



IREL (India) Limited

(A Govt. of India Undertaking – Department of Atomic Energy)

Manavalakurichi, Kanniyakumari District, Tamil Nadu

Mining of Atomic Minerals (Monazite, Zircon, Ilmenite, Rutile, Sillimanite and Garnet) over an Extent of 1144.0618 Ha @ 1.50 MTPA ROM in Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode-A & B Villages of Killiyoor Taluk, Kanniyakumari District, Tamil Nadu

Environmental Clearance under EIA Notification, 2006 & CRZ Notification, 2011

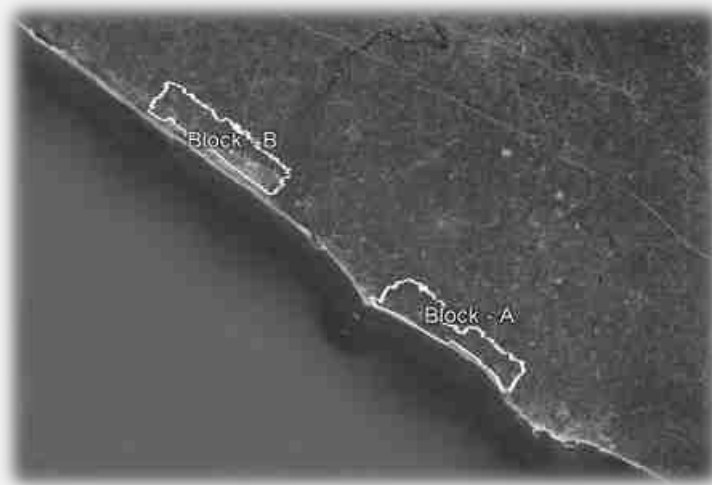
SI. No. 1(a) - Category 'A' of EIA Notification, 2006 (NDS Project)

Permissible Activities under Para 3 Clause (x) (a) and Para 4 Clause (ii)(g) of CRZ Notification, 2011

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

ToR awarded by MoEF&CC vide F. No. IA-Z-11013/10/2023-IA-I dated 22nd February 2023

Baseline Period: December 2022 to February 2023 – Winter Season 2022 - 23



July 2024

EIA Consultant



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QCI/NABET Accreditation vide NABET/EIA/2225/RA0290 dated 11.06.2023 with Validity till 16.11.2025

SI. No. 4 of List dated 15.07.2024



Table of Contents

Project Proponent Declaration	9
EIA Consultant Undertaking	10
Certificate of Plagiarism Check	11
Disclosure of Experts	12
Awarded Terms of Reference	14
Compliance to awarded Terms of Reference	30
1.0 Introduction	62
1.1 Purpose of the Report.....	62
1.2 Project Proponent.....	65
1.3 Existing Mining Leases.....	66
1.4 Need for the Project.....	66
1.5 Statutory Approvals.....	67
1.6 Mining Lease Area.....	68
1.7 Area in CRZ.....	80
1.8 Mining Lease Area Surface Right.....	80
1.9 Environmental Setting.....	83
1.10 Mining Profile.....	86
1.11 Project Cost.....	87
1.12 EIA Study.....	87
2.0 Project Description	89
2.1 Type of Project.....	89
2.2 Technology & Magnitude of Operation.....	89
2.3 Project Description.....	91
2.3.1 Geology.....	91
2.3.2 Exploration.....	92
2.3.3 Reserves & Resources.....	93
2.3.4 Heavy Minerals & their Uses.....	98
2.4 Proposed Mining.....	97
2.5 Yearwise Development & Production Plan.....	101
2.6 Machineries.....	117
2.7 Competent Mining Personnel.....	117
2.8 Facilities in the Mining Lease.....	118
2.9 Progressive Mine Closure & Conceptual Plans (Land Use Pattern).....	118
2.10 Water Demand.....	119
2.11 Power & Fuel Demand.....	120
2.12 Occupational Health & Safety.....	120
2.12.1 Radiation Monitoring.....	120
3.0 Description of environment	121
3.1 Project Site and Study Area.....	121
3.2 Environmental Components and Methodology.....	124
3.3 Physiography.....	125
3.4 Drainage Pattern.....	125
3.5 CRZ Area.....	131
3.6 Seismicity.....	136
3.7 Regional Hydrogeology.....	136
3.7.1 Hydrogeology.....	137
3.8 Long term study of Land Use in study and surrounding area.....	137
3.8.1 Land Use in the Study area.....	138
3.9 Meteorology.....	144
3.9.1 Wind speed and direction.....	144



3.9.2	Temperature	145
3.9.3	Relative humidity	145
3.9.4	Rainfall	146
3.10	Baseline data generation/establishment of baseline for environmental components	147
3.10.1	Micro meteorology	148
3.10.2	Air Environment	150
3.10.3	Noise Environment	165
3.10.4	Water Environment	169
3.10.5	Soil Environment	201
3.10.6	Terrestrial Ecology	210
3.10.7	Marine Environment	254
3.11	Marine Ecology and Biodiversity	268
3.11.1	Introduction	268
3.11.2	Macrophytes	270
3.11.3	Primary productivity	270
3.11.4	Chlorophyll	271
3.11.5	Plankton	272
3.11.6	Benthos	276
3.11.7	Fish & Other Marine Community	278
3.11.8	Seaweeds and Sea Grasses	279
3.11.9	Mangroves	279
3.11.10	Corals	279
3.11.11	Marine protected area	279
3.11.12	Marine mammals	279
3.11.13	Endangered species	279
3.12	Traffic Scenario	279
3.13	Socio – Economic Study	282
3.13.1	Demographic pattern	283
3.13.2	Demographic pattern of district	283
3.14	Radioactivity – Background Status	288
4.0	Anticipated Environmental Impact and Mitigation Measures	301
4.1	Identification of Impacts	301
4.2	Construction Phase	301
4.3	Impact and Mitigation Measures During Operation Phase	301
4.3.1	Land Environment	301
4.3.2	Traffic Volume	302
4.3.3	Air Quality	304
4.3.4	Noise Levels	309
4.3.5	Water Environment	309
4.3.6	Biological Environment	310
4.3.7	Occupational Health and Safety	312
4.3.8	Soil & Agriculture	313
4.3.9	Socio Economics	313
5.0	Analysis of alternatives (Technology and site)	316
5.1	Technological alternatives	316
5.2	Site Options	316
6.0	Environmental Monitoring Programme	317
6.1	Environment Cell and Compliances	317
6.2	Post Project Monitoring	317
7.0	Additional Studies	318



7.1	Hazards Identification & Risk Assessment	318
7.2	Emergency Preparedness Plan	318
7.3	Disaster Management Plan	318
8.0	Project Benefits	328
9.0	Environmental Cost Benefits Analysis	329
10.0	Environmental Management Plan	330
10.1	EMP for Construction Phase	330
10.2	EMP for Operation Phase	330
10.2.1	Land Environment	330
10.2.2	Traffic Impact	330
10.2.3	Air Environment	330
10.2.4	Noise Levels	331
10.2.5	Water Environment	331
10.2.6	Biological Environment	331
10.2.7	Social Measures	331
10.2.8	Occupational Health Measures	331
10.2.9	Plastic Waste Management	331
10.3	EMP Budget	331
10.4	Environmental Policy of IREL	332
11.0	Summary Environmental Impact Assessment Report	337
11.1	Introduction	337
11.2	Project Proponent	337
11.3	Project Profile	338
11.4	Description of the Environment	343
11.4.1	Environmental Setting	343
11.5	Baseline Environmental Status	345
11.6	Anticipated Environmental Impacts	348
11.7	Environmental Monitoring Programme	355
11.8	Additional Studies	355
11.9	Project Benefits	355
11.10	Environmental Management Plan	356
12.0	Disclosure of consultant	359
12.1	Services of ABC Techno Labs India Pvt Ltd	359



List of Tables

Table 1.1 : Village wise extent of area of the proposed mine	68
Table 1.2 Area falling in CRZ	80
Table 1.3 The Latitude and Longitude of the Mining Lease Area – Villagewise	83
Table 2.1 Development & Production – Plan Period & Subsequent Periods	90
Table 2.2 Plan Period Production & Expected Mineral Production from ROM	90
Table 2.3 Geological Reserves / Resources Estimation	93
Table 2.4 Reserves / Resources Estimation - Categorywise	95
Table 2.5 Mineral Reserves and Resources as on 01.04.2023	98
Table 2.6 Bench Bark Locations in the Study Area	99
Table 2.7 Development & Production - Plan Period	117
Table 2.8 Villagewise land use breakup	118
Table 3.1 Environmental Sensitivity – 15 km radius	121
Table 3.2 Environmental components and methodologies	124
Table 3.4 Annual Temperature Data	145
Table 3.5 Relative Humidity	148
Table 3.6 Total Rainfall & Number of Rainy Days	147
Table 3.7 Summarized meteorological data for winter (2022-23)	149
Table 3.8 Wind Frequency Distribution at IREL during winter season, 2022-23	149
Table 3.9 Ambient Air Quality (AAQ) monitoring stations	150
Table 3.10 Methodology of sampling & analysis and equipment used	152
Table 3.11 National Ambient Air Quality standards	152
Table 3.12 Summarized Ambient Air Quality monitoring results (Winter 2022-23)	163
Table 3.13 Results of free silica in respirable dust ($\mu\text{g}/\text{m}^3$)	164
Table 3.14 Summarized results of metals	165
Table 3.15 Ambient noise monitoring stations	165
Table 3.16 Summarized results of noise monitoring	168
Table 3.17 MOEF&CC norms in respect of noise	168
Table 3.18 Surface water location	169
Table 3.19 Water quality criteria as per Central Pollution Control Board	181
Table 3.20 Results of surface water analysis	181
Table 3.21 Water sampling locations	188
Table 3.22 Results of groundwater analysis	198
Table 3.23 List of soil sampling locations	201
Table 3.24 Physical properties of soil	209
Table 3.25 Chemical properties of soil	209
Table 3.26 Available NPK contents in soil	209
Table 3.27 Exchangeable cations	210
Table 3.28 Available micro-nutrients in soil	210
Table 3.29 Details of locations for plot survey	219
Table 3.30 Floristic Diversity in the Core Area	220
Table 3.31 Phytosociological Analysis Of Tree Species	225
Table 3.32 Interpretation of Vegetation Results in the Core Area	229
Table 3.33 Interpretation of Vegetation results in the Core Area	229
Table 3.34 FLORISTIC DIVERSITY IN THE BUFFER AREA	230
Table 3.35 Phytosociological Analysis of Tree Species	238
Table 3.36 Interpretation of Vegetation Results in the Buffer Area	246
Table 3.37 Interpretation of Vegetation results in the Core Area	248
Table 3.38 Fauna Recorded from the Primary Survey in the Study Area and their Conservation Status	248

Table 3.39 Characterization of Fauna in The Study Area (As Per W.P Act, 1972, Last Updted 1-4-2023)	253
Table 3.40 Description of Flora and Fauna	253
Table 3.41 Bed sediment sampling locations	254
Table 3.42 Marine Sediment Quality Results	259
Table 3.43 Marine water sampling locations	260
Table 3.44 Results for marine water analysis	268
Table 3.45 Marine Sampling Locations	269
Table 3.46 Description of Macrophytes	270
Table 3.47 Primary productivity and chlorophyll concentration	271
Table 3.48 Chlorophyll Concentration	271
Table 3.49 Analysis Result of Phytoplankton	273
Table 3.50 Analysis Result of Zooplankton	274
Table 3.51 Plankton Biodiversity Indices results	276
Table 3.52 Sub tidal and inter tidal benthic population	277
Table 3.53 Fish and Marine Species reported	278
Table 3.54 Traffic Density near Nithiravilai (T1) during Study period	280
Table 3.55 Traffic Density near Midalam (T2) during study period	281
Table 3.56 Level of Service & Performance of a Road (IRC:64-1990 Norms)	282
Table 3.57 Predicted Traffic Scenario at the Junction	282
Table 3.58 Population within 5 km Radius	283
Table 3.59 Population within 10 km radius	284
Table 3.60 Ambient Outdoor External Dose Rate [Hp(10)], $\mu\text{Sv h}^{-1}$ at Block A	290
Table 3.61 Ambient Outdoor External Dose Rate [Hp(10)], $\mu\text{Sv h}^{-1}$ at Block B	291
Table 3.62 Ambient Outdoor External Dose Rate [Hp(10)], $\mu\text{Sv h}^{-1}$ – Buffer Zone	292
Table 3.63 Comparison of estimated external dose rate at mined and un-mined locations	292
Table 3.64 Ambient outdoor external dose rate at intertidal regions along western coast of Kanyakumari	293
Table 3.65 Long lived gross alpha air activity at Block A locations	295
Table 3.66 Long lived gross alpha air activity at Block B locations	295
Table 3.67 Estimation of Arsenic and Fluoride in ground water (mg l^{-1}) at Block-A	299
Table 3.68 Estimation of Arsenic and Fluoride in ground water (mg l^{-1}) at Block-B	299
Table 4.1 PM 2.5 – Input Data	305
Table 4.2 PM 2.5 – Output data	305
Table 4.3 PM 10 – Input data	306
Table 4.4 PM 10 – Output Data	306
Table 4.5 Predicted GLCs	306
Table 4.6 Source Noise Levels - Mine Machineries	309
Table 4.7 Green Belt Development	311
Table 4.8 CSR Activities in the Region by IREL	313
Table 6.1 Post Project Monitoring Schedule	317
Table 7.1 Potential Hazards due to Proposal	318
Table 7.2 Risk Matrix (R)	318
Table 10.1 EMP with Monitoring Matrix	334

List of Figures

Figure 1.1 Index Map	69
Figure 1.2 Site Photographs	79
Figure 1.4 HTL/LTL (CRZ Map) prepared by IRS, Anna University, Chennai	81
Figure 1.5 7km (CRZ Map) prepared by IRS, Anna University, Chennai	82
Figure 1.6 Topo Map covering 10km radius	84
Figure 2.1 Schematic Diagram of Method of Mining	98
Figure 2.2 Bench Bark Locations	99
Figure 2.3 Key Plan – Block A & Block B	102
Figure 2.4 Mine Lease Plan – Block A	103
Figure 2.5 Mine Lease Plan – Block B	104
Figure 2.6 Surface Plan – Block A	105
Figure 2.7 Surface Plan – Block B	106
Figure 2.8 Geological Plan – Block A	107
Figure 2.9 Geological Section – Block A	108
Figure 2.10 Geological Plan – Block B	109
Figure 2.11 Geological Sections – Block B	110
Figure 2.12 Progressive Plan – Block A	111
Figure 2.13 Progressive Plan – Block B	112
Figure 2.14 Environment Management Plan – Block A	113
Figure 2.15 Environment Management Plan – Block B	114
Figure 2.16 Environmental Plan – Block A	115
Figure 2.17 Environmental Plan – Block B	116
Figure 3.1 Study area of 15 km radius	123
Figure 3.2 Physiography	126
Figure 3.3 Contour Map – 2km radius	127
Figure 3.4 Drainage Pattern	129
Figure 3.5 Drainage Pattern – 2km radius	130
Figure 3.6 Approved CZMP Sheet No. 4	131
Figure 3.7 Approved CZMP Sheet No. 11	132
Figure 3.8 Approved CZMP Sheet No. 10	132
Figure 3.9 Shoreline Change of Kanniyakumari Coast	133
Figure 3.10 Shoreline Changes Map – Block A	134
Figure 3.11 Shoreline Changes Map – Block B	135
Figure 3.12 Satellite imagery – 15km radius	141
Figure 3.13 Land use/Land Cover Map	143
Figure 3.14 Historical windrose diagram	144
Figure 3.15 Average monthly min and max temperature	145
Figure 3.16 Relative humidity during daytime and night time (1970-2000)	146
Figure 3.17 Monthly total rainfall and rainy days	147
Figure 3.18 Windrose for Study period	148
Figure 3.19 Monitoring locations	151
Figure 3.20 Monitoring Locations	166
Figure 3.21 Sampling Locations	170
Figure 3.22 Sampling Locations	197
Figure 3.23 Sampling Locations	202
Figure 3.24 Forest Map of Tamil Nadu (Source: Forest Survey of India, 2008)	213
Figure 3.25 Map showing the Bio-geographic Provinces of India	216
Figure 3.26 Sampling Locations	255
Figure 3.27 Sampling Locations	267



Figure 3.28 10km radius of Settlements from the Project Site.....	288
Figure 4.1 Mineral Transportation through the Lease Area	303
Figure 4.2 Predicted GLCs – PM 2.5	307
Figure 4.3 Predicted GLCs – PM 10	308

List of Annexures

- Doc:1 – Letter of Intent (LoI) issued by Government of Tamil Nadu
- Doc:2 – Letter of Mining Plan Approved by AMD.
- Doc:3 – Baseline Monitoring Photographs
- Doc:4 – Hydrogeology : Ground Water Level Data.

Project Proponent Declaration

[in compliance with MoEF Office Memorandum No. J-11013/41/2006-IA.II (I) dated 04.08.2009]



आईआरईएल (इंडिया) लिमिटेड
IREL (India) Limited
 (Formerly Indian Rare Earths Limited)
 (भारत सरकार का उपक्रम)
 (A Govt. of India Undertaking)
 CIN: U18700SN195003008187 Website: www.irel.co.in
 ISO 9001:2015 ISO 14001:2015 & ISO 45001:2018 Company

Project Proponent Declaration

[in compliance with MoEFCC Office Memorandum No. J-11013/41/2006-IA II (I) dated 04.08.2009]

We, M/s. IREL (India) Limited (IREL), a Central Public Sector Enterprise (CPSE), proposes the Mining of Atomic Minerals (Monazite, Zircon, Ilmenite, Rutile, Sillimanite and Garnet) over an extent of 1144.0618 ha in Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode-A & B Villages of Killiyoor Taluk, Kanniyakumari District, Tamil Nadu. The Proposal requires prior EC under EIA Notification-2006 under Sl. No.1 (a)-Category 'A' as well as under CRZ Notification-2011, as amended. Accordingly, IREL submitted Application to the MoEFCC, New Delhi on 28.12.2022 to obtain the Terms of References (TORs). The Proposal was deliberated in 53rd Expert Appraisal Committee for Nuclear, Defense and other Strategic Projects – EAC (N&D) meeting held on 27th January 2023. TOR has been awarded vide F. No. IA-Z-11013/10/2023-IA-I dated 22.02.2023.

The EIA Consultant, M/s. ABC Techno Labs India Private Limited, Chennai has been accredited for various Sectors including Sector-1 (Mining Projects) for Category 'A' by the National Accreditation Board for Education & Training (NABET), Quality Council of India vide Certificate No.NABET/EIA/2225/RA0290 dated 11.06.2023 with validity till 16.11.2025 (Sl. No. 4 of QC/NABET List dated 22.02.2024).

The ABC Techno Labs India Private Limited Laboratory is accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) vide Certificate No. TC-5770 dated 03.04.2022 with validity till 02.04.2024. The Lab is also recognised by the Ministry of Environment, Forest and Climate Change (MoEF&CC) vide F. No. Q-15018/04/2019-CPW dated 14.10.2019 with validity of 5 years.

The Environmental Impact Assessment (EIA) Report and Summary Environmental Impact Assessment Reports have been prepared in compliance with the awarded TORs and as per the generic structure proposed in EIA Notification 2006 and submitted. The data submitted in the EIA Report are factually correct.



For IREL (India) Limited,

(Signature)
(N.Selvarajan) 04/03/24

Chief General Manager & Head
Authorized Signatory

Date: 04.03.2024

Place: Manavalakurichi

अणुआयुर्वेद, कन्नियकुमारी जिला, तमिलनाडु - 629 252

Manavalakurichi, Kanyakumari Dist. Tamil Nadu - 629 252

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EIA Consultant Undertaking

[in compliance with MoEF Office Memorandum No. J-11013/41/2006-IA.II (I) dated 04.08.2009]

M/s. IREL (India) Limited (IREL), a Central Public Sector Enterprise (CPSE), proposes the Mining of Atomic Minerals (Ilmenite, Rutile, Zircon, Monazite, Sillimanite and Garnet) over an extent of 1144.0618 ha in Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode-A & B Villages of Killiyoor Taluk, Kanniyakumari District, Tamil Nadu.

The Proposal requires prior EC under EIA Notification under Sl. No.1(a)-Category 'A' as well as under CRZ Notification 2011, as amended. Accordingly, IREL has filed the Application to MoEF&CC on 26.12.2022. The Proposal was deliberated in 53rd Expert Appraisal Committee (EAC) – Nuclear & Defense (ND) meeting held on 27th January 2023. TOR has been awarded vide F. No. IA-Z-11013/10/2023-IA-I dated 22.02.2023.

The EIA Consultant, M/s. ABC Techno Labs India Private Limited, Chennai has been accredited for various Sectors including Sector-1 (Mining Projects) for Category 'A' by the National Accreditation Board for Education & Training (NABET), Quality Council of India vide Certificate NABET/EIA/2225/RA0290 dated 11.06.2023 with Validity till 16.11.2025 (Sl. No. 4 of QCI/NABET List dated 05.06.2024). The ABC Techno Labs India Private Limited Laboratory is accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) vide Certificate No. TC-5770 dated 03.04.2022 with validity till 02.04.2024. The Lab is also recognized by the Ministry of Environment, Forest and Climate Change (MoEF&CC) vide Letter F. No. Q-15018/04/2019-CPW dated 14.10.2019 with validity of 5 years.

The Environmental Impact Assessment (EIA) Report and Summary Environmental Impact Assessment Reports have been prepared in compliance with the awarded TORs and as per the generic structure proposed in EIA Notification 2006 and submitted. The data submitted in the EIA Report are factually correct.

For ABC Techno Labs India Private Limited

Date : 02.03.2024

Place : Chennai



Authorized Signatory

Certificate of Plagiarism Check

Title of EIA Report	M/s. IREL (India) Limited (IREL), a Central Public Sector Enterprise (CPSE), proposed Mining of Atomic Minerals (Ilmenite, Rutile, Zircon, Monazite, Sillimanite and Garnet) over an extent of 1144.0618 ha in Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode-A & B Villages of Killiyoor Taluk, Kanniyakumari District, Tamil Nadu
Name of Accredited Organization	ABC Techno Labs India Private Limited, Chennai
Name of EIA Coordinator (EC)	K Sekar
Name of the Software	Plagiarism Software – Online Plagiarism Checker https://plagiarismchecker.co
Date of check	Completed on 07.09.2023

I hereby certify that this EIA report has been evaluated using online software Online Plagiarism Checker (<https://plagiarismchecker.co>). The report has been analysed by the system and based on it, I certify that the EIA Report produced in accordance with good scientific practice.

Signature of EIA Coordinator : 

Name: K. Sekar
Designation: EC
Date: 02.03.2024

Signature of Head of Accredited Organization : 

Name of the EIA Consultant Organization: ABC Techno Labs India Private Limited, Chennai
NABET Certificate No. & Issue Date: NABET/EIA/2225/RA0290 dated 11.06.2023 with Validity till 16.11.2025
Date: 02.03.2024

Disclosure of Experts

Details as per Schedule of EIA Notification 2006, as amended till date

Name of the Project EC for Mining of Atomic Minerals (Ilmenite, Rutile, Zircon, Monazite, Sillimanite and Garnet) over an extent of 1144.0618 ha in Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode-A & B Villages of Killiyoor Taluk, Kanniyakumari District, Tamil Nadu by M/s. IREL (India) Limited-EIA & CRZ Clearances.

Schedule as per EIA notification 2006 1 (a)

Category A

NABET Sector No. 1

DECLARATION:

Declaration by experts contributing to the Environmental Impact Assessment Report for Mining of Atomic Minerals (Ilmenite, Rutile, Zircon, Monazite, Sillimanite and Garnet) over an extent of 1144.0618 ha in Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode-A & B Villages of Killiyoor Taluk, Kanniyakumari District, Tamil Nadu by M/s. IREL (India) Limited.

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA/EMP.

EIA Coordinator Signature:

Name : K. Sekar

Signature 

Period of involvement : Sep. 2022 to till date

Contact information : abc@abctechnolab.com


Sl. No.	Functional Areas	Name of the Expert/s	Involvement (Period)	Signature & Date
1.	LU	Dr. N. Rama Krishnan	Sep. 2022 to till date	
2.	AP	Dr. Muthiah Mariappan	Sep. 2022 to till date	
3.	AQ	Mohammad Akhtar	Sep. 2022 to till date	
4.	WP	Abhik Saha	Sep. 2022 to till date	
5.	EB			
6.	SHW			
7.	NV	Haneesh K. R	Sep. 2022 to till date	
8.	SE	Dr. Sreenivasagam Geetha	Sep. 2022 to till date	
9.	HG	Dr.S. Veezhinathan	Sep. 2022 to till date	
10.	GEO			
11.	SC	Amitaben Rathod	Sep. 2022 to till date	
12.	RH	Vinod Kumar Gautam	Sep. 2022 to till date	



Declaration by the head of the Accredited Consultant Organization

I, Mr. G. Murugesh, hereby confirm that the above-mentioned experts prepared the EIA/EMP Report for Mining of Atomic Minerals (Ilmenite, Rutile, Zircon, Monazite, Sillimanite and Garnet) over an extent of 1144.0618 ha in Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode-A & B Villages of Killiyoor Taluk, Kanniyakumari District, Tamil Nadu by M/s. IREL (India) Limited.

I also confirm that ABC Techno Labs India Pvt. Ltd. shall be fully accountable for any misleading information mentioned in this statement.

Signature	:	
Name	:	Mr. G. Murugesh
Designation	:	Chairman & Managing Director
Name of the EIA Consultant Organization	:	ABC Techno Labs India Private Limited.
NABET Certificate No. & Issue Date	:	Certificate NABET/EIA/2225/RA0290 dated 11.06.2023 with Validity till 16.11.2025

Awarded Terms of Reference

Page | 1

SPEED POST

F. No. IA-Z-11013/10/2023-IA-I

Government of India
Ministry of Environment, Forest and Climate Change
(IA Division)

Indira Paryavaran Bhawan,
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Dated: 22nd February, 2023

To,

Sh. N Selvarajan
General Manager & Head
IREL (India) Limited
(A Government of India Undertaking -
Department of Atomic Energy)
Manavalakurichi – 629 252
Kanyakumari District, Tamilnadu
Telephone: 04651-237325, 237309
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Subject: Terms of Reference (ToR) for Mining of Atomic Minerals (Ilmenite, Rutile, Zircon, Monazite, Sillimanite and Garnet) over an extent of 1144.0618 ha in Kanniyakumari, Tamil Nadu by IREL (India) Limited-reg.

This has reference to your communication no. IREL/MK/Res/EC/205C/2022/5830 dated 26th December 2022 regarding the project proposal pertaining to above cited subject. The proposal was considered during the 53rd EAC (N&D) meeting held on 27th January 2023.

2. The above-mentioned project/activity is covered under category 'A' of item 1 (a) 'Mining of minerals' of the Schedule to the EIA Notification, 2006 as amended, and being strategic project requires appraisal at Central Level by EAC(N&D).

3. As part of the presentation and various other documents submitted to the Ministry, the proponent submitted following information about the project:

- i. **Project Description:** The Project is for mining and separation of Monazite (Uranium bearing mineral) which is radioactive and prescribed substance under the Atomic Energy Act, 1962 and other associated minerals i.e., Ilmenite, Rutile, Zircon, Sillimanite and Garnet from the Beach Sand Mineral (BSM) deposit.



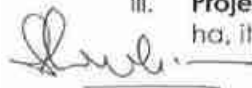
Terms of Reference (ToR) for Mining of Atomic Minerals (Ilmenite, Rutile, Zircon, Monazite, Sillimanite and Garnet) over an extent of 1144.0618 ha in Kanniyakumari, Tamil Nadu by IREL (India) Limited

- ii. **Project Location:** The Mine Lease (ML) area is spread over an area of 1144.0618 ha (Government Land - 79.8613 ha and Private Land - 1064.2005 ha) in Killiyoor Taluk, Kanniyakumari district of state Tamil Nadu. The mining lease area is as per the letter of intent dated 28.06.2022 received from Govt of Tamil Nadu. The project site bifurcated into two adjacent non-contiguous blocks. Block A includes 544.0688 ha (Keezhmidalam-A, Midalam-B and Enayamputhanthurai); Block B includes 599.99.30 ha (Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B). Village wise details of the Mining lease area is as follows:

Sl. No	VILLAGES	LATITUDE	LONGITUDE
1	Keezhmidalam-A	08°11'19.78" to 08°12'37.53" N	77°13'01.76" to 77°14'08.82" E
2	Midalam-B	08°12'04.09" to 08°13'18.51" N	77°11'53.12" to 77°13'10.98" E
3	Enayamputhanthurai	08°12'44.61" to 08°13'33.12" N	77°11'13.13" to 77°12'15.36" E
4	Ezhudesam-A	08°15'17.31" to 08°15'49.46" N	77°09'12.69" to 77°09'34.63" E
5	Ezhudesam-B	08°16'31.24" to 08°17'03.15" N	77°07'45.99" to 77°08'48.20" E
6	Ezhudesam-C	08°15'17.31" to 08°16'31.24" N	77°07'45.22" to 77°09'12.69" E
7	Kollencode-A	08°17'10.98" to 08°17'32.23" N	77°07'07.45" to 77°07'33.66" E
8	Kollencode-B	08°16'24.86" to 08°17'19.44" N	77°06'50.15" to 77°07'56.20" E

SL. NO	VILLAGES	TOTAL EXTENT (HA)	PATTA LAND (HA)	PORAMBOKE LAND (HA)
1	Keezhmidalam-A	204.06.52	194.70.74	9.35.78
2	Midalam-B	202.96.86	190.10.98	12.85.88
3	Enayamputhanthurai	137.03.50	134.36.50	2.67.00
4	Ezhudesam-A	41.10.00	35.89.50	5.20.50
5	Ezhudesam-B	82.90.00	80.58.50	2.31.50
6	Ezhudesam-C	275.82.90	246.17.92	29.64.88
7	Kollencode-A	28.39.50	25.76.50	2.63.00
8	Kollencode-B	171.77.00	156.59.41	15.17.59
Total		1144.06.18	1064.20.05	79.86.13

- iii. **Project Capacity:** Considering the Mineral content in the area of 1144.0618 ha, it is proposed to extract 5000 tons of ore per day and 15.00 lakh tons of



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ore per annum in consonance with the consented mineral production capacity of 1,14,600 tons per annum. The mined out BSM Ore will be transported from the mining lease area to the existing Mineral Separation Plant (Mineral Beneficiation Plant) of IREL for separation of individual atomic minerals. The Mineral Separation Plant (MSP) is located in the existing Mining Lease area of IREL (141.2269 ha) in the village of Manavalakurichi. MSP is in operation since 1970 and is having valid Consent to Operate (CTO) from Tamil Nadu Pollution Control Board for production of 1,14,600 TPA total minerals. The RoM from the proposed mining lease area will be transported to the existing MSP for up-gradation of Atomic Minerals from the BSM Ore and finally separation of individual minerals. The distance between the Plant and the new mining lease area of 1144.06.18 ha ranges between 12-30 km.

- iv. **Land use and Land ownership:** The new mining lease area of 1144.0618 ha comprises Patta and Poramboke land. The Private patta lands are found with scattered Coconut trees. The mining operation over the private lands will be carried out only after obtaining the Consent from the respective land owners and after mining and backfilling, the land will be returned to the respective land owners within 11 months along with payment of Lease Compensation as per the Land Leasing Policy of IREL. On return of land, the land owners predominantly carry out the plantation of Coconut and other fruit bearing trees and also utilize the land for other activities including construction. The mining would not result in change of ownership of the land. **No mining would be carried out in the mining lease area where the permanent structures/ public places exist and the Village built-up area shall not be disturbed. Mining shall not lead to any displacement.**
- v. **Land use break-up:** The land use break-up of the Mine lease area is shown below:

Village name	Total extent in Ha	Built up area (Buildings/ Houses, Church /Temple, Cemetery, etc.,) in Ha	Area covered under Road in Ha	Area covered under Water bodies/ Pond/ Canal in Ha	Vacant land (with bushes and Coconut trees) in Ha
Keezh midalam-A	204.06.52	52.00.84	4.20.00	5.40.50	142.45.18
Midalam- B	202.96.86	51.67.78	8.36.50	5.94.31	136.98.27
Enayam Puthanthurai	137.03.50	8.44.47	1.83.50	2.70.60	124.04.93
Ezhudesam-A	41.10.00	3.57.24	0.26.50	0.13.00	37.13.26
Ezhudesam-B	82.90.00	20.85.01	2.38.90	0.53.60	59.12.49
Ezhudesam-C	275.82.80	85.19.33	8.00.10	1.36.70	181.26.67
Kollencode-A	28.39.50	7.97.00	1.08.50	0.14.00	19.20.00
Kollencode-B	171.77.00	32.97.68	3.31.16	1.56.00	133.92.16
Total	1144.0618	262.69.35	29.45.16	17.78.71	834.12.96



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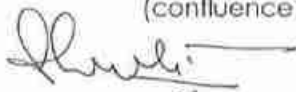
- vi. **Method of Mining:** The method of mining is opencast mechanized mining and mining does not involve drilling nor blasting as the deposit is sandy and soft in nature. The mineral bearing sand is extracted and loaded using excavator and transported to Mineral Separation Plant through tippers for separation of individual minerals. After taking out minerals in MSP, the balance sand will be returned back to backfill the areas where mining has been done, Details of machineries involved will be as follows:

Equipment	Nos.	Capacity	Make
Tipper	30	25/30 tons	TATA, Ashok Leyland, Volvo
Hydraulic Excavators	3	1.1 m ³ or 3 tons	TATA, Hitachi, Caterpillar
Dozer	1	D155 or D110	Caterpillar, Komatsu, Hitachi

- vii. **Total Cost of the project** is Rs.648 lakhs. Details as follows:

Sl. No	Description of the Cost	Cost in Lakhs (Rs)
I. Fixed Asset Cost		
1	Land Cost (Lease)	10.00
	Labor Shed	10.00
	Sanitary facilities	10.00
	Fencing Cost	5.00
	Sub Total	35.00
II. Variable cost		
1	Operational Cost	525.00
	Machineries	20.00
	Sub Total	545.00
2	EMP Cost	20.00
	Afforestation	15.00
	Water Sprinkling	5.00
	Water Quality Test	12.00
	Air Quality Test	12.00
	Noise/Vibration Test	6.00
Sub Total	68.00	
3	Grant total	648.00
	CSR Activities	150.00

- viii. **Number of working days:** 365 Days / Year.
- ix. **Water requirement and source:** Mining/ excavation operation from 1144.0618 ha ML area does not require any water and hence there is no abstraction or transfer of water from ground or surface waters. The quantity of water required for the new mining lease area is 2.5 KLD for drinking and other miscellaneous purpose. For the existing Mineral Separation Plant at Manavalakurichi, IREL is permitted to draw 4500 KLD of water from the Vallyar river at tail end (confluence with Arabian Sea) in the village of Manavalakurichi by the Water



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- Resources Department, Government of Tamilnadu. Hence, through the same source, the water requirement would be met by using Tanker Lorry.
- x. **Electricity requirement:** The mining operation over 1144.0618 ha is proposed to be carried out in 3 shifts. Power supply is required only for lighting purpose. The estimated power requirement would be 200 kVA which will be met through the Tamil Nadu Electricity Board power supply. Diesel Generators, each 125 kVA are proposed for emergency purpose. Excavation of atomic mineral bearing sand and transportation will be carried out through outsourcing. Diesel requirement for excavation and transportation of BSM Ore is 1.5 KLD.
- xi. **Alternate site examined:** Alternative site is not considered.
- xii. **Solid and Liquid Waste Generation:** No solid/ liquid wastes are generated due to mining operations. Water is not required for mining operation and hence no effluent would be generated in the mining lease area. Domestic effluent from the mine office would be collected in a septic tank and soak pit. No toxic effluent would be generated in the form of solid, liquid and gases and hence requirement does not arise for its treatment.
- xiii. **Green Belt Development:** The new mining lease area consists mostly of private patta lands. The Private Patta lands are found with scattered Coconut trees. The mining operation over the private lands will be carried out only after obtaining the Consent from the respective land owners and after mining and backfilling, the land will be returned to the respective land owners within 11 months along with payment of Lease Compensation as per the Land Leasing Policy of IREL. On return of land, the land owners predominantly carry out the plantation of Coconut and other fruit bearing trees. The mining would not result in change of ownership of the land. Generally, 70 coconut saplings are planted in one acre of land.
- xiv. **Rehabilitation and Resettlement (R&R) Plan:** IREL formulated a Policy called IREL's Concession Option Scheme for taking possession of the Private Patta land on lease. The land leasing period will be 11 months. Mining and backfilling will be simultaneously carried out within the lease period of 11 months and thereafter the land will be returned to the respective land owners with lease compensation as worked out under the IREL's Concession Option Scheme. Mining in the lease hold areas will not result in any displacement nor change in the ownership of the land. Also, after mining, the land will be brought to its original topography and will not have mining foot print. Neither land acquisition nor purchase of land would be done in the proposed mining lease area. The permanent structures will not be disturbed and mining shall not lead to displacement of people. There will not be any involuntary displacement of people due to mining operations by IREL.
- xv. **CRZ Clearance:** Requirement of CRZ Clearance: The proposed Mining Lease area lies adjacent to Arabian Sea covering a coastal length of 11.2 Km. Out of the total area of 1144.0618 ha, 334 ha area falls under the CRZ area and thus the Project attracts CRZ Notification 2011. The mining lease area falls under the category of CRZ-1 (B), II and III. The proposed project is a permissible activity as per clause 4 (ii) (g) of CRZ Notification-2011 dated 06.01.2011 and amendment dated 06.10.2017).
- xvi. **NBWL Clearance:** NA
- xvii. **Forest Clearance:** No forest land is involved with the ML area.



- xviii. **Details of Court cases:** No litigation is pending against the instant proposal.
- xix. **Details of water bodies nearby:** The following are the list of rivers/ Ponds/other water bodies existing within the radius of 10 Km of the proposed mining lease area.
- Thamirabarani river – 260 m (W)
 - Kulathoor – 4.49 Km (WNW)
 - Neyyar Backwater – 5.26 Km (NW)
 - Perumkulam pond – 5.52 Km (ENE)
 - Vaalankulam Pond – 6.78 Km (ENE)
 - Vazhode pond – 6.95 Km (ENE)
 - Valiyakulam pond – 7.68 Km (NNW)
 - Periyakulam – 8.18 Km (ESE)
- xx. **Details of critically polluted area:** NA
- xxi. **Tree Cutting:** The project area of 1144.0618 Ha is devoid of any notable species of trees except coconut plantation. Coconut plantation is removed prior to commencement of mining activities.
- xxii. **Impact on drainage pattern:** The proposed mining lease area is located near to the coastal belt which is highly permeable, hence there are no noteworthy drainage pattern witnessed. Mining of atomic minerals will not have any impact on drainage pattern. Mining will be carried out at a depth of 6.5 mts and refilling of the minedout area will be carried out simultaneously.
- xxiii. **Employment generation:** The mining & allied activities would provide direct employment to 155 persons and indirect employment to 250 persons.
- xxiv. **Benefits of the project:** Strategic importance for country's energy security, defence and space.
- xxv. **EIA Consultant-** ABC Techno Labs Private Limited, Chennai (Certificate No. NABET/EIA/1922/RA0155 validity extended to 27.01.2023)

4. The committee noted that the method of mining proposed is opencast mechanized mining and mining does not involve drilling or blasting as the deposit is sandy and soft in nature. Moreover, after mining, the land will be brought to its original topography and will not have mining foot print. Further, it doesn't have any impact on social-culture aspect of the area, with no component of R&R activity.

5. It was further confirmed by the PP that there is no ban for sand beach mining for government companies as per OM No 1/1/2019-M.VI dated 1st March 2019 of Ministry of Mines.

6. EAC noted that the proponent has applied for ToR for both Mining activity (category 'A' of item 1 (a)) and 'Mineral Beneficiation (Category 'B' of item 2(b)). However, during the deliberation proponent informed that the Mineral separation plant (1,14,600 TPA Production capacity) is located 12-26 km from the proposed mining lease and the said plant is in operation since 1970. In view of this, EAC opined that ToR for Mineral Beneficiation is not required as this will be executed outside the proposed MLA (1144.0618 ha) in the facility that already exists and is operating.



7. On basis of detailed deliberations and recommendation of EAC (N&D), the Ministry of Environment, Forest and Climate Change hereby accords Terms of References for preparation of the EIA/EMP report for 'Mining of Atomic Minerals (Ilmenite, Rutile, Zircon, Monazite, Sillimanite and Garnet) over an extent of 1144.0618 ha in Kanniyakumari, Tamil Nadu by M/s IREL (India) Limited' with following stipulations:

SPECIFIC TOR

1. **STUDY AREA:** Core zone i.e. 1144.0618 ha of Mining Lease area of the project and Buffer zone of 10 km radius all around outside the boundary of the core zone.
2. **STUDY PERIOD:** Environmental Baseline data generation is to be for one season comprising of 3 months during pre or post monsoon.
3. In order to ascertain statistically significant analysis, adequate representative sample size traversing across the lease area of 1144.0618 ha shall be taken for each parameter including for the radiological parameters to be monitored utilizing appropriate sampling methods as part of the baseline studies. Frequency of the studies shall be minimum three times during the study period. Grid based analysis of sampling to be done.
4. Baseline background radiation including radon concentration across the lease area shall be plotted on map for presentation.
5. Possible Radiological impact of the proposed mining on labours health and adjacent areas need to be addressed along with mitigation measures as per the provisions of AERB.
6. Regular ground water monitoring including the background status to be undertaken which shall *inter-alia* include the concentration of arsenic, fluoride and uranium in GW.
7. External gamma radiation, gross alpha & beta activity levels in Air, Water, soil and biological samples by HPU of BARC in study area to be ensured both during the study period and during the project implementation period.
8. Impacts on background radiation levels on account of the project, if any, shall be predicted.
9. Impacts on ambient air quality due to material handling on surface, operation of boiler in mill and material despatch shall be predicted using computerized mathematical dispersion models.
10. Impact on ground water and ambient air quality due to tailings dam shall be predicted using appropriate mathematical dispersion models.
11. Zero discharge ETP shall be ascertained.
12. PP should make provisions for installation of solar panels to ensure the energy efficiency in the project area.
13. Strategic nature of the project shall be certified by Department of Atomic Energy (DAE) if seeking exemption from public hearing under para 7(i)iii(f) of EIA Notification, 2006.
14. CRZ Related Studies
 - a. Probability, impact and management plan wrt Coastal erosion due to proposed mining shall be studied.
 - b. Non-eroding coast to be confirmed by satellite imagery.

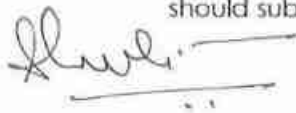


- c. Assessment of shoreline changes. Shoreline assessment study of the area to see impact of reclamation on the project site and on the adjacent site and hydrodynamic study for flooding in the area.
- d. A map covering aerial distance of 15 km on the landward side from the proposed project boundary delineating environmental sensitive areas as specified in column no 9(iii), Form 1 of EIA notification dated September 14, 2006.
- e. Land use map of the study area to 1:25,000 scale based on recent satellite imagery of the proposed area and 10 kms from the proposed project boundary delineating the cropping pattern, wastelands, forest area and built-up areas, water bodies, human habitation and other surface features such as railway tracks, ports, airports, roads, NH, major industries etc.
- f. Area drainage contour map of the project area 2.5 km from the proposed project area shall be clearly indicated. In case of any proposed diversion of nallah/canal/river, same shall also be shown in the map.
- g. Assessment of marine water quality with respect to Physico-chemical characteristics.
- h. Assessment of Biological Environmental Status:
 - i. Food Chain Organisms: Phytoplankton, Zooplankton (species diversity, density, dominance etc.)
 - ii. Benthic organism (Species diversity, density, dominance etc.).
 - iii. Fishery Resources.
 - iv. Coastal vegetation.
 - v. Corals and mangroves
 - vi. Rare, Protected and Threatened Flora/Fauna their Conservation Concern with Respect to the Study Area.
- i. Assessment of impact of the dredging activity on the Marine environment and on heavy metal changes to be ensured.
- j. Details of water bodies and impact on drainage to be evaluated. It is to be made sure that marine environment is not harmed during the construction and operation activities.
- k. Assessment of sea water, sea sediments, marine ecology within 1km radial area of the project activity.
- l. Details of impact on corals and mangroves.
- m. Slope stability study and impact on creek to be assessed.

STANDARD TOR FOR MINING PROJECT

A. Project Details

- 1. A copy of the document in support of rightful lessee of the mine should be submitted. In case of new mines copy of Lol granted by State Government to be submitted. PP should ensure that Lol is valid at the time of grant of ToR. PP should submit the copy of lease deed/supplementary lease deed/extension



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- letter/transfer deed, from its initial grant to subsequent renewals/transfer/extension of validity.
2. All documents including approved mine plan, EIA and Public Hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management, mining technology etc. and should be in the name of the lessee.
 3. PP should submit the District Survey Report (DSR) as per S.O. 3611(E) dated 25.07.2018 in case of minor minerals.
 4. Brief of proposal to be submitted which include total excavation of the material required for the production of certain quantity of the minerals, location of the project, mining lease area, latitude longitude, seismic zone etc. In case of expansion, project details of expansion viz. expansion in mining lease area or expansion in production of any particular mineral or expansion in total excavation, latest certified Compliance report (CCR) from IRO of conditions granted in existing EC needs to be submitted.
 5. The PP should submit the real-time aerial video footage & video of the mining lease area and of the transportation route.
 6. All corner coordinates of the mine lease area, superimposed on a High-Resolution Imagery/toposheet, topographic sheet, geomorphology and geology of the area should be provided. Such an Imagery of the proposed area should clearly show the land use and other ecological features of the study area (core and buffer zone).
 7. Information should be provided in Survey of India Toposheet in 1:50,000 scale indicating geological map of the area, geomorphology of land forms of the area, existing minerals and mining history of the area, important water bodies, streams and rivers and soil characteristics.
 8. The PP should collect the Baseline data (BLD) in respect of initial level of the mining lease. For this permanent bench marks (BM) needs to be established at prominent location preferably close to mining leases in question and should have precisely known relationship to the level datum of the area, typically mean sea level.
 9. A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the Project. Phase-wise plan of plantation and compensatory afforestation should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to pollution.
 10. Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report.
 11. Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA report.
 12. The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.



13. Benefits of the Project if the Project is implemented should be spell out. The benefits of the Project shall clearly indicate environmental, social, economic, employment potential, etc.
14. Compliance of the Ministry's Office Memorandum No. F: 3-50/2017-IA.III (Pt.), dated 30.05.2018 on the judgment of Hon'ble Supreme Court, dated the 2nd August, 2017 in Writ Petition (Civil) No. 114 of 2014 in the matter of Common Cause versus Union of India needs to be submitted and included in the EIA/EMP Report.

B. Forest

15. PP shall submit a certificate from Chief Conservator of Forests regarding involvement of Forest Land in the mining lease area if any. In case forest land is involved i) PP should submit the proof of application made for obtaining forest clearance and ii) a map clearly showing the forest & non-forest area.
16. Status of forestry clearance for the broken-up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished.
17. Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.
18. The vegetation in the RF / PF areas in the study area, with necessary details should be given. The details shall encompass enumeration of trees which inter-alia shall include name of species and girth wise classification.

C. Court Matters

19. Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.

D. Land Environment

20. PP should submit the details of survey number [viz. survey no, area in hectare, classification of land (government, private, forest, grazing land etc.), villages] duly authenticated by State Government, falling in the mining lease area.
21. The study area will comprise of 10km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine / lease period.
22. Land use of the study area delineating forest area, agricultural land, grazing land, wildlife sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.
23. Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area, distance from mine lease, its land use, R&R issues, if any, should be given.



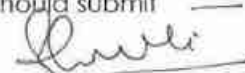
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E. Wildlife

24. A study shall be got done to ascertain the impact of the Mining Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly, detailed mitigative measures required, should be worked out with cost implications and submitted.
25. A detailed biological study of the study area [core zone and buffer zone] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. PP shall submit list of Schedule-1 species present in core and buffer zone duly authenticated by CWLW. In case of any Scheduled-I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with State Forest/Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost. Proof of its submission of conservation plan to the CWLW needs to be submitted.
26. PP shall submit a certificate from Chief Wildlife Warden regarding distance of mining lease from the protected area falling within 10 KM of the mining lease. In case project requires clearance under Wildlife (Protection) Act, 1972 then copy of application made for the same needs to be submitted.

F. Baseline Environment:

27. One season (non-monsoon) [i.e. March - May (Summer Season); October - December (post monsoon season); December - February (winter season)] primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre-dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given.
28. Air quality modelling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modelling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The windrose showing pre-dominant wind direction may also be indicated on the map.
29. 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 from which samples were analyzed.

G. Water Environment

30. The water requirement for the Project, its availability and source should be furnished. Quantity of surface or ground water to be used for the Project should be indicated. A detailed water balance should also be provided. Submit the year wise target for reduction in consumption of the ground/surface water by developing alternative source of water through rain water harvesting measures. Description of water conservation measures proposed to be adopted in the Project should be given. Details of rainwater harvesting proposed in the Project, if any, should be provided. The capital and recurring expenditure to be incurred needs to be submitted.
31. Impact of the Project on the water quality, both surface and groundwater, should be assessed and necessary safeguard measures, if any required, should be provided.

H. Hydro Geology

32. Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and the impact of the same on the hydrology should be.
33. Information on site elevation, working depth, groundwater table etc. Should be provided both in AMSL and BGL. A schematic diagram may also be provided for the same.
34. Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working bench will intersect groundwater table, a detailed Hydro Geological Study should be undertaken and Report furnished. The Report inter-alia shall include details of the aquifers present and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished. In case of surface water is proposed to be utilized then Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided.

I. Transportation

35. Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered. Project Proponent shall conduct Impact of Transportation study as per Indian Road Congress Guidelines.



J. Land Acquisition and R&R

36. Details about the land proposed for mining activities should be given with information as to whether mining conforms to the land use policy of the State; land diversion for mining should have approval from State land use board or the concerned authority.
37. R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need-based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectoral programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the mine lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects should be discussed in the Report.

K. Socio-Economic Environment

38. Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.
39. Measures of socio-economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.
40. Public Hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan with budgetary provisions to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.
41. Activity-wise time-bound action plan on the issues raised and commitment made during public hearing to be submitted as part of the final EMP Report in compliance of the Ministry's OM F.No.22-65/2017-IA.III dated 30th September, 2020.

L. Environmental Monitoring and Management

42. It should be clearly stated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spell out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/ violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances / violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large, may also be detailed in the proposed safeguard measures in each case should also be provided.




43. Detailed environmental management plan (EMP) to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if any, occupational health impacts besides other impacts specific to the proposed Project.

M. Critically Polluted Areas, Aravali & CRZ

44. Proximity to Areas declared as 'Critically Polluted' or the Project areas likely to come under the 'Aravali Range', (attracting court restrictions for mining operations), should also be indicated and where so required, clearance certifications from the prescribed Authorities, such as the SPCB or State Mining Dept. Should be secured and furnished to the effect that the proposed mining activities could be considered.
45. Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the mine lease w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Mining Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).

N. Risk Assessment & Disaster Management

46. Issues relating to Mine Safety, including subsidence study in case of underground mining and slope study in case of open cast mining, blasting study etc. should be detailed. The proposed safeguard measures in each case should also be provided.
47. Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed.
48. A Disaster Management Plan shall be prepared and included in the EIA/EMP Report.
49. Environmental Management Plan (EMP) EMP shall be specific to the outcome of EIA Studies. EMP should include:
- i. Recommendations for Air, Noise, Water, Sediments, Solid and Hazardous Waste Management, Conservation of Marine Life and Local Ecosystem during the Proposed Project Activities.
 - ii. Summary of potential adverse impacts and recommended mitigation measures.
 - iii. Allocation of resources and responsibilities for implementation.
 - iv. Administrative and Technical setup for the Management of Environment.
 - v. Institutional arrangements proposed with other organizations/ Government authorities for effective implementation of environmental measures proposed in the EIA.
 - vi. Environmental specifications for the contractors should contain adequate safeguards to ensure that Management measures will

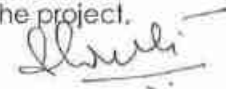


- not be compromised under adverse field conditions or time constraints.
- vii. Emergency preparedness manual shall be prepared, which should also include plant emergency, site emergency and general emergency exercises and their periodicity.
 - viii. Risk Assessment and Emergency Planning with assessment of risks involved in construction and operation phases, and identification of maximum credible accident scenario, Emergency Preparedness Plan and Suggestions for Disaster Management Planning.
 - ix. Energy efficiency measures
 - x. Waste and effluent management details
 - xi. Air pollution, water pollution and noise pollution mitigation measures.
 - xii. Due mitigations to be adopted in case of any impact identified at the stage of EIA preparation.
 - xiii. Suggestion of suitable measures for prevention and control of marine pollution from proposed project activities.
 - xiv. A well-defined monitoring matrix shall be part of EMP.

O. Miscellaneous

50. The general points are also to be followed: -

- a. All documents to be properly referenced with index and continuous page numbering.
- b. Where data are presented in the Report especially in Tables, the period in which the data were collected and the sources should be indicated.
- c. Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the Project.
- d. Where the documents provided are in a language other than English, an English translation should be provided.
- e. The Questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry shall also be filled and submitted.
- f. While preparing the EIA report, the instructions for the Proponents and instructions for the Consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II (I) dated 4th August, 2009, which are available on the website of this Ministry, should be followed.
- g. Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA/EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation.
- h. As per the circular no. J-11011/618/2010-IA.II (I) dated 30.5.2012, certified report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project.



should be obtained from the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.

- i. The EIA report should also include (i) surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area.

8. The prescribed TOR would be valid for a period of four years for submission of the EIA/EMP report, as per the notification S.O 751 (E) dated 17.02.2020. The PP shall submit the EIA/EMP report within the stipulated time period of 4 years as per the procedure prescribed in OM vide F. No. IA3-22/10/2022-IA.III [E 177258] dated 08.06.2022.

9. The Project Proponent should submit the EIA/EMP report as per the generic structure prescribed in Appendix-III of the EIA Notification, 2006 after incorporating the details of public hearing conducted and covering the above-mentioned issues, to take further necessary action for obtaining environmental clearance in accordance with the procedure prescribed under the EIA Notification, 2006.

10. This issues with the approval of the Competent Authority.



(Dr. Shruati Rai Bhardwaj)
Director/Scientist 'F'

Copy to:

1. Director, Department of Environment, No. 1, Jeenis Road, Panagal Building, Ground Floor, Saidpet, Chennai-600015, Tel- 044-24336421, 24336928, E-mail: tn DOE@tn.nic.in
2. Addl. Principal Chief Conservator of Forests (C), Ministry of Environment, Forests and Climate Change, Integrated Regional Office, 1st and 11nd Floor, Handloom Export Promotion Council, 34, Cathedra, Garden Road, Nungambakkam, Chennai – 34, Email: ro.moefccc@gov.in
3. The Chairman, Central Pollution Control Board Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, New Delhi - 110 032. Email: ccb.cpcb@nic.in
4. The Chairman, Tamil Nadu Pollution Control Board, 76, Mount Salai, Guindy, Chennai- 600032, Tel- 044-22353134-139, Email-ID: tnpcb-chn@gov.in
5. Guard File/ Monitoring Cell



(Dr. Shruati Rai Bhardwaj)
Director/Scientist 'F'

Compliance to awarded Terms of Reference

S.No	ToR Conditions	Compliance & Page No.
Specific ToRs		
1.	Study Area: Core zone i.e.1144.0618 ha of Mining Lease area of the project and Buffer zone of 10 km radius all around outside the boundary of the core zone.	Mining Lease area has been designated as the core zone. The buffer zone for the present study has been considered as an area encompassing 10 km from boundary of the Mining Lease. Para 1.9 – Page No. 83 Para 3.1 - Page No. 121
2.	Study Period: Environmental Baseline data generation is to be for one season comprising of 3 months during pre or post monsoon.	Baseline Data (BLD) collected during December 2022-February 2023 representing Winter 2022-23 Season has been utilised for the EIA Study. Para 1.12-Page No. 87
3.	In order to ascertain statistically significant analysis, adequate representative sample size traversing across the Mining lease area of 1144.0618 ha shall be taken for each parameter including for the radiological parameters to be monitored utilizing appropriate sampling methods as part of the baseline studies. Frequency of the studies shall be minimum three times during the study period. Grid based analysis of sampling to be done.	Digital map of these areas were generated and monitoring grid patterns with dimension 1 x 1 km were developed using ArcGIS Version:10 software. The Core Area – “Block A” was divided into 12 grids whereas Core Area – “Block B” was divided into 11 grids. An accessible location near the centre of each grid was chosen as preferred reference spot for radiological monitoring. Similarly, the buffer areas with dimension of 5 x 5 km were demarcated around the core zone and sampling locations were identified at the centre of each grid. The radiation survey of core and buffer zone locations were carried out and the Radiological monitoring was carried out by the Health Physics Division, Bhabha Atomic Research Centre during Pre-Monsoon period of March, April and May 2023. Para 3.14 - Page No. 288
4.	Baseline background radiation including radon concentration across the Mining lease area shall be plotted on map for presentation.	Ten readings at one metre height from ground are taken from each location and average of the same is calculated in micro-sievert per hour (μSvh^{-1}). The minimum detection limit (MDL) for the dose rate measurement is $0.01 \mu\text{Sv h}^{-1}$. GIS based Dose rate profile / contour of the Block A & B are given in the EIA Report. Page No. 290
5.	Possible Radiological impact of the proposed mining on labors health and adjacent areas need to be addressed along with	The study locations consist of noted Natural High Background Radiation Area of these coastal stretches in Manavalakurichi. Some hinterland

S.No	ToR Conditions	Compliance & Page No.
	mitigation measures as per the provisions of AERB.	locations have Monazite content in the soil in the range of 5-12%. Due to the presence of Monazite, the radiation field and individual doses are much higher in these coastal areas as compared to other locations. This has been evidenced that the residents of Block A, Block B and Buffer zone receive significantly higher doses as compared to other populations. On removal of the BSM ore (Run of Mines) containing Monazite and other minerals and backfilling with Monazite free tailings over the mined-out areas, the background radiation in the mined out and back filled area is brought down to 0.2 - 0.4 μSvh^{-1} . In other words, there has been 8-to-10-fold reduction in the radiation level in the area where mining & backfilling is carried out by IREL and as such our mining does not affect either environment or people and makes the area free from high background radiation. Para 4.3.7 - Page No. 312.
6.	Regular ground water monitoring including the background status to be undertaken which shall <i>inter-alia</i> include the concentration of arsenic, fluoride and uranium in GW.	Baseline Ground Water Quality was monitored at 10 Locations and Report submitted. Page No. 187. Apart from the radiological measurements, measurement of Total dissolved salts (TDS), pH fluoride and arsenic in ground water was also carried out. Para 3.14 - Page No. 288 - 300
7.	External gamma radiation, gross alpha & beta activity levels in Air, Water, Soil and biological samples by HPU of BARC in study area to be ensured both during the study period and during the project implementation period.	The radiological monitoring carried out at core areas and buffer areas by the Health Physics Division, Bhabha Atomic Research Centre during Pre-Monsoon period includes (1) Ambient outdoor gamma dose rate (2) Air activity measurements of long lived (^{232}Th) radionuclides (3) Air activity measurements of radon (^{222}Rn), thoron (^{220}Rn) and progenies (4) Gross dust load in air (5) Gross alpha and gross beta activity in ground water (6) Measurement of uranium and thorium concentration in ground water (7) Measurement of thorium and uranium activity in the soil (8) Measurement of gross alpha and gross beta activity in food stuff and (9) Estimation of external dose

S.No	ToR Conditions	Compliance & Page No.
		received by general public in the study area. Para 3.14 - Page No. 288.
8.	Impacts on background radiation levels on account of the project, if any, shall be predicted.	On removal of the BSM ore (Run of Mines) containing Monazite and other minerals and backfilling with monazite free tailings over the mined-out areas, the background radiation in the mined out and back filled area is brought down to 0.2 - 0.4 μSvh^{-1} In other words, there has been 8-to-10-fold reduction in the radiation level in the area where mining & backfilling is carried out by IREL and as such our mining does not affect either environment or people and makes the area free from high background radiation. Para 4.3.7 - Page No. 312
9.	Impacts on ambient air quality due to material handling on surface, operation of boiler in mill and material dispatch shall be predicted using computerized mathematical dispersion models.	Mining of BSM Ore is only proposed and no process involved in the Proposal. The Stand-Alone Mineral Separation Plant is located at Manavalakurichi. Para 1.10 – Page No. 86
10.	Impact on ground water and ambient air quality due to tailings dam shall be predicted using appropriate mathematical dispersion models.	No tailing dam is proposed. The mining will be carried out at an average depth of 6 m and upto a maximum depth of 9 m depending upon the location and mineralization. No ground water-table intersection is envisaged as ground water-table level in the Mining Lease Area ranges between 10-15 m BGL. No mine pit will be there and thus; no mine drain is envisaged. Thus, no impact is anticipated on the ground water sources in the Mining Lease vicinity. Para 4.3.5 – Page No. 309 Loading and Transporting activities would generate both fugitive dust emissions and smoke from HEM Machineries/Equipments & Transporting Tippers. Para 4.3.3 – Page No. 304
11.	Zero discharge ETP shall be ascertained.	The mining will be carried out at an average depth of 6 m and upto a maximum depth of 9 m depending upon the location and mineralization. No ground water-table intersection is envisaged. With no permanent facilities proposed in the Mining Lease area and with the moving population of worker/employees

S.No	ToR Conditions	Compliance & Page No.
		<p>during the mining, the water demand will be 2.5 KLD only. Sewage generation of 2.2 KLD will be biologically treated in a mobile Bio-Toilets and the sludge will be used as manure for the Green Belt development. No Workshop is proposed and thus, no trade effluent generation from the Mine. No mine pit will exist and thus; no mine drain is envisaged. Thus, 'Zero Effluent Discharge' will be adopted/ practiced. Para 4.3.5 – Page No. 309</p>
12.	PP should make provisions for installation of solar panels to ensure the energy efficiency in the project area.	With no permanent facilities proposed in the Mining Lease, there is no provision for installation of solar panels.
13.	Strategic nature of the project shall be certified by Department of Atomic Energy (DAE) if seeking exemption from public hearing under para 7(i)III(f) of EIA Notification, 2006.	Public Hearing is being conducted for the Project and Action Plan to address the PH issues along with Budget provision will be incorporated in the EIA report.
14.	CRZ Related Studies	
a.	Probability, impact and management plan wrt Coastal erosion due to proposed mining shall be studied.	<p>As per National Centre for Coastal Research (NCCR), Blocks A & B falls in Low erosion and Low accretion area. Also, some Mining lease pockets in Block A falls in the intertidal zone. Shoreline changes are studied based on imageries of 2010-2015, 2010-2020, 2010-2023 and stable coastline has been observed in both the Blocks. As the mining in CRZ area is proposed to be regulated in accordance with the guidelines issued by MoEFCC, no impact is anticipated to the Mining Lease area due to Shoreline Changes. Para 3.5 - Page No. 131</p>
b.	Non-eroding coast to be confirmed by satellite imagery.	<p>Shoreline changes are studied based on imageries of 2010-2015, 2010-2020, 2010-2023 and stable coastline has been observed in both the Blocks. As the mining in CRZ area is proposed to be regulated in accordance with the guidelines issued by MoEFCC, no impact is anticipated to the Mining Lease area due to Shoreline Changes. Para 3.5 - Page No. 131</p>
c.	Assessment of shoreline changes. Shoreline assessment	Block A Area is about 0-310 m from the Coastline. As Block B Area is about 365 m

S.No	ToR Conditions	Compliance & Page No.
	study of the area to see impact of reclamation on the project site and on the adjacent site and hydrodynamic study for flooding in the area.	from the Coastline no impact is anticipated to the Mining Lease due to Shoreline Changes. Para 3.5 – Page No. 131
d.	A map covering aerial distance of 15 km on the landward side from the proposed project boundary delineating environmental sensitive areas as specified in column no 9(iii), Form 1 of EIA notification dated September 14, 2006.	The study area map of 15 km is shown as Fig. 3.1. Page No. 123
e.	Land use map of the study area to 1:25,000 scale based on recent satellite imagery of the proposed area and 10 kms from the proposed project boundary delineating the cropping pattern, wastelands, forest area and built-up areas, water bodies, human habitation and other surface features such as railway tracks, ports, airports, roads, NH, major industries etc.	Land Use/Land Cover (LU/LC) at 10 km radius based on recent Satellite Imagery are studied and submitted. Fig. 3-12 & Fig. 3-14 Page No. 141 & 143
f.	Area drainage contour map of the project area 2.5 km from the proposed project area shall be clearly indicated. In case of any proposed diversion of nallah/canal/river, same shall also be shown in the map.	The drainage pattern of the study area is shown in Fig. 3.4 and 2km radius Drainage map is given as Fig 3.5. As observed, there is no marked drainage pattern in the Mining lease area and the existing water bodies like ponds/streams will not be disturbed. Block-B is does not contain river or stream whereas, there are 2 streams in Block A which will not be disturbed as such. Page No. 129 - 130
g.	Assessment of marine water quality with respect to Physico-chemical characteristics.	The collected marine water samples were analyzed and results of marine water analysis are given in Table 3.44. Page No. 259
h.	Assessment of Biological Environmental Status:	
i.	Food Chain Organisms: Phytoplankton, Zooplankton (species diversity, density, dominance etc.)	Para 3.11 – Page No. 268 - 279
ii.	Benthic organism (Species diversity, density, dominance etc.).	
iii.	Fishery Resources.	
iv.	Coastal vegetation.	Page No. 279

S.No	ToR Conditions	Compliance & Page No.
v. vi.	Corals and mangroves. Rare, Protected and Threatened Flora/Fauna their Conservation Concern with Respect to the Study Area.	
i.	Assessment of impact of the dredging activity on the Marine environment and on heavy metal changes to be ensured.	Not Applicable. No dredging activity is proposed.
j.	Details of water bodies and impact on drainage to be evaluated. It is to be made sure that marine environment is not harmed during the construction and operation activities.	There is no marked drainage pattern in the Mining lease area and the existing water bodies like ponds/streams will not be disturbed. Block-B is devoid of any streams whereas, there are 2 streams in Block A which will not be disturbed as such. The river Thamiraparani flows in the Eastern parts of Block B at an elevation of 18-33 m AMSL while Block B is located in the elevation range of 37 m AMSL near the water course. There will not be any flood risk to the mining lease area as well as no impacts anticipated due to the mining on the river course. Para 3.4 – Page No. 125 Being a Mine Proposal without any installation, no Construction Phase activities will be there. Mining in the CRZ Area will be regulated by IREL so as to maintain the marine environment as such.
k.	Assessment of sea water, sea sediments, marine ecology within 1 km radial area of the project activity.	Para 3.10.7 – Page No. 254
l.	Details of impact on corals and mangroves.	Not Applicable. The Study Area is devoid of Corals and Mangroves. Page No. 279
m.	Slope stability study and impact on creek to be assessed.	As Mining is proposed upto the maximum depth of 9m with an average of 6m and simultaneous backfilling, no mine pit will be there. With backfilling the mined-out void will be reclaimed to its original status. Thus, Slope Stability study is not required. Block A Area is about 0-310 m from the Coastline. Block B Area is about 365 m from the Coastline. Mining in the CRZ Area will be regulated by IREL so as to maintain the marine environment as such. Thus, no impact anticipated on the creek. Page No. 128

Standard ToR for Mining Project

S.No	ToR Conditions	Compliance & Page No.
A	Project Details	
1.	A copy of the document in support of rightful lessee of the mine should be submitted. In case of new mines copy of Lol granted by State Government to be submitted. PP should ensure that Lol is valid at the time of grant of ToR. PP should submit the copy of lease deed/supplementary lease deed/extension letter/transfer deed, from its initial grant to subsequent renewals/transfer/extension of validity.	The Ministry of Mines, Government of India issued the Notification vide G.S.R.399(E) dated 11.06.2021 reserving the area of 1144.0618 Ha for mining by IREL under section 17A (1A) of Mines and Minerals (Development and Regulation) Act, 1957. The Government of Tamil Nadu has issued the Letter of Intent (LOI) vide No.12503/MMD.2/2015-19 dated 28.06.2022. Doc-1 – Page No. 54
2.	All documents including approved mine plan, EIA and Public Hearing should be compatible with one another in terms of the mine lease area, production levels, waste generation and its management, mining technology etc. and should be in the name of the lessee.	Complied. All documents including approved mine plan and EIA report are compatible with one another in terms of the mine lease area, production levels, waste generation and its management, mining technology etc. and are in the name of the lessee. IREL has requested the Ministry to exempt the Public Hearing.
3.	PP should submit the District Survey Report (DSR) as per S.O. 3611 (E) dated 25.07.2018 in case of minor minerals.	Not Applicable. Proposal is for Mining of Monazite (Prescribed substances under the Atomic Energy Act, 1962) and other Atomic Minerals.
4.	Brief of proposal to be submitted which include total excavation of the material required for the production of certain quantity of the minerals, location of the project, mining lease area, latitude longitude, seismic zone etc. In case of expansion, project details of expansion viz. expansion in mining lease area or expansion in production of any particular mineral or expansion in total excavation, latest certified Compliance report (CCR) from IRO of conditions	The Mining Lease area of 1144.0618 Ha comprises of 79.8613 Ha Government land and 1064.2005 Ha Private Patta lands. There is no forest land involved. The Mining Lease area is located at Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B Villages, Killiyoor Taluk, Kanniyakumari District, Tamil Nadu. Para 1.6 – Page No. 68 ML Block - A is located 08°11'19.78" to 08°13'33.12" North Latitudes and 77°11'13.13" to 77°14'08.82" East

S.No	ToR Conditions	Compliance & Page No.
	granted in existing EC needs to be submitted.	<p>Longitudes and Block - B is located between 08°15'17.31" to 08°17'32.23" North Latitudes and 77°06'50.15" to 77°09'34.63" East Longitudes.</p> <p>Para 1.9 - Page No. 83</p> <p>The method of mining will be Non-Conventional Opencast Mechanized Mining by Excavator-Tipper combination with no Drilling & Blasting involved. It is proposed to mine out Atomic Minerals-BSM Ore @ 5000 Tonnes per day (TPD) ROM viz. 15.00 Lakh Tonnes ROM. Mining operation will be carried out at an average depth of 6 m and a maximum depth of 9 m depending upon the location and mineralization.</p> <p>Para 1.10 – Page No. 86</p>
5.	The PP should submit the real-time aerial video footage & video of the mining lease area and of the transportation route.	To be submitted at the time of EC Presentation.
6.	All corner coordinates of the mine lease area, superimposed on a High-Resolution imagery/toposheet, topographic sheet, geomorphology and geology of the area should be provided. Such an Imagery of the proposed area should clearly show the land use and other ecological features of the study area (core and buffer zone).	<p>The study area falls in the Survey of India Topo Sheet No. 58H/3, 58H/4, 58H/7 and 58H/8. Topo map of 10km radius is shown in Fig 1.6 - Page No. 84.</p> <p>Regional & Local Geology in Para 2.3.1- Page No. 91</p> <p>HRS depicted in Fig. 1-1 - Page No. 69.</p> <p>Satellite Imagery as Fig. 3-12 – Page No. 141</p> <p>Land Use Map as Fig. 3-13 – Page No. 143</p>
7.	Information should be provided in Survey of India Toposheet in 1:50,000 scale indicating geological map of the area, geomorphology of land forms of the area, existing minerals and mining history of the area, important water bodies, streams and rivers and soil characteristics.	<p>Topo map of 10km radius is shown in Fig 1.6 - Page No. 84.</p> <p>Regional & Local Geology in Para 2.3.1 - Page No. 91</p> <p>Drainage Pattern – Para 3.4 – Page No. 125</p> <p>Fig. 3.4 – Page No. 129</p>
8.	The PP should collect the Baseline data (BLD) in respect of initial level of the mining lease. For this	The topography of the new mining lease area is flat except undulation found in certain patches.

