL	1x40 KL
Acetylene	Welding purpose	Flammable	Vertical	1x 50 L	1x 50 L
HCl/NaOCl	Auxiliary cooling tower & wastewater treatment plant	Toxic/Corrosive	Tank with dyke	15m ³ (400 kg)	15m ³ (400 kg)

Table 7.6: Physical properties of chemicals stored at site

Chemical	TLV (mg/m ³)	BP	MP	FP	LEL	UEL
		(°C)			%	
HSD	800 ppm	215 - 376	-	32	0.6	6.0
LDO	-	207 – 535	-	>66°	0.5	5.0
Acetylene	-	- 84	- 81	- 17	2.5	100
HCl	5 ppm	50.5	-25	-	-	-
NaOCl	0.5 ppm (as Cl ₂)	110	18	-	-	-
TLV : Threshold Limit Value			BP : Boiling Point			
MP : Melting Point			FP : Flash Point			
UEL : Upper Explosive Limit			LEL : Lower Explosive Limit			

7.3.1.2 Fire Explosive Toxicity Index (FETI)

The FEI calculation is a tool to help determine the areas of greatest loss potential in a particular process and also enables one to predict the physical damage that would occur in the event of an incident. The computations of FEI are derived from National Fire Protection Association (NFPA) code using Appendix A or NFPA (49, 704, 325M) or MSDS of chemicals to determine Health (Nh), Flammability (Nf), Reactivity (Nr), and Material Factor (MF) under consideration. The general process hazard (GPH) and specific process hazard (SPH) factors were calculated accordingly.

$$FEI = MF * (GPH) * (SPH)$$

$$TI = \left(\frac{Th + Ts}{100} \right) (1 + GPH + SPH)$$

The FEI and TI values are ranked into following categories as per **Table 7.7** and calculated values are given in **Table 7.8**.

Table 7.7: Degree of hazard based on F & EI

S. No.	F&EI index range	Degree of hazard
1	1-60	Light
2	61-96	Moderate
3	97-127	Intermediate
4	128-158	Heavy
5	>159	Severe
<i>Source: Dow's Fire and Explosion Index Hazard Classification Guide</i>		

Table 7.8: F & EI and TI of chemicals used in the proposed project

Chemical/Fuel	NFPA Classification				GPH	SPH	FEI	FEI Category	TI	Toxicity category
	Nh	Nf	Nr	MF						
HSD	1	2	0	10	1.8	2.8	50.4	Light		
LDO	1	2	0	10	1.8	2.8	50.4	Light		
Acetylene	0	4	3	29	-	-	-	-		

From the above table, it can be inferred that, HSD/LDO comes under low category and nil toxicity.

7.3.2 Hazard from oil storage

Diesel is a flammable liquid having a flash point of 32°C. However, its auto ignition temperature is 225°C. Its boiling point ranges between 215-376°C. Major hazards from oil storage can be fire and maximum credible accidents from oil storage tank can be:

- Tank fire
- Pool / Dyke fire

a) Tank fire

Oil is stored in a floating roof tank; any leak in rim seal or spillage leads to accumulation of vapour which can be a source of ignition and can cause tank fire.

b) Pool / Dyke fire

If there is outflow from the tank due to any leakage from tank or any failure of connecting pipes or valves, oil will flow outside and form a pool. When the tank is surrounded by a dyke, the pool of oil will be restricted within that dyke. After sometime, the vapour from the pool can catch fire and can cause pool or dyke fire.

7.3.2.1 Heat radiation and thermal damage criteria

The level of damage caused by heat radiation due to fire is a function of duration of exposure as well as heat flux (i.e. radiation energy onto the object of concern) and is true

for effect on building, plant equipment and also for the effect on personnel. The effect of heat radiation on percentage fatality with variation in exposure time is given in **Table 7.9** and **Table 7.10**.

Table 7.9: Heat radiation and fatality

Incident Radiation Intensity (KW/m ²)	Type of Damage
37.5	Sufficient to cause damage to process equipment
25	Minimum energy required to ignite nearby wood at infinitely long exposure (non-piloted)
12.5	Minimum energy required for piloted ignition of wood, melting plastic tubing etc. 1 st degree burns for 10 seconds exposure.
4.5	Sufficient to cause pain to personnel if unable to reach cover within 20 seconds; however blistering of skin (1 st degree burns) is likely.
1.6	Will cause no discomfort to long exposure
<i>Source: Techniques for Assessing Industrial Hazards by World Bank</i>	

Table 7.10: Heat radiation and fatality on humans

Incident Radiation Intensity (KW/m ²)	Type of Damage
37.5	100% lethality in 1 min, 1% lethality in 10s
25	100% lethality in 1 min, significant injury in 10s
12.5	1% lethality in 1 min, 1 st degree burns in 10s
4.5	Causes pain if duration is longer than 20s but blistering is unlikely
1.6	Causes no discomfort for long exposure
<i>Source: Techniques for Assessing Industrial Hazards by World Bank</i>	

Rupture of tank is considered as one of the major accidental scenarios. A large quantity of HSD will be leaked into the surrounding areas of the storage tank. If any ignition source is available near the accidental site, the leaked fuel will easily catch fire. It is assumed that complete liquid leaks due to tank failure or ruptures and develops into a pool and gets ignited. Hazard distances have been arrived due to effect of pool fires. For computing the damage distances, Areal Locations of Hazardous Atmospheres (ALOHA) software is used. Full tank storage capacity has been considered for the calculations. The effect of heat radiation and subsequent damage distances for pool fire and BLEVE for HSD and LDO is given in **Table 7.11 to 7.14**.

Table 7.11: Effect of heat radiation due to HSD (Pool fire)

Input Data		Results of Computation	
Spilled quantity	1 KL	Flame length	7 m
Circular opening diameter	2.5 cm	Max burn rate	21.4 kg/min

Wind speed	2.44 m/s	Total amount burned	561 kg
Heat Radiation at ground level kW/m²		Damage distances (m)	
12.5		<10 m	
4.5		10 m	
1.6		17 m	

Table 7.12: Effect of heat radiation due to LDO (Pool fire)

Input Data		Results of Computation	
Spilled quantity	40 KL	Flame length	7 m
Circular opening diameter	2.5 cm	Max burn rate	22 kg/min
Wind speed	2.44 m/s	Total amount burned	590 kg
Heat Radiation at ground level kW/m²		Damage distances (m)	
12.5		<10 m	
4.5		11 m	
1.6		17 m	

Table 7.13: Effect of heat radiation due to HSD (BLEVE)

Input Data		Results of Computation	
Spilled quantity	1 KL	% tank mass in fireball	100
Circular opening diameter	2.5 cm	Fireball diameter	48 m
Wind speed	2.44 m/s	Burn duration	4 s
Heat Radiation at ground level kW/m²		Damage distances (m)	
37.5		54	
25		69	
12.5		99	

Table 7.14: Effect of heat radiation due to LDO (BLEVE)

Input Data		Results of Computation	
Spilled quantity	40 KL	% tank mass in fireball	100
Circular opening diameter	2.5 cm	Fireball diameter	166 m
Wind speed	2.44 m/s	Burn duration	11 s
Heat Radiation at ground level kW/m²		Damage distances (m)	
37.5		175	
25		223	
12.5		324	

Acetylene

Cylinder with a damaged hole as cause for accident and two scenarios have been considered, one being flammable area vapor cloud and other being BLEVE (boiling liquid

expanding vapor explosion). Acetylene when leaked into the atmosphere forms a mixture of air-acetylene because of its high reactivity resulting in a violent explosion.

Flammable Area Vapor Cloud

Threat Zone:

Red: --- 18 m (25000 ppm = LEL)

Orange: --- 23 m (15000 ppm = 60% LEL = Flame Pockets)

Yellow: --- 71 m (2500 ppm = 10% LEL)

BLEVE

Percentage of Tank Mass in Fireball: 100%

Fireball Diameter: 15 m

Burn Duration: 2 s

Threat Zone:

Red: --- 18 m (37.5 kW/(sqm))

Orange: --- 23 m (25 kW/(sqm))

Yellow: --- 34 m (12.5 kW/(sqm))

HCl/NaOCl

Due to model constraints of ALOHA, a direct modeling on HCl/NaOCl could not be done to obtain threat zones and damage distances. However, a basic model assuming Cl_2 has been run for the same.

Threat Zone:

Model Run: Heavy Gas

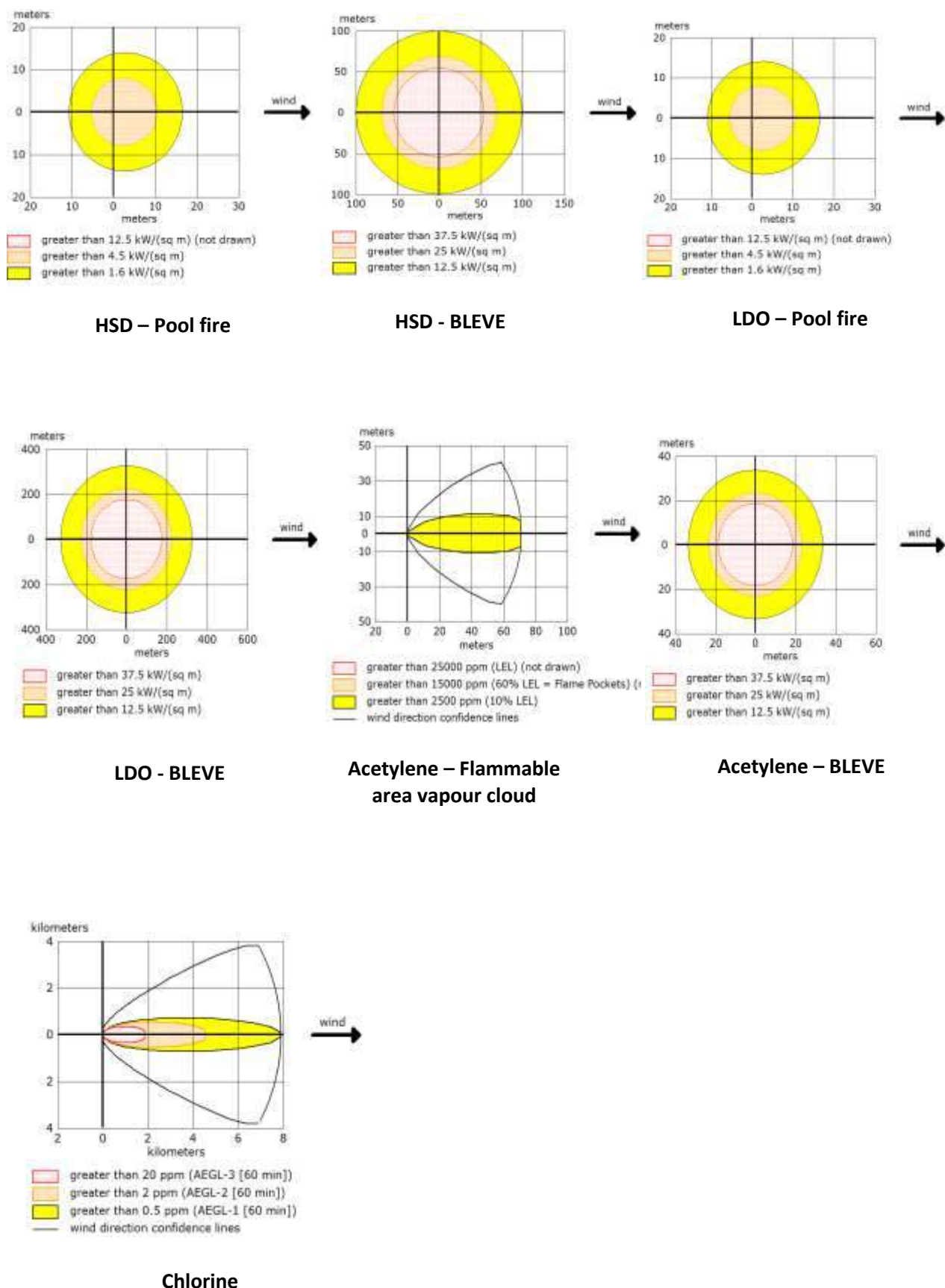
Red : 1.9 km --- (20 ppm)

Orange: 4.6 km --- (2 ppm)

Yellow: 7.9 km --- (0.5 ppm)

The thermal radiation threat zone is shown in **Figure 7.1**.

Figure 7.1: Thermal radiation threat zones of chemicals



7.3.3 Hazards occurring at site

The project authorities shall prepare detailed emergency control measures and give information such as the quantity of hazardous material stored, the location of storage, the approximate population living in the vicinity and the detail of the hazardous characteristic of the material to the employees, concerned government departments and the public living in the vicinity regularly to enable the government to prepare the on-site disaster management plan, educate employees and the public living in the vicinity on the safety measures required to be taken in the event of an accident taking place.

General control measures

- Ensure that well-covered storage space is available for flammable waste material (RDF) and the storage area is well ventilated to prevent accumulation and concentration of gases below the explosive and flammable limit. Install gas detectors and explosive level meters with early warning alarm.
- Installation of smoke detection and warning and automatic fire hydrant with foam monitors, automatic sprinklers, mist sprays and CO₂ flooding system in RDF storage will help a lot in early detection and automatic firefighting. Provide separate storage for reactive chemicals.
- Windssocks with wind speed indicators maybe installed on the site to see the wind direction from any location. Lightning arrestors maybe installed to cover the whole site. Employ only qualified and trained employees to supervise the storage activities.
- In laboratory, limited quantity of chemicals will be used for testing purposes and Material Safety Data Sheet (MSDS) for all reactive as well as flammable chemicals shall be put up along with instructions manual for safe handling of the chemicals. Employees will be encouraged to wear appropriate PPE and suitable safety systems shall be installed for quick handling of any emergency, if any arises.

7.3.4 Boiler hazards

Irrespective of the type of fuel being fired, boiler explosion causes long outage and loss of power generation and may result in loss of life and property. Evaluating the cause, documenting it for corrective and preventive action is essential. Various failures in boiler are caused by the following:

- Operation of burners with insufficient air for perfect combustion
- Boiler fouling - increases the deposits in the tubes and risk of corrosion

Precautionary measures

- Major exposed portions of the boiler unit to be thermally insulated
- Regular inspection of safety valves for proper functioning
- Optimization of convective exchanger arrangement to prevent corrosion and fouling

- Avoid flue-gas preferential path, leading to temperature stratification and ineffective heat exchange
- Necessary measures and training to be given to the personnel operating near the boiler

7.3.5 Fire

To increase the level of safety in proposed expansion project, fire-fighting systems will be proposed at strategic locations. To prevent fire mishaps and to manage the emergency situation during fire in the proposed project, the following activities and precautions are proposed:

- Emergency evacuation plan
- Regular mock drills to create awareness on procedures to be followed in times of emergency situation/evacuation
- It will be advised to keep oxygen cylinders, medical kits and masks to prevent smoke inhalation, especially for those with respiratory disorders, for smoke inhalation can be very dangerous
- Plant manager will be advised to ensure that the fire-fighting equipment are in good working conditions in sufficient numbers

The following fire-fighting fire systems maybe proposed in the proposed project:

- Fire extinguishers of suitable types and capacities
- Fire hydrant system
- Heat detectors & fire alarms
- Automatic sprinkler systems
- Hydrant valves
- Water monitors
- Deluge valves
- Fire tenders

Figure 7.2: Fire-fighting equipment



Water monitor



Hydrant valve



Fire tender

General rules for fire extinguishers

- The number and size of fire extinguishers required shall be determined by appropriate authority taking into account the following factors:
 - ✓ Severity of fire anticipated
 - ✓ Rapidity with which a fire may spread
 - ✓ Intensity of fire
 - ✓ Type of material/features the area may contain
- Fire extinguishers should be placed as near as possible to exits/stair lands where they are readily visible/accessible to be used.
- Extinguishers should be sited in such a way that not more than 15 m is required to reach from the fire site
- Fire extinguishers should be protected from excessive heat/cold and corrosive environment
- A detailed manual including locations of extinguishers, means of access, how-to-use, etc. should be put up at suitable locations
- A well-planned maintenance schedule should be formulated with periodic inspection/maintenance to ensure efficient and proper working of fire extinguishers.

7.3.6 Electrical accidents

Electrical hazards can cause burns, shocks, and electrocution which can lead to serious injury and even death.

Prevention of electrical accidents

- Grounding/Earthing all electrical equipment to an approved electrical ground
- Using correct cable size as using an improper/unsuitable cables may result in sustained overloading which may result in possible cable failure and result in possible electrical shock or fire hazard
- Make sure all electrical connections are tight, clean and dry; Poor electrical connections can heat up, and even melt. They can also cause bad welds and produce dangerous arcs and sparks
- Keep cables and connectors in good condition: Improper or worn electrical connections can cause short circuits and can increase the chance of an electrical shock. Do not use worn, damaged, or bare cables
- Usage of proper protective equipment like dry gloves, rubber-soled shoes, etc. to be worn before carrying out any electric equipment related works and repairs
- Flexible cords connected to appliance should be wired to conform to the international colour code
- The appliance should preferably be tested and certified by a national or reputed standards testing authority

- All electrical wiring, rewiring or extension work must be carried out by licensed electrical contractors. On completion, the contractors should test before electricity supply is connected.
- To ensure electrical safety in the facility, a current-operated earth leakage circuit breaker (ELCB) or residual current circuit breaker (RCCB) set to operate at a very small leakage current is recommended. In case of dangerous electrical leakage to earth, it should automatically cut-off the supply of electricity.

7.4 Emergency response plan

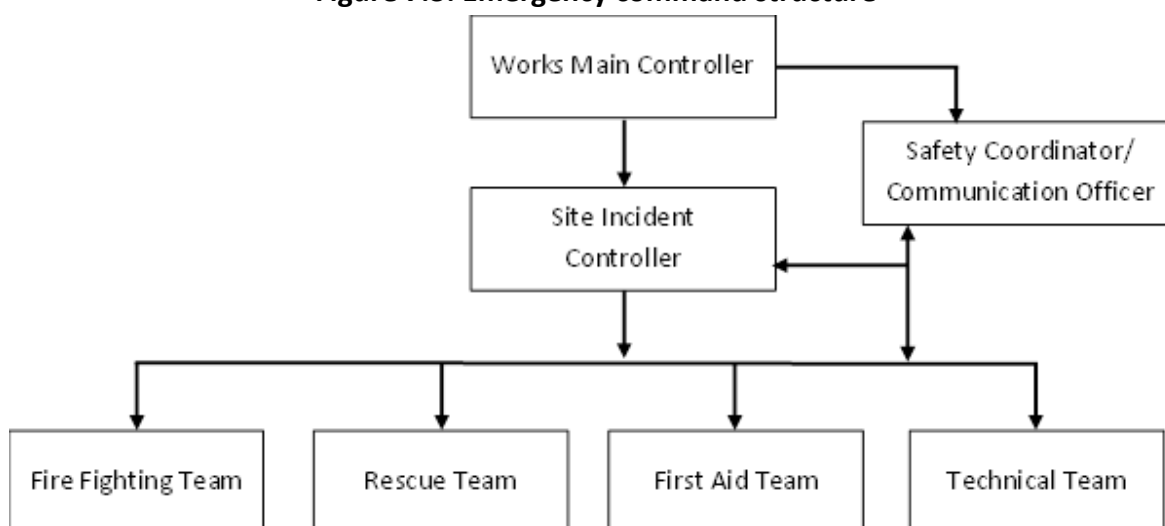
The purpose of this procedure is to have a plan to contain and control incidents in shortest possible time during emergency situations so that damage is minimized, to rescue victims and treat them suitably, to safeguard other assets, to safeguard other personnel and evacuate them to safer place, prevention and mitigation of the environmental impacts associated with accidents and emergency situations and to ensure the preparedness and response process of the organisation.

If an accident/incident takes place within the facility and its effects are confined to the premises, involving only the persons working and the property inside, it is called as on-site disaster. The following are the key members during emergency control.

7.4.1 Roles and responsibilities of emergency personnel

The emergency command structure and the roles and responsibilities of the personnel are given in **Figure 7.3** and **Table 7.15** respectively.

Figure 7.3: Emergency command structure



Emergency control room - Emergency control room is to be set up and marked on the site plan. The control room will be the main focal point in case of an emergency, from where the operations to handle the emergency are directed and coordinated. It will control all the site

activities and should be furnished with external and internal telephone connections, list of essential telephone numbers, list of key persons and their addresses, overall facility map and map showing emergency evacuation routes. Emergency equipment like SCBA (self-contained breathing apparatus), additional nos. of fire extinguishers, PPE like gloves, boots, face shields, etc., torches, etc. should also be stored and be in proper working order for emergency use.

Assembly points - Assembly points are to be set up farthest from the location of likely hazardous events where pre-designated persons from the works, contractors and visitors would assemble in case of emergency. Up-to-date list of pre-designated employees of various departments (shift-wise) must be available at these points so that roll call could be taken. Pre-designated persons would take charge of these points and mark presence as the people come into it.

Occupational health centre - An occupational health centre (OHC) maybe setup in the project premises to ensure immediate attention to any injured personnel during an emergency. An OHC should be well-looked and maintained with equipment like oxygen cylinders with mask, observation beds, wheel chairs, first-aid kits, stretchers, bio-medical disposable bins, and an ambulance on standby to shift injured personnel to hospitals.