S.No	ToR Conditions	Compliance & Page No.
	<p>permanent bench marks (BM) needs to be established at prominent location preferably close to mining leases in question and should have precisely known relationship to the level datum of the area, typically mean sea level.</p>	<p>Para 3.3 - Page No. 125</p>
<p>9.</p>	<p>A time bound Progressive Greenbelt Development Plan shall be prepared in a tabular form (indicating the linear and quantitative coverage, plant species and time frame) and submitted, keeping in mind, the same will have to be executed up front on commencement of the Project. Phase-wise plan of plantation and compensatory afforestation should be charted clearly indicating the area to be covered under plantation and the species to be planted. The details of plantation already done should be given. The plant species selected for green belt should have greater ecological value and should be of good utility value to the local population with emphasis on local and native species and the species which are tolerant to pollution.</p>	<p>It is proposed to plant and develop 1,41,700 No's Coconut trees in Mined out and reclaimed area of 834.12 Ha @ 170 Trees per Ha by the land owners. Survival rate will be 85 – 90%. Para 4.3.6 – Page No. 310</p>
<p>10.</p>	<p>Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report.</p>	<p>The mining will be carried out in the Mining Lease Area in a staggered manner after obtaining land owners' consent. Thus, there is no infrastructure facilities required for the Mine. The Mineral Separation Plant is provided with all facilities like drinking water, canteen, rest shelter, latrines and urinals, bathrooms, first aid centre, dispensary, vocational training center, workshops for Electrical, Mechanical and Civil etc. Food at the canteen is supplied at subsidized rate. Occupational Health Centre exists at MSP. Medical facilities are available</p>

S.No	ToR Conditions	Compliance & Page No.
		round the clock and the OHC is equipped with an ambulance. Para 2.8 – Page No. 118
11.	Conceptual post mining land use and Reclamation and Restoration of mined out areas (with plans and with adequate number of sections) should be given in the EIA report.	At the Conceptual Stage, 834.1296 Ha will be the mined out and back filled area. Backfilled area will be used for plantation of Coconut trees & fruit bearing trees and other activities by the respective land owners. Para 2.9 – Page No. 118 - 119
12.	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	The Project Cost is Rs.31.25 Crores. An amount of Rs. 20.00 Lakhs is earmarked as Capital EMP Budget and Rs10.50 Lakhs per Annum is Operating Cost. Para 10.3 – Page No. 331
13.	Benefits of the Project if the Project is implemented should be spelt out. The benefits of the Project shall clearly indicate environmental, social, economic, employment potential, etc.	IREL is the only CPSE in the country being authorized to mine and handle “Monazite” and its value-added products. The Zircon produced from Manavalakurichi Unit is directly sent to the Nuclear Fuel Complex (NFC), Department of Atomic Energy for strategic applications. Chapter 8 – Page No. 328
14.	Compliance of the Ministry's Office Memorandum No. F: 3-50/2017-IA.III (Pt.), dated 30.05.20 18 on the judgment of Hon'ble Supreme Court, dated the 2 nd August, 2017 in Writ Petition (Civil) No. 114 of 2014 in the matter of Common Cause versus Union of India needs to be submitted and included in the EIA/EMP Report.	Not Applicable. Fresh Mining Lease and Mining is yet to be commenced and there is no violation for this application attracting Common Cause Judgement.
B.	Forest	
15.	PP shall submit a certificate from Chief Conservator of Forests regarding involvement of Forest Land in the mining lease area if any. In case forest land is involved i) PP should submit the proof of application made for obtaining forest clearance and ii) a map clearly showing the forest & non-forest area.	Not Applicable. Entire Mining Lease Area is private patta land & Govt. Land and no Forest Land is involved. No Reserved Forest within the Study Area. Para 1.6 - Page No. 68

S.No	ToR Conditions	Compliance & Page No.
16.	Status of forestry clearance for the broken-up area and virgin forestland involved in the Project including deposition of net present value (NPV) and compensatory afforestation (CA) should be indicated. A copy of the forestry clearance should also be furnished.	Not Applicable. The proposal does not require any forest clearance.
17.	Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 should be indicated.	Not Applicable. There is no Reserved Forest within the study area of 10 km radius.
18.	The vegetation in the RF / PF areas in the study area, with necessary details should be given. The details shall encompass enumeration of trees which interalia shall include name of species and girth wise classification.	Not Applicable. There is no Reserved Forest within the study area of 10 km radius.
C.	Court Matters	
19.	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.	No litigation pending against the Proposal. Page No. 313
D.	Land Environment	
20.	PP should submit the details of survey number [viz. survey no, area in hectare, classification of land (government, private, forest, grazing land etc.), villages] duly authenticated by State Government, falling in the mining lease area.	Provided in Page No. 70 - 78 as given by the State Govt. in the LOI.
21.	The study area will comprise of 10 km zone around the mine lease from lease periphery and the data contained in the EIA such as waste generation etc. should be for the life of the mine / lease period.	Mining Lease area has been designated as the core zone. The buffer zone for the present study has been considered as an area encompassing 10 km from boundary of the Mining lease. All the data are provided for the Plan Period and Conceptual Stage. Fig. 3.1 – Page No. 123
22.	Land use of the study area delineating forest area, agricultural land, grazing land, wildlife	Page No. 137 - 138 Land use plan of the Mining lease area for preoperational, operational and post

S.No	ToR Conditions	Compliance & Page No.
	sanctuary, national park, migratory routes of fauna, water bodies, human settlements and other ecological features should be indicated. Land use plan of the mine lease area should be prepared to encompass preoperational, operational and post operational phases and submitted. Impact, if any, of change of land use should be given.	operational phases is given in Table 2.8. Para 2.9 – Page No. 118 – 119
23.	Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area, distance from mine lease, its land use, R&R issues, if any, should be given.	No Dump is proposed as simultaneous backfilling by the tailings from MSP is proposed. Para 2.4 - Page No. 97 Neither land acquisition nor purchase of land would be done for the Project. The permanent structures will not be disturbed and mining shall not lead to displacement of people. Thus, no R&R issue due to the Proposal. Page No. 63
E.	Wildlife	
24.	A study shall be got done to ascertain the impact of the Mining Project on wildlife of the study area and details furnished. Impact of the project on the wildlife in the surrounding and any other protected area and accordingly, detailed mitigative measures required, should be worked out with cost implications and submitted.	Not Applicable There are no Eco Sensitive Areas like National Parks, Wildlife Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar Sites, Tiger/Elephant Reserves, Reserved Forests, etc. within 10 km from the Mining Lease Area. Page No. 83
25.	A detailed biological study of the study area [core zone and buffer zone] shall be carried out. Details of flora and fauna, endangered, endemic and RET Species duly authenticated, separately for core and buffer zone should be furnished based on such primary field survey, clearly indicating the Schedule of the fauna present. PP shall submit list of Schedule-1 species present in core and buffer zone duly authenticated	Dealt under Para 3.10.6 Terrestrial Ecology. Page No. 210 No Scheduled-I fauna found and thus no Conservation Plan is required. Page No. 254

S.No	ToR Conditions	Compliance & Page No.
	<p>by CWLW. In case of any Scheduled-I fauna found in the study area, the necessary plan along with budgetary provisions for their conservation should be prepared in consultation with State Forest/Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost. Proof of its submission of conservation plan to the CWLW needs to be submitted.</p>	
26.	<p>PP shall submit a certificate from Chief Wildlife Warden regarding distance of mining lease from the protected area falling within 10 KM of the mining lease. In case project requires clearance under Wildlife (Protection) Act, 1972 then copy of application made for the same needs to be submitted.</p>	<p>Not Applicable. There is no protected area within 10 km study area from the mining lease. Kanniyakumari Wildlife Sanctuary is at 25 km (shortest) distance in northeast.</p>
F.	Baseline Environment:	
27.	<p>One season (non-monsoon) [i.e. March - May (Summer Season); October - December (post monsoon season); December - February (winter season)] primary baseline data on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna shall be collected and the AAQ and other data so compiled presented date-wise in the EIA and EMP Report. Site-specific meteorological data should also be collected. The location of the monitoring stations should be such as to represent whole of the study area and justified keeping in view the pre dominant downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500 m of the mine lease in the pre-</p>	<p>Baseline Data (BLD) collected during December 2022-February 2023 representing Winter 2022-23 Season has been utilised for the EIA Study. Chapter 3 covers all the data. Page No. 121</p>

S.No	ToR Conditions	Compliance & Page No.
	dominant downwind direction. The mineralogical composition of PM 10, particularly for free silica, should be given.	
28.	Air quality modelling should be carried out for prediction of impact of the project on the air quality of the area. It should also take into account the impact of movement of vehicles for transportation of mineral. The details of the model used and input parameters used for modelling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site, location of sensitive receptors, if any, and the habitation. The wind rose showing pre-dominant wind direction may also be indicated on the map.	AERMOD View Software is used for Predicting the maximum Ground Level Concentrations (GLCs) including Transportation Impact. Para 4.33 – Page No. 304 – 308 Predicated GLC contours superimposed on Baseline map are given as Fig 4.2 & 4.3 Page No. 307 – 308 Windrose Diagram is shown as Fig 3.18. Page No. 148
29.	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 from which samples were analyzed.	Complied. Photograph of monitoring stations & sampling locations along with Lab Reports are provided in Chapter 3.0. Page No. 128
G.	Water Environment	
30.	The water requirement for the Project, its availability and source should be furnished. Quantity of surface or ground water to be used for the Project should be indicated. A detailed water balance should also be provided. Submit the year wise target for reduction in consumption of the ground/surface water by developing alternative source of water through rain water harvesting measures. Description of water conservation measures proposed to be adopted in the Project should be	Water demand will be 2.5 KLD which will be sourced from permitted 4500 KLD from Valliyar River for the existing MSP at Manavalakurichi. Also, the quantity will be managed with local Drinking Water Suppliers. Sewage generation of 2.2 KLD will be biologically treated in a mobile Bio Toilets and the sludge will be used as manure for the Green Belt/Afforestation. No Workshop is proposed and thus, no trade effluent generation from the Mine. No mine pit will be there and thus; no mine drain is envisaged.

S.No	ToR Conditions	Compliance & Page No.
	given. Details of rainwater harvesting proposed in the Project, if any, should be provided. The capital and recurring expenditure to be incurred needs to be submitted.	Para 2.10 – Page No. 119 With simultaneous backfilling of mined out voids, there is no provision for Rainwater Harvesting in the Mining Lease Area.
31.	Impact of the Project on the water quality, both surface and groundwater, should be assessed and necessary safeguard measures, if any required, should be provided.	There will not be any disturbance due to the mining on the natural drains and rivers in the vicinity Para 4.3.5 – Page No. 309 – 310
H.	Hydro Geology	
32.	Details of any stream, seasonal or otherwise, passing through the lease area and modification/diversion proposed, if any, and the impact of the same on the hydrology should be.	Block-B is devoid of any water body and there are 2 Nos. streams in Block A which will not be disturbed as such. As the mined-out areas are going to be backfilled simultaneously, no surface Runoff generation from the Mining Lease (Pre-Project & Post-Project Runoffs will remain almost same). Also, there will not be any disturbance due to the mining on the natural drains and rivers in the vicinity. Page No. 309
33.	Information on site elevation, working depth, groundwater table etc. Should be provided both in AMSL and BGL. A schematic diagram may also be provided for the same.	The topography of the new mining lease area is flat except undulation found in certain patches. Page No. 125 The mining will be carried out at an average depth of 6 m and upto a maximum depth of 9 m depending upon the location and mineralization. No ground water-table intersection is envisaged as ground water-table level in the Mining Lease Area ranges between 10-15 m BGL. Page No. 310
34.	Based on actual monitored data, it may clearly be shown whether working will intersect groundwater. Necessary data and documentation in this regard may be provided. In case the working bench will intersect groundwater table, a detailed Hydro Geological Study should be	No ground water-table intersection is envisaged as ground water-table level in the Lease Area ranges between 10-15 m BGL. Page No. 310 No NOC from State GWA is required.

S.No	ToR Conditions	Compliance & Page No.
	<p>undertaken and Report furnished. The Report inter-alia shall include details of the aquifers present and impact of mining activities on these aquifers. Necessary permission from Central Ground Water Authority for working below ground water and for pumping of ground water should also be obtained and copy furnished. In case of surface water is proposed to be utilized then Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided.</p>	
I.	Transportation	
35.	<p>Impact on local transport infrastructure due to the Project should be indicated. Projected increase in truck traffic as a result of the Project in the present road network (including those outside the Project area) should be worked out, indicating whether it is capable of handling the incremental load. Arrangement for improving the infrastructure, if contemplated (including action to be taken by other agencies such as State Government) should be covered. Project Proponent shall conduct Impact of Transportation study as per Indian Road Congress Guidelines.</p>	<p>The existing traffic volume in the Project vicinity was found to be 9,458 Passenger Car Units (PCUs)/day. In the Post-Project Scenario, there will be an addition of 334 Vehicle (in 2 ways) due to due to the Project. It is worked to be only 16% volume addition to the existing traffic volume. The existing Roads/SH are adequate to handle the proposed traffic volume due to the Project. Para 4.3.2 – Page No. 302</p>
J.	Land Acquisition and R&R	
36.	<p>Details about the land proposed for mining activities should be given with information as to whether mining conforms to the land use policy of the State; land diversion for mining should have approval from State land use board or the concerned authority.</p>	<p>The Mining Lease area of 1144.0618 Ha comprises of 79.8613 Ha Government land and 1064.2005 Ha Private Patta lands. IREL has formulated a Policy i.e., Concession Option Scheme for taking possession of the Private Patta land on lease for mining. The land leasing period will be 11 months. Mining and backfilling will be simultaneously carried out within the</p>

S.No	ToR Conditions	Compliance & Page No.
		<p>lease period of 11 months and thereafter the land will be returned to the land owners with lease compensation. Neither land acquisition nor purchase of land would be done for the Project. The permanent structures will not be disturbed and mining shall not lead to displacement of people. Thus, no Rehabilitation & Resettlement (R&R) issue due to the Proposal. Para 1.8 – Page No. 80</p>
37.	<p>R&R Plan/compensation details for the Project Affected People (PAP) should be furnished. While preparing the R&R Plan, the relevant State/National Rehabilitation & Resettlement Policy should be kept in view. In respect of SCs /STs and other weaker sections of the society in the study area, a need-based sample survey, family-wise, should be undertaken to assess their requirements, and action programmes prepared and submitted accordingly, integrating the sectorial programmes of line departments of the State Government. It may be clearly brought out whether the village(s) located in the mine lease area will be shifted or not. The issues relating to shifting of village(s) including their R&R and socio-economic aspects should be discussed in the Report.</p>	<p>No Rehabilitation & Resettlement (R&R) issue due to the Proposal. Para 1.8 – Page No. 80</p>
K.	Socio-Economic Environment	
38.	<p>Public health implications of the Project and related activities for the population in the impact zone should be systematically evaluated and the proposed remedial measures should be detailed along with budgetary allocations.</p>	<p>On removal of the BSM ore (Run of Mines) containing Monazite and other minerals and backfilling with monazite free tailings over the mined-out areas, the background radiation in the mined out and back filled area is brought down to 0.2 - 0.4 μSvh^{-1}. In other words, there has been 8-10 fold reduction in the radiation level in the area where mining</p>

S.No	ToR Conditions	Compliance & Page No.
		<p>& backfilling is carried out by IREL and as such our mining does not affect either environment or people and makes the area free from high background radiation. Para 4.3.7 - Page No. 312</p>
39.	<p>Measures of socio-economic significance and influence to the local community proposed to be provided by the Project Proponent should be indicated. As far as possible, quantitative dimensions may be given with time frames for implementation.</p>	<p>Commencement of mining operation over the mining lease area of 1144.06.18 ha will result in overall development of the region in its own way like provision of direct & indirect employment, improvement in the general living standards and knowledge sharing, improved wage level and the living standard of the local people and continual improvements in the amenities and infrastructure facilities for the local populace. As such, extraction of Monazite and Zircon along with other associated minerals is very much essential for country's nuclear energy programme and transition to Green Energy etc., IREL is the only CPSE in the country being authorized to mine and handle "Monazite" and its value-added products. The Zircon produced from Manavalakurichi Unit is directly sent to the Nuclear Fuel Complex (NFC), Department of Atomic Energy for strategic applications. Page No. 328</p>
40.	<p>Public Hearing points raised and commitment of the Project Proponent on the same along with time bound Action Plan with budgetary provisions to implement the same should be provided and also incorporated in the final EIA/EMP Report of the Project.</p>	<p>Public Hearing is being conducted for the Project and Action Plan to address the PH issues along with Budget provision will be incorporated in the Final EIA-EMP report.</p>
41.	<p>Activity-wise time-bound action plan on the issues raised and commitment made during public hearing to be submitted as part of the final EMP Report in compliance of the Ministry's OM F.No.22-</p>	<p>Public Hearing is being conducted for the Project and Action Plan to address the PH issues along with Budget provision will be incorporated in the Final EIA-EMP report.</p>

S.No	ToR Conditions	Compliance & Page No.
	65/2017-IA.III dated 30111 September, 2020.	
L.	Environmental Monitoring and Management	
42.	It should be clearly stated whether the proponent Company has a well laid down Environment Policy approved by its Board of Directors? If so, it may be spelt out in the EIA Report with description of the prescribed operating process/procedures to bring into focus any infringement/deviation/violation of the environmental or forest norms/ conditions? The hierarchical system or administrative order of the Company to deal with the environmental issues and for ensuring compliance with the EC conditions may also be given. The system of reporting of non-compliances/violations of environmental norms to the Board of Directors of the Company and/or shareholders or stakeholders at large, may also be detailed in the proposed safeguard measures in each case should also be provided.	IREL has well laid 'Quality, Environment, Occupational Health & Safety' Policy approved by its Unit Head as appended. There is a hierarchy system established in the Unit to deal with Environmental issues. Any non-compliance will be reported to the Unit Head who will direct the Environment Cell to address the issue and place the action plan report. IREL will ensure the compliance of all Environmental Norms. Page No. 332 – 333
43.	Detailed environmental management plan (EMP) to mitigate the environmental impacts which, should inter-alia include the impacts of change of land use, loss of agricultural and grazing land, if any, occupational health impacts besides other impacts specific to the proposed Project.	Chapter 10.0 Page No. 330 - 336
M.	Critically Polluted Areas, Aravali & CRZ	
44.	Proximity to Areas declared as 'Critically Polluted' or the Project areas likely to come under the 'Aravali Range', (attracting court restrictions for mining operations), should also be indicated and where so required, clearance certifications from the prescribed Authorities,	Not Applicable. The project area does not fall in 'Critically Polluted Area' or in 'Aravali Range'.

S.No	ToR Conditions	Compliance & Page No.
	such as the SPCB or State Mining Dept. Should be secured and furnished to the effect that the proposed mining activities could be considered.	
45.	Similarly, for coastal Projects, A CRZ map duly authenticated by one of the authorized agencies demarcating LTL, HTL, CRZ area, location of the mine lease w.r.t CRZ, coastal features such as mangroves, if any, should be furnished. (Note: The Mining Projects falling under CRZ would also need to obtain approval of the concerned Coastal Zone Management Authority).	Out of the total area of 1144.0618 Ha, 353.4876 Ha area falls under CRZ-I(B), II and III categories. MoEF&CC authorized agency, Institute of Remote Sensing (IRS), Anna University, Chennai has prepared HTL/LTL (CRZ) Maps as required and submitted. Para 1.7 – Page No. 80 For obtaining TNSCZMA recommendations for the proposal, IREL has submitted the CRZ application to DCZMA, Kanniyakumari and the same is under their perusal. The recommendation will be obtained and submitted to the Ministry Para 1.12 – Page No. 87
N.	Risk Assessment & Disaster Management	
46.	Issues relating to Mine Safety, including subsidence study in case of underground mining and slope study in case of open cast mining, blasting study etc. should be detailed. The proposed safeguard measures in each case should also be provided.	The method of mining will be Non-Conventional Opencast Mechanized Mining by Excavator-Tipper combination with no Drilling & Blasting involved. Mining operation will be carried out at an average depth of 6 m and a maximum depth of 9 m depending upon the location and mineralization. Para 2.2 – Page No. 89
47.	Occupational Health impacts of the Project should be anticipated and the proposed preventive measures spelt out in detail. Details of pre-placement medical examination and periodical medical examination schedules should be incorporated in the EMP. The project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed.	IREL will provide and continually improve the occupational health and safety performance. Personal Protective Equipments will be provided to the mine employees. All the workers will be provided with Internal Dosimetry and Medical Surveillance. Maintenance of Pre, during & Post Employment Records will be done. Duly qualified Radiological Safety Officer (RSO) will be appointed. External Radiation Monitoring (by BARC) will be carried out periodically All the workers will be trained and instructed in radiation safety

S.No	ToR Conditions	Compliance & Page No.
		Para 4.3.7 – Page No. 312
48.	A Disaster Management Plan shall be prepared and included in the EIA/EMP Report.	IREL is having an effective Disaster Management Plan (DMP)/Emergency Preparedness Plan (EPP) in place in their Plants and Mines. The same procedure will be adopted/in place for the Proposed Project also. Para 7.3 – Page No. 318
49.	Environmental Management Plan (EMP) EMP shall be specific to the outcome of EIA Studies. EMP should include:	
i.	Recommendations for Air, Noise, Water, Sediments, Solid and Hazardous Waste Management, Conservation of Marine Life and Local Ecosystem during the Proposed Project Activities.	Environmental Management Plan (EMP) is suggested to mitigate the possible negative impacts that may be caused to the various attributes of environment due to the proposed mining operations.
ii.	Summary of potential adverse impacts and recommended mitigation measures.	Chapter 10.0 – Page No. 330
iii.	Allocation of resources and responsibilities for implementation.	
iv.	Administrative and Technical setup for the Management of Environment.	
v.	Institutional arrangements proposed with other organizations/Government authorities for effective implementation of environmental measures proposed in the EIA.	
vi.	Environmental specifications for the contractors should contain adequate safeguards to ensure that Management measures will not be compromised under adverse field conditions or time constraints.	Personal Protective Equipments will be provided to the mine employees. All the workers will be provided with Internal Dosimetry and Medical Surveillance. Maintenance of Pre, during & Post Employment Records will be done. Duly qualified Radiological Safety Officer (RSO) will be appointed. Para 2.12 – Page No. 120
vii.	Emergency preparedness manual shall be prepared, which should also include plant emergency, site emergency and general emergency exercises and their periodicity.	IREL is having an effective Disaster Management Plan (DMP)/Emergency Preparedness Plan (EPP) in place in their Plants and Mines. The same

S.No	ToR Conditions	Compliance & Page No.
		procedure will be adopted/in place for the Proposed Project also. Para 7.3 – Page No. 318
viii.	Risk Assessment and Emergency Planning with assessment of risks involved in construction and operation phases, and identification of maximum credible accident scenario, Emergency Preparedness Plan and Suggestions for Disaster Management Planning.	There is no storage of Hazardous Chemicals in the Mine lease area and thus, no Modelling is warranted. Para 7.1 – Page No. 318 IREL is having an effective Disaster Management Plan (DMP)/Emergency Preparedness Plan (EPP) in place in their Plants and Mines. The same procedure will be adopted/in place for the Proposed Project also. Para 7.3 – Page No. 318
ix.	Energy efficiency measures	Not Applicable
x.	Waste and effluent management details.	Not Applicable
xi.	Air pollution, water pollution and noise pollution mitigation measures.	Page No. 330 – 331
xii.	Due mitigations to be adopted in case of any impact identified at the stage of EIA preparation.	Environmental Management Plan (EMP) is suggested to mitigate the possible negative impacts that may be caused to the various attributes of environment due to the proposed mining operations. Chapter 10.0 – Page No. 330
xiii.	Suggestion of suitable measures for prevention and control of marine pollution from proposed project activities.	All parameters were estimated following the standard methods. Biological variables have also been studied and this includes planktons (both Phyto and Zooplankton), productivity and benthos (macro & meio). Marine water samples were collected from 10 locations within 10 Km radius of the project site. Page No. 254
xiv.	A well-defined monitoring matrix shall be part of EMP.	Radioactivity Monitoring as per AERB Norms and periodical monitoring of Ambient Air Quality (3 locations), Fugitive emissions/Workzone Air Quality (4 locations), Ambient & Workzone Noise Levels (4 locations), Water (4 Surface & 4 Ground waters along with Mine Pit water) and Soil

S.No	ToR Conditions	Compliance & Page No.
		Quality (3 Locations) shall be undertaken and reported to Authorities. Page No. 288
O.	Miscellaneous	
50.	The general points are also to be followed: -	
a.	All documents to be properly referenced with index and continuous page numbering.	Complied.
b.	Where data are presented in the Report especially in Tables, the period in which the data were collected and the sources should be indicated.	Complied.
c.	Project Proponent shall enclose all the analysis/testing reports of water, air, soil, noise etc. using the MoEF&CC/NABL accredited laboratories. All the original analysis/testing reports should be available during appraisal of the Project.	Complied.
d.	Where the documents provided are in a language other than English, an English translation should be provided.	Complied.
e.	The Questionnaire for environmental appraisal of mining projects as devised earlier by the Ministry shall also be filled and submitted.	Submitted as Form – I.
f.	While preparing the EIA report, the instructions for the Proponents and instructions for the Consultants issued by MoEF vide O.M. No. J-11013/41 /2006-IA.II (I) dated 4th August, 2009, which are available on the website of this Ministry, should be followed.	Complied. Page No. 9 & 10
g.	Changes, if any made in the basic scope and project parameters (as submitted in Form-I and the PFR for securing the TOR) should be brought to the attention of MoEF&CC with reasons for such	Noted and Complied. There is no change in basic scope and project parameters as submitted in TOR Application and EIA Report deliberated already. Now, the EIA Report along with Summary EIA reports in English and

S.No	ToR Conditions	Compliance & Page No.
	changes and permission should be sought, as the TOR may also have to be altered. Post Public Hearing changes in structure and content of the draft EIA /EMP (other than modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation.	Tamil languages are submitted for Public Consultation & Public Hearing.
h.	As per the circular no. J-11011/618/2010-IA.II(I) dated 30.5.2012, certified report of the status of compliance of the conditions stipulated in the environment clearance for the existing operations of the project, should be obtained from the Regional Office of Ministry of Environment, Forest and Climate Change, as may be applicable.	Not Applicable. Fresh Proposal for EC.
i.	The EIA report should also include (i) surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) sections of the mine pit and external dumps, if any, clearly showing the land features of the adjoining area.	Complied. Surface Plan – Page No. 104 – 105 Geological Plan – Page No. 106 & 108 Geological Section – Page No. 107 & 109

Doc – 1. Precise Area Communication



Industries (MMD.2) Department,
Secretariat, Chennai – 600 009.

Letter No.12503/MMD.2/2015-19, dated 28.06.2022

From
Thiru S.Krishnan, I.A.S.,
Additional Chief Secretary to Government.

To
The General Manager and Head,
Tvl.IREL (India) Limited,
Manavalakurichi,
Kanyakumari District – 629 252.

Sir,

Sub: Industries - Mines and Minerals – Atomic Minerals/Beach Sand Minerals – Area of an extent of 1144.06.18 hectares of Government and Private lands reserved by the Central Government in Kanyakumari District, Tamil Nadu for undertaking prospecting or mining operations through Tvl.IREL (India) Limited – Mining Lease application preferred by Tvl.IREL (India) Limited – Communication of precise area/Letter of Intent – Regarding.

- Ref:
1. Government of India, Ministry of Mines Notification No.G.S.R.399 (E), dated 11.06.2021.
 2. Mining lease application preferred by the General Manager & Head, Manavalakurichi, Tvl.IREL (India) Limited (Formerly Indian Rare Earths Limited), dated 24.06.2021.
 3. Government letter No.12503/MMD.2/2015-14, dated 08.12.2021 and 20.04.2022 addressed to the Government of India, Ministry of Mines.
 4. From the Government of India, Ministry of Mines, Order No.M.IV-7/74/2021-Mines IV, dated 21.04.2022.
 5. From the Government of India, Ministry of Mines, letter No.M.IV-7/74/2021-Mines IV, dated 22.04.2022.

I am directed to invite attention to the references cited. In the reference 5th cited, the Government of India, Ministry of Mines has conveyed its previous approval for grant of mining lease in favour of Tvl.IREL (India) Limited under the proviso to Section 5(1) and proviso to section 17A(2A) of the Mines and Minerals (Development and Regulation) Act, 1957 in respect of Beach Sand Minerals (BSM) over an extent of 1144.06.18 hectares in Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B Villages in Killiyoor Taluk, Kanyakumari District.

(p.t.o.)

..2..

2. Accordingly, under rule 6(5) of the Atomic Minerals Concession Rules, 2016, I am directed to request you to submit the Approved Mining Plan and other necessary clearances from the concerned Government agencies as required for grant of mining lease under section 17A(2A) of the Mines and Minerals (Development and Regulation) Act, 1957 for mining Beach Sand Minerals (BSM) over an extent of 1144.0618 hectares comprised in survey numbers as annexed to this letter in Keezhmidalam-A, Midalam-B, Enayamputhenthural, Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B Villages in Killiyoor Taluk, Kanyakumari District for a period until the entire reserves of the Beach Sand Minerals are exhausted subject to the following conditions:-

- (i) Tvl.IREL (India) Limited should submit an undertaking or an affidavit stating that consent of the private land owner or surface rights will be obtained and furnished in a phased manner to the State Government prior to entering into the private lands for mining, and no mining shall be carried out in private lands not owned by IREL without obtaining the consents or surface rights.
- (ii) Mining operations shall not cause any hindrance to the local public and adjoining pattadars.
- (iii) All conditions prescribed under Rule 10 of Atomic Minerals Concession Rules, 2016 shall be strictly adhered to.
- (iv) The applicant company is required to obtain a licence from the Atomic Energy Regulatory Board (AERB), Mumbai under Rule 3 of Atomic Energy (Radiation Protection) Rules, 2004.
- (v) The applicant company is required to obtain a licence from the Department of Atomic Energy under Rule 3 of the Atomic Energy (Working of the Mines, Minerals and Handling of Prescribed Substances) Rules, 1984.
- (vi) The applicant company should prepare a Mining Plan and obtain approval (including Progressive Mine Closure Plan) from the Atomic Minerals Directorate for Exploration and Research approved by the AMD, Hyderabad within a period of twelve months from the date of issuance of the communication from the Government.
- (vii) The applicant company shall obtain environmental clearance from the Ministry of Environment, Forest and Climate Change.
- (viii) The applicant company shall obtain CRZ clearance from the Competent Authority.
- (ix) The applicant company should provide a performance security to the State Government in the form of a bank guarantee or as a security deposit for an amount equivalent to 0.50 percent of the value of estimated resources as per Rule 6(6)(b) of AMCR 2016.

(contd..)

..3..

- (x) The applicant company should sign a Mine Development and Production Agreement with the State Government as per the format specified by the Central Government after compliance of conditions specified in clauses (a), (b), (c) and (d) of rule 6(6) of AMCR 2016.
- (xi) The applicant company should obtain approval or permit or no-objection or the like from the concerned Government authorities as may be required under applicable laws for commencement of mining operations.

Yours faithfully,

Dr. S. S. Srinivas
28/06/2022
for Additional Chief Secretary to Government
28/6/2022

Copy to:

The Secretary to Government of India,
Ministry of Mines,
Shastri Bhavan,
Dr. Rajendra Prasad Road,
New Delhi – 110 001.

The Secretary to Government of India,
Department of Atomic Energy,
Anushakti Bhavan,
C.S.M.Marg, Mumbai-400 001.

The Commissioner of Geology and Mining,
Guindy, Chennai – 600 032.

The District Collector,
Kanyakumari,
Nagercoil – 629 001.

Doc – 2. Mining Plan Approval by AMD

भारत सरकार Government of India
परमाणु ऊर्जा विभाग Department of Atomic Energy
परमाणु खनिज अन्वेषण एवं अनुसंधान निदेशालय
Atomic Minerals Directorate for Exploration and Research

1-10-153/156, बेगमपेट Begumpet,
हैदराबाद Hyderabad-500 016
दिनांक Date: 21.02.2024

संख्या No. AMD/MRG-4/6/2/2(8A)

विषय: मेसर्स आईआरईएल (इंडिया) लिमिटेड, मनावालाकुरिची के पक्ष में ग्राम कील मिदालम-ए, मिदालम-बी, इनयमपुयेंथुराई, एलदेसम-ए, बी & सी, एवं कोल्लेकोडे-ए & बी, जिला : कन्नियाकुमारी, तमिल नाडु में क्षेत्रफल 1144.0618 हेक्टेयर की सीमा में खनन योजना और प्रगामी खान बंदीकरण योजना के अनुमोदन के संदर्भ में।

Sub: Approval of Mining Plan and Progressive Mine Closure Plan over an extent of 1144.0618 ha in Keezhimidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode- A & B villages, Kanniyakumari district, Tamil Nadu in favour of M/s IREL (India) Limited, Manavalakurichi – Reg.

संदर्भ Ref : पत्र संख्या Letter No. IREL/MK/ 1144.0618 Ha /2024/107, दिनांक dated 02.02.2024

खान और खनिज (विकास और विनियमन) अधिनियम, 1957 के धारा 5 के उपधारा (2) के परंतुक (बी) और परमाणु खनिज रियायत नियमावली, 2016 के नियम 8(1) के द्वारा प्रदत्त शक्तियों का उपयोग करते हुए निदेशक, प.ख.नि. द्वारा मेसर्स आईआरईएल (इंडिया) लिमिटेड (आईआरईएल), के पक्ष में ग्राम कील मिदालम-ए, मिदालम-बी, इनयमपुयेंथुराई, एलदेसम-ए, बी & सी, एवं कोल्लेकोडे-ए & बी, जिला : कन्नियाकुमारी, तमिल नाडु में क्षेत्रफल 1144.0618 हेक्टेयर की सीमा में खनन योजना और प्रगामी खान बंदीकरण योजना निम्नलिखित शर्तों के तहत अनुमोदित किया जाता है:

In exercise of the powers conferred by clause (b) of sub-section (2) of Section 5 of the Mines and Minerals (Development and Regulation) Act, 1957 and Rule 8 (1) of the Atomic Minerals Concession Rules, 2016, the Mining Plan and Progressive Mine Closure Plan in Keezhimidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode- A & B villages, Kanniyakumari district, Tamil Nadu, extending over 1144.0618 ha is approved by the Director, AMD in favour of M/s IREL (India) Limited (IREL), subject to the following conditions:

- खनन योजना और प्रगामी खान बंदीकरण योजना तटीय बालू खनिज नामतः इल्मेनाइट, रुटाइल, जिरकान, मोनाज़ाइट, गार्नेट और सिलिमनाइट के संबंध में अनुमोदित है जिसे खान और खनिज (विकास और विनियमन), 1957 की प्रथम अनुसूची के भाग-ख के अधीन 'परमाणु खनिज' के रूप में अधिमूचित किया गया है।
The Mining Plan and Progressive Mine Closure Plan is approved in respect of beach sand minerals viz. ilmenite, rutile, zircon, monazite, garnet and sillimanite which are notified as 'Atomic Minerals' under Part B of First Schedule of Mines and Minerals (Development & Regulation) Act, 1957.
- यह अनुमोदन खनन पट्टा विलेख के निष्पादन और अन्य वैधानिक मंजूरी प्राप्त करने के बाद वर्ष I से वर्ष V तक पांच वर्ष की योजना अवधि के लिए वैध है।
This approval is valid for the five-year plan period from Year I to Year V after the execution of mining lease deed and obtaining other statutory clearances.
- आईआरईएल एएमसीआर, 2016 के प्रावधानों के अनुसार प्रत्येक पाँच वर्ष में खनन योजना की समीक्षा करेगा और इन नियमों के अंतर्गत विनिर्दिष्ट समय सारणी के अनुसार प.ख.नि. के अनुमोदन के लिए उसे प्रस्तुत करेगा।
IREL shall review the mining plan for every five-year as per the provisions of AMCR, 2016 and submit the same for approval of AMD as per the time schedule specified under these Rules.
- यह अनुमोदन खनन कार्यों के लिए आवश्यक केंद्रीय और राज्य प्राधिकरणों / विभाग से अन्य वैधानिक मंजूरी की पूर्ति के अधीन है।
This approval is subject to fulfilment of other statutory clearances from the Central and the State Authorities / Department(s) required for mining operations.

5. आईआरईएन परमाणु ऊर्जा (खान, खनिज कार्यकरण और विहित पदार्थ उठाई-धराई) नियमावली, 1984 के प्रावधानों के अनुसार अनुमानित मात्रा के प्रहसन/खनन का उल्लेख करते हुए, परमाणु ऊर्जा विभाग में लाइसेंस प्राप्त करे तथा संबंधित लाइसेंस में यथानिर्दिष्ट निबंधन एवं शर्तों का पालन करे। इसकी एक प्रतिलिपि प.ख.नि. के रिकार्ड हेतु भेजी जाए।
IREL shall obtain License from DAE to handle/mine the estimated quantities of prescribed substances as per the provisions of Atomic Energy (Working of Mines, Minerals and Handling of Prescribed Substances) Rules, 1984 and comply with the terms and conditions stipulated in the said License. A copy of the same may be submitted to AMD for records.
6. परमाणु ऊर्जा (विकिरण संरक्षण) नियम, 2004 (दिनांक 09.05.2009 के स्था.आदेश सं. 1210) के प्रावधानों के अनुसार, आईआरईएन एईआरबी से लाइसेंस प्राप्त करेगा। इसकी एक प्रतिलिपि प.ख.नि. के रिकार्ड हेतु भेजी जाए।
IREL shall obtain License from AERB as per the provisions of Atomic Energy (Radiation Protection) Rules, 2004 (vide S. O. No. 1210 dated 09.05.2009). A copy of the same may be submitted to AMD for records.
7. परमाणु ऊर्जा नियमांक परिषद के निदेशानुसार खनिज पृथक्करण संयंत्र में उत्पादित मोनाज़ाइट समृद्ध भारी खनिज मांडन का भंडारण अलग से किया जाए। उत्पादित मोनाज़ाइट का भंडारण/निपटान पकवि एवं एईआरबी के लाइसेंस की शर्तों के अतिरिक्त एमएमडीआर अधिनियम, 1957 के अंतर्गत प्रावधानों के अधीन होगा।
The monazite-rich heavy mineral concentrate produced from the mineral separation plant shall be stored separately as per the directions from AERB. The storage/disposal of monazite recovered shall be subjected to the conditions of licenses issued by DAE and AERB and also the provisions specified under MMDR Act, 1957.
8. भारत सरकार, राज्य सरकार अथवा किसी अन्य प्राधिकारी द्वारा तैयार, समय-समय पर खान/क्षेत्र पर निदेशित / अधिमूर्तित किसी कानून के तहत बिना किसी पूर्वग्रह के खान योजना तथा प्रगामी खान बंदीकरण योजना का अनुमोदन किया जाता है।
That the Mining Plan and Progressive Mine Closure Plan is approved without any prejudice to any other laws applicable to the mine/area from time to time whether made by the Government of India, State Government, or any other authority.
9. खनन योजना (प्रगामी खान बंदीकरण योजना सहित) का यह अनुमोदन किसी भी तरह से खान एवं खनिज (विकास एवं विनियम) अधिनियम, 1957 अथवा परमाणु खनिज रियायत नियम, 2016 अथवा वन (संरक्षण) अधिनियम, 1960, पर्यावरण संरक्षण अधिनियम, 1986 और उनके तहत बनाये गये नियमों का किसी भी अन्य प्रावधानों के संदर्भ में सरकार के अनुमोदन का संकेत नहीं देता है।
That this approval of the Mining Plan (including Progressive Mine Closure Plan) does not in any way imply the approval of the Government in terms of any other provisions of the Mines and Minerals (Development and Regulation) Act, 1957 or the Atomic Minerals Concession Rules, 2016 or any other law including Forest (Conservation) Act 1960, Environment Protection Act, 1985 and the rules made thereunder.
10. खान एवं खनिज (विकास एवं विनियम) अधिनियम, 1957 के प्रावधानों तथा उसके अंतर्गत बनाए गए नियमों का और अन्य वैधानिक प्रावधानों का अनुपालन किया जाए।
That the provisions of the Mines and Minerals (Development and Regulation) Act, 1957 and Rules made thereunder and other statutory provisions shall be complied with.
11. खान को प्रारंभ करने की सूचना, प्रबंधक तथा अन्य वैधानिक प्राधिकारियों की नियुक्ति सहित और खान अधिनियम, 1952 के प्रावधानों तथा उसके अंतर्गत बनाए गए नियमों और विनियमों के अनुपालन को सुनिश्चित किया जाए।
That the provisions of the Mines Act, 1952 and Rules and Regulations made thereunder including submission of notice of opening, appointment of manager and other statutory officials shall be complied with.
12. इस खनन योजना (प्रगामी खान बंदीकरण योजना सहित) का अनुमोदन किसी अन्य आदेश या न्याय क्षेत्राधिकार रखने वाले किसी न्यायालय के निदेशों पर पूर्वग्रह के बगैर किया गया है।
That this Mining Plan (including Progressive Mine Closure Plan) is approved without prejudice to any other order or direction from any court of competent jurisdiction.

13. खनन योजना (प्रगामी खान बंदीकरण योजना सहित) का निष्पादन, यदि कोई प्रतिबंधन आदेश/नोटिस हो तो उसके निरस्त होने की शर्त पर किया जाएगा।
The execution of Mining Plan (Including Progressive Mine Closure Plan) shall be subjected to vacation of prohibitory orders/notices, if any.
14. यदि खनन योजना (प्रगामी खान बंदीकरण योजना सहित) और सुधार प्रस्ताव की विषय-वस्तु में किसी ऐसे तथ्य को छिपाया हुआ पाया जाता है जिसे की खान अधिनियम, 1952 के अंतर्गत खुलासा करना अनिवार्य है, तो इस अनुमोदन को तत्काल प्रभाव से निरस्त समझा जाए।
If anything is found to have been concealed, which otherwise is required to be disclosed under the Mines Act, 1952 and MMDR Act, 1957 or the Rules made under the said Acts, in the contents of the Mining Plan (including Progressive Mine Closure Plan) and the proposals for rectification, the approval shall be deemed to have been withdrawn with immediate effect.
15. यदि किसी चरण में यह पता चलता है कि दस्तावेज में दी गई जानकारी असत्य है या किसी तथ्य को गलत ढंग में प्रस्तुत किया गया है, तो इस प्रलेख का अनुमोदन तत्काल प्रभाव से वापस ले लिया जायेगा।
If at any stage, it is observed that the information furnished in the document is incorrect or misrepresent facts, the approval of the document shall be revoked with immediate effect.
16. खनन प्रचालन और उससे संबद्ध गतिविधियों के लिए अनुमोदन केवल खनन पट्टा क्षेत्र (तमिल नाडु सरकार द्वारा मर्यादित अनुमोदित) में दिया गया है। खनन पट्टा क्षेत्र वह होगा जो अनुमोदित खनन योजना के अधीन पट्टेदार/ आर्हित व्यक्ति/आवेदक द्वारा सांविधिक योजनाओं में दिखाया गया है। आवेदक/पट्टेदार द्वारा प्रस्तुत पट्टे का नक्शा और अन्य योजनाओं के तहत प्रस्तुत जानकारी के संदर्भ में स्थल पर पट्टे क्षेत्र की परिसीमा (वाउंड्री) की सत्यता के संबंध में प.ख.नि. की कोई जिम्मेदारी नहीं होगी।
This approval of mining operations and associated activities is restricted to the mining lease area (as approved by the Government of Tamil Nadu) only. The mining lease area is as shown on the statutory plans in the approved mining plan submitted by the lessee/qualified person/applicant. AMD does not take any responsibility regarding correctness of the boundaries of the lease shown on the ground with reference to the lease map and other plans furnished by the applicant/lessee.
17. आईआरईएल राज्य सरकार द्वारा दिए गए खनन पट्टे का विवरण या उसमें किए गए संशोधनों की सूचना निदेशक, प.ख.नि. को रिवाई के लिए भेजे।
IREL shall furnish the details of grant of lease or modifications in mining lease by State Government to Director, AMD for record.
18. खनन योजना (प्रगामी खान बंदीकरण योजना सहित) के क्रियान्वयन के दौरान, राज्य सरकार द्वारा खनन पट्टे की मंजूरी पर विचार करते समय विनिर्दिष्ट शर्तों का पालन किया जाए।
The conditions stipulated by the State Government, if any, while considering the grant of mining lease shall be taken care of while implementing the Mining Plan (including Progressive Mine Closure Plan).
19. यदि खान के प्रचालन के दौरान किसी भी समय यह पाया जाता है कि मौजूदा कानूनो का पालन नहीं किया जा रहा है तो निदेशक, प.ख.नि. लिखित रूप में संबंधित कारण बताते हुए अनुमोदन को निलंबित कर सकते हैं।
That if anytime, during the operation of mines, it is found that the existing laws are not being followed, Director, AMD may suspend the approval accorded by giving the relevant reasons in writing.
20. मुख्य नियंत्रक खनन, आईबीएम नागपुर द्वारा उनके दिनांक 06.04.2010 के पत्रांक 11013/3/एमपी/90-नीसीओएम वाल्यूम VII द्वारा जारी किये गये परिपत्रांक 2/2010 की अंतर्वस्तु का अनुपालन किया जाए और पत्रांक को इसकी प्रति पृष्ठांकित की जाए।
The contents of circular No. 2/2010 issued by the Chief Controller of Mines, IBM, Nagpur vide his letter No. 11013/3/MP/90-CCoM Vol VII dated 06.04.2010 shall be complied with and a copy endorsed to AMD.
21. यदि खनन/प्रक्रमण पद्धति में कोई बड़ा परिवर्तन होता है तो तत्संबंधी सूचना निदेशक, प.ख.नि., हैदराबाद को प्रस्तुत की जाए तथा खनन योजना में आवश्यकतानुसार और भी संशोधन किए जाए।

That if there is any drastic change in the method of mining/processing, the information in this regard shall be submitted to Director, AMD, Hyderabad and the mining plan may be subjected to further revision as per requirement.

22. खनन योजना के कार्यान्वयन की निरीक्षण / मॉनिटरिंग के लिए परमाणु खनिज अन्वेषण एवं अनुसंधान निदेशालय के सहाय प्राधिकारी या प्राधिकृत अधिकारी को पूर्ण सुविधाएँ प्रदान की जाएंगी।
Full facilities shall be accorded to the Competent Authority or the Authorised Officer of the Atomic Minerals Directorate for Exploration and Research for inspection/monitoring of implementation of mining plan.

23. विद्यमान नियमों के अनुसार सभी सांविधिक विवरणियों और सूचनाओं की प्रतियाँ राज्य सरकार और निदेशक, प.ख.नि. को रिकार्ड हेतु प्रस्तुत किए जाएँ।
Copies of all statutory returns and notices as per rules in vogue shall be submitted to the State Government and the Director, AMD, Hyderabad for record.

उपरोक्त शर्तों की पूर्ति के अधीन तटीय बालू खनिज नामतः इलमेनाइट, रुटाइल, जिरकॉन, मोनाज़ाइट, गार्नेट और सिलिमनाइट के संबंध में अनुमोदित खनन योजना की दो प्रतियाँ संलग्न हैं।

Two copies of approved Mining Plan in respect of beach sand minerals viz. Ilmenite, Rutile, Zircon, Monazite, Garnet and Sillimanite subject to fulfilment of above conditions are enclosed.

Saravanan
21/2/2014

(नास्करन सरवणन Saravanan)
निदेशक/Director
निदेशक, प.ख.नि./DIRECTOR, AMD

सेवा में To

श्री एन सेल्वाराजन, मुख्य महाप्रबंधक एवं प्रमुख, आईआरईएन (इंडिया) लिमिटेड, मनावालाकुरिची, जिला : कन्नियाकुमारी, तमिल नाडु - 629 252	Shri N Selvarajan, Chief General Manager & Head, IREL (India) Ltd., Manavalakurichi, Kanniyakumari district, Tamil Nadu- 629 252
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सूचनार्थ प्रतिलिपि प्रेषित Copy for information to:

- संयुक्त सचिव (आई एंड एम), परमाणु ऊर्जा विभाग, पञ्चवि सचिवालय, अणुशक्ति भवन, सीएसएम मार्ग, मुंबई-400001.
Joint Secretary (I&M), Department of Atomic Energy, DAE Secretariat, Anushakti Bhavan, Chatrapati Shivaji Maharaj Marg, Mumbai- 400001
- चेयरमैन, आईआरबी, निषामक भवन, अणुशक्ति नगर, चेम्बूर ईस्ट, मुंबई - 400094
The Chairman, Atomic Energy Regulatory Board, Niyamak Bhavan, Anushakti Nagar, Chembur East, Mumbai- 400094
- अध्यक्ष एवं महाप्रबंधक, मेसर्स आई आर ई एन (इंडिया) लिमिटेड, प्लॉट नं 1207, वीर सावरकर मार्ग, प्रभादेवी, मुंबई - 400028.
Chairman and Managing Director, M/s IREL (India) Ltd., Plot No. 1207, Veer Savarkar Marg, Prabhadevi Mumbai-400028.

4. मुख्य खान नियंत्रक, भारतीय खान ब्यूरो, 6वां तम, 'डी' ब्लॉक, इंदिरा भवन, सिविल लाइन्स, नागपुर-440001.
The Chief Controller of Mines, Indian Bureau of Mines, 6th Floor, Block 'D', Indira Bhavan, Civil Lines, Nagpur-440001.
5. क्षेत्रीय खान नियंत्रक, भारतीय खान ब्यूरो, राजाजी भवन, C-4 A, सीजीओ कॉम्प्लेक्स, बेसंत नगर, चेन्नई - 600 090.
The Regional Controller of Mines, Indian Bureau of Mines, Rajaji Bhavan, C-4A, CGO Complex, Besant Nagar, Chennai – 600 090.
6. आयुक्त, भूविज्ञान और खनन आयुक्तमलय, खान एवं भूविज्ञान विभाग, औद्योगिक एस्टेट, गिन्दी, चेन्नई – 600 032.
The Commissioner, Commissionerate of Geology and Mining, Department of Mines and Geology, Industrial Estate, Guindy, Chennai – 600 032.
7. निदेशक, खान सुरक्षा महानिदेशालय, चेन्नई क्षेत्र, तीसरी मंजिल, बाएं विंग, नया अतिरिक्त भवन, सीजीओ कॉम्प्लेक्स, शास्त्री भवन, नुंगम्बक्कम, चेन्नई - 600 006.
The Director, Directorate General of Mines Safety, Chennai Region, 3rd Floor, Left Wing, New Additional Building, CGO Complex, Shastri Bhawan, Nungambakkam, Chennai- 600 006.

(भास्करन सरवणन B. Saravanan)
निदेशक Director

1.0 Introduction

1.1 Purpose of the Report

M/s. IREL (India) Limited (IREL) is a Multi-Unit-Multi-Product Central Public Sector Enterprise (CPSE) incorporated under the Companies Act 1913 and wholly owned by the Government of India, under the Administrative Control of the Department of Atomic Energy (DAE). IREL was established in August 1950 and entered into the activities of mining, mineral beneficiation and refining of heavy minerals found in the coastal stretches and inland Teri deposits. The Beach Sand Mineral (BSM) are suite of 7 minerals viz., Monazite, Zircon, Ilmenite, Rutile, Garnet, Sillimanite, and Leucoxene. These seven minerals occur together in nature by virtue of their formation along with coastal stretches/ inland areas near to the shore and in Teri deposits in varying grades in India.

IREL's first Plant was set up at Rare Earth Division (RED) in Aluva, Kerala started operations in the year 1952. IREL took over the operations of M/s. Travancore Minerals Limited in Chavara, Kerala and Manavalakurichi (MK), Tamil Nadu in 1965. Subsequently, in order to augment its share in strategic and commercial sectors, IREL set up its flagship unit Orissa Sands Complex (OSCOM) at Chatrapur, Ganjam District, Odisha in 1979 which is the largest mining and mineral separation unit in operation at present. The present total installed production capacity of all the above plants of IREL in Odisha, Tamil Nadu and Kerala is 10.04 lakh tonnes of minerals per annum (LTPA).

IREL is also involved in processing of the **Prescribed Substance, Monazite**, to extract Mixed Rare Earth Chloride (MRCL), Nuclear Grades Ammonium Di-Uranite (NGADU), Tri-Sodium Phosphate and Thorium Nitrate. The MRCL is further refined to produce separated High Pure Rare Earths. IREL is the only CPSE in the country being authorized to mine and handle "Monazite" and its value-added products. IREL is a 'Mini Ratna' Category-I CPSE with "Excellent" MoU rating over the last four consecutive years.

The Coastal stretches in Kanniyakumari District of Tamil Nadu is bestowed with the world best deposit of Monazite containing Uranium, Thorium and Rare Earth Oxide. The Monazite mineral is present in the deposit along with Titanium bearing mineral (Ilmenite, Rutile and Leucoxene), superior grade of Zircon (which is further processed to produce Zircon alloy for use in Nuclear Power Plant), Sillimanite and Garnet.

IREL, Manavalakurichi Unit in Kanniyakumari District of Tamil Nadu has been in operation since 1970, before Environmental Impact Assessment (EIA) & Coastal Regulation Zone (CRZ) Notifications came into force in the Country. The Unit is harnessing Monazite & Zircon along with other associated minerals and supplying the same to the Department of Atomic Energy and other downstream industries in the value chain. The Unit is being operated for an annual production capacity of 1,14,600 Tonnes of Atomic Minerals (HM).

As Tamil Nadu Pollution Control Board (TNPCB) has issued Consents to Operate (CTOs) for producing Ilmenite, Rutile, Zircon, Sillimanite, Monazite and Garnet from the BSM. Monazite is supplied to IREL Rare Earth Extraction Plant located in OSCOM, Chathrapur for producing Rare Earth concentrate as Mixed Rare Earth Chloride (MRCL),

Tri-sodium Phosphate, Thorium Nitrate along with other strategic materials for supplying to DAE.

IREL has been initially granted with 3 Mining Leases in Kanniyakumari District by the Government of Tamil Nadu. The First Mining Lease granted for 7.06 Ha vide G.O. Ms.No.3707 dated 01.11.1968, was renewed vide GO 3(D) No.6 dated 28.01.2000 and extended vide G.O.Ms.No.327 dated 01.12.2021 with validity till the mineral is exhausted. The Second Mining Lease granted vide G.O.Ms.No.1085 dated 21.09.1977 was executed on 15.10.1979. The Third Mining Lease for an extent of 141.2269 Ha has been granted vide G.O.Ms.No.1114 dated 12.08.1981 and extended vide G.O.Ms.No.73 dated 11.02.2021 with validity till the mineral is exhausted. EC for this Mining Lease has been awarded by MoEF&CC vide Order No. J-11015/387/2010-IA-II (M) dated 06.04.2018 for 10.00 Lakhs Tonnes Run-of-Mines (ROM) per annum.

Meanwhile, considering the importance of the strategic minerals i.e., Monazite and Zircon, DAE vide Letter No.3/10(21)/2015-PSU/11010 dated 13.08.2015 sought the concurrence of the Government of Tamil Nadu for reservation of Monazite rich area of 1144.0618 Ha in Kanniyakumari District for the purpose of mining of Atomic Minerals by IREL. Upon concurrence given by the Government of Tamil Nadu vide letter No.12503/MMD.2/2015-12 dated 15.04.2021, the Ministry of Mines, Government of India issued the Notification vide G.S.R.399(E) dated 11.06.2021 reserving the **area of 1144.0618 Ha for mining by IREL** under section 17A (1A) of Mines and Minerals (Development and Regulation) Act, 1957. Consequent to the issuance of the aforesaid Notification dated 11.06.2021, IREL has submitted the Application dated 25.06.2021 for grant of Mining Lease. On the said application, the Government of Tamil Nadu issued the Letter of Intent (LOI) vide No.12503/MMD.2/2015-19 dated 28.06.2022 and sought the required statutory clearances including approved Mining Plan towards the grant of Mining Lease.

The Mining Lease area of 1144.0618 Ha comprises of 79.8613 Ha Government land and 1064.2005 Ha Private Patta lands located in villages Keezhmidalam-A, Midalam-B, Enayamputhenthurai (**Block A**), Ezhudesam-A, B & C and Kollencode A & B Villages (**Block B**) of Killiyoor Taluk in Kanniyakumari District. Out of the total area of 1144.0618 Ha, 353.4876 Ha area falls under the CRZ zone. IREL has formulated a Policy i.e., Concession Option Scheme for taking possession of the Private Patta land on lease for mining. The land leasing period will be 11 months. Mining and backfilling will be simultaneously carried out within the lease period of 11 months and thereafter the land will be returned to the land owners with lease compensation.

Neither land acquisition nor purchase of land would be done for the Project. The permanent structures will not be disturbed and mining shall not lead to displacement of people. Thus, **no Rehabilitation & Resettlement (R&R) issue due to the Proposal.**

The mineable reserves estimated in the new mining lease area of 1144.0618 Ha is **59.88 Million Tonnes** ('111' category) and total reserve and resources is 109.15 Million Tonnes. Mineral content in the deposit varies between 10.0% and 22.6% with an average 14.5%. The method of mining will be **Non-Conventional Opencast Mechanized Mining** by Excavator-Tipper combination with no Drilling & Blasting involved. It is proposed to mine out Beach Sand Minerals-BSM @ 5000 Tonnes per day (TPD) ROM viz. 1.5 Million

Tonnes ROM per Annum. Mining operation will be carried out average depth of 6 m and a maximum depth of 9 m depending upon the location and mineralization. **No ground water-table intersection** is envisaged as ground water-table level in the Mining Lease Area ranges between 10-15 m BGL

ROM from the new mining lease will be transported and separated for individual atomic minerals at existing Mineral Separation Plant (MSP) at Manavalakurichi. In the MSP, the ROM is fed to Heavies Upgradation Section (HUS) and subsequently separated using its physical properties viz., Specific Gravity, Conductivity and Magnetic Susceptibility.

In the production quantity of 15.00 Lakhs TPA ROM & with about 70% recovery, the feed to the Mineral Separation Plant can have mineral production of 1,52,250 TPA. The generation of tailings (after removal of Minerals-Quartz) will be about 13,47,750 Tons per annum which will be transported to the mined-out voids and backfilled. Mining and backfilling will be carried out simultaneously. Thus, there will be **no bench** formation and **no Mine Pit** in the Mining Lease. Ore: Waste Ratio will be 1:0.

The Proposal requires prior EC under EIA Notification under Sl. No.1(a)-Category 'A' as well as under CRZ Notification 2011, as amended. Accordingly, IREL has filed the Application to MoEF&CC on 26.12.2022 to obtain the Terms of Reference (TOR) for carrying out the EIA Study. The Proposal was deliberated in 53rd Expert Appraisal Committee (EAC) – Nuclear & Defense (ND) meeting held on 27th January 2023. ToR has been awarded vide F. No. IA-Z-11013/10/2023-IA-I dated 22.02.2023.

Baseline Data (BLD) collected during December 2022-February 2023 representing Winter 2022-23 Season has been utilised for the EIA Study in compliance with MoEF&CC Office Memorandum No. J-11013/41/2006-IA-II(I)(Part) dated 29.08.2017. EIA Report has been prepared in compliance with awarded ToRs and submitted as per generic structure proposed in Appendix-III of EIA Notification 2006.

The EIA Consultant, M/s. ABC Techno Labs India Private Limited, Chennai has been accredited for various Sectors including Sector-1 (Mining Projects) for Category 'A' by the National Accreditation Board for Education & Training (NABET), Quality Council of India vide Certificate NABET/EIA/2225/RA0290 dated 11.06.2023 with Validity till 16.11.2025 (Sl. No. 4 of QCI/NABET List dated 15.07.2024). The ABC Techno Labs India Private Limited Laboratory is accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) vide Certificate No. TC-5770 dated 03.04.2024 with validity till 02.04.2026. The Lab is also recognised by the Ministry of Environment, Forest and Climate Change (MoEF&CC) vide Letter F. No. Q-15018/04/2019-CPW dated 14.10.2019 with validity of 5 years.

The EC Proposal was deliberated in the 61st EAC (N&D) Meeting held on 23.04.2024 as Agenda Sl. No. 3.1. The additional details sought by the committee are addressed in this Report and submitted for Public Hearing with Summary EIA reports in English and Tamil language. Action Plan to address the PH issues along with Budget provision will be incorporated in the Final EIA-EMP report.

1.2 Project Proponent

IREL (India) Limited is a Multi-Unit-Multi-Product Central Public Sector Enterprise (CPSE) incorporated under the Companies Act 1913 and wholly owned by the Government of India, under the Administrative Control of the Department of Atomic Energy. IREL was established in August 1950 and entered into the activities of mining, mineral beneficiation and refining of heavy minerals found in the coastal stretches and inland Teri deposits.

IREL's first Plant was set up at Rare Earth Division (RED) in Aluva, Kerala started operations in the year 1952. IREL took over the operations of M/s. Travancore Minerals Limited in Chavara, Kerala and Manavalakurichi (MK), Tamil Nadu in 1965. Subsequently, in order to augment its share in strategic and commercial sectors, IREL set up its flagship unit Orissa Sands Complex (OSCOM) at Chatrapur, Ganjam District, Odisha in 1979 which is the largest mining and mineral separation unit in operation at present.

IREL is also involved in processing of the **Prescribed Substance, Monazite**, to extract Mixed Rare Earth Chloride (MRCL), Nuclear Grade Ammonium Di-Uranite (NGADU), Tri-Sodium Phosphate and Thorium Nitrate. The MRCL is further refined to produce separated High Pure Rare Earths. IREL is the only CPSE in the country being authorized to mine and handle "Monazite" and its value-added products.

IREL has also set up a Rare Earth Extraction Plant (REEP) in its unit at OSCOM with installed capacity of producing about 11,200 TPA of Rare Earth concentrate as Mixed Rare Earth Chloride (MRCL), 13,500 TPA of Tri-sodium Phosphate, 150 TPA of Thorium Nitrate along with other strategic materials which are supplied to DAE. Thorium oxalate generated during the process is stored in engineered trenches for future use in the 2nd & 3rd stage nuclear power programme of the Country while the High Pure Rare Earth Plant located in Aluva, Kerala further processes the Mixed Rare Earth Chloride (MRCL) produced in Odisha to produce separated High Pure Rare Earths (HPRE) such as compounds of Lanthanum, Cerium, Neodymium-Praseodymium, Samarium, Gadolinium, Dysprosium etc.

IREL has set-up a Rare Earth Permanent Magnet Plant (REPM) in Bhabha Atomic Research Centre (BARC) Campus, Vishakhapatnam for production of Samarium-Cobalt Magnets for use in Defense, Space and Atomic Energy Sectors. Further, a Rare Earth & Titanium Theme Park is being set up in Bhopal, Madhya Pradesh to demonstrate pilot plants of scientific principles developed by BARC in laboratory scale and to provide hands-on experience of the plant to entrepreneurs so as to encourage them to set up commercial operations and develop the skilled manpower to operate the plants of future.

IREL is a 'Mini Ratna' Category-I CPSE with "Excellent" MoU rating over the last four consecutive years. IREL contributes to atomic energy programme by way of supplying strategic material to the DAE and also has excellent contribution for sustenance of industries in the value chain of its mineral & rare earth products. The processed mineral products find application in number of commercial sectors such as aerospace industry, infrastructure development, ceramics, foundries, oil industries etc., while Rare Earths are used in niche applications such as consumer electronics, renewable energy, EVs, etc.

All production units of the company are certified by ISO 9001:2015, ISO 14001:2015 and OHSAS 45001:2018. All the R&D Centers are NABL accredited as per ISO/IEC 17025 standard.

IREL, Manavalakurichi Unit in Kanniyakumari District of Tamil Nadu has been in operation since 1970, before Environmental Impact Assessment (EIA) & Coastal Regulation Zone (CRZ) Notifications came into force in the Country. The Unit is harnessing Monazite & Zircon along with other associated minerals and supplying the same to the Department of Atomic Energy and other downstream industries in the value chain. The Unit is being operated for an annual production capacity of 1,14,600 Tonnes of Atomic Minerals (HM).

Monazite is supplied to IREL Rare Earth Extraction Plant located in OSCOM, Chathrapur for producing Rare Earth concentrate as Mixed Rare Earth Chloride (MRCL), Tri-sodium Phosphate, Thorium Nitrate along with other strategic materials for supplying to DAE. Zircon produced from Manavalakurichi Unit is directly sent to the Nuclear Fuel Complex (NFC), Department of Atomic Energy for strategic applications.

Address for correspondence of project proponent:

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Phone: 04651-237325
Email: head.mk@irel.co.in
Website: www.irel.co.in

1.3 Existing Mining Leases

IREL has been initially granted with 3 Mining Leases in Kanniyakumari District by the Government of Tamil Nadu. The First Mining Lease granted for 7.06 Ha vide G.O. Ms.No.3707 dated 01.11.1968, was renewed vide GO 3(D) No.6 dated 28.01.2000 and extended vide G.O.Ms.No.327 dated 01.12.2021 with validity till the mineral is exhausted. The Second Mining Lease granted vide G.O.Ms.No.1085 dated 21.09.1977 was executed on 15.10.1979. The Environmental Clearance (EC) obtained for the Mining Lease from the Ministry of Environment, Forest and Climate Change (MoEF&CC) is pending before Hon`ble Supreme Court of India. The Third Mining Lease for an extent of 141.2269 Ha has been granted vide G.O.Ms.No.1114 dated 12.08.1981, executed on 27.06.1984 and extended vide G.O.Ms.No.73 dated 11.02.2021 with validity till the mineral is exhausted. EC for this Mining Lease has been awarded by MoEF&CC vide Order No. J-11015/387/2010-IA-II (M) dated 06.04.2018 for 10.00 Lakhs Tonnes ROM per annum.

1.4 Need for the Project

Continuing the operation in the aforesaid Mining Leases for the last 50 years and that too in a small extent of area, the minable reserves within the Mining Leases are nearly exhausted. The Plant capacity utilization during the past 10 years has been less than

40%. Hence, in order to ensure uninterrupted supply of strategic materials i.e., Monazite and Zircon to the Department of Atomic Energy, Defence, Space etc., DAE vide Letter No.3/10(21)/2015-PSU/11010 dated 13.08.2015 sought the concurrence of the Government of Tamil Nadu for reservation of Monazite rich area of 1144.0618 Ha in Kanniyakumari District for the purpose of mining of Atomic Minerals by IREL.

The new mining lease area of 1144.0618 Ha was explored in detail by Atomic Minerals Directorate for Exploration and Research (AMD) in various periods from 1994 to 2003. The mineable reserves estimated is 59.88 Million Tonnes. Mineral content in the deposit varies between 10.0% and 22.6% with an average 14.5%. Thus, the New Mining Lease will feed the Manavalakurichi Plant sustainably for another 40 Years period.

The processed mineral products, apart from its usage for strategic purpose in Nuclear Energy, Defence, Space, etc., finds application in number of commercial sectors such as aerospace industry, infrastructure development, ceramics, foundries, oil industries etc., while Rare Earths are used in niche applications such as consumer electronics, renewable energy, EVs, etc., As such, extraction of Monazite and Zircon along with other associated minerals is very much essential for country's nuclear energy programme, transition to Green Energy, etc., The project will generate revenue in terms of royalty and taxes etc. to the state of Tamil Nadu in addition to make available of strategic material. The project will also generate employment to the people and ancillary industries around the area. All these minerals and Rare Earth's provides input for other industries and plays a vital role in global economy. Hence, the project is of utmost importance for the country and the region.

1.5 Statutory Approvals

1.5.1 ML Grant

Upon concurrence given by the Government of Tamil Nadu vide letter No.12503/MMD.2/2015-12 dated 15.04.2021, the Ministry of Mines, Government of India issued the Notification vide G.S.R.399(E) dated 11.06.2021 reserving the **area of 1144.0618 Ha for mining by IREL** under section 17A (1A) of Mines and Minerals (Development and Regulation) Act, 1957. Consequent to the issuance of the aforesaid Notification dated 11.06.2021, IREL has submitted the Application dated 25.06.2021 for grant of Mining Lease. On the said application, the Government of Tamil Nadu issued the Precise Area Notification/Letter of Intent (LOI) vide No.12503/MMD.2/2015-19 dated 28.06.2022 with validity till the minerals are exhausted. It has also sought the required statutory clearances including approved Mining Plan towards the grant of Mining Lease.

1.5.2 Approved Mining Plan

IREL has applied and obtained the approval of Mining Plan along with Progressive Mine Closure Plan under Rule 8(1) of AMCR 2016 and Rule 23 of MCDR 2017 from Atomic Minerals Directorate for Exploration and Research (AMD), Hyderabad vide its Letter No. AMD/MRG-4/6/2/2(8A) dated 21.02.2024 with 5 years validity (Doc – 2).

On obtaining EC, the Mining Lease will be granted and executed. Consents to Establish (CTEs) and Consents to Operate (CTOs) will also be applied and obtained from TNPCB. The expected implementation schedule is 3 months on obtaining all statutory approvals.

1.6 Mining Lease Area

The Mining Lease area of 1144.0618 Ha comprises of 79.8613 Ha Government land and 1064.2005 Ha Private Patta lands. There is **no forest land** involved. ML area mainly consists of Teri Sand & Beach sand. There is no forest land involved.

Private Patta Lands	:	1064.2005 Ha
Government Lands	:	79.8613 Ha
Total ML Area	:	1144.0618 Ha

Out of the total area of 1144.0618 Ha, 353.4876 Ha area falls under the CRZ I-B, II & III Areas and 790.5742 Ha area falls in Non-CRZ Area. Government Lands mainly comprises of Road, Ponds and Public Buildings. Private Patta Lands fall in Dry Teri Sands with Coconut Plantations, permanent structures for residential use, etc. However, the permanent structures will not be disturbed at all for the Mining.

Details of tree cutting: Most of the private patta lands are found with scattered Coconut trees @ 70 Nos. per Ac. which will be cleared in the identified pocket lands for mining.

The Mining Lease area is located at Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B Villages, Killiyoor Taluk, Kanniyakumari District, Tamil Nadu and Index map is shown in Fig 1.1. For operational convenience, the total area of 1144.0618 Ha is divided into two Blocks i.e., "**Block A**" covering an area of **544.0688 Ha** in three villages viz., Keezhmidalam-A, Midalam-B & Enayamputhenthurai and "**Block B**" covering an area of **599.9930 Ha** in five villages viz., Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B. Mining Lease Area Survey Nos. are given in Table 1.1. Site Photographs are appended as Fig 1.2.

Table 1.1 : Village wise extent of area of the proposed mine

Name of the Village	Total Extent (Ha)	Patta Land (Ha)	Poramboke Land (Ha)
Block A			
Keezhmidalam - A	204.0652	194.7074	9.3578
Midalam - A	202.9686	190.1098	12.8588
Enayamputhenthurai	137.0350	134.3650	2.6700
Sub Total	544.0688	519.1822	24.8866
Block B			
Ezhudesam - A	41.1000	35.8950	5.2050
Ezhudesam - B	82.9000	80.5850	2.3150
Ezhudesam - C	275.8280	246.1792	29.6488
Kollencode - A	28.3950	25.7650	2.6300
Kollencode - B	171.7700	156.5941	15.1759
Sub Total	599.9940	545.0183	54.9747
Total	1144.0618	1064.20.05	79.86.13

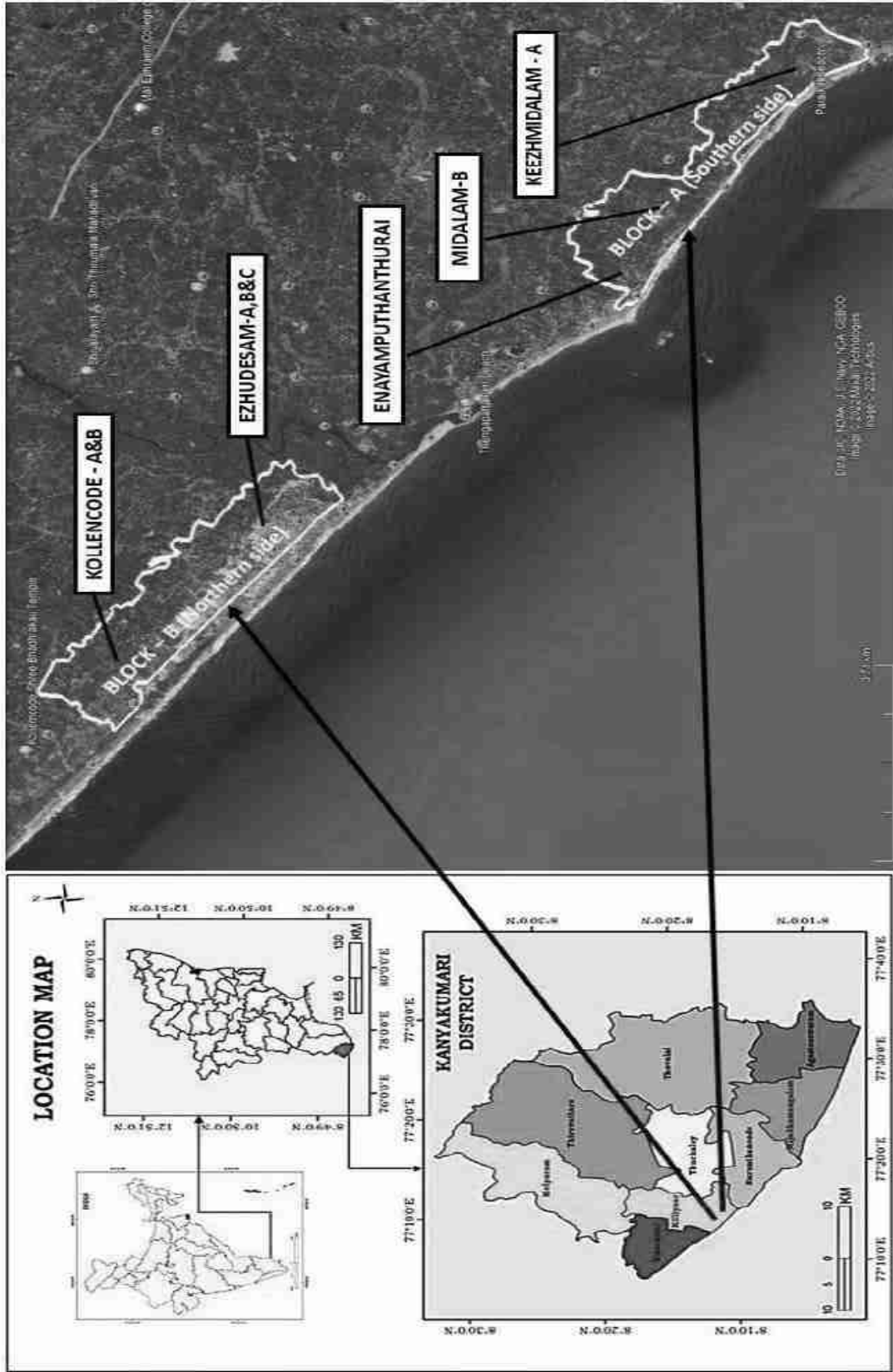


Figure 1.1 Index Map

Mining Lease Area Survey Numbers

Letter No.12503/MMD.2/2015-19, Industries (MMD.2) Department dated 28.06.2022					
DISTRICT: KANNIYAKUMARI			TALUK: KILLIYOOR		
VILLAGE: KEEZHIDALAM-A					
Serial No.	Resurvey No.	Total Extent	IREL Proposed Area	Patta Land	Poramboke Land
		Hectares	Hectares	Hectares	Hectares
1	16	3.83.00	3.83.00	3.71.00	0.12.00
2	17	3.34.50	3.34.50	2.97.50	0.37.00
3	18	4.82.00	4.82.00	4.49.50	0.32.50
4	19	4.42.50	4.42.50	4.19.00	0.23.50
5	45	3.89.00	3.89.00	3.81.50	0.07.50
6	46	4.17.50	4.17.50	3.91.50	0.26.00
7	47	4.04.50	4.04.50	3.97.00	0.07.50
8	48	3.07.50	3.07.50	2.59.00	0.48.50
9	49	3.38.50	3.38.50	3.13.50	0.25.00
10	50	3.11.50	3.11.50	3.11.50	0.00.00
11	51	3.12.00	3.12.00	3.12.00	0.00.00
12	52	3.55.00	3.55.00	3.32.50	0.22.50
13	53	4.27.00	4.27.00	4.27.00	0.00.00
14	54	3.66.00	3.66.00	3.66.00	0.00.00
15	55(Part)	0.74.80	0.74.80	0.74.80	0.00.00
16	56(Part)	0.29.07	0.29.07	0.29.07	0.00.00
17	57(Part)	3.26.00	3.26.00	3.26.00	0.00.00
18	58	2.37.50	2.37.50	2.31.50	0.06.00
19	59	3.83.50	3.83.50	3.79.50	0.04.00
20	60	3.24.50	3.24.50	3.12.50	0.12.00
21	61	2.35.50	2.35.50	2.06.50	0.29.00
22	69	1.15.50	1.15.50	1.15.50	0.00.00
23	70	1.42.50	1.42.50	1.34.00	0.08.50
24	71	0.19.50	0.19.50	0.00.00	0.19.50
25	72	0.36.00	0.36.00	0.00.00	0.36.00

26	73	2.71.00	2.71.00	2.71.00	0.00.00
27	74	1.07.00	1.07.00	1.07.00	0.00.00
28	75	0.41.00	0.41.00	0.00.00	0.41.00
29	76	2.69.00	2.69.00	2.69.00	0.00.00
30	77	0.24.50	0.24.50	0.00.00	0.24.50
31	78	1.86.00	1.86.00	1.85.00	0.01.00
32	79	0.40.50	0.40.50	0.00.00	0.40.50
33	80	0.56.00	0.56.00	0.00.00	0.56.00
34	81	2.38.50	2.38.50	2.38.50	0.00.00
35	82(Part)	1.61.00	1.61.00	1.61.00	0.00.00
36	83(Part)	2.23.44	2.23.44	2.23.44	0.00.00
37	84	1.28.50	1.28.50	1.28.50	0.00.00
38	85	2.15.00	2.15.00	2.15.00	0.00.00
39	86	1.20.50	1.20.50	1.20.50	0.00.00
40	87	7.91.50	7.91.50	7.85.00	0.06.50
41	88	3.95.00	3.95.00	3.87.50	0.07.50
42	89(Part)	2.40.33	2.40.33	2.40.33	0.00.00
43	90(Part)	0.00.61	0.00.61	0.00.61	0.00.00
44	91(Part)	1.05.27	1.05.27	1.05.27	0.00.00
45	92	3.01.50	3.01.50	3.01.50	0.00.00
46	93	1.96.50	1.96.50	1.96.50	0.00.00
47	94	3.91.00	3.91.00	3.91.00	0.00.00
48	95	2.40.00	2.40.00	2.40.00	0.00.00
49	96(Part)	22.31.00	22.31.00	22.24.50	0.06.50
50	97	3.73.00	3.73.00	3.73.00	0.00.00
51	98	4.50.50	4.50.50	3.64.22	0.86.28
52	99	0.96.00	0.96.00	0.84.00	0.12.00
53	100	2.08.50	2.08.50	2.08.50	0.00.00
54	101	3.71.50	3.71.50	3.71.50	0.00.00
55	102	2.27.00	2.27.00	2.15.00	0.12.00
56	103	2.66.00	2.66.00	2.07.00	0.59.00

57	104	1.63.50	1.63.50	1.59.50	0.04.00
58	105	3.64.00	3.64.00	3.45.50	0.18.50
59	106	1.23.00	1.23.00	1.04.00	0.19.00
60	107	3.50.00	3.50.00	3.18.00	0.32.00
61	108	0.44.50	0.44.50	0.44.50	0.00.00
62	109	0.28.50	0.28.50	0.07.50	0.21.00
63	110	0.67.50	0.67.50	0.66.50	0.01.00
64	123	3.52.50	3.52.50	3.33.00	0.19.50
65	124	2.92.00	2.92.00	2.82.00	0.10.00
66	126	2.50.50	2.50.50	2.38.00	0.12.50
67	127	1.75.50	1.75.50	1.71.50	0.04.00
68	128	2.43.00	2.43.00	2.31.50	0.11.50
69	129	3.45.50	3.45.50	3.39.00	0.06.50
70	136	2.62.50	2.62.50	2.20.50	0.42.00
71	137	2.13.50	2.13.50	2.03.00	0.10.50
72	138	3.50.00	3.50.00	3.50.00	0.00.00
73	139	3.17.50	3.17.50	3.17.50	0.00.00
74	140	2.29.00	2.29.00	2.15.00	0.14.00
75	141(Part)	0.72.00	0.72.00	0.72.00	0.00.00
TOTAL		204.06.52	204.06.52	194.70.74	9.35.78
VILLAGE: MIDALAM B					
1	80	3.85.50	3.85.50	3.63.50	0.22.00
2	82	2.10.50	2.10.50	1.86.00	0.24.50
3	83	2.37.00	2.37.00	2.37.00	0.00.00
4	84	1.98.50	1.98.50	1.44.50	0.54.00
5	85	2.92.00	2.92.00	2.92.00	0.00.00
6	86	1.68.00	1.68.00	1.68.00	0.00.00
7	87	2.07.00	2.07.00	2.06.50	0.00.50
8	88	2.32.50	2.32.50	2.32.50	0.00.00
9	89	2.07.00	2.07.00	2.06.50	0.00.50
10	90	0.16.00	0.16.00	0.16.00	0.00.00

11	91	0.25.50	0.25.50	0.21.00	0.04.50
12	92	1.93.00	1.93.00	1.32.50	0.60.50
13	93	1.48.00	1.48.00	1.48.00	0.00.00
14	94	2.69.50	2.69.50	2.65.50	0.04.00
15	95	2.67.50	2.67.50	2.60.50	0.07.00
16	96	1.93.00	1.93.00	1.93.00	0.00.00
17	97	1.67.50	1.67.50	1.44.00	0.23.50
18	98	2.01.50	2.01.50	1.88.00	0.13.50
19	99	1.75.50	1.75.50	1.41.50	0.34.00
20	100	3.72.50	3.72.50	3.71.00	0.01.50
21	101	3.30.50	3.30.50	3.06.50	0.24.00
22	105	2.58.50	2.58.50	2.45.50	0.13.00
23	106	2.60.50	2.60.50	2.46.00	0.14.50
24	107	1.49.50	1.49.50	1.39.50	0.10.00
25	108	3.31.00	3.31.00	3.31.00	0.00.00
26	109	2.79.00	2.79.00	2.79.00	0.00.00
27	110	1.21.00	1.21.00	0.92.00	0.29.00
28	111	0.40.50	0.40.50	0.18.50	0.22.00
29	112	3.37.00	3.37.00	3.37.00	0.00.00
30	113(Part)	4.76.00	4.76.00	4.76.00	0.00.00
31	114	3.39.50	3.39.50	3.39.50	0.00.00
32	115(Part)	2.42.50	2.42.50	2.42.50	0.00.00
33	116	0.53.00	0.53.00	0.00.00	0.53.00
34	117	1.11.50	1.11.50	1.01.00	0.10.50
35	118	4.64.00	4.64.00	4.64.00	0.00.00
36	119	3.45.50	3.45.50	3.01.00	0.44.50
37	120	3.08.50	3.08.50	2.96.50	0.12.00
38	121	3.34.50	3.34.50	3.19.50	0.15.00
39	122	1.43.00	1.43.00	1.29.50	0.13.50
40	123	0.26.50	0.26.50	0.00.00	0.26.50
41	124	1.87.00	1.87.00	1.40.50	0.46.50

42	125	1.14.50	1.14.50	1.14.50	0.00.0
43	126	1.77.00	1.77.00	1.77.00	0.00.0
44	127	1.52.00	1.52.00	1.52.00	0.00.0
45	128	4.41.00	4.41.00	4.41.00	0.00.0
46	129	2.16.00	2.16.00	2.16.00	0.00.0
47	130	3.84.50	3.84.50	3.84.50	0.00.0
48	131	1.71.50	1.71.50	1.71.50	0.00.0
49	132	1.87.50	1.87.50	1.55.00	0.32.5
50	133	0.14.50	0.14.50	0.00.00	0.14.5
51	134	0.52.50	0.52.50	0.00.00	0.52.5
52	135	4.16.00	4.16.00	4.03.00	0.13.0
53	136	3.69.50	3.69.50	3.60.00	0.09.5
54	137	3.09.50	3.09.50	3.03.50	0.06.0
55	138	2.54.00	2.54.00	2.47.50	0.06.5
56	139	3.12.50	3.12.50	3.08.50	0.04.0
57	140	0.17.00	0.17.00	0.17.00	0.00.0
58	141	1.44.50	1.44.50	1.44.50	0.00.0
59	142	0.31.00	0.31.00	0.00.00	0.31.0
60	143	2.74.35	2.74.35	1.98.91	0.75.4
61	144	3.29.50	3.29.50	3.17.50	0.12.0
62	145	2.28.00	2.28.00	2.11.00	0.17.0
63	146	1.81.00	1.81.00	1.76.50	0.04.5
64	147	2.34.50	2.34.50	2.25.00	0.09.5
65	148	2.43.00	2.43.00	2.36.50	0.06.5
66	149	2.80.50	2.80.50	2.80.50	0.00.0
67	150	0.18.50	0.18.50	0.00.50	0.18.0
68	151	2.43.50	2.43.50	2.43.50	0.00.0
69	152	0.18.00	0.18.00	0.00.00	0.18.0
70	153	2.97.00	2.97.00	2.97.00	0.00.0
71	154	1.42.00	1.42.00	1.42.00	0.00.0
72	155	1.32.00	1.32.00	1.32.00	0.00.0

73	156	1.82.00	1.82.00	1.82.00	0.00.00
74	157	0.23.50	0.23.50	0.23.50	0.00.00
75	158	0.14.00	0.14.00	0.14.00	0.00.00
76	159	2.02.50	2.02.50	0.84.00	1.18.50
77	160	1.84.00	1.84.00	1.84.00	0.00.00
78	161	0.96.00	0.96.00	0.96.00	0.00.00
79	162	3.43.95	3.43.95	3.43.95	0.00.00
80	163(Part)	0.00.38	0.00.38	0.00.19	0.00.19
81	166(Part)	0.72.52	0.72.52	0.72.52	0.00.00
82	167	1.45.00	1.45.00	1.38.50	0.06.50
83	168	1.31.50	1.31.50	1.31.50	0.00.00
84	169	1.63.50	1.63.50	1.63.50	0.00.00
85	170(Part)	0.06.09	0.06.09	0.06.09	0.00.00
86	173	2.32.50	2.32.50	2.22.00	0.10.50
87	174	0.40.00	0.40.00	0.00.00	0.40.00
88	175	3.36.00	3.36.00	3.23.50	0.12.50
89	176(Part)	0.04.31	0.04.31	0.03.07	0.01.24
90	177(Part)	2.13.52	2.13.52	1.88.02	0.25.50
91	178(Part)	0.38.14	0.38.14	0.38.14	0.00.00
92	179(Part)	0.46.69	0.46.69	0.46.69	0.00.00
93	180(Part)	0.66.50	0.66.50	0.66.50	0.00.00
94	182(Part)	2.15.00	2.15.00	2.15.00	0.00.00
95	183	2.53.50	2.53.50	2.37.50	0.16.00
96	184	1.94.50	1.94.50	1.83.00	0.11.50
97	185	1.56.50	1.56.50	1.42.50	0.14.00
98	186	2.15.50	2.15.50	2.01.00	0.14.50
99	187	2.80.41	2.80.41	2.46.90	0.33.51
100	188	2.05.00	2.05.00	1.94.00	0.11.00
101	189	1.47.00	1.47.00	1.26.50	0.20.50
102	190	0.24.00	0.24.00	0.17.00	0.07.00
103	191	0.19.50	0.19.50	0.19.50	0.00.00

104	192	1.77.00	1.77.00	1.77.00	0.00.00
105	193	1.17.00	1.17.00	1.14.50	0.02.50
106	194	0.24.00	0.24.00	0.23.50	0.00.50
107	196	0.25.50	0.25.50	0.00.00	0.25.50
108	203	0.06.50	0.06.50	0.06.50	0.00.00
TOTAL		202.96.86	202.96.86	190.10.98	12.85.88
VILLAGE: ENAYAMPUTHENTHURAI					
1	494(Part)	2.81.51	2.81.51	2.81.51	0.00.00
2	495	3.57.50	3.57.50	3.57.50	0.00.00
3	496	0.24.00	0.24.00	0.00.00	0.24.00
4	529	1.08.00	1.08.00	1.08.00	0.00.00
5	530	1.80.00	1.80.00	1.80.00	0.00.00
6	531	2.40.00	2.40.00	2.40.00	0.00.00
7	532	0.99.00	0.99.00	0.99.00	0.00.00
8	533	2.13.00	2.13.00	2.13.00	0.00.00
9	534	2.24.50	2.24.50	2.24.50	0.00.00
10	535	2.16.50	2.16.50	2.16.50	0.00.00
11	536	1.58.00	1.58.00	1.59.00	0.08.00
12	537	1.20.00	1.20.00	1.20.00	0.00.00
13	541	1.25.50	1.25.50	1.25.50	0.00.00
14	542	1.23.50	1.23.50	1.23.50	0.00.00
15	543	1.04.49	1.04.49	1.04.49	0.00.00
16	544	1.57.50	1.57.50	1.57.50	0.00.00
17	545	1.32.50	1.32.50	1.23.00	0.09.50
18	546	1.17.00	1.17.00	0.99.50	0.17.50
19	547	1.90.50	1.90.50	1.90.50	0.00.00
20	548	1.65.00	1.65.00	1.65.00	0.00.00
21	549	0.17.50	0.17.50	0.04.50	0.13.00
22	550	0.66.50	0.66.50	0.66.50	0.00.00
23	551	1.13.00	1.13.00	1.13.00	0.00.00
24	552	2.71.50	2.71.50	2.71.50	0.00.00

25	553	0.17.00	0.17.00	0.17.00	0.00.00
26	554	0.22.00	0.22.00	0.22.00	0.00.00
27	555	1.85.50	1.85.50	1.85.50	0.00.00
28	556	1.20.50	1.20.50	1.20.50	0.00.00
29	557	0.09.50	0.09.50	0.09.50	0.00.00
30	558	0.85.00	0.85.00	0.85.00	0.00.00
31	559	0.30.00	0.30.00	0.00.00	0.30.00
32	560	2.46.00	2.46.00	2.46.00	0.00.00
33	561	2.21.00	2.21.00	2.21.00	0.00.00
34	562	2.49.00	2.49.00	2.49.00	0.00.00
35	563	3.14.50	3.14.50	3.14.50	0.00.00
36	564	1.69.50	1.69.50	1.69.50	0.00.00
37	565	1.75.50	1.75.50	1.75.50	0.00.00
38	566	1.53.50	1.53.50	1.53.50	0.00.00
39	567	1.11.50	1.11.50	1.11.50	0.00.00
40	578	3.70.00	3.70.00	3.70.00	0.00.00
41	581	2.58.50	2.58.50	2.58.50	0.00.00
42	582	1.32.00	1.32.00	1.32.00	0.00.00
43	585	0.07.00	0.07.00	0.07.00	0.00.00
44	587	0.41.50	0.41.50	0.41.50	0.00.00
45	588	0.09.00	0.09.00	0.08.50	0.00.50
46	589	1.02.50	1.02.50	1.02.50	0.00.00
47	590	0.09.50	0.09.50	0.00.00	0.09.50
48	591	1.53.50	1.53.50	1.40.50	0.13.00
49	592	0.07.50	0.07.50	0.00.00	0.07.50
50	593	1.68.50	1.68.50	1.68.50	0.00.00
51	594	0.07.00	0.07.00	0.01.50	0.05.50
52	595	2.76.50	2.76.50	2.76.50	0.00.00
53	596	0.29.00	0.29.00	0.03.50	0.25.50
54	597	0.24.00	0.24.00	0.00.00	0.24.00
55	598	0.42.50	0.42.50	0.07.50	0.35.00

56	599	0.17.50	0.17.50	0.00.00	0.17.50
57	600	1.44.50	1.44.50	1.44.50	0.00.00
58	601	2.35.00	2.35.00	2.35.00	0.00.00
59	602	1.13.00	1.13.00	1.13.00	0.00.00
60	603	0.75.50	0.75.50	0.75.50	0.00.00
61	604	4.11.50	4.11.50	4.11.50	0.00.00
62	605	1.76.50	1.76.50	1.76.50	0.00.00
63	606	1.27.00	1.27.00	1.27.00	0.00.00
64	607	1.73.00	1.73.00	1.73.00	0.00.00
65	608	2.71.00	2.71.00	2.71.00	0.00.00
66	609	1.15.00	1.15.00	1.15.00	0.00.00
67	610	0.86.50	0.86.50	0.86.50	0.00.00
68	611	1.67.00	1.67.00	1.67.00	0.00.00
69	612	0.19.50	0.19.50	0.19.50	0.00.00
70	613	0.19.00	0.19.00	0.19.00	0.00.00
71	614	2.15.00	2.15.00	2.15.00	0.00.00
72	615	0.18.00	0.18.00	0.17.50	0.00.00
73	616	1.82.50	1.82.50	1.82.00	0.05.00
74	617	3.61.50	3.61.50	3.56.00	0.05.00
75	618	1.64.50	1.64.50	1.63.00	0.01.00
76	619	1.37.00	1.37.00	1.37.00	0.00.00
77	620	1.49.00	1.49.00	1.49.00	0.00.00
78	621	2.26.50	2.26.50	2.26.50	0.00.00
79	622	3.34.00	3.34.00	3.34.00	0.00.00
80	623	0.73.00	0.73.00	0.73.00	0.00.00
81	624	1.45.50	1.45.50	1.45.50	0.00.00
82	625	1.67.50	1.67.50	1.67.50	0.00.00
83	626	3.35.50	3.35.50	3.35.50	0.00.00
84	627	0.18.50	0.18.50	0.18.50	0.00.00
85	628	0.13.50	0.13.50	0.13.50	0.00.00
86	629	0.17.50	0.17.50	0.17.50	0.00.00

87	630	2.47.00	2.47.00	2.47.00	0.00.00
88	631	0.22.50	0.22.50	0.08.50	0.14.00
89	632	4.07.50	4.07.50	4.07.50	0.00.00
90	633	3.47.00	3.47.00	3.47.00	0.00.00
91	634	4.09.00	4.09.00	4.09.00	0.00.00
TOTAL		137.03.50	137.03.50	134.36.50	2.67.00
VILLAGE: EZHUDESAM-A					
1	374(PART)	0.31.50	0.31.50	0.31.50	0.00.00
2	402	1.88.00	1.88.00	1.88.00	0.00.00
3	404	0.94.50	0.94.50	0.94.50	0.00.00
4	403	1.66.00	1.66.00	1.66.00	0.00.00
5	407	2.91.50	2.91.50	2.83.00	0.08.50
6	408	4.10.00	4.10.00	1.32.00	2.78.00
7	409	2.12.50	2.12.50	2.12.50	0.00.00
8	410	1.55.50	1.55.50	1.54.50	0.01.00
9	411	1.68.00	1.68.00	1.68.00	0.00.00
10	412	0.74.00	0.74.00	0.74.00	0.00.00
11	413	2.05.50	2.05.50	2.05.50	0.00.00
12	448	1.41.50	1.41.50	1.41.50	0.00.00
13	449	0.77.00	0.77.00	0.77.00	0.00.00
14	450	0.82.00	0.82.00	0.82.00	0.00.00
15	451	4.75.50	4.75.50	2.71.50	2.04.00
16	452	1.97.00	1.97.00	1.97.00	0.00.00
17	453	2.44.50	2.44.50	2.44.50	0.00.00
18	455	1.91.00	1.91.00	1.90.00	0.01.00
19	456	1.62.50	1.62.50	1.62.50	0.00.00
20	457	1.20.00	1.20.00	1.20.00	0.00.00
21	458	1.01.00	1.01.00	0.88.00	0.13.00
22	488	2.35.00	2.35.00	2.35.00	0.00.00
23	490	0.86.00	0.86.00	0.71.00	0.15.00
TOTAL		41.10.00	41.10.00	35.89.50	5.20.50

VILLAGE: EZHUDESAM-B					
1	139	4.09.00	4.09.00	4.02.50	0.06.50
2	146	1.10.50	1.10.50	1.10.50	0.00.00
3	149	0.13.00	0.13.00	0.00.00	0.13.00
4	150	0.91.50	0.91.50	0.75.50	0.16.00
5	151	2.43.00	2.43.00	2.40.00	0.03.00
6	152	1.39.00	1.39.00	1.26.00	0.13.00
7	153	3.61.50	3.61.50	3.45.50	0.16.00
8	154	3.58.00	3.58.00	3.58.00	0.00.00
9	157	0.09.50	0.09.50	0.06.50	0.03.00
10	169	2.80.50	2.80.50	2.76.50	0.04.00
11	170	4.29.50	4.29.50	4.29.50	0.00.00
12	171	3.37.00	3.37.00	3.23.50	0.13.50
13	172	1.21.00	1.21.00	1.21.00	0.00.00
14	173	3.70.00	3.70.00	3.62.00	0.08.00
15	174	3.23.00	3.23.00	3.11.50	0.11.50
16	175(Part)	2.14.55	2.14.55	2.14.55	0.00.00
17	186	1.86.00	1.86.00	1.86.00	0.00.00
18	187	2.55.00	2.55.00	2.55.00	0.00.00
19	192	3.14.00	3.14.00	3.14.00	0.00.00
20	193	1.30.00	1.30.00	1.30.00	0.00.00
21	194	3.13.95	3.13.95	3.13.95	0.00.00
22	195	3.32.50	3.32.50	3.26.00	0.06.50
23	196	2.95.50	2.95.50	2.95.50	0.00.00
24	197	2.65.50	2.65.50	2.63.00	0.02.50
25	198	2.59.00	2.59.00	2.46.00	0.13.00
26	199	1.94.50	1.94.50	1.81.50	0.13.00
27	200	1.49.50	1.49.50	1.43.00	0.06.50
28	201	3.96.50	3.96.50	3.55.00	0.41.50
29	202	2.66.50	2.66.50	2.66.50	0.00.00
30	203	1.21.00	1.21.00	1.21.00	0.00.00

31	204	1.96.00	1.96.00	1.96.00	0.00.00
32	205	3.32.00	3.32.00	3.32.00	0.00.00
33	208	2.21.50	2.21.50	2.01.00	0.20.50
34	207	2.50.50	2.50.50	2.30.00	0.20.50
TOTAL		82.90.00	82.90.00	80.58.50	2.31.50
VILLAGE: EZHUDESAM C					
1	206	3.54.50	3.54.50	3.37.00	0.17.50
2	209	2.04.50	2.04.50	1.96.50	0.08.00
3	210	3.16.00	3.16.00	3.14.00	0.02.00
4	211	3.40.50	3.40.50	2.73.00	0.67.50
5	212	1.61.00	1.61.00	1.34.50	0.26.50
6	213	2.59.50	2.59.50	2.31.00	0.28.50
7	214	2.44.00	2.44.00	2.37.00	0.07.00
8	215	1.73.50	1.73.50	1.44.00	0.29.50
9	216	1.14.50	1.14.50	1.00.00	0.14.50
10	217	2.02.50	2.02.50	1.93.00	0.09.50
11	218	1.57.00	1.57.00	1.57.00	0.00.00
12	219	1.12.50	1.12.50	1.12.50	0.00.00
13	220	8.55.00	8.55.00	8.55.00	0.00.00
14	221	5.35.50	5.35.50	5.35.50	0.00.00
15	225	8.81.00	8.81.00	8.81.00	0.00.00
16	226	6.90.00	6.90.00	6.90.00	0.00.00
17	228	6.83.00	6.83.00	6.83.00	0.00.00
18	229	2.03.50	2.03.50	2.03.50	0.00.00
19	246	9.10.00	9.10.00	9.06.00	0.04.00
20	247	8.19.50	8.19.50	8.19.50	0.00.00
21	248	2.93.50	2.93.50	2.93.50	0.00.00
22	249	1.45.00	1.45.00	1.39.50	0.05.50
23	250	1.86.00	1.86.00	1.80.00	0.06.00
24	251	2.37.00	2.37.00	2.37.00	0.00.00
25	252	1.51.00	1.51.00	1.33.00	0.18.00

26	253	1.40.50	1.40.50	1.30.50	0.10.00
27	254	1.28.50	1.28.50	1.28.50	0.00.00
28	255	0.68.50	0.68.50	0.61.00	0.07.50
29	256	3.20.50	3.20.50	2.90.50	0.30.00
30	258	0.13.50	0.13.50	0.00.00	0.13.50
31	259	0.20.50	0.20.50	0.00.00	0.20.50
32	261	2.30.00	2.30.00	2.30.00	0.00.00
33	262	3.44.00	3.44.00	3.44.00	0.00.00
34	263	1.65.50	1.65.50	1.65.50	0.00.00
35	264	2.69.00	2.69.00	2.69.00	0.00.00
36	265	2.39.00	2.39.00	2.39.00	0.00.00
37	266	1.83.00	1.83.00	1.78.00	0.05.00
38	267	1.16.50	1.16.50	1.15.00	0.01.50
39	268	1.16.50	1.16.50	1.16.50	0.00.00
40	269	1.83.50	1.83.50	1.83.50	0.00.00
41	270	0.17.00	0.17.00	0.00.00	0.17.00
42	271	1.39.50	1.39.50	1.19.50	0.20.00
43	272	0.84.00	0.84.00	0.74.50	0.09.50
44	273	1.16.00	1.16.00	1.08.00	0.08.00
45	274	0.60.00	0.60.00	0.52.00	0.08.00
46	275	0.51.50	0.51.50	0.51.50	0.00.00
47	276	0.56.50	0.56.50	0.56.50	0.00.00
48	277	0.21.00	0.21.00	0.00.00	0.21.00
49	278	2.27.50	2.27.50	2.16.00	0.11.50
50	279	0.22.50	0.22.50	0.22.50	0.00.00
51	280	0.99.00	0.99.00	0.98.50	0.00.50
52	281	1.48.50	1.48.50	1.47.50	0.01.00
53	282	6.68.00	6.68.00	6.66.00	0.02.00
54	283	7.95.50	7.95.50	6.76.00	1.19.50
55	294	0.24.50	0.24.50	0.24.50	0.00.00
56	295	3.78.50	3.78.50	3.78.50	0.00.00

57	296	17.14.30	17.14.30	16.46.30	0.68.00
58	319	9.31.50	9.31.50	8.54.50	0.77.00
59	320	8.29.00	8.29.00	8.29.00	0.00.00
60	322	6.41.00	6.41.00	5.59.00	0.82.00
61	327	3.38.00	3.38.00	3.38.00	0.00.00
62	328	6.91.00	6.91.00	6.00.00	0.91.00
63	329	22.85.00	22.85.00	9.80.50	13.04.50
64	330	3.00.50	3.00.50	2.91.50	0.09.00
65	331	1.95.00	1.95.00	1.87.00	0.08.00
66	332	1.08.50	1.08.50	1.07.00	0.01.50
67	333	0.76.50	0.76.50	0.64.50	0.12.00
68	334	1.65.00	1.65.00	1.48.50	0.16.50
69	335	1.86.00	1.86.00	1.85.00	0.01.00
70	336	2.53.00	2.53.00	2.39.50	0.13.50
71	337	2.02.00	2.02.00	2.02.00	0.00.00
72	338	4.58.00	4.58.00	4.58.00	0.00.00
73	339	1.49.00	1.49.00	1.41.00	0.08.00
74	340	4.43.50	4.43.50	4.34.00	0.09.50
75	341	2.77.50	2.77.50	2.77.50	0.00.00
76	342	1.06.50	1.06.50	1.00.00	0.06.50
77	343	2.32.00	2.32.00	2.18.00	0.14.00
78	344	2.06.50	2.06.50	1.75.50	0.31.00
79	345	2.31.00	2.31.00	2.23.50	0.07.50
80	346	0.98.00	0.98.00	0.98.00	0.00.00
81	347	3.12.50	3.12.50	2.98.00	0.14.50
82	348	3.06.50	3.06.50	2.96.00	0.10.50
83	351	1.99.00	1.99.00	1.99.00	0.00.00
84	352	2.78.50	2.78.50	2.77.50	0.01.00
85	353	1.24.50	1.24.50	1.24.50	0.00.00
86	354	2.03.00	2.03.00	2.03.00	0.00.00
87	355	1.90.00	1.90.00	1.61.50	0.28.50

88	359(Part)	1.72.00	1.72.00	1.72.00	0.00.0
TOTAL		275.82.80	275.82.80	246.17.92	29.64.1
VILLAGE: KOLLENCODE-A					
1	347	2.80.50	2.80.50	2.80.50	0.00.0
2	348	1.80.50	1.80.50	1.80.50	0.00.0
3	354(Part)	3.25.50	3.25.50	3.04.00	0.21.5
4	355	4.59.50	4.59.50	4.44.00	0.15.5
5	356	3.48.00	3.48.00	3.16.00	0.32.0
6	357	2.48.50	2.48.50	2.21.00	0.27.5
7	358	3.27.00	3.27.00	1.85.00	1.42.0
8	362	0.95.50	0.95.50	0.87.00	0.08.5
9	363	2.69.50	2.69.50	2.51.50	0.16.0
10	364	1.37.50	1.37.50	1.37.50	0.00.0
11	365	1.67.50	1.67.50	1.67.50	0.00.0
TOTAL		28.39.50	28.39.50	25.76.50	2.63.1
VILLAGE: KOLLENCODE-B					
1	585	2.87.00	2.87.00	2.80.81	0.06.11
2	586	2.13.00	2.13.00	2.13.00	0.00.0
3	587	0.82.50	0.82.50	0.82.50	0.00.0
4	588	4.71.00	4.71.00	4.71.00	0.00.0
5	589	4.17.50	4.17.50	4.17.50	0.00.0
6	590	1.51.00	1.51.00	1.51.00	0.00.0
7	591	3.30.50	3.30.50	3.30.50	0.00.0
8	595	1.53.50	1.53.50	1.42.00	0.11.5
9	596	1.63.00	1.63.00	1.63.00	0.00.0
10	601	1.89.00	1.89.00	1.89.00	0.00.0
11	602	2.18.50	2.18.50	2.18.50	0.00.0
12	603	3.53.00	3.53.00	3.53.00	0.00.0
13	604	3.78.50	3.78.50	3.71.00	0.07.5
14	605	5.09.50	5.09.50	0.00.00	5.09.5
15	606	2.15.50	2.15.50	2.01.00	0.14.5

16	607	3.32.50	3.32.50	3.00.50	0.32.00
17	608	2.77.00	2.77.00	2.44.00	0.33.00
18	609	3.06.50	3.06.50	3.06.50	0.00.00
19	610	2.74.50	2.74.50	2.74.50	0.00.00
20	611	1.26.50	1.26.50	1.18.00	0.08.50
21	612	0.79.00	0.79.00	0.79.00	0.00.00
22	613	1.98.00	1.98.00	1.99.00	0.00.00
23	614	3.29.50	3.29.50	3.26.50	0.03.00
24	615	2.18.50	2.18.50	2.05.50	0.13.00
25	616	2.44.00	2.44.00	2.21.00	0.23.00
26	617	2.34.00	2.34.00	2.34.00	0.00.00
27	618	2.25.00	2.25.00	2.17.00	0.08.00
28	619	1.97.00	1.97.00	1.81.00	0.16.00
29	620	2.52.00	2.52.00	2.46.00	0.06.00
30	621	2.09.00	2.09.00	2.09.00	0.00.00
31	623(Part)	1.50.15	1.50.15	1.50.15	0.00.00
32	651	2.80.00	2.80.00	2.31.00	0.49.00
33	652	1.30.00	1.30.00	1.16.50	0.13.50
34	655	2.68.90	2.68.90	2.53.40	0.15.50
35	656	2.10.50	2.10.50	2.05.50	0.05.00
36	657	2.88.00	2.88.00	2.80.50	0.07.50
37	658	1.33.50	1.33.50	1.21.00	0.12.50
38	659	0.69.00	0.69.00	0.59.50	0.09.50
39	660	1.14.00	1.14.00	1.14.00	0.00.00
40	661	1.02.50	1.02.50	1.02.50	0.00.00
41	662	1.11.00	1.11.00	1.01.50	0.09.50
42	663	1.59.50	1.59.50	1.46.00	0.13.50
43	664	1.52.50	1.52.50	1.46.50	0.06.00
44	665	2.00.50	2.00.50	1.81.00	0.19.50
45	666	2.77.50	2.77.50	2.77.50	0.00.00
46	667	1.78.00	1.78.00	1.63.50	0.14.50

47	668	2.48.00	2.48.00	2.48.00	0.00.00
48	669	2.33.50	2.33.50	2.33.50	0.00.00
49	670	1.71.00	1.71.00	1.55.50	0.15.50
50	671	1.43.00	1.43.00	1.39.00	0.04.00
51	672	2.37.00	2.37.00	2.19.00	0.18.00
52	673	0.86.50	0.86.50	0.86.50	0.00.00
53	674	1.95.00	1.95.00	1.95.00	0.00.00
54	675	2.36.50	2.36.50	2.19.00	0.17.50
55	676	9.85.95	9.85.95	9.69.45	0.16.50
56	677	3.01.50	3.01.50	3.01.50	0.00.00
57	678	3.90.50	3.90.50	3.90.50	0.00.00
58	679	3.54.00	3.54.00	3.38.00	0.16.00
59	680	2.09.50	2.09.50	2.09.50	0.00.00
60	681	1.90.00	1.90.00	1.90.00	0.00.00
61	682	3.85.00	3.85.00	3.85.00	0.00.00
62	683	1.23.50	1.23.50	1.23.50	0.00.00
63	684	2.57.00	2.57.00	2.57.00	0.00.00
64	685	2.45.50	2.45.50	2.45.50	0.00.00
65	686	3.00.00	3.00.00	2.99.00	0.01.00
66	687	2.49.50	2.49.50	2.29.50	0.20.00
67	688	3.89.50	3.89.50	3.89.50	0.00.00
68	689	2.83.50	2.83.50	2.41.60	0.41.90
TOTAL		171.77.00	171.77.00	156.59.41	15.17.59

S. KRISHNAN
ADDITIONAL CHIEF SECRETARY TO GOVERNMENT

// True copy //

S. KRISHNAN
SECTION OFFICER

ABSTRACT

Letter No. 12503/IMD,2/2015-19 Industries (IMD,2) Department,
Dated 28.06.2022

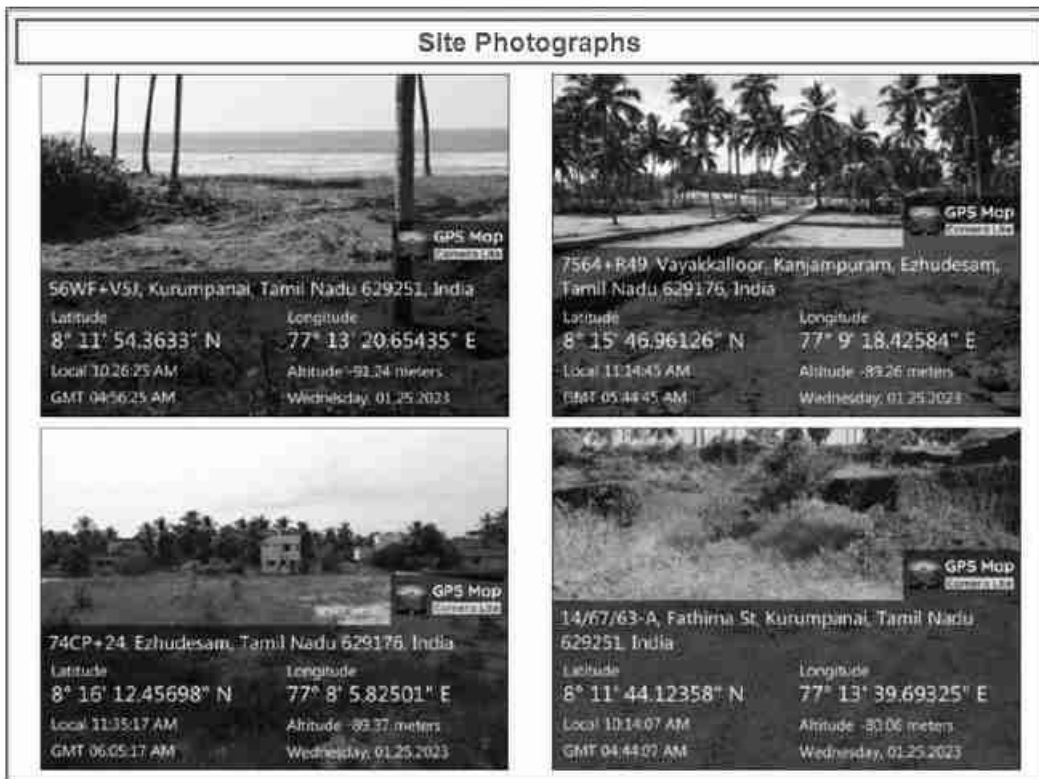
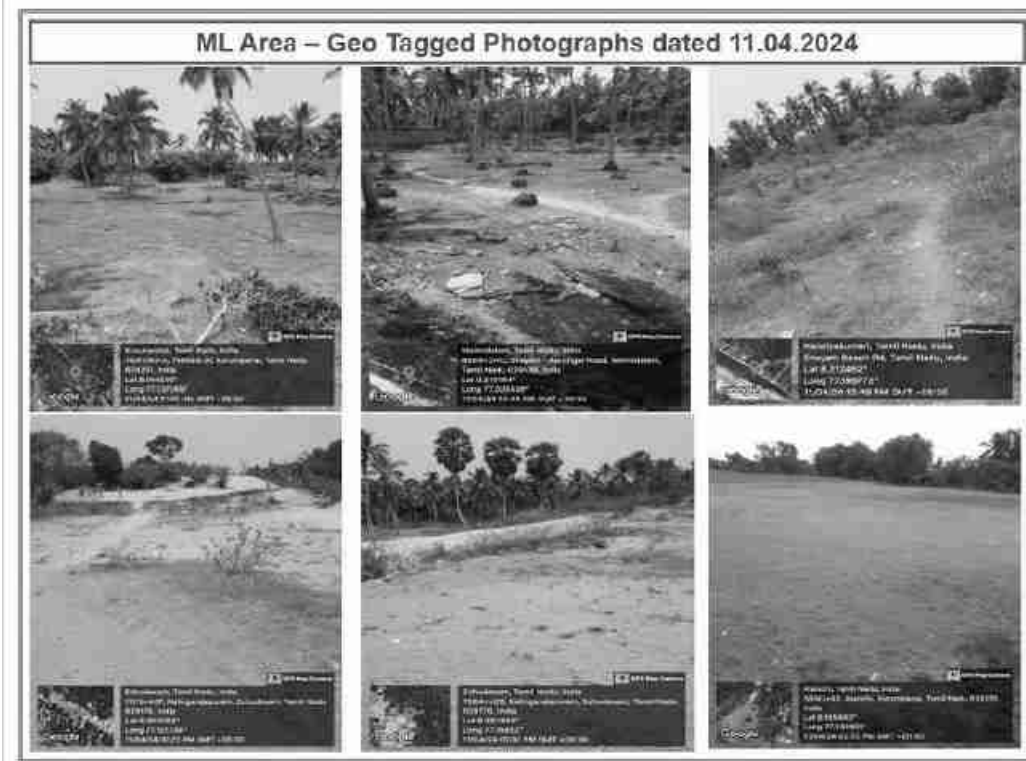
Sl. No.	Village	Total Extent	IREL Proposed Area	Water Land	Forest Land
		Hectares	Hectares	Hectares	Hectares
1	NEEDHADALAM - A	204.96.52	204.06.52	194.70.34	9.35
2	NEEDALAM - B	202.96.86	202.96.86	100.10.93	12.01
3	SHAYAMPUTHENTHURAI	137.03.50	137.03.50	134.36.50	2.67
4	EZHODESAM - A	41.10.00	41.10.00	35.89.50	5.20
5	EZHODESAM - B	82.90.00	82.90.00	80.58.50	2.31
6	EZHODESAM - C	275.82.80	275.82.80	246.17.92	29.64
7	KALLENTIDE - A	38.20.50	38.20.50	30.76.50	7.03
8	KOLLECODE - B	171.77.00	171.77.00	156.59.41	15.17
Total		1144.06.18	1144.06.18	1004.29.05	79.00

S. KRISHNAN
ADDITIONAL CHIEF SECRETARY TO GOVERNMENT

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S. KRISHNAN
SECTION OFFICER

Figure 1.2 Site Photographs



1.7 Area in CRZ

Out of the total area of 1144.0618 Ha, **353.4876 Ha area falls under CRZ-I(B), II and III categories.** Area falling in CRZ area are given in Table 1.2.

ML Area falls in:

CRZ-IB	:	5.2946 Ha
CRZ-II	:	203.3491 Ha
CRZ-III	:	144.8439 Ha

Area falls in CRZ Area	:	353.4876 Ha.
Area falls in Non-CRZ Area	:	790.5742 Ha

Total ML Area	:	1144.0618 Ha

MoEF&CC authorized agency, the **Institute of Remote Sensing (IRS), Anna University, Chennai** has prepared HTL/LTL (CRZ) Maps as required and submitted as Fig 1.4 & 1.5. IRS, Anna University report is appended as Annexure.