Table 7.15: Roles and responsibilities of emergency personnel

Works main controller (WMC)	➤ On receiving any emergency calls from site incident controller or any others, provide direction to site incident controller to conduct or activate emergency response action suitably ➤ Monitor the emergency from Emergency Control Center (ECC) ➤ Keep informed of the situation from site incident controller ➤ Ensure notification of appropriate local governmental/municipal authorities of the emergency situation and request assistance where needed ➤ Approve statements to media ➤ Prioritize repairs and salvage operations ➤ Deactivate the ECC after termination of emergency
Site incident controller (SIC)	➤ On hearing the emergency siren or call from security or any person, he will rush to emergency control Centre ➤ Assess the situation and informed to WMC about emergency situation ➤ Visits the Emergency spot & assess intensity of the situation ➤ Deploy the ERT teams ➤ Priority is to contain the Emergency with the available resources ➤ If it seems to be beyond control, inform safety department and

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

	works Main controller for external help ➤ If needed, arrange for evacuation of all people from the emergency area & advise them to assemble at safe Assembly Point ➤ Coordinate with site Main controller for final assessment of situation & declare the emergency situation under control
Safety coordinator/ Communication officer (CO)	➤ Rush to the Safe assembly point and coordinate with ECC ➤ Based on the instructions from Incident controller and Site Main Controller, inform and organize required internally and external sources like ambulances, fire department, etc. ➤ Collect all safe assembly zones roll calls with the count of employees, visitors & contractors ➤ Review the roll call information with the security head count data and find out any personnel is missing and their last known location ➤ Direct Rescue Team to search in the plant to find out missing personnel is trapped inside the plant and rescue
Technical team (TT)	➤ On hearing the siren or message, rush to the spot and ensure affected person has been moved to OHC ➤ Switch off the machine / electrical power supply/ close the control valve ➤ Alert others to evacuate the place ➤ Provide technical assistance to incident controller and ERT members ➤ Give feedback to the Incident controller/Safety engineer indicating whether there were any problems found during the evacuation, in order that improvements can be made ➤ Participate in the incident investigation
Safety Officer (SO)	➤ Rush to the spot and alert the personnel in the location ➤ Ensure effective response and Help ERT members to mitigate the emergency ➤ Rush to the spot and ensure affected person has been treated ➤ Arrange for ambulance and move to the nearest hospital, if required ➤ Inform to site incident controller about the incident ➤ All clear and Re-entry procedure: Go through the points of emergency and check the following points before giving all clear

	and re-entry instruction to incident controller; ➤ Confirm the place is suitable and safe for working ➤ Confirm all the fire extinguishers and other fire prevention systems are in working condition ➤ Confirm that all the energy control devices are put back to the working condition ➤ Help in mobilizing all resources for controlling the emergency ➤ Assist site main controller to verify the attendance at Emergency Assembly Point ➤ Train & Educate all in the Factory about the emergencies & methods to control / mitigate the same ➤ Perform investigation and take corrective action(s). ➤ Verify the implementation and effectiveness of corrective action ➤ Record and communicate the results of action taken ➤ Inform Site Main Controller and WMC about "All clear and Re-entry status" ➤ Collect feedbacks from Site Main Controller, Communication Officer, Functional heads and ERTs about the adequacy and suitability of Emergency Response Plan and whether there were any problems found during the response / evacuation, in order that improvements can be made ➤ Record and communicate the results of action taken
Evacuation team (ET)	➤ Rush to your assigned location and alert others inside the plant ➤ Guide all your employees, any visitors, and contractors under your control or in your area and take them to the nearest Safe Assembly Zone as per Emergency Exit Plan ➤ Check rest room, meeting rooms and toilets ➤ Assist physically challenged people and children ➤ At safe assembly zone take a roll call with count of employees, visitors & contractors ➤ The roll call information to be reported to Communication Officer including any missing personnel and their last known location ➤ Give feedback to the incident controller / Safety engineer indicating whether there were any problems found during the evacuation, in order that improvements can be made
Fire-fighting team (FFT)	➤ On hearing emergency siren, find out the location of fire from Site Incident Controller or ECC and collect the information's like; ✓ Location

	✓ Type of material on fire (e.g. HSD, RDF etc.) ✓ Nature of fire ✓ Wind direction ✓ Availability of extinguisher (Quantity, type etc.) ➤ Wear the fire-fighting suit ➤ See the type of fire and then select the extinguishers ➤ Fight the fire with suitable Extinguishers ➤ Be ready with the hydrant system as back up arrangement ➤ If the fire is out of control, leave the spot and inform to incident controller and move combustibles away from the hot work site; ➤ Shield combustibles with fire blankets or welder's blankets; ➤ Protect stored items as soon as possible ➤ Assist fire brigade

7.4.2 Operational systems during emergency

7.4.2.1 Communication system

There are different types of alarms to differentiate one type of an emergency from other such as - fire or gas, normal fire siren, emergency/evacuation and high-pitched wailing siren. Apart from these alarms, an adequate number of external and internal telephone connections should be installed for passing the information effectively.

Siren code – for “DECLARING EMERGENCY”

- Siren shall be blown for 2.5 minutes in total
- Each cycle of blowing for 20 seconds, pause for 10 seconds
- There will be 5 cycles of blowing of siren totaling to 2.5 minutes

Siren code – for “CLOSING AN EMERGENCY”

- Long siren of 2 minutes shall be blown only once

Warning system and control

Control centres - The control centres should be located at an area of minimum risk or vulnerability in the premises concerned, taking into account the wind direction, areas which might be affected by fire/explosion, toxic releases, etc.

Emergency services - Under this, each site should describe the facilities of fire-fighting, first-aid and rescue. Alternate sources of power supply for operating fire pumps, communication with local bodies, fire brigade, etc. should also be clearly indicated.

The emergency action plan will address all potential emergencies which can be expected in the workplace with detail procedures to be taken by those employees who must remain behind to care for essential plant operations until their evacuation becomes absolutely

necessary. This may include monitoring plant power supplies, water supplies and other essential services that cannot be shut down for every emergency alarm.

For emergency evacuation, the use of floor plans or workplace maps which clearly show the emergency escape routes and safe areas will be included in the plan. All employees will be informed what actions they are to take in the emergency situation that may occur in the workplace. Above all, the plan will be reviewed with employees initially when the plan is developed and whenever the employee's responsibilities under the plan change and whenever the plan is changed.

7.4.3 Off-site disaster management plan

When the damage extends to the neighboring areas, affecting local population beyond plant boundaries, off-site emergency plan is put into action in which quick response and services of many agencies are involved. The off-site emergency plan shall be prepared in consultation with the factory management and Govt. agencies. The plan contains up-to-date details of outside emergency services and resources such as fire services, hospitals, police etc. with telephone number. The district authorities are to be included in the plan are:

- Police department
- Revenue department
- Fire brigade
- Medical department
- Municipality
- Electricity department
- Pollution control department
- Press and Media

Functions of the state crisis group

- a) Review all district off-site emergency plans in the State with a view to examine its adequacy in accordance with the MSIHC amendment rules
- b) Assist the state government in the planning, preparedness and mitigation of major chemical accidents at a site in the State
- c) Continuously monitor the post-accident situation and review the progress

Functions of the district crisis group

- a) Assist the preparation of the district off-site emergency plan
- b) Review all the on-site emergency plans prepared by the occupier of major accident hazards installation for the preparation of the off-site emergency plan
- c) Assist the district administration in the management of chemical accidents at a site lying within the district and monitor every chemical accident and ensure continuous information flow from the district to the state

- d) Conduct full scale mock-drill of a chemical accident at a site each year and forward a report of the strength and the weakness of the plan to the state crisis group.

Functions of the local crisis group

- a) Prepare local emergency plan for the industrial pocket
- b) Ensure dovetailing of local emergency plan with the district off-site emergency plan
- c) Train personnel involved in chemical accident management
- d) Educate the population likely to be affected in a chemical accident about the remedies and existing preparedness in the area
- e) Conduct at least one full scale mock-drill of a chemical accident at a site every six months and forward a report to the District Crisis Group

Occupational health and safety program for the project

Some of the preventive safety measures to be taken to minimize the risk of accident with respect to technical safety, organizational safety and personal safety are listed below:

- All building plans and installations to be as per relevant acts and duly approved by competent government authorities
- Treatment equipment to be designed by qualified and experienced professionals and fabricated to applicable national / international codes with stage wise inspection
- Entire processes to be operated by trained workers and to be looked after by qualified and experienced supervisors
- Safety features such as fire extinguishers, fire hydrant system and suitable Personal Protective Equipment (PPE) to be provided. Regular operations and testing of fire extinguishers to be carried out
- Periodic inspection & maintenance and testing equipment, machineries and equipment to be done
- Training of workers and staff to be given for safe waste, fire-fighting, first aid and integrating safety, in all activities
- Periodic health check-up for employees as per factories act during joining and once in six months shall be done
- Suitable notices/boards to be displayed at several locations indicating appropriate hazards warning as well as DOs and DON'Ts for ensuring operational and personal Safety for information of workers / staff and visitors

Mock drill monitoring

On-site mock drills are an essential procedure as it helps employees to be aware of the safety procedures and how to react during times of emergencies. Mock drills at regular intervals elevates preparedness and checks the viability of environmental/disaster management plan. Mock drills are important for following reasons:

- Helps in improving/enhancing environmental/disaster management plan
- To bring about change in attitude of the workers towards safety and risk management
- To evaluate the skills and readiness of trained officials towards unforeseen event. Helps to check whether the emergency equipment are maintained and ready to use

The project proponent/EHS department/EMP cell shall conduct periodic on-site mock drills of following activities:

- Fire, natural calamities like earthquake, cyclones etc.
- Power breakdown
- Oil spill
- Bomb threats
- Accidents

Mock drills should also ensure that local services like fire department, police, and hospitals etc. are required to provide emergency support. Documentation of the outcome and recording of the drills is an important part as this helps in looking back and tweaking the current plan for better preparedness. In every safety programs, employment of right personnel for controlling the emergency is of utmost importance.

As this is expansion of existing WTE plant; the existing unit ensures the regular mock drill as per planned. Record of training conducted in the year of 2022 is enclosed as **Annexure-5**

7.5 Geology and Hydrogeological studies

7.5.1 Physiography and Drainage

The project site area is situated on plain and little undulating land, and the region falls in the trans-Gangetic plain in agro-climatic zone. The topographic elevation is ranged from 210 to 230 m AMSL (metres above mean sea level) in the study area within 5 km (kilometre) radius, and the orientation of slope is mainly towards east direction [*source of map data: digital topographic elevation database of shuttle radar topographic mission (SRTM) of United States of America*]. The contour map of study area within 5 km radius is shown in **Figure 7.4**. The project site is at an elevated land at 217 m AMSL. The climate in general is humid subtropical to semiarid in condition.

The natural drainage consists of pond, stream, aqueduct and water-canal features. Some minor streams are originating at the uplands in the study area, flowing towards major stream. The surface flow conditions in the stream-channels is of ephemeral nature that is flow is during rains. The flow of water in the streams is governed by slope, geomorphology and the rains. The drainage system is showing a pattern of dendritic and deranged types in general of the drainage network of the basin covered in the study area. The drainage map of study area within 5 km radius is shown in **Figure 7.5**. The area is covered in the Yamuna upper sub-basin of Yamuna basin of Ganga basin.

Figure 7.4: Contour map of study area 5-kilometre radius

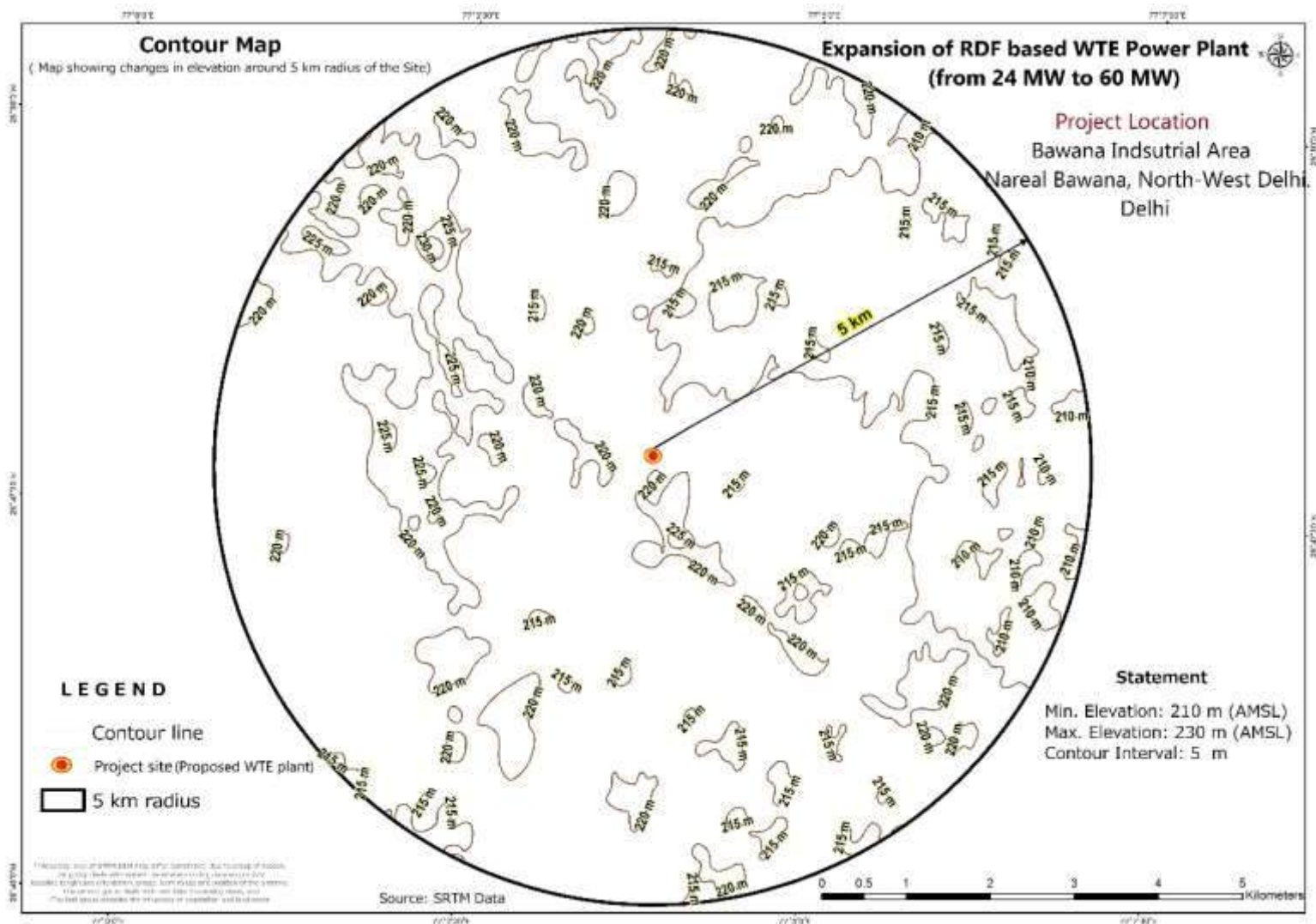
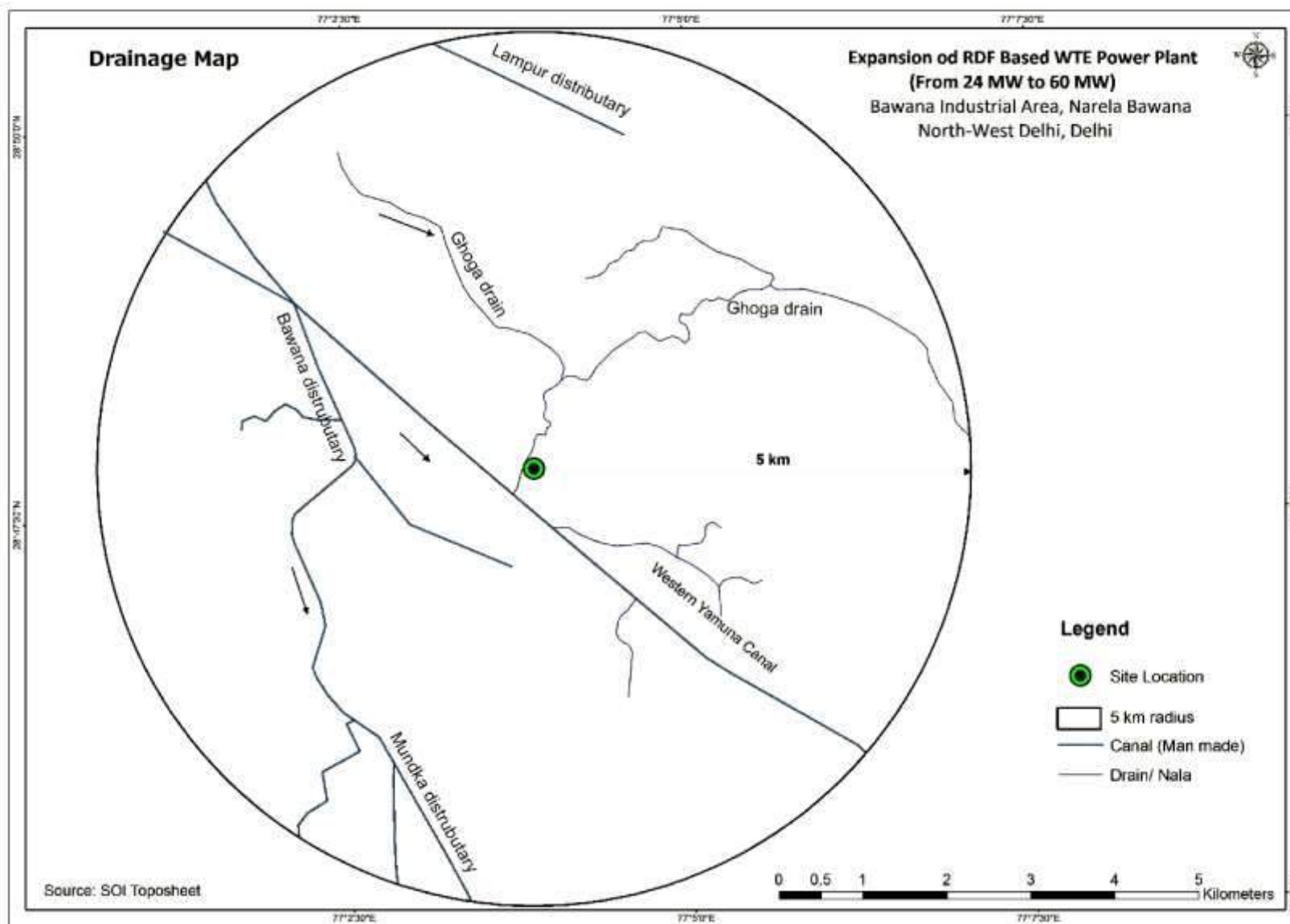


Figure 7.5: Drainage map



There are no major waterbodies and river in the study area of 5 km radius. The Yamuna River is flowing at far distance in the east. There are aqueducts of open lined type which are of minor importance. There is a major waterway canal present in the study area, the Yamuna western canal is passing at 0.5 km SW direction from the project site, and it is in south-western side of the project site and is away from project area. At the project site, there are no natural lake-bodies or ponds present within, nor is a natural major stream and river is passing through the proposed project site. There is a minor stream, a natural drain of first-order type and is a tributary-stream of Ghoga drain, is present near and outside the premises on north-western side of the proposed project site. In addition to the natural waterbodies present in the study area, also there are water-tanks or farm ponds of small and big of size and are of minor type, they are sparsely spread and occupied in the agricultural lands, they are multi-used mostly for irrigation of agricultural crops, and they are also acting as groundwater recharge areas.

7.6 Geology

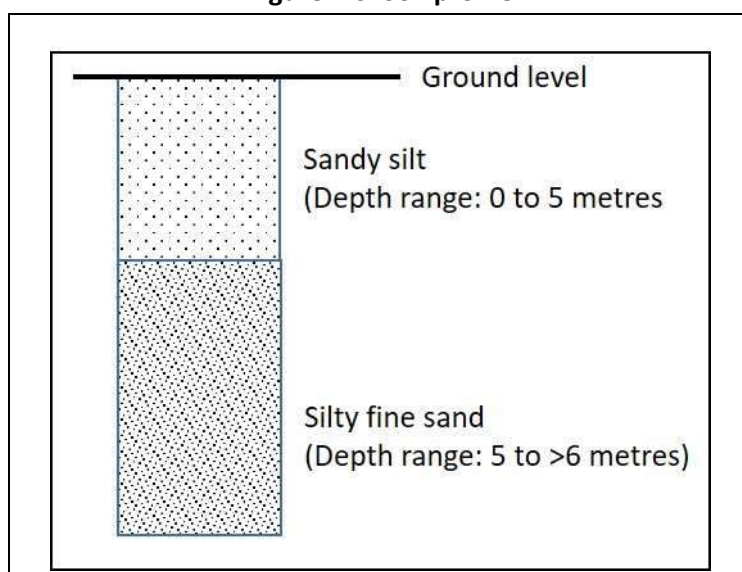
The rock formations underlying, in the study area of 10 km radius, belong to the geologic age of quaternary and proterozoic. And, locally the project site and its surroundings are covered with quaternary alluvium and acting as top-surface layer. It is an older alluvium belonging to Varanasi/Ambala alluvium formation. This alluvium was brought by river system and wind originating from the uplands and high-hills of Himalayas also the Aravallies. The older (fluvio-aeolian) away from, and the newer (riverine) alluvium is occurring, near and along the Yamuna river portions that is eastern side of study area. And below the alluvial formation, the rock formation consists of mainly quartzite which belong to Delhi super group of palaeo–mesoproterozoic age. The general geo-stratigraphic succession is as below.