Table 1.2 Area falling in CRZ

Survey Nos.	Zonation	Area(Ha)
Proposed Project Site in Keezhmidalam-A, Midalam-B, Enayamputhenthurai Villages	CRZ-IB	4.4700
	CRZ-II	122.0806
	CRZ-III (200m to 500m from HTL)	80.6453
	CRZ-III (NDZ No Development Zone)	64.1986
	OUT OF CRZ	272.6742
	TOTAL	544.0688
Proposed Project Site in Kollencode – A & B and Ezhudesam - A, B & C Villages	CRZ-IB	0.8246
	CRZ-II	81.2685
	OUT OF CRZ	517.8999
	TOTAL	599.9930

1.8 Mining Lease Area Surface Right

IREL will not acquire any Private Patta land for the project. It has formulated a Policy i.e., Concession Option Scheme for taking possession of the Private Patta land on lease for mining. Private land owners voluntarily provide their lands to IREL under this Scheme for mining. The land leasing period will be 11 months. Mining and backfilling will be simultaneously carried out within the lease period of 11 months and thereafter the land will be returned to the land owners with lease compensation. On return of land, the land owners predominantly carry out the plantation of Coconut and other fruit bearing trees and also utilize the land for other activities including construction. **Mining in the lease hold areas will not result in any displacement nor change in the ownership of the land.**

Neither land acquisition nor purchase of land would be done for the Project. The permanent structures, village builtup areas, etc. will not be disturbed and mining shall not lead to displacement of people. Thus, **no Rehabilitation & Resettlement (R&R) issue due to the Proposal.**

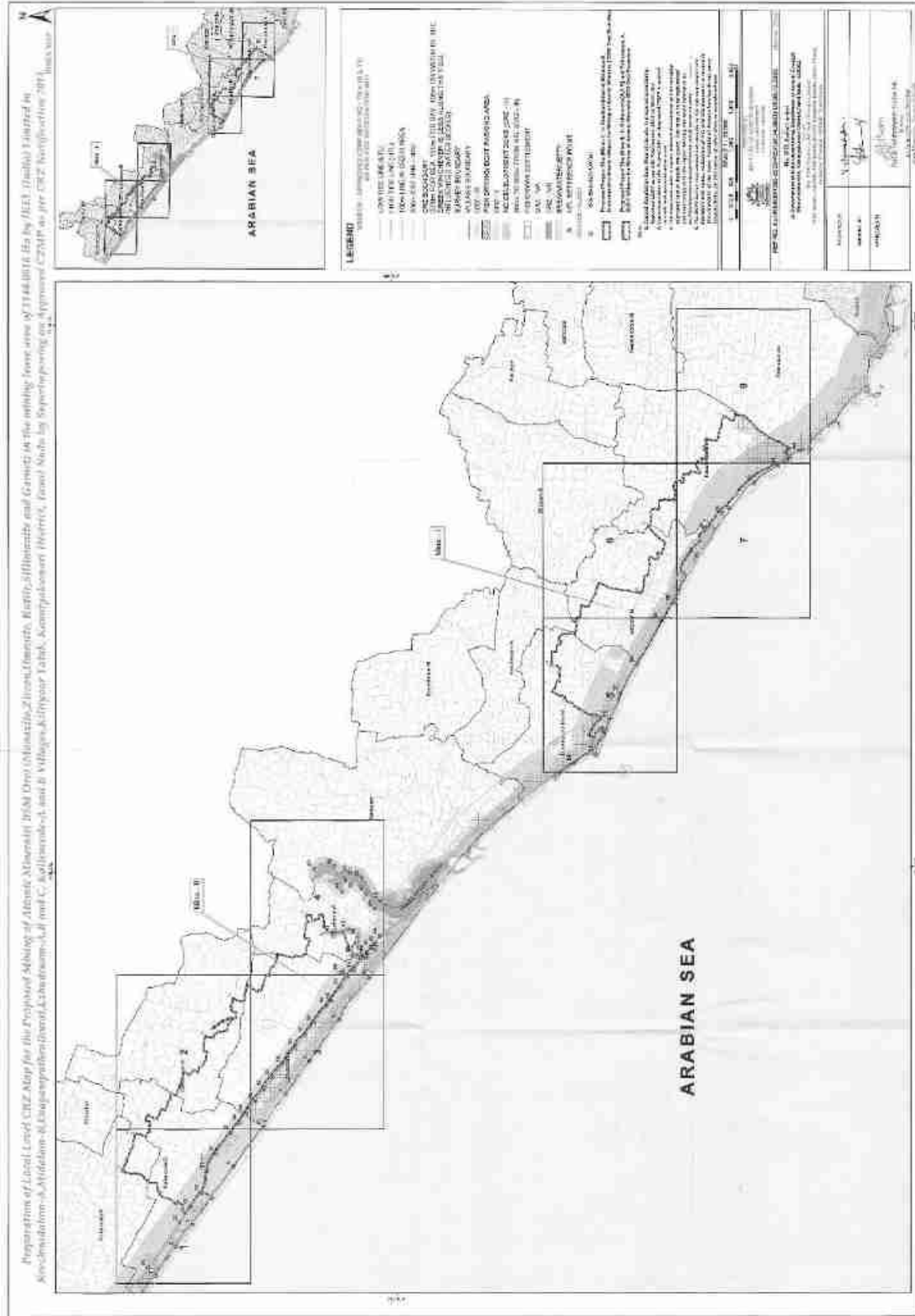


Figure 1.3 HTL/LTL (CRZ Map) prepared by IRS, Anna University, Chennai

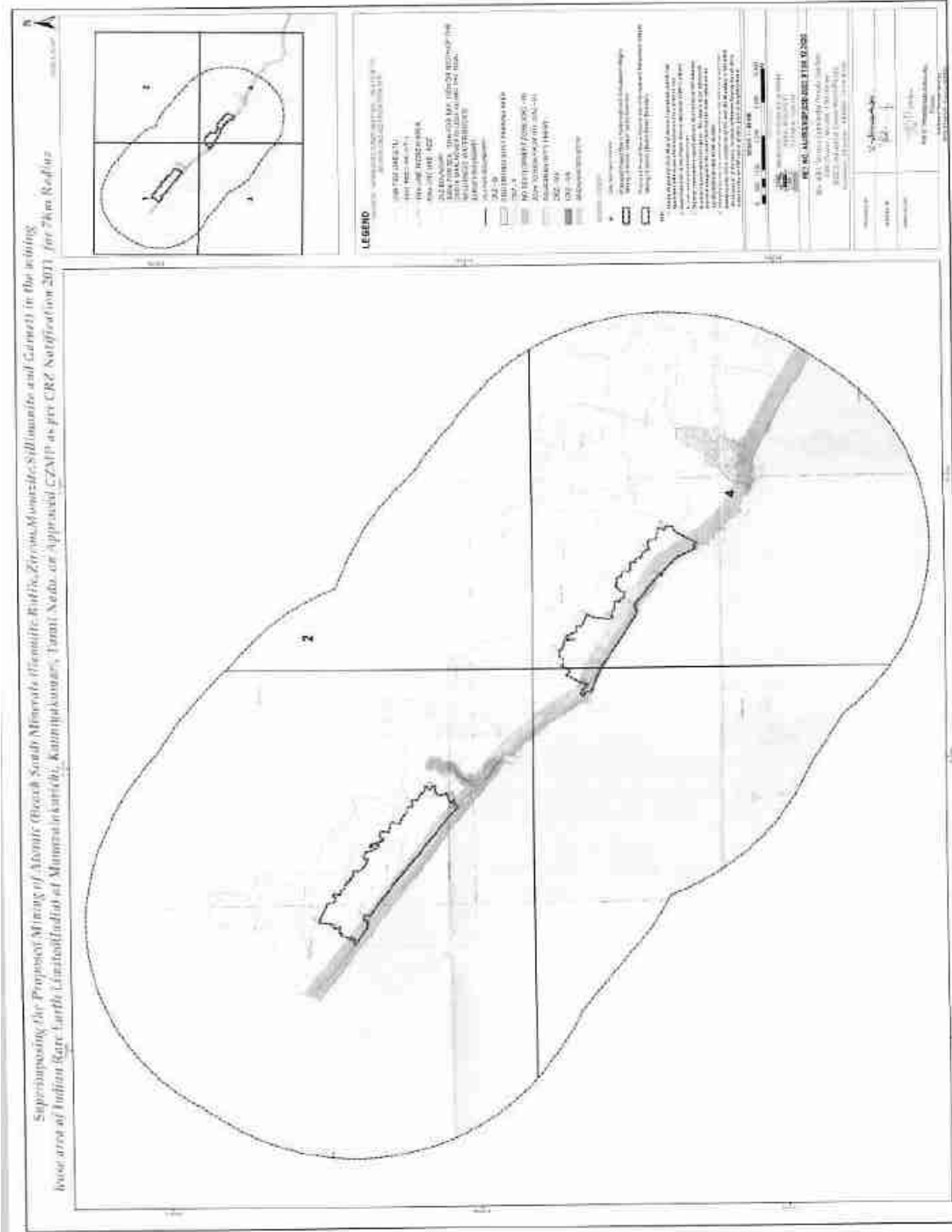


Figure 1.4 7km (CRZ Map) prepared by IRS, Anna University, Chennai

1.9 Environmental Setting

The study area falls in the Survey of India Topo Sheet No. 58H/3, 58H/4, 58H/7 and 58H/8. Topo map of 10km radius is shown in Fig 1.6. The mining area is accessible by SH-179 (West Coast Road-WCR). Block-A is connected to SH 179 by a series of Major District Roads (MDRs) and Block-B is connected by SH- 179 which is passing through the site.

The ML Block-A is located 08°11'19.78" to 08°13'33.12" North Latitudes and 77°11'13.13" to 77°14'08.82" East Longitudes and Block-B is located between 08°15'17.31" to 08°17'32.23" North Latitudes and 77°06'50.15" to 77°09'34.63" East Longitudes (Table 1.3).

Table 1.3 The Latitude and Longitude of the Mining Lease Area – Villagewise

Sl. No	Village	Latitude	Longitude
1	Keezhmidalam-A	08°11'19.78" to 08°12'37.53" N	77°13'01.76" to 77°14'08.82" E
2	Midalam	08°12'04.09" to 08°13'18.51" N	77°11'53.12" to 77°13'10.98" E
3	Enayamputhenthurai	08°12'44.61" to 08°13'33.12" N	77°11'13.13" to 77°12'15.36" E
4	Ezhudesam- A	08°15'17.31" to 08°15'49.46" N	77°09'12.69" to 77°09'34.63" E
5	Ezhudesam- B	08°16'31.24" to 08°17'03.15" N	77°07'45.99" to 77°08'48.20" E
6	Ezhudesam- C	08°15'17.31" to 08°16'31.24" N	77°07'45.22" to 77°09'12.69" E
7	Kollencode- A	08°17'10.98" to 08°17'32.23" N	77°07'07.45" to 77°07'33.66" E
8	Kollencode- B	08°16'24.86" to 08°17'19.44" N	77°06'50.15" to 77°07'56.20" E

There are **no Eco Sensitive Areas** like National Parks, Wildlife Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar Sites, Tiger/Elephant Reserves, Reserved Forests, etc. (existing as well as proposed) within 10 km from the Mining Lease Area. Kanniyakumari Wildlife Sanctuary is at 25 km (shortest) distance in northeast.

Existing Mineral Separation Plant located at Manavalakurichi is aerielly located at 8.4 km from Block-A and 19.4 km from Block-B in the southeast (road distance 12 km from Block-A and 30 km from Block-B). Existing Mining Leases are in and adjacent to the Mineral Separation Plant.

Two Mining Leases of 2.42 Ha & 3.63 Ha granted to M/s. V V Minerals are demarcated separately in the Mining Lease plan. IREL approached the Tribunal (Mines), Ministry of Mines, Govt. of. India and the granted Mining Lease was set aside by the Tribunal.

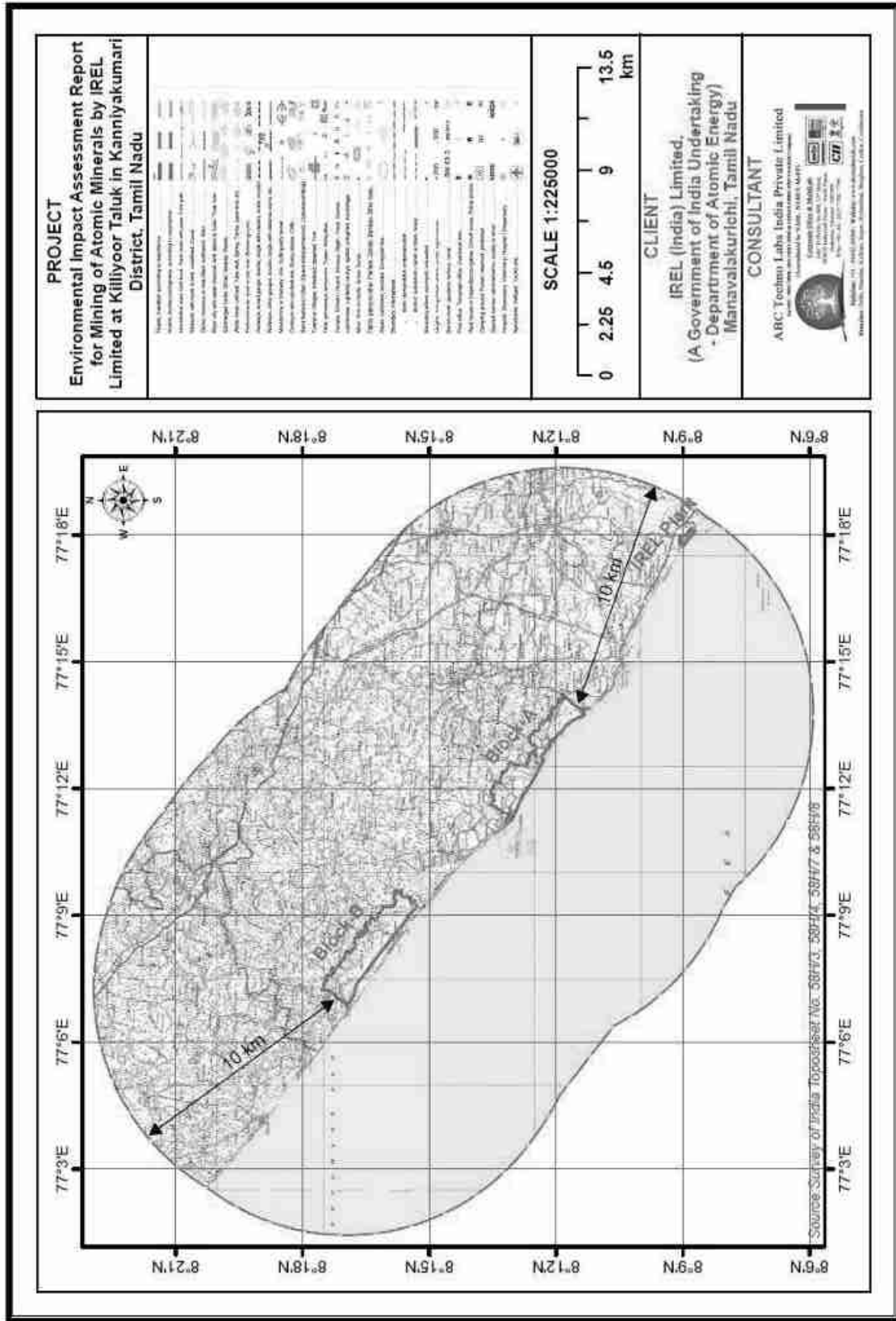


Figure 1.5 Topo Map covering 10km radius



River Valliar drains the eastern parts of the Study Area and River Thamirabarani drains the central parts of the Study Area which flows adjacent to the Block-B at 0.12 km in the northeast and 4.5 km from Block-A in the northwest. Valliyar River flows eastern side of the Mineral Separation Plant at Manavalakurichi and is flowing at 9.6 km from Block-A and 20.7 km from Block-B in southeast. Arabian Sea and its coastline are in southern parts.

Tamil Nadu-Kerala State Boundary is at 1.5 km in the west from Block-B & 12.4 km from Block-A and General Condition applies to this Mining Project. There is no major industry in the Study Area. The mining area does not fall Critically Polluted Areas /Industrial Clusters identified by CPCB. The project area (ML Area) does not fall in the Aravali Range. Part of the Mining Lease Area falls in Coastal Regulation Zone Area and thus, attracts Clearance under CRZ Notification 2011.

Thiruvananthapuram-Nagercoil Section of National Highway NH-66 runs at 9.3 km north of Block-A and 6.5 km north of Block-B. The State Highway SH-179 runs parallel and through the Mining Lease. Nagercoil- Thiruvananthapuram Section of Southern Railway BG Line runs at a distance of 6.5-7.0 km in the north. Nagercoil Junction is at 23 km from the Mining Lease in the east. The nearest airport is Thiruvananthapuram at 28 km in the northwest. Thengapattinam Port is at 2 km in the southeast from Block-B and Colachel Port is at 2.0 km in the southeast from Block-A.

Moderately populated villages such as Pallapallam, Enayamputhenthurai, Karungal, Puthukadai, Manavalakurichi, Monday Market, Neyyoor, Kalingarajapuram, Nithiraivilai and Poothurai. Hospitals, Schools, Churches, Temples, Mosque, Community Halls, recreation clubs etc. are located within the study area. Municipal Corporations of Colachel and Kollencode are located near the Mining Lease. Kanniyakumari District Head Quarters Nagercoil is at 23 km in the east from Block-A.

There is no litigation, directions or any order passed by any Court of Law or pending against the project.

1.10 Mining Profile

The Beach Sand Mineral (BSM) are suite of 7 minerals viz., Ilmenite, Rutile, Zircon, Monazite, Sillimanite, Leucoxene and Garnet. These seven minerals occur together in nature by virtue of their formation along with coastal stretches/ inland areas near to the shore and in Teri deposits in varying grades in India.

The mineable reserves estimated in the new mining lease area of 1144.0618 Ha is **59.88 Million Tonnes**. Mineral content in the deposit varies between 10.0% and 22.6% with an average 14.5%. The method of mining will be **Non-Conventional Opencast Mechanized Mining** by Excavator-Tipper combination with no Drilling & Blasting involved. It is proposed to mine out Beach Sand Minerals-BSM @ 5000 Tonnes per day (TPD) ROM viz. 15.00 Lakh Tonnes ROM. Mining operation will be carried out average depth of 6 m and a maximum depth of 9 m depending upon the location and mineralization. No ground water-table intersection is anticipated due to the mining.

ROM from the new mining lease will be transported and separated for individual atomic minerals at existing Mineral Separation Plant (MSP) at Manavalakurichi. In the MSP, the ROM is fed to Heavies Upgradation Section (HUS) and subsequently separated using its physical properties viz., Specific Gravity, Conductivity and Magnetic Susceptibility.

In the production quantity of 15.00 Lakhs TPA ROM & with about 70% recovery, the feed to the Mineral Separation Plant can have mineral production of 1,52,250 TPA. The generation of tailings (after removal of Minerals-Quartz) will be about 13,47,750 Tons per annum which will be transported to the mined-out voids and backfilled. Mining and backfilling will be carried out simultaneously.

Mine Profile:

Description	Area/Capacity
Total Mining Lease area	1144.0618 ha.
Total Mineable Quantity	59.88 Million Tonnes
Annual Production	1.5 Million Tonnes @ 5000 TPD (Max)
No of working days	300 days (3 Shifts)
Life of the Mine	40 Years
Method of Mining	Open cast (without drilling & blasting) – No topsoil & No OB – Excavator and tipper combination upto a maximum depth of 9 m (average 6 m)
	No ground water intersection involved.
	No R&R issue due to the proposal

1.11 Project Cost

The Project Cost is Rs.31.25 Crores with the following break-ups:

Land Compensation for Surface Rights	:	Rs.10.65 Crores
Machineries (on Contract)	:	Rs.15.00 Crores
Others (Documentation & Incidental)	:	Rs. 5.60 Crores

Total	:	Rs.31.25 Crores

Adequate EMP Budget and CER Budgets are allotted.

1.12 EIA Study

The Proposal requires prior EC under EIA Notification under Sl. No.1(a) (>250 Ha)-Category 'A' as well as under CRZ Notification 2011, as amended. Accordingly, IREL has filed the Application to MoEF&CC on 26.12.2022 to obtain the Terms of Reference (ToR) for carrying out the EIA Study. As it is involved the mining of Prescribed Substance Monazite, the Proposal was deliberated in 53rd Expert Appraisal Committee (EAC) – Nuclear & Defense (ND) meeting held on 27th January 2023. ToR has been awarded vide F. No. IA-Z-11013/10/2023-IA-I dated 22.02.2023.

Baseline Data (BLD) collected during December 2022-February 2023 representing Winter 2022-23 Season has been utilised for the EIA Study in compliance with MoEF&CC Office Memorandum No. J-11013/41/2006-IA-II(I)(Part) dated 29.08.2017. EIA Report has been prepared in compliance with awarded ToRs and submitted as per generic structure proposed in Appendix-III of EIA Notification 2006.

For obtaining TNSCZMA recommendations for the proposal, IREL has submitted the CRZ application to DCZMA, Kanniyakumari on 08.03.2024 and the same is under their perusal. Being a parallel activity, the SCZMA recommendation will be obtained and submitted to the Ministry for awarding the EC.

The EIA Consultant, M/s. ABC Techno Labs India Private Limited, Chennai has been accredited for various Sectors including Sector-1 (Mining Projects) for Category 'A' by the National Accreditation Board for Education & Training (NABET), Quality Council of India vide Certificate NABET/EIA/2225/RA0290 dated 11.06.2023 with Validity till 16.11.2025 (Sl. No. 4 of QCI/NABET List dated 15.07.2024). The ABC Techno Labs India Private Limited Laboratory is accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) vide Certificate No. TC-5770 dated 03.04.2024 with validity till 02.04.2026. The Lab is also recognised by the Ministry of Environment, Forest and Climate Change (MoEF&CC) vide Letter F. No. Q-15018/04/2019-CPW dated 14.10.2019 with validity of 5 years.

The **EIA Report has been prepared and submitted as per the awarded ToRs** and as per generic structure proposed in Appendix-III of EIA Notification with the following Chapters:

Chapter-1: Introduction with Need for the Project & Environmental Setting of the Project.
Chapter-2: Project Profile - an outline of the Project and allied activities.

- Chapter-3: Description of Environment (Baseline Status).
- Chapter-4: Anticipated Impacts, with Prediction of Impacts and Mitigation Measures.
- Chapter-5: Analysis of Alternatives (Technology & Site).
- Chapter-6: Environmental Quality Monitoring Programme.
- Chapter-7: Additional Studies like Risk Assessment, DMP, Hydrogeological Study, etc.
- Chapter-8: Project Benefits.
- Chapter-9: Cost-Benefit Analysis, if any.
- Chapter-10: Environmental Management Plan
- Chapter-11: Summary EIA.
- Chapter-12: Disclosure of Consultants engaged.

IREL has requested the Ministry for exemption of Public Hearing under Para 7(ii) of EIA Notification 2006 vide The Chairman, Atomic Energy Commission & Secretary, Department of Atomic Energy letter dated 28.02.2023. The Proposal was deliberated in the 61st EAC (N&D) Meeting held on 23.04.2024 as Agenda Sl. No. 3.1. The Hon'ble Committee advised to review the request of exemption from Public Hearing. Accordingly, Public Hearing is being conducted for the Project and Action Plan to address the PH issues along with Budget provision will be incorporated in the Final EIA-EMP report. The additional details sought by the Hon'ble Committee are also addressed in this Report and submitted for Public Consultation & Public Hearing with Summary EIA reports in English and Tamil languages.

2.0 Project Description

2.1 Type of Project

The Project is for mining of atomic minerals (BSM Ore) containing Monazite (Uranium & Thorium bearing mineral) which is radioactive and Prescribed Substance under the Atomic Energy Act, 1962 along with other associated minerals i.e., Zircon, Ilmenite, Rutile, Sillimanite and Garnet.

Mining Lease Area is 1144.0618 Ha. It is proposed to mine @ 5,000 TPD and 1.50 MTPA ROM. The ROM will be transported to the existing Mineral Separation Plant (MSP) located at Manavalakurichi. The MSP is having consented production capacity of 1,14,600 TPA minerals.

The Proposal requires prior EC under EIA Notification under Sl. No.1(a) (>250 Ha)-Category 'A' as well as under CRZ Notification 2011, as amended. Accordingly, IREL has filed the Application to MoEF&CC on 26.12.2022 to obtain the Terms of Reference (ToR) for carrying out the EIA Study. As it is involved the mining of Prescribed Substance Monazite, the Proposal was deliberated in 53rd Expert Appraisal Committee (EAC) – Nuclear & Defense (ND) meeting held on 27th January 2023. ToR has been awarded vide F. No. IA-Z-11013/10/2023-IA-I dated 22.02.2023.

2.2 Technology & Magnitude of Operation

The mineable reserves estimated in the new mining lease area of 1144.0618 Ha is 59.88 Million Tonnes. Mineral content in the deposit varies between 10% and 22.6% with an average 14.5%. There will be no Top Soil or Over Burden (OB) in the Mining Lease as the entire Soil have Heavy Minerals and will be mined out as such. The method of mining will be Non-Conventional Opencast Mechanized Mining by Excavator-Tipper combination with no Drilling & Blasting involved. Mining operation will be carried out average depth of 6 m and a maximum depth of 9 m depending upon the location and mineralization. It is proposed to mine out Beach Sand Minerals-BSM @ 5000 TPD ROM viz. 1.50 MTPA ROM.

ROM from the new mining lease will be transported and separated for individual atomic minerals at existing Mineral Separation Plant (MSP) at Manavalakurichi. In the MSP, the ROM is fed to Heavies Upgradation Section (HUS) and subsequently separated using its physical properties viz., Specific Gravity, Conductivity and Magnetic Susceptibility.

In the production quantity of 15.00 Lakhs TPA ROM & with about 70% recovery, the feed to the Mineral Separation Plant can have mineral production of 1,52,250 TPA. The generation of tailings (after removal of Minerals-Quartz) will be about 13,47,750 Tons per annum which will be transported to the mined-out voids and backfilled. Mining and backfilling will be carried out simultaneously.

During the Plan Period, 7.50 Million Tonnes of ROM @ 1.50 MTPA will be mined out and the tailings - Quartz (after removal of Minerals) will be generated from the MSP to the tune of 6.738 Million Tonnes @ 1.347 MTPA, which will be transported back to the Mining Lease Area to backfill the mined-out voids. This process would continue till the Conceptual Stage.

Table 2.1 Development & Production - Plan Period & Subsequent Periods

Year	Top Soil, Tons	Over Burden, Tons	Mineral Rejects, Tons	ROM Production,		Anticipated Atomic Minerals Concentrate in Tonnes	Wastes (Quartz) from MSP for Backfilling Mined out Voids, Tons
				cu. m	Tonnes		
First Plan/ Block Period:							
I	0	0	0	9,37,500	15,00,000	1,52,250	13,47,750
II	0	0	0	9,37,500	15,00,000	1,52,250	13,47,750
III	0	0	0	9,37,500	15,00,000	1,52,250	13,47,750
IV	0	0	0	9,37,500	15,00,000	1,52,250	13,47,750
V	0	0	0	9,37,500	15,00,000	1,52,250	13,47,750
Total	0	0	0	46,87,500	75,00,000	7,61,250	67,38,750
Subsequent Plan/Block Periods							
2 nd Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
3 rd Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
4 th Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
5 th Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
6 th Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
7 th Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
8 th Block Period (4 Years only)	0	0	0	46,12,500	73,80,000	7,49,070	66,30,930
Grand Total	0	0	0	3,74,25,000	5,98,80,000	60,77,820	5,38,02,180

Table 2.2 Plan Period Production & Expected Mineral Production from ROM

Year	ROM, Tonnes	Anticipated Atomic Minerals Production in Tonnes	Expected Individual Mineral Production, Tonnes					
			Monazite	Zircon	Ilmenite	Rutile	Sillimanite	Garnet
I	15,00,000	1,26,349	7182	5563	92352	2772	11718	6762
II	15,00,000	1,26,349	7182	5563	92352	2772	11718	6762
III	15,00,000	1,26,349	7182	5563	92352	2772	11718	6762
IV	15,00,000	1,26,349	7182	5563	92352	2772	11718	6762
V	15,00,000	1,26,349	7182	5563	92352	2772	11718	6762
Total	75,00,000	6,31,745	35,910	27,815	4,61,760	13,860	58,590	33,810

2.3 Project Description

2.3.1 Geology

2.3.1.1 Regional Geology

The rocks of Kanniyakumari district belong mainly to Archaean age, except for a narrow girdle along the coast in the southwest and south, occupied by sediments of Tertiary and Quaternary ages, respectively. Rocks of Eastern Ghats Supergroup of Archaean age include three divisions, viz, Khondalite, Charnockite and migmatite. The khondalite group comprises garnet-biotite-sillimanite, with thin bands and lenses of quartzite, calc granulite and crystalline limestone. The charnockite litho unit of the Charnockite group is well exposed in the southern and southwestern parts of the district, occurring mainly as concordant bands and lenses of variable dimension, associated with Khondalite group of rocks. The migmatite complex comprises garnet-biotite gneiss, garnetiferous quartzofeldspathic gneiss and quartzofeldspathic granulites. Cuddalore formation of Mio-Pliocene age (Correlatable with Warkalli/Quilon beds of Kerala), comprising calcareous sandstone/limestone is exposed as thin cappings southwest of Kuzhitura nearer to the coast, bordering Kerala State. Quaternary sediments of fluvial, fluviomarine, Aeolian and southern part of the district, adjacent to coast.

Atomic minerals concentrations (Monazite, Zircon, Ilmenite, Rutile, Sillimanite, Leucosene & Garnet) occur in beach sands along the east coast and west coast in the Kanniyakumari District. Significant concentration occurs between Vattakottai and Lipuram, Manavalakurichi deposit, Midalam deposit and Vayakkallur-Thoothur deposit.

2.3.1.2 Local Geology

The Mining Lease area mainly consists of beach sand, Teri sand/soil underlain by the laterite/gravel bed while the latter is commonly observed in the northern part. The Teri sands are massive but at places they are clearly bedded and even show graded bedding. Beach sands with varying degree of admixture of fine Teri occur in the southern part. Few scattered outcrops of leptynite (garnetiferous biotite gneiss) and charnockite (Pre-Cambrian) are also seen within the applied area.

The Ilmenite-rich Teri sand and beach sand of Quaternary period overlies the laterite, which has developed on the crystallines, namely, Proterozoic charnockite and khondalite. Outcrops of these rocks are found to occur in the southern part of the deposit. A thin veneer of gravel bed overlies the laterite in a few locations in the northern part of the dune. A few occurrences of sandstone and conglomerate of Tertiary period have been observed in the nala cutting to the east and north of the dune. The deposit sand is coated with red ochrous material (iron oxide).

The sands occurring in the project area of the beach sands and the Teri sands. The beach sands are found in the Southern part of the project are over a width of about 800 m (across the coast) and are devoid of any rock outcrops. The Teri sands occur in the Northern part over a width of 200 – 600 m.

The Proterozoic khondalites, lyptynites and charnockite are major rock types that outcrop to the North of the applied mine lease area. The charnockite group consists mainly of charnockite, pyroxene granulite and their associated migmatite. Khondalites group comprises garnetiferous sillimanite-graphite gneiss, garnet-biotite gneiss and their

migmatite derivatives. Warkalli beds of Tertiary age occur as thin cappings South-West of Kuzhidurai (7 km Northwest of the applied Mining Lease area).

Heavy minerals of economic value are found along the western and eastern coast of Indian Peninsula. The source rock for many of these heavy mineral deposits are charnockites and pensinsular gneiss intruded by leptynites and Khondalite to some extent. These deposits are formed by weathering and transportation processes. In suitable location, enrichment of heavy mineral in the western coast is due to cyclic subsidence of coast, wind and wave action. Fossiliferous sandstone is predominant in inland and placer deposit.

Proterozoic khondalites and charnockites are the two groups of rocks outcrop in the region especially in the north with few isolated outcrops in the coastal plains. Charnockite group consists mainly of charnockite, pyroxene-granulite, and their associated migmatites. Khondalite group comprises garnetiferous – Sillimanite – graphite gneiss, garnet-biotite gneiss and their migmatite derivatives with granite permeations. Charnockites also occur as thin lenses and bands within khondalite group at several places. The deposit is covered by sedimentary formation comprising coastal alluvium and beach sand. This is underlain by the crystalline rock of the Archaean age. The rock type is garnetiferous granitic gneisses (Leptynytes).

2.3.2 Exploration

Coastal stretches of Kanniyakumari District including this mining lease area was investigated in detail by Atomic Minerals Directorate for Exploration and Research (AMD), Hyderabad, Department of Atomic Energy, Government of India. Taking into consideration of the detailed investigations conducted by AMD in different phases from 1994 to 2003, no further exploration proposals are envisaged for the Mining Lease area of 1144.0618 Ha.

The Block wise details of exploration carried out in the mining lease area are as under:

Blocks	Extent, Ha	Period of exploration	Total No. of Holes	Avg. Depth, m	No. of samples	Grid interval, m	Type of drill
Midalam Deposit	167	1997-98	193	4.15	568	100 x 50	Hand Auger and Conrad Bunka Drill
Midalam Inayam	294	2002-03	589	5.15	2168	100 x 50	
Inayam	55	2000-01	210	5.82	847	50 X 50	
Vayakkallur - Thoothur	Block-I 100	1994-95	441	6.5	2002	50 x 50	Conrad Bunka Drill
	Block-II 105	1996-97	165	7.9	913	100 x 50-100	Hand Auger and Conrad Bunka Drill
	Block-III 187	1997-98	318	6.7	1216	100 x 50-100	
	Block-IV 347	2002-2003	347	7.4	1622	100 x 100	

2.3.3 Reserves & Resources

There is no top soil or over-burden in these deposits and the entire mineral sand available up to the drilling depth is taken as proved reserves. The weight percent of each individual mineral is calculated from the total number of grains counted for each mineral, its specific gravity and the weight of the respective sieve fractions. Initially, pure fractions of all the individual heavy minerals are separated and their specific gravities are determined with a gravity bottle. Only these values are used for calculations in lieu of empirical values. The weight of the individual minerals in the respective sieve fractions are summed up to determine the total weight percentage of that mineral in the original sample. The total tonnage of raw sand in each block was calculated from its volume and the tonnage factor/bulk density of the corresponding composite/block samples. The individual mineral tonnages in total raw sand in each block are calculated from their respective weight percentages, the weighted average for each mineral in a given block.

Based on the above and the Economic axis has been fulfilled all the aspects of UNFC classification, the raw sand reserve of the proposed mining lease area is categorized "111".

Strike length / continuity (m)	11.2 km
Dip continuity (m)	Almost Flat
Width / thickness (m)	400 – 1440 m
Cut-off grade (%)	2%
Estimated Bulk Density (g/cc) or Specific Gravity as the case may be	1.6
Explored Depth	13.5 m BGL
Vertical intercept of mineralization	Mineralization occurs from surface.
Threshold Value (As per AMCR,2016)	Threshold value is 0.00% Monazite in total heavy minerals of Beach sand mineral deposit as per AMCR,2016. The proposed mining lease area consist monazite content more than threshold value as per the exploration report of AMD.

Geological Reserves/Resources are given in Table 2.3.

Table 2.3 Geological Reserves / Resources Estimation

Block-A (Inayam and Midalam Block, Midalam Block & Inayam Block)							
Enayamputhenthurai							
Section line	Section area (m ²) (a)	Influence (m) (b)	Volume (m ³) (c) = a x b	BD (g/cc) (d)	Raw sand / ROM Quantity (MT) (e)=(c)x(d)	Av. THM Grade (%) (Wt. Avg.) (f)	Quantity of HM (MT) (g) =e x f/100
B-B'	5891	150	883680	1.65	1458072	17.57	256183
C-C'	9858	200	1971680	1.69	3332139	24.01	799973
D-D'	9022	200	1804480	1.65	2977392	22.77	677952
E-E'	7483	200	1496640	1.68	2514355	32.75	823451
F-F'	6882	200	1376320	1.57	2160822	25.09	542150
G-G'	5392	200	1078400	1.7	1833280	27.87	510935

Total					14276061	25.29	3610645
Midalam-B							
H-H'	5218	200	1043680	1.71	1784693	31.43	560929
I-I'	6952	200	1390400	1.7	2363680	31.93	754723
J-J'	2430	200	486080	1.61	782589	24.61	192595
K-K'	4368	200	873600	1.56	1362816	18.30	249395
L-L'	3963	200	792640	1.57	1244445	15.45	192267
M-M'	2482	200	496480	1.61	799333	18.33	146518
N-N'	3435	200	687040	1.62	1113005	20.46	227721
O-O'	3604	200	720800	1.57	1131656	14.93	168956
P-P'	2293	200	458560	1.59	729110	18.26	133136
Q-Q'	1521	200	304160	1.59	483614	15.84	76605
R-R'	3595	200	719040	1.6	1150464	16.61	191092
S-S'	4322	200	864320	1.64	1417485	21.81	309153
Total					14362890	22.30	3203089
Keezhmidalam-A							
T-T'	2509	200	501760	1.64	822886	29.77	244973
U-U'	3054	200	610880	1.59	971299	24.34	236414
V-V'	2795	200	559040	1.51	844150	17.88	150934
W-W'	3824	200	764800	1.53	1170144	10.72	125439
X-X'	3526	200	705120	1.53	1078834	21.88	236049
Y-Y'	2708	200	541600	1.56	844896	21.49	181568
Z-Z'	2342	200	468480	1.5	702720	19.96	140263
ZA-ZA'	3094	200	618880	1.49	922131	12.53	115543
ZB-ZB'	4411	200	882240	1.49	1314538	18.59	244373
ZC-ZC'	3773	262	988474	1.54	1522249	19.73	300340
Total					10193848	19.38	1975896
Block-B (Vayakkallur Deposit Block-I to IV)							
Kollencode A&B							
BB - BB'	9185	220	2020700	1.52	3071464	5.08	156030
CC - CC'	10383	200	2076640	1.6	3322624	6.75	224277
DD - DD'	9716	200	1943200	1.55	3011960	6.25	188248
EE - EE'	8498	200	1699520	1.58	2685242	5.85	157087
FF - FF'	7930	200	1586080	1.53	2426702	6.75	163802
GG - GG'	8201	200	1640160	1.58	2591453	13.14	340517
HH - HH'	8163	200	1632640	1.63	2661203	13.45	357932
II - II'	9148	200	1829600	1.56	2854176	10.15	289699
JJ - JJ'	8560	200	1712000	1.59	2722080	10.89	296435
KK - KK'	9094	200	1818720	1.61	2928139	11.19	327659
Total					28275043	8.85	2501685
Ezhudesam A, B & C							
LL - LL'	8002	200	1600480	1.61	2576773	7.49	193000
MM - MM'	6579	200	1315840	1.56	2052710	6.49	133221
NN - NN'	7256	200	1451200	1.61	2336432	8.61	201167
OO - OO'	7790	200	1557920	1.6	2492672	8.62	214868
PP - PP'	7437	200	1487360	1.62	2409523	10.69	257578
QQ - QQ'	7752	200	1550400	1.59	2465136	10.36	255388
RR - RR'	8899	200	1779840	1.71	3043526	13.40	407833
SS - SS'	9028	200	1805600	1.57	2834792	8.44	239256
TT - TT'	10312	200	2062400	1.59	3279216	10.38	340383
UU-UU'	7842	200	1568320	1.62	2540678	9.43	239586
VV-VV'	7447	200	1489440	1.63	2427787	9.94	241322
WW-WW'	7928	200	1585600	1.65	2616240	11.36	297205
XX-XX'	6361	200	1272160	1.65	2099064	13.92	292190

YY - YY'	4663	200	932640	1.74	1622794	15.92	258349
ZZ - ZZ'	4648	200	929600	1.78	1654688	18.66	308765
ZZA-ZZA'	7904	200	1580800	1.7	2687360	13.14	353119
ZZB-ZZB'	7672	230	1764560	1.65	2911524	11.79	343269
Total					42050916	10.88	4576498
Grand Total					109158757		15867813

Heavy Minerals Grade in **Block-A** is found to be **22.6%** and in **Block-B** is **10.0%** only with **Average of 14.5%** (Table 2.4).

Table 2.4 Reserves / Resources Estimation - Categorywise

Reserve/Resource estimation for 1144.0618 Ha						
	Block-A		Block-B		Total	
	Area in Ha	Reserves/ Resources in million Tonnes	Area in Ha	Reserves/ Resources in million Tonnes	Area in Ha	Reserves/ Resources in million Tonnes
Mineable area and Reserve - 111	315	22.49	319	37.39	634	59.88
Resources under 7.5 meters safety barrier - 211	31	2.21	29	3.40	60	5.61
Resources under 50 meters distance from private Permanent structures- 221& 222	58.0688	4.14	81.993	9.61	140.0618	13.75
Resources under Permanent structures- 331	140	9.99	170	19.92	310	29.91
Total	544.0688	38.83	599.993	70.32	1144.0618	109.15
Average thickness	4.43 m		7.28 m		5.86 m	
Average Grade in %	22.6 % THM		10.0 % THM		14.5 % THM	

About 5.57 Million Tonnes Ore is blocked due to 7.5 m Safety Barriers - '211' Category (2.20 Million tons in Block-A and 3.37 Million tons in Block-B), 13.67 Million Tonnes Ore is blocked due to safety distance from the private permanent structures – '221' & '222' Categories (4.12 million tons in Block-A and 9.55 Million tons in Block-B) and 29.73 Million Tonnes Ore is blocked due to presence of permanent structures- '331' Category (9.92 Million tons for Block-A and 19.81 Million tons for Block-B).

The **Total Mineral Reserves/Resources** estimated as on **01.04.2023**, as per UNFC, are given in Table 2.5.

Table 2.5 Mineral Reserves and Resources as on 01.04.2023

Sl. No.	Description & UNFC Category	ROM Quantity in Million Tonnes	Grade
1	Proved Mineral Reserves (111)	59.88	Block-A – 22.6% Block-B – 10.0% Average – 14.5%
2	Feasibility Mineral Resources (211)	5.61	
3	Prefeasibility Mineral Resources (221 & 222)	13.75	
4	Measured Mineral Resources (331)	29.91	
Total Reserves & Resources		109.15	

The Proved/Mineable Reserves, as on 01.04.2023, is 59.88 Million Tonnes and the total Resources available is 109.15 Million Tonnes.

2.3.4 Heavy Minerals & their Uses

- **Monazite** is a radioactive mineral and a prescribed substance under the Atomic Energy Act, 1962 and it contains 0.38% of Uranium, 9% of Thorium and 60% of Rare Earth Oxide which is further processed to produce High Pure Rare Earths (HPRE) such as compounds of Lanthanum, Cerium, Neodymium-Praseodymium, Samarium, Gadolinium, Dysprosium etc. The sector wise use of rare earths includes Aerospace, Defence, Health Care, Clean Energy, Nuclear Energy, Electronics, Chemicals, Oil refineries and in the manufacture of many specialty metal alloys.
- **Zircon** is Zirconium Silicate ($ZrSiO_4$). Zirconium metal which is used in atomic reactors to provide cladding for cylindrical fuel rods that helps nuclear reaction. Zircon is used for production of i) Zircon flour and opacifier that are used as a coating in ceramics, sanitary ware, etc. to impart opacity to the end-products ii) Special purpose refractories and iii) various zirconium compounds.
- **Ilmenite** is a Titaniferrous mineral ($FeTiO_3$) and the TiO_2 content is 55%. Ilmenite is used for production of i) Titanium dioxide pigment which is used in paints, papers, plastics, textiles, industries. ii) Intermediate products like Synthetic Rutile (SR) and TiO_2 slag that are further processed for producing TiO_2 pigment iii) Titanium sponge, that finds application in aircraft body, artificial limbs, golf clubs, etc.
- **Rutile** is a Titanium bearing mineral (TiO_2). The TiO_2 content is over 94%. Rutile is used for the production of i) Titanium dioxide pigment, used in paints, papers, plastics, textiles, etc., ii) Titanium sponge that finds application in aircraft body, artificial limbs, golf clubs, etc., iii) Welding fluxes, used as a coating on welding electrodes.
- **Sillimanite** is Alumino-silicate mineral (Al_2SiO_5). It is used in production of refractories that find usage in metal and alloy making industry. Also, by ceramic and foundry industry.
- **Garnets** are a Silicate group of minerals. Major grades produced are Coarse grade (30-60 mesh), Normal grade (60-100 mesh) and medium grade (50-100 mesh). Garnet is used i) as abrasive for sandblasting for descaling of vessels and surface preparation ii) in water jet cutting for a precision cutting job iii) as abrasive in grinding wheels iv) as medium for water filtration and iv) for rough glass polishing.

Uses of Rare Earths

- **Neodymium** is used in manufacture of permanent magnets in industries along with boron and iron. It is also employed in the laser industry for the manufacturing crystals such as yttrium aluminum garnet. It can absorb the glare in the flame; it is utilized for the purpose of coloring glasses.
- **Praseodymium** is used in the aircraft engines in the form of alloying agent and for the purpose of creating high field strengths. It is also utilized in the permanent magnets present in the wind turbines and motors. The carbon electrodes used in the arc lightning lamps make use of the oxides of Praseodymium.
- **Samarium** - The most important application of Samarium is Samarium-Cobalt magnets which can withstand high temperature. These magnets are used in strategic sectors like defence, space and atomic energy. This element is also used in the manufacture of solar-powered electric aircrafts. Samarium can be used in the production of superconducting materials and samarium-doped iron superconductors are among the highest-temperature superconductors known.
- **Gadolinium** is used in the field of atomic energy, microwave application and also used in color television sets in the form of phosphorous. The alloys of gadolinium are utilized in the manufacture of magnetic and electronic gadgets such as video recorder, etc. The isotope of gadolinium Gd is widely employed in curing tumors and neutron therapy.
- **Lanthanum** is found in modern television sets, the energy saving lamps, fluorescent tubes, etc. It is also used in the field of optics as lenses and radiation absorbing glasses. One of the most important applications is as catalysis in the field of petroleum refineries.
- **Cerium** is the key component of mischmetal alloy which is used in flints for cigarette lighters. The reason for it is cerium produces sparks when struck. It is also used in almost all color televisions and energy-saving lamps.
- Minerals are produced in standard specifications which are called as **MK Grade**.

2.4 Proposed Mining

Mining activity in this mining lease area will be carried out by Fully mechanized Non-Conventional Opencast method of Mining - Inland mining (non-replenishable deposit) @ 15.00 Lakhs Tonnes ROM per Annum. The inland areas of the mining lease areas will be mined by Excavator-Tipper combination. There will be no Drilling & Blastings. Also, there will be no Developmental activities like Top Soil & Over Burden removal. Thus, there will be **no Dump** in the Mining Lease.

The mining will be carried out at an average depth of 6 m and upto a maximum depth of 9 m depending upon the location and mineralization. **No ground water-table intersection** is envisaged as ground water-table level in the Mining Lease Area ranges between 10-15 m BGL. The mining operation will consist of two-layer operation. The mineralisation occurs from the surface. First, the surface layer up to 2.5-3.0 m from surface is excavated by Tipper & Excavator combination and followed by the excavation in bottom layer. While excavating the bottom layer, backfilling of the mined-out voids by

the Tailings from MSP will be carried out simultaneously. Thus, there will be **no bench** formation and **no Mine Pit** in the Mining Lease. Ore: Waste Ratio will be 1:0.

After mining and backfilling, the land would be returned to the respective land owners within a lease period of 11 months along with lease compensation. Plantation is predominantly carried out in the mined-out areas after backfilling and the land is used for other activities including construction and thereby ensuring Eco-friendly and Sustainable mining.

Mined out atomic mineral bearing sand as ROM will be transported to the existing Mineral Separation Plant (MSP) at Manavalakurichi, with a lead distance of 12-30 km, for separation of individual Heavy Minerals.

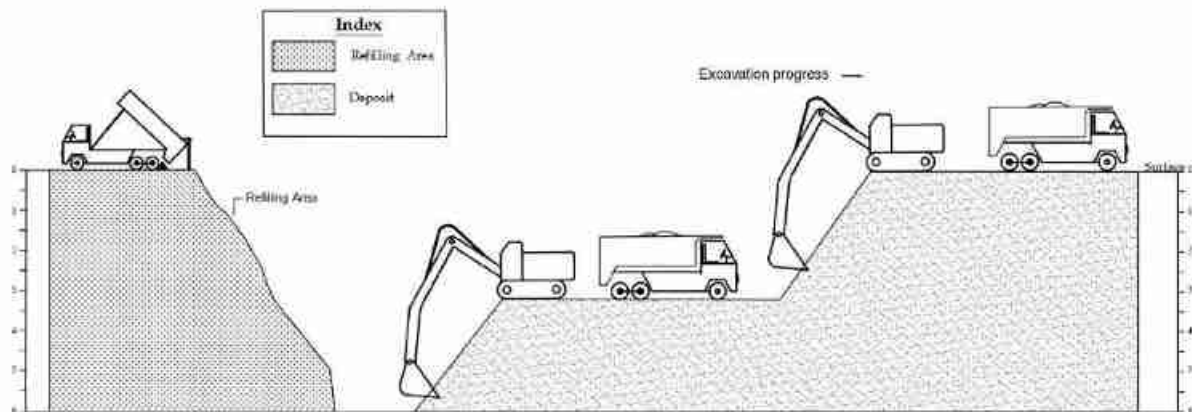


Figure 2.1 Schematic Diagram of Method of Mining

Leveling survey of the area to be done before start of mining would be carried out by using precise datum levels. Bench Bark locations is given in **Table 2.6**.



Figure 2.2 Bench Bark Locations

Table 2.6 Bench Bark Locations in the Study Area

Location	Bench Mark at	Latitude	Longitude	Elevation in M
1	Sri Bhadrakali Amman Temple, Pattariyar Street	8°12'16.39"N	77°18'54.92"E	53
2	CSI Church Kadamankuzhi, kuttuthani	8°12'27.20"N	77°14'0.99"E	72
3	CSI Church (Manavalakurichi)	8° 9'5.63"N	77°18'27.92"E	41
4	St. Lucia's Church, Puthoor	8° 9'36.02"N	77°16'56.36"E	38
5	Arulmigu Sri Mandaikadu Bhagavathi Temple	8° 9'47.79"N	77°16'47.78"E	40
6	Mead Memorial Church (CSI) Mondaikad - Protestant church	8° 9'58.39"N	77°16'41.24"E	49
7	CSI Auditorium Mandaikadu	8°10'0.44"N	77°16'44.34"E	49
8	St. Alex Church - Kottilpadu	8°10'13.47"N	77°15'52.17"E	29
9	CSI Church Kariyavilai	8°10'23.10"N	77°16'27.04"E	69
10	CSI Church, Paruthivilai	8°10'23.92"N	77°16'51.49"E	73
11	CSI Church Cheramangalam	8° 9'55.71"N	77°17'58.89"E	53
12	St. Jude's Church	8°10'37.29"N	77°14'41.00"E	30
13	Saint Bartholomew's Church	8°10'39.04"N	77°14'25.86"E	29
14	Bethel Church	8°10'49.19"N	77°14'17.10"E	30
15	St. James Church Vaniyakudi	8°11'0.11"N	77°14'4.44"E	33

Location	Bench Mark at	Latitude	Longitude	Elevation in M
16	Siluvaiyar Kurusadi Kurumpanai	8°11'11.14"N	77°13'51.26"E	31
17	PFC Ground Kurumpanai - Football club	8°11'14.43"N	77°14'1.10"E	39
18	St Francis Xavier's school ground, Alanchi	8°11'43.22"N	77°13'56.88"E	79
19	Paraikal Beach Resort, Kanyakumari district	8°11'51.90"N	77°13'25.25"E	36
20	Forane Church of St. Francis Xavier, Alanchy	8°11'50.96"N	77°13'59.94"E	78
21	Ilangam Sree Bhahreshwari Amman Thiru Kovil	8°12'3.66"N	77°13'32.19"E	42
22	Udayamarthandam Bus Stop	8°12'21.63"N	77°12'56.80"E	40
23	South India Full Gospel Church	8°12'31.41"N	77°13'1.37"E	53
24	St.AntonysKurusady - Chapel	8°12'31.53"N	77°12'17.60"E	34
25	Koodavilai CSI Church	8°12'42.71"N	77°12'28.30"E	46
26	C.S.I Church - Parakkanvilai	8°13'18.22"N	77°12'8.05"E	68
27	St. Francis Xavier Church, Enayam Helen Nagar	8°12'51.98"N	77°11'51.40"E	36
28	Zion Lutheran Church (I.E.L.C), Paravai	8°13'26.25"N	77°11'29.94"E	48
29	Dem Boys Beach Football Ground	8°13'9.23"N	77°11'3.74"E	19
30	Barath Matriculation School,Ananvilai,Keezhkulam	8°14'3.29"N	77°11'4.79"E	59
31	St. Barbara's Church, Ramanthurai	8°13'43.08"N	77°10'45.14"E	31
32	Thengapattanam Fishing Harbour	8°14'20.60"N	77°10'10.90"E	33
33	Amsi Mukkadu CSI Church	8°15'12.52"N	77°10'26.22"E	55
34	Hindu Temple	8°15'19.12"N	77° 9'1.31"E	31
35	Nithiravilai Police Station	8°15'42.58"N	77° 9'2.63"E	32
36	AV Charitable Foundation	8°16'1.12"N	77° 8'4.44"E	31
37	Jaya Matha Matriculation School	8°16'24.60"N	77° 8'15.07"E	38
38	SJYSC (St.Jude's Youth Sports Clup)	8°16'36.07"N	77° 7'25.76"E	31
39	Rethinapuram CSI Church	8°17'3.27"N	77° 7'45.55"E	43
40	SASC Ground Vallavilai - Playground	8°17'4.38"N	77° 6'53.78"E	27
41	ABC Matric Hr Sec School Kollencode	8°17'23.07"N	77° 7'19.69"E	43
42	Sri Subramaniya Swamy Temple	8°17'14.56"N	77° 6'31.42"E	36
43	St.Mathews English Medium School	8°18'14.89"N	77° 5'31.70"E	43
44	Lekshmi Central School	8°18'43.07"N	77° 6'22.23"E	84

Location	Bench Mark at	Latitude	Longitude	Elevation in M
45	Bethel A G Church, Ambanthalai, Kattukadai, Palavilai	8°18'9.26"N	77° 7'45.96"E	64
46	St. Joseph's Church, Valanoor	8°17'54.47"N	77° 8'24.92"E	88
47	CSI Pastorate Church, Nadaikkavu	8°17'25.36"N	77° 8'50.62"E	82
48	CSI Church Pallikkal	8°16'40.52"N	77° 9'32.07"E	46
49	Govt high school ananthamangalam	8°16'0.74"N	77°10'36.69"E	74
50	AvurankuzhiVilai Amman Temple	8°14'38.63"N	77°11'18.96"E	59
51	Rose of Sharon Matriculation School	8°13'36.66"N	77°12'39.87"E	86
52	Manikkavilai Bus stop	8°12'59.45"N	77°13'23.48"E	74
53	CSI Church Kadamankuzhi, kuttuthani	8°12'27.07"N	77°14'1.13"E	72
54	Holy Mother Shrine, Neeruvakuzhi, Alanchy	8°12'9.21"N	77°14'22.89"E	72
55	Ritapuram Colony Amman Temple	8°11'20.46"N	77°15'6.19"E	50
56	St. Rita's Church, Ritapuram	8°11'25.01"N	77°15'0.55"E	59
57	Sri Sakthi Vinayagar Temple	8°11'17.80"N	77°14'48.67"E	43
58	CSI Home Church, Neyyoor	8°12'26.39"N	77°18'14.43"E	88
59	Karungal bus stand - Bus depot	8°14'17.73"N	77°14'28.46"E	99
60	St. Joseph's Church	8°15'18.73"N	77°12'44.86"E	107
61	Eraniel (railway station)	8°12'49.35"N	77°18'29.57"E	70
62	Palliyadi (railway station)	8°15'56.83"N	77°15'34.26"E	64
63	Kulitturai (railway station)	8°18'4.69"N	77°13'7.28"E	40
64	Kulitturai west rail station	8°19'26.49"N	77°12'32.03"E	53
65	Parassala (railway station)	8°20'23.39"N	77° 9'55.97"E	63
66	Dhanuvatchapuram station	8°22'41.56"N	77° 7'33.05"E	59

2.5 Yearwise Development & Production Plan

During the Plan Period, 75.00 Lakh Tonnes of ROM @ 15.00 Lakh Tonnes ROM per Annum will be mined out. With the proposed production, Life of the Mine is 40 Years. Balance Reserves will be mined out during subsequent Plan/Scheme Periods. The Rejects (mainly Quartz Material-Sand) from the HUS & MSP to the tune of 6.738 Million Tons @ 1.347 Million Tonnes per Annum will be generated which will be transported back to the Mining Lease Area to backfill the mined-out voids. This process of Mining and backfilling will be carried out simultaneously till the Conceptual Stage.

With 70% recovery, the feed to the Mineral Separation Plant can have mineral production of about 1,52,250 TPA. However, IREL will maintain the consented production capacity of 1,14,600 TPA.

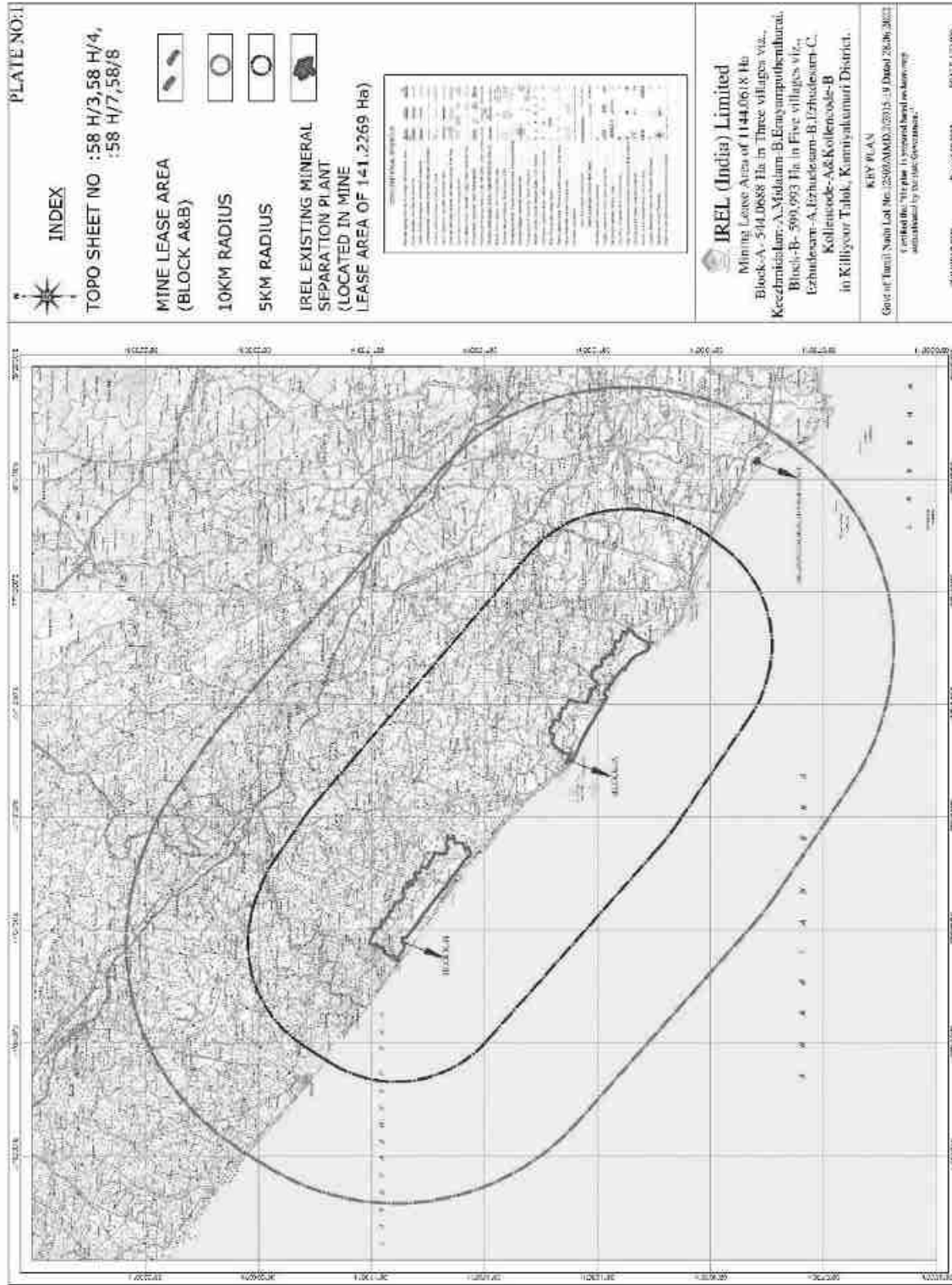


Figure 2.3 Key Plan – Block A & Block B

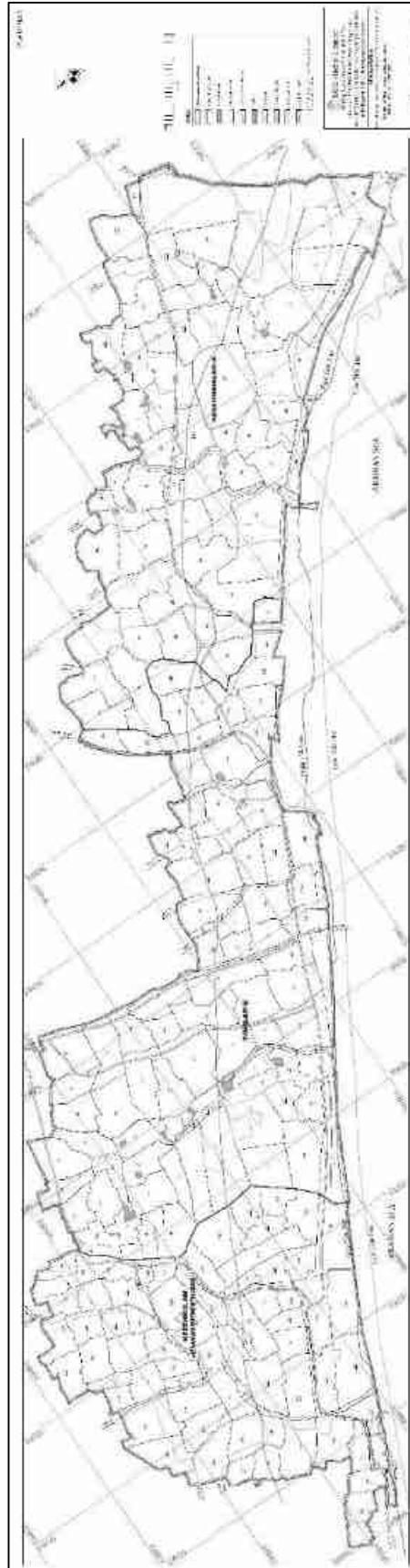


Figure 2.4 Mine Lease Plan – Block A

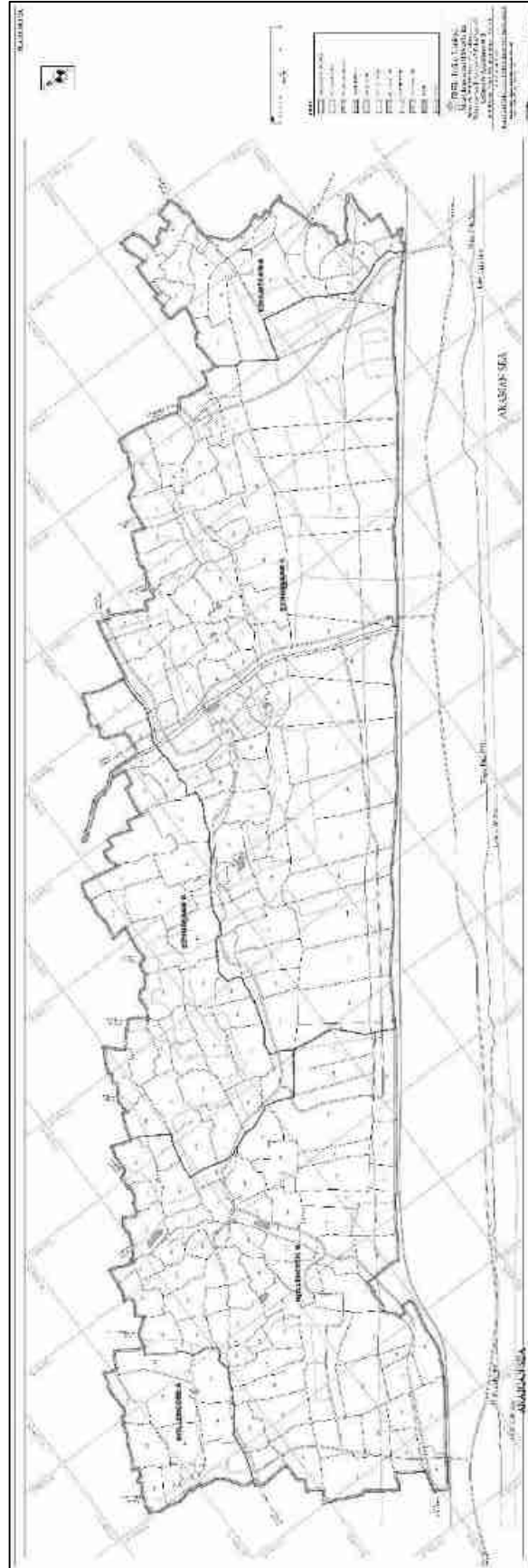


Figure 2.5 Mine Lease Plan – Block B



Figure 2.6 Surface Plan – Block A



Figure 2.7 Surface Plan – Block B



Figure 2.8 Geological Plan – Block A

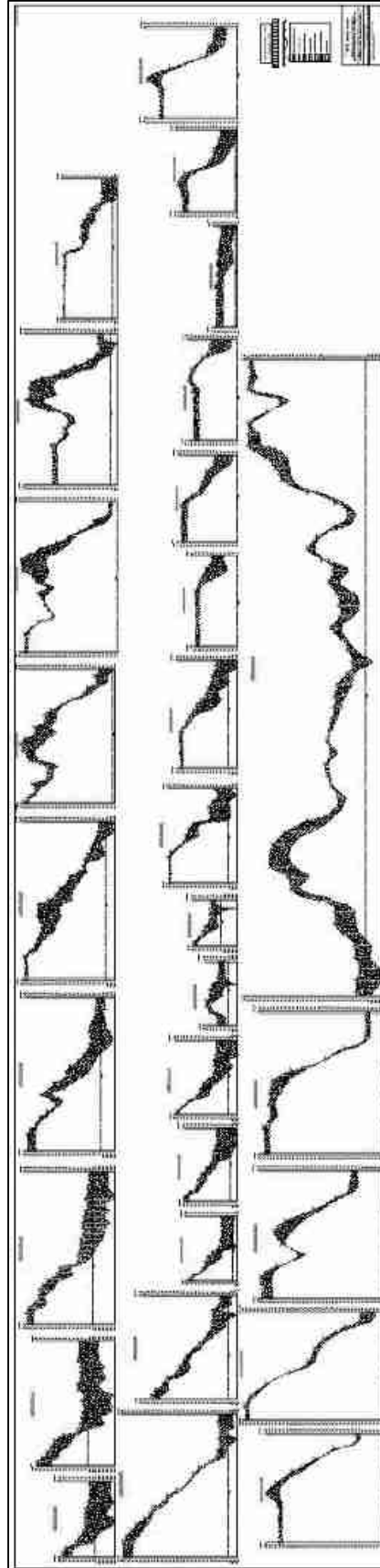


Figure 2.9 Geological Section – Block A

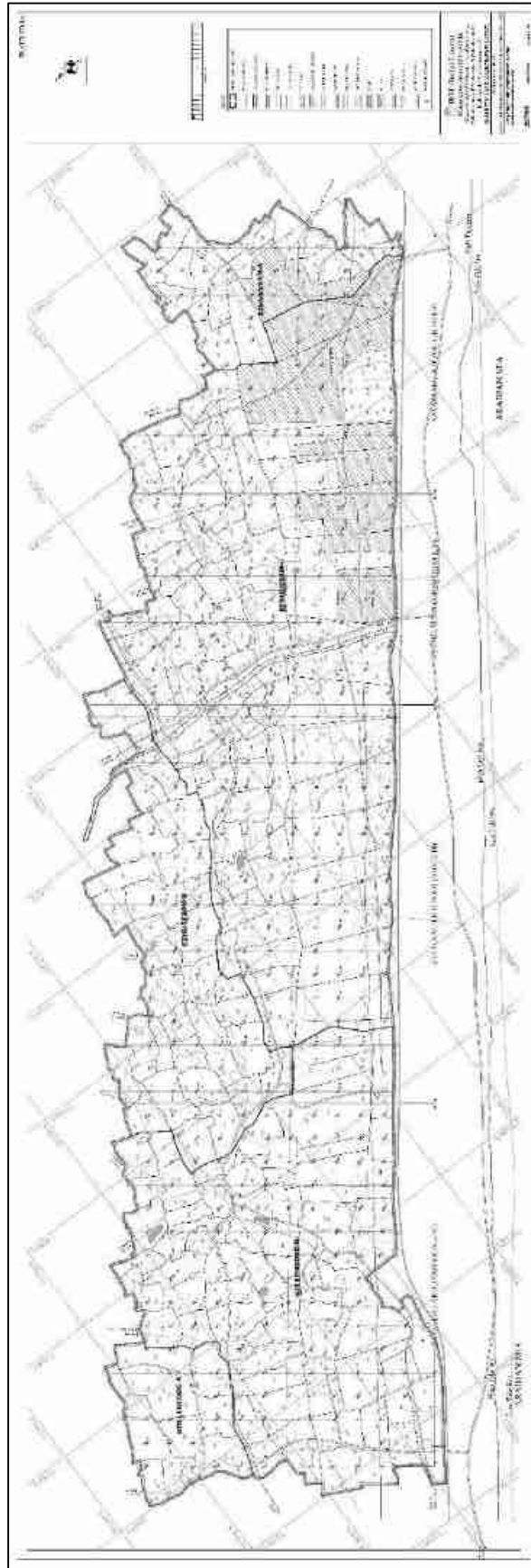


Figure 2.10 Geological Plan – Block B

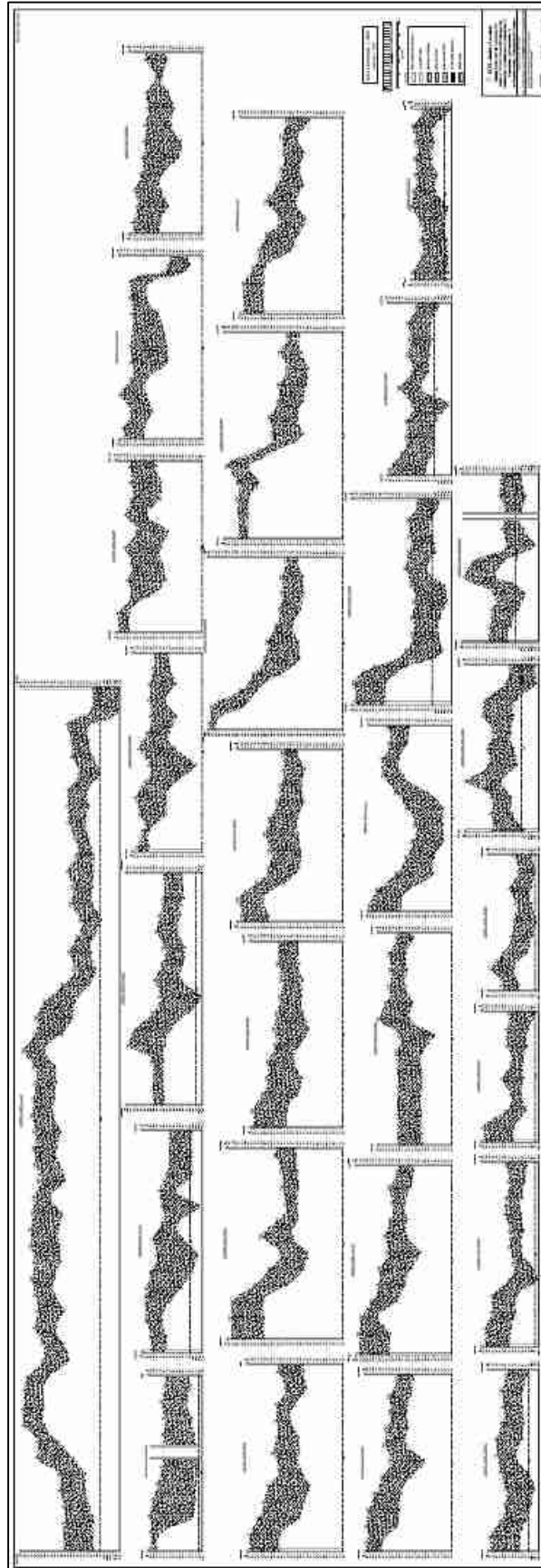


Figure 2.11 Geological Sections – Block B



Figure 2.12 Progressive Plan – Block A

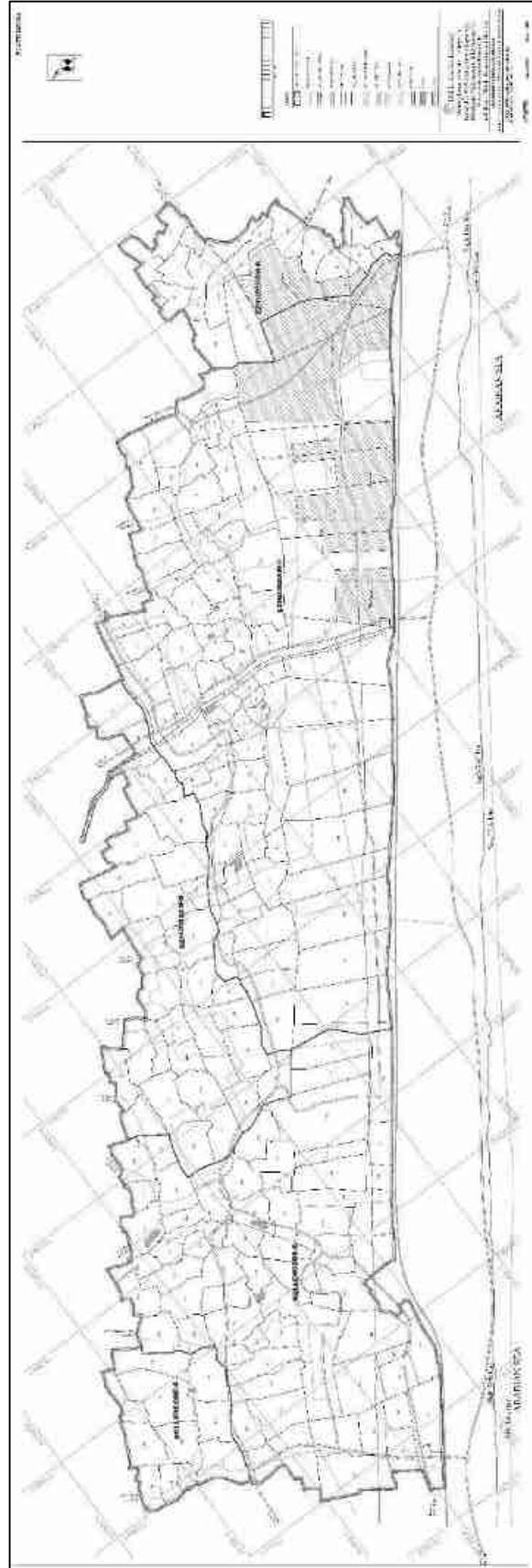


Figure 2.13 Progressive Plan – Block B



Figure 2.14 Environment Management Plan – Block A

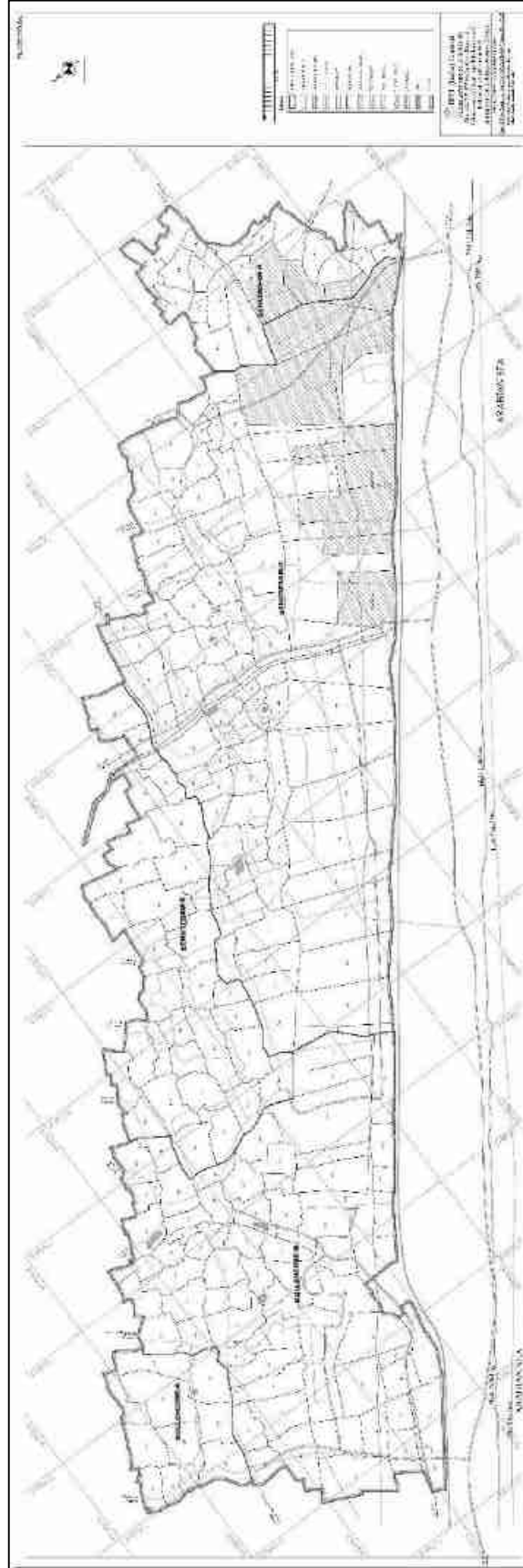


Figure 2.15 Environment Management Plan – Block B

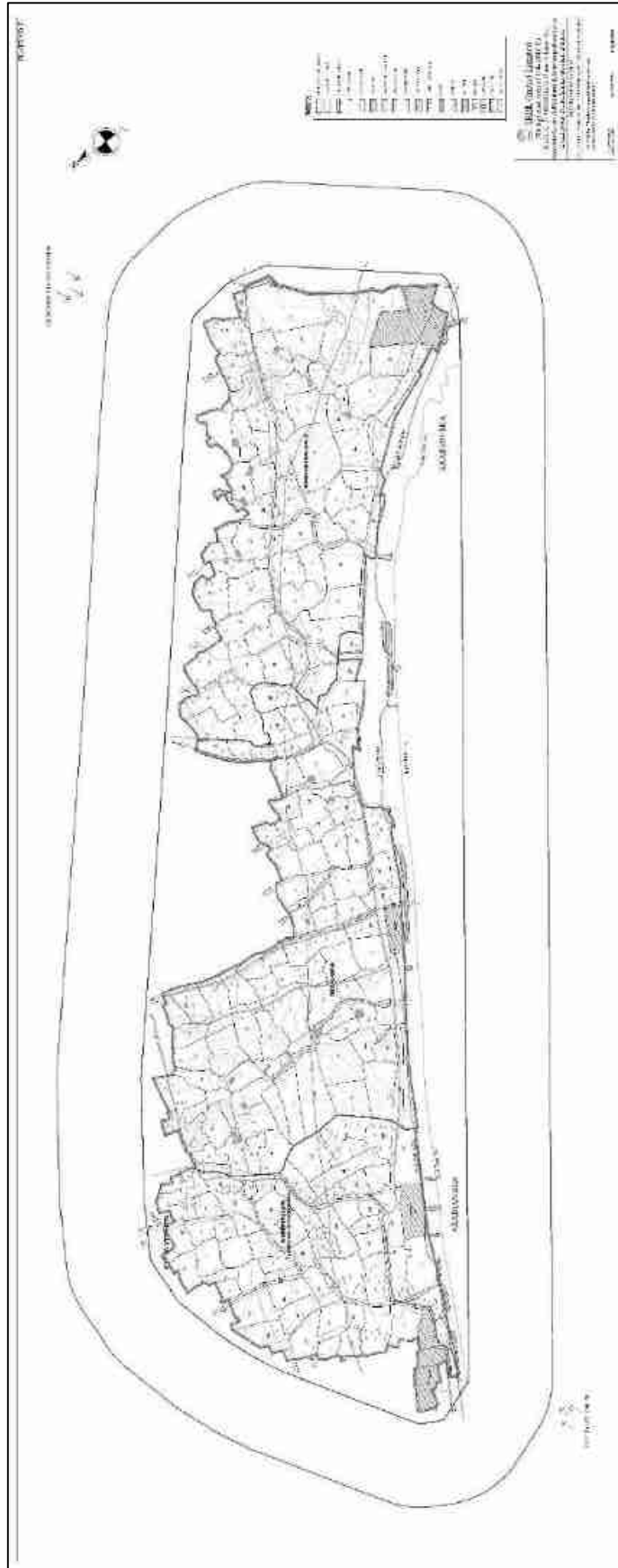


Figure 2.16 Environmental Plan – Block A



Figure 2.17 Environmental Plan – Block B

Table 2.7 Development & Production - Plan Period

Year	Top Soil, Tons	Over Burden, Tons	ROM Production,		Ore: Waste Ratio	Wastes (Quartz) from MSP for Backfilling Mined out Voids, Tons
			cu. m	Tonnes		
I	0	0	9,37,500	15,00,000	1:0	13,47,750
II	0	0	9,37,500	15,00,000	1:0	13,47,750
III	0	0	9,37,500	15,00,000	1:0	13,47,750
IV	0	0	9,37,500	15,00,000	1:0	13,47,750
V	0	0	9,37,500	15,00,000	1:0	13,47,750
Total	0	0	46,87,500	75,00,000	1:0	67,38,750

ROM Production per annum	:	15,00,000 Tonnes @ 5,000 TPD
Ore: Waste Ratio	:	1:0
No. of days per annum	:	300
No of shifts in a day	:	3
Expected life of the mine	:	40 years

Mining activity is limited to only in mineral deposit area. Hence, ultimate pit limit lies on the mineral deposit area only.

2.6 Machineries

The machineries to be deployed for the Mine are given in Table. To facilitate the maintenance of all equipments, there is a central workshop available at MSP for electrical, mechanical and instrumentation repairs.

Equipment	Nos.	Capacity
Hydraulic Excavators	4	3 – 5 tons
Dozer	2	15 – 20 tons
Tipper	35	25/30 tons

2.7 Competent Mining Personnel

The Mine will be operated with the required Statutory Officials and Competent Persons mandatorily appointed as per the provisions of Mines Act 1952, AMCR 2016 and MCDR 2017. Project will employ about 155 persons directly and 250 persons indirectly.

Sl.No.	Operations	No. of Persons required	
		Departmental	Contract
1	Mines Manager	1	-
2	Asst.Mines Manager	4	-
3	Geologist	1	-
5	Chemist	1	-
6	Mines Foreman/Mate	-	15

Sl.No.	Operations	No. of Persons required	
		Departmental	Contract
7	Semi Skilled Persons – Drivers and Operators	-	80
8	Mechanic cum fitter	-	10
9	Helpers, Mazdoors	-	40
10	Clerk	-	3
	Total	7	148

2.8 Facilities in the Mining Lease

The mining will be carried out in the Mining Lease Area in a staggered manner after obtaining land owners' consent. Thus, there is no infrastructure facilities required for the Mine.

The Mineral Separation Plant is provided with all facilities like drinking water, canteen, rest shelter, latrines and urinals, bathrooms, first aid centre, dispensary, vocational training center, workshops for Electrical, Mechanical and Civil etc. Food at the canteen is supplied at subsidized rate. Occupational Health Centre exists at MSP. Medical facilities are available round the clock and the OHC is equipped with an ambulance.

2.9 Progressive Mine Closure & Conceptual Plans (Land Use Pattern)

The land use break-up of the Mine lease area is given in Table 2.8.

Table 2.8 Villagewise land use breakup

Village name	Total extent in Ha	Built up area (Buildings/ Houses, Church /Temple, Cemetery, etc.,) in Ha	Area covered under Road in Ha	Area covered under Water bodies/ Pond/ Canal in Ha	Vacant land (with bushes and Coconut trees) in Ha
Keezh midalam-A	204.06.52	52.00.84	4.20.00	5.40.50	142.45.18
Midalam- B	202.96.86	51.67.78	8.36.50	5.94.31	136.98.27
Enayam Puthanthurai	137.03.50	8.44.47	1.83.50	2.70.60	124.04.93
Ezhudesam-A	41.10.00	3.57.24	0.26.50	0.13.00	37.13.26
Ezhudesam-B	82.90.00	20.85.01	2.38.90	0.53.60	59.12.49
Ezhudesam-C	275.82.80	85.19.33	8.00.10	1.36.70	181.26.67
Kollencode-A	28.39.50	7.97.00	1.08.50	0.14.00	19.20.00
Kollencode-B	171.77.00	32.97.68	3.31.16	1.56.00	133.92.16
Total	1144.0618	262.69.35	29.45.16	17.78.71	834.12.96

About 106.50 Ha is required for Mining during the Plan Period which will be mined out, back filled and handed over to the Land Owners. At the Conceptual Stage, 834.1296 Ha will be the mined out and back filled area. Backfilled area will be used for Coconut tree plantation by the respective land owner.

Net area put to use for mining & allied services for the proposed period is 13.60.00 Ha. As per rule 27(2) of MCDR 2017, an amount of Rs 68,00,000/- (Rupees sixty-eight lakh only) @ Rs. 5,00,000/- per Ha of bank guarantee towards the Financial Assurance will be submitted to the Director, Atomic Minerals Directorate for Exploration and Research, Hyderabad.

Sl. No.	Activities		Land Use, Ha		
			At Start of Plan Period	End of Plan Period	End of Life of Mine (Conceptual)
1	Area under inland mining	Mined out	0.000	106.500*	834.1296**
		Active Mine	0.000	3.000	0.000
		Backfilled	0.000	103.500*	834.1296**
2	Storage of topsoil		0.000	0.000	0.000
3	Overburden/dump/Waste dump		0.000	0.000	0.000
4	Mineral storage		0.000	0.000	0.000
5	Infrastructure		0.000	0.000	0.000
6	Road		29.4516	29.4516	29.4516
7	Railways		0.000	0.000	0.000
8	Tailing pond		0.000	0.000	0.000
9	Effluent treatment plant		0.000	0.000	0.000
10	Mineral separation plant		0.000	0.000	0.000
11	Township		0.000	0.000	0.000
12	Coastal sea		0.000	0.000	0.000
13	Greenbelt/Afforested area		0.000	103.50.00	834.1296
14	Inhabitated Village areas and water bodies		280.4806	280.4806	280.4806
15	Undisturbed Area		834.130	727.630	0.00.00
Total			1144.0618	1144.0618	1144.0618

*: Mining will be carried out at the rate of 21.3 Ha per Annum and Backfilled simultaneously – Land use for 5 years is considered. Backfilled area will be used for Coconut tree plantation by the respective land owner.

** : At conceptual stage 834.1296 Ha will be the Mined-out area backfilled simultaneously.

2.10 Water Demand

With no permanent facilities proposed in the Mining Lease and with the moving population of worker/employees during the mining, water demand will be 2.5 KLD which will be sourced from permitted 4500 KLD from Valliyar River for the existing MSP at Manavalakurichi. Also, the quantity will be managed with local Drinking Water Suppliers Sewage generation of 2.2 KLD will be biologically treated in a mobile Bio Toilets and the sludge will be used as manure for the Green Belt/Afforestation purpose. No Workshop is proposed and thus, no trade effluent generation from the Mine. **No mine pit will be there** and thus; no mine drain is envisaged.

2.11 Power & Fuel Demand

There is no Power requirement for the Project. However, mobile Light Towers with 2 x 125 KVA DG Set will be utilized for night time operations. **HSD @ 2,500 lits. /Day** is required for the mining equipments and transportation. Commercial mobile lighting towers are available from 7.5 kVA for lighting 10–15 LUX intensity at the working areas for night operation. The engine capacity will be 16-20 BHP.

2.12 Occupational Health & Safety

IREL will provide and continually improve the occupational health and safety performance. Personal Protective Equipments will be provided to the mine employees. All the workers will be provided with Internal Dosimetry and Medical Surveillance. Maintenance of Pre, during & Post Employment Records will be done. Duly qualified Radiological Safety Officer (RSO) will be appointed. External Radiation Monitoring (by BARC) will be carried out periodically All the workers will be trained and instructed in radiation safety.

2.12.1 Radiation Monitoring

Personal Monitoring:

- Persons working in the mines will be provided with Thermo Lumiesent Dosimeter (TLD). The TLD will be issued on quarterly basis and it will be evaluated by Nuclear Fuel Complex (NFC). External dose level will be calculated and the same will be recorded.
- Work place monitoring: Radiation in work place will be carried out by Radiation survey meter. Radiation survey will be conducted once in a month.
- First aid room will be provided in the site and the same will be maintained as per Mines Rules, 1955.
- All persons to be employed would undergo Initial Periodical Medical Examination as per Mines Act, 1952 and AERB guidelines.
- Periodical Medical examination: Once in 5 years for below 45 years and once in 3 years for above 45 years.
- As per Radiation Protection Rules, 2004, periodical medical examination will be conducted once in a year for the persons working in mines site.
- Medical examination will be carried out for the persons retiring (30 days before retirement)
- All the data will be digitally maintained.

3.0 Description of environment

3.1 Project Site and Study Area

IREL mining lease area has been designated as the core zone. The buffer zone for the present study has been considered as an area encompassing 10 km from boundary of the mine lease. The core zone and the buffer zone together constitute the study area. The study area map of 15 km is shown in Table 3.1.

Table 3.1 Environmental Sensitivity – 15 km radius

Sl. No.	Areas Name/Identity	Aerial distance (within 15 km) Proposed project boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value.	No protected area falls within 15 km of the proposed mining lease area.
2	Areas which are important or sensitive for ecological reasons –Wet lands, water courses or other water bodies, coastal zone, biospheres, mountains, forests	Part of proposed mining lease area falls under the Coastal Regulation Zone. For operational convenience, the proposed mining lease area are considered into two blocks, “Block A” and “Block B”. Thamirabarani river, which is flowing between Block-A and Block-B, is about 0.12 km away from the Eastern boundary of Block-B and 4.5 Km away from the Western boundary of Block-A. No Wet lands, mountains, bio-spheres and forests fall in the study area.
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	No protected areas relating to sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration falls within the study areas.
4	Inland, coastal, marine or underground waters	River Valliar drains the eastern parts of the Study Area and River Thamirabarani drains the central parts of the Study Area which flows adjacent to the Block-B at 0.12 km in the northeast and 4.5 km from Block-A in the northwest. Valliyar River flows eastern side of the Mineral Separation Plant at Manavalakurichi and is flowing at 9.6 km from Block-A and 20.7 km from Block-B in southeast. Arabian Sea and its coastline are in southern parts.
5	State, National boundaries	Kerala state boundary is located at a distance of 1.5 km from the proposed mining lease area.
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	National Highway NH-66 runs at 9.3 km north of Block-A and 6.5 km north of Block-B. The State Highway SH-179 runs parallel and through the Mining Lease. Mandakkadu Baghavathy amman

Sl. No.	Areas Name/Identity	Aerial distance (within 15 km) Proposed project boundary
		temple, a famous pilgrimage centre is located near MSP on SH-179.
7	Defence installations	No defence installation is located in the proposed study area.
8	Densely populated or built-up area	The Municipal Corporations of Colachel on the South-East side and Kollencode on the North-West side fall under the study area. Moderately populated villages such as Pallapallam, Enayamputhenthurai, Karungal, Puthukadai, Manavalakurichi, Monday Market, Neyyoor, Kalingarajapuram, Nithiraivilai, Poothurai etc., are located within the study area.
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	Hospitals, Schools, Churches, Temples, Community Halls, recreation clubs etc. are located within the study area. Proposed mining operations would not have impact on any of these activities.
10	Areas containing important, high quality or scarce resources (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	The proposed mining lease area contains Monazite (Uranium, Thorium and Rare Earth Oxide) in the BSM Ore, which is required for strategic applications by Department of Atomic Energy.
11	Areas already subjected to pollution or environmental damage. (Those where existing legal environmental standards are exceeded)	The study area is not subjected to any pollution or environmental damage. The coastal areas in Kanniyakumari District which includes the proposed mining lease area are having high natural background radiation in the range of 1 to 4 Micro Sievert per hour. This high radiation is primarily due to the presence of Monazite which is a radioactive mineral. Backfilling the mined-out areas with monazite free tailings reduces the background radiation to 0.2 to 0.4 Micro Sievert per hour. In other words, there has been 8-to-10-fold reduction in the radiation level in the area where mining is carried out and as such our mining does not affect either environment or people and makes the area free from high background radiation.
12	Areas susceptible to natural hazard which could cause the project to present environmental problems (earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)	No such areas are available in the study area.

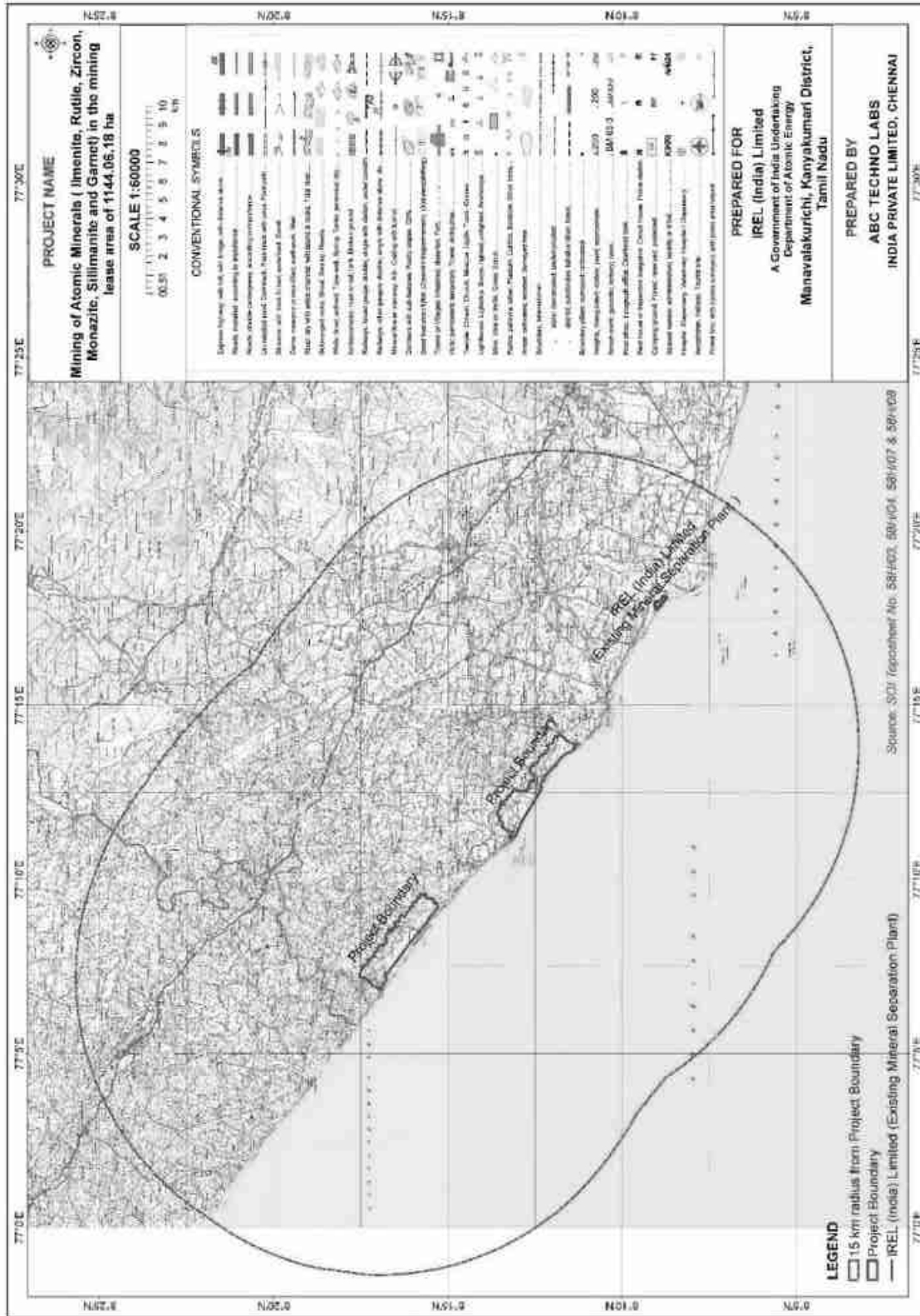


Figure 3.1 Study area of 15 km radius

3.2 Environmental Components and Methodology

The environmental components studied and the methodologies followed for the preparation of EIA report are given in Table 3.2.

Table 3.2 Environmental components and methodologies

Sl.No.	Environmental Components	Area	Parameters	Methodology	Frequency
1	Air	10 locations in Core zone & Buffer zone	Meteorology	Field monitoring/ secondary data	Continuous for 3 months
			Ambient Air Quality (PM ₁₀ , PM _{2.5} , SO ₂ , NO _x , Pb and other metals composition in PM ₁₀)		24 hourly-Twice a week for 3 months in Non-Monsoon season
2	Water	10 locations in Core zone & Buffer zone	Water Quality Surface (parameters as per IS:10500) Ground (parameters as per IS:10500) Ground water regime (hydrogeology) Water level measurement (in pre and post monsoon seasons)	Field Monitoring	Once in season
3	Soil	10 locations in Core zone & Buffer zone	Soil Quality (pH, Elect. Conductivity, texture, NPK, Exch. cations, micronutrients)	Field monitoring	Once in season
4	Noise	10 locations in Core zone & buffer zone	Noise levels	Field monitoring	Once in season
5	Ecological Features	Core zone & Buffer zone	Flora & fauna	Field study/ Secondary data	Once in season

Sl.No.	Environmental Components	Area	Parameters	Methodology	Frequency
6	Socio-economic Features	Core zone & Buffer zone	Parameters related to socio-economic aspects (agricultural situation, employment, income, consumption and saving etc.)	Field Study (Public Consultation by questionnaire survey)/ Secondary Data	Once in season
7	Traffic Survey		Traffic density to understand interface of study area & project site	Field Monitoring	Once in season
8	Land Use	Core zone & Buffer zone	Land cover categories based on satellite image	Land schedule records, Satellite image processing	Once in season

3.3 Physiography

The topography of the new mining lease area is flat except undulation found in certain patches.

Sl.no.	Villages	Elevation, AMSL (m)
1.	Keezhmidalam	6.0
2.	Midalam	6.1
3.	Enayamputhenthurai	4.9
4.	Ezhudesam	4.9
5.	Kollencode	3.4

Contour Map of the study area is given as Fig. 3.2 and 2 km radius Contour Map is given as Fig 3.3.

3.4 Drainage Pattern

River Valliar drains the eastern parts of the Study Area and River Thamirabarani drains the central parts of the Study Area which flows adjacent to the Block-B at 0.12 km in the northeast and 4.5 km from Block-A in the northwest. Valliyar River flows eastern side of the Mineral Separation Plant at Manavalakurichi and is flowing at 9.6 km from Block-A and 20.7 km from Block-B in southeast. Arabian Sea and its coastline are in southern parts.

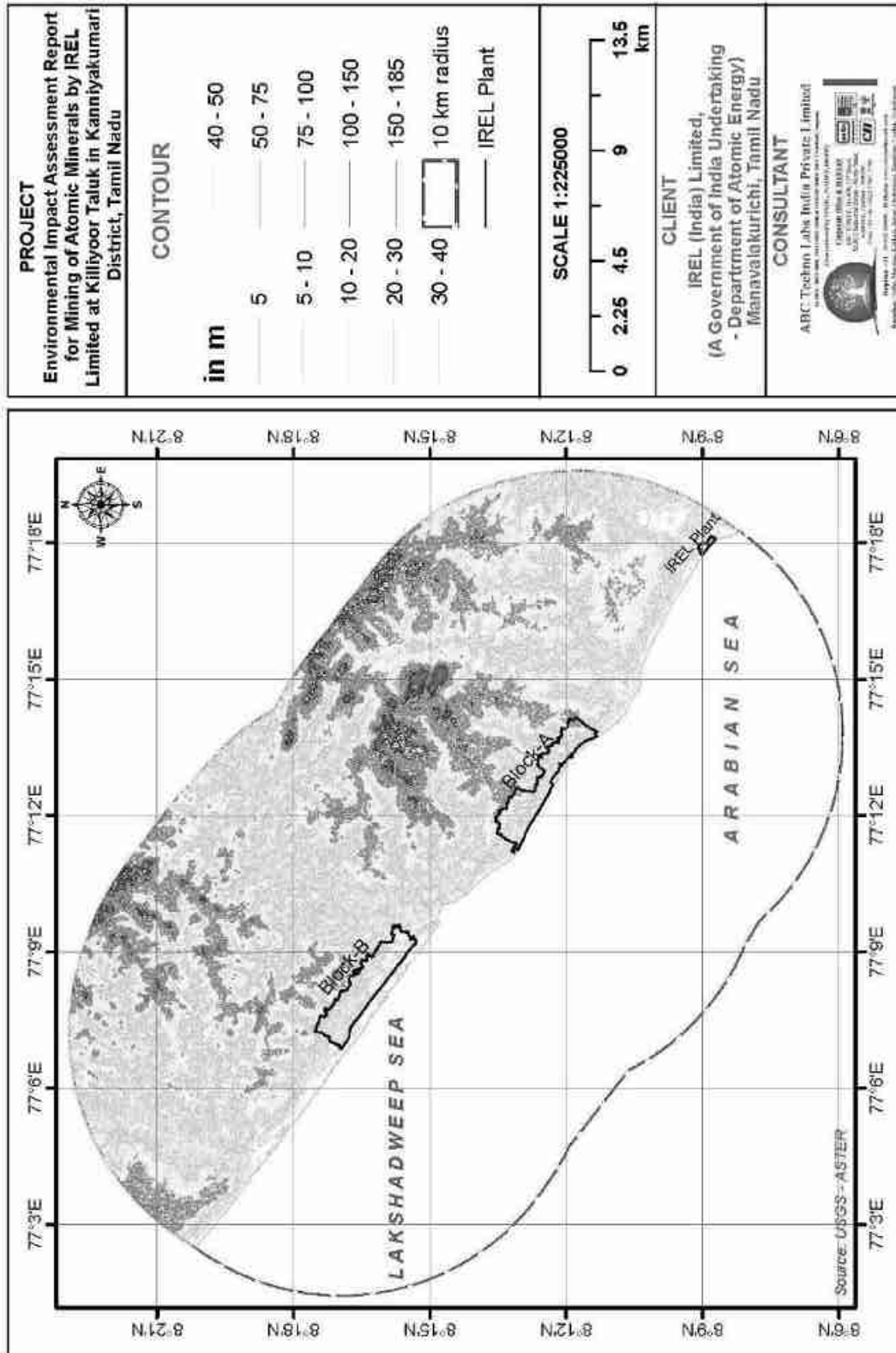


Figure 3.2 Physiography

The drainage pattern of the study area is shown in Fig. 3.4 and 2km radius Drainage map is given as Fig 3.5. As observed, there is no marked drainage pattern in the Mining Lease area and the existing water bodies like ponds/streams will not be disturbed. Block-B is devoid of any streams whereas, there are 2 streams in Block A which will not be disturbed as such. The river Thamirabarani flows in the Eastern parts of Block B at an elevation of 18-33 m AMSL while Block B is located in the elevation range of 37 m AMSL near the water course. There will not be any flood risk to the mining lease as well as no impacts anticipated due to the mining on the river course.

There are 2 stream crossing in Block 'A' which will be maintained as such till Conceptual Stage. There is no marked drainage pattern.

Photographs showing the Monitoring locations are appended and also in the Annexure.



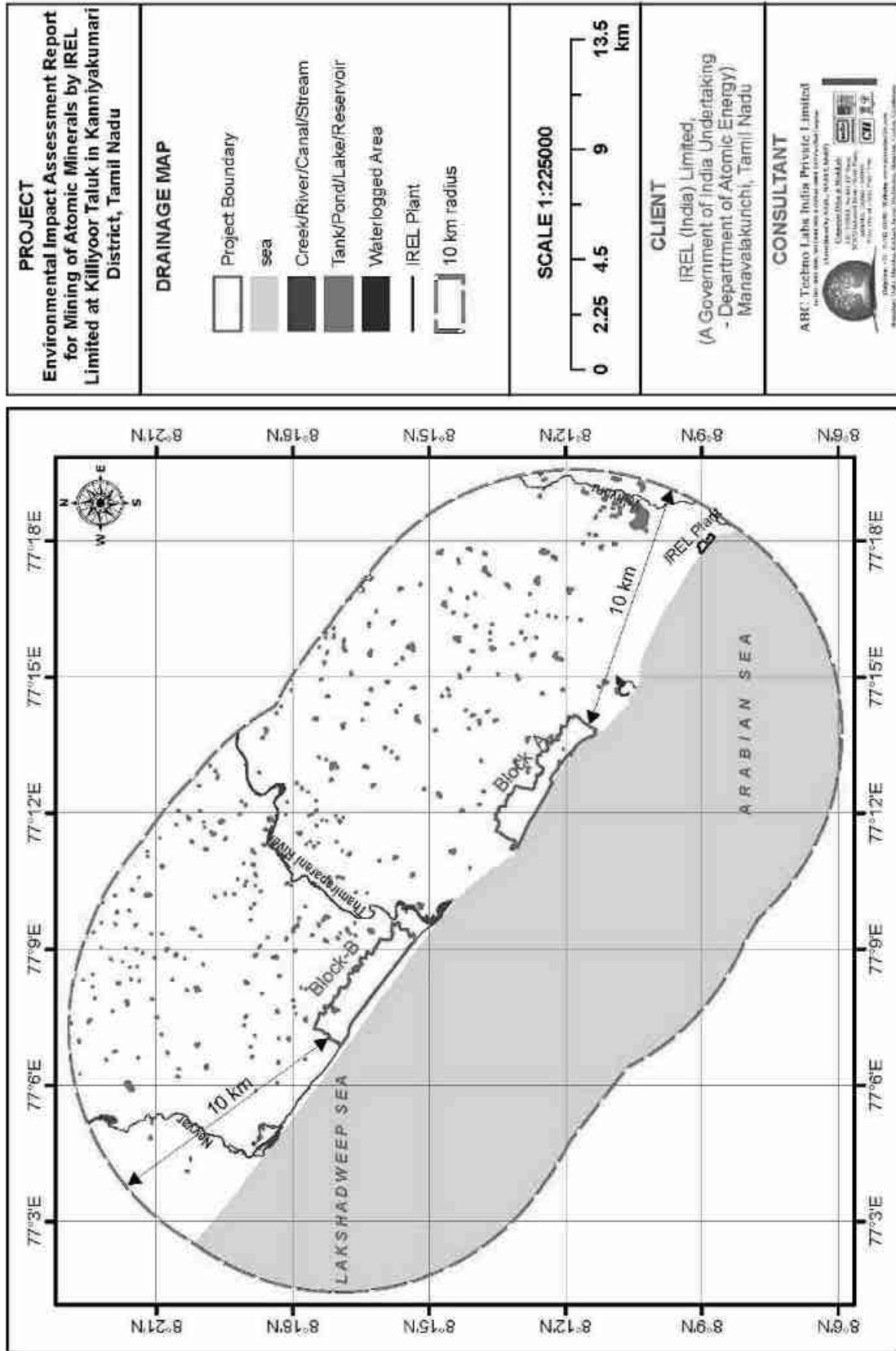


Figure 3.4 Drainage Pattern

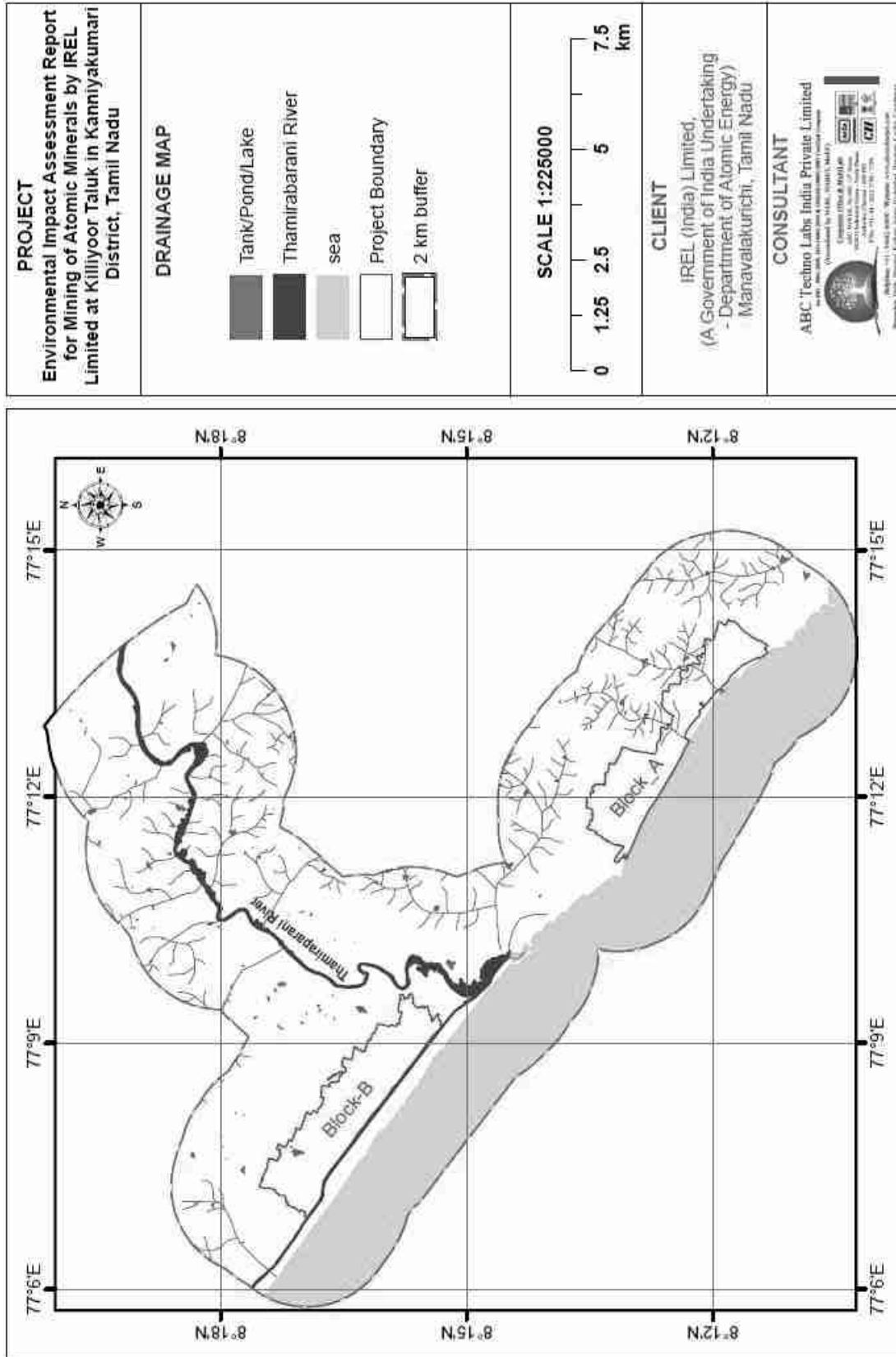


Figure 3.5 Drainage Pattern – 2km radius

3.5 CRZ Area

The Mining Lease area partly falls in CRZ and falls in approved Coastal Zone Management Plan (CZMP) of Tamil Nadu map nos. 4, 11 & 10 as appended Fig 3.6, 3.7 & 3.8. HTL/LTL CRZ Maps referred by the Institute of Remote Sensing, Anna University for the project are given as Fig 1.4 & 1.5 in chapter 1. Out of the total area of 1144.0618 Ha, 353.4876 Ha area falls under CRZ-I(B), II and III categories. As per National Centre for Coastal Research (NCCR), Block A & B falls in Low erosion and Low accretion area. Also, some Mining Lease pockets in Block A falls in the intertidal zone. Shoreline changes are studied based on satellite imageries of 2010-2015, 2010-2020, 2010-2023 and stable coastline has been observed in both the block areas. There was accretion to an extent of 4.0 m near Block B. As Block B Area is about 365 m from the coastline no impact is anticipated to the Mining Lease area due to Shoreline Changes.

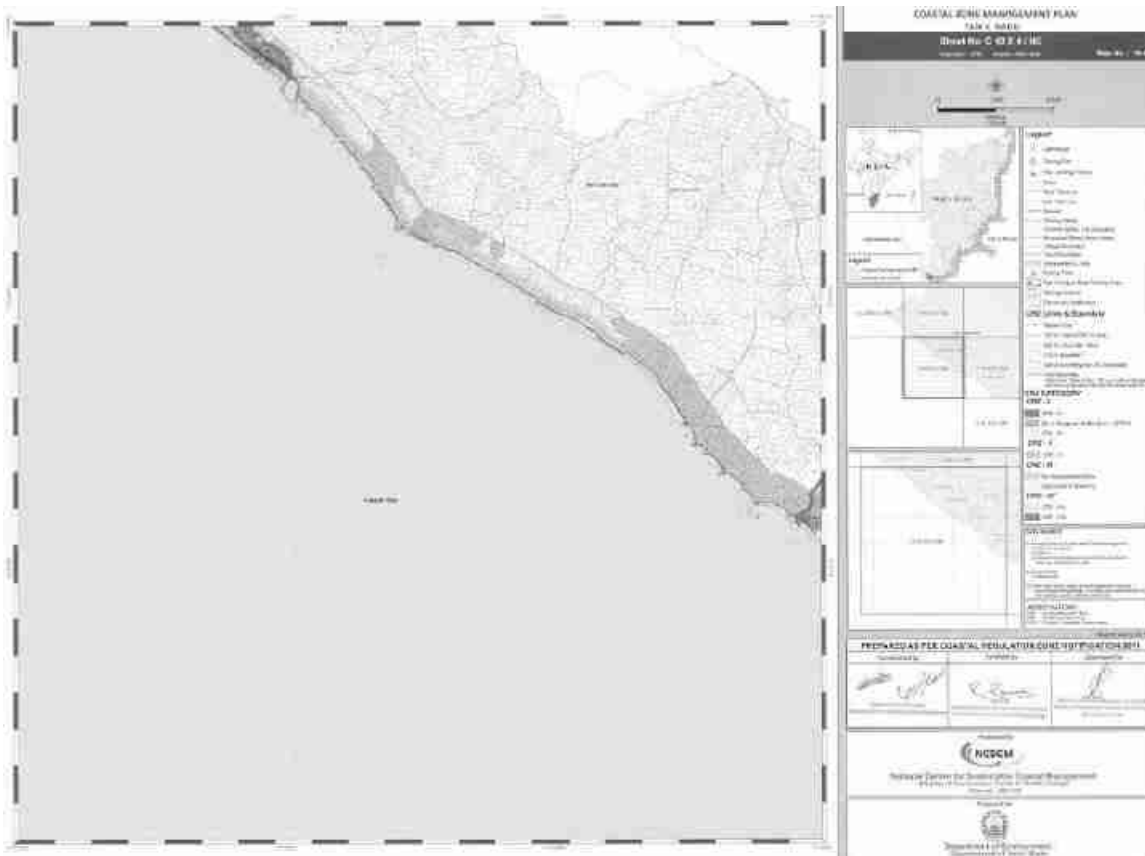


Figure 3.6 Approved CZMP Sheet No.4

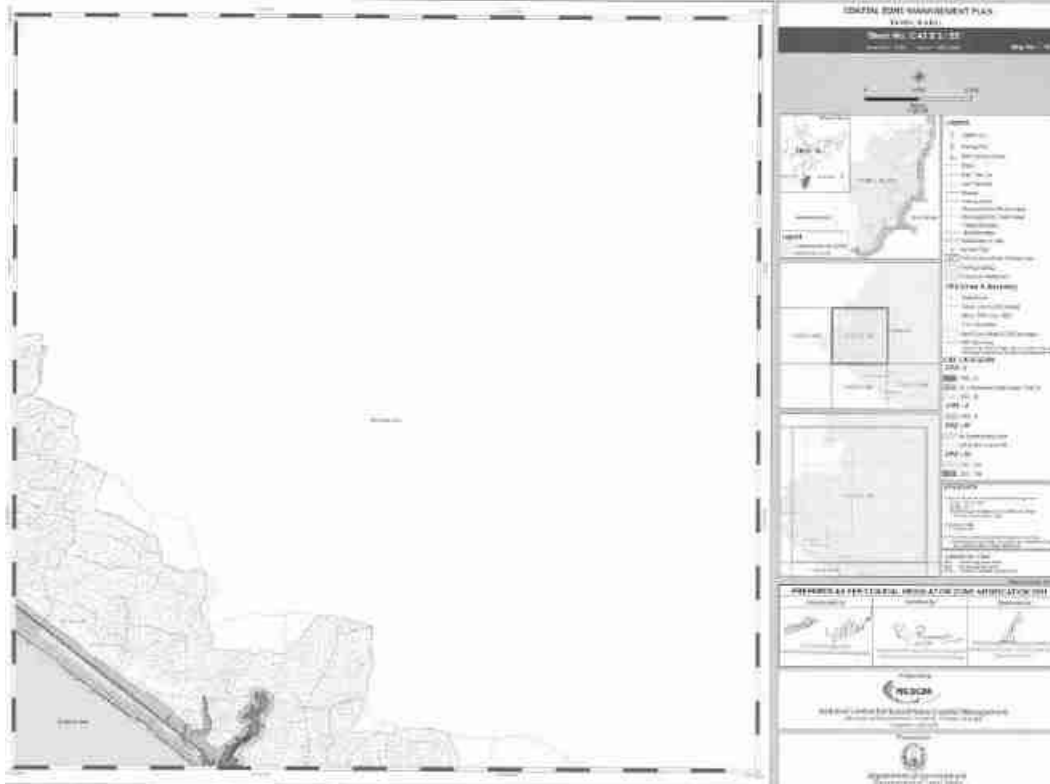


Figure 3.7 Approved CZMP Sheet No.11

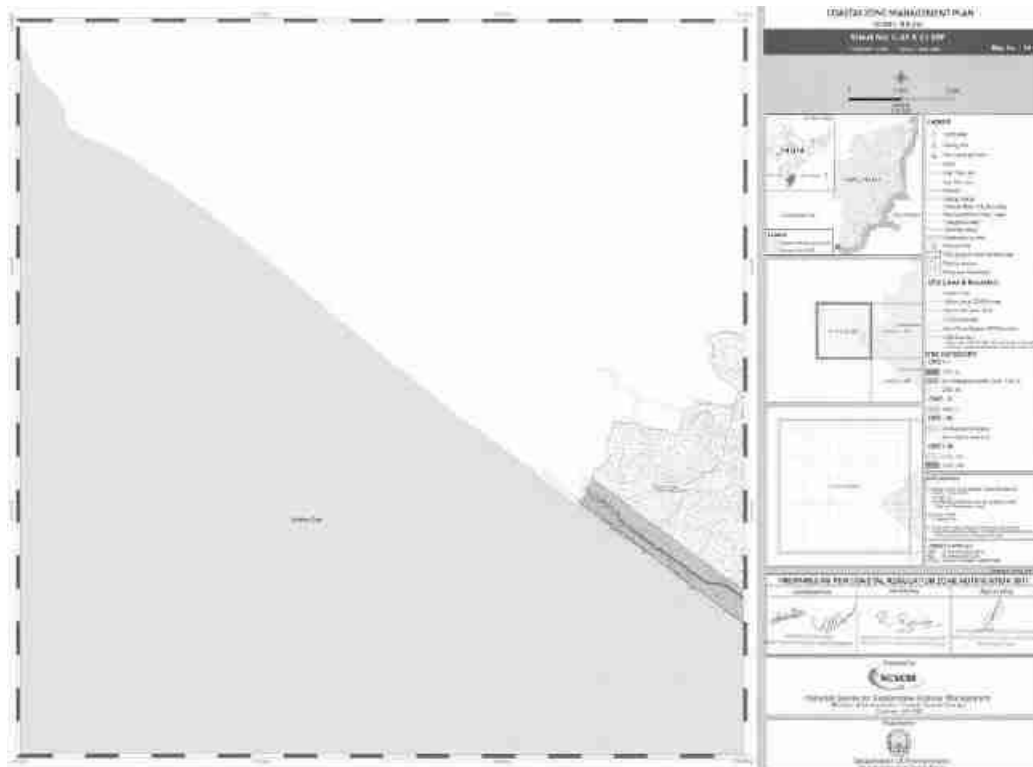
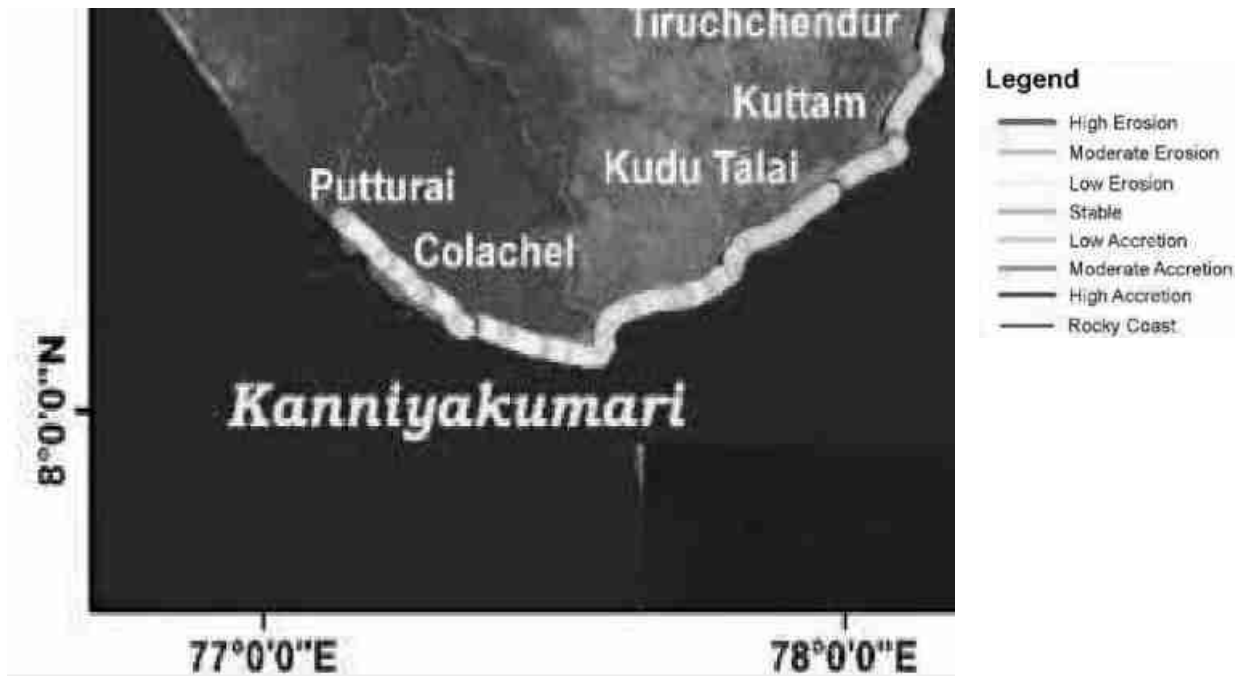


Figure 3.8 Approved CZMP Sheet No.10



Source: National Assessment of Shoreline Changes along Indian Coast (1990 – 2016) by NCCR

Figure 3.9 Shoreline Change of Kanniyakumari Coast

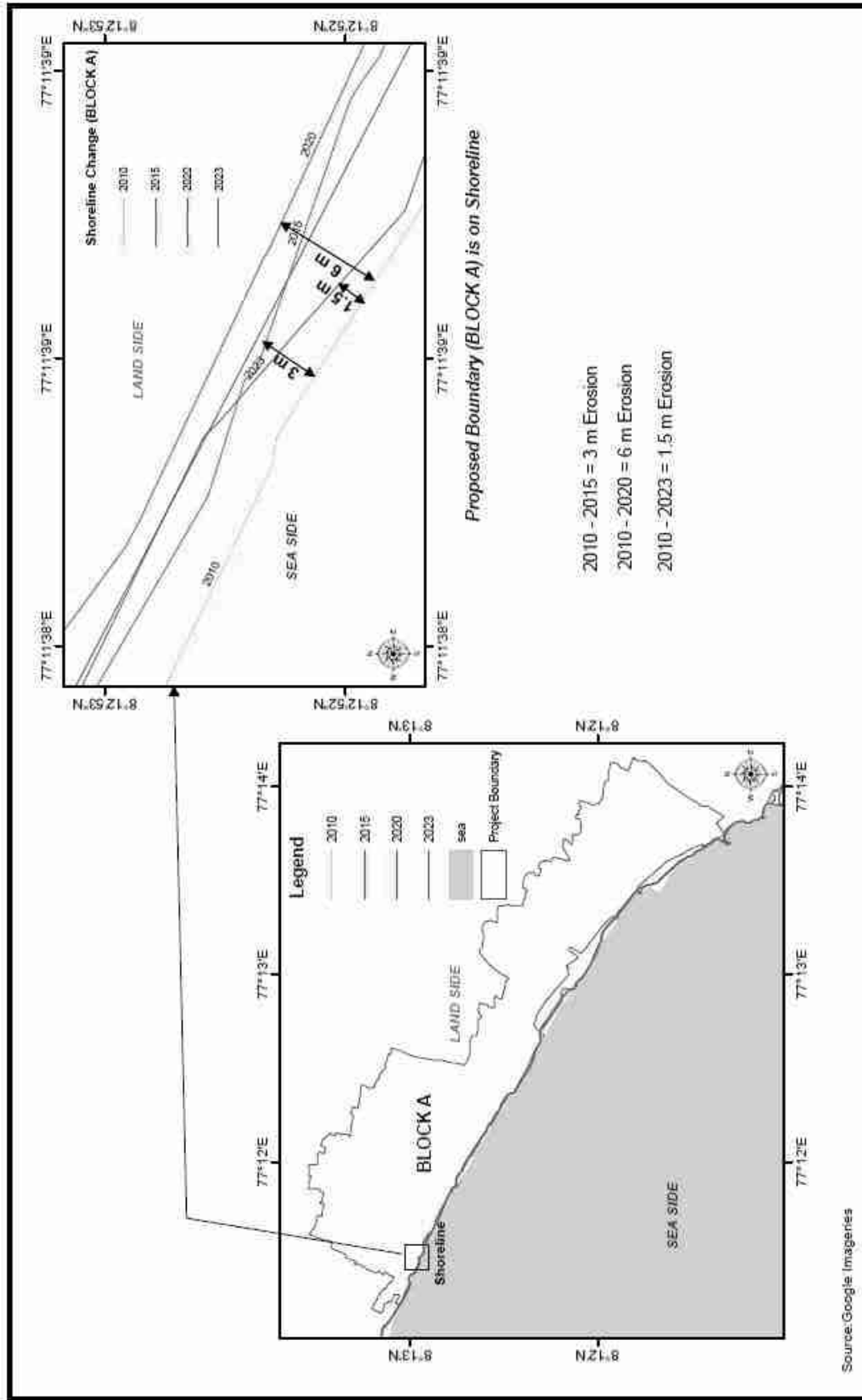


Figure 3.10 Shoreline Changes Map – Block A

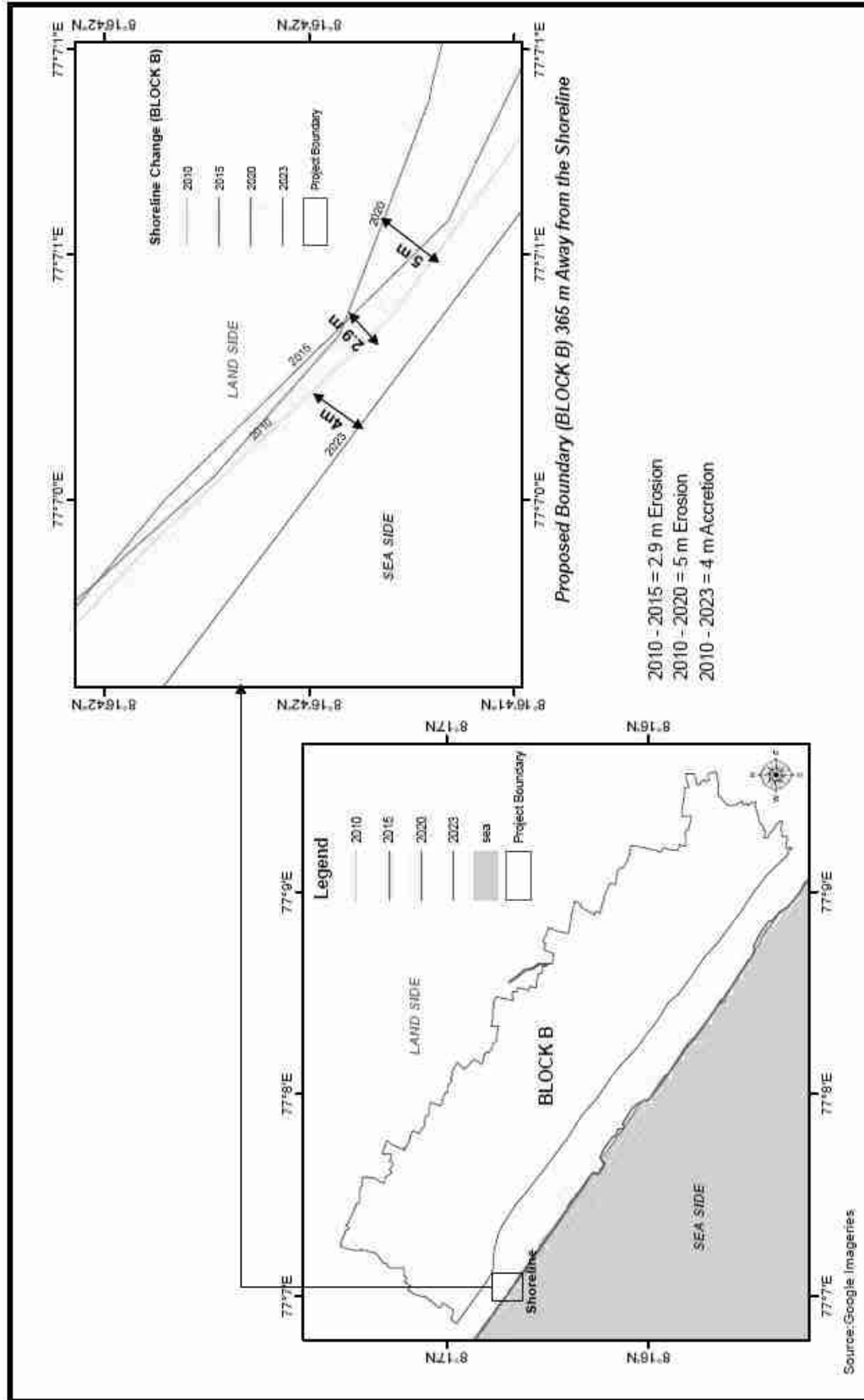


Figure 3.11 Shoreline Changes Map – Block B

3.6 Seismicity

There are 4 major seismic zones (zones II, III, IV and V) in India, based on the seismotectonic parameters, history of seismicity and certain geophysical parameters. The Study Area is categorized in the **seismic zone III**, which is classified as having **Moderate risk zone**.