<u>Age</u>	<u>Group/formation</u>	<u>Lithology</u>
Quaternary	Newer alluvium	Unconsolidated inter bedded lenses of sand, silts, gravel and clay confined to the flood plains of Yamuna river (terrace alluvium).
	Older alluvium	Unconsolidated inter bedded, inter-fingering deposit sand clay and kankar. Moderately sorted, thickness variable at places more than 300 m.

The landform is a plain with undulating surface formed by fluvio-aeolian origin. It composed of unconsolidated sediments mostly of sand, silt and clay in various combinations. It is of depth from shallow to deep. The area gets recharge from topographic highs from which surface runoff flows over it and infiltrates through the thick sandy soil profile and forms moderate potential zone for groundwater occurrence. The soil is spread and covered with alluvial soil type, occurring as brown colour natural. It is covered by fine to coarse loamy soils with different levels of moisture retention capacity. At the project site and its

surroundings, the alluvium is older alluvium type which mostly would be consisting of sandy and silty clayey loam also clayey. The soil is mostly light with subordinate amount of fine to medium textured type. The light texture soil is represented by sandy, loamy, sand and sandy loam types; whereas medium texture soils are represented by clayey loam and silty loam types. The general soil profile of the project surrounding is shown as diagram in **Figure 7.6**. [reference: *geotechnical report of WTE plant (24-MW existing unit located adjacent (south-eastern side)*]. The soil infiltration rate would be around 1 centimetre per hour approximately at the project site surroundings where the soil is comprised of mostly sandy silty and silty clayey (or fine) loam type mostly and partly clayey silt as well.

Figure 7.6: Soil profile



Regarding mineral resource occurrences, the area is a source of quartzite, also the river-sand mostly. At project site area, the site land is not located on any potentially mineable mineral deposit [reference: *map of geological, geomorphological and mineral map of Delhi 'Misc. Pub No. 30, Pt XVI' published by geological survey of India in 2006*].

7.7 Hydrogeology

7.7.1 Groundwater occurrence and scenario

The groundwater is occurring as unconfined and confined also as semi-confined types in both the younger and older alluvium aquifer types, and the bed rock is overlined by the alluvial deposit. The granular zone is comprising of medium to fine sand intercalated with clay beds or pockets would be occurring as potential aquifer zones. In this the coarse granular strata, more water bearing zones would be occurring as unconfined to confined conditions below the ground surface. The bed-rock would be existing at about 250 to 300 or more metres below ground level (m bgl) in this area. (Reference: *CGWB (central ground water board) 2022*). The surficial aquifer will be consisting of both younger and older alluvium which are youngerly formed and belongs to the age of quaternary. The older alluvium would be mostly interbedded, lenticular and inter fingering with clay, silt and sand also with kankar at

some places. It would be, at places, heterogeneous nature, and more vertically deep and laterally wide. And, this is over lined by newer (riverine) alluvium, which would be occurring mostly in the flood plains of the river, the Yamuna, also along the major stream courses. It also comprises of fines of clay and silt with small mica flakes, and medium to coarse sediments of sand and gravel. The aquifer zones occurring at shallow depth in the granular zone existing below the ground surface at about 50 m bgl would be occurring as unconfined, while the zones which are deep below the surface of about more than 200 and less than 250 m bgl would be occurring as confined condition type; in between the zones, also would be occurring as semiconfined condition in the interstitial pore spaces of the sub-surface lithological formations or sub-surface reservoirs; reference: CGWB 2022.

The depth to water level during the period of pre- and post-monsoon seasons is varying from 8 to 15 metres and 5 to 8 metres below ground level, respectively, in the study area of 10 km radius. The more potential zones would be occurring at deeper depths. The fluctuation of water level in pre- to post-monsoon season show a rise of water levels ranged from 2 to 4 m bgl during May and November of 2021 in the study area of 10 km radius (**reference: CGWB 2022**). The depth to water-level of the groundwater surrounding within the study area of 10 km radius, is ranging from 15 to 20 metres below ground level during post-monsoon season (depth data of bore-wells surveyed and collected during Oct 2022 year). The groundwater level near project site is 18 m bgl. The water level depth of the existing bore-wells is provided in **Table 7.16** (water-level depth data of water wells).

Table 7.16: Water-level depth data of water wells

Well number	Place name	Well location	Distance & direction	Water level
W01	Treatment storage disposal facility, Bawana	28°48'0.00"N 77° 4'17.00"E	0.5 km (east)	18
W02	JJ Cluster colony, Bawana	28°48'45.50"N 77° 3'57.94"E	1.5 km (north)	17
W03	Sector 2, Bawana	28°47'37.51"N 77° 3'12.81"E	1.3 km (southwest)	18.5
W04	Khera khurd, Bawana	28°46'34.05"N 77° 4'52.25"E	2.8 km (southeast)	20
W05	Marmurpur	28°51'56.08"N 77° 6'22.33"E	8.5 km (northeast)	15
W06	Bakhtawarpur	28°48'54.34"N 77° 9'34.73"E	9.3 km (east)	18
W07	Khera kala, Siraspur	28°45'31.01"N 77° 7'24.75"E	7 km (southeast)	17.5
W08	Rohini	28°43'35.84"N 77° 5'5.61"E	8 km (south)	17
W09	Auchandi	28°48'32.17"N 76°59'5.70"E	8 km (northwest)	20

W10	Karala	28°44'28.91"N 77° 1'32.42"E	7.5 km (southwest)	19
W11	Katlupur	28°50'44.11"N 77° 2'35.92"E	9 km (northeast)	20
W12	Ishwar colony, Bawana	28°46'56.30"N 77° 1'17.55"E	4.5 km (southwest)	17
Note: well location, geographic coordinates as latitude and longitude, in degrees minutes seconds system; well type, all are tube-wells; water level, in meters below ground level; values, rounded-off for convenience; km, is kilometre.				

The flow direction of the groundwater, in the study area of 10 km radius, inferred from the main topographic slope, also as per water table map of report of CGWB 2022, and irrespective of the natural flow discharges to the surface waterbodies or stream-courses and other (local) flow deviations artificially-caused, in general would be mainly towards northeast direction; and locally at the project area, the groundwater flow direction in general would be towards north direction. The tube-wells tapping granular zones of 25 to 65 metres within the depth span, in general the well discharges would be in the range of 300 to 2000 litres per minute approximate. **(Reference: CGWB 2022).**

The groundwater is one of the sources of water supply in this region which is abstracted for the purpose of potable and non-potable use in this area. The abstraction of groundwater is by tube-wells mostly, also by dug-wells at few places. The quality of water in the surficial aquifer would be variable but generally is suitable for potable and can be used for drinking and other purposes. It would be saline at some places which could be due to local water-logging conditions.

7.7.2 Groundwater resource and classification as per CGWA

The dynamic groundwater resource potential was estimated as per the methodology suggested by the groundwater estimation committee. According to the revised methodology, the resource assessment was estimated based on the percentage of groundwater utilization. Regarding the dynamic ground water resources, the stage of development in the assessment unit of Narela in North district of Delhi state is categorized as 'over-exploited' **[reference: CGWB block wise ground water resource assessment 2022].**

7.7.3 Water conservation and groundwater development

The use of fresh water will be conserved to the extent possible. The use of it will be minimized with good practices and measures, like shower-fixtures, recycled water uses for toilet flushing and for other uses, use of tap-aerators, pressure reducing or sensor-based control devices for water flow control shall be used; also, separation of used water, practicing cascade use and recycled treated water.

The rainwater will be collected, harvested, treated and reused in the project site area, which supplement and/or replace to some extent the use of fresh water. The stormwater will be

collected from the built-up area, and this will be managed by a stormwater drainage system. The storm water runoff generated volume is provided in below **Table 7.17**.

Table 7.17: Estimated storm water runoff

Estimated water volume is as below:			
Amount of rainfall	:	0.3 metres	
<u>Type of surface area</u>		Area of surface	Yield of water
Built-up	:	70	12
Total, per day volume (in cubic metres)->	:	--	12
Note: (1) <u>Rainfall</u>:- (a) Source — India meteorological department (IMD): highest (in 24 hours) is 265.8 mm (or 0.2658 metres, rounded-off as 0.3), occurred on 9th July 1972, rain-gauge station at New Delhi Palam (A) [location details: Indira Gandhi International Airport, New Delhi; Palam in national capital territory of Delhi in India]; geo-coordinates: 28° 34' north latitude & 77° 07' east longitude, recorded data of 29-years period during 1981 to 2009, data source: IMD, ministry of earth science, government of India. (b) Other source — worldweatheronline.com, mean maximum of a day is 75.73333 millimetres (or 0.075733 metres), occurred maximum rainfall is 227.20 millimetres in 3 days in July-2015, weather station at Bawana (Delhi in India), recorded rainfall data of 12.10-year-period during January-2010 to October-2022. (2) <u>Type of surface area</u>: Built-up area 69.8 sq.m (17.24 acres) rounded-of as 70 sq. m. (3) <u>Runoff coefficient value considered</u>: 55% for built-up area, which includes: building roof-top, open and mixed-paved and unpaved areas [note: values, of area of surface and yield of water, units in square and cubic metres respectively, and are approximate and rounded-off for convenience].			

The collected storm water from built-up and green-belt area is estimated as 12 cubic metres volume during peak rainfall day. The rainwater accumulated on the various land surface types within the project area is channelled, collected and is pre-treated for debris removal then redirected through the storm water drains of the project to the treatment plant (leachate). This drain system of lined with concrete cement or plastered to prevent any leakage of water directly into the ground and it is of rectangular shape. The treated water is reused.

The rainwater will not be artificially recharged to avoid contamination of groundwater resource, it is harvested then reused. The generated storm water nor the wastewater will not be discharged-off to outside natural drains, it will be fully utilized for the project purpose. The excess recycled water in case if any will be discharged-off to outside natural drains as per the discharge standards of the local governing body. It will be ensured its value of pH and other important parameters are within the standard limits before it gets released to outside water environment.

7.7.4 Use of water resources for project

The water is required for consumption for various purposes of project operations such as for different project process-activities mostly also partly for drinking purposes, the amount needed will be of adequate quantity every day. The same will be sourced from Delhi Jal Board and Industrial Waste Water of adjacent Pragati Power Plant. And, there is no plan of use of natural water (surface and ground water resource) for the project purpose.

7.7.5 Effects of soil on water resources

The soil found in the study area was originated and derived from the rock formations present in the higher elevated areas of hills and uplands and deposited in the topographic lows. The soil would be of with medium porosity. The permeability is semi-pervious with slow flow, the infiltration rate would be low with 1 centimeter per hour approximately, this is indicating good water holding capacity of this soil type, and contributing to moderate to high surface runoff.

7.8 Geo-impacts

The proposed project is an expansion project, planned to increase the capacity of power generation from 24 MW to 60 MW through development of new WTE power plant adjacent to the existing unit. The anticipated impacts during operation phase related to soil and water area detailed below.

7.8.1 Anticipated impacts on soil and land during construction phase

The construction activity will impact on the land and soil. The activities during pre-construction and construction such as, site clearance and site preparation, removal of existing vegetation, civil works such as earth moving and building of structures including temporary structures for material storage and manpower residing, heavy equipment operation, ground grading, levelling and removing of and/or importing soil and rock material, disposal of construction waste, generation of and installing of pipes for sewerage wastewater disposal, construction of temporary motor drive-ways for transportation of construction material into the site and so on. There will be change of land use from present land for construction of new buildings and other civil infrastructure. Soil will be extracted for grading and levelling. The toxic and non-toxic, and hazardous (construction purpose used) materials (both solid and liquid) due to accidental spill cause soil contamination. The open sewage wastewater flows and discharges also the overflowing storm water. All these will create disturbance to the land and soil and would cause soil erosion, sediment transport and contamination and also loss of soil quality (at onsite mostly).

Mitigation measures:

Precautions will be taken to prevent change and the effects, with better measures by properly planned site design, reducing amount of impervious land cover, and with erosion and sediment transport control plan. The land will be properly planned and zoned (land use

zoning) as per project site conditions and other requirements. Will be minimized the land extents of site clearance also grading and levelling (mostly within actual construction or plinth areas of plots) and the excavated soil will be reused within site for ground levelling, slope maintenance and greenbelt development, existing or old drive-ways will be used and their lengths shortened to minimize transport distance and time, their unpaved ways are water sprinkled for erosion prevention and dust suppression. For road construction, approximately 0.5 meter top-soil will be excavated, the excavated soil will be reused for greenbelt development and other project purposes. Muck disposal and solid waste management plans; storm water and sewage wastewater system will be designed and implemented with soil erosion control features. Will be controlled the sediment transport by keeping sediment from moving off-site and from entering any surface waterbodies with sediment traps and basins. Soil management plan, for ensuring soil sustainability also to avoid risk of losing, damaging and contaminating valuable soil resource, will be implemented; a detailed soil investigation will be carried-out onsite before construction begins. The existing vegetation, like plants and trees, will be saved also conserved with additional vegetation like seeding grass on sloppy land surfaces which would be a few places. Greenbelt with native vegetation (preferably) consisting of grass, shrubs and trees of draught-resistant species varieties will be grown and developed; it be either by seed planting (preferably) and/or transplanting (which is an economical and environmental alternative) which conserve soil, prevents soil blow, reduce soil erosion and sediment transport. Monitoring with regular physical inspection, maintenance and/or modification of soil erosion, rain runoff and sediment controls also pollution prevention measures will be under-taken.

7.8.2 Anticipated impacts on water resources during construction phase

During the construction period, the activities include civil structures, storing of construction materials, cleaning and washing of equipment, vehicles et cetera, which produces polluted water. During rainy season the runoff from these areas carries the waste materials and accumulates in the near-by waterbodies resulting in increase of siltation and reduction in water quality.

The storage of used or un-used engine oils, lubrication oil and others may create spillages, if not maintained in the storage facilities properly. These spillages when mixed with rainwater (during rains) infiltrate into the top surface soil layers and also runoff flow into the near-by waterbodies resulting in contamination of groundwater and surface water resources. Wastewater from eating areas, sewage water from temporary sanitary facilities used by the personnel stationed at the site area. These causes change in water quality in the receiving waterbodies, if this wastewater is not treated properly before it gets released.

Mitigation measures:

Precautions will be taken to prevent change in water quality of near-by waterbodies. The runoff from the site area of construction will be collected in a sedimentation tank, and the overflow excess water will be diverted to the greenbelt or plantation areas. The wastewater generated from cleaning of equipment, eating areas will be collected and diverted to sedimentation tank in which the suspended solids, if any, will be separated and the settled water will be re-used for construction purpose and also used for sprinkling on roads to control the dust suppression. The sewage wastewater will also be treated properly. Inlet protection will be provided for storm water drains. The waste oil will be segregated and disposed of to an authorized recycler. The solid waste like, soiled cotton, paper and so on, will be disposed of to the municipal-bins or municipal solid waste facility. With the proper management of these measures, the impact on water quality during the construction activity is expected to be insignificant.

7.8.3 Anticipated impacts on soil and land during operation phase

The impacts associated with soil and land is the erosion of soil on the open land areas and bare slopes. There will be loss of soil stability and soil erosion when surface water drains over them during rains and especially it will be more during heavy rainfall or storm events. The eroded soil along with surface runoff will be carried from the site to the outside resulting in water pollution to the surface waterbodies present in the downstream side (outside of the project area). The spillages from stored containers of engine oil, solvents, process chemicals, wastewater occurs will leach into and pollute the soil.

Mitigation measures

To avoid soil erosion problems, it will be provided arrangement to reduce water flow over bare and erodible soils by vegetation of bare ground; will be constructed storm water drainage system with culverts, ditches, surface water diversion channels and storm water pond (underground sump for water storage) for rain events which checks and also controls storm water flow velocities at reasonable level. So, there could not have any significant adverse effects to the soil, land also to the surface waterbodies flowing at the downstream side. The engine oil, solvent, process chemicals and others will be kept in containers in designated areas only, to avoid leakages and accidental spills and further to avoid soil contamination. The floor surfaces of these storage areas are constructed with smooth and leak-proof construction material to obstruct any spillages to percolate into the ground.

In the project site area, during operations, spillages from used engine oil, solvent, cleaning agents, chemicals, waste water and contaminants and others, occur and percolate and infiltrate in to the soil and pollute it then to the groundwater also, and the surface runoff from these areas when mixed with water in the surface waterbodies also pollutes these surface waterbodies thereby causing environmental concern. The waste water from the

process areas and from other sources generated and the release of this into the outside waterbodies like natural drains can cause severe pollution. The water requirement for the project operation purpose will have impacts on the groundwater resources causing depletion locally, causing water scarce situations if it is the main source.

The leachate generated will be treated fully in the leachate treatment plant located within the premises preferably (or to the adjacent existing plant). Also, the domestic waste water, the waste water from floor cleaning, vehicle and tank cleaning and the domestic wastewater will be treated and this recycled water will be reused for project operations and greenbelt development. Re-utilization saves water, money and makes no discharges of the effluents (leachate) to outside the project area, which also makes to comply with pollution control norms.

The water requirement for the project during operation phase will be met from the supply from industrial-recycled water (external source) and municipal water for drinking. So, no impact on surface and ground water resources. Apart from the water (fresh water) use for project operations and drinking facilities, there would be no substantial requirement, and no water shall be wasted and the use of it shall be controlled. The water will be saved by good plumbing and sanitary fixture appliances for efficient use.

All the rainwater from the roof-top and/or shed areas will be collected, pre-treated and harvested for use of project operations, greenbelt development and other uses. No untreated water will be released to outside environment. During the project design and construction phase only, it will be provided with a proper collection, treatment, storage and discharge of this storm water runoff to mitigate contamination of the downstream natural waterbodies. So, there could not have impact to the surrounding environment neither to surface waterbodies like ponds and lakes, nallahs and streams nor to the groundwater.

7.8.4 Impacts and mitigations of the natural stream passing adjacent to project site

During the preliminary field study, it was observed that a natural stream of first-order stream and rain-dependent flow condition type, is passing near to the south-western boundary of the proposed project site, and further to the downhill side it is merged with a major stream named as Ghoga drain; this major stream is at distance (is 0.7 km northeast). Also observed, this natural stream presently is in the form of open and unlined flowing (urban) drain of the most part of its length, the use of water of this stream would be not using either for drinking nor is agriculture purpose, the water-flow is debunching directly in to the main stream. There will be sufficient stream-flow only during good rainfall times

The site basin runoff, wastewater, leachate, storm water, also the liquid and semi-liquid waste leakages and spillages, their untreated and uncontrolled discharges in to the stream course, if any such will cause surface water pollution, and the impact could be adversely on the downstream-side water users with duration ranging from short- and long-term (during

construction and operation phases respectively). The impacts thus arising will be minimized and mitigated, they will be taken care with procedures and preventive pollution control measures; the excess discharges if any will be as per the discharge standards or norms of the government, so that there will have no influence on the stream-course.

It will be ensured a proper care to prevent waste being thrown in to the stream (or drain). A land separation will be created interfacing the adjacent passing stream with open land covered with small plants and/or trees.

7.8.5 Impact of project development on surface runoff

Due to the proposed land development (industrial land use), the runoff discharges to surface waterbodies that is to the streams will be more quickly in general, the change influences the stormwater volume, rate of flow of water and time. Below is the estimate of the before and after development runoff volume estimate. The change of surface runoff volume is estimated and shown in **Table 7.18**.

Table 7.18: Change of surface runoff

<u>Estimated change of runoff generation on land use change of project land cover:</u>			
<u>Phase and features of proposed project</u>	<u>Pre-development phase</u>	<u>Development phase</u>	<u>Change</u>
Land area	70 square metres		No change of land area
Surface runoff cum/day	8	12	50% increase
Note: rainfall peak is 0.3 metres (see, rainfall details provided in foot-note, in Section 7.7.3 Table 7.17—stormwater runoff estimate); runoff coefficient (composite) considered for pre-development phase as 40 percent, and for development phase, considered is the stormwater outfall of volume 12 cu.m (refer Section 7.7.3 Table 7.17—stormwater runoff estimate); values, are approximate and rounded-off for convenience; runoff volume, in cubic metres (cu.m) per day.			

The project area is an open land without scrub, after the planned development it consists of a mix of project land use types like built-up, green buffer, paved and unpaved areas, thus there will be change of land-use [from open space area of non-built-up land to industrial land use for municipal solid waste to energy power plant]. The (upcoming) change of amount of runoff volume due to land-use change (which is within project area only) because of proposed development in the land portion, which is about 50 percent increase, even though there is runoff volume increase it is anticipated there will not be no impact on receiving surface waterbodies (with more inflow volume to the downstream natural streams or drains) carrying capacity because of change (increase) of surface runoff volume, since the surface runoff generated within the project will be collected and [the treated is] reused as recycled water for project purpose as part of fresh water conservation measure, the runoff collected will be fully reused also as a precautionary measure it will not be discharged off to outside natural drains to avoid surface water pollution.