3.7 Regional Hydrogeology

Ground water in phreatic aquifers in Kanniyakumari district, in general, is colourless, odourless and slightly alkaline in nature. The specific electrical conductance of ground water in phreatic zone (in Micro Seimens at 25° C) was in the range of 150 to 2240 in the district. It is between 750 and 2250 $\mu\text{S}/\text{cm}$ at 25° C in the major part of the district. Conductance below 750 $\mu\text{S}/\text{cm}$ has been observed in ground water in parts of Marthandam, Attur, Villukuri and Chettiyarmadam.

It is observed that the ground water is suitable for drinking and domestic uses in respect of all the constituents except total hardness and Nitrate. The incidence of high total hardness is attributed to the composition of litho units constituting the aquifers in the district, whereas the Nitrate pollution is most likely due to the use of pesticides and fertilizers for agriculture.

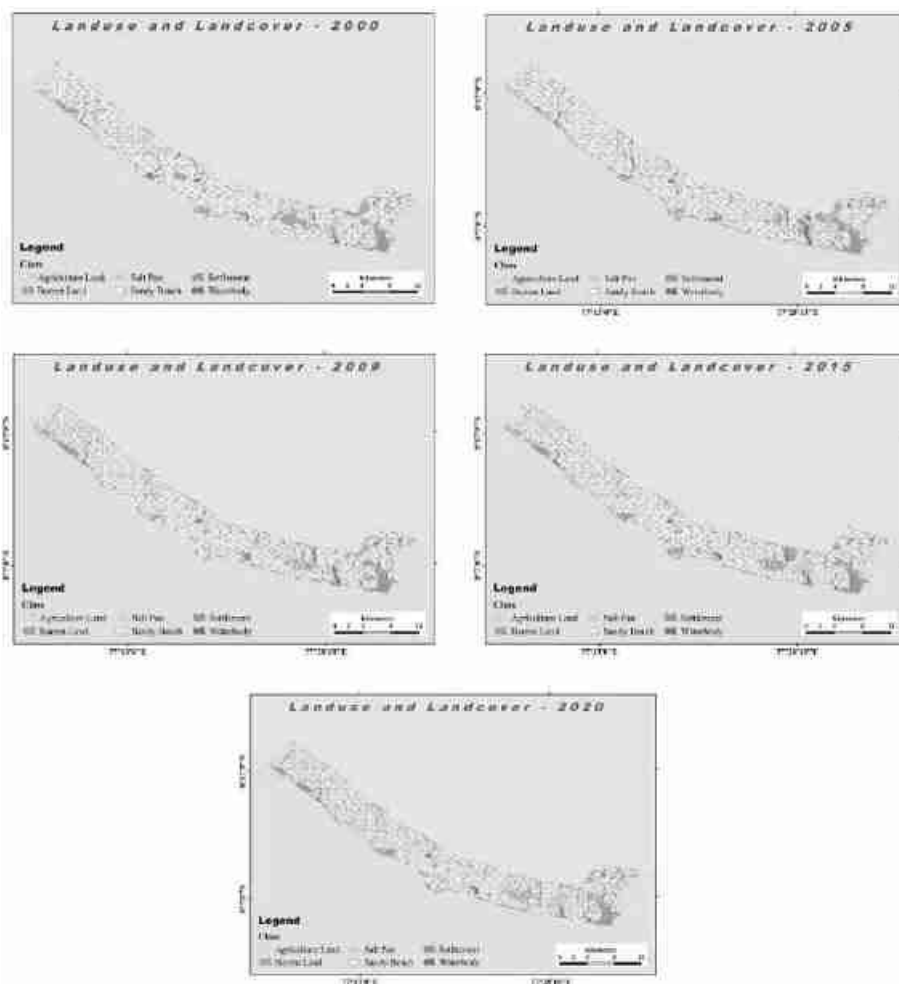
The estimation of groundwater resources for the district has shown that all block is under **“Safe”** category.

3.7.1 Hydrogeology

During baseline data generation, the hydrogeological studies were also conducted in detail within a 10 km radius of the study area. About 30 bore wells were inventoried and the water levels were measured to understand the characteristics of phreatic aquifers. The hydrogeological details of the measured wells around the project site are given in Annexure as Doc 4.

3.8 Long term study of Land Use in study and surrounding area

The terrain is classified as Agriculture Land, Barren Land (empty land with sand exposure and rocky surfaces), Sandy Beach, Salt Pan, Settlement (built-up land), and Waterbody (rivers, small reservoirs, and ponds) to study the land use and land cover changes. The changes figured from 2000 to 2020 are generated and shown in below figure.



Recorded Land use pattern from 2000 to 2020

The changes in the area for the years 2000, 2005, 2009, 2015, and 2020 are examined, and each classified area is tabulated in Table. Through this study, it is significantly observed rapid growth in Settlement areas. The Settlement region is increased gradually in each period: 5.94% (2000); 6.37% (2005); 7.05% (2009); 8.07% (2015); and, 9.52% (2020). On the other hand, a simultaneous quandary decrease in Agriculture and Barren

Land is seen. The Settlement Area increased abruptly along the coast from 2000 to 2011 by converting Agriculture Land and Barren land. The changes in Agriculture Land is observed to be 84.57% (2000), 84.58% (2005), 84.42% (2009), 83.87% (2015), and 83.12% (2020). The changes in Barren Land seem to have decreased from 4.86% in 2000 to 4.61% in 2005 and 4.25% in 2009; it decreased again to 3.95% in 2015 and 3.22% in 2020. The Waterbody seems to be decreased from 2.05% in 2000 to 1.85% in 2020. The variation in the amount of rainfall and alteration of the waterbodies to built-up and agricultural land leads to the loss of the waterbodies. The Salt Pan is reduced from 1.31% (2000) to 1.01% (2020). The intense decrease in the Salt Pan in 2005 (0.87%) is due to the effect of the tsunami in 2004. However, in Sandy Beach, no significant change is noted, but the dynamic change is due to the erosion and accretion by the sea waves and the creeks in this region.

The overall difference in the percentage of land use and land cover changes from 2000 to 2020. From 2000 to 2020, the Agriculture Land, Barren Land, Salt pan, and Waterbody decreased by 20.09%, 22.88%, 4.21%, and 2.79%, respectively, with an increase in the Settlement area by 49.89%. The decrease in the area of Agriculture Land and Barren Land is reflected in this conversion to Settlement areas.

Variation in land use from 2000 to 2020

Year	2000		2005		2009		2015		2020	
Class	Area		Area		Area		Area		Area	
	km ²	%	km ²	%	km ²	%	km ²	%	km ²	%
Agriculture Land	257.3	84.57	257.33	84.58	256.86	84.42	255.17	83.87	252.91	83.12
Barren Land	14.8	4.86	14.01	4.61	12.93	4.25	12.01	3.95	9.8	3.22
Salt Pan	3.98	1.31	2.64	0.87	3.18	1.05	3.22	1.06	3.06	1.01
Sandy Beach	3.84	1.26	4.12	1.35	3.93	1.29	3.43	1.13	3.87	1.27
Settlement	18.08	5.94	19.38	6.37	21.44	7.05	24.56	8.07	28.98	9.52
Waterbody	6.25	2.05	6.75	2.22	5.92	1.95	5.87	1.93	5.64	1.85
Total	304	100	304	100	304	100	304	100	304	100

3.8.1 Land Use in the Study area

Information on existing LU/LC, its spatial distribution and change are essential pre-requisite for land use planning. In order to use the land optimally, it is not only necessary to have information on existing LU/LC but also its capability to monitor the dynamics of land use change. The land use planning and land management strategies hold key for development of any region.

The present work is preparing LU/LC for the proposed mining of atomic minerals (BSM Ore) (Monazite, Zircon, Ilmenite, Rutile, Sillimanite and Garnet) in the mining lease area of 1144.0618 Ha by IREL (India).

3.8.1.1 Methodology for land use/land cover mapping

The present LU/LC map prepared based on the following method. Google Satellite imageries were collected and processed using GIS software through add base map plugin. The satellite imageries initially converted into geographical coordinate system WGS 84 then converted into projected coordinate system (UTM Zone). Followed by all images layer stacked and clipped into 10km radius from the proposed project boundary.

3.8.1.2 Geo-database

Geo database was created for LU/LC classes using GIS software and the LU/LC classification were processed based National Remote Sensing Centre (NRSC), Department of Space, Government of India LU/LC classification by using visual interpretation method. Visual image interpretation is a first analysis approach to remote sensing imagery. Here, the tone, shape, size, pattern, texture, shadow, association and position of objects as well as the contrast and colour saturation are analyzed on the corresponding FCC satellite images. Field verification/ground truth has been carried out to cross check the LU/LC classes. Accordingly, the LU/LC map was prepared by using GIS software.

LU/LC Map Interpretation: The given figure shows the spatial distribution of Land Use/Land Cover (LU/LC) at 10 km radius from the proposed project boundary, which includes rural built-up with plantation, Industrial area, crop land, Plantation, barren land, river/creek/ stream/canals, tank/pond/lake/reservoir, waterlogged area, scrub land, sea, sandy area, existing shore protection structures.

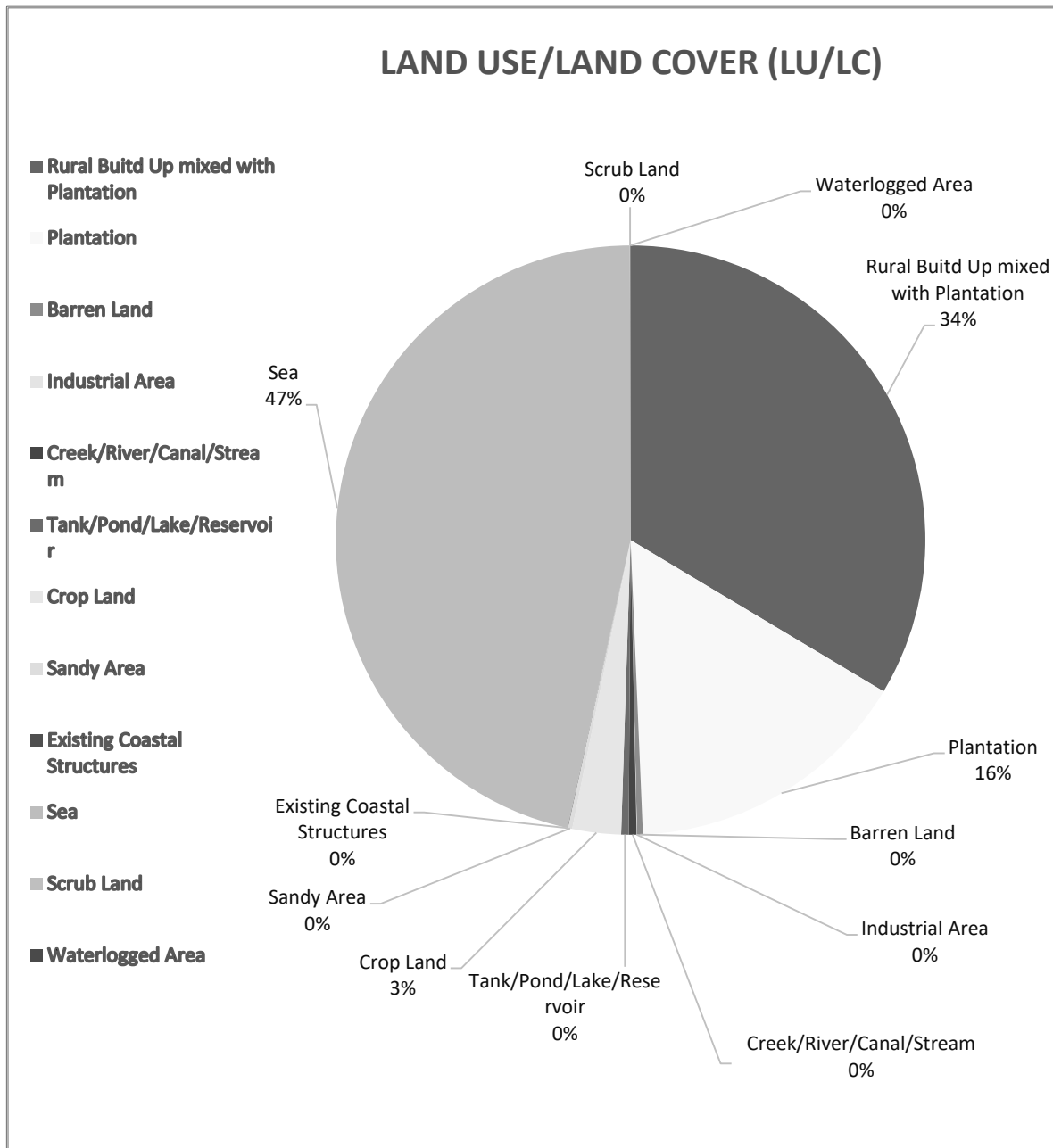
Continuous patches of rural settlement along with the mixed plantation exists in majority of the terrestrial portion, which occupies 33 % of total land. The major rural settlement in 10 km radius is Colachel, Vaniyakudi, Mandaikadu, Neyyoor, Eraniel, Karungal, Marthandam, Kuzhithurai, Kaliyakkavillai, Puthukkadai, Kollamkode, Poovar, Methukummil, Ayira, Pozhiyoor, Chenkal, Vattivila, Kulathoor, Plamoottukada, Parassala, Nadaikavu, Nithiravilai, Keezhkulam, Enayam, Karumkulam, Arumanoor, Swamiyar Madam, Kappukadu, Kalluvilai, Kuzhicode, Vizhunthayambalam. In which Vaniyakudi, Enayam, Kollamcode and Nithiravilai are very adjacent to the proposed project location.

Mineral Separation Plant of IREL (India) Limited, is located 8.5 km from the proposed boundary on the southern portion of the 10 km radius. The big patches of crop land noted nearby Kulathoor, Puthukkadai, Keelkulam, Enayam Kolachal and northern side of Mandaikadu villages respectively, which is exists 166 ha. The area under plantation is widely distributed all over the 10 km radius of the project boundary. In particular, the major portion of plantation is planted either side Thamirabarani, Neyyar and Valliyaru of river bank. Also, Continuous patches of Plantation were found near Karungal, Kuzhicode, Karumkulam and poovar villages respectively, which is noted 10927 ha.

Very small batches of Barren land identified near Karungal and Keezhkulam villages, which received 222 ha.

The small patches of Tank/Pond/Lake/Reservoir are found all over the terrestrial portion of 284 ha and spatial distribution Creek/River/Canal/Stream also exist in the 10 km radius namely, Neyyar is present 6 km away, Thamirabarani river is 120 m away and Valliyar is 9.6 km away from the project boundary also AVM canal is found nearby the project boundary.

A big patch of waterlogged area found near Colachel fishing Harbour of 16 ha land. Area under scrub is noted nearby the sand area and a continuous patches of sandy area exist along the shore of 15 ha. There are some existing shore protection structures also identified near Neerody, Enayam, Thengapattinam, Melmidalam, Colachel, Mandaikadu, Chinnavilai etc., in the 10 km radius.



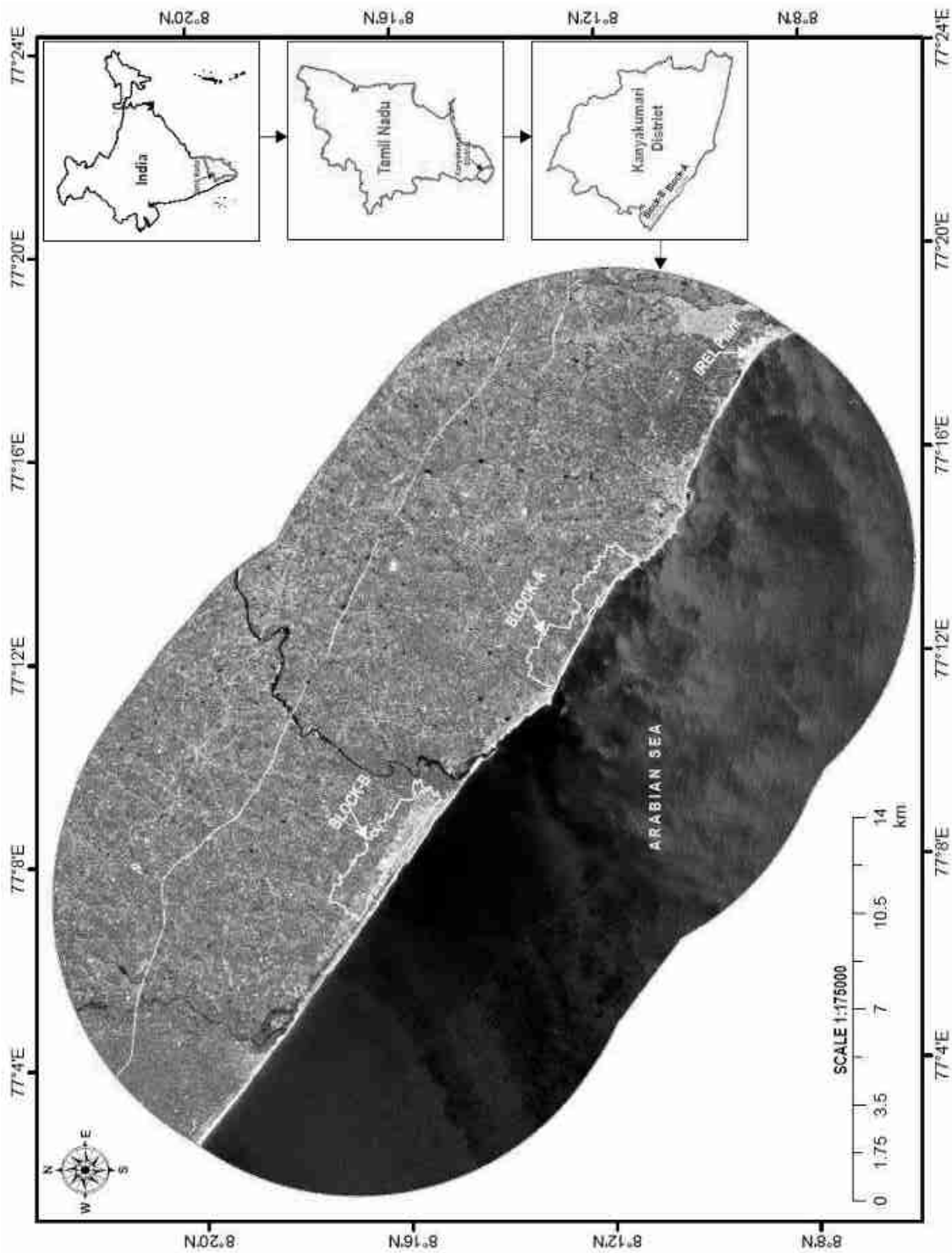


Figure 3.12 Satellite Imagery – 15km radius



Land Use/Land Cover split up:

SI. No.	LC/LC Classes	Area in Ha	Area in %
1	Rural Build Up mixed with Plantation	23295.20	33.58
2	Plantation	10927.10	15.75
3	Barren Land	222.59	0.32
4	Industrial Area	14.62	0.02
5	Creek/River/Canal/Stream	296.39	0.43
6	Tank/Pond/Lake/Reservoir	284.20	0.41
7	Crop Land	1847.35	2.66
9	Sandy Area	166.13	0.24
10	Existing Coastal Structures	15.45	0.02
11	Sea	32271.40	46.52
12	Scrub Land	11.70	0.02
13	Waterlogged Area	16.69	0.02
	Total	69,368.82	100

Inference:

Based on the present LU/LC map describes that the Project site is bifurcated into two adjacent non-contiguous blocks. "Block A" – 544.0688 ha (Keezhmidalam, Midalam, Enayamputhenthurai Villages in killiyoor Taluk, Kanniyakumari District) "Block B" – 599.99.30 ha (Ezhudesam, Ezhudesam, Kollencode, Villages in killiyoor Taluk, Kanniyakumari District). Total Mining Lease area is 1144.0618 ha. The major land use is rural build up with mixed plantation are the dominating land use features. The major source of the Water Bodies is Neyyar, Thamirabarani river and Valliyar. Thamirabarani river and AVM canal is very near to the project boundary. The horticulture and plantations are the major preferable crops produced by the local farmers. Agriculture and fishing are the major source of income for their livelihoods. Colachel Fishing Harbour, Thengaipattinam fishing harbour were identified within 10 km radius. Trivandrum – Nagercoil, Panvel-Kochi-Kanniyakumari, National highways NH 66 and many major state highways like SH 91, SH 179, SH 181 were identified the important routes in the 10 km radius from the project boundary

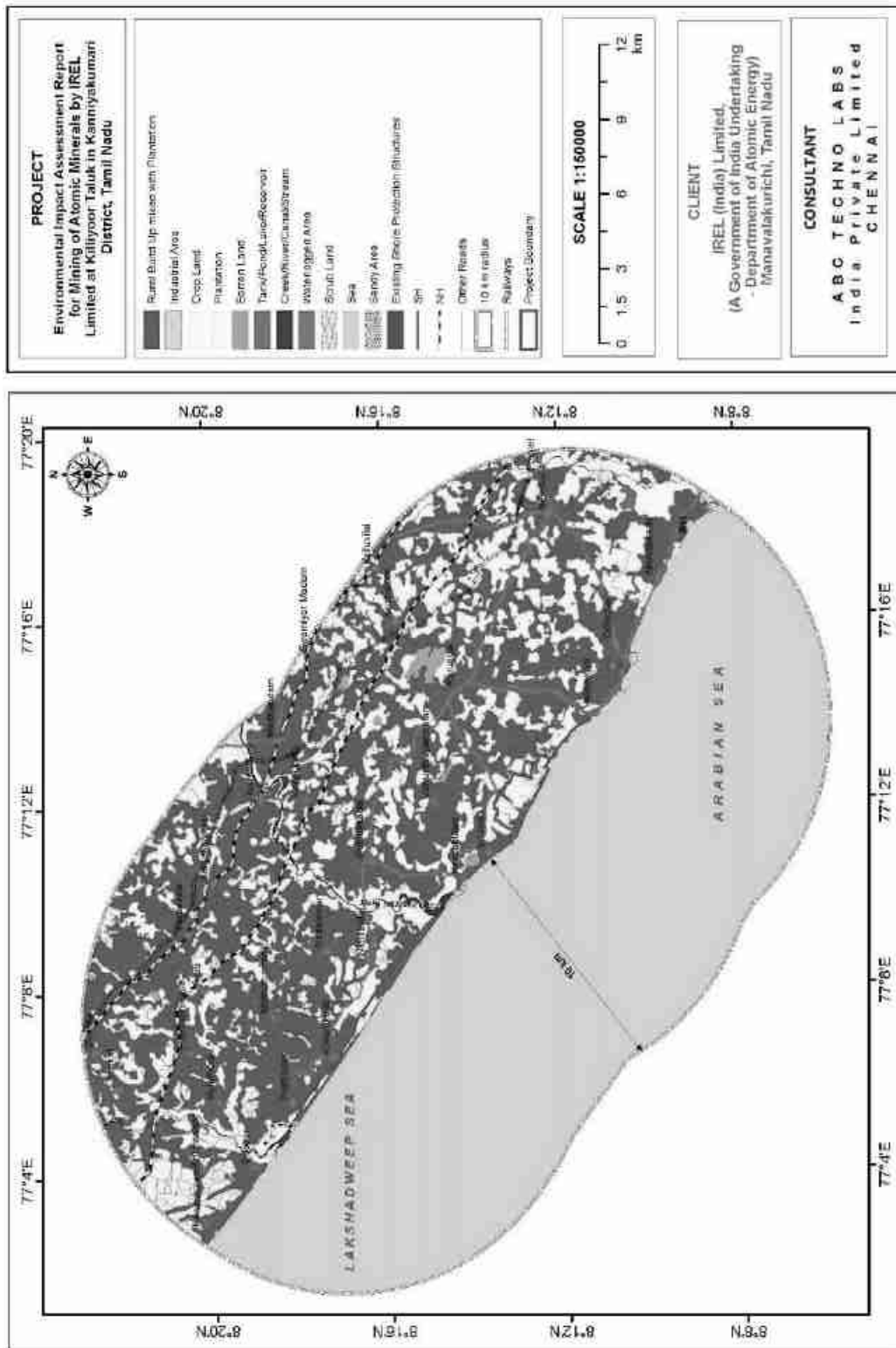


Figure 3.13 Land use/Land Cover Map

3.9 Meteorology

The study area lies in the tropical region where the climate is witnessed by very hot summers, mild winters with monsoon rains. The historical meteorological data is collected from the nearest Indian Meteorological Department (IMD) station located at Thiruvananthapuram in order to understand the macro - meteorological parameters. The climatological data for Thiruvananthapuram (8.5241° N, 76.9366° E), published by the IMD, based on daily observations at 08:30 and 17:30 hour IST for the past 30-year period is detailed in the following sections.

3.9.1 Wind speed and direction

From historical data the predominant wind direction was from northwest (25%) and the second predominant direction was from west (24%). This historical data has been used as a base for selecting the sampling locations. The wind rose based on historical data is shown in Fig 3.15.

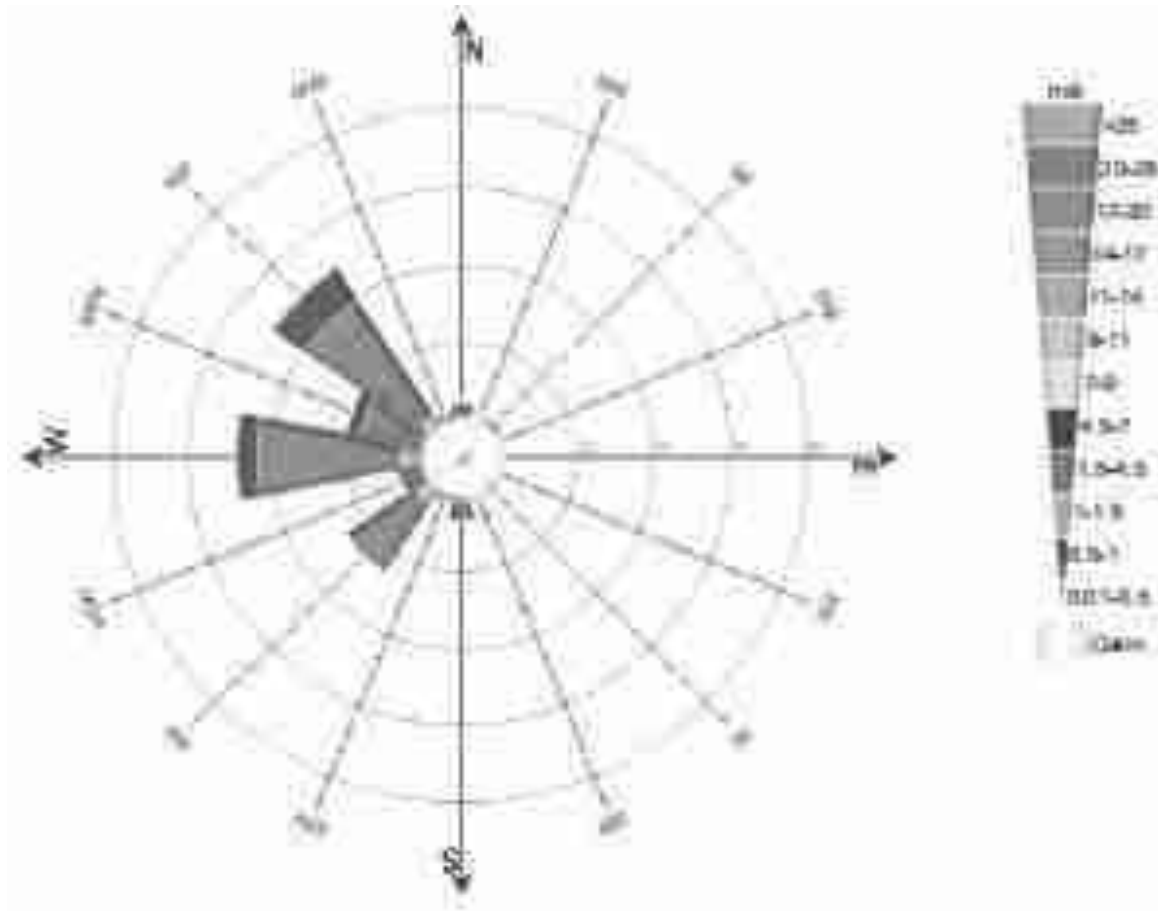


Figure 3.14 Historical windrose diagram

3.9.2 Temperature

Table 3.4 presents the annual monthly distribution of temperature during the Period. From the table it can be observed that December and January are the coldest months and March, April and May are the hottest month of the year. Fig 3.16 bar chart depicts monthly mean max and min. temperature. The mean monthly max temperature is recorded in the month of March/April/May as 35.1°C and mean monthly min. temperature is recorded in December/January as 20.5°C & 20.1°C. Summer is typically from March to June and winter is from November to February.

Table 3.3 Annual Temperature Data

Month	Temperature (°C)	
	Mean monthly max.	Mean monthly min.
January	34.0	20.1
February	34.2	20.8
March	35.1	22.1
April	34.8	22.9
May	34.3	22.6
June	32.4	22.0
July	31.7	21.6
August	31.7	21.6
September	32.6	22.2
October	32.2	21.9
November	32.6	21.6
December	33.6	20.5

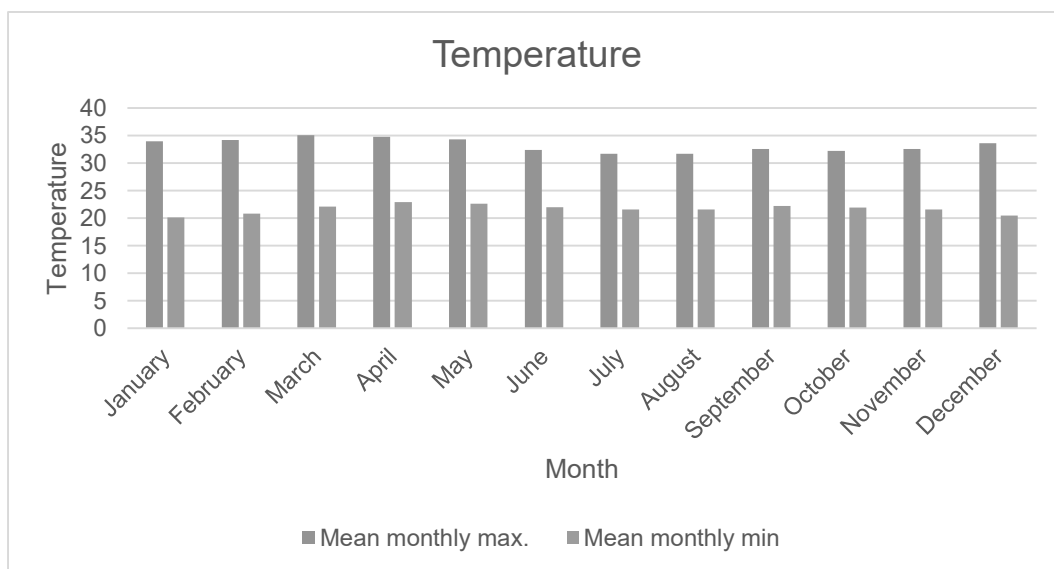


Figure 3.15 Average monthly min and max temperature

3.9.3 Relative humidity

The annual average relative humidity is in the range of 75-88% for daytime and 63-80% for nighttime. Table 3.5 and Fig 3.17 shows the historical relative humidity data.

Table 3.4 Relative Humidity

Months	Relative Humidity (%)	
	Daytime	Night time
January	75	63
February	77	63
March	78	66
April	80	73
May	82	75
June	88	80
July	88	79
August	88	78
September	85	77
October	87	80
November	86	78
December	78	69
Annual mean	83	73

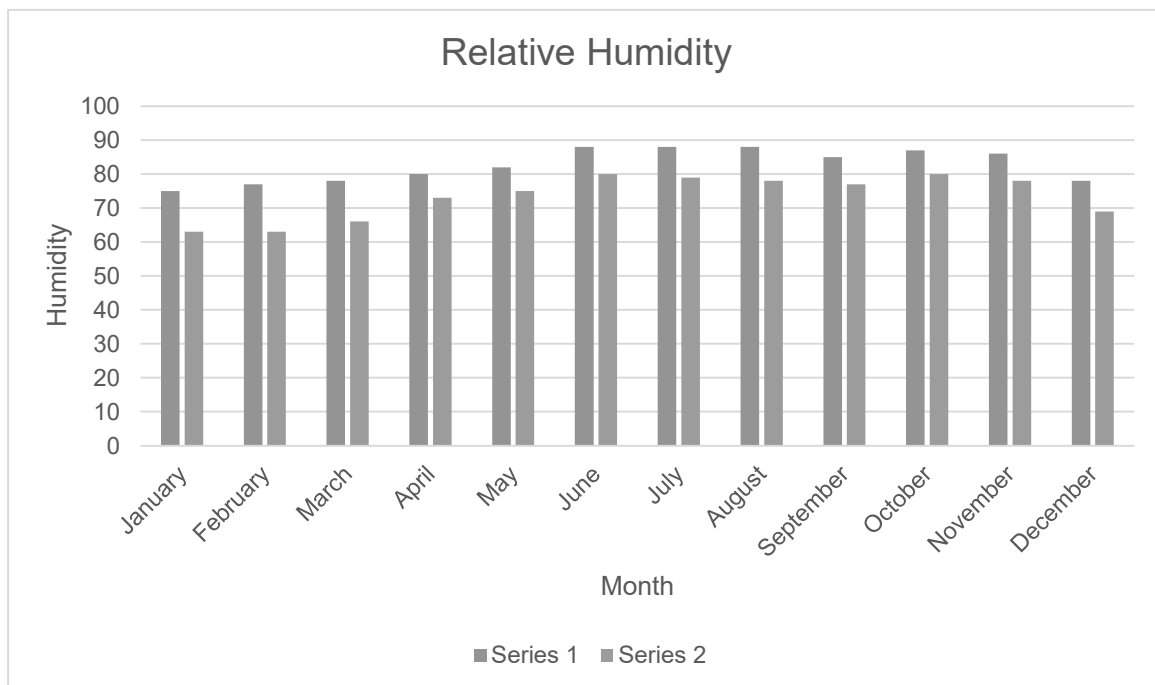


Figure 3.16 Relative humidity during daytime and night time (1970-2000)

3.9.4 Rainfall

The average annual rainfall as recorded at IMD observatory at Thiruvananthapuram is 1754.2 mm. The Southwest monsoon lasts from mid-June to mid-November and the area gets more than 80% of the annual rainfall during this period. The no. of rainy days is observed as 95.4. Table 3.6 and Fig 3.18 shows mean total rainfall and no. of rainy days during the Period.

Table 3.5 Total Rainfall & Number of Rainy Days

Months	Monthly total rainfall (mm)	No. of rainy days
January	15.9	1.0
February	22.7	1.7
March	27.8	2.3
April	118.8	6.5
May	198.6	9.7
June	330.4	16.6
July	188.1	13.4
August	152.3	10.3
September	169.1	8.7
October	254.5	11.7
November	211.9	9.2
December	64.0	4.2
Annual total	1754.2	95.4

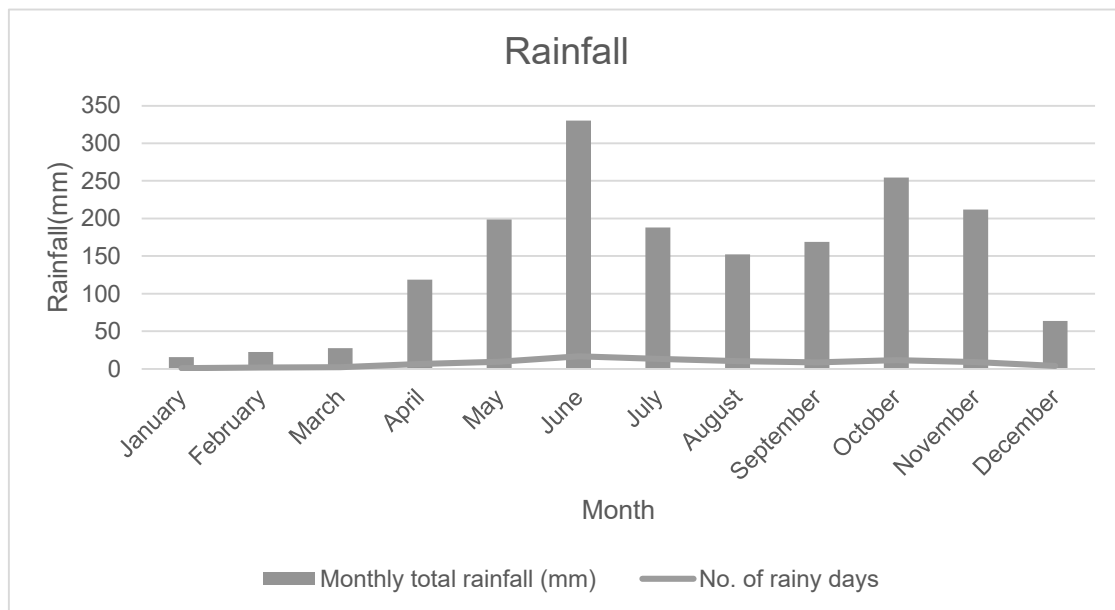


Figure 3.17 Monthly total rainfall and rainy days

3.10 Baseline data generation/establishment of baseline for environmental components

Establishment of the baseline conditions of different environmental components in the study area and in the core zone has been carried out by conducting field monitoring for baseline data generation. The data generation was carried out covering Meteorology, Ambient Air Quality, Noise Levels, Surface and groundwater quality, soil, traffic density, ecology and socio-economic features. Besides additional data/information regarding ecology, demographic pattern and socio-economic conditions were collected from various central and state government agencies.

3.10.1 Micro meteorology

Prevailing micro-meteorological conditions at site regulate the dispersion (and hence dilution) of air pollutants in the atmosphere. Therefore, study of micro-meteorological conditions is an integral part of environmental impact assessment studies.

Accordingly, a meteorological station was set up at settlement which lies within Mining Lease boundary. The following parameters were recorded at hourly intervals continuously during the monitoring seasons:

- Wind speed
- Wind direction
- Air temperature

Summary of meteorological data collected during winter season, 2022-23 is given in Table 3.7. The wind frequency distribution, overall, day time and night time is presented in Table 3.8.

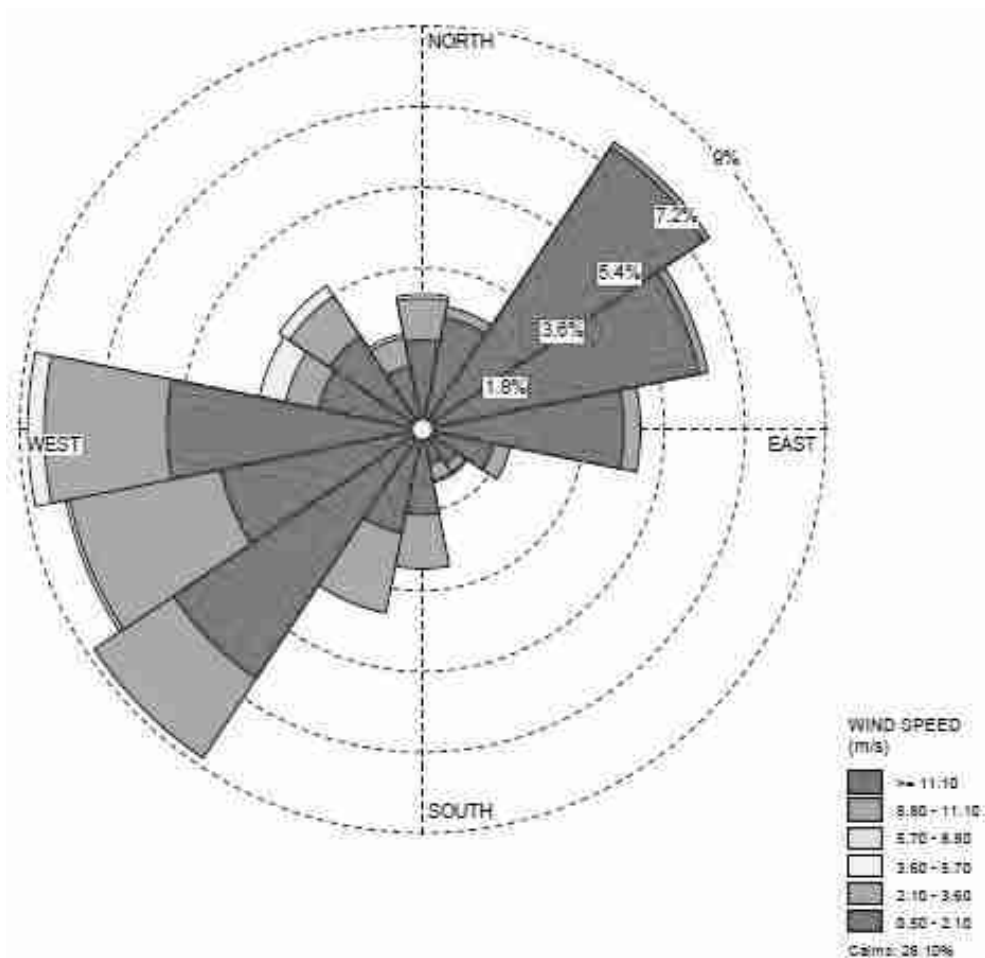


Figure 3.18 Windrose for Study period

Table 3.6 Summarized meteorological data for winter (2022-23)

Month	Wind speed (m/s)			Temperature (°C)			Relative humidity (%)		
	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.
Dec 2022	2.17	8	1	25.77	34	20	82.63	100	33
Jan 2023	2.1	4	1	25.58	35	19	74.68	94	49
Feb 2023	2.69	10.8	1	28.19	33.4	20.4	70.33	94	30

Table 3.7 Wind Frequency Distribution at IREL during winter season, 2022-23

Direction	Velocity Ranges (m/s)						Sum %
	0.50 - 2.10	2.10 - 3.60	3.60 - 5.70	5.70 - 8.80	8.80 - 11.10	>= 11.10	
N	1.99074	0.92593	0.09259	0	0	0	3.00926
NNE	2.5463	0.23148	0	0	0	0	2.77778
NE	7.5463	0.13889	0	0	0	0	7.68519
ENE	6.2963	0.18519	0	0	0	0	6.48148
E	4.49074	0.37037	0	0	0	0	4.86111
ESE	1.62037	0.37037	0	0	0	0	1.99074
SE	0.92593	0.23148	0.0463	0	0	0	1.2037
SSE	0.78704	0.37037	0.0463	0	0	0	1.2037
S	1.89815	1.2037	0	0	0	0	3.10185
SSW	2.36111	1.80556	0	0	0	0	4.16667
SW	6.66667	2.12963	0	0	0	0	8.7963
WSW	4.58333	3.42593	0.09259	0	0	0	8.10185
W	5.69444	2.73148	0.37037	0	0	0	8.7963
WNW	2.36111	0.74074	0.60185	0	0	0	3.7037
NW	2.5	1.06481	0.27778	0	0	0	3.84259
NNW	1.43519	0.64815	0.09259	0	0	0	2.17593
SUM %	53.7037	16.5741	1.62037	0	0	0	71.8981
CALM % = 28.1019							

3.10.2 Air Environment

To quantify the impact of the mining and allied activities on the ambient air quality, it is necessary at first to evaluate the existing ambient air quality of the core and the buffer zones. The existing ambient air quality, in terms of Respirable Particulate Matter (PM₁₀& PM_{2.5}), Sulphur-dioxide (SO₂) and Oxides of Nitrogen (NO_x) and Carbon monoxide (CO) have been measured through a planned field monitoring. In addition, free silica and mineralogical composition of PM₁₀ have also been analyzed.

3.10.2.1 Ambient Air Quality (AAQ)

In order to fix the locations of the monitoring stations, a model suggested by Houghland and Stephens (Ref: The Design of Air Quality Monitoring Network; R.E. Munn, 1981) has been used. This model suggests setting up of monitoring stations at those locations where ground level concentration (GLC) is high. The probability factor was found by determining the "coverage factor" for potential monitoring locations around the project, which are likely to be affected due to air pollutants from the project. The coverage factor for all potential locations was calculated by the following formula:

$$A_{jk} = \frac{\text{Freq. (k)}}{(1 + D_j)}$$

Where,

A_{jk} = Coverage factor of the monitoring site in the kth downwind sector

Freq. (k) = Frequency of wind direction in the kth sector.

D_j = Distance (km) from the source (project) to the site.

The wind rose data of IMD Thiruvananthapuram observatory was used to calculate the A_{jk} values of all potential AAQ monitoring stations. Stations were set up all around the project site.

Stations were set up at all around the two noncontiguous blocks of mine lease area. Possible stations covering all possible downwind directions and in varying distances up to a limited stretch from the project site were tested with this mathematical model. The list of selected AAQ Stations is given in Table 3.9. Ten locations were identified for establishing Ambient Air Quality monitoring network. The table gives location of the ambient air quality monitoring stations and their coverage factors.

Table 3.8 Ambient Air Quality (AAQ) monitoring stations

StnNo.	Location	Latitude	Longitude
A1	Ezhudesam 1	08°16'02.28" N	77°08'35.98" E
A2	Ezhudesam 2	08°15'54.53" N	77°09'40.85" E
A3	Midalam	08°12'16.76" N	77°12'56.31" E
A4	Alanji	08°11'51.90" N	77°13'58.48" E
A5	Helen Nagar	08°12'53.02" N	77°11'51.34" E
A6	Simon Colony	08°10'35.07" N	77°14'44.88" E
A7	Paloor Vattakkottai	08°14'54.50" N	77°13'36.94" E
A8	Rethapuram	08°11'44.45" N	77°15'04.46" E
A9	Kollencode	08°17'03.38" N	77°07'31.94" E
A10	Chemmanvillai	08°18'09.32" N	77°09'55.44" E

3.10.2.2 Monitoring schedule

As mentioned earlier, the EIA report has been prepared on the basis of Ambient Air Quality data generated in the study area for one full season covering three months of winter season (December-January-February) in 2022-2023. Samples of 24-hourly durations were taken for monitoring PM₁₀, PM_{2.5}, SO₂, NO_x and free silica.

3.10.2.3 Methods of Sampling and Analysis

The methods of sample collection, equipment used and analysis procedures as followed are given in Table 3.10 and National Ambient Air Quality Standards are given in Table 3.11.

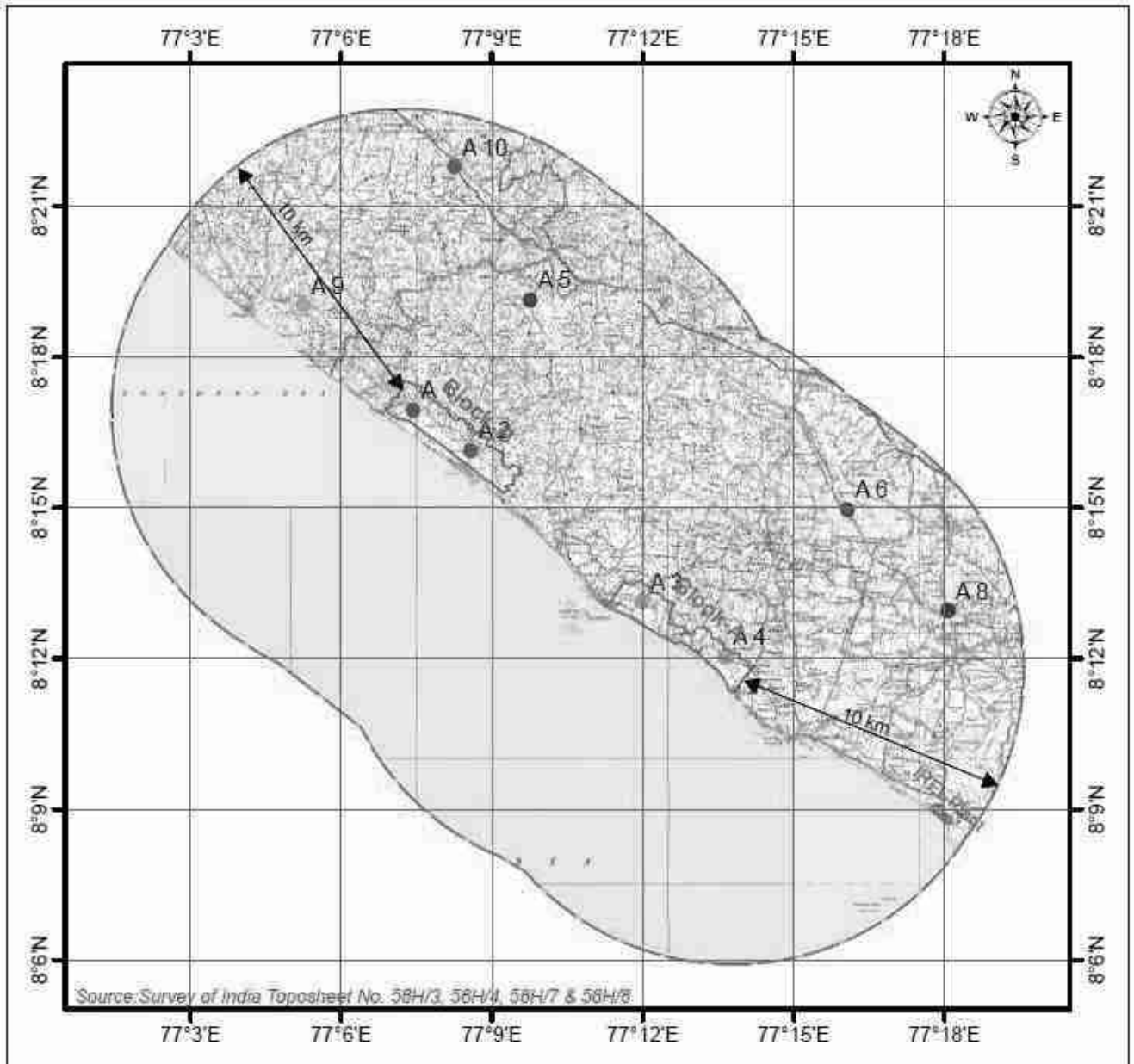


Figure 3.19 Monitoring locations

Table 3.9 Methodology of sampling & analysis and equipment used

Sl. No.	Parameter	Instrument/ Apparatus Used	Methodology	Reference
1.	SO ₂ (µg/m ³)	RDS with Impinger Tube, Spectrophotometer	Improved West & Gaecke Method	MOEFCC G.S.R 826 (E) dtd. 16.11.09
2.	NO _X (µg/m ³)	RDS with Impinger Tube, Spectrophotometer	Jacobs & Hoccheiser Modified (Na-Arsenite) Method	-do-
3.	PM ₁₀ (µg/m ³)	Respirable Dust Sampler (RDS)	Gravimetric	-do-
4.	PM _{2.5} (µg/m ³)	PM _{2.5} fine Dust Sampler	Gravimetric	-do-
5.	Free Silica	FTIR	NIOSH 7603	-do-
6.	Lead (Pb) and other Metals (µg/m ³)	AAS, sampling on EPM 2000	Gravimetric followed by AAS	-do-

Table 3.10 National Ambient Air Quality standards

Sl.No	Parameter	Time Weighted Average	Concentration in Ambient Air	
			Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Area by (Notified Central Government)
1	SO ₂ ; (µg/m ³)	Annual*	50	20
		24 Hours**	80	80
2	NO _x ; (µg/m ³)	Annual*	40	30
		24 Hours**	80	80
3	PM ₁₀ ; (µg/m ³)	Annual*	60	60
		24 Hours**	100	100
4	PM _{2.5} ; (µg/m ³)	Annual*	40	40
		24 Hours**	60	60
5	Free Silica	8 Hours**	02	02
		1 Hour*	04	04
6	Lead (Pb); (µg/m ³)	Annual*	0.50	0.50
		24 Hours**	1.0	1.0
7	Arsenic (As); (ng/m ³)	Annual*	06	06
8	Nickel (Ni); (ng/m ³)	Annual*	20	20

*Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals

**24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be compiled with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days.



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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(An ISO 9001, ISO 14001, ISO 45001 & ISO 22000 Certified Company)

Accredited by NABL vide TC-5770, NABET / QCI; Recognised by MoEF&CC, BIS, APEDA, IOEPC, Top Board, India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Parameter Test Method	PM 2.5 µg/m³	PM 10 µg/m³	SO ₂ µg/m³	NO _x µg/m³	CO mg/m³	O ₃ µg/m³	NH ₃ µg/m³	Lead µg/m³	Benzene µg/m³	BisJP ng/m³	Ni ng/m³	As ng/m³
Date of Monitoring	EPA 40 CFR P90	IS: 5182 P23	IS: 5182 P2	IS: 5182 P6	IS: 5182 P10	ABCT/LSOP /A/07	ABCT/LS /OPIA/06	IS: 5182 P22	IS: 5182 Part 11	IS: 5182 Part 12	USEPA Method IO-3.2	ABCT/LSOPIA10
05.12.2022	21	46	7.6	14.8	0.11	10.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
08.12.2022	17	39	6.5	15.8	0.13	11	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
12.12.2022	21	45	6.9	16.1	0.17	10.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
14.12.2022	24	52	7.2	16.8	0.15	12.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
19.12.2022	22	47	7.1	17	0.14	13.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
22.12.2022	24	53	7.0	15.5	0.16	11.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
26.12.2022	21	44	5.9	14.8	0.15	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
29.12.2022	19	40	7.4	16.7	0.17	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
03.01.2023	21	43	6.6	15.5	0.16	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
05.01.2023	23	47	7.4	13.9	0.18	10.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
09.01.2023	19	41	4.9	14.7	0.13	12.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
12.01.2023	18	38	5.8	16.3	0.21	13.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
17.01.2023	21	46	5.7	15.5	0.14	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
19.01.2023	23	47	7.1	14.2	0.18	12.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
23.01.2023	20	41	7.7	13.9	0.19	11.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
27.01.2023	24	50	6.5	16.7	0.17	14.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
02.02.2023	21	44	6.3	15.5	0.15	13.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
06.02.2023	19	41	5.8	17.1	0.18	14.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
09.02.2023	18	39	5.4	14.6	0.13	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
13.02.2023	21	44	6.2	16.5	0.19	13.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
15.02.2023	20	42	6.6	14.7	0.14	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
20.02.2023	22	47	6.1	14.9	0.11	12.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
23.02.2023	19	40	5.7	15.5	0.15	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
27.02.2023	21	46	5.9	16.3	0.12	13.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
Min	17	38	5.7	13.9	0.11	10.4	-	-	-	-	-	-
Max	24	53	7.9	17.1	0.21	14.6	-	-	-	-	-	-
Mean	20.79	44.33	6.72	15.47	0.15	12.48	-	-	-	-	-	-
SD	-	-	-	-	-	-	-	-	-	-	-	-
percentile	24	52.54	7.808	17.05	0.2008	14.37	-	-	-	-	-	-
CPCB Standard	50	100	80	80	2	100	400	1	5	1	20	6

BDL-Below Detection Limit

....End of report....

S.Dharani
Quality Manager



A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



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ISSUED TO: **The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.**

TEST REPORT

Report number	ABCTL/IREL/EIA/2022/12/AAQ2											
Sample drawn by	ABC Techno Labs India Private Limited											
Sample description	Ambient Air Quality Monitoring -24 Hourly Basis Twice a week for three Month											
Location of sampling	AAQ 2: Ezhudesam Sample 2, 30 m from Nedampuram Sree Mathumariamman Temple, N-08°15'54.53" E- 77°09'40.85"											
Project name	Mining of Atomic Minerals at Kerkzhimalam -A, Midalam -B, Enayamputhenthurai, Ezhudesam -A,B & C and Kollencode A & B Villages of Killyoore Taluk in Kanyakumari district, Tamil Nadu											
Date of sampling	05-12-2022 TO 27-02-2023											
Report date	06-03-2023 Page 1 of 1											
Parameter	PM 2.5 µg/m ³	PM 10 µg/m ³	SO ₂ µg/m ³	NO _x µg/m ³	CO mg/m ³	O ₃ µg/m ³	NH ₃ µg/m ³	Lead µg/m ³	Benzene µg/m ³	B(a)P ng/m ³	Ni ng/m ³	As ng/m ³
Test Method	EPA 40 CFR P50	IS: 5182 P23	IS: 5182 P2	IS: 5182 P4	IS: 5182 P10	ABCT/ABCT/ L/SOP /A/B/7	ABCT/ SOP/A/0 5	IS: 5182 P22	IS: 5182 Part 11	IS: 5182 Part 12	USEPA Method ID- 3.2	ABCT/ SOP/A/10
Date of Monitoring	05.12.2022	20	43	BDL(<5)	12.5	BDL(<0.1)	9.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
08.12.2022	17	36	BDL(<5)	13.6	BDL(<0.1)	10.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
13.12.2022	21	44	BDL(<5)	14	BDL(<0.1)	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
14.12.2022	18	39	BDL(<5)	12.7	BDL(<0.1)	9.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
19.12.2022	17	36	BDL(<5)	13.3	BDL(<0.1)	11.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
22.12.2022	21	43	BDL(<5)	14.9	BDL(<0.1)	13.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
26.12.2022	17	37	BDL(<5)	13.5	BDL(<0.1)	16.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
29.12.2022	19	41	BDL(<5)	22.7	BDL(<0.1)	9.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
03.01.2023	17	37	BDL(<5)	14.7	BDL(<0.1)	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
05.01.2023	19	41	BDL(<5)	13.6	BDL(<0.1)	11.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
09.01.2023	17	36	BDL(<5)	13.1	BDL(<0.1)	10.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
12.01.2023	20	42	BDL(<5)	14.5	BDL(<0.1)	12.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
17.01.2023	18	38	BDL(<5)	13.7	BDL(<0.1)	11.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
19.01.2023	21	45	BDL(<5)	15.1	BDL(<0.1)	12.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
23.01.2023	18	40	BDL(<5)	14.8	BDL(<0.1)	12.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
27.01.2023	17	36	BDL(<5)	13.5	BDL(<0.1)	11.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
02.02.2023	19	39	BDL(<5)	14.7	BDL(<0.1)	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
06.02.2023	18	42	BDL(<5)	13.9	BDL(<0.1)	11.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
08.02.2023	17	38	BDL(<5)	15.8	BDL(<0.1)	13.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
11.02.2023	21	44	BDL(<5)	12.6	BDL(<0.1)	10.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
16.02.2023	19	39	BDL(<5)	13.1	BDL(<0.1)	11.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
20.02.2023	20	41	BDL(<5)	14.4	BDL(<0.1)	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
23.02.2023	21	44	BDL(<5)	12.7	BDL(<0.1)	10.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
27.02.2023	19	38	BDL(<5)	13.7	BDL(<0.1)	10.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
Air	17	36	-	12.5	-	9.5	-	-	-	-	-	-
Max	25	65	-	15.8	-	13.3	-	-	-	-	-	-
Max	18.79	39.92	-	13.00	-	11.41	-	-	-	-	-	-
%	-	-	-	-	-	-	-	-	-	-	-	-
percentile	21	44.54	-	15.478	-	13.024	-	-	-	-	-	-
CPCB Standard	60	100	80	80	2	300	400	1	5	1	20	6

BDL-Below Detection Limit

...End of report...

S. Dharami
Quality Manager



A. Robson Chinnadural
Technical Manager

Verified by

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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(An ISO : 9001, ISO : 14001, ISO : 45001 & ISO : 22000 Certified Company)

Accredited by NABL vide TC-5770, NABET / QCI, Recognised by MoE, MCC, BIS, APEDA, IDFFPG, Top Brand India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report number	ABCTL/IREL/EIA/2022/12/AAQ3
Sample drawn by	ABC Techno Labs India Private Limited
Sample description	Ambient Air Quality Monitoring -24 Hourly Basin Twice a week for three Month
Location of sampling	AAQ 3: Midalam Sample, Karungal Midalam Road, 115 m from Govt.High School Udayamarthandam N-08°12'16.76" E- 77°12'56.31"
Project name	Mining of Atomic Minerals at Keerzhaidalam -A, Midalam -B, Enayampathenthur, Extaduesam -A,B & C and Kollencode A & B Villages of Killiyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	05-12-2022 TO 27-02-2023
Report date	06-03-2023

Page 3 of 1

Parameter Test Method Date of Monitoring	PM 2.5 µg/m ³	PM 10 µg/m ³	SO ₂ µg/m ³	NO _x µg/m ³	CO mg/m ³	O ₃ µg/m ³	NH ₃ µg/m ³	Lead µg/m ³	Benzene µg/m ³	B(a)P ng/m ³	NI ng/m ³	Aa ng/m ³
	EPA 40 CFR P50	IS: 6182 P22	IS: 6182 P2	IS: 6182 P6	IS: 6182 P10	ABCTL/ SOP/A/ 07	ABCTL/ SOP/A/ 06	IS: 6182 P22	IS: 6182 Part 11	IS: 6182 Part 12	USEPA Method IO- 3.2	ABCTL/ SOP/A/10
05.12.2022	21	44	5.7	14.4	0.14	10.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
08.12.2022	25	53	6.3	12.8	0.11	9.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
12.12.2022	20	41	6.9	13.8	0.15	10.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
14.12.2022	29	48	5.5	14.7	0.17	11.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
19.12.2022	22	47	7.1	13.1	0.16	10.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
22.12.2022	26	53	6.8	14.2	0.11	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
26.12.2022	23	48	5.7	14.9	0.14	13.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
29.12.2022	24	50	6.4	13.8	0.13	11.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
03.01.2023	21	44	5.9	12.6	0.11	9.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
05.01.2023	19	41	6.6	13.9	0.16	10.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
09.01.2023	22	47	6.7	14.7	0.13	11.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
12.01.2023	21	43	7.1	15.3	0.14	12.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
17.01.2023	22	46	6.8	15.1	0.17	12.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
18.01.2023	20	42	6.5	14.6	0.11	12.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
23.01.2023	18	39	6.1	16.0	0.12	13.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
27.01.2023	24	48	5.8	13.7	0.15	11.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
03.02.2023	21	45	5.1	12.6	0.13	10.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
06.02.2023	26	57	5.8	12.9	0.14	10.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
09.02.2023	23	47	6.6	13.7	0.12	10.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
13.02.2023	25	51	6.4	14.4	0.13	11.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
16.02.2023	22	44	6.2	13.8	0.11	11.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
20.02.2023	20	42	6.7	15.7	0.14	12.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
23.02.2023	23	48	7.2	15.0	0.13	12.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
27.02.2023	24	49	6.1	13.6	0.15	10.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
Min	18	39	5.2	12.6	0.11	9.6	-	-	-	-	-	-
Max	26	53	7.2	16	0.17	13.1	-	-	-	-	-	-
Mean	22.25	46.38	6.34	14.14	0.14	11.40	-	-	-	-	-	-
99th percentile	26	53	7.154	15.862	0.17	13.1	-	-	-	-	-	-
CPCH Standard	60	100	80	80	2	100	400	1	5	1	20	6

BDL-Below Detection Limit
S. Dharani
Quality Manager



---End of report---



A. Robson Chinnadurai
Technical Manager

Verified by:

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report number	ABCTL/IREL/EIA/2022/12/AAQ4
Sample drawn by	ABC Techno Labs India Private Limited
Sample description	Ambient Air Quality Monitoring - 24 Hourly Basis Twice a week for three Month
Location of sampling	AAQ 4: Alanji Sample 30 m from St. Francis Xavier Church N- 08°11'51.90" E- 77°13'58.48"
Project name	Mining of Atomic Minerals at Keerthimadalam -A, Midalam -B, Enayamputhenturai, Ezhadesam -A,B & C and Kollencode A & B Villages of Killyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	05-12-2022 TO 27-02-2023
Report date	06-03-2023

Parameter Test Method	PM 2.5 µg/m ³	PM 10 µg/m ³	SO ₂ µg/m ³	NO _x µg/m ³	CO mg/m ³	O ₃ µg/m ³	NH ₃ µg/m ³	Lead µg/m ³	Benzene µg/m ³	B(a)P ng/m ³	NI ng/m ³	As ng/m ³
	EPA 40 CFR P50	IS: 5182 P23	IS: 5182 P2	IS: 5182 P6	IS: 5182 P10	ABCT L/50P A/07	ABCTL/ SOP/A0 S	IS: 5182 P22	IS: 5182 Part 11	IS: 5182 Part 12	USEPA Method ID- 3.2	ABCTL/ SOPIA10
05.12.2022	17	38	6.6	13.7	0.14	10.1	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
08.12.2022	21	44	6.9	14.8	0.13	11.2	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
12.12.2022	23	47	7.5	12.8	0.16	9.8	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
14.12.2022	19	41	7.1	15	0.17	12.7	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
18.12.2022	17	39	7.7	13.6	0.18	10.5	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
22.12.2022	21	43	8.8	14.4	0.14	11.1	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
26.12.2022	18	40	5.9	13.3	0.11	10.8	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
29.12.2022	21	44	6.8	14.1	0.16	12.2	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
03.01.2023	18	40	8.4	13.3	0.12	9.5	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
05.01.2023	17	36	7.7	13.9	0.16	10.3	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
09.01.2023	18	38	7.1	14.5	0.13	11.8	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
12.01.2023	21	45	5.9	15.8	0.14	12.1	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
17.01.2023	19	41	6.2	14.7	0.12	11.8	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
19.01.2023	21	46	5.8	12.8	0.11	10.8	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
23.01.2023	20	42	7.4	12.5	0.13	10.1	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
27.01.2023	18	37	7.3	13.6	0.15	11.1	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
02.02.2023	18	42	6.9	14.7	0.12	12.7	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
04.02.2023	17	39	5.9	15.8	0.14	13.3	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
08.02.2023	18	37	8.8	13.6	0.13	12.2	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
13.02.2023	21	45	8.8	14.7	0.16	10.9	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
16.02.2023	19	41	6.5	15.9	0.11	12.3	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
20.02.2023	18	38	6.4	13.5	0.15	11.1	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
23.02.2023	22	46	7.7	14.0	0.16	12.3	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
27.02.2023	18	40	6.9	13.3	0.13	10.9	BDL(+5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(+1)	BDL(+1)
Min	17	36	5.8	12.5	0.11	9.5	-	-	-	-	-	-
Max	23	48	7.7	15.9	0.18	13.3	-	-	-	-	-	-
Mean	19.33	41.42	6.77	14.10	0.14	11.36	-	-	-	-	-	-
90th percentile	23	47.54	7.7	15.854	0.1754	13.02	-	-	-	-	-	-
CPCB Standard	60	100	80	80	2	100	400	1	5	1	20	6

BDL-Below Detection Limit

....End of report....