7.9 Geohazards

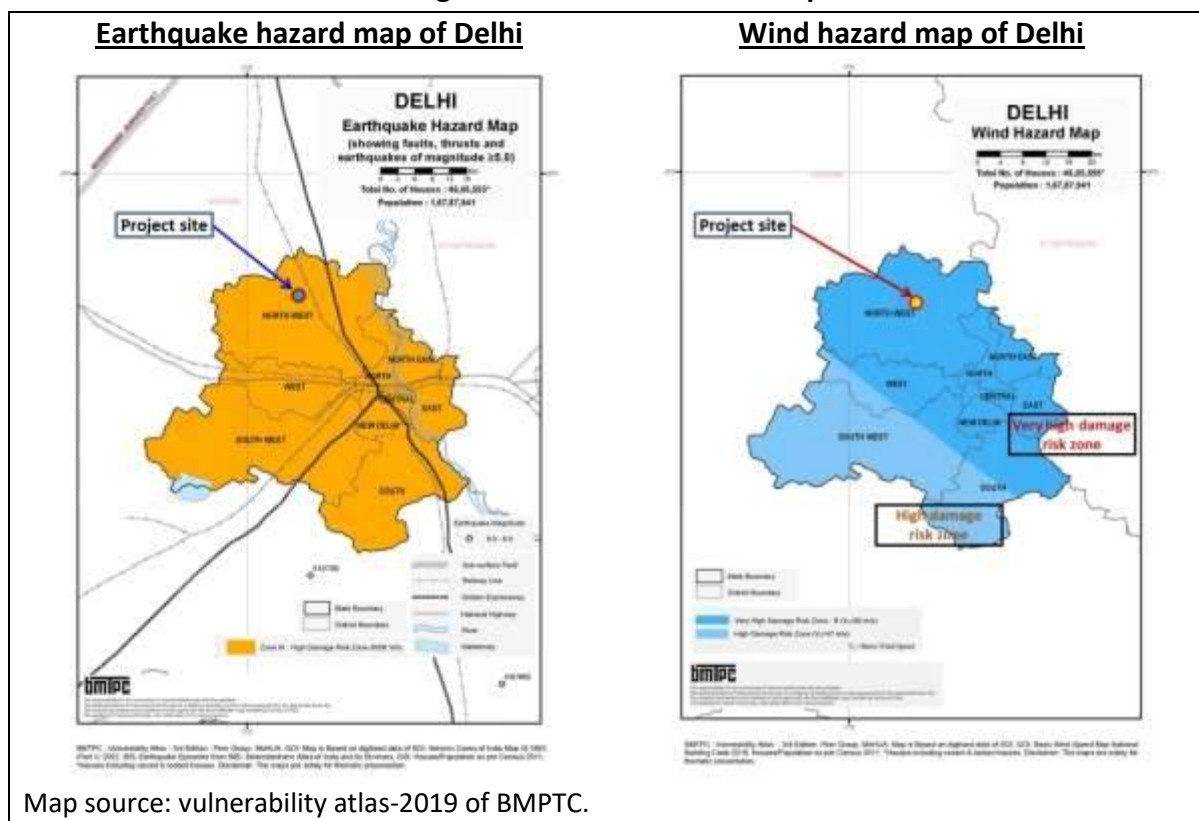
The hazards like soil hazard, earthquake are the natural occurring events which might occur and could cause hazard threat in this area.

About the soil hazard, in the project area it will be stored and used many types of materials which are in the form of solid and liquid; the liquid types like oil and fuel, toxic and non-toxic materials, chemicals and hazardous and non-hazardous substances or materials would be stored. The improper maintenance and accidental spillages of these on the top-soil will contaminate the soil horizons, thus deteriorate the quality and leads to soil pollution. These chemicals can also enter and/or infiltrate through soil horizons when mixed with water especially rainwater, and percolate in to the groundwater and there it contaminates the groundwater resource. During the rains, the surface runoff from the contaminated soil surface areas spreads and contaminates the near-by also far-off areas causing hazards on the surrounding soil and land environment also the surface waterbodies such as, streams and rivers also the groundwater resources.

Regarding the earthquakes, according to the earthquake hazard map of Delhi state, project site area is covered in the seismic zone, 'zone-IV' classed as 'high damage risk zone (MSK-VIII)' which is indicating a high vulnerability to this event [reference: vulnerability atlas of India-2019 map prepared as per map of seismic zones of India of bureau of Indian standards (BIS), IS 1893-Part 1:2002 by building materials & technology promotion council (BMTPC) of ministry of housing & urban affairs of government of India]. The earthquake hazard map of Delhi state marked with and showing the tentative location of project site is shown in **Figure 7.8** (map on left-side).

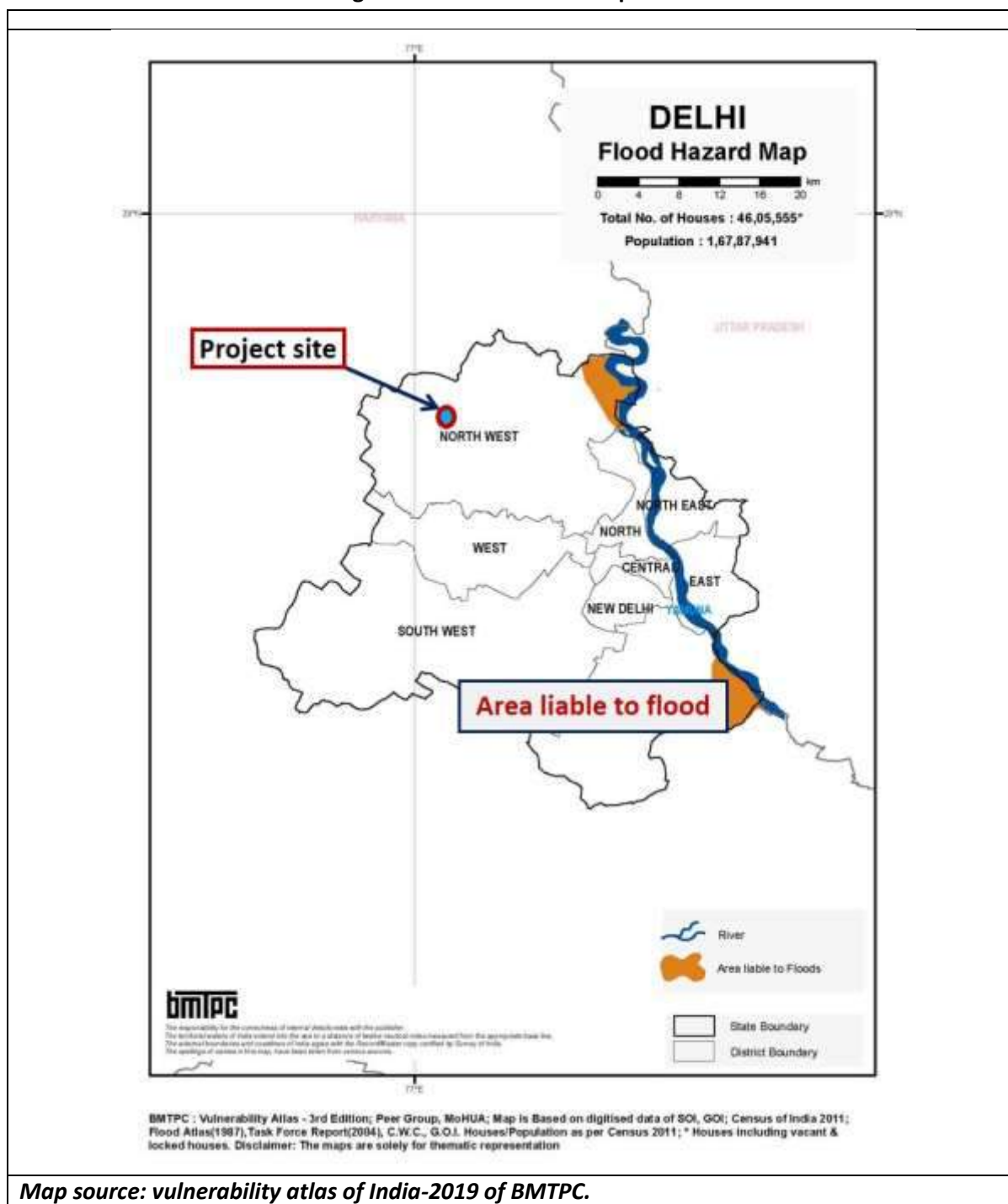
According to the map of wind hazard map of Delhi state, the project site is covered in the zone of 'very high damage risk zone-B (Vb=50 m/s)'. The wind hazard map of Delhi marked with and showing the tentative location of project site is shown in **Figure 7.8** (map on right-side).

Figure 7.7: Natural hazard maps



Regarding the riverine-flood risk aspect of Yamuna river: As per flood hazard map of Delhi state, the project site is not covered in the zone of 'area liable to floods', so it is not vulnerable to flood event [reference: vulnerability atlas of India-2019 by building materials & technology promotion council (BMTPC) of ministry of housing & urban affairs of government of India]. The flood hazard map of Delhi with tentative location of project site is shown in **Figure 7.9**.

Figure 7.8: Flood hazard map of Delhi



Map source: vulnerability atlas of India-2019 of BMTPC.

Also note, the maximum flood water elevation level, based on the flood level information sourced from the organization of central water commission figures showed, that is the data recorded at the site of Delhi railway bridge in North Delhi district of Delhi state [location details: Old Iron Bridge in New Delhi, at distance 23 km southeast; tentative location coordinates are 28° 39' 42.50"N, 77° 14' 41.51"E by the office, the warning water level is 204m, danger level is 205m and the high water level is 207m [data source: central water commission (CCWC) of India 'flood forecasting sites of Yamuna basin organization, webpage updated 18th Aug 2020]. The flood width (inundation) extent would come up to a maximum

level (vertical elevation) of 207m approximately from the base level of the coursing river during high flow at the river reach of the channel study section nearer to the project site. On the ground, the project site is located at a topographic elevation of 217m above mean sea level, and from this level location the project site is at an elevated height of 10m from the topographic floodplain (high) extent of the river section, which the flowing Yamuna river is at 13km distance in the east direction (note: distance is aerial measured; source of elevation data is digital topographic elevation database of shuttle radar topographic mission of United States of America; values, are approximate and rounded-of). The analyzed data revealed also it is anticipated that there would not be a riverine-flood risk posed to the project site.

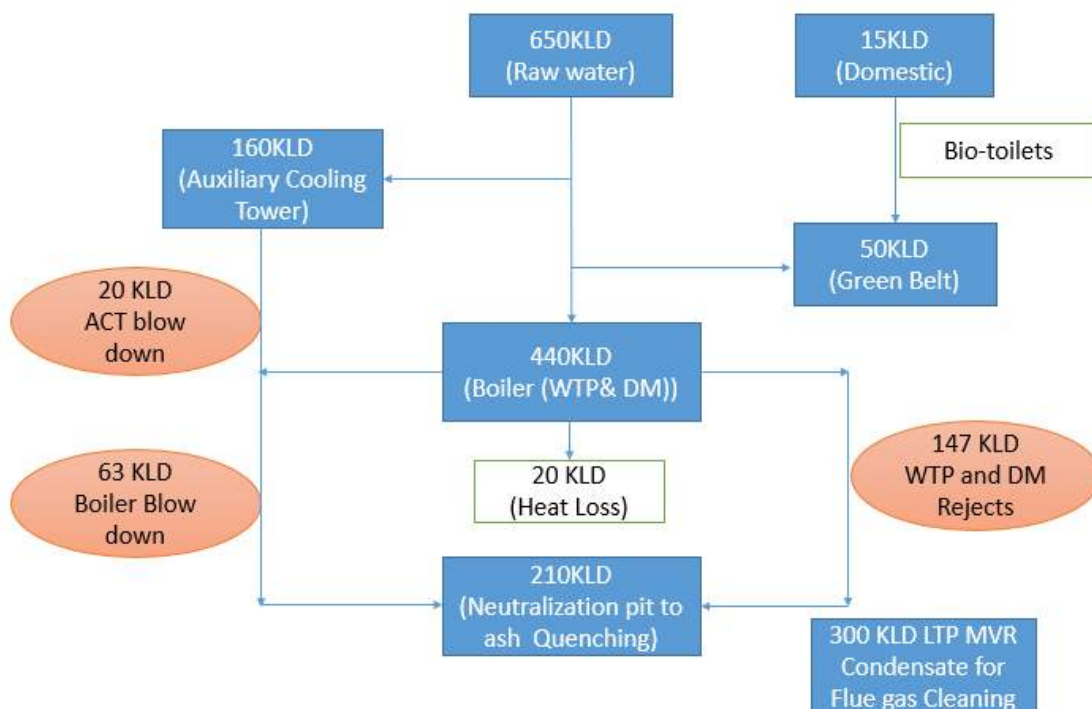
7.10 Zero Liquid Discharge (ZLD)

Total water requirement for Existing project is 313 KLD. Total water requirement for the proposed expansion project is 337 KLD. The same will be sourced from Delhi Jal Board and Industrial Waste Water of adjacent Pragati Power Plant. The wastewater as liquid waste of 105 KLD will be generated which includes cooling tower blow down, boiler blow down and DM regeneration and Leachate. The generated leachate will be treated in the existing LTP, blow down water from ancillary cooling tower, boiler blow down and WTP Rejects will be collected neutralization tank and neutralised by adding neutralized agents then utilized in the bottom ash quenching and in Air Pollution Control Devices. Thus, facility will achieve the zero-liquid discharge. Domestic water requirement is 15 KLD which is achieved by Municipal Water Supply. The domestic waste water generated from the proposed project will be sent to bio toilets and septic tank followed by soak pit. The detailed water requirement and wastewater generation breakup is given in **Table 7.19**. Water balance is shown in **Figure 7.10**.

Table 7.19: Water Requirement and Wastewater Generation

Utility	Water Requirement (KLD)			Wastewater generation (KLD)		Remarks
	Existing	Expansion	Total	Existing	Expansion	
Power Plant						
Boiler (WTP+DM plant)	183	257	440	95	95	Recycle / reuse for ash quenching, Flue gas cleaning
Auxiliary Cooling Tower	80	80	160	10	10	
Green Belt	50	-	50	-	-	-
Sub Total	313	337	650	105	105	-
Source: Having agreement with PPCL for 350 KLD and permission from Delhi Jal board 1000 KLD						
Note: PPCL agreement is expandable						
Note: 1) Drinking water requirement is 15 KLD (source Municipal Supply), wastewater 13 KLD sent to bio toilets and septic tank followed by soak pit.						
2) Leachate quantity is around 200 KLD treated in MVR						

Figure 7.9: Water Balance



7.11 Effluent Treatment Plan

Mechanical Vapour low temperature evaporator (LTE) is essentially an evaporation process designed to reduce water volumes by recovering most of the water in the solution. The recovered water is of good quality and can be recycled and reused in plant. Waste water treatment through MVR is based on evaporation without use of steam. On progressive lowering of pressure in L.T.E., water starts boiling and subsequently generation of vapours. Generated vapours compressed through MVR technique and recycled as heating medium. It is based on principal of heat recycling without any addition or blowdown of heat. Over time, the concentrated waste/product reaches a saturation point and must be discharged for waste disposal. Dehydration of solution in low temperature evaporator is a very efficient process. In this technology mechanical vapour recompressions raises the vapour temperature and pressure, recirculate it as heating medium.

Mechanical vapor recompression (MVR) is an energy recovery process. It involves taking vapor (usually water vapor) at certain pressure and adding energy to it by compression. The result is a smaller volume of vapor, at a higher temperature and pressure, which can be used to do useful work. During mechanical vapor recompression, the vapor of an evaporator is recompressed to a higher pressure by means of a mechanically driven compressor. The recompression, therefore also operates as heat pump. A full assembly of Spray low temperature evaporator consists of L.T.E. chambers, plate type heat exchanger (P.H.E.), direct contact heater (DCH) and a concentrator. The efficiency and performance of this system has a major impact on environment. Initially start the vacuum pump and

maintain a required vacuum in calandria of evaporator. Solution from PHE is fed into the DCH and then from DCH to evaporator by distributor. Now, system will start to generate vapor and this vapor will send to the MVR booster/fan which is mounted on the top of the concentrator. After certain level of condensate in condensate tank, pass it through the PHE with the help of pump where condensate transfers sensible heat to inlet solution. In this way, solution temperature rises. NCG from concentrator sent through DCH to vacuum pump so that NCG losses its sensible heat to incoming feed in DCH and also many volatiles got removed from the DCH. So there is no heat wastage, system uses its own heat and serving its purpose very well.

Benefit of MVR Process

The main benefit of vapor compression is that it allows for significant energy savings. Mechanical vapor compression, unlike the alternative thermal vapor compression, does not require an additional steam supply. And since no fluid mixing occurs, all of the available vapor can be compressed for energy recovery. This method is ideally suited for systems operating on a low temperature difference such as many evaporation plants; in these applications, heat exchangers with a large heat transfer area can be employed to maximize energy recovery. The energy-saving potential of mechanical vapor recompression is especially significant when compared to the energy required to generate new steam. In fact, it is not uncommon for multi-effect evaporators to be fitted with mechanical vapor recompression processes. Even for multi-effect systems in which the vapor from the last effect is condensed in the first-effect heat exchanger, mechanical vapor recompression can be very economical.

Working Principle

Mechanical vapor compression is positive displacement compressors, single stage or multi stage centrifugal compressors used to raise the pressure and temperature of the generated vapour and recirculate it as heating media to the evaporator system. Compression ratio must be seen from commercial perspective. Increase of energy costs must justify on comparing prevalent alternatives of evaporation along with user and environment friendly.

The principle is simple. Vapor from an evaporator is compressed (with a positive-displacement, centrifugal or axial-flow compressor) to a higher pressure (upgradation of heat value) so that it can be condensed in the heat exchanger of same evaporator which has generated. Mechanical recompression works best in a system with low boiling point elevation and where larger heat transfer surfaces can be used to lower the differential temperatures in the heat exchanger. MVR evaporator operates on a “heat pump” principle. The evaporated water vapor is recompressed with a simple, low speed centrifugal fan or compressor. The fan increases the saturation temperature of the vapour. After the fan, vapor can be used as heating media in the same unit. The recompressed vapor condenses

and releases its latent heat through the heat transfer surface for further evaporation of the effluent. An MVR evaporator is also called a Vapor Compression Evaporator (VCE). Process of MVR evaporator is shown in **Figure 7.10** and photos of MVR evaporator unit is shown in **Figure 7.11**.

Process description

- Process wastewater is fed by the feed pump through the feedstock heat exchanger and into the circulating stream. The feedstock heat exchanger is used to heat the wastewater by transferring sensible heat from the hot condensate to the cooler feed.
- The recirculation pump circulates wastewater from the separation tank through the main heat exchanger, to the orifice plate, and back into the separation tank. The latent heat from the compressed vapor is transferred to the wastewater via the main heat exchanger.
- An orifice plate is used to reduce the pressure of the circulating stream. The downstream pressure is low enough to allow flashing of the circulating stream into liquid and vapor components.
- The liquid and vapor then flow to the separation tank where they are separated. The liquid steam exits the tank at the bottom and flows back to the recirculation pump. The vapor stream exits the tank at the top and flows to the vapor compressor(s).
- A mist pad is provided at the top of the separation tank to remove small droplets of liquid from the vapor.
- The vapor compressor compresses the vapor (raising the temperature and pressure), and sends the vapor to the main heat exchanger, where it transfers its latent heat to the wastewater in the recirculation loop.
- High temperature condensate exits the main heat exchanger and flows to the condensate tank, where any remaining vapor is separated. The hot condensate is then pumped to the feedstock heat exchanger, where it transfers sensible heat to the incoming feed wastewater.
- Upon reaching steady-state at the target concentration, the concentrated wastewater is purged from the recirculation loop, using the residue valve. Depending on the energy balance, energy can be added to the system by electric heaters / process steam or excess energy can be removed from the system by the steam relief valve.

Figure 7.10: Process flow of MVR evaporator (Vapour Compression Evaporator)

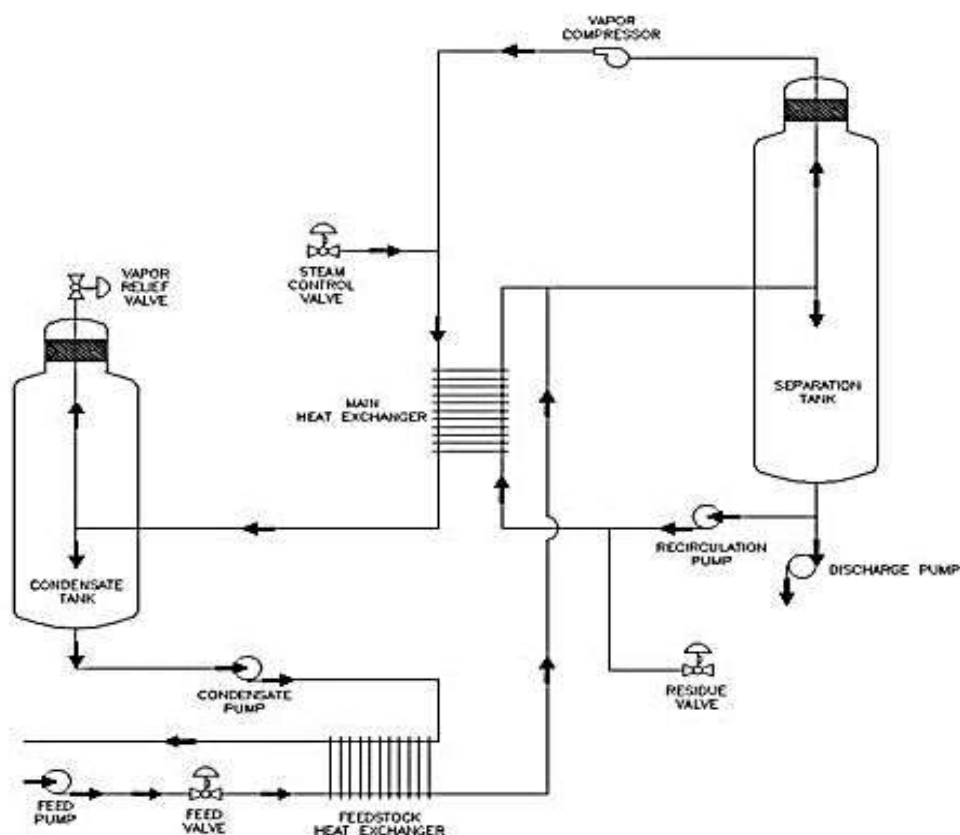


Figure 7.11: Photos of the MVR



7.12 Ash Management

About 450 TPD of Ash will be cumulatively generated from Existing and Proposed Waste to Energy Plant. Following is the details for quantity of Ash generated since 2017 and management.

Table 7.20: Quantity of Ash generation and disposal

DELHI WtE - Bottom and Fly Ash						
Financial year	17-18	18-19	19-20	20-21	21-22	22-23 till oct
Bottom Ash MT	166972	161136	124887	161683	127409	58231
Fly Ash MT	11211	5683	5997	7345	5649	2182
Total Ash MT	178183	166819	130884	169028	133058	60413

- Aggregate (8-20 mm)
- Coarse sand (3-8 mm)
- Fine sand (1-3 mm)
- Silt
- Large objects (> 40 mm, rags)

7.12.1 Processing and flowchart

Generated bottom ash will be carted to the receiving platform of the ash recycling unit. The material will be feeded in to the primary segregation unit which has grizzly screen whereas the material will be crushed into different sizes. Here the large objects also be removed. The crushed material goes in to further segregation, i.e. 20-40 mm size, 8-20mm size and >8 mm size. The 20-40 mm material goes to cone crushing unit to come down to 8 -20 mm size. Below 8mm material will be washed with water to making it to slurry, that slurry goes in to sand washer. After washing the 8mm material will be collected as coarse and fine sand as per market requirement. The leftover silt will be used as landfill cover. The process flow chart is shown in **Figure 7.16**. Washing of crushed output using spay jets and screening using two-part screening. Dewatering screening for +3 mm separation and secondary screening through Hydro cyclone for recovery of -3mm fraction and removal of slurry (0.75 mm) overflow. The overflow slurry is taken into clarifier to recover water and then to sludge tank after dosing of polymer for easy settling of sludge. The output of the product is shown in **Figure 7.17**.

Figure 7.12: Process flow of Ash recycling plant

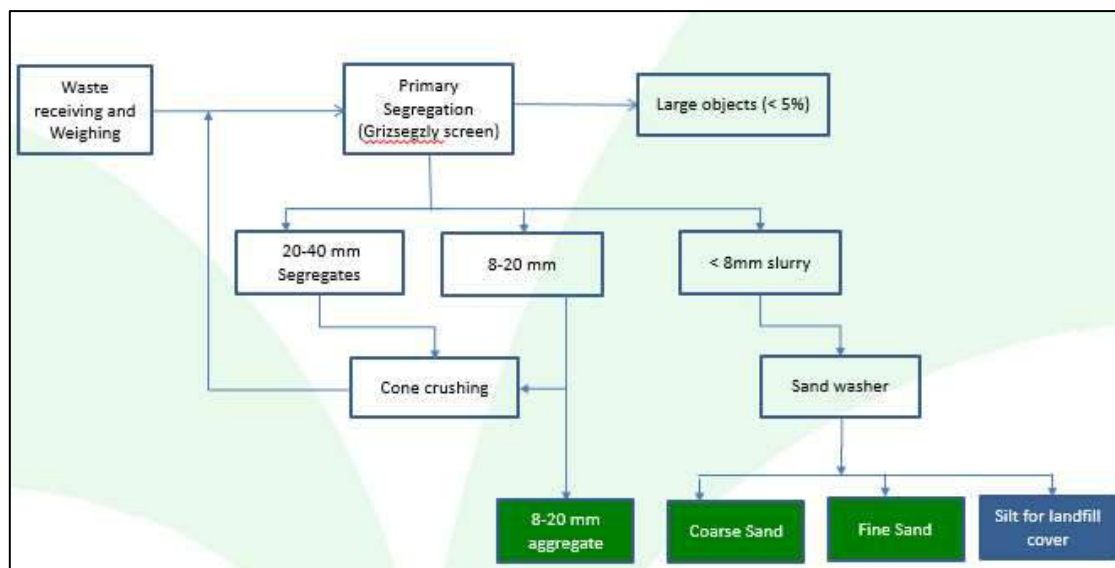


Figure 7.13: Output of Ash recycling plant



CHAPTER 8

PROJECT BENEFITS

Chapter 8

Project Benefits

8.1 Introduction

The proposed expansion of the waste to energy power plant unit adjacent to the existing operating unit will result in improvement of infrastructure as well as overall socio-economic development in the study area. The people staying in the nearby areas will be benefited directly as well as indirectly due to the proposed expansion project. It is expected that the proposed project will provide benefit for the locals in two phases i.e. during construction phase as well as during operation phase of the unit. In operation phase, the proposed expansion plant would require significant workforce of skilled and unskilled category to work in technical and non-technical jobs. Migration of persons with better education and professional experience will result in increase of population and literacy in the surrounding residential areas. Other benefits from the project are as follows.

- Conservation of fossil fuels as RDF from MSW will be used as main fuel
- Power plant based on RDF, reduces the space requirement for disposal of MSW
- Power plant within Integrated MSW management facility avoids transportation of RDF for end users

8.1.1 Benefits of refuse derived fuel (RDF)

The term "RDF" is involved in finding solution to the problems associated with recovering energy from solid waste. It is the fraction of municipal solid waste or other solid wastes composed mainly of cellulose and petroleum derivatives, whether mixed with other non-combustibles in its un-processed form, or in its various processed forms. The various advantages of utilizing RDF as alternate fuel are given here under.

- RDF would benefit reduction in the volume of solid waste and the possibility of energy recovery
- Refuse derived fuel has good calorific value, it also has least polluting bi-products and its usage leads to a proper solid waste management as well
- Offers an alternative technique to mass burning of solid waste and low cost of solid waste disposal
- RDF is increasingly used as a low-cost and regionally available energy source for cement industry all over the world.
- Study shows that RDF has considerable potential for removal of colouring agent from waste water over a wide range of concentrations

8.1.2 Benefits of waste to energy power plant

Waste-to-Energy (or energy-from-waste) facilities provide a safe, technologically advanced means of waste disposal that reduces greenhouse gases, generates clean energy and recycles metal. Waste-to-Energy (WTE) is widely recognized as a technology that can help mitigate climate change. WTE fulfils two important roles, it turns the non-recyclable waste into secure energy and valuable raw materials in an environmentally safe manner.

WTE achieves a reduction of greenhouse gas emissions by generating electrical power or steam, WTE avoids carbon dioxide emissions from fossil fuel based electrical generation. It is an effective supplement to fossil fuel-based power sources while also reducing landfill requirement in urban environments, generating renewable energy and producing revenue for municipalities and governments. Waste-to-energy is often promoted as “clean energy” when compared to wasteful incineration practices of the previous decades. In this regard, it is utilizing energy that would otherwise be wasted, while not technically increasing the amount of waste burned.

Benefits of WTE

- Reduction of Waste Going to Landfill Sites
- Reduction of Greenhouse Gases
- Reduction in the Use of Fossil Fuel
- It is Environment-friendly
- The Creation of Jobs
- Better Recovery of Products
- Save Ecological Cycles

Disadvantages of WTE

- Generation of pollution and particulates
- All the carbon burnt is emitted as carbon dioxide
- It recovers some of the resources such as metals, in the process it destroys resources such as minerals, wood, plastic,

8.1.3 Employment potential associated directly with the project

A society as a whole will have a major objective to increase national income, but it clearly has many significant and additional objectives. One of the most important of these is income distribution, another is simply to increase the number of productive job opportunities so that unemployment may be reduced.

The lack of adequate employment opportunities is one of the important economic and social problems in the neighbouring villages /residential areas of the proposed project area. The occupational structure of residents in the study area is studied with reference to main

workers, marginal workers and non-workers. The main workers include four categories of workers defined by the Census Department consisting of cultivators, agricultural labors, those engaged in manufacturing, processing and repairs in household industries and others including construction, trade and commerce, transport and communication and other services. The marginal workers are those workers engaged in some work for a period of less than six months during the reference year prior to the census survey. The non-workers include those engaged in unpaid household duties, students, retired persons, dependents, beggars, vagrants etc., institutional inmates or all other non-workers who do not fall under any of the above mentioned categories.

The proposed expansion project will provide direct employment opportunities to the local people as skilled workers and unskilled workers after commissioning. The direct manpower of the existing plant is 215 and the requirement for the proposed expansion project is about another 260. During construction it is expected to have more direct and indirect employment for locals as construction workers. The employment opportunities for skilled workers will also be available based on skill set. Thus, this project will be able to reduce the numbers of the non-workers and will increase the employment among all categories of the people.

8.1.4 Indirect employment potential

Project management proposes to give priority to engage local people in the nearby villages for the employment opportunities at local/regional level due to contractual, marketing and jobs directly associated with the project. The other related indirect employment due to transportation requirement, supply of essential items and services to the project site and other community services will also be generated. The possibility of development of trades and occupations linked with the project benefited personnel like dairy, poultry, commercial shops etc. are also expected to boost the local employment levels.

Employment in these sectors will be permanent on the basis of own initiatives and interest of the individual. Involvement of unskilled labour requirement will be on continuous basis depending on the requirement of contractor at site. A major part of this labour force will be hired from nearby villages.

8.1.5 Improvements in the local infrastructure

The proposed expansion project is expected to support the government to further develop the local infrastructure such as improvement in water supply, sewerage and medical facilities etc., for catering to the needs of the project personnel (additional for proposed expansion) and their families. The establishment of the proposed project will help in sustaining the development of the project area and nearby villages including further development of physical infrastructural facilities.

8.1.6 Transportation

Proposed expansion project in this area will boost infrastructural facilities like materials transportation, mechanical workshops, etc.

8.1.7 Improvements in the socio-economic aspects

The following changes in socio-economic status are expected to take place with this project.

- i. Due to increased income levels and raising consumption levels through multiplier effect will have a positive impact on economy of the region.
- ii. Project management will train people for increasing their employability in the plant.
- iii. There will be increased revenue to the state in the form of taxes & duties which will find their way to support the overall development of the region.
- iv. Project will also help in the development of social infrastructures such as education facilities, banking facilities, post offices and communication facilities, medical facilities, recreation facilities, business establishments, plantation and parks, community facilities etc.

8.1.8 Secondary developments

Some secondary developments like opening of new shops, medical facilities may take place in view of the increased population due to the proposed employment. These factors will be beneficial to local resident's people in the study area and also to the people staying in the near-by villages.

8.2 Corporate Social Responsibility

8.2.1 Introduction

Corporate Social Responsibility (CSR) also known as Corporate Responsibility, Corporate Conscience, Corporate Citizenship, Responsible Business, Sustainable Responsible Business (SRB), or Corporate Social Performance, is a form of corporate self-regulation integrated into a business model. Ideally, CSR policy would function as a built-in, self-regulating mechanism whereby business would monitor and ensure its support to ethical standards and international norms. Consequently, business would adopt responsibility for the impact of its activities on the environment, consumers, employees, Communities, Stakeholders and all other members of the public sector. CSR focused businesses would proactively promote the public interest by encouraging community growth and development, and voluntarily eliminating practices that harm the public sector, regardless of legality.

Public Corporations have legal responsibilities to maximize shareholder profits, but a shift in corporate mindset led by social expectations and pressure is causing business leaders to rethink their responsibilities with respect to corporate performance measured in terms of economic impact, social Impact and environmental impact-commonly called the Triple Bottom Line. Essentially, CSR is the deliberate inclusion of public interest into corporate decision making, and the honouring of a triple bottom line.

Economic growth is possible only through consumption of inputs available in the environment and society. The harnessing of natural resources has a direct impact on the economy, environment and the society at large. CSR is a concept whereby organizations serve the interests of society by taking responsibility for the impact of their activities on customers, employees, shareholders, communities and the environment in all aspects of their operations.

Thus CSR is a management's commitment to operate in an economically, socially and environmentally sustainable manner, while recognizing the interests of its stakeholders. This commitment is beyond statutory requirements. CSR is therefore closely linked with the practice of sustainable development. It extends beyond philanthropic activities and reaches out to the integration of social and business goals. These activities need to be seen as those which would in the long term, help secure a sustainable competitive advantage.

8.2.2 Planning

The planning for CSR starts with the identification of the activities/projects to be undertaken. CSR projects/activities may be undertaken in the periphery where project management carries out its commercial activities as far as possible. However, if it's not possible or applicable, then project management may choose to locate CSR projects anywhere in the country.

Selection of activities under CSR would be made to ensure that the benefits reach the smallest unit i.e. Village, Panchayat, Block or District depending upon the operations and resource capability of the proposed project. The approach to CSR planning will be shifted from an ad-hoc charity to a long-term sustainable approach. The Project management monitoring skills available would be shared with the local administration by training and setting up required structures and systems as far as possible.

The long-term CSR Plan will match with the long term Business Plan. This will be broken down into medium term and short term plans. Each of these plans will be clearly specified the following

- i. Requirements relating to baseline survey
- ii. Activities to be undertaken
- iii. Budgets allocated
- iv. Time-lines prescribed
- v. Responsibilities and authorities defined
- vi. Major results expected

However, these plans shall also clearly specify the implementation guidelines and the involvement of the implementing agency. The procedures and methodologies prescribed for monitoring shall be highlighted as well as the modalities of the concurrent and final evaluation.

8.2.3 Implementation

CSR initiatives will be considered in the following parameters for identifications/selection of schemes/projects as per the stipulated guidelines:

- Investment in CSR would be project based.
- CSR activities would generate community goodwill, create social impact and visibility.
- For every project, the time-frame and periodic milestones would be finalized at the outset.
- CSR activities also involve the suppliers in order to ensure that the supply-chain also follows the CSR principles.
- CSR activities help in building a positive image of the company in the public perception.
- CSR projects may be closely linked with the principles of sustainable Development. Based on the immediate and long term social and environmental consequences of their activities.
- Project management would take the shoulder responsibility for restoring/compensating for any ecological damage that is taking place as a result of its operations.
- Care will be taken to ensure that work towards fulfilment of the National Plan goals and objectives, as well as the Millennium Development Goals adopted by our country, ensure gender sensitivity, skill enhancement, entrepreneurship development and employment generations by co-creating value with local institutions/people.
- Project management will define their business continuity plan to factor in Hazards, risks and vulnerabilities. They would also create value in innovative social investments in the community and may focus on the areas of “Preparedness and Capacity Building” in Disaster Management (DM).
- Public-Private Partnership between the Government and the Central Public Sector could also be encouraged to leverage the strengths of the latter in Disaster Management needs to network with the Ministries in Government of India/NDMA at the National Level and State Governments/SDMAs at the State Level to Strengthen and formalize their role in the DM process for ensuring preparedness of the communities towards disaster resilience.

Project activities identified under CSR will be implemented generally by specialized agencies with coordination of project management. Specialized agencies would be made to work singly or in tandem with other agencies.

Specialized agencies would include:

- Community based organizations whether formal or informal
- Elected local bodies such as Panchayat
- Voluntary Agencies (NGOs)
- Institutes/Academic Organizations

- Trusts, Missions etc.
- Self-help Groups
- Government, Semi-Government and autonomous Organizations
- Standing Conference of Public Enterprises (SCOPE)
- Mahila Mandals/Samitis
- Contracted agencies for civil works
- Professional Consultancy Organizations etc.

Project Management will take responsibility to develop awareness among all levels of their staff about CSR activities and the integration of social processes with business processes. Those involved with the undertaking of CSR activities will be provided with adequate training and re-orientation.

8.2.4 Possible areas of activities under CSR

Some of the possible areas of activities under CSR are mentioned below. They will be undertaken depending on the local requirement and its immediate need.

- Drinking Water Facility
- Education
- Solar Lighting System
- Health and Family Welfare
- Sanitation and Public Health
- Pollution Control
- Animal Care
- Promotion of Sports and Games
- Promotion of Art and Culture
- Environment Friendly technologies
- Promotion of livelihood for economically weaker sections through forward and backward linkages.
- Supplementing Development Programme of the Government
- Non-conventional Energy Sources
- Imparting Vocational Training
- Setting up of skill development centres
- Taking action on points suggested by Ministry of Environment & Forests pertaining to Charter on Corporate Responsibility for Environment Protection for 17 categories of Industries.
- Scholarships to meritorious students belonging to SC, ST, OBC and disabled categories
- Adoption/Construction of Hostels (especially those for SC/ST and girls)
- Skill training, entrepreneurship development and placement assistance Programme for youth
- Building of Roads, Pathways and Bridges
- Entrepreneurship Development Programme (EDP)

- Disaster Management Activities including those related to amelioration /mitigation
- Activities related to the preservation of the Environment/Ecology and to sustainable Development

8.2.5 Monitoring of CSR activities

Monitoring of the CSR projects is very crucial and needs to be a periodic activity of monitoring by project officials. These activities will be strengthened focusing on Education, Health and Improvement of basic amenities.

- The Board of Directors would discuss the implementation of CSR activities in their board meetings.
- A separate paragraph/Chapter will be included in the annual report on the implementation of CSR activities/projects including the facts relating to physical and financial progress.
- Project management will appoint a CSR committee or a Social Audit Committee or a suitable, credible external agency for proper and periodic monitoring of CSR activities.
- Project management will promote to evaluate the CSR projects by an independent external agency. This evaluation should be both concurrent and final.

8.2.6 Budget for CSR

The CSR budget is mandatory as per the guidelines created through a board resolution as a percentage of net profit as per the rule prescribed by the government of India / Companies Act 2013. The CSR Budget will be fixed for each financial year. This funding will not lapse. The criteria for applicability of CSR under section 123 (I) of companies act 2013 is given in **Table 8.1**.

Table 8.1: Criteria for Applicability of CSR under Section 135 (I) of Companies Act, 2013

Either of the Following 3 Criteria		
Turnover Criteria Turnover during financial Year is INR 1000 Crores or More	Net Profit Criteria Net profit during financial year is INR 5 Crores or more	Net worth Criteria Net worth is INR 500 Crores or More
As per the act the management board shall ensure that at least 2% of average net profits of the company made during three immediately preceding financial years shall be spent on CSR activities in every financial year.		

8.3 Corporate environmental responsibility (CER) funding

Corporate Environmental Responsibility has become an integral, self-regulating mechanism through which business monitors and safeguards its active compliance with the Law and ethical standards. CER aims to embrace responsibility for the company's actions and encourage a positive impact through its activities on the environment, employees, consumers, stakeholders, communities and the larger public.

The project would further promote public interest through provision of basic amenities such as roads, transportation, electricity, education, and sanitation and healthcare facilities. This would also encourage community growth and development and improved socio-economic conditions, and quality of life of the people living in the project area. The company shall also continue to have among its objectives the promotion and growth of the national economy through increased productivity, effective utilization of material, manpower resources and continued application of modern scientific and managerial techniques, in keeping with the national aspiration; and the company shall continue to be mindful of its social and moral responsibilities to consumers, employees, shareholders, society and the local community. The company shall earmark funds for CER in the surrounding villages towards development of education, healthcare, skill development, drinking water supply, avenue plantation, strengthening of infrastructure facilities and capacity building of local communities. These funds shall be utilized over a period of 3 years initially.

8.3.1 CER Budget

In the past MOEFCC has issued Office Memorandum on 1st May 2018, in order to have transparency and uniformity while recommending CER by EAC/ SEAC and issued the guidelines for both greenfield project and brownfield projects based on capital investment proposed as given in **Table 8.2**.

Table 8.2: CER fund as per MOEFCC OM F.No.22-65/2017-IA.III dated 1st May 2018

Capital investment/additional capital investment (in Rs.)	Greenfield project	Brownfield project
≤ 100 crores	2.0%	1.0%
> 100 crores ≤ 500 crores	1.5%	0.75%
> 500 crores ≤ 1000 crores	1.0%	0.50%
> from 1000 crores to ≤ 10000 crores	0.5%	0.25%
> 10000 crores	0.25%	0.125%

However, the MOEFCC in its recent Office Memorandum on 30th September 2020 and subsequently on 20th October 2020 suppressed the earlier OM of 1st May 2018. The new OM has empowered the Expert Appraisal Committee (EAC) or State Level Expert Appraisal Committees (SEAC) to deliberate on the commitments made by the project proponent to address concerns raised during the public consultation. The EAC/SEAC would thereby prescribe specific condition (s) in physical terms while recommending the proposal, for grant environment clearance instead of allocation of funds under Corporate Environment Responsibility.

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

The CER activities will be based on the community need assessment and analysis of the existing infrastructure facilities in project area villages. These activities will be implemented through credible partners and monitored periodically by the company. The implementation agencies would submit a monthly progress report, quarterly report and other relevant documents for information and mandatory compliance.

8.3.2 CSR and CER Budget spent and proposed

The details of the amount spent for various CSR/CER activities undertaken by the existing unit is given in **Table 8.3**.