S. Dharani
Quality Manager



A. Robson Chinnadurai
Technical Manager

Verified by

Authorized Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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Accredited by NABL vide TC-5770, NABET / DCU Recognised by METFRCC, BIS, APEDA, IOFPEC, Tea Board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report number	ABCTL/IREL/EIA/2022/12/AAQ5											
Sample drawn by	ABC Techno Labs India Private Limited											
Sample description	Ambient Air Quality Monitoring -24 Hourly Basis Twice a week for three Month											
Location of sampling	AAQ 5: Helen Nagar Sample 10 m from St. Francis Xavier Church Enayam Helen Nagar N- 08°12'53.02" E- 77°11'51.34"											
Project name	Mining of Atomic Minerals at Keezhmidalam -A, Midalam -B, Enayamputhenthurai, Echiadenari -A,B & C and Kallendode A & B Villages of Killyoor Taluk in Kanniyakumari district Tamil Nadu											
Date of sampling	05-12-2022 TO 27-02-2023											
Report date	06-03-2023											
Parameter	PM 2.5 µg/m ³	PM 10 µg/m ³	SO ₂ µg/m ³	NO _x µg/m ³	CO mg/m ³	O ₃ µg/m ³	NH ₃ µg/m ³	Lead µg/m ³	Benzene µg/m ³	B[a]P ng/m ³	Ni ng/m ³	As ng/m ³
Test Method	EPA 40 IS: 5182 CPR P60	IS: 5182 P23	IS: 5182 P2	IS: 5182 P6	IS: 5182 P10	ABCT ABCT L/SOP IA/07	ABCT/ SOP/IA/0 I	IS: 5182 P22	IS: 5182 Part 11	IS: 5182 Part 12	USEPA Method IO-3.2	ABCTL/ SOP/IA/10
Date of Monitoring												
05.12.2022	20	43	7.0	14.4	0.18	11.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
08.12.2022	23	49	8.1	15.9	0.19	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
12.12.2022	19	41	7.7	14.2	0.21	11.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
14.12.2022	34	51	7.9	16.3	0.15	13.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
18.12.2022	27	47	7.1	15.8	0.17	13.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
22.12.2022	25	53	6.8	15.7	0.15	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
26.12.2022	33	50	7.4	14.9	0.14	12.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
29.12.2022	19	43	6.6	15.3	0.21	13.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
03.01.2023	22	45	7.3	14.8	0.17	12.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
05.01.2023	24	49	7.1	13.6	0.13	11.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
09.01.2023	25	51	6.9	15.9	0.15	12.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
12.01.2023	22	47	5.4	16.1	0.16	13.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
17.01.2023	21	46	6.2	16.9	0.14	13.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
19.01.2023	20	42	5.9	14.8	0.12	12.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
23.01.2023	23	48	6.8	13.9	0.16	11.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
27.01.2023	24	51	7.1	15.5	0.17	12.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
02.02.2023	22	46	7.0	14.7	0.16	12.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
06.02.2023	25	52	6.8	16.7	0.14	11.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
09.02.2023	22	47	6.5	15.6	0.13	12.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
13.02.2023	23	51	6.1	15.1	0.13	12.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
16.02.2023	22	49	7.2	16.1	0.18	13.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
20.02.2023	21	44	5.9	15.3	0.10	12.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
23.02.2023	20	43	6.4	15.1	0.13	11.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
27.02.2023	23	48	6.9	12.8	0.19	10.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
Min	19	41	5.9	12.9	0.1	10.8	-	-	-	-	-	-
Max	25	53	8.1	16.9	0.21	13.7	-	-	-	-	-	-
Mean	22.25	47.33	6.91	15.18	0.16	12.48	-	-	-	-	-	-
90 percentile	25	52.54	7.962	16.808	0.21	13.65	-	-	-	-	-	-
CPCB Standard	60	100	80	80	2	100	400	1	5	1	20	6

BDL-Below Detection Limit

....End of report....

S. Dharani

Quality Manager

Verified by



A. Robson Chinnadurai

Technical Manager

Authorized Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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[An ISO 9001, ISO 14001, ISO 45001 & ISO 22000 Certified Company]

Accredited by NABL vide TC-5770, NABET / QCI. Recognised by MoEF&CC, IIS, APEDA, IOFEPIC, Test Board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	ABCTL/IREL/EIA/2022/12/AAQ6												
Sample drawn by	ABC Techno Labs India Private Limited												
Sample description	Ambient Air Quality Monitoring - 24 Hourly Basis Twice a week for three Month												
Location of sampling	AAQ 6: Sunon Colony Sample, Kodinunai-Vaniyakudi Road 115 m from St. Judes Church N- 08°10'35.07" E- 77°14'44.88"												
Project name	Mining of Atomic Minerals at Keerthimadalam -A, Midalam -B, Enayamputhenturai, Estudesam -A, B & C and Kollencode A & B Villages of Killyoor Taluk in Kanyakumari district, Tamil Nadu												
Date of sampling	05-12-2022 To 27-02-2023												
Report date	06-03-2023												
	Page 1 of 1												
Parameter	PM 2.5 µg/m ³	PM 10 µg/m ³	SO ₂ µg/m ³	NO _x µg/m ³	CO mg/m ³	O ₃ µg/m ³	NH ₃ µg/m ³	Lead µg/m ³	Benzene µg/m ³	B[<i>a</i>]P ng/m ³	NI ng/m ³	As ng/m ³	
Test Method	EPA 40 CFR P80	IS: 5182 P23	IS: 5182 P2	IS: 5182 P6	IS: 5182 P10	ABCT L/SOP IA/07	ABCTL/ SGP/IA/0 5	IS: 5182 P22	IS: 5182 Part 11	IS: 5182 Part 12	USEPA Method 30-3.2	ABCTL/ SOP/IA10	
Date of Monitoring	05.12.2022	23	51	8.1	16.6	0.16	13.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	
08.12.2022	23	43	7.4	14.2	0.17	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
12.12.2022	23	49	6.8	15.9	0.13	12.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
14.12.2022	26	55	7.7	17	0.19	12.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
19.12.2022	22	47	7.9	13.8	0.22	10.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
22.12.2022	19	41	8.3	15.6	0.14	11.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
26.12.2022	21	45	6.5	16.3	0.17	13.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
29.12.2022	24	53	7.4	16.7	0.11	12.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
03.01.2023	23	47	6.6	14.4	0.16	12.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
05.01.2023	25	53	6.9	16.9	0.17	11.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
09.01.2023	19	42	7.1	15.7	0.16	13.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
12.01.2023	23	48	5.8	16.9	0.21	12.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
17.01.2023	25	52	5.9	15.4	0.14	12.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
19.01.2023	22	47	6.2	17.3	0.16	13.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
23.01.2023	24	50	6.9	15.8	0.22	11.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
27.01.2023	22	46	7.1	16.6	0.23	12.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
01.02.2023	28	53	7.7	14.2	0.21	12.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
06.02.2023	22	44	6.4	15.9	0.17	14.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
09.02.2023	23	49	5.9	13.6	0.13	12.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
13.02.2023	25	51	6.8	15.1	0.14	12.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
16.02.2023	21	43	7.2	14.8	0.17	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
20.02.2023	29	52	5.4	17.1	0.13	13.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
23.02.2023	24	50	6.6	12.9	0.16	11.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
27.02.2023	22	46	6.3	14.5	0.14	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)	
Min	19	41	5.8	12.9	0.11	10.0	-	-	-	-	-	-	
Max	26	55	8.3	17.3	0.23	13.5	-	-	-	-	-	-	
Mean	22.86	48.08	6.89	15.34	0.17	12.43	-	-	-	-	-	-	
95 percentile	26	54.08	8.208	17.208	0.2254	13.654	-	-	-	-	-	-	
CPCB Standard	60	100	80	80	2	100	400	1	5	1	20	6	

BDL- Below Detection Limit

...End of report...

S. Dharani
Quality Manager



A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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(As ISO : 9001, ISO : 74001, ISO : 45001 & ISO : 22000, Certified Company)

Accredited by NABL vide TC-5770, NABET / QC, Recognised by METREC, BIS, APEDA, IOPEPC, Teq Bannr India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Parameter	PM 2.5 µg/m ³	PM 10 µg/m ³	SO ₂ µg/m ³	NO _x µg/m ³	CO mg/m ³	O ₃ µg/m ³	NH ₃ µg/m ³	Lead µg/m ³	Benzene µg/m ³	B[a]P ng/m ³	NI ng/m ³	As ng/m ³
Test Method	EPA 40	IS: 6182	IS: 6182	IS: 6182	IS: 6182	ABCT L/SOP A/07	ABCT/ SOP/A/0 6	IS: 6182 P22	IS: 6182 Part 11	IS: 6182 Part 12	USEPA Method IO- 3.2	ABCT/ SOP/A/10
Date of Monitoring	CFR P50	P22	P2	P2	P10							
05.12.2022	18	40	6.9	15.4	0.13	11.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
08.12.2022	21	46	7.8	13.6	0.15	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
12.12.2022	17	39	7.4	14.7	0.12	12.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
14.12.2022	22	47	8.2	13.7	0.17	11.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
19.12.2022	20	43	7.1	14.4	0.16	12.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
22.12.2022	23	48	8.3	13.9	0.13	11.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
26.12.2022	19	47	6.9	15.8	0.18	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
29.12.2022	22	47	7.5	16.1	0.11	12.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
01.01.2023	21	44	7.8	17.3	0.20	13.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
05.01.2023	25	51	7.1	15.7	0.19	12.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
09.01.2023	21	44	8.8	16.3	0.24	11.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
11.01.2023	23	49	7.5	14.7	0.18	12.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
17.01.2023	19	40	7.1	16.7	0.11	13.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
19.01.2023	24	47	7.7	15.5	0.15	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
23.01.2023	21	43	7.4	16.8	0.17	13.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
27.01.2023	22	46	7.4	15.2	0.16	12.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
02.02.2023	20	41	7.8	14.9	0.14	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
06.02.2023	21	48	6.9	13.8	0.11	11.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
09.02.2023	25	51	7.1	15.5	0.16	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
13.02.2023	19	40	6.5	16.9	0.13	13.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
16.02.2023	21	43	5.9	14.7	0.14	12.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
20.02.2023	19	39	8.3	15.5	0.13	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
23.02.2023	22	45	6.6	16.3	0.15	13.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
27.02.2023	22	46	6.3	14.5	0.14	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
Min	17	39	5.9	13.6	0.11	11.1	-	-	-	-	-	-
Max	25	51	8.3	17.3	0.20	13.6	-	-	-	-	-	-
Mean	21.17	44.50	7.19	15.31	0.15	12.58	-	-	-	-	-	-
99 percentile	25	51	8.254	17.116	0.2616	13.6	-	-	-	-	-	-
ISPCB Standard	60	100	80	80	2	100	400	1	5	1	20	6

BDL-Below Detection Limit

....End of report....

S.Dharani
Quality Manager

Verified by



A. Robson Chinnadurai
Technical Manager

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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TC - 5770

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Accredited by NABL vide TC-5770, NABET / QCI, Recognised by MoEF&CC, BS, APEDA, IOPEPC, Test Board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report number:	ABCTL/IREL/EIA/2022/12/AAQ8											
Sample drawn by:	ABC Techno Labs India Private Limited											
Sample description:	Ambient Air Quality Monitoring - 24 Hourly Basis Twice a week for three Month											
Location of sampling:	AAQ 8: Rethapuram Sample, Municipality Office Rethapuram Karungal Road N-08°11'44.45" E-77°15'04.46"											
Project name:	Mining of Atomic Minerals at Keelhidalam -A, Midalam -B, Enayamputhenthurath, Echudesam -A & C and Kollencode A & B Villages of Kalliyoor Taluk in Kanniyakumari district, Tamil Nadu											
Date of sampling:	05-12-2022 TO 27-02-2023											
Report date:	06-03-2023											
Page 1 of 1												
Parameter	PM 2.5 µg/m ³	PM 10 µg/m ³	SO ₂ µg/m ³	NO _x µg/m ³	CO mg/m ³	O ₃ µg/m ³	NH ₃ µg/m ³	Lead µg/m ³	Benzene µg/m ³	DEHP ng/m ³	NI ng/m ³	As ng/m ³
Test Method	EPA 40 CFR P50	IS: 5102 P23	IS: 5182 P2	IS: 5182 P6	IS: 5182 P10	ABCT I/SOP /A/97	ABCTL SOP/A/0 5	IS: 5182 P22	IS: 5182 Part 11	IS: 5182 Part 13	USEPA Method IO-3.2	ABCTL/ SOP/A/10
Date of Monitoring	05.12.2022	22	47	8.8	15.8	0.19	12.8	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1
08.12.2022	26	56	7.4	17.7	0.13	13.5	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
12.12.2022	34	51	7.9	16.9	0.17	12.7	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
14.12.2022	26	58	8.6	14.7	0.15	12.2	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
18.12.2022	23	48	8.3	15.8	0.24	13.1	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
22.12.2022	24	51	6.9	17.1	0.18	13.8	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
26.12.2022	21	48	8.2	16.4	0.23	1.8	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
29.12.2022	29	53	8.7	15.3	0.17	12.7	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
03.01.2023	22	46	6.9	14.8	0.16	12.9	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
05.01.2023	19	40	7.4	13.8	0.13	13.3	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
09.01.2023	23	48	8.3	15.5	0.12	12.5	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
12.01.2023	24	52	6.9	15.7	0.14	13.1	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
17.01.2023	21	47	7.8	14.8	0.17	12.9	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
19.01.2023	24	50	7.3	16.6	0.18	11.7	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
23.01.2023	24	51	6.2	19.2	0.13	12.6	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
27.01.2023	18	43	6.9	14.7	0.14	13.3	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
02.02.2023	21	47	5.9	16.9	0.13	12.3	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
06.02.2023	23	50	6.3	15.3	0.15	11.8	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
09.02.2023	19	53	7.2	13.6	0.19	12.3	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
13.02.2023	24	49	7.7	14.5	0.14	10.9	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
16.02.2023	19	45	7.3	13.3	0.12	12.1	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
20.02.2023	25	51	6.8	15.8	0.15	13.3	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
23.02.2023	27	53	7.5	16.6	0.13	12.5	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
27.02.2023	22	46	8.3	14.7	0.12	12.9	BDL<0.1	BDL<0.1	BDL<0.01	BDL<1	BDL<1	BDL<1
Min	18	40	5.9	13.3	0.12	10.9	-	-	-	-	-	-
Max	27	56	8.8	17.7	0.24	13.9	-	-	-	-	-	-
Mean	22.79	49.04	7.29	15.48	0.15	12.67	-	-	-	-	-	-
95th percentile	26.54	55.06	8.754	17.424	0.2354	13.71	-	-	-	-	-	-
CPCB Standard	60	100	80	80	2	100	400	1	5	1	20	6

BDL-Below Detection Limit

....End of report....

S. Dharami
Quality Manager



A. Robson Chinnadural
Technical Manager

Verified by

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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TC - 5770

(AN ISO 9001, ISO 14001, ISO 45001 & ISO 22000 Certified Company)

Accredited by NABL vide TC-5770, NABET / QCI, Recognised by MoEF&CC, BIS, APEDA, IOPEPC, Teq Bount India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report number	ABC/TL/IREL/EIA/2022/12/AAQ9											
Sample drawn by	ABC Techno Labs India Private Limited											
Sample description	Ambient Air Quality Monitoring - 24 Hourly Basis Twice a week for three Month											
Location of sampling	AAQ 9: Kallencode Sample, 300m from St. George Shrine, Pazha Uthakkada -Kanniyakumari West Coast Road N- 08°17'03.38" E- 77°07'31.94"											
Project name	Mining of Atomic Minerals at Kezhimadam -A, Midalam -B, Enayamputhuthurai, Ezhadsam -A,B & C and Kallencode-A & B Villages of Killyvoor Taluk in Kanniyakumari district, Tamil Nadu											
Date of sampling	05-12-2022 TO 27-02-2023											
Report date	06-03-2023 Page 1 of 1											
Parameter	PM 2.5 µg/m ³	PM 10 µg/m ³	SO ₂ µg/m ³	NO _x µg/m ³	CO mg/m ³	O ₃ µg/m ³	NH ₃ µg/m ³	Lead µg/m ³	Benzene µg/m ³	BisPP ng/m ³	Ni ng/m ³	As ng/m ³
Test Method	EPA 40 CFR F50	IS: 5182 P23	IS: 5182 P2	IS: 5182 P6	IS: 5182 P10	ABCT L/SOP A/07	ABCT/ SOP/A/0 8	IS: 5182 P22	IS: 5182 Part 11	IS: 5182 Part 12	USEPA Method IO- 3.2	ABCT/ SOP/A/10
Date of Monitoring	05-12-2022	21	45	7.1	15.0	0.12	12.5	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)
08-12-2022	25	52	7.8	14.4	0.19	13.7	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
12-12-2022	20	42	8.3	13.8	0.13	10.4	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
14-12-2022	22	49	8.7	14.1	0.14	12.2	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
18-12-2022	24	51	8.0	15.2	0.17	12.9	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
22-12-2022	22	47	7.4	15.3	0.11	13	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
26-12-2022	26	50	7.1	15.7	0.16	12.8	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
29-12-2022	21	45	8.4	14.6	0.14	12.2	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
03-01-2023	22	47	5.9	14.4	0.16	11.8	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
05-01-2023	25	51	6.3	14.3	0.15	11.4	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
09-01-2023	22	45	5.8	15.9	0.11	12.6	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
12-01-2023	20	42	6.4	16.6	0.17	13.1	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
17-01-2023	23	49	5.9	15.7	0.12	12.3	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
19-01-2023	19	41	7.1	16.9	0.18	12.9	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
23-01-2023	22	47	6.9	15.1	0.13	12.7	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
27-01-2023	20	42	7.2	16.3	0.14	13.3	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
02-02-2023	23	48	6.9	16.7	0.18	13.8	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
06-02-2023	25	50	6.5	15.8	0.11	12.8	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
09-02-2023	21	43	6.3	14.4	0.12	11.4	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
13-02-2023	22	47	7.4	13.8	0.15	11.1	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
16-02-2023	19	40	8.9	15.2	0.13	12.4	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
20-02-2023	22	46	6.5	14.9	0.14	12.3	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
23-02-2023	20	42	8.1	16.7	0.12	13.3	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
27-02-2023	23	48	6.3	14.2	0.17	12.4	BDL(+5)	BDL(+0.1)	BDL(+0.1)	BDL(+0.01)	BDL(+1)	BDL(+1)
Min	19	40	5.8	13.6	0.11	10.4	-	-	-	-	-	-
Max	26	50	8.7	16.9	0.19	13.6	-	-	-	-	-	-
Mean	22.08	46.46	6.93	15.28	0.14	12.38	-	-	-	-	-	-
98 percentile	25.54	54.16	8.562	16.808	0.1854	2	-	-	-	-	-	-
CPCB Standard	60	100	80	80	2	100	400	1	5	1	20	6

BDL-Below Detection Limit

....End of report....

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorized Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



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(An ISO 9001, ISO 14001, ISO 45001 & ISO 22000 Certified Company)

Accredited by NABL vide TC:5770, NABET / QCI, Recognised by MoEF,CC, BIE, APEDA, IOPEKC, Tea Board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Parameter	PM 2.5 µg/m ³	PM 10 µg/m ³	SO ₂ µg/m ³	NO _x µg/m ³	CO mg/m ³	O ₃ µg/m ³	NH ₃ µg/m ³	Lead µg/m ³	Benzene µg/m ³	D(a)P ng/m ³	NI ng/m ³	As ng/m ³
Test Method	EPA 40 CFR P50	IS: 5182 P23	IS: 5182 P2	IS: 5182 P6	IS: 5182 P10	ABCT USOP IA/07	ABCTL/ SOPA/0 5	IS: 5182 P22	IS: 5182 Part 11	IS: 5182 Part 12	USEPA Method IO-1.2	ABCTL/ SOPA/10
Date of Monitoring	05.12.2022	08.12.2022	13.12.2022	14.12.2022	15.12.2022	15.12.2022	15.12.2022	15.12.2022	15.12.2022	15.12.2022	15.12.2022	15.12.2022
05.12.2022	22	47	7.1	14.5	0.18	12.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
08.12.2022	21	43	8.5	13.9	0.16	11.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
13.12.2022	26	56	7.1	15.7	0.13	12.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
14.12.2022	24	53	7.9	16.6	0.17	13.3	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
15.12.2022	21	48	8.4	14.8	0.14	12.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
22.12.2022	24	53	7.3	15.2	0.18	12.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
26.12.2022	22	47	7.7	17	0.15	13.6	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
28.12.2022	25	51	8.1	15.3	0.14	12.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
03.01.2023	22	47	8.9	15.7	0.12	13.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
05.01.2023	26	53	7.8	16.6	0.16	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
04.01.2023	22	48	7.1	15.4	0.16	12.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
12.01.2023	25	54	8.2	14.9	0.17	12.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
17.01.2023	22	47	7.7	15.1	0.15	13.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
19.01.2023	23	49	7.6	17	0.14	13.7	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
23.01.2023	25	52	7.1	16.9	0.16	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
27.01.2023	27	55	7.9	15.8	0.13	13.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
02.02.2023	19	41	8.8	14.3	0.12	11.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
06.02.2023	22	48	6.4	14.2	0.15	12.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
09.02.2023	25	51	8.7	14.8	0.17	12.9	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
13.02.2023	20	53	8.5	13.5	0.16	13.2	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
16.02.2023	22	47	8.8	14.7	0.21	11.8	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
20.02.2023	26	52	8.9	16.9	0.22	12.5	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
23.02.2023	21	46	8.7	13.9	0.18	13.4	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
27.02.2023	24	50	7.9	15.1	0.14	14.1	BDL(<5)	BDL(<0.1)	BDL(<0.1)	BDL(<0.01)	BDL(<1)	BDL(<1)
Min	19	41	8.4	13.9	0.12	11.6	-	-	-	-	-	-
Max	27	56	8.5	17	0.23	14.1	-	-	-	-	-	-
Mean	23.46	49.54	7.38	15.59	0.16	12.81	-	-	-	-	-	-
95 percentile	26.54	55.54	8.454	17	0.2208	13.91	-	-	-	-	-	-
CPCB Standard	60	100	80	80	2	100	400	1	5	1	20	6

BDL-Below Detection Limit

...End of report...

S. Dharrani
Quality Manager



A. Robson Chinnadural
Technical Manager

Verified by

Authorised Signatory

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Table 3.11 Summarized Ambient Air Quality monitoring results (Winter 2022-23)

StnNo.	Parameter Permission limit	PM ₁₀ 100 µg/m ³				PM _{2.5} 60 µg/m ³			
	AAQ monitoring station	Max	Min	Avg	C98	Max	Min	Avg	C98
A1	Ezhudesam 1	53	38	44.33	52.54	24	17	20.79	24
A2	Ezhudesam 2	45	36	39.92	44.54	21	17	18.79	21
A3	Midalam	53	39	46.38	53	26	18	22.25	26
A4	Alanji	48	36	41.42	47.54	23	17	19.33	23
A5	Helen Nagar	53	41	47.33	52.54	25	19	22.25	25
A6	Simon Colony	55	41	48.08	54.08	26	19	22.88	26
A7	Paloor Vattakkottai	51	39	44.50	51	25	17	21.17	25
A8	Rethapuram	56	40	49.04	55.08	27	18	22.79	26.54
A9	Kollencode	56	40	46.46	54.16	26	19	22.08	25.54
A10	Chemmanvillai	56	41	49.54	55.54	27	19	23.46	26.54

StnNo.	Parameter Permission limit	SO ₂ 80 µg/m ³				NO _x 80 µg/m ³			
	AAQ monitoring station	Max	Min.	Avg.	C98	Max.	Min	Avg.	C98
A1	Ezhudesam 1	7.9	5.7	6.72	7.808	17.1	13.9	15.47	17.05
A2	Ezhudesam 2	<5	<5			15.8	12.5	13.80	15.478
A3	Midalam	7.2	5.2	6.34	7.154	16	12.6	14.14	15.862
A4	Alanji	7.7	5.8	6.77	7.7	15.9	12.5	14.10	15.854
A5	Helen Nagar	8.1	5.9	6.91	7.962	16.9	12.9	15.18	16.808
A6	Simon Colony	8.3	5.8	6.89	8.208	17.3	12.9	15.34	17.208
A7	Paloor Vattakkottai	8.3	5.9	7.19	8.254	17.3	13.6	15.31	17.116
A8	Rethapuram	8.8	5.9	7.29	8.754	17.7	13.3	15.48	17.424
A9	Kollencode	8.7	5.8	6.93	8.562	16.9	13.6	15.28	16.808
A10	Chemmanvillai	8.5	6.4	7.38	8.454	17	13.9	15.50	17

StnNo.	Parameter Permission limit	CO 2000 µg/m ³			
	AAQ monitoring station	Max	Min	Avg	C98
A1	Ezhudesam 1	0.21	0.11	0.15	0.2008
A2	Ezhudesam 2	<0.1	<0.1		
A3	Midalam	0.17	0.11	0.14	0.17
A4	Alanji	0.18	0.11	0.14	0.1754
A5	Helen Nagar	0.21	0.1	0.16	0.21
A6	Simon Colony	0.23	0.11	0.17	0.2254
A7	Paloor Vattakkottai	0.28	0.11	0.15	0.2616
A8	Rethapuram	0.24	0.12	0.15	0.2354
A9	Kollencode	0.19	0.11	0.14	0.1854
A10	Chemmanvillai	0.23	0.12	0.16	0.2208

Table 3.12 Results of free silica in respirable dust ($\mu\text{g}/\text{m}^3$)

St. No.	Station Name	Sample-1	Sample-2	Sample-3	Sample-4	Sample-5
A1	Ezhudesam 1	<10	<10	<10	<10	<10
A2	Ezhudesam 2	<10	<10	<10	<10	<10
A3	Midalam	<10	<10	<10	<10	<10
A4	Alanji	<10	<10	<10	<10	<10
A5	Helen Nagar	<10	<10	<10	<10	<10
A6	Simon Colony	<10	<10	<10	<10	<10
A7	Paloor Vattakkottai	<10	<10	<10	<10	<10
A8	Rethapuram	<10	<10	<10	<10	<10
A9	Kollencode	<10	<10	<10	<10	<10
A10	Chemmanvillai	<10	<10	<10	<10	<10

St. No.	Station Name	Sample-6	Sample-7	Sample-8	Sample-9	Sample-10
A1	Ezhudesam 1	<10	<10	<10	<10	<10
A2	Ezhudesam 2	<10	<10	<10	<10	<10
A3	Midalam	<10	<10	<10	<10	<10
A4	Alanji	<10	<10	<10	<10	<10
A5	Helen Nagar	<10	<10	<10	<10	<10
A6	Simon Colony	<10	<10	<10	<10	<10
A7	Paloor Vattakkottai	<10	<10	<10	<10	<10
A8	Rethapuram	<10	<10	<10	<10	<10
A9	Kollencode	<10	<10	<10	<10	<10
A10	Chemmanvillai	<10	<10	<10	<10	<10

3.10.2.4 Results and Discussions

The summarized results of ambient air quality monitoring are given in Table 3.12. The results when compared with National Ambient Air Quality Standards (NAAQS) of Central Pollution Control Board (CPCB) indicate that values of PM₁₀, PM_{2.5}, SO₂ and NO_x were found to be well below the prescribed standards at all the stations.

Table 3.13 depicts free silica in range of BDL <10. The summarized results of metals given in Table 3.14 show that for Lead, Arsenic and Nickel, the observed values are well within the National Ambient Air Quality Standards, 2009.

Mineralogical composition

The mineralogical composition was carried out in selected samples for all the ambient air monitoring location for Lead, Nickel and Arsenic.

Table 3.13 Summarized results of metals

Sl. No.	Parameters	Lead as Pb ($\mu\text{g}/\text{m}^3$)	Nickel as Ni (ng/m^3)	Arsenic as (ng/m^3)
	Norms	1 $\mu\text{g}/\text{m}^3$	20 ng/m^3	6 ng/m^3
A1	Ezhudesam 1	<0.1	<1	<1
A2	Ezhudesam 2	<0.1	<1	<1
A3	Midalam	<0.1	<1	<1
A4	Alanji	<0.1	<1	<1
A5	Helen Nagar	<0.1	<1	<1
A6	Simon Colony	<0.1	<1	<1
A7	Paloor Vattakkottai	<0.1	<1	<1
A8	Rethapuram	<0.1	<1	<1
A9	Kollencode	<0.1	<1	<1
A10	Chemmanvillai	<0.1	<1	<1

3.10.3 Noise Environment

The assessment of ambient noise levels in the study area have been undertaken considering the various factors like potential damage to hearing, physiological responses, general community responses and annoyance. These monitoring locations were selected based on the following criteria:

Locations, where noise generation is restricted or silence zone (e.g. near hospitals, health centres, and educational institutions)

Locations, where ambient noise levels are affected by existing sources such as commercial activities, public gathering places, and road traffic

Background settings i.e. locations where there are no sources of man-made noise except natural activities. Locations like the proposed site will serve as background ambient noise level for the study area

In order to have an idea about the existing noise levels in the study area, noise monitoring has been carried out at ten locations listed in Table 3.15.

Table 3.14 Ambient noise monitoring stations

Stn. No.	Location	Latitude	Longitude
N1	Ezhudesam 1	08°16'02.28" N	77°08'35.98" E
N2	Ezhudesam 2	08°15'54.53" N	77°09'40.85" E
N3	Midalam	08°12'16.76" N	77°12'56.31" E
N4	Alanji	08°11'51.90" N	77°13'58.48" E
N5	Helen Nagar	08°12'53.02" N	77°11'51.34" E
N6	Simon Colony	08°10'35.07" N	77°14'44.88" E
N7	Paloor Vattakkottai	08°14'54.50" N	77°13'36.94" E
N8	Rethapuram	08°11'44.45" N	77°15'04.46" E
N9	Kollencode	08°17'03.38" N	77°07'31.94" E
N10	Chemmanvillai	08°18'09.32" N	77°09'55.44" E

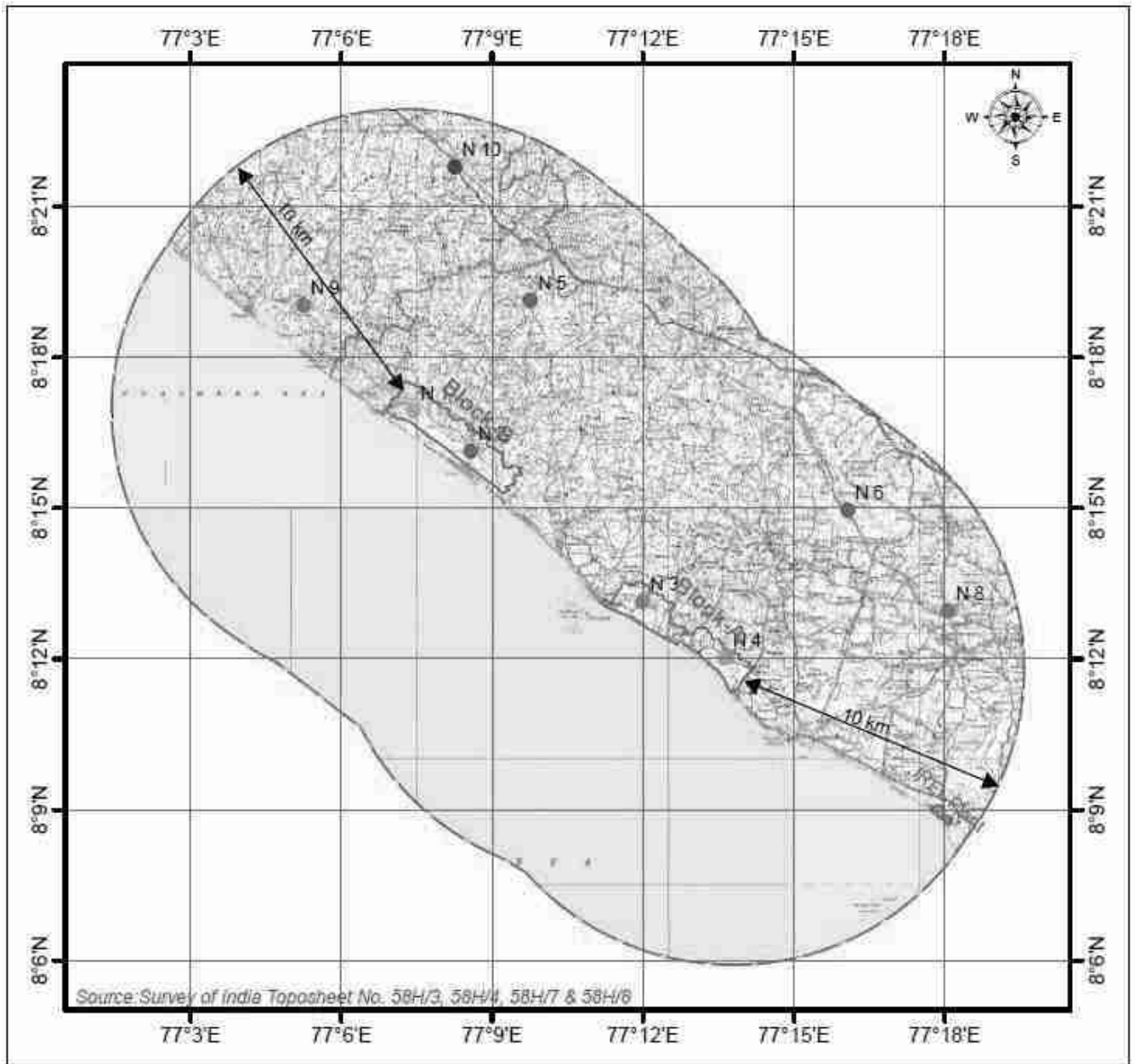


Figure 3.20 Monitoring Locations



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/N1-N10
Sampled by	: ABC Techno Labs India Private Limited
Sample description	: Noise Level Monitoring
Project Name	: Mining of Atomic Minerals at Kozhmidalam -A, Midalam -B, Enayampothenthurai, Ezhudesam -A & C and Kollencode A & B Villages of Killyoor Taluk in Kanyakumari district, Tamil Nadu
Date of sampling	: 02-12-2022 TO 12-12-2022
Date of Receipt	: 13-12-2022
Report date	: 28-12-2022

Page 1 of 1

Location Code	Location	Lday [dB(A)]	Lnight [dB(A)]	Leq [dB(A)]
N1	Ezhudesam Sample 1, 50 m from St.Judes College, N- 08°16'02.28" E- 77°08'35.98"	53.1	42.7	51.5
N2	Ezhudesam Sample 2, 30 m from Nerumpuram Sree Muthumariamman Temple, N- 08°15'54.53" E- 77°09'40.85"	48.3	41.8	47.0
N3	Midalam Sample, Karungal Midalam Road, 115 m from Govt.High School Udayamarthandam N- 08°12'16.76" E- 77°12'56.31"	50.2	42.5	48.8
N4	Alanji Sample 30 m from St. Francis Xavier Church N- 08°11'51.90" E- 77°13'58.48"	49.4	39.8	48.2
N5	Helen Nagar Sample 10 m from St. Francis Xavier Church Enayam Helen Nagar, N- 08°12'53.02" E- 77°11'51.34"	51.7	43.6	50.3
N6	Simon Colony Sample, Kodimunai-Vaniyakudi Road 115 m from St. Judes Church, N- 08°10'35.07" E- 77°14'44.88"	53.7	44.2	52.2
N7	Paloor Vattakkottai, 15 m from Paloor Vattakkottai Bus Stand N- 08°14'54.50" E- 77°13'36.94"	51.4	41.9	49.9
N8	Rethapuram Sample, Municipality Office Rethapuram Karungal Road, N- 08°11'44.45" E- 77°15'04.46"	53.7	43.2	52.1
N9	Kollencode Sample, 300m from St. George Shrine, Pazha Uchalekarda -Kanyakumari West Coast Road, N- 08°17'03.38" E- 77°07'31.94"	52.8	44.6	51.4
N10	Chemmanvillai Sample, 70 m from St. Judes Polytechnic College, Chemmanvillai, Arudesam, N- 08°18'09.32" E- 77°09'55.44"	54.1	44.1	52.6

Method: IS: 9989-1981 (Reaff: 2020)-Ambient

Ambient Noise Standards

Zone Classification	Lday dB(A)	Lnight dB(A)
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

—End of report—

S.Dharani
Quality Manager



A. Robson Chinnadural
Technical Manager

Verified by

Authorised Signatory

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Noise Monitoring

A precision integrating sound level meter (Model 2221, manufactured by Bruel and Kjaer of Denmark) was used to measure the noise levels around the study area. Monitoring was carried out during winter season 2022-23. At each ambient noise monitoring station, Leq noise level was recorded at hourly intervals for 24 hours continuously.

Results and Discussions

The summarized results of ambient noise monitoring are given in Table 3.16. The results have been compared with the standards specified in Schedule III, Rule 3 of Environmental Protection Rules given in Table 3.17.

Table 3.15 Summarized results of noise monitoring

Stn. No.	Location	Results		
		Day (0600-2200 hr.)	Night (2200-0600 hr.)	Equivalent Noise
		Lday [dB(A)]	Lnight [dB(A)]	Leq D&N [dB(A)]
N1	Ezhudesam 1	53.1	42.7	51.5
N2	Ezhudesam 2	48.3	41.8	47.0
N3	Midalam	50.2	42.5	48.8
N4	Alanji	49.4	39.8	48.2
N5	Helen Nagar	51.7	43.6	50.3
N6	Simon Colony	53.7	44.2	52.2
N7	Paloor Vattakkottai	51.4	41.9	49.9
N8	Rethapuram	53.7	43.2	52.1
N9	Kollencode	52.8	44.6	51.4
N10	Chemmanvillai	54.1	44.1	52.6

Table 3.16 MOEF&CC norms in respect of noise

(As Per Schedule III, Rule 3 of Environment Protection Rules)

Type of Area	Day (0600 - 2200 hrs.)	Night (2200 – 0600 hrs.)
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

All Values in dB (A)

The result of Ambient noise level shows that all the values measured in both the day and night time, are well within the prescribed norms of Noise Regulation & Control - Rules, 2000 for Industrial area, commercial area, residential area and Silence zone.



3.10.4 Water Environment

Surface water quality

Surface water sources

The study area is witnessed with two water courses. The Neyyar River, Tamirabharani River and Valliyar are the surface water sources observed at the study area. The Valliyar River is located at 9.6 km in Eastern side of the project area. The Tamirabharani River confluence point is observed very near to Block B about 120 m in East. Whereas, the Neyyar River is located at 6 km in Western side of the project area also AVM canal is found nearby the project boundary.

Water sampling locations

Considering, availability of surface water sources in study area, ten samples were collected, in order to determine the quality of the surface water.

Table 3.17 Surface water location

Stn no.	Location Name	Latitude	Longitude
SW1	Tamirabarani River	8°15'45.97"N	77° 9'40.29"E
SW2	Perumkulam (Pond)	8°12'50.21"N	77°12'57.38"E
SW3	Neyyar River	8°18'32.01"N	77° 4'45.94"E
SW4	Arasakulam (Pond)	8°14'29.17"N	77°11'8.83"E
SW5	Nadukulam (Pond)	8°11'10.93"N	77°14'12.04"E
SW6	AVM Canal	8°16'55.00"N	77° 6'53.74"E
SW7	Marauapuram (Pond)	8°17'51.28"N	77°11'33.70"E
SW8	Udappukulam (Pond)	8°20'34.94"N	77° 8'52.87"E
SW9	Vaikundapuram (Pond)	8°15'29.49"N	77°18'5.57"E
SW10	Perumchirai (Pond)	8°15'16.01"N	77°14'4.29"E

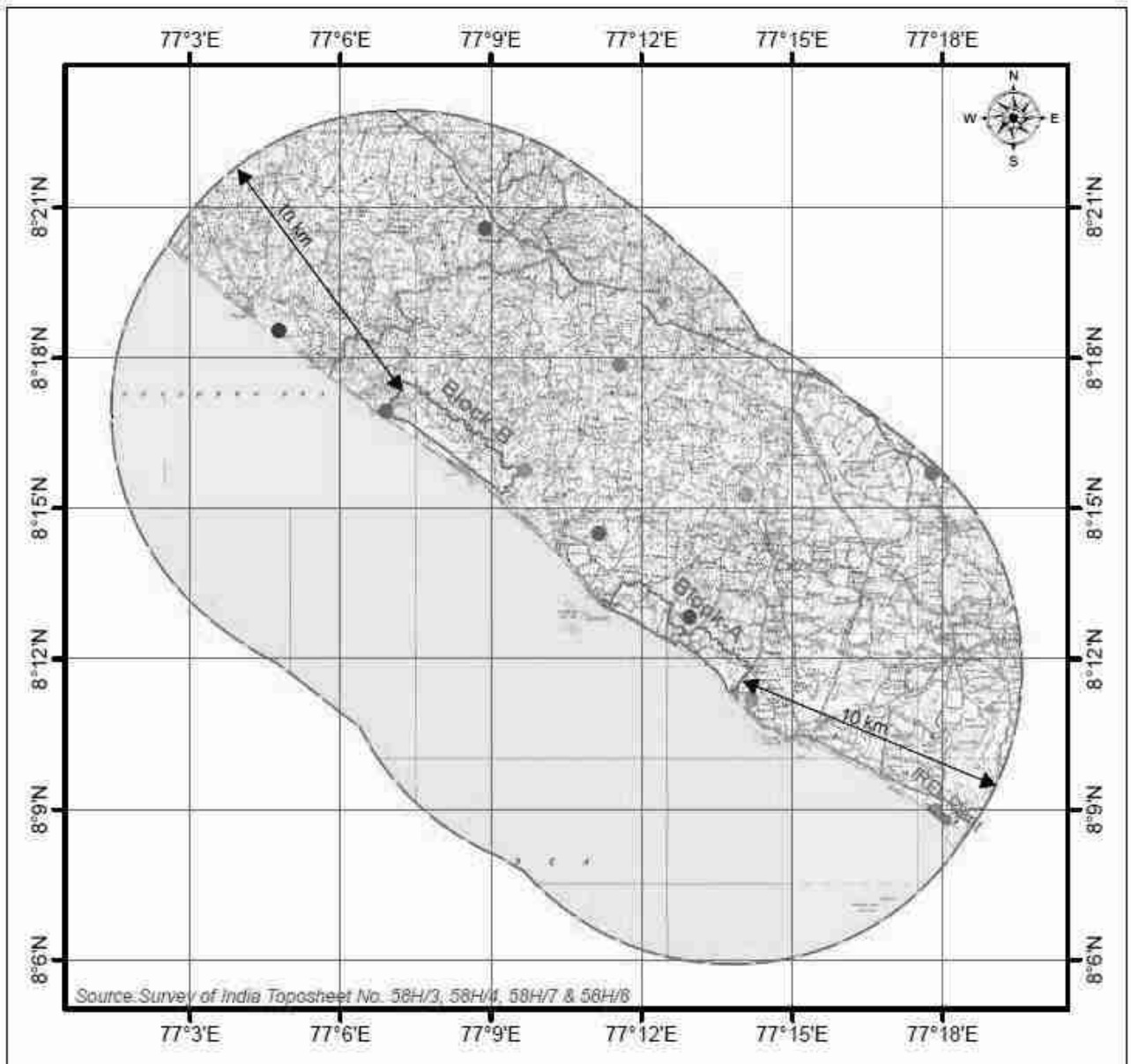


Figure 3.21 Sampling Locations



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SW1-SW2
Sample Drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622-1981
Sample description	: Surface Water - SW1 - Tamirabarani River, SW2 - Perumkulam (Pond).
Project Name	: Mining of Atomic Minerals at Keezhmidalam - A, Midalam - B, Enayamputhenthurai, Ezhudesam - A, B & C and Kollencode A & B Villages of Killiyour Taluk in Kanyakumari district, Tamil Nadu
Date of sampling	: 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 13-12-2022
Report date	: 28-12-2022

Page 1 of 2

S. No.	Parameter	Unit	Results		Test procedure
			SW1	SW2	
1	Temperature	°C	26.3	25.7	APHA 23 rd EDN -2550B
2	Colour	Hazen	5	4	APHA 23 rd EDN-2120 C
3	Odour	-	No Odour Observed	No Odour Observed	APHA 23 rd EDN -2150 B
4	pH at 25°C	-	6.84	7.09	IS : 3025 Part 11- 1983 (Reaff: 2017)
5	Electrical Conductivity	µS/cm	1735	437	IS : 3025 Part 14- 1984 (Reaff: 2019)
6	Turbidity	NTU	3.5	2.8	IS : 3025 Part 10-1984 (Reaff: 2017)
7	Total Dissolved Solids	mg/l	1003	244	IS : 3025 Part 16-1984 (Reaff: 2017)
8	Total Hardness as CaCO3	mg/l	404	85	IS : 3025 Part 21-1983 (Reaff: 2019)
9	Total Alkalinity as CaCO3	mg/l	106	57	IS : 3025 Part 23- 1986 (Reaff: 2019)
10	Chloride as Cl	mg/l	459	62	IS : 3025 Part 32-1988 (Reaff: 2019)
11	Sulphate as SO ₄	mg/l	99	51	APHA 23 rd EDN - 4500- SO ₄ ²⁻ E
12	Fluoride as F	mg/l	0.22	0.11	APHA 23 rd EDN - 4500-F B&D
13	Nitrate as NO ₃	mg/l	3	1	APHA 23 rd EDN - 4500- NO ₃ B
14	Ammonia as NH ₃	mg/l	0.90	0.25	APHA 23 rd EDN - 4500- NH ₃ B&C
15	Phosphate as PO ₄	mg/l	0.12	0.08	IS : 3025 Part 31-1988 (Reaff: 2019)
16	Sodium as Na	mg/l	230	50	IS:3025 Part 45-1993(Reaff: 2019)
17	Potassium as K	mg/l	3.5	2.7	IS:3025 Part 45-1993(Reaff: 2019)
18	Calcium as Ca	mg/l	56	23	IS:3025 Part 40-1991(Reaff: 2019)
19	Magnesium as Mg	mg/l	64	7	APHA 23 rd EDN 3500 Mg B

BDL - Below Detection Limit

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S. Dharani
Quality Manager



A. Robson Chinnadural
Technical Manager

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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SW1-SW2
Sample description	: Surface Water - SW1 - Tamirabarani River, SW2 - Perumkulam (Pond),
Report date	: 28-12-2022 Page 2 of 2:

S. No	Parameter	Unit	Results		Test Procedure
			SW1	SW2	
20	Iron as Fe	mg/l	0.41	0.24	IS : 3025 Part 53-2003(Reaff: 2019)
21	Manganese as Mn	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -3111 B
22	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	APHA 23 rd EDN -5540 C
23	Total Suspended Solids	mg/l	5	3	IS:3025 Part 17-1984(Reaff: 2017)
24	Dissolved Oxygen as O ₂	mg/l	6	6.4	IS:3025:Part-38:1989(Reaff: 2019)
25	Chemical Oxygen Demand	mg/l	20	18	IS:3025:Part-58:2006(Reaff: 2017)
26	Bio-Chemical Oxygen Demand @ 27°C for 3 days	mg/l	2.2	2	IS:3025:Part-44:1993(Reaff: 2019)
27	Phenolic compounds as C ₆ H ₅ OH	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN 5530 B,C,D
28	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B
29	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN -3112 B
30	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	APHA 23 rd EDN -3111 B
31	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B
32	Total Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B
33	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN-4500-CN E
34	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B
35	Zinc as Zn	mg/l	0.15	0.05	APHA 23 rd EDN -3111 B
36	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B
37	Nickel as Ni	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -3111 B
38	Oil & Grease	mg/l	BDL(<1)	BDL(<1)	IS:3025:Part-39:1991(Reaff: 2019)
39	Total Coliform	MPN/100ml	>1600	>1600	IS - 1622 -1981 (Reaff - 2019)
40	Faecal Coliform	MPN/100ml	700	350	IS - 1622-1981(Reaff - 2019)

BDL - Below Detection Limit

...End of Report...

S.Dharani
Quality Manager



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Technical Manager

Verified by

Authorised Signatory

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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SW3-SW4
Sample Drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622 -1981
Sample description	: Surface Water- SW3- Neyyar River, SW4- Arasakulam (Pond)
Project Name	: Mining of Atomic Minerals at Keezhmidalam -A, Midalam -B, Enayamputhenthurai, Ezhudesam -A,B & C and Kollencode A & B Villages of Killyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 13-12-2022
Report date	: 28-12-2022

Page 1 of 2

S. No	Parameter	Unit	Results		Test procedure
			SW3	SW4	
1	Temperature	°C	25.8	26.1	APHA 23 rd EDN -2550B
2	Colour	Hazen	10	12	APHA 23 rd EDN-2120 C
3	Odour	-	No Odour Observed	No Odour Observed	APHA 23 rd EDN -2150 B
4	pH at 25°C	-	7.09	7.59	IS : 3025 Part 11- 1983 (Reaff: 2017)
5	Electrical Conductivity	µS/cm	940	740	IS : 3025 Part 14- 1984 (Reaff: 2019)
6	Turbidity	NTU	1.8	3.7	IS : 3025 Part 10-1984 (Reaff: 2017)
7	Total Dissolved Solids	mg/l	536	422	IS : 3025 Part 16-1984 (Reaff: 2017)
8	Total Hardness as CaCO ₃	mg/l	141	153	IS : 3025 Part 21-1983 (Reaff: 2019)
9	Total Alkalinity as CaCO ₃	mg/l	127	163	IS : 3025 Part 23- 1986(Reaff: 2019)
10	Chloride as Cl	mg/l	214	137	IS : 3025 Part 32-1988 (Reaff: 2019)
11	Sulphate as SO ₄	mg/l	31	18	APHA 23 rd EDN - 4500- SO ₄ ²⁻ E
12	Fluoride as F	mg/l	0.14	0.21	APHA 23 rd EDN - 4500-F B&D
13	Nitrate as NO ₃	mg/l	8	4	APHA 23 rd EDN - 4500- NO ₃ - B
14	Ammonia as NH ₃	mg/l	0.25	0.10	APHA 23 rd EDN - 4500- NH ₃ B&C
15	Phosphate as PO ₄	mg/l	0.13	0.23	IS : 3025 Part 31-1988 (Reaff: 2019)
16	Sodium as Na	mg/l	150	110	IS:3025 Part 45-1993(Reaff: 2019)
17	Potassium as K	mg/l	3.3	2.7	IS:3025 Part 45-1993(Reaff: 2019)
18	Calcium as Ca	mg/l	32	40	IS:3025 Part 40-1991(Reaff: 2019)
19	Magnesium as Mg	mg/l	15	13	APHA 23 rd EDN 3500 Mg B

BDL - Below Detection Limit

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Quality Manager



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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SW3-SW4
Sample description	: Surface Water- SW3- Neyyar River, SW4- Arasakulam (Pond)
Report date	: 28-12-2022 Page 2 of 2

S. No	Parameter	Unit	Results		Test Procedure
			SW3	SW4	
20	Iron as Fe	mg/l	0.18	0.14	IS : 3025 Part 53-2003(Reaff: 2019)
21	Manganese as Mn	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -3111 B
22	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	APHA 23 rd EDN -5540 C
23	Total Suspended Solids	mg/l	4	3	IS:3025 Part 17-1984(Reaff: 2017)
24	Dissolved Oxygen as O ₂	mg/l	6.1	5.8	IS:3025:Part-38:1989(Reaff: 2019)
25	Chemical Oxygen Demand	mg/l	16	14	IS:3025:Part-58:2006(Reaff: 2017)
26	Bio-Chemical Oxygen Demand @ 27°C for 3 days	mg/l	<2	<2	IS:3025:Part-44:1993(Reaff: 2019)
27	Phenolic compounds as C ₆ H ₅ OH	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN -5530 B,C,D
28	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B
29	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN -3112 B
30	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	APHA 23 rd EDN -3111 B
31	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B
32	Total Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B
33	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN-4500-CN E
34	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B
35	Zinc as Zn	mg/l	0.10	0.08	APHA 23 rd EDN -3111 B
36	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B
37	Nickel as Ni	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -3111 B
38	Oil & Grease	mg/l	BDL(<1)	BDL(<1)	IS:3025:Part-39:1991(Reaff: 2019)
39	Total Coliform	MPN/100ml	>1600	>1600	IS - 1622-1981 (Reaff - 2019)
40	Faecal Coliform	MPN/100ml	280	700	IS - 1622-1981(Reaff - 2019)

BDL - Below Detection Limit

....End of Report....

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorized Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

ABC TOWER #400, 13th Street, SIDCO Industrial Estate - North Phase,
Ambattur, Chennai - 600 098, Tamilnadu, INDIA.
Ph: +91-44-2625 7788 / 99, +91 94442 60000 / 95661 87777
Email: lab@abctechnolab.com / Web: www.abctechnolab.com



(An ISO 9001, ISO 14001, ISO 45001 & ISO 22000 Certified Company)

Accredited by NABL vide TC-5770, NABET / QCI, Recognized by MoEF&CC, BIS, APEDA, IOEPPC, Top board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SW5-SW6
Sample Drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622 - 1981
Sample description	: Surface Water - SW5- Nadukulam (Pond), SW6- AVM Canal.
Project Name	: Mining of Atomic Minerals at Kozhmidalam - A, Midalam - B, Enayamputhenthurai, Ezhudesam - A, B & C and Kollencode A & B Villages of Killiyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 13-12-2022
Report date	: 28-12-2022

Page 1 of 2

S. No	Parameter	Unit	Results		Test procedure
			SW5	SW6	
1	Temperature	°C	26.6	27.3	APHA 23 rd EDN - 2550B
2	Colour	Hazen	5	3	APHA 23 rd EDN-2120 C
3	Odour	-	No Odour Observed	No Odour Observed	APHA 23 rd EDN - 2150 B
4	pH at 25°C	-	7.41	7.48	IS : 3025 Part 11- 1983 (Reaff: 2017)
5	Electrical Conductivity	µS/cm	457	428	IS : 3025 Part 14- 1984 (Reaff: 2019)
6	Turbidity	NTU	3.9	2.6	IS : 3025 Part 10-1984 (Reaff: 2017)
7	Total Dissolved Solids	mg/l	261	231	IS : 3025 Part 16-1984 (Reaff: 2017)
8	Total Hardness as CaCO ₃	mg/l	82	72	IS : 3025 Part 21-1983 (Reaff: 2019)
9	Total Alkalinity as CaCO ₃	mg/l	46	40	IS : 3025 Part 23- 1986(Reaff: 2019)
10	Chloride as Cl	mg/l	115	96	IS : 3025 Part 32-1988 (Reaff: 2019)
11	Sulphate as SO ₄	mg/l	18	14	APHA 23 rd EDN - 4500- SO ₄ ²⁻ E
12	Fluoride as F	mg/l	0.15	0.17	APHA 23 rd EDN - 4500-F B&D
13	Nitrate as NO ₃	mg/l	6	3	APHA 23 rd EDN - 4500- NO ₃ ⁻ B
14	Ammonia as NH ₃	mg/l	0.14	0.10	APHA 23 rd EDN - 4500- NH ₃ B&C
15	Phosphate as PO ₄	mg/l	0.15	0.11	IS : 3025 Part 31-1988 (Reaff: 2019)
16	Sodium as Na	mg/l	68	52	IS:3025 Part 45-1993(Reaff: 2019)
17	Potassium as K	mg/l	2	1.3	IS:3025 Part 45-1993(Reaff: 2019)
18	Calcium as Ca	mg/l	14	12	IS:3025 Part 40-1991(Reaff: 2019)
19	Magnesium as Mg	mg/l	11.4	10	APHA 23 rd EDN 3500 Mg B

BDL - Below Detection Limit

Contd.....

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadural
A. Robson Chinnadural
Technical Manager

Verified by

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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(An ISO - 9001, ISO - 14001, ISO - 45001 & ISO - 22000 Certified Company)

Accredited by NABL vide TC-5770, NABET / QCI, Recognised by MEF&CC, BIS, APEDA, IOPEPC, Tea Board India

ISSUED TO: The General Manager and Head
IREL, India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SW5-SW6
Sample description	: Surface Water - SW5- Nadukulam (Pond), SW6- AVM Canal.
Report date	: 28-12-2022 Page 2 of 2

S. No	Parameter	Unit	Results		Test Procedure
			SW5	SW6	
20	Iron as Fe	mg/l	0.28	0.13	IS : 3025 Part 53-2003(Reaff: 2019)
21	Manganese as Mn	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -3111 B
22	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	APHA 23 rd EDN -5540 C
23	Total Suspended Solids	mg/l	5	3	IS:3025 Part 17-1984(Reaff: 2017)
24	Dissolved Oxygen as O ₂	mg/l	6.3	6.5	IS:3025-Part-38:1989(Reaff: 2019)
25	Chemical Oxygen Demand	mg/l	18	14	IS:3025-Part-58:2006(Reaff: 2017)
26	Bio-Chemical Oxygen Demand @ 27°C for 3 days	mg/l	2.1	<2	IS:3025-Part-44:1993(Reaff: 2019)
27	Phenolic compounds as C ₆ H ₅ OH	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN 5530 B,C,D
28	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B
29	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN -3112 B
30	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	APHA 23 rd EDN -3111 B
31	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B
32	Total Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B
33	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN-4500-CN E
34	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B
35	Zinc as Zn	mg/l	0.12	0.06	APHA 23 rd EDN -3111 B
36	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B
37	Nickel as Ni	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -3111 B
38	Oil & Grease	mg/l	BDL(<1)	BDL(<1)	IS:3025-Part-39:1991(Reaff: 2019)
39	Total Coliform	MPN/100ml	>1600	>1600	IS - 1622 -1981 (Reaff - 2019)
40	Faecal Coliform	MPN/100ml	900	500	IS - 1622-1981(Reaff - 2019)

BDL - Below Detection Limit

...End of Report...

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorized Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha
in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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Accredited by NABL vide TC-5770, NABET / QCI, Recognised by MoEF&CC, RIS, APEEDA, IOPEFC, Test Board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SW7-SW8
Sample Drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622 - 1981
Sample description	: SurfaceWater-SW7- Marauapuram (Pond), SWB- Udappukulam (Pond).
Project Name	: Mining of Atomic Minerals at Keezhmidalam -A, Midalam -B, Enayamputhenthurai, Ezhudesam - A, B & C and Kollencode A & B Villages of Killyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 13-12-2022
Report date	: 28-12-2022

Page 1 of 2

S. No	Parameter	Unit	Results		Test procedure
			SW7	SW8	
1	Temperature	°C	26.4	26.7	APHA 23 rd EDN - 2550B
2	Colour	Hazen	7	4	APHA 23 rd EDN-2120 C
3	Odour	-	No Odour Observed	No Odour Observed	APHA 23 rd EDN - 2150 B
4	pH at 25°C	-	7.41	8.04	IS: 3025 Part 11- 1983 (Reaff: 2017)
5	Electrical Conductivity	µS/cm	514	18630	IS: 3025 Part 14- 1984 (Reaff: 2019)
6	Turbidity	NTU	3.2	2.3	IS: 3025 Part 10-1984 (Reaff: 2017)
7	Total Dissolved Solids	mg/l	276	11778	IS: 3025 Part 16-1984 (Reaff: 2017)
8	Total Hardness as CaCO3	mg/l	96	2100	IS: 3025 Part 21-1983 (Reaff: 2019)
9	Total Alkalinity as CaCO3	mg/l	52	188	IS: 3025 Part 23- 1986 (Reaff: 2019)
10	Chloride as Cl	mg/l	124	6268	IS: 3025 Part 32-1988 (Reaff: 2019)
11	Sulphate as SO ₄	mg/l	20	840	APHA 23 rd EDN - 4500- SO ₄ ²⁻ E
12	Fluoride as F	mg/l	0.16	0.82	APHA 23 rd EDN - 4500-F B&D
13	Nitrate as NO ₃	mg/l	4	1.6	APHA 23 rd EDN - 4500- NO ₃ B
14	Ammonia as NH ₃	mg/l	0.16	0.10	APHA 23 rd EDN - 4500- NH ₃ B&C
15	Phosphate as PO ₄	mg/l	0.15	0.10	IS: 3025 Part 31-1988 (Reaff: 2019)
16	Sodium as Na	mg/l	66	3800	IS:3025 Part 45-1993(Reaff: 2019)
17	Potassium as K	mg/l	1.7	180	IS:3025 Part 45-1993(Reaff: 2019)
18	Calcium as Ca	mg/l	15	168	IS:3025 Part 40-1991 (Reaff: 2019)
19	Magnesium as Mg	mg/l	14	408	APHA 23 rd EDN 3500 Mg B

BDL - Below Detection Limit

Contd

S. Dharani
Quality Manager



A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



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(AH 150 - 9001, ISO - 14001, ISO - 45001 & ISO - 22000 Certified Company)

Accredited by NABL vide TC-5770, NABET / OCI, Recognized by MoEF&CC, BIS, APEDA, IOFSPC, Tea Board India

ISSUED TO: The General Manager and Head
IREL, India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SW7-SW8
Sample description	: Surface Water- SW7- Maraiapuram (Pond), SW8- Udappukulam (Pond).
Report date	: 28-12-2022 Page 2 of 2

S. No	Parameter	Unit	Results		Test Procedure
			SW7	SW8	
20	Iron as Fe	mg/l	0.21	0.11	IS: 3025 Part 53-2003(Reaff: 2019)
21	Manganese as Mn	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -3111 B
22	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	APHA 23 rd EDN -5540 C
23	Total Suspended Solids	mg/l	5	5	IS:3025 Part 17-1984(Reaff: 2017)
24	Dissolved Oxygen as O ₂	mg/l	6.2	5.7	IS:3025-Part-38-1989(Reaff: 2019)
25	Chemical Oxygen Demand	mg/l	20	16	IS:3025-Part-58-2006(Reaff: 2017)
26	Bio-Chemical Oxygen Demand @ 27°C for 3 days	mg/l	2.5	<2	IS:3025-Part-44-1993(Reaff: 2019)
27	Phenolic compounds as C ₆ H ₅ OH	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN 5530 8,C,D
28	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B
29	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN -3112 B
30	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	APHA 23 rd EDN -3111 B
31	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B
32	Total Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B
33	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN-4500-CN E
34	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B
35	Zinc as Zn	mg/l	0.16	0.11	APHA 23 rd EDN -3111 B
36	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B
37	Nickel as Ni	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -3111 B
38	Oil & Grease	mg/l	BDL(<1)	BDL(<1)	IS:3025-Part-39-1991(Reaff: 2019)
39	Total Coliform	MPN/100ml	>1600	>1600	IS - 1622 -1981 (Reaff - 2019)
40	Faecal Coliform	MPN/100ml	900	1100	IS - 1622-1981(Reaff - 2019)

BDL - Below Detection Limit

...End of Report...