Table 8.3: Budget spent for the CSR/CER activities by existing unit (last five years)

CSR Expenditure – Existing unit (in Lakhs)				
2017-18	2018-19	2019-20	2020-21	2021-22
8.5	10.5	12.25	13.05	15.6
The above budget has been spent for the activities like First Aid training program, Mega Health check-up camp, note books & School bags distribution, Stress management & Naturopathy program, Haritha Haram Plantation, Provision of salary to a primary teacher, construction of RO based water treatment plants, construction of primary health centre, renovation of school buildings, training on sewing machines, supply of drinking water etc.				

Pictorial view of activities undertaken by the company is enclosed as **Annexure-6**

The proposed CSR / CER budget and activities are given in below **Table 8.4**. The CSR /CER activities have been proposed based on the community need assessment and analysis the existing infrastructure facilities in project area villages.

Table 8.4: Proposed need-based CSR activities and its budget

S. No	Activities	Details	Frequency/ timelines	Yearly Budget (in Lakhs)			Amount (in Lakhs)
				1 st	2 nd	3 rd	
1	Health check-ups	Health check-up for communities in the nearby villages and distribution of medicines to the needy	Once in a month in villages of core zone and needy villages in the study area	1.5	2	2.5	6.00
2	Installation of RO based Water Treatment Plants	Community managed RO based Water treatment Units in the nearby villages	A total of 10 plants in needy villages	1.05	1.5	1.75	4.30

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

S. No	Activities	Details	Frequency/ timelines	Yearly Budget (in Lakhs)			Amount (in Lakhs)
				1 st	2 nd	3 rd	
3	Infrastructure Development of Schools	Modernization of class rooms, renovation / construction of school buildings, donation of computers, note books, need-based education materials etc.	Need based	1.5	2.5	3.25	7.25
4	Vocational Education Training program	Youth in all Project affected villages and Core Zone	Quarterly yearly one batch	1.5	2.25	2.25	6.00
5	Income Generation Training programs	For nearby villagers – Women empowerment initiative for SHGs	Quarterly training program for women	2	2.5	2.75	7.25
6	Merit Scholarships for students	For employee children and others studying in the nearby schools	Once in a Year	2	2.05	2.07	6.12
7	Covid relief activities	vaccination drives for children and needy	Once in a month	1.5	2.5	2.5	6.50
8	Creation of Community Assets	Renovation of Community Centres, check-dams, library, bus shelters and other public utilities in needy villages	Need based	1.5	2.25	2.5	6.25
9	Plantation Drives	Avenue Plantation in villages and community buildings	Need based	1.5	1.5	1.25	4.25
10	Encouraging rural sports/events	Organizing Sports meets/ competitions for the youth in the nearby villages	Twice in a Year/Need based	2	2	2.20	6.20
Grand Total				16.06	21.05	23.02	60.12
Note: Company shall earmark Rs. 60.12 Lakhs for CSR and other developmental activities. This fund shall be utilized over a period of 3 years. Thereafter the company shall allot 0.50% of the annual profit. The CSR budget has been proposed keeping in view the requirement of the study are persons needs and it would be revised as per the discussion of the EAC committee.							

CHAPTER 9

ENVIRONMENTAL COST BENEFIT ANALYSIS

Chapter 9

Environmental Cost Benefits Analysis

9.1 Environmental Cost Benefit Analysis

Cost-benefit analysis is a procedure for evaluating the desirability of a project by weighting benefits against costs. Results may be expressed in different ways, including internal rate of return, net present value and benefit-cost ratio. Appraisal of the proposed 36 MW WTE power plant project should consider as the project is financially profitable, makes a positive contribution to the country's economy, technically feasible and environmentally sound and sustainable.

There are good reasons for estimating the costs and benefits of major environmental inputs and including them in a project economic analysis. Such analyses would result in:

- More accurate estimates of the WTE power plant project development impacts
- Inform action base for investment decision making
- Development of an environmental management tool for the WTE power plant

These above activities require additional expenses. The cost-benefit analysis has been confined to direct or indirect, costs and benefits. The environmental impacts are quantified as much as possible by measuring the change in output that these impacts cause in the economy. The environmental impacts identified for the WTE power plant project were measured in two scenarios:

- The proposed 36 MW WTE plant operates by making investments for environmental improvements, i.e., without any environmental management
- Environmental investments are implemented as planned and WTE productions are continued without any hindrance

Differences in the environmental impacts projected in the “with” and “without” scenarios represent environmental costs and benefits quantified and monetized. Costs for this project are mainly investments and operating costs of the new equipment to reduce pollution level to the prescribed national standards.

9.2 Pollution levels from the WTE power plant

The air pollution control equipment proposed for the reduction in particulate matter is bag filters with a removal efficiency of more than 99 %. Similarly, for SO₂ and NO_x emission control a semidry flue gas cleaning system consisting of spray reactor with quality lime slurry and

activated carbon is used. The stack height proposed is 60 m to meet the regulatory guidelines for power plants. To control NO_x emissions low NO_x burners are used. The boiler furnace temperature is maintained at minimum 950 +/- 50 °C with a minimum of 2 seconds of residence time to control the dioxins & furans in the flue gas. To achieve the regulatory standards for air quality an account of around Rs. 130.5 crores is demarcated as capital cost under EMP to maintain all the APCD systems under working conditions.

The leachate generated from the storage yard of the raw MSW is collected properly into the storage tanks and mostly reused for maintaining the moisture content of compost yard and also a separate LTP plant is proposed with a cost of around Rs. 7.5 crores with physico-chemical and biological treatment units to meet the regulatory standards. The odour control system for MSW based WTE plant is of critical component and around Rs. 9.0 crores of amount is demarcated to reduce the odour levels in the WTE plant. In addition to the ash handling system, fire-fighting & protection systems will enhance the safety and health aspects of working employees and other infrastructure availability for better environment. The treated wastewater which meets the regulatory standards also reduces the input raw water quality. The permeate/condensate from the mechanical vapour recompression (MVR) of 200 KLD leachate will be reused for flue gas cleaning, lime and dust suppression.

The benefits of MVR technology mainly comprises of no external heat source needed, no heat rejection unit, no chemical treatment, no RO membrane systems required and no ground water extraction is needed for this process.

The storm water and rain water management systems provided in the project will collect all the rain water and systematically recharged into the ground water system, thus conservation of ground water in the plant premises.

The overall cost of environmental investments as EMP budget for the proposed WTE project consists of around Rs. 134.5 crores as capital cost around Rs. 20 crores(15%) per annum as recurring cost for maintaining the pollution control equipment.

The capital cost of EMP includes installation of all equipment/devices to control or minimise air pollution, water pollution, noise levels and soil contamination etc., and to treat the solid waste and LTP for leachate generated from the proposed project activities, so that the waste discharges and air emission are well maintained below the maximum allowable limits as per regulatory standards. The benefits consist of lower raw material costs, uninterrupted process operations and production levels lower health risks to employees and to the nearby inhabitants, lower PM, SO₂ and NO_x impacts as well as minimised liquid effluent impacts due to the provision of LTP treatment plant with MVR technology. The other important aspect of cost-benefit assessment was to estimate the benefits of the project to the surrounding villages/People. The major benefit of the WTE project is mainly reduction of odour levels due

to the MSW storage time will be reduced drastically as all the MSW received at site is directly used and treated in boilers as feed fuel, thus all the odour impacts and aesthetic impacts are minimised due to 36 MW WTE plant operations.

The Cost Benefit Analysis (CBA), of 36 MW WTE plant is to establish an applied welfare economics approach to estimate and compare the total project costs and benefits of alternative policies and scenarios. Construction and operations of all the air and water pollution control facilities involve a range of direct and indirect costs. The operations & maintenance (O&M) costs mainly include raw materials, labour costs, and maintenance of treatment facilities/equipment such as bag filters, spray dryer, gas cleaning mechanism, MVR system and also training to the technical employees. Many infrastructure facilities like water supply lines, firefighting systems, electric grid supply, roads and admin buildings, MSW storage yards and mainly inert/ash disposal to the landfill site and already available with the existing 24 MW WTE power project.

There are mainly four types of sources of revenues for the proposed 36 MW power project which includes gate fees (TPD/energy sales (MW), recycling metal post incineration and combustion residues (ash). The gate fee, that is the quantity of MSW tonnages received at the plant and sales from energy (electricity and heat) are the main sources revenues. The combustion residues can be recycling of metals, ash as aggregate materials to the construction industry. No fuel cost is considered. The gate fee is for SLF, composting and C&T of MSW.

9.3 Conclusions and recommendations

Establishing the 36 MW WTE is more favourable with allotment of Rs. 134.5 crores for the EMP, identified to mitigate the impacts arising out of all the power plant activities. Without allotting EMP cost and not providing EMP equipment or by doing nothing for the environmental pollution control, in the medium to long term, would put the WTE plant assets, both tangible and nontangible at a high risk of greater deterioration and increased vulnerability due to climate variability. The major benefits of the project considered for assessing the environmental cost-benefit are:

Savings incurred due to efficient utilization of water, treated water reuse and recycle for industrial processes, greenbelt development and other industrial usage. The efficient reuse of water amounts to reduction in fresh water requirement leading to a major benefit to the WTE project. The capital investment made for LTP/MVR is around Rs. 7.5 crores. The LTP provided will cater to the WTE plant and comply with the discharge standards by treating the effluents as per regulatory requirements. In case of leachate, the effluent treatment cost will be considerably less due to economy of scale. This facility results in the benefit of resources cost savings to WTE. The cost savings of reuse of treated water, thus reducing the fresh water

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s. Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

resources required for WTE will provide considerable cost-benefit scenario for the WTE project.

From an economic, social and environmental perspective the proposed 36 MW WTE project is desirable and it becomes even more desirable for WTE power plant growth in the region with multiple and benefits in producing the employment opportunities, through planned landscaping & greenbelt development adding to the scenic beauty and aesthetics of area within & surrounding the project area, improving the quality of life of the surrounding population and economic growth of the region.

CHAPTER 10

ENVIRONMENTAL MANAGEMENT PLAN

Chapter 10

Environmental Management Plan

10.1 Introduction

Any developmental activity is associated with certain positive impacts as well as some negative impacts on the environment. However, the negative or adverse impacts cannot possibly rule out scientific development. At the same time adverse impacts cannot be neglected. The Environmental Management Plan (EMP) is required to ensure sustainable development in the area of the proposed plant site. It is the process used to control adverse impact due to proposed activity by means of proper system and its efficient operation.

The environmental management plan is an action plan aiming to control pollution at the source level to the possible extent with the available and affordable technology followed by treatment measures before they are let out/discharged. An environmental management plan shall be formulated for mitigation of the adverse impacts and is based on the present environmental conditions and the environmental impact appraisal. This plan helps in formulation, implementation and monitoring of the environmental parameters during and after commissioning of the project.

10.2 Environmental Management during Construction

The impacts during the construction phase on the environment would be basically of temporary nature and are expected to reduce gradually on completion of the construction activities, however in this proposed expansion, there are no major construction activities proposed, except erection of plant & machinery and other admin blocks required for expansion unit.

10.2.1 Air Quality Management Measures

For the proposed expansion no major site levelling and grading is carried out, few supporting structures will be constructed for erecting plant and machinery along with other pollution controlling equipment.

Due to these activities if any dust is generated from the movement of construction vehicles on paved or unpaved roads. The control measures proposed to be taken up are given below:

- Water sprinkling on main haul roads in the project area will be done. This activity will be carried out at least twice a day, if need arises frequency will be increased on windy days and in this way around 50% reduction on the dust from the exposed surface will be achieved.
- The duration of stockpiling will be as short as possible as most of the material will be

used as backfill material for the open cut trenches for road development.

- Tin sheets of sufficient height will be provided around the site of dust generation or all around the project site as barrier for dust control.
- All the vehicles carrying raw materials will be covered with tarpaulin / plastic sheet, unloading and loading activity will be stopped during windy period.
- To reduce the dust movement from civil construction site to the neighbourhood, the external part of the building will be covered by plastic sheets.

The implementation of proper control measures for dust suppression, no adverse impacts are expected and compliance with the ambient air quality will be achieved at Air pollution Sensitive Receivers (ASR's) at all time.

10.2.2 Water Quality Management Measures

During site development for proposed expansion activities, necessary precautions will be taken so that the runoff water from the site gets collected to working pit and any over flow, will be diverted to nearby greenbelt / plantation area.

During construction activity all the equipment wash water will be diverted to working pit to arrest the suspended solids if any and the settled water will be reused for construction purposes and for sprinkling on roads to control the dust emission, etc.

The waste generated from the site workshop will be segregated like used oil, lubricants, soiled cotton, paper, etc. and disposed to authorized recyclers. The workers will be using the toilet facilities of the existing unit, therefore, impact due to sewage waste water of the proposed expansion would be insignificant.

10.2.3 Noise Management Measures

Noise generating equipment will be used during day time only for short period of time as per its requirement. Acoustic enclosures will be arranged to reduce the noise levels, where ever possible and the noise generating equipment will be kept away from the human habitation or movement. Compound wall of sufficient height is present all around the site which will act as barrier for minimizing the noise travel to surrounding areas. Therefore, impact on noise environment due to proposed expansion project would be insignificant. All vehicles entering into the project site will be informed to maintain speed limits and not blow horns unless it is required. Personal protective equipment like earmuffs, helmets covering ears would be provided to the workers working near noise generating equipment and would see that workers use the protective gadgets regularly.

10.2.4 Solid Waste Management Measures

The solid waste generated during construction period/activities being predominantly inert in nature (construction and demolition waste) does not create chemical or biochemical

pollution. However maximum effort would be made to reuse and recycle them. The most of the solid waste material will be used for filling/ levelling of low-laying areas and as road construction material, if any excess waste is found, that will be given to local contractors for lifting and dumping in low lying areas. All attempts would be made to stick to the following measures

- All construction waste shall be stored within the site itself. A proper screen will be provided so that the waste does not get scattered.
- Attempts will be made to keep the waste segregated into different heaps as far as possible so that their further gradation and reuse is facilitated.
- Materials, which can be reused for purpose of construction, levelling, making roads/ pavement will also be kept in separate heaps from those which are to be sold or land filled.
- The local body or a private company may be arranged to provide appropriate number of skip containers/ trolleys on hire.

The use of the construction material basically depends on their separation and conditions of the separated material. A majority of these materials are durable and therefore, have a high potential for reuse. It would, however, be desirable to have quality standards for the recycled materials. Construction waste can be used in the following manner.

- 1) Reuse of bricks, tiles, stone slabs, timber, piping railings etc. to the extent possible and depending upon their conditions.
- 2) Sale/ auction of material which cannot be used at the site due to design constraint.
- 3) Plastics, broken glass, scrap metal, used cement bags, etc. can be sent to recycling industries.
- 4) Rubble/ brick bats can be used for building activity, such as levelling, under coat of lanes where the traffic does not constitute heavy moving loads.
- 5) Larger unusable pieces can be sent for filling up low laying areas.
- 6) Fine material such as sand, dust etc. can be used as cover material.
- 7) The unearthed soil can be used for levelling as well as for lawn development.
- 8) The broken pieces of the flooring material can be used for levelling in the building or can be disposed-off.
- 9) The unused or remaining paints/varnishes/wood can either be reused or can be disposed-off.

10.2.5 Ecological aspects

During construction period, there could be clearing of vegetation in order to prepare the site for construction. However, this project is establishing within the existing site, there will not be much disturbance to the existing natural environment. A comprehensive greenbelt program will be implemented to improve the existing ecological condition of the region. As the project site is located within the existing waste management facility area; thick

greenbelt already developed by existing WTE plant as well as waste management plant which help to trap the dust arising during construction period.

10.2.6 Site Security

Being an existing WTE plant operating from a few years there are adequate security arrangements made to ensure that the local inhabitants and the stray cattle are not exposed to the potential hazards of construction activities. Round the clock security personnel are available to restrict entry of unwanted people to the site.

10.3 Environmental Management during Operational Stage

Necessary control measures will be undertaken at the design stage to meet the statutory requirements and towards minimizing environmental impacts. The design basis for all process units will lay special emphasis on measures to minimize effluent generation and emission control at source. The specific control measures related to gaseous emissions, liquid effluent discharges, noise generation, solid waste disposal etc. are described below.

10.3.1 Air Quality Management

From the proposed expansion there will be increased pollution loads as there is increase in power generation from new unit. The existing air pollution sources are as follows:

- Particulate matter, sulphur dioxide, nitrogen oxides, Dioxins and furans from power plant
- Sulphur dioxide and nitrogen oxides from DG sets
- Dust particulates due to movement of vehicles and road sweepings

The following methods of abatement will be employed for the air pollution control;

- Bag filter with an efficiency of 99.5% to limit PM in outlet to less 30 mg/Nm³ is proposed
- To minimize the SO₂, HCl and other emissions as semi-dry /dry flue gas cleaning system consist of spray reactor with lime slurry and activated carbon is used. The chimney is selected considering sulphur dioxide emissions and to meet central pollution control board norms. The height of chimney has been selected as 65 m for the power plant.
- Provision is also made by way of over fire air system in the furnace to contain NO_x emission from the power plant boiler.
- The furnace and the flue gas residence time (minimum 2 seconds with a minimum flue gas temperature of 950°C) in the furnace are designed such that, the dioxins and furans emissions are reduced.
- The flue gas is further treated with activated carbon which ensures the PCDD/ PCDF are limited to less than 0.1 ng/Nm³ of flue gas.
- Semi-dry/dry type gas cleaning system with lime dosing is envisaged for reduction of

acid gases and activated carbon injection is envisaged for reducing the dioxins/furans and heavy metal emissions.

- The RDF storage has been envisaged in a completely closed shed in the tipping / storage area. This measure will reduce the dust nuisance and bird menace in the power plant area.
- Forced draught suction fan is provided in the storage pit there by maintaining slightly negative pressure in the RDF storage pit. This will eliminate odour in the RDF storage pit area.
- Arrangement will be made for suitable spray of enzymes on the RDF to overcome the mosquito and fly nuisance and odour. Ultrasonic sound identified hooter will be provided to overcome the nuisance of birds,
- Internal roads are concreted / asphalted to reduce fugitive emissions and water will be sprayed to mask the dust.
- A thick Greenbelt will be provided around the power plant, along the internal roads and along the plant boundary.

10.3.2 Water Quality Management

Effluent from water treatment plant - Hydrochloric acid and sodium hydroxide will be used as regenerants in the proposed de-mineralization plant of water treatment plant. The acid and alkali effluents generated during the regeneration process of the ion-exchangers would be drained into an acid/alkali proof lined underground neutralizing pit. Generally, these effluents are self-neutralizing. However, provisions will be made such that the effluents will be neutralized by addition of either acid or alkali to achieve the required pH of about 7.0.

The rejects from RO plant will have high TDS which could be diluted and used for cleaning purposes in the project. This water also could be used for Ash Quenching / Dust suppression.

Chlorine in cooling water - In auxiliary cooling tower water, residual chlorine of about 0.2 ppm is maintained at the outlet. This chlorine dosing is done to prevent biological growth in the cooling tower system. This value would not result in any chemical pollution of water and also meets the national standards for the liquid effluent.

Steam generator blow down for each block - The salient characteristics of blow down water from the point of view of pollution are the pH and temperature of water since suspended solids are negligible. The pH would be in the range of 9.8 to 10.3 and the temperature of blow down water will be about 100°C. The quantity of about 1.2 TPH (approx.) of blow down from each boiler is very small and hence, it is proposed to put the blow down into the trench and leave it in the neutralizing pits along with the WTP rejects. Same will be utilised in Ash Quenching and Flue Gas Treatment System.

Sewage from various buildings in the plant - Sewage from various buildings in the power plant area will be conveyed through separate drains to the septic tank. The effluent from the septic tank will be sent to soak pit through bio toilets. There will be no ground pollution because of leaching due to this. Sludge will be removed occasionally and disposed to land fill or used as manure.

Thermal Pollution - The power plant is equipped with an air-cooled condenser and hence, there is much less water pollution which otherwise would have emanated from water cooling system. There is only an auxiliary cooling tower which is used for cooling the plant auxiliaries and the capacity of the cooling tower is much less and blow down from cooling tower will be let into the neutralization pit. This eliminates the letting out of high temperature water into the canals and prevents thermal pollution. Blow down from the cooling tower will be trenched out and ultimately conveyed to the neutralization pit. Hence, there is no separate pollution on account of blow down from cooling water system.

10.3.3 Noise Quality Management

Existing DG set has been bought acoustically enclosed & placed inside an acoustically treated room as per CPCB guidelines and same shall be followed for additional DG set proposed. Noise generating units like machinery area, canteen etc. are well insulated with doors curtains.

- The rotating equipment in the power plant will be designed to operate with a total noise level of not exceeding 85 to 90 dB (A) as per the requirement of Occupational Safety and Health Administration (OSHA) Standards/Noise at work of International Labour Organisation (ILO)
- The Turbo generator will be equipped with acoustic enclosure and all the boiler ancillaries insulated where ever required.
- All the design/installation precautions as specified by the manufacturers with respect to noise control will be strictly complied
- Major noise generating sources are insulated adequately by providing suitable enclosures
- Other than the regular maintenance of the various equipment ear plugs is provided to the personnel close to the noise generating units.
- Vehicle and people flow during shift changes shall be regulated by allowing exits in a phased manner.
- The green belt will help in reducing noise levels in the complex as a result of attenuation of noise generated due to plant operations and transportation.

10.3.4 Solid Waste Management

Domestic solid waste generated around 100 kg/day will be sent to the composting plant after proper segregation. The total ash (existing and proposed units) generated from the

WTE power plant will be around 450 TPD (maximum). The ash collected from the bag filter hoppers, economizer hoppers and evaporator /super heater hoppers called fly ash will be sent to adjacent TSDF for stabilization of hazardous waste. Ash collected from the furnace bottom called Bottom ash will be segregated in the ash recycling unit into useful material. Which will be sent to cement plants, brick manufacturing units, NHAI for road making etc., a non-usable or reject will be disposed via secured landfilling.

10.3.5 Greenbelt Development

Greenbelt means planting of special type of plants suitable to that particular agro-climate zone and soil characteristics in a place which will make the area cooler, reduce air pollution, prevent soil erosion and further improve the soil fertility status. A green belt around the periphery of boundary and road side will be created to avoid erosion of soil, minimize the air pollution and noise pollution in the project area. The green plants are capable of absorbing air pollutants and forming sinks for pollutants. Leaves with their vast area in a tree crown, absorb pollutants on their surface, effectively reducing their concentration and noise level in the ambient.

10.3.5.1 Location of the Greenbelt Development

Greenbelt will be developed within project site boundary (Core Zone), along internal road, around built-up area. Greenbelt with 15 m wide was developed all around the existing IMSWMF and the total area allocated for greenbelt development is 33.2 Acres (13.48 Ha) out of 100 Acres (40.46 Ha). In addition, completed sanitary landfill facility will be brought under green cover once the landfill area is completely occupied by MSW.

10.3.5.2 Existing Greenbelt

As the project is an existing facility adequate greenery has been developed in the site. There are 12365 trees have been planted and grown in 36 Acres of land within the premises of facility. List of flora present within the existing greenbelt in IMSWMP site is given **Table 10.1** and photographs of greenbelt shown in **Figure 10.1**.

Table 10.1: List of flora within existing greenbelt in IMSWMF site

S. No.	Name of the plants	Botanical Name	Number
1	Neem	<i>Azadirachta indica</i>	619
2	Papri	<i>Terminalia catappa</i>	1064
3	Gulmohar	<i>Delonix regia</i>	483
4	Siras	<i>Albizia lebbbeck</i>	23
5	Sisso	<i>Dalbergia sissoo</i>	276
6	Weeping fig	<i>Ficus benjamina</i>	876
7	Indian Cork Tree	<i>Millingtonia hortensis</i>	448
8	Spanish cherry	<i>Mimusops elengi</i>	10
9	Pipal	<i>Ficus religiosa</i>	189
10	White Fig	<i>Ficus virens</i>	235

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

S. No.	Name of the plants	Botanical Name	Number
11	Black Board Tree	<i>Alstonia scholaris</i>	692
12	Yellow Flametree	<i>Peltophorum pterocarpum</i>	19
13	Gular	<i>Ficus racemosa</i>	27
14	Amaltas	<i>Cassia fistula</i>	286
15	Indian elm or jungle cork tree	<i>Holoptelea integrifolia</i>	58
16	Kachnar	<i>Bauhinia variegata</i>	24
17	Kadam	<i>Neolamarckia cadamba</i>	12
18	Subabool	<i>Leucaena leucocephala</i>	637
19	Babool	<i>Vachellia nilotica</i>	46
20	Shashtoot	<i>Morus Alba</i>	22
21	Arjun	<i>Terminalia Arjuna</i>	35
22	Gurhal	<i>Hibiscus rosa-sinensis</i>	133
23	Red kaner	<i>Nerium oleander</i>	178
24	Ficus Species	<i>Ficus Island</i> <i>Ficus starlite</i> <i>Ficus panda</i>	5015
25	Cycas palm	<i>Cycas revoluta</i>	102
26	Furcaria	<i>Furcaria</i>	27
27	Bael patra	<i>Aegle marmelos</i>	10
28	Gardinia	<i>Gardenia jasminoides</i>	15
29	Aavla	<i>Phyllanthus emblica</i>	54
30	Rose	<i>Rosa species</i>	87
31	Champa	<i>Plumeria Alba</i>	87
32	Kajurina tapory	<i>Casuarina equisetifolia</i>	60
33	Aerocaria	<i>Araucaria heterophylla</i>	10
34	Rubber plants	<i>Ficus elastica</i>	4
35	Bottal plam	<i>Hyophorbe lagenicaulis</i>	40
36	Bougainveleia	<i>Bougainvillea glabra</i>	230
37	Tamarind (Emali)	<i>Tamarindus indica</i>	17
38	Mango	<i>Mangifera indica</i>	25
39	Anar	<i>Punica granatum</i>	17
40	Litchi	<i>Litchi chinensis</i>	2
41	Jamun	<i>Syzygium cumini</i>	24
42	Chikoo	<i>Manilkara zapota</i>	23
43	Lemon	<i>Citrus limon</i>	33
44	Guvava	<i>Psidium guajava</i>	24
45	Custurd apple	<i>Annona reticulata</i>	12
46	Dramstrick	<i>Moringa oleifera</i>	35
47	Harshringar	<i>Nyctanthes arbortristis</i>	4
48	Mogra	<i>Jasminum sambac</i>	16
Total			12365

Figure 10.1: Photos of Existing Greenbelt developed at site



10.3.5.3 Proposed Greenbelt in the Core Zone

An effective green belt will be developed along the periphery of the proposed unit. Plantation will be carried out near / around built-up areas and along internal roads of the project area. Additionally, 3900 trees are proposed to be planted the project premises. The existing trees species planted at site shows good survival rate hence the same will be planted as additional plantation work. DMSWSL has developed an inhouse nursery shown in Figure 10.2.

Figure 10.2: Inhouse nursery



10.3.5.4 Budgetary Allocation for Greenbelt Development

Greenbelt with in project site/ core zone will be developed within three years. Budget for greenbelt development is given Table 10.2.

Table 10.2: Estimated Budget for Greenbelt Development

Work or Activity	1 th year	2 nd year	3 rd year	Budget (INR)
Greenbelt project site / core zone, around 3900 saplings will be required (approx. cost @ Rs. 200 per sapling).				
Saplings Required	1500	1500	900	780000.00
Estimated Amount	300000	300000	180000	

10.3.5.5 Plantation Technique and Care

Plantation Technique

Following basic procedures need to be followed for greening the area.

- Plantation of tree species required approx. 1m³ pit for soil enrichment
- Pit should be filled with imported soil with 3:1:1 the ratio of sand, silt and farm yard manure
- Procure well grown saplings of recommended species from the nearby Forest Department nursery or inhouse nursery
- Make 1 m diameter ring bund around the planted saplings for water retention
- Watering of sapling is species specific, therefore watering need to be done once in 2 or 3 days for a period of two years
- Soil work and weeding need to be done once in two months

Monitoring Protocol

- The plantations need to be managed by regular watering, soil enrichment work, applying manure, weeding and provide proper protection.
- Replacement of sapling (replanting) required whenever mortality occurs in the plantation during the growth stage.
- Plantation requires after care for a period of minimum five years till the saplings attain matured tree stage.
- Any damage to the developed greenbelt due to any natural or cattle activity should be redeveloped and maintained by the agency.

10.3.6 Occupational Health and Safety

The Project design and development has been planned with utmost care and all provisions have been considered for the safety and security of the plant and personnel. For protection of the facility against fire, explosion or gas leak, all the blocks and yards will be equipped with required firefighting arrangement including Fire hydrants, DCP and CO₂ Fire extinguishers. Following safety measures shall be implemented:

- Hydrant System
- Fire Detection and Alarm System
- Water sprinklers system High Velocity Water Spray System (HVWSS) and Medium Velocity Water Spray System (MVWSS)
- Different types of Fire Extinguishers (CO₂ & DCP)
- Personal Protective Equipment (PPEs) to the workers

Safety Gears & PPEs

DMSWSL is fully aware for protection from probable hazards which will be a responsible cause of the accident to the employees. Company will ensure the safety of the workers while working in the plant. For this, following PPEs are proposed as given in **Table 10.3**.

Table 10.3: List of PPEs proposed

Sr. No.	PPEs	Mode of Action
1	Helmet	Protect head at workplace and during causality
2	Hand gloves	Protect hand from burning, cutting
3	Electrical Hand Gloves	Protect from Electric Shock
4	Cartridge type Nose Mask	Protect from fume, dust and smog and allow to breath properly
5	Self-Contained Breathing Apparatus	Used for proper breathing in irrespirable condition
6	Monkey Ladder	Used to safely approach high rise area
7	Safety Belt	Protect during working in high rise area
8	Welding Shield	Protect eyes from light
9	Safety Shoes	Protect from slipping and electric contact
10	Ear Plugs/Muff	Protect from high noise
11	Air Breathing Apparatus	Used for proper breathing in irrespirable condition
12	Boiler operator/worker suits	Workers used in the shutdown period for boiler cleaning.

10.4 Post Clearance Monitoring Proposal

This is being a Category A Project, after grant of environmental clearance from the MOEFCC; the copy of the clearance will be made available to the public along with its conditions so that people are aware of the obligation of project proponent. This shall also be given in the local newspaper for the knowledge of public and stakeholders. The environmental clearance granted will also be placed in official website of the state government in concerned department. Copies of the environmental clearance will also be submitted to municipal bodies and other relevant department.

The half yearly compliance reports shall be submitted in hard and soft copies to the concerned State level departments on 1st June and 1st December of each calendar year with respect to EC conditions. All such compliance reports submitted will be the public documents. Copies of the same shall be made available to any person on request. The DPCC may incorporate EIA clearance conditions into consent and make sure that it is being followed and implemented by the project proponent to fulfil the statutory obligation and EC condition. In case, there is any deviation, it shall be brought to the notice.

10.5 Operational and Management Performance Monitoring

It is proposed that voluntary reporting of environmental performance with reference to the EMP should be undertaken. The overall responsibility of monitoring the above parameters shall lie with the management. The Environmental Monitoring cell shall be responsible for day to day monitoring of effluent, raw water and treated water quality. The ambient air

quality, stack emissions, soil, noise and water quality shall be monitored by third party at the site or its own laboratory. Records are maintained for the analysis of raw effluents and treated effluents, ambient air quality data, stack emissions monitoring results, noise levels, etc. as per the EC & CFE conditions.

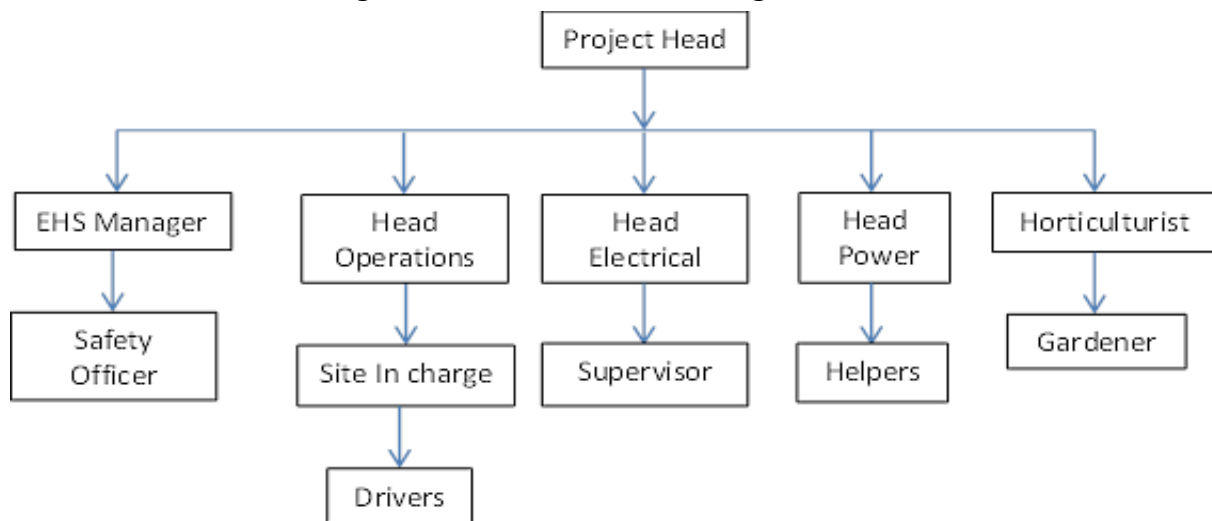
The environmental monitoring cell is coordinating all monitoring programs at site and data generated is regularly furnished to the State regulatory agencies. The frequency of reporting is half yearly/yearly basis to Pollution Control Board (PCB) and on half yearly basis to MOEFCC. The environmental audit reports shall be prepared for the entire year of operations and shall be regularly submitted to regulatory authorities. Environmental monitoring reports for all the attributes as stipulated in CFE in construction phase /CFO in operations phase will be submitted to State PCB periodically.

Operational and management team will be involved in checking that all data is properly documented and interpreted. This will also ensure that corrective actions are properly followed up and implemented. The documentation system (logbooks, internal/external communication documents etc.) and environmental register will be regularly checked and will be updated daily. Reporting system provides the necessary feedback for project management to ensure quality of the works and that the management plan is in implementation. The rationale for a reporting system is based on accountability to ensure that the measures proposed as part of the environmental management plan get implemented at the site. Important members of environmental management cell are given in **Table 10.4** and shown in **Figure 10.3**

Table 10.4: Members of Environmental Management Cell

S. No	Designation	Minimum Qualification	Minimum Experience (years)
1	Project Head	M.Tech/B.Tech	5
2	EHS Manager	M.Tech/M.Sc.	5
3	Safety Officer	B.Tech/Diploma	3
4	Site in charge	M.Tech/ B.Tech	3
5	Supervisor	B.Tech	3
6	Head Operations	ITI/Diploma	3
7	Head Electrical	ITI/Diploma	3
8	Head Power	ITI/Diploma	3
9	Horticulturist	Graduate - Science	3
10	Driver	10 th /Inter	1
11	Gardener	Trained	1
12	Helpers	10 th / Inter	1

Figure 10.3: Environment Management Cell



10.6 Environmental Monitoring Budget

There are several other environmental aspects that have been addressed as a part of good engineering control and practice. In order to comply with the environmental protection measures as suggested in the above sections, the project management has made budgetary provision for environmental protection and safety measures. In addition to environmental monitoring plan budget of the existing unit, additional amount is proposed for expansion. The budget details for various environmental monitoring budget of existing 24 MW WTE plant is given in **Table 10.5**. Budget for implementation of EMP for proposed 36 MW WTE expansion during construction and operation phases are given in **Table 10.6** and **Table 10.7**.

Table 10.5: Environmental Management Budget of Existing 24 MW WTE plant

S. No	Particulars	Capital Cost (Rs. Crores)	Recurring Cost (Rs. Lakhs/Annum)
Existing Budget (IMSWMP Facility)			
1	Air pollution control systems Bag filter/ESP, scrubber etc.	10.0	12
2	Ambient air quality monitoring, laboratory equipment's, stack monitoring, etc.	3.0	
3	LT collection system, holding tank, STP, etc.	10.0	
4	Gas collection, management, etc.	2.5	
5	Noise control measures – acoustic enclosures for DG set, noise barriers for pumps, boiler, etc.	1.5	
6	Greenbelt development	1.0	
7	Rainwater harvesting, storm water drains,	2.0	
8	Lakes remediation, soil remediation, etc	4.0	
	Total	34	12

Table 10.6: Environmental Management Budget for Proposed Expansion 36 MW WTE plant- Construction Phase

S. No.	Particulars	Capital Cost (Rs. Lakhs)	Recurring Cost (Rs. Lakhs/Annum)
1	Water sprinkling for dust suppression (during construction phase only)	10	12.6
2	Barrication (with 3-meter-high GI sheets) around the perimeter of the site	15	
3	Provision of green net for the area under construction for dust suppression	8	
4	Temporary toilets and provision for mobile STP (only during construction)	6	
5	Top soil conservation measures	3	
6	Health and safety measures including PPE for workers etc.	13	
7	Environmental monitoring by approved third party agencies	15	
8	Miscellaneous	5	
	Total	63	12.6

Table 10.7: Environmental Management Budget for Proposed Expansion 36 MW WTE - Operation Phase

S. No	Particulars	Capital Cost (Rs. Crores)	Recurring Cost (Rs. Lakhs/Annum)
1	Air pollution control systems Flue Gas Cleaning System, Stacks, etc.	45.0	20.5
2	Leachate & Waste water treatment plant	15.0	
3	Ash handling system	45.0	
4	Greenbelt Development	0.1	
5	Fire Fighting and Protection System	4.0	
6	Online monitoring system	5.0	
7	Noise control management	7.0	
8	Odour control management	9.0	
9	Miscellaneous (CER/CSR, etc)	4.4	
	Total	134.5	20.5
Capital cost of the proposed expansion project is Rs 900.1 Crores			

10.7 Status of Compliance Earlier EC Condition

Environmental clearance for existing WTE power plant of Min 36 MW having MSW processing capacity up to 3000 TPD waste secured on 8th May, 2012. As per MOEFCC Office Circular No. J-11011/618/2010-IA (II) (I) dated 30/05/2012; certified copy of Compliance from Regional Office of MOEFCC was secured and copy of the same is enclosed as **Annexure 7**.

CHAPTER 11

SUMMARY & CONCLUSIONS

Chapter 11

Summary and Conclusion

11.1 Introduction

M/s. Delhi MSW Solutions Ltd. (DMSWSL) has developed an existing 24 MW RDF based Power Plant within the integrated MSW Management Facility (IMSWMF) at the site notified by Municipal Corporation of Delhi (MCD) for which EC was obtained from MOEFCC with 4000 TPD capacity with minimum 36 MW WTE capacity of 3000 TPD wide EC vide no. F. No.-67/2009-IA.III dt. 8th May 2012.

The plant was installed and is operating successfully after obtaining CFE and CFO from Delhi Pollution Control Committee (DPCC) vide letter No. DPCC/PLG/2016/36691 dated 10th Mar 2016 and vide letter no. DPCC/PLG/2017/39391 dated 20th Feb 2017. Now DMSWSL has proposed to expand the capacity of WTE plant from 24 MW to 60 MW in the same premises. The existing IMSWMF has a processing capacity of 4000 TPD.

11.2 Details of project capacity

M/s. Delhi MSW Solutions Ltd. (DMSWSL) has developed the Integrated MSW Management Facility (IMSWMF) at the identified site by Municipal Corporation Delhi (MCD). DMSWSL initially established IMSWMF with the capacity of 4000 TPD and standalone WTE plant of 24 MW with 1200 TPD of RDF as fuel was developed. Now DMSWSL has proposed to utilize the leftover 1800 TPD of RDF by installing another 36 MW WTE Power plant cumulatively 60 MW. The proposed expansion of waste to energy power plant will be located within the existing facility of IMSWMF at Pocket N-1 Sector 5, Bawana Industrial Area, Tehsil Narela, District North West Delhi, Delhi.

11.3 Details of land area breakup

Total plot area of IMSWMF is 100 Acre (40.46 Ha) out of which land (built up area) demarcated for WTE is 17.24 Acre (6.97 Ha). Existing WTE power plant was developed on 8.62 Acre (3.48 Ha) area and total 8.62 Acre (3.48 Ha) is allotted for proposed expansion of WTE plant.

11.4 Water requirement

Total water requirement for existing project is 313 KLD and for the proposed expansion project it is 337 KLD. The same will be sourced from Delhi Jal Board and Industrial Waste Water of adjacent Pragati Power Plant. The wastewater as liquid waste of 105 KLD will be generated which includes cooling tower blow down, boiler blow down and DM regeneration and Leachate. The generated leachate (100 KLD) will be treated in an advanced MVR

technology based LTP. Blow down water from ancillary cooling tower, boiler blow down and WTP Rejects will be collected neutralization tank and neutralized by adding neutralized agents then utilized in the bottom ash quenching and in Air Pollution Control Devices. Thus, facility will achieve zero-liquid discharge (ZLD). Domestic water requirement is 15 KLD which is met by Municipal Water Supply. The domestic wastewater of 13 KLD will be treated in septic tank followed by soak pit /bio toilets.

11.5 Power and fuel requirement

The total power required for operations is approximately 5.4 MW and the same is met from existing WTE Plant of 24 MW capacity. Once the expansion power plant will be fully operational the power requirement will be met from the same plant and excess will be interconnected to sub-station of state grid.

11.6 Required manpower

Total manpower requirement of both existing and proposed WTE site is 475. Total 215 workers are appointed for existing WTE plant and additional 260 workers and technical staff will be required for expansion unit. Most of workers have appointed locally in the existing project. For expansion project also; preference will be given to the local population.

11.7 Baseline environmental status

The baseline data for the project was earlier collected from Sep 2019 to December 2019. Additional baseline data for the proposed expansion project was collected during 23rd Sep 2022 to 22nd Oct 2022. The data is collected with respect to meteorological conditions, air pollution levels, noise levels, water quality, soil quality, land use and socio-economic conditions during the study period. Summary of baseline is tabulated below:

11.7.1 Air quality

The ambient air quality was monitored at 10 locations. The minimum and maximum 98th percentile values of pollutants are shown in **Table 1**.

Table 11.1: Results of ambient air quality ($\mu\text{g}/\text{m}^3$)

Details	PM ₁₀	PM _{2.5}	SO ₂	NO _x	O ₃	CO	NH ₃	C ₆ H ₆
Minimum In 98 th Percentile	84.5	56.5	20.4	29.3	26.5	860	29.3	0.50
Maximum In 98 th Percentile	212	132	28.1	38.1	40.3	1482	47.2	0.95
NAAQ Standards 2009	100	60	80	80	100 (8 hourly)	2000 (8 hourly)	400	5 (Annual)

11.7.2 Ground and surface water quality

Water samples in the study area were collected from 10 ground water and 4 surface water sources respectively. The samples were analyzed for various physical and chemical characteristics, the results of which are given in **Table 2** and **Table 3** respectively.

Table 11.2: Results of ground water analysis

Parameters	Units	Minimum	Maximum	Drinking water Standards IS: 10500:2012	
				Acceptable	Permissible
pH	-	7.4	8.4	6.5-8.5	No Relaxation
TDS	mg/l	680	2373	500	2000
Chlorides	mg/l	98.3	685	250	1000
Hardness	mg/l	198	886	200	600
Fluorides	mg/l	1.13	1.79	1.0	1.5

Table 11.3: Results of surface water analysis

Parameters	Units	Min	Max	CPCB water quality criteria as updated on 11 th September, 2017				
				A	B	C	D	E
pH	-	7.4	8.5	6.5-8.5		6-9	6.5-8.5	6-8.5
EC	μS/cm	486	1912	-	-	-	-	2250
DO	mg/l	1.5	4.8	6	5	4	4	-
BOD	mg/l	<4	70	2	3	3	-	-
Total coliform	MPN/100ml	920	1600	50	500	5000	-	-

11.7.3 Noise quality

Baseline noise levels have been monitored at 9 locations within the study zone, using a continuous noise measurement device. The day equivalents during the study period ranged between 53.9 to 68.2 dB (A) whereas the night equivalents were in the range 43.9 to 54.6 dB (A). It was observed that the night equivalents were within the AAQ standards in respect of Noise SO 123 (E) dt 14th Feb 2000 for Residential and Commercial area. However, the day equivalents are above the specified standards in some locations.

11.7.4 Traffic study

The traffic survey was carried out on the major district road (MDR) near the project site during site visit (Oct 2022) of the baseline study period. From MDR, we observed that the highest peak was 2171 PCU/hr during 09 to 10 am. It was observed that the existing Level of Service (LOS) is good on both MDR and site access road. The traffic study was compared with previous baseline locations at MDR. Comparing from 2019 to 2022 the traffic volume at MDR was increased from peak hours 1672 to 2171 PCU's per hour due to ongoing urbanization and increase in population. The LOS during 2019 and as well as during 2022 are in "good" (C) performance.

11.7.5 Soil quality

To determine the impact of proposed activity on soil and agricultural productivity soil samples were collected from 9 locations. The results of important parameters are summarized in **Table 4**.

Table 11.4: Soil quality in the study area

Parameters	Minimum	Maximum	Standard Soil Classification – (Indian Council of Agricultural Research, New Delhi)
pH	7.7	8.3	Acidic<6.0, Normal to Saline 6.0-8.5, Tending to become Alkaline 8.6 to 9.0, Alkaline above 9.
EC (μS/cm)	133	537	Normal<1000, Critical for germination 1000-2000, Critical for growing 2000 - 4000, Injurious to most crops>4000
Organic carbon (%)	0.26	1.50	Low < 0.5, Medium 0.5 – 0.75, High > 0.75
Nitrogen (kg/Ha)	107	196	Low below 280, Medium 280-560, High above 560
Phosphorous (kg/Ha)	13	20	Low below 10, Medium 10-25, High above 25
Potassium (kg/Ha)	102	399	Low below 110, Medium 110-280 High above 280

11.7.6 Ecology & Biodiversity

There is no National Parks / Wildlife Sanctuary / Forests / Tiger reserve / Wetlands / Biosphere Reserve/ Tiger Reserves and Elephant corridor etc. present within 10 km radius from project site. The reserve forests (RF) include Bawana RF at 1.5 km (N), Shri Krishna Sultanpur RF at 5.0 km (SW) and Marmurpur PF located 7 km (NE) identified in the study area. There is no forest land present within the project site. No any kind of forest diversion is involved in the project.

There are no perennial water bodies such as rivers and reservoirs, pools, ponds, drains, and canals. Village water tanks and paddy fields are the common aquatic and semi aquatic ecosystems found in the proposed project area.

11.7.7 Socioeconomic Study

The study area comprises Narela Tehsil of North West Delhi (NCT Delhi) covering majority of the study area and a part of Sonipat Tehsil of Haryana, consisting of 6,74,439 and 44,184 population as per Census of India, respectively. Output of the study is given below:

- Men and women in Narela Tehsil of North West Delhi (NCT Delhi) constitute about 54.2% and 45.8% in the study area respectively. Whereas, the gender diversity, as percentage of men and women in the parts of Sonipat Tehsil of Haryana accounted to be about 54.9% and 45.1% respectively.

- Average family size in the study area is 5 persons per household.
- Male and female constitute 54.2% and 45.8% respectively and number of females per 1000 males is low at 846.
- Average density of population of the study area is 272 persons per km².
- The Socio-Economic study observed that 20.7% of total population in the study area which includes Narela Tehsil of North West Delhi (NCT Delhi) belongs to Scheduled Caste (SC) category. Whereas, a part of Sonipat Tehsil which is coming within the study area evidences 20.9% of total population belongs to Scheduled Caste category.
- The analysis of the literacy levels in selected villages of Narela Tehsil of North West Delhi (NCT Delhi) reveals an average literacy rate of 69.5% as per available census data. However, the male literacy rate of the study area is 58.7%, whereas the literacy rate among women is estimated to be as low as 41%. Literacy levels in selected villages of Sonipat Tehsil of Haryana indicate an average rate of about 69.4% as per census 2011 data. The male literacy rate of the selected villages is 60%, and the literacy rate among women is estimated to be around 40%.
- Well-developed medical and health care center, which includes both private and government facilities, are available in the study area.

Study area accounted for 29 % of the main working class of the total population. Whereas, marginal workers and non-workers constitute 2% and 69% of the total population, respectively. However, the selected villages of Sonipat Tehsil within a 5-10km radius have 28% of the total population's main workers, followed by marginal workers and non-workers, who account for 6% and 65% of the total population, respectively.

11.8 Anticipated impacts

The impacts due to project on the environment are classified into two phases and the possible impacts are assessed.

- During Construction phase
- During Operation phase

The impact of the above activities would be temporary and will be confined within the project boundary.

11.8.1 Impacts during construction phase

Construction phase works include site clearance, site formation, building works, infrastructure provision and other infrastructure activities. However, this project is expansion of existing WTE plant, the impact during construction phase is not much envisaged.

11.8.2 Impacts during operation phase

11.8.2.1. Impact on air quality

The proposed project is expansion of existing waste to energy power plant and the major source of pollution would be the emissions from the stack. The main raw materials required for the project is Refused Derived Fuel (RDF) for producing the energy by combustion/incineration. The important air pollutants generated from the power plant are particulate matter (PM), sulfur di-oxide (SO₂), oxides of nitrogen (NO_x), dioxins and furans (PCDDs & PCDFs). High Speed Diesel (HSD) is used for DG set and Light Diesel Oil (LDO) is used only for power plant start-up activity, heat transfer furnace. The major air pollutants generated from the proposed operation are:

- Dust particulates in flue gas from chimney
- SO₂, NO_x, dioxins and furans in flue gas
- Fly ash dust particles from ash silos and ash disposal areas

To estimate the ground level concentration of air pollutants released from 60 m height of the stack provided for the power plant, a study state dispersion model based on Gaussian Plume (AERMOD Version 7.0.3) software is used to calculate the concentrations for PM, SO₂ and NO_x.

The proposed mitigation measures

- Bag filter with an efficiency of more than 99% to limit PM in outlet to less 30 mg/Nm³.
- To minimize the SO₂ and NO_x emissions a semidry flue gas cleaning system consist of spray reactor with lime slurry and activated carbon is used.
- The chimney is selected considering sulphur dioxide emissions and to meet central pollution control board norms. The height of chimney has been selected as 65 m for the power plant.
- To control NO_x emission from the power plant boiler over fire air system and low NO_x burners is used.
- Semi dry type gas cleaning system is envisaged for this plant. The acid gas emissions are controlled by dozing lime slurry into the gas steam.
- The furnace and the flue gas residence time (minimum 2 seconds with a minimum flue gas temperature of 950°C) in the furnace are designed such that, the dioxins and furans (PCDDs & PCDFs) emissions are mitigated.
- The flue gas is further treated with activated carbon which ensures the PCDDs & PCDFs are limited to less than 0.1 ng/TEQ/Nm³ of flue gas.
- Semi-dry type gas cleaning system with lime dozing is envisaged for reduction of acid gases and activated carbon injection is envisaged for reducing the dioxins/ furans and heavy metal emissions.
- The RDF storage has been envisaged in a completely closed shed in the tipping /

storage area. This measure will reduce the dust nuisance in the power plant area. Also the forced draught fan takes suction from the storage pit there by maintaining slightly negative pressure in the RDF storage pit. This will eliminate odour in the RDF storage pit area.

- As RDF will be stored in a covered shed, no bird menace is envisaged. Arrangement will be made for suitable spray on the RDF to overcome the nuisance of bird menace, mosquito and fly nuisance and odour.
- Internal roads are concreted / asphalted to reduce fugitive emissions
- Greenbelt will be provided around the power plant, along the internal roads and along the plant boundary and wherever required.

11.8.2.2. Impact on water quality and Management

Total water requirement for existing project is 313 KLD. Total water requirement for the proposed expansion project is 337 KLD. The same will be sourced from Delhi Jal Board and recycled Industrial Waste Water of adjacent Pragati Power Plant. The wastewater as liquid waste of 105 KLD will be generated which includes cooling tower blow down, boiler blow down and DM regeneration and Leachate. The generated leachate (100 KLD) will be treated in the existing LTP, blow down water from ancillary cooling tower, boiler blow down and WTP Rejects will be collected neutralization tank and neutralised by adding neutralized agents then utilized in the bottom ash quenching and in Air Pollution Control Devices. Thus, facility will achieve the zero-liquid discharge (ZLD). Domestic water requirement is 15 KLD which is met by Municipal Water Supply. The domestic wastewater of 13 KLD will be treated in septic tank followed by soak pit / bio toilets

11.8.2.3. Impact on noise levels

Any activity in general, consists of several sources of noise pollution. The different sources of noise pollution are mentioned below:

- Boiler feed pumps
- Turbo generators
- Cooling towers
- Diesel generators
- Frequent vehicular movement

The proposed mitigation measures are

- Noise level specification of various equipment as per the Occupational Safety and Health Association (OSHA) standards.
- Providing suitable enclosures (adequate insulation) to minimize the impact of high noise generating sources.
- Employees will be provided with PPE like ear plugs, helmets, safety shoes etc.
- Development of greenbelt all along the boundary and along the roads within the project site.

11.9. Environmental monitoring plan

The main spirit of environmental monitoring plan is aimed such that there is not much of time lag between commencements of damage to environment mitigation measures to various environmental parameters that are being affected. Environmental monitoring program has been prepared for assessing the efficiency of implementation of Environment Management Plan and details of the same are given in **Table 5**.

Table 11.5: Environmental monitoring plan during operational phase

S. No	Potential Impact	Detailed actions to be followed as per EMP	Parameters/Points to be monitored	Frequency of Monitoring
1.	Air Emissions	Stack emissions from boiler	Stack emissions from boiler for PM ₁₀ , HCl, SO ₂ , NO _x , CO, TOC, HF, Total dioxins & furans, Cd+Th+ their compounds, Hg & its compounds, heavy metals (Sb+As+Pb+Cr+Co+Cu +Mn+Ni+V+ their compounds),	As per CFE conditions/Emission standards as per SWM rules 2016 / once in month for regular parameters.
		DG sets, etc.	DG sets for PM, SO ₂ & NO _x	As per MOEFCC/CPCB guidelines once in a Month.
		AAQ shall be monitored within the project premises and nearby habitations (minimum 3 places). All vehicles shall have Pollution Under Control (PUC) certificate.	PM, SO ₂ , NO _x VOC etc.) Vehicle logbooks shall be maintained. Greenbelt will be developed for minimizing dust propagation	
		Meteorological data	Wind speed, direction, temperature, relative humidity and rainfall.	As per CFE condition
2.	Noise	Noise generated during operation of boiler, cooling towers, DG sets etc. shall be	Spot Noise Level will be recorded and shall meet the limits set by relevant legislation	Periodic during operation phase. As per CFE condition

Expansion of Waste to Energy Plant from 24 MW to 60 MW by M/s Delhi MSW Solutions Ltd. (DMSWSL) at Tehsil Narela, District North West, Delhi

		monitored		
3.	Wastewater Discharge	Wastewater must be treated and must Comply to wastewater discharge standards and achieve zero liquid discharge.	pH, TSS, TDS, BOD, COD, Oil & Grease and other parameters as mentioned in the CFE	Daily at regular intervals and Once in a month by third party
4.	Solid waste/ Haz. waste	During operational phase, waste should be handled according to the waste management plan as per Hazardous and other waste (Management and Transboundary Movement) Rules, 2016 its amendments till date. Solid waste should handle as per SWM rules, 2016	Logbook shall be maintained to record the amounts of wastes generated, transportation routes and final reuse/disposal. Solid and Hazardous waste quantities and destination (final disposal) will be documented and kept to ensure proper handling and disposal.	Periodically and as per CFE condition
5.	Ground Water Quality and Water Levels	Ground water quality and ground water levels must be monitored. Ground water monitoring during operation phase shall form part of the continuous QA/QC procedures for the plant subject to ongoing inspection.	Comprehensive monitoring of ground water quality and ground water levels as per IS 10500-2012 (important major, minor ions, heavy metals)	Periodically or once in a year
6.	Flora and fauna	Vegetation, Greenbelt/ Green cover development	Number and type of plant species will be recorded	Once a year
7.	Soil quality	Checking & Maintenance of good soil quality around	Soil quality will be analysed for Physico-chemical parameters and presence of	Every quarter

			metals.	
8.	Health Conditions Accidents	A baseline health check-up of all employees and migrant labour shall be carried out. The Emergency Response Plan will be monitored and tested frequently to ensure its effective in the event of an emergency.	Follow-up medical Check-up shall be carried out and results must be documented. Safety records and monitoring of plant safety rules.	Regular check-up as per factories act.

11.10 Risk analysis

The principal objective of the risk assessment study is to identify and quantify the major hazards and the risk associated with various operations of the project, which may lead to emergency consequences (disasters) affecting the public safety and health. All necessary measures to minimize the risk due to the project are taken viz, Fire & safety control measures, Emergency preparedness plan, Disaster Management plan, etc.

11.11 Project benefits

The contribution of the power plant on local social infrastructure is expected to be significant. The proposed expansion of power plant will stimulate the growth of industrial and commercial activities in and around the district, by improving the availability of the power. This project will provide a significant amount of direct and indirect employment opportunities to the local people with different skills and trades.

The physical infrastructure and socio-economic status of the surrounding areas will be benefited as follows:

- Road transport facilities which improve accessibility
- Improvement in education, housing, and banking facilities
- Improvement in postal & communication services
- Recreation facilities
- Improvement in power supply, water supply and sanitation
- Improvement in economic conditions
- Proper training to the local people will be given to improve the employment potential within the plant
- Increase in revenue to the state in the form of taxes and duties from the development of local businesses
- Local markets with food and non-food commodities will be improved due to the increase inflow of human residents within the district.
- Waste to Energy facilities provide a safe, technologically advanced means of waste

- disposal that reduces greenhouse gases, generates clean energy and recycles metal.
- Waste to Energy facilities will save space and conserve foot print of SLF.
 - In terms of CO₂ emissions, waste to energy saves one ton of CO₂ per ton of waste, when compared to landfills that do recover their landfill gases, it saves about half a ton of CO₂ per ton of waste.

11.12 Cost estimate of the project

The Environmental Management Plan (EMP) is required to ensure a sustainable development of the plant area and the surrounding areas of the plant. The EMP will be integrated in all the major activities of the project, with clearly defined policies, to ensure that the ecological balance of the area is maintained and the adverse effects are minimized. EMP requires multidisciplinary approach with mitigation, management, monitoring and institutional measures to be taken during implementation and operation, to eliminate adverse environmental impacts or reduce them to acceptable levels. In order to ensure sustainable development in the study area, it needs to be an all-encompassing plan for which the plant authorities, government, regulating agencies, and the population of the study area need to extend their cooperation and contribution.

The mitigation measures are planned for construction and operation phases and the overall management plan helps to improve the supportive capacity of the receiving bodies. The EMP aims to control pollution at the source level to the possible extent with the available and affordable technology followed by the standard treatments before getting discharged. The recommended mitigation measures will synchronize the economic development of the study area with the environmental protection of the region.

The budget proposed for implementation of EMP measures in operation phase is Rs. 134.5 Crores is capital cost and Rs. 20.5 crores /annum is recurring cost.

11.13. Conclusions

The municipal solid waste generation is increasing day by day with the increase in the urban population and thereby causing the need for sustainable management or disposal of the generated solid waste. The waste to energy power plant is now a better option for solid waste management as there is a shortage of land area for scientific landfill and also the demand for electricity has been steadily increasing. Expansion of power plant in this area will benefit the society by providing better infrastructural, educational and medical facilities in the area also improvement in indirect employment and economic growth of the area. The project provides job opportunities to around 260 persons will get direct employment and around 150 people will get indirect employment.

CHAPTER 12

DISCLOSURE OF CONSULTANT

Chapter 12

Disclosure of consultants engaged

12.1 Accredited consultant organization

The consultancy group, Re Sustainability Solutions Private Limited (RSSPL) (formerly known as Ramky Enviro Services Private Limited) has a strength of around 40 scientific and technical persons with a background in Civil, Chemical & Mechanical engineering as well as Environmental Science & Energy Management experts including Microbiology & Biotechnology experts. The field sample analysis is carried out in the laboratory of Hyderabad Waste Management Project (HWMP), a subsidiary company under Re Sustainability Limited, which is a NABL accredited laboratory and as well as recognized as Environmental Laboratory by MOEFCC under the Environment (Protection) Act 1986.

RSSPL is accredited with 12 sectors under QCI-NABET Scheme with all 12 FAEs are available as in-house/ empaneled experts and self-sufficient in handling EIA /EMP projects. RSSPL consultancy group also provides training and course work for obtaining M.Sc. / M. Tech project works for students under various institutions and universities. The consultancy group also collaborates with research institutions and reputed educational institutions for carrying out Research & Development activities. The group is also empaneled with reputed government organizations like TSPCB, HPCL, OSPCB, TSIIC, APIIC, EPCO & NTPC. The services offered by the RSSPL are mentioned below.

12.2 Consultancy services

- Facilitating environmental clearances from MOEFCC, New Delhi and SEAC/SEIAA from different states.
- Obtaining consent for establishment and consent for operation from State Pollution Control Boards for industries.
- Preparing of environmental impact assessment & environmental management plan reports.
- Environmental audits to help industries to recycle and reuse resources and plan for low polluting technologies.
- Risk assessment studies for hazardous chemical storage & processes in order to prepare onsite and offsite disaster and emergency plans.
- Identification and evaluation of hazardous waste disposal sites.
- Environmental management systems standards.
- Characterization and quantification of biomedical waste, municipal solid waste and design of treatment and disposal facilities.
- Effluent treatment plant & sewage treatment plant designs.

- Post project monitoring network design
- Consultancy services for setting up environmental laboratories
- Design of waste treatment plants
- Health and socio- economic surveys
- Resettlement and rehabilitation plans

12.3 Laboratory services

- Analysis of air samples for ambient air quality and from industrial sources for both routine and industry specific pollutants
- Water and waste water analysis for all parameters as per standard methods, including pesticides and poly hydro carbons
- Solid and hazardous waste analysis including TCPL tests
- Monitoring of noise levels at source and in ambient air
- Development of new methods and quality assurances of results obtained
- Design and settings of analytical laboratories

12.4 Training services

- Monitoring of environmental parameters –air, water, noise, soil etc.
- Environmental impact assessment and environmental management plans
- Effluent treatment plant operations and maintenance
- Sewage treatment plant operations and maintenance
- ISO 9001: 2015 awareness, documentations, internal auditors
- Establishment environmental laboratories
- Pollution control in industries

12.5 Field services

- Site selection and suitability studies for setting up of Industries
- Ambient air quality monitoring for all gaseous pollutants
- Noise level monitoring & traffic management studies
- Meteorological data collection as per CPCB norms
- Stack emission monitoring for all pollutants and assessment of efficiency of control equipment
- Water, wastewater and soil sample collection
- Assessment of efficiency of CETP and analysing critical parameters.
- Flora and fauna assessment through sectorial studies and damage assessment due to development projects
- Damage assessment studies in case of oil well blowouts, major industrial accidents

12.6 Solid waste management services

RSSPL also prepares PFR/DPRs based on the field/engineering data for the following:

- Hazardous waste management Facility
- Municipal solid waste management Facility
- Biomedical solid waste Treatment Facility
- E-waste management & recycling waste

12.7 List of accreditations

- International Organization for Standardization (ISO) 9001:2015 from TUV SUD South Asia Private Limited
- National Accreditation Board for Education and Training (NABET) from Quality Council of India (QCI) for Environmental Consultants
- National Accreditation Board for Testing and Calibration Laboratories (NABL) from Quality Council of India (QCI) for Environmental Laboratory.
- Ministry of Environment, Forest and Climate Change (MOEFCC) for Environmental Laboratory.