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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(AH ISO : 9001), ISO : 14001, ISO : 45001 & ISO : 22000 Certified Company

Accredited by NABL vide TC-5770, NABET / QCI, Recognized by MoEF&CC, BIS, APEDA, IOFEPIC, Tea Board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SW9-SW10
Sample Drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622 - 1981
Sample description	: Surface Water- SW9- Vaikundapuram (Pond), SW10- Perumchirai (Pond)
Project Name	: Mining of Atomic Minerals at Keekhidalam -A, Midalam -B, Enayamputhenthurai, Ezhudesam -A, B & C and Kollamcode A & B Villages of Killiyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 13-12-2022
Report date	: 28-12-2022

Page 1 of 2

S. No	Parameter	Unit	Results		Test procedure
			SW9	SW10	
1	Temperature	°C	27.3	26.5	APHA 23 rd EDN -2550B
2	Colour	Hazen	10	3	APHA 23 rd EDN-2120 C
3	Odour	-	No Odour Observed	No Odour Observed	APHA 23 rd EDN -2150 B
4	pH at 25°C	-	7.90	7.52	IS : 3025 Part 11- 1983 (Reaff: 2017)
5	Electrical Conductivity	µS/cm	13100	442	IS : 3025 Part 14- 1984 (Reaff: 2019)
6	Turbidity	NTU	4.6	3.1	IS : 3025 Part 10-1984 (Reaff: 2017)
7	Total Dissolved Solids	mg/l	7841	236	IS : 3025 Part 16-1984 (Reaff: 2017)
8	Total Hardness as CaCO ₃	mg/l	1460	74	IS : 3025 Part 21-1983 (Reaff: 2019)
9	Total Alkalinity as CaCO ₃	mg/l	172	42	IS : 3025 Part 23- 1986(Reaff: 2019)
10	Chloride as Cl	mg/l	4364	102	IS : 3025 Part 32-1988 (Reaff: 2019)
11	Sulphate as SO ₄	mg/l	610	16	APHA 23 rd EDN - 4500- SO ₄ ²⁻ E
12	Fluoride as F	mg/l	0.26	0.21	APHA 23 rd EDN - 4500-F B&D
13	Nitrate as NO ₃	mg/l	2.6	3	APHA 23 rd EDN - 4500- NO ₃ B
14	Ammonia as NH ₃	mg/l	0.12	0.10	APHA 23 rd EDN - 4500- NH ₃ B&C
15	Phosphate as PO ₄	mg/l	0.27	0.13	IS : 3025 Part 31-1988 (Reaff: 2019)
16	Sodium as Na	mg/l	2700	58	IS:3025 Part 45-1993(Reaff: 2019)
17	Potassium as K	mg/l	110	1.8	IS:3025 Part 45-1993(Reaff: 2019)
18	Calcium as Ca	mg/l	88	13	IS:3025 Part 40-1991(Reaff: 2019)
19	Magnesium as Mg	mg/l	301	10	APHA 23 rd EDN 3500 Mg B

BDL - Below Detection Limit

Contd

S. Dharami
S. Dharami
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorized Signatory

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Accredited by NABL vide TC-5770, NABET / QCI, Recognised by MoEF&CC, BIS, APEDA, IOFPC, Test Board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Mannavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SW9-SW10				
Sample description	: Surface Water- SW9- Vaikundapuram (Pond), SW10- Perumchirai (Pond)				
Report date	: 28-12-2022		Page 2 of 2		
S. No	Parameter	Unit	Results		Test Procedure
			SW9	SW10	
20	Iron as Fe	mg/l	0.24	0.12	IS: 3025 Part 53-2003(Reaff: 2019)
21	Manganese as Mn	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -3111 B
22	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	APHA 23 rd EDN -5540 C
23	Total Suspended Solids	mg/l	7	3	IS:3025 Part 17-1984(Reaff: 2017)
24	Dissolved Oxygen as O ₂	mg/l	5.6	6.4	IS:3025:Part-38:1989(Reaff: 2019)
25	Chemical Oxygen Demand	mg/l	22	14	IS:3025:Part-58:2006(Reaff: 2017)
26	Bio-Chemical Oxygen Demand @ 27°C for 3 days	mg/l	3.7	<2	IS:3025:Part-44:1993(Reaff: 2019)
27	Phenolic compounds as C ₆ H ₅ OH	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN 5530 B,C,D
28	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B
29	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN -3112 B
30	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	APHA 23 rd EDN -3111 B
31	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B
32	Total Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B
33	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN-4500-CN E
34	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B
35	Zinc as Zn	mg/l	0.14	0.06	APHA 23 rd EDN -3111 B
36	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B
37	Nickel as Ni	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -3111 B
38	Oil & Grease	mg/l	BDL(<1)	BDL(<1)	IS:3025:Part-39:1991(Reaff: 2019)
39	Total Coliform	MPN/100ml	>1600	>1600	IS -1622 -1981 (Reaff - 2019)
40	Faecal Coliform	MPN/100ml	>1600	170	IS -1622-1981(Reaff - 2019)

BDL - Below Detection Limit

....End of Report....

S. Dharani
S. Dharani
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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Results and discussions

The collected sample was tested for insitu parameters like pH, dissolved oxygen, TDS & TSS and are preserved with addition of nitric acid for testing metal constituents at laboratory. The collected sample was analyzed in accordance with Indian Standards and the results have been compared with recent CPCB norms for surface water quality criteria for Class A to E, given in Table 3.19. Since, the water is used for drinking water purpose the quality is also compared with IS: 10500. Analytical results for monitoring season are given in Table 3.20.

Table 3.18 Water quality criteria as per Central Pollution Control Board

Parameters	Class A	Class B	Class C	Class D	Class E
1. pH	6.5–8.5	6.5–8.5	6.0-9.0	6.5–8.5	6.0–8.5
2. Dissolved oxygen (as O ₂), mg/l, min	6	5	4	4	-
3. BOD, 3 days at 27° C, max	2	3	3	-	-
4. Total coliform organism, MPN/100 ml, max	50 or less	500 or less	5000 or less	-	-
5. Free ammonia (as N), mg/l, max	-	-	-	1.2	-
6. Electrical conductivity, at 25° C, µmhos/cm, max	-	-	-	-	2250
7. Sodium absorption ratio, max.	-	-	-	-	26
8. Boron (as B), mg/l, max.	-	-	-	-	2

Class A: Drinking water source without conventional treatment but after disinfection

Class B: Outdoor bathing (organized)

Class C: Drinking water source after conventional treatment and after disinfection

Class D: Propagation of Wild life and Fisheries

Class E: Irrigation, Industrial Cooling, and Controlled Waste Disposal

Below E: Not meeting A, B, C, D & E Criteria

Table 3.19 Results of surface water analysis

Sl. No.	Parameter	Permissible limits *		SW1	SW2	SW3	SW4	SW5
		Desirable limits	Permissible limits					
1.	Colour, Hazen units, Max	5	15	5	4	10	12	5
2.	Odour	Agreeable	Agreeable	No odour observed	No odour observed	No odour observed	No odour observed	No odour observed
3.	pH Value	6.5 to 8.5	No Relaxation	6.84	7.09	7.09	7.59	7.41
4.	Turbidity, NTU, Max	1	5	3.5	2.8	1.8	3.7	3.9
5.	Total dissolved solids, mg/l	500	2000	1003	244	536	422	261
6.	Calcium (as Ca), mg/l, max.	75	200	56	23	32	40	14



Sl. No.	Parameter	Permissible limits *		SW1	SW2	SW3	SW4	SW5
		Desirable limits	Permissible limits					
7.	Chloride (as Cl), mg/l, max.	250	1000	459	62	214	137	115
8.	Copper (as Cu), mg/l, max.	0.05	1.5	<0.03	<0.03	<0.03	<0.03	<0.03
9.	Fluoride (as F), mg/l, max.	1.0	1.5	0.22	0.11	0.14	0.21	0.15
10.	Iron (as Fe), mg/l, max.	0.3	No Relaxation	0.41	0.24	0.18	0.14	0.28
11.	Magnesium (as Mg), mg/l, max.	30	100	64	7	15	13	11.4
12.	Manganese (as Mn), mg/l, max.	0.1	0.3	<0.02	<0.02	<0.02	<0.02	<0.02
13.	Nitrate (as NO ₃), mg/l, max.	45	No Relaxation	3	1	8	4	6
14.	Phenolic compounds (as C ₆ H ₅ OH), mg/l, max.	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
15.	Sulphate (as SO ₄), mg/l, max.	200	400	99	51	31	18	18
16.	Total alkalinity (as CaCO ₃), mg/l	200	600	106	57	127	163	46
17.	Total hardness (as CaCO ₃), mg/l, max	200	600	404	85	141	153	82
18.	Zinc (as Zn), mg/l, max.	5	15	0.15	0.05	0.10	0.08	0.12
19.	Cadmium (as Cd), mg/l, max.	0.003	No relaxation	<0.003	<0.003	<0.003	<0.003	<0.003
20.	Cyanide (as CN), mg/l, max.	0.05	No relaxation	<0.02	<0.02	<0.02	<0.02	<0.02
21.	Lead (as Pb), mg/l, max.	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
22.	Mercury, (as Hg), mg/l, max.	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001
23.	Nickel (as Ni), mg/l, max.	0.02	No relaxation	<0.02	<0.02	<0.02	<0.02	<0.02
24.	Total arsenic (as As), mg/l, max.	0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01



Sl. No.	Parameter	Permissible limits *		SW1	SW2	SW3	SW4	SW5
		Desirable limits	Permissible limits					
25.	Total chromium (as Cr), mg/l, Max.	0.05	No relaxation	<0.03	<0.03	<0.03	<0.03	<0.03
26.	Total Coliform bacteria, MPN/100ml	-	-	>1600	>1600	>1600	>1600	>1600
27.	Dissolved Oxygen, mg/l, minimum	-	-	6	6.4	6.1	5.8	6.3
28.	BOD, mg/l Max.	-	-	2.2	2	<2	<2	2.1
29.	Electrical Conductivity at 25° C, µmhos/cm, max			1735	437	940	740	457
30.	Free ammonia (as N), mg/l, max			0.90	0.25	0.25	0.10	0.14

*Drinking Water Specification IS: 10500 (2012); ** Requirement (Acceptable limits); *** Permissible limits in the absence of alternate source; #Additional Characteristics as per - Water Quality Criteria as per Central Pollution Control Board

Sl. No.	Parameter	Permissible limits *		SW6	SW7	SW8	SW9	SW10
		Desirable limits	Permissible limits					
1.	Colour, Hazen units, Max	5	15	3	7	4	10	3
2.	Odour	Agreeable	Agreeable	No odour	No odour	No odour	No odour	No odour
3.	pH Value	6.5 to 8.5	No Relaxation	7.48	7.41	8.04	7.98	7.52
4.	Turbidity, NTU, Max	1	5	2.6	3.2	2.3	4.6	3.1
5.	Total dissolved solids, mg/l	500	2000	231	276	11778	7841	236
6.	Calcium (as Ca), mg/l, max.	75	200	12	15	168	88	13
7.	Chloride (as Cl), mg/l, max.	250	1000	96	124	6268	4364	102
8.	Copper (as Cu), mg/l, max.	0.05	1.5	<0.03	<0.03	<0.03	<0.03	<0.03
9.	Fluoride (as F), mg/l, max.	1.0	1.5	0.17	0.16	0.82	0.26	0.21
10.	Iron (as Fe), mg/l, max.	0.3	No Relaxation	0.13	0.21	0.11	0.24	0.12



Sl. No.	Parameter	Permissible limits *		SW6	SW7	SW8	SW9	SW10
		Desirable limits	Permissible limits					
11.	Magnesium (as Mg), mg/l, max.	30	100	10	14	408	301	10
12.	Manganese (as Mn), mg/l, max.	0.1	0.3	<0.02	<0.02	<0.02	<0.02	<0.02
13.	Nitrate (as NO ₃), mg/l, max.	45	No Relaxation	3	4	1.6	2.6	3
14.	Phenolic compounds (as C ₆ H ₅ OH), mg/l, max.	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
15.	Sulphate (as SO ₄), mg/l, max.	200	400	14	20	840	610	16
16.	Total alkalinity (as CaCO ₃), mg/l	200	600	40	52	188	172	42
17.	Total hardness (as CaCO ₃), mg/l, max	200	600	72	96	2100	1460	74
18.	Zinc (as Zn), mg/l, max.	5	15	0.06	0.16	0.11	0.14	0.06
19.	Cadmium (as Cd), mg/l, max.	0.003	No relaxation	<0.003	<0.003	<0.003	<0.003	<0.003
20.	Cyanide (as CN), mg/l, max.	0.05	No relaxation	<0.02	<0.02	<0.02	<0.02	<0.02
21.	Lead (as Pb), mg/l, max.	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
22.	Mercury, (as Hg), mg/l, max.	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001
23.	Nickel (as Ni), mg/l, max.	0.02	No relaxation	<0.02	<0.02	<0.02	<0.02	<0.02
24.	Total arsenic (as As), mg/l, max.	0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01
25.	Total chromium (as Cr), mg/l, Max.	0.05	No relaxation	<0.03	<0.03	<0.03	<0.03	<0.03
26.	Total Coliform bacteria,	-	-	>1600	>1600	>1600	>1600	>1600



Sl. No.	Parameter	Permissible limits *		SW6	SW7	SW8	SW9	SW10
		Desirable limits	Permissible limits					
	MPN/100 ml							
27.	Dissolved Oxygen, mg/l, minimum	-	-	6.5	6.2	5.7	5.6	6.4
28.	BOD, mg/l Max.	-	-	<2	2.5	<2	3.7	<2
29.	Electrical Conductivity at 25° C, µmhos/cm, max			428	514	18630	13100	442
30.	Free ammonia (as N), mg/l, max			0.10	0.16	0.10	0.12	0.10

The surface water quality when compared with water quality criteria as per Central Pollution Control Board (CPCB) meets the criteria specified for Class B, C, D and E. It was observed that the water quality is good for irrigation purpose; outdoor bathing. It can also be used as drinking water source with conventional treatment followed by disinfection. Further, the analytical results are compared with the drinking water quality standards as specified in IS:10500.

The results indicate that the pH is recorded as 8.04, which is well within the range of 6.5 - 8.5 as specified in standard limit. The TDS value is 11778 mg/l which is more than the desirable limit. The Chloride is 6268 mg/l and sulphate is 840 mg/l and the parameters are higher than tolerance limits. The heavy metals content is observed below detectable limits. Dissolved Oxygen was observed as 5.6 to 6.4 and BOD was observed as 2.0 to 3.7 mg/l which indicate the surface water quality is in good quality.

Groundwater quality

Groundwater source

The main source of groundwater recharge in this region is south-west monsoon. A partial contribution for groundwater recharge comes from the north-east monsoon. In this area, ground water is withdrawn by means of tube wells/bore wells. In the absence of surface water sources, groundwater is used for drinking and irrigation purposes.

Water sampling locations

Water samples have been collected during Dec – Feb (2022 – 23) from locations, which are listed in Table 3.21.

Table 3.20 Water sampling locations

Stn.No.	Location Name	Latitude	Longitude
GW1	Ezhudesam 1	08°16'02.28" N	77°08'35.98" E
GW2	Ezhudesam 2	08°15'54.53" N	77°09'40.85" E
GW3	Midalam	08°12'16.76" N	77°12'56.31" E
GW4	Alanji	08°11'51.90" N	77°13'58.48" E
GW5	Helen Nagar	08°12'53.02" N	77°11'51.34" E
GW6	Simon Colony	08°10'35.07" N	77°14'44.88" E
GW7	Paloor Vattakkottai	08°14'54.50" N	77°13'36.94" E
GW8	Rethapuram	08°11'44.45" N	77°15'04.46" E
GW9	Kollencode	08°17'03.38" N	77°07'31.94" E
GW10	Chemmanvillai	08°18'09.32" N	77°09'55.44" E

Results and discussions

The analytical result of analysis of groundwater is given in Table 3.22. The results have been compared with the drinking water quality standards specified in IS: 10500 (2012). The results indicate that the pH ranges from 6.58 to 7.97 which is well within the specified standard limit of 6.5 to 8.5. Total hardness was recorded in the range of 66 to 405 mg/l, except GW2, GW5, GW9 and GW10, all other samples are above acceptable limit (200 mg/l) but are within the permissible limit (600 mg/l). The other general parameters are all within permissible limits. The results show that the ground water quality parameters analyzed meets the prescribed norms and the result values are found to be well within the acceptable limits except the above mentioned parameters.



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/GW1-GW2
Sample drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622-1981
Sample description	: Ground Water - GW1- Ezhudesam Sample 1, 50 m from St.Judes College, N- 08°16'02.28" E- 77°08'35.98" GW2 - Ezhudesam Sample 2, 30 m from Nedumpuram Sree Muthumariamman Temple, N- 08°15'54.53" E- 77°09'40.85"
Project Name	: Mining of Atomic Minerals at Knezhimudalam -A, Midalam -B, Enayamputhenthurai, Ezhudesam -A,B & C and Kallencode A&B Villages of Killypur Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 13-12-2022
Report date	: 28-12-2022

Page 1 of 3

S. No.	Parameter	Unit	Results		Test procedure	Acceptable limit as per IS 10500 : 2012
			GW1	GW2		
1	Colour	Hazen	<1	<1	IS 3025(part 4)1983(RA 2017)	5
2	Odour	-	No Odour Observed	No Odour Observed	IS 3025(part 8)1984(RA 2017)	Agreeable
3	Turbidity	NTU	BDL(<0.5)	BDL(<0.5)	IS:3025 Part 10-1984(Reaff: 2017)	1
4	pH at 25 °C	-	7.31	6.58	IS:3025 Part 11-1983(Reaff: 2017)	6.5-8.5
5	Conductivity at 25 °C	µS/cm	1118	840	IS:3025 Part 14- 1984 (Reaff:2017)	Not Specified
6	Total dissolved solids	mg/l	633	482	IS:3025 Part 16-1984(Reaff: 2017)	500
7	Total Suspended solids	mg/l	<2	<2	IS-3025 Part 17-1984(Reaff: 2017)	Not Specified
8	Total Alkalinity as CaCO ₃	mg/l	353	92	IS: 3025 Part 23-1986(Reaff: 2019)	200
9	Total Hardness as CaCO ₃	mg/l	405	82	IS: 3025 Part 21-2009	200
10	Calcium as Ca	mg/l	118	21	IS: 3025 Part 40-1991(Reaff: 2019)	75
11	Magnesium as Mg	mg/l	27	7	APHA 23 rd EDN -3500 Mg B	30
12	Chloride as Cl ⁻	mg/l	107	209	IS:3025 Part 32-1988(Reaff: 2019)	250
13	Sulphate as SO ₄	mg/l	60	15	APHA 23 rd EDN -4500-SO ₄ ²⁻ E	200
14	Nitrate as NO ₃	mg/l	11	7	APHA 23 rd EDN -4500- NO ₃ ⁻ B	45
15	Iron as Fe	mg/l	BDL(<0.05)	BDL(<0.05)	IS 3025(part 53)1987(Reaff: 2019)	1
16	Manganese as Mn	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B	0.10
17	Fluoride as F	mg/l	0.26	0.29	APHA 23 rd EDN -4500-F B&D	1.00

Contd...

S. Dharani
Quality Manager



A. Robson Chinnadural
Technical Manager

Verified by

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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report no	: ABCTL/IREL/EIA/2022/12/GW1-GW2
Sample description	: Ground Water - GW1- Ezhudesam Sample 1, 50 m from St.Judes College, N- 08°16'02.28" E- 77°08'35.98", GW2 - Ezhudesam Sample 2, 30 m from Nedumpuram Sree Muthumariamman Temple, N- 08°15'54.53" E- 77°09'40.85"
Date of report	: 28-12-2022 Page 2 of 2

S. No.	Parameter	Unit	Results		Test procedure	Acceptable limit as per IS 10500 : 2012
			GW1	GW2		
18	Sodium as Na	mg/l	70	152	IS : 3025 Part 45-1993 (Reaff-2019)	Not Specified
19	Potassium as K	mg/l	2.2	3	IS : 3025 Part 45-1993 (Reaff-2019)	Not Specified
20	Barium as Ba	mg/l	BDL(<0.1)	BDL(<0.1)	APHA 23 rd EDN -3111 D	0.7
21	Residual Free Chlorine	mg/l	BDL(<0.1)	BDL(<0.1)	APHA 23 rd EDN -4500-CI B	0.20
22	Aluminium as Al	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN 3500 Al B	0.03
23	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	APHA 23 rd EDN -3111 B	0.003
24	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
25	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B	0.05
26	Zinc as Zn	mg/l	0.08	0.05	APHA 23 rd EDN -3111 B	5.00
27	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B	0.05
28	Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
29	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -4500-CN E	0.05
30	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
31	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	IS APHA 23 rd EDN -3112 B	0.001
32	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	APHA 23 rd EDN 5540 C	0.20
33	Phenolic Compounds as Phenol	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN 5530 B,C	0.001
34	Pesticides	mg/l	Absent	Absent	APHA 23 rd EDN -6630 B, C	Absent
35	Total Coliforms	MPN/100ml	<2	<2	IS-1622-1981 (Reaff-2019)	Absent /100ml
36	E.coli	MPN/100ml	<2	<2	IS-1622-1981 (Reaff-2019)	Absent /100ml

BDL- Below Detection Limit

---End of report---

S. Dharani
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Quality Manager



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Accredited by NABL vide TC-5770, NABET / QCI, Recognized by NIEF&CC, IIS, APEDA, ICIPERC, Tax Board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTLI/IREL/EIA/2022/12/GW3-GW4
Sample drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622 -1981
Sample description	: Ground Water-GW3- Midalam Sample, Karungal Midalam Road, 115 m from Govt. High School Udayamarthandam N- 08°12'16.76" E- 77°12'56.31", GW4 - Alinjil Sample 30 m from St. Francis Xavier Church-N- 08°11'51.90" E- 77°13'58.48"
Project Name	: Mining of Atomic Minerals at Keelamidalam - A, Midalam - B, Enayamputhenthurai, Ezhudesam - A, B & C and Kallecode A & B Villages of Killyoor Taluk in Kanyakumari district, Tamil Nadu
Date of sampling	: 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 13-12-2022
Report date	: 28-12-2022

Page 1 of 2

S. No	Parameter	Unit	Results		Test procedure	Acceptable limit as per IS 10500 : 2012
			GW3	GW4		
1	Colour	Hazen	<1	<1	IS 3025(part 4)1983(RA 2017)	5
2	Odour	-	No Odour Observed	No Odour Observed	IS 3025(part 8)1984(RA 2017)	Agreeable
3	Turbidity	NTU	0.6	BDL(<0.5)	IS:3025 Part 10-1984(Reaff: 2017)	1
4	pH at 25 °C	-	7.88	7.18	IS :3025 Part 11-1983(Reaff: 2017)	6.5-8.5
5	Conductivity at 25 °C	µS/cm	1085	1290	IS :3025 Part 14- 1984 (Reaff:2017)	Not Specified
6	Total dissolved solids	mg/l	619	705	IS :3025 Part 16-1984(Reaff: 2017)	500
7	Total Suspended solids	mg/l	<2	<2	IS :3025 Part 17-1984(Reaff: 2017)	Not Specified
8	Total Alkalinity as CaCO ₃	mg/l	162	141	IS : 3025 Part 23-1986(Reaff: 2019)	200
9	Total Hardness as CaCO ₃	mg/l	307	252	IS : 3025 Part 21-2009	200
10	Calcium as Ca	mg/l	105	65	IS : 3025 Part 40-1991(Reaff: 2019)	75
11	Magnesium as Mg	mg/l	28	21	APHA 23 rd EDN -3500 Mg B	30
12	Chloride as Cl	mg/l	158	316	IS :3025 Part 32-1988(Reaff: 2019)	250
13	Sulphate as SO ₄	mg/l	115	33	APHA 23 rd EDN -4500-SO ₄ ²⁻ E	200
14	Nitrate as NO ₃	mg/l	6	2	APHA 23 rd EDN -4500- NO ₃ B	45
15	Iron as Fe	mg/l	0.06	BDL (<0.05)	IS 3025(part 53)1987(Reaff: 2019)	1
16	Manganese as Mn	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B	0.10
17	Fluoride as F	mg/l	0.22	0.41	APHA 23 rd EDN -4500-F B&D	1.00

Contd...

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadural
A. Robson Chinnadural
Technical Manager

Verified by

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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{An ISO 9001:2015, ISO 14001:2015, ISO 45001:2018 & ISO 22000:2018 Certified Company}

Accredited by NABL vide TC-5770, NABET / QCI, Recognised by MoEF&CC, BIS, APEDA, IOEPC, Tea Board India

ISSUED TO:- The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manvalakurichi, Kanyakumari District.

TEST REPORT

Report no	: ABCTL/IREL/EIA/2022/12/GW3-GW4
Sample description	: Ground Water-GW3- Midalam Sample, Karungal Midalam Road, 115 m from Govt.High School Udayamarthandam N- 08°12'16.76" E- 77°12'56.31", GW4- Alanji Sample 30 m from St. Francis Xavier Church-N- 08°11'51.90" E- 77°13'58.48"
Date of report	: 28-12-2022

Page 2 of 2

S. No.	Parameter	Unit	Results		Test procedure	Acceptable limit as per IS 10500 : 2012
			GW3	GW4		
18	Sodium as Na	mg/l	108	170	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified
19	Potassium as K	mg/l	2.4	3	IS : 3025 Part 45 -1993 (Reaff:2019)	Not Specified
20	Barium as Ba	mg/l	BDL(<0.1)	BDL(<0.1)	APHA 23 rd EDN -3111 D	0.7
21	Residual Free Chlorine	mg/l	BDL(<0.1)	BDL(<0.1)	APHA 23 rd EDN -4500-Cl B	0.20
22	Aluminium as Al	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN 3500 Al B	0.03
23	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	APHA 23 rd EDN -3111 B	0.003
24	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
25	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B	0.05
26	Zinc as Zn	mg/l	0.10	0.14	APHA 23 rd EDN -3111 B	5.00
27	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B	0.05
28	Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
29	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -4500-CN E	0.05
30	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
31	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	IS APHA 23 rd EDN -3112 B	0.001
32	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	APHA 23 rd EDN 5540 C	0.20
33	Phenolic Compounds as Phenol	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN 5530 B,C	0.001
34	Pesticides	mg/l	Absent	Absent	APHA 23 rd EDN -6630 B, C	Absent
35	Total Coliforms	MPN/100ml	<2	4	IS-1622-1981 (Reaff -2019)	Absent /100ml
36	E.coli	MPN/100ml	<2	<2	IS-1622-1981 (Reaff-2019)	Absent /100ml

BDL- Below Detection Limit

...End of report...

S.Dharani
Quality Manager

Verified by



A. Robson Chinnadurai
Technical Manager

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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(An ISO : 9001, ISO : 14001, ISO : 45001 & ISO : 22000 Certified Company)

Accredited by NABL vide TC-5770, NABET / QCI, Recognized by MoEF&CC, BIS, APEDA, IDPEPC, Tea Board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/GW5-GW6
Sample drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622 -1981
Sample description	: Ground Water, GW5- Helen Nagar Sample 10 m from St. Francis Xavier Church Enayam Helen Nagar, N- 08°12'53.02" E-77°11'51.34", GW6 - Simon Colony Sample, Kodimunai-Vaniyakudi Road 115 m from St. Jude Church, N- 08°10'35.07" E- 77°14'44.88"
Project Name	: Mining of Atomic Minerals at Keethimilalam -A, Midalam -B, Enayanputhenthurai, Ezhudasam -AB & Cand Kallencode A & B Villages of Killiyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 13-12-2022
Report date	: 28-12-2022 Page 1 of 2

S. No.	Parameter	Unit	Results		Test procedure	Acceptable limit as per IS 10500 : 2012
			GW5	GW6		
1	Colour	Hazen	<1	<1	IS 3025(part 4)1983(RA 2017)	5
2	Odour	-	No Odour Observed	No Odour Observed	IS 3025(part 8)1984(RA 2017)	Agreeable
3	Turbidity	NTU	0.5	BDL(<0.5)	IS:3025 Part 10-1984(Reaff: 2017)	1
4	pH at 25 °C	-	7.46	6.97	IS :3025 Part 11-1983(Reaff: 2017)	6.5-8.5
5	Conductivity at 25 °C	µS/cm	315	1440	IS:3025 Part 14- 1984 (Reaff:2017)	Not Specified
6	Total dissolved solids	mg/l	166	844	IS :3025 Part 16-1984(Reaff: 2017)	500
7	Total Suspended solids	mg/l	<2	<2	IS :3025 Part 17-1984(Reaff: 2017)	Not Specified
8	Total Alkalinity as CaCO ₃	mg/l	109	151	IS : 3025 Part 23-1986(Reaff: 2019)	200
9	Total Hardness as CaCO ₃	mg/l	79.5	310	IS : 3025 Part 21-2009	200
10	Calcium as Ca	mg/l	20	78	IS:3025 Part 40-1991(Reaff: 2019)	75
11	Magnesium as Mg	mg/l	7	28	APHA 23 rd EDN -3500 Mg B	30
12	Chloride as Cl	mg/l	21	342	IS :3025 Part 32-1988(Reaff: 2019)	250
13	Sulphate as SO ₄	mg/l	10	88	APHA 23 rd EDN -4500-SO ₄ ²⁻ E	200
14	Nitrate as NO ₃	mg/l	1	4	APHA 23 rd EDN -4500-NO ₃ ⁻ B	45
15	Iron as Fe	mg/l	BDL(<0.05)	0.05	IS 3025(part 53)1987(Reaff: 2019)	1
16	Manganese as Mn	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B	0.10
17	Fluoride as F	mg/l	0.18	0.37	APHA 23 rd EDN -4500-F B&D	1.00

Contd...

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadural
A. Robson Chinnadural
Technical Manager

Verified by

Authorized Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report no	: ABCTL/IREL/EIA/2022/12/GW5-GW6
Sample description	: Ground Water, GW5- Helen Nagar Sample 10 m from St. Francis Xavier Church Kaayam Helen Nagar, N- 08°12'53.02" E- 77°11'51.34", GW6 - Simon Colony Sample, Kodimunai-Vaniyakudi Road 115 m from St. Judes Church, N- 08°10'35.07" E- 77°14'44.88"
Date of report	: 28-12-2022 Page 2 of 2

S. No.	Parameter	Unit	Results		Test procedure	Acceptable limit as per IS 10500 : 2012
			GW5	GW6		
18	Sodium as Na	mg/l	30	202	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified
19	Potassium as K	mg/l	2.1	4.2	IS : 3025 Part 45 -1993 (Reaff:2019)	Not Specified
20	Barium as Ba	mg/l	BDL(<0.1)	BDL(<0.1)	APHA 23 rd EDN -3111 D	0.7
21	Residual Free Chlorine	mg/l	BDL(<0.1)	BDL(<0.1)	APHA 23 rd EDN -4500-Cl B	0.20
22	Aluminium as Al	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN 3500 Al B	0.03
23	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	APHA 23 rd EDN -3111 B	0.003
24	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
25	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B	0.05
26	Zinc as Zn	mg/l	0.02	0.10	APHA 23 rd EDN -3111 B	5.00
27	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B	0.05
28	Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
29	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -4500-CN E	0.05
30	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
31	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	IS APHA 23 rd EDN -3112 B	0.001
32	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	APHA 23 rd EDN 5540 C	0.20
33	Phenolic Compounds as Phenol	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN 5530 B,C	0.001
34	Pesticides	mg/l	Absent	Absent	APHA 23 rd EDN -6630 B, C	Absent
35	Total Coliforms	MPN/100ml	<2	<2	IS-1622-1981 (Reaff-2019)	Absent /100ml
36	E.coli	MPN/100ml	<2	<2	IS-1622-1981 (Reaff-2019)	Absent /100ml

BDL- Below Detection Limit

...End of report...

S. Dharani
Quality Manager



A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



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Accredited by NABL vide TC-5770, NABET / QCI, Recognised by MoEF&CC, BIS, APEEDA, IOI/EPIC, Fed. Bd of India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy,
Monavalakurichi, Kanniyakumari District.

TEST REPORT

Report Number	: ABCTL/IREL/EIA/2022/12/GW7- GW8
Sample drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622 -1981
Sample description	: Ground Water -GW7- Paloor Vattakkottai, 15 m from Paloor Vattakkottai Bus Stand N- 08°14'54.50" E- 77°13'36.94" GW8-Rethapuram Sample, Municipality Office Rethapuram Karungal Road, N- 06°11'44.45" E- 77°15'04.46"
Project Name	: Mining of Atomic Minerals at Keezhmidalam -A, Midalam -B, Enayamputhenthurai, Ezhudesam -A,B & C and Kollencode A & B Villages of Rullyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 13-12-2022
Report date	: 28-12-2022

Page 1 of 2

S. No.	Parameter	Unit	Results		Test procedure	Acceptable limit as per IS 10500 : 2012
			GW7	GW8		
1	Colour	Hazen	1	<1	IS:3025(part 4)1983(RA 2017)	5
2	Odour	-	No Odour Observed	No Odour Observed	IS:3025(part 8)1984(RA 2017)	Agreeable
3	Turbidity	NTU	BDL(<0.01)	BDL(<0.01)	IS:3025 Part 10-1984(Reaff: 2017)	1
4	pH at 25 °C	-	7.97	7.69	IS:3025 Part 11-1983(Reaff: 2017)	6.5-8.5
5	Conductivity at 25 °C	µS/cm	1026	1190	IS:3025 Part 14- 1984 (Reaff:2017)	Not Specified
6	Total dissolved solids	mg/l	594	672	IS:3025 Part 16-1984(Reaff: 2017)	500
7	Total Suspended solids	mg/l	<2	<2	IS:3025 Part 17-1984(Reaff: 2017)	Not Specified
8	Total Alkalinity as CaCO ₃	mg/l	162	172	IS: 3025 Part 23-1986(Reaff: 2019)	200
9	Total Hardness as CaCO ₃	mg/l	350	380	IS: 3025 Part 21-2009	200
10	Calcium as Ca	mg/l	83	90	IS:3025 Part 40-1991(Reaff: 2019)	75
11	Magnesium as Mg	mg/l	35	37.6	APHA 23 rd EDN -3500 Mg B	30
12	Chloride as Cl ⁻	mg/l	158	195	IS:3025 Part 32-1988(Reaff: 2019)	250
13	Sulphate as SO ₄ ²⁻	mg/l	129	124	APHA 23 rd EDN -4500-SO ₄ ²⁻ E	200
14	Nitrate as NO ₃ ⁻	mg/l	11	7	APHA 23 rd EDN -4500- NO ₃ ⁻ B	45
15	Iron as Fe	mg/l	BDL(<0.05)	BDL(<0.05)	IS 3025(part 53)1987(Reaff: 2019)	1
16	Manganese as Mn	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B	0.10
17	Fluoride as F	mg/l	0.12	0.22	APHA 23 rd EDN -4500-F B&D	1.00

Contd....

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report Number	: ABCTL/IREL/EIA/2022/12/GW7-GW8
Sample description	: Ground Water -GW7-Paloor Vattakkottai, 15 m from Paloor Vattakkottai Bus Stand N- 08°14'54.50" E- 77°13'36.94" GW8-Rethapuram Sample, Municipality Office Rethapuram Karungal Road, N- 08°11'44.45" E- 77°15'04.46"
Date of report	: 28-12-2022

Page 2 of 2

S. No.	Parameter	Unit	Results		Test procedure	Acceptable limit as per IS 10500 : 2012
			GW7	GW8		
18	Sodium as Na	mg/l	90	108	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified
19	Potassium as K	mg/l	1.7	2.6	IS : 3025 Part 45 -1993 (Reaff:2019)	Not Specified
20	Barium as Ba	mg/l	BDL(<0.1)	BDL(<0.1)	APHA 23 rd EDN -3111 D	0.7
21	Residual Free Chlorine	mg/l	BDL(<0.1)	BDL(<0.1)	APHA 23 rd EDN -4500-Cl B	0.20
22	Aluminium as Al	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN 3500 Al B	0.03
23	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	APHA 23 rd EDN -3111 B	0.003
24	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
25	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B	0.05
26	Zinc as Zn	mg/l	0.03	0.05	APHA 23 rd EDN -3111 B	5.00
27	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B	0.05
28	Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
29	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -4500-CN E	0.05
30	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
31	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	IS APHA 23 rd EDN -3112 B	0.001
32	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	APHA 23 rd EDN 5540 C	0.20
33	Phenolic Compounds as Phenol	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN 5530 B,C	0.001
34	Pesticides	mg/l	Absent	Absent	APHA 23 rd EDN -6630 B, C	Absent
35	Total Coliforms	MPN/100ml	<2	<2	IS-1622-1981 (Reaff -2019)	Absent /100ml
36	E.coli	MPN/100ml	<2	<2	IS-1622-1981 (Reaff-2019)	Absent /100ml

BDL- Below Detection Limit

....End of report....

S. Dharani
Quality Manager



A. Robson Chinnadurai
Technical Manager

Verified by

Authorized Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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(An ISO - 9001, ISO - 14001, ISO - 45001 & ISO - 22000 Certified Company)

Accredited by NABL vide TC-3770, NABET / GCI, Recognised by MoEF&CC, BIS- ARED, IGPFC, Tea Board India

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

TEST REPORT

Report number	: ABCTI/IREL/EIA/2022/12/GW9- GW10
Sample drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622 - 1981
Sample description	: Ground Water -GW9-Kollencode Sample, 300m from St. George Shrine, Parha Uchakkada - Kanniyakumari West Coast Road, N- 08°17'03.38" E- 77°07'31.94" GW10- Chemmanvillal Sample, 70 m from St. Judes Polytechnic College, Chemmanvillal, Arudesam, N- 08°18'09.32" E- 77°09'55.44"
Project Name	: Mining of Atomic Minerals at Keezhmidalam -A, Midalam -B, Enayamputhenthurai, Ezhudesam -A, B & C and Kollencode A & B Villages of Killiyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 13-12-2022
Report date	: 28-12-2022

Page 1 of 2

S. No.	Parameter	Unit	Results		Test procedure	Acceptable limit as per IS 10500 : 2012
			GW9	GW10		
1	Colour	Hazen	<1	<1	IS 3025(part 4)1983(RA 2017)	5
2	Odour	-	No Odour Observed	No Odour Observed	IS 3025(part 8)1984(RA 2017)	Agreeable
3	Turbidity	NTU	BDL(<0.01)	BDL(<0.01)	IS:3025 Part 10-1984(Reaff: 2017)	1
4	pH at 25 °C	-	6.73	6.89	IS :3025 Part 11-1983(Reaff: 2017)	6.5-8.5
5	Conductivity at 25 °C	µS/cm	382	858	IS :3025 Part 14- 1984 (Reaff:2017)	Not Specified
6	Total dissolved solids	mg/l	218	486	IS :3025 Part 16-1984(Reaff: 2017)	500
7	Total Suspended solids	mg/l	<2	<2	IS :3025 Part 17-1984(Reaff: 2017)	Not Specified
8	Total Alkalinity as CaCO ₃	mg/l	63	101	IS : 3025 Part 23-1986(Reaff: 2019)	200
9	Total Hardness as CaCO ₃	mg/l	66	155	IS : 3025 Part 21-2009	200
10	Calcium as Ca	mg/l	21	38	IS :3025 Part 40-1991(Reaff: 2019)	75
11	Magnesium as Mg	mg/l	4	14	APHA 23 rd EDN -3500 Mg B	30
12	Chloride as Cl ⁻	mg/l	77	193	IS :3025 Part 32-1988(Reaff: 2019)	250
13	Sulphate as SO ₄	mg/l	23	42	APHA 23 rd EDN -4500-SO ₄ ²⁻ E	200
14	Nitrate as NO ₃	mg/l	1	7	APHA 23 rd EDN -4500- NO ₃ ⁻ B	45
15	Iron as Fe	mg/l	BDL(<0.05)	BDL(<0.05)	IS 3025(part 53)1987(Reaff: 2019)	1
16	Manganese as Mn	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3111 B	0.10
17	Fluoride as F	mg/l	0.17	0.27	APHA 23 rd EDN -4500-F B&D	1.00

Contd....

S. Dharani
Quality Manager



A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report no	: ABCTL/IREL/EIA/2022/12/GW9-GW10
Sample description	: Ground Water -GW9-Kollencode Sample, 300m from St. George Shrine, Pazha Ichaikkada - Kanyakumari West Coast Road, N- 08°17'03.38" E- 77°07'31.94" GW10- Chemmanvillal Sample, 70 m from St. Judes Polytechnic College, Chemmanvillal, Arudesam, N- 08°18'09.32" E- 77°09'55.44"
Date of report	: 28-12-2022 Page 2 of 2

S. No.	Parameter	Unit	Results		Test procedure	Acceptable limit as per IS 10500 : 2012
			GW9	GW10		
18	Sodium as Na	mg/l	54	130	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified
19	Potassium as K	mg/l	1.1	2.2	IS : 3025 Part 45-1993 (Reaff:2019)	Not Specified
20	Barium as Ba	mg/l	BDL(<0.1)	BDL(<0.1)	APHA 23 rd EDN -3111 D	0.7
21	Residual Free Chlorine	mg/l	BDL(<0.1)	BDL(<0.1)	APHA 23 rd EDN -4500-CI B	0.20
22	Aluminium as Al	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN 3500 AI B	0.03
23	Cadmium as Cd	mg/l	BDL(<0.003)	BDL(<0.003)	APHA 23 rd EDN -3111 B	0.003
24	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
25	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B	0.05
26	Zinc as Zn	mg/l	0.03	0.07	APHA 23 rd EDN -3111 B	5.00
27	Total Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	APHA 23 rd EDN -3111 B	0.05
28	Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
29	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	APHA 23 rd EDN -4500-CN E	0.05
30	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	APHA 23 rd EDN -3113 B	0.01
31	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	IS APHA 23 rd EDN -3112 B	0.001
32	Anionic Surfactants as MBAS	mg/l	BDL(<0.025)	BDL(<0.025)	APHA 23 rd EDN 5540 C	0.20
33	Phenolic Compounds as Phenol	mg/l	BDL(<0.001)	BDL(<0.001)	APHA 23 rd EDN 5530 B,C	0.001
34	Pesticides	mg/l	Absent	Absent	APHA 23 rd EDN -6630 B,C	Absent
35	Total Coliforms	MPN/100ml	<2	<2	IS-1622-1981 (Reaff-2019)	-
36	E.coli	MPN/100ml	<2	<2	IS-1622-1981 (Reaff-2019)	-

BDL- Below Detection Limit

...End of report...

S. Dharami
S. Dharami
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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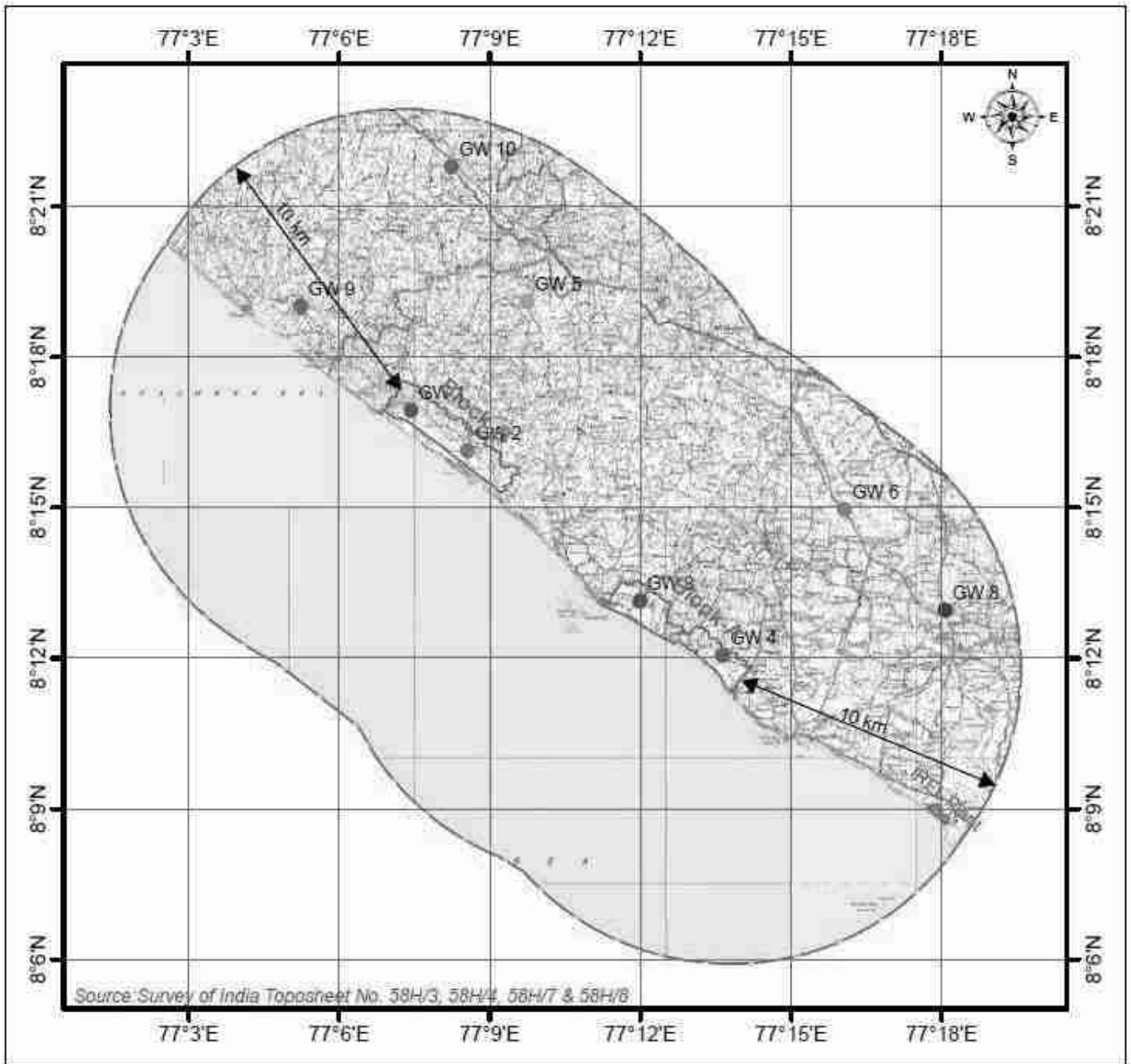


Figure 3.22 Sampling Locations

Table 3.21 Results of groundwater analysis

Sl. No.	Parameters	Permissible Limits		GW1	GW2	GW3	GW4	GW5
		** Acceptable limits	*** Permissible limits					
1.	Colour, Hazen units, Max	5	25	<1	<1	<1	<1	<1
2.	Odour	Agreeable	Agreeable	No odour	No odour	No odour	No odour observed	No odour observed
3.	pH Value	6.5 to 8.5	No Relaxation	7.31	6.58	7.88	7.18	7.46
4.	Turbidity, NTU, Max	1	5	<0.5	<0.5	0.6	<0.5	0.5
5.	Total dissolved solids, mg/l	500	2000	633	482	619	705	166
6.	Aluminium (as Al), mg/l	0.03	0.2	<0.03	<0.03	<0.03	<0.03	<0.03
7.	Calcium (as Ca), mg/l, max.	75	200	118	21	105	65	20
8.	Chloride (as Cl), mg/l, max.	250	1000	107	209	158	316	21
9.	Copper (as Cu), mg/l, max.	0.05	1.5	<0.03	<0.03	<0.03	<0.03	<0.03
10.	Fluoride (as F), mg/l, max.	1.0	1.5	0.26	0.29	0.22	0.41	0.18
11.	Iron (as Fe), mg/l, max.	0.3	No Relaxation	<0.05	<0.05	0.06	<0.05	<0.05
12.	Magnesium (as Mg), mg/l, max.	30	100	27	7	28	21	7
13.	Manganese (as Mn), mg/l, max.	0.1	0.3	<0.01	<0.01	<0.01	<0.01	<0.01
14.	Nitrate (as NO ₃), mg/l, max.	45	No Relaxation	11	7	6	2	1
15.	Phenolic compounds (as C ₆ H ₅ OH), mg/l, max.	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
16.	Sulphate (as SO ₄), mg/l, max.	200	400	60	15	115	33	10



Sl. No.	Parameters	Permissible Limits		GW1	GW2	GW3	GW4	GW5
		** Acceptable limits	*** Permissible limits					
17.	Total alkalinity (as CaCO ₃), mg/l	200	600	353	92	162	141	109
18.	Total hardness (as CaCO ₃), mg/l, max	200	600	405	82	307	252	79.5
19.	Zinc (as Zn), mg/l, max.	5	15	0.08	0.05	0.10	0.14	0.02
20.	Cadmium (as Cd), mg/l, max.	0.003	No relaxation	<0.003	<0.003	<0.003	<0.003	<0.003
21.	Cyanide (as CN), mg/l, max.	0.05	No relaxation	<0.02	<0.02	<0.02	<0.02	<0.02
22.	Lead (as Pb), mg/l, max.	0.01	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
23.	Mercury, (as Hg), mg/l, max.	0.001	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001
24.	Total arsenic (as As), mg/l, max.	0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01
25.	Total chromium (as Cr), mg/l, Max.	0.05	No relaxation	<0.03	<0.03	<0.03	<0.03	<0.03

* Drinking Water Specification IS: 10500 (2012); ** Requirement (Acceptable limit); *** Permissible limits in the absence of alternate source

Sl. No.	Parameter	Permissible limits *		GW6	GW7	GW8	GW9	GW10
		** Acceptable limits	*** Permissible limits					
				<1	1	<1	<1	<1
1.	Colour, Hazen units, Max	5	25	No odour observed	No odour observed	No odour observed	No odour observed	No odour observed
2.	Odour	Agreeable	Agreeable	Agreeable				
3.	pH Value	6.5 to 8.5	No Relaxation	6.97	7.97	7.69	6.73	6.89
4.	Turbidity, NTU, Max	1	5	<0.5	<0.01	<0.01	<0.01	<0.01
5.	Total dissolved	500	2000	844	594	672	218	486



Sl. No	Parameter	Permissible limits *		GW6	GW7	GW8	GW9	GW10
		** Acceptable limits	*** Permissible limits					
	solids, mg/l			<1	1	<1	<1	<1
6.	Aluminium (as Al), mg/l	0.03	0.2	<0.03	<0.03	<0.03	<0.03	<0.03
7.	Calcium (as Ca), mg/l, max.	75	200	78	83	90	21	38
8.	Chloride (as Cl), mg/l, max.	250	1000	342	158	195	77	193
9.	Copper (as Cu), mg/l, max.	0.05	1.5	<0.03	<0.03	<0.03	<0.03	<0.03
10.	Fluoride (as F), mg/l, max.	1.0	1.5	0.37	0.12	0.22	0.17	0.27
11.	Iron (as Fe), mg/l, max.	0.3	No Relaxation	0.05	<0.05	<0.05	<0.05	<0.05
12.	Magnesium (as Mg), mg/l, max.	30	100	28	35	37.6	4	14
13.	Manganese (as Mn), mg/l, max.	0.1	0.3	<0.01	<0.01	<0.01	<0.01	<0.01
14.	Nitrate (as NO ₃), mg/l, max.	45	No Relaxation	4	11	7	1	7
15.	Phenolic compounds (as C ₆ H ₅ OH), mg/l, max.	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
16.	Sulphate (as SO ₄), mg/l, max.	200	400	88	129	124	23	42
17.	Total alkalinity (as CaCO ₃), mg/l	200	600	151	162	172	63	101
18.	Total hardness (as CaCO ₃), mg/l, max	200	600	310	350	380	66	155



Sl. No.	Parameter	Permissible limits *		GW6	GW7	GW8	GW9	GW10
		** Acceptable limits	*** Permissible limits					
19.	Zinc (as Zn), mg/l, max.	5	15	<1	1	<1	<1	<1
20.	Cadmium (as Cd), mg/l, max.	0.003	No relaxation	<0.02	<0.02	<0.02	<0.02	<0.02
21.	Cyanide (as CN), mg/l, max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
22.	Lead (as Pb), mg/l, max.	0.01	No relaxation	<0.001	<0.001	<0.001	<0.001	<0.001
23.	Mercury, (as Hg), mg/l, max.	0.001	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
24.	Total arsenic (as As), mg/l, max.	0.01	0.05	<0.03	<0.03	<0.03	<0.03	<0.03
25.	Total chromium (as Cr), mg/l, Max.	0.05	No relaxation	<0.03	<0.03	<0.03	<0.03	<0.03

3.10.5 Soil Environment

To assess the quality of soil within the study area, soil samples were collected from ten locations. Table 3.23 shows the details of soil sampling locations.

Table 3.22 List of soil sampling locations

Sample No.	Location	Coordinates	
S1	Ezhudesam 1	08°16'02.28" N	77°08'35.98" E
S2	Ezhudesam 2	08°15'54.53" N	77°09'40.85" E
S3	Midalam	08°12'16.76" N	77°12'56.31" E
S4	Alanji	08°11'51.90" N	77°13'58.48" E
S5	Helen Nagar	08°12'53.02" N	77°11'51.34" E
S6	Simon Colony	08°10'35.07" N	77°14'44.88" E
S7	Paloor Vattakkottai	08°14'54.50" N	77°13'36.94" E
S8	Rethapuram	08°11'44.45" N	77°15'04.46" E
S9	Kollencode	08°17'03.38" N	77°07'31.94" E
S10	Chemmanvillai	08°18'09.32" N	77°09'55.44" E

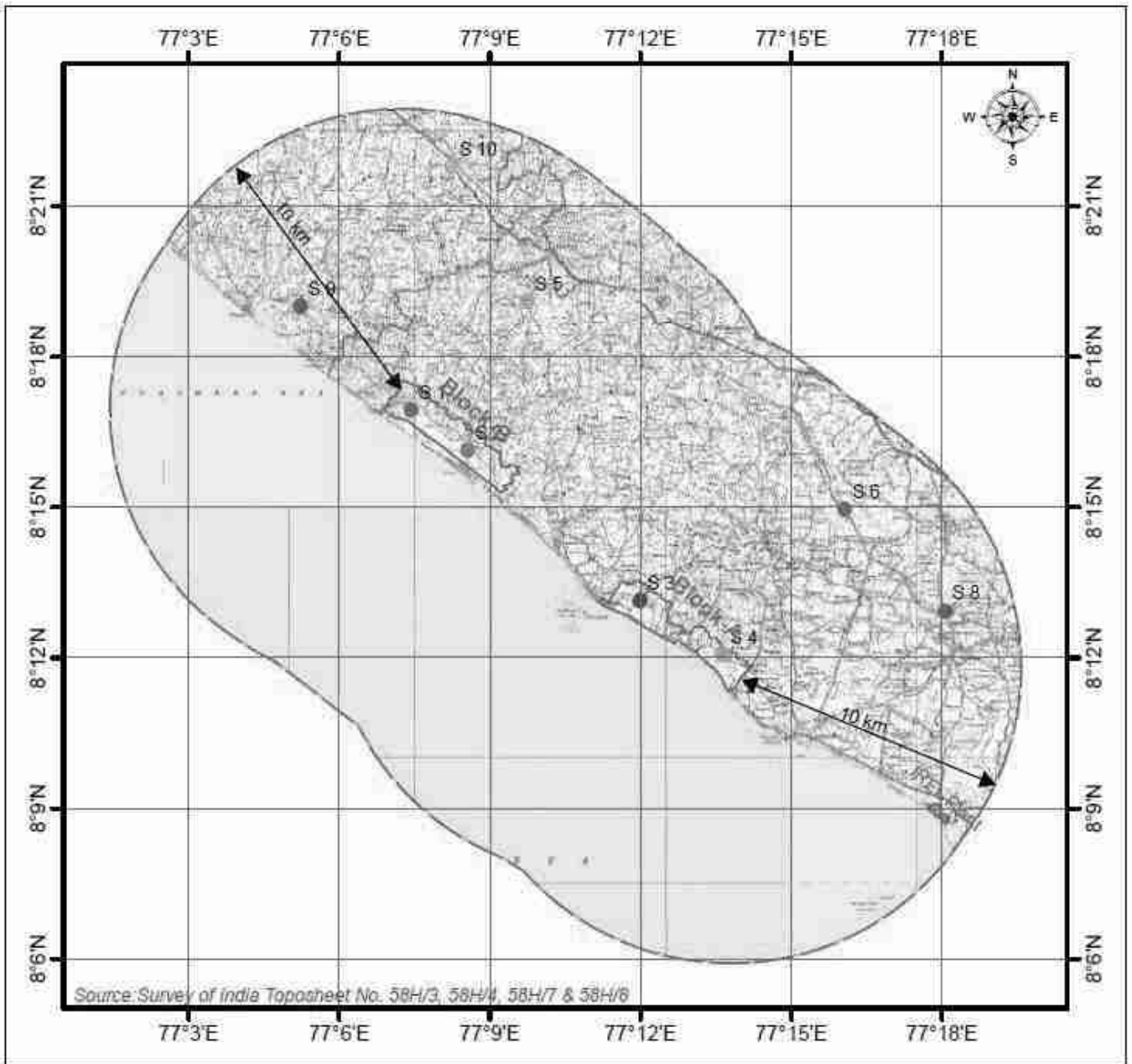


Figure 3.23 Sampling Locations

The analyzed results are given in Table 3.24, 3.25, 3.26.



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SOIL/S1-510
Sample collected by	: ABC Techno Labs India Private Limited
Sample description	: Soil Analysis
Project Name	: Mining of Atomic Minerals at Keeshmidaiam -A, Midalam -B, Enyamputhenthurai, Ezhudesam -A & C and Kollencode A & B Villages of Killiyoor Taluk in Kanyakumari district, Tamil Nadu
Date of sampling	: 02-12-2022 TO 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 14-12-2022
Report date	: 28-12-2022
Location of Sampling	: S1- Ezhudesam Sample 1, 50 m from St.Judes College, S2- Ezhudesam Sample 2, 30 m from Nedumpuram Sree Muthumarjammian Temple, S3- Midalam Sample, Karungal Midalam Road, 115 m from Govt.High School Udayamarthandam

Page 1 of 6

S.No.	Parameters	Test Methods	S1	S2	S3
1	pH	IS -2720 (Part 26) 1987 (RA 2021)	6.70	6.97	7.67
2	Bulk Density, g/cc	FAO Chapter 3, ABCTL/SOIL/SOP 1	1.39	1.41	1.52
3	Electrical Conductivity, mS/cm	IS -14767:2000 (RA 2021)	0.153	0.194	0.265
4	Total Nitrogen, kg/ha	IS -14684:1999, Reaff:2019	114	132	96
5	Available Phosphorous, kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 2	39.7	18.2	23.3
6	Available Potassium, kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 7	302	348	274
7	Exchangeable Calcium as Ca, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 4	15.6	16.4	12.7
8	Exchangeable Magnesium as Mg, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 5	4.11	5.32	3.98
9	Exchangeable Sodium as Na, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 6	1.07	1.24	1.37
10	Organic matter (%)	IS 2720 (Part 22):1972, Reaff:2020	1.58	1.24	0.87
15	Copper as Cu, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
16	Zinc as Zn, mg/kg	EPA 3050 B & 7000 B	14.1	18.6	10.7
17	Manganese as Mn, mg/kg	EPA 3050 B & 7000 B	23.7	32.2	17
18	Nickel as Ni, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
19	Iron as Fe, mg/kg	EPA 3050 B & 7000 B	248	332	187
20	Lead as Pb, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
21	Cadmium as Cd, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
22	Antimony as Sb, mg/kg	EPA 3050 B & 6020B	BDL(<2)	BDL(<2)	BDL(<2)
23	Arsenic as As, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
24	Barium as Ba, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
25	Molybdenum as Mo, mg/kg	EPA 3050 B & 7000 B	BDL(<5)	BDL(<5)	BDL(<5)
26	Mercury as Hg, mg/kg	EPA 3050 B & 6020B	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)
27	Boron as B, mg/kg	ABCTL/SOP/S/13	2.36	1.74	1.52

S.Dharani
Quality Manager



Contd...
A. Robson Chinnadurai
Technical Manager

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TEST REPORT

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

Report number	: ABCTL/IREL/EIA/2022/12/SOIL/S1-S10
Sample collected by	: ABC Techno Labs India Private Limited
Sample description	: Soil Analysis
Project Name	: Mining of Atomic Minerals at Keezhmidalam - A, Midalam - B, Enayamputhenthurai, Ezhudesam - A & C and Kollencode A & B Villages of Killyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 02-12-2022 TO 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 14-12-2022
Report date	: 28-12-2022
Location of Sampling	: S1- Ezhudesam Sample 1, 50 m from St.Judes College, S2- Ezhudesam Sample 2, 30 m from Nedumpuram Sree Muthumariamman Temple, S3- Midalam Sample, Karungal Midalam Road, 115 m from Govt.High School Udayamarthandam

Page 2 of 6

S. No.	Parameters	Test Methods	S1	S2	S3
28	Chromium as Cr3+, mg/kg	By Calculation	BDL(<2)	BDL(<2)	BDL(<2)
29	Chromium as Cr6+, mg/kg	EPA 7196 A	BDL(<2)	BDL(<2)	BDL(<2)
30	Cobalt as Co, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
31	Texture Classification		Sandy Loam	Sandy Loam	Loamy Sand
32	Sand (%)	Robinson Pipette Method	71.5	66.5	81.3
33	Clay (%)		5.5	10.3	1.6
34	Silt (%)		23	23.2	17.1

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Quality Manager



A. Robson Chinnadural
Technical Manager

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ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

TEST REPORT

Report number	: ABCTL/IREL/EIA/2022/12/SOIL/S1-S10
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Sample description	: Soil Analysis
Project Name	: Mining of Atomic Minerals at Keezhimidalam -A, Midalam -B, Enayampurtheithurai, Echhadesam -A,B & C and Kollencode A & B Villages of Kiliyoor Taluk in Kanniyakumari district, Tamil Nadu
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Date of Receipt	: 13-12-2022
Date of Analysis	: 14-12-2022
Report date	: 28-12-2022
Location of Sampling	: S4- Alanji Sample 30 m from St. Francis Xavier Church, S5- Helen Nagar Sample 10 m from St. Francis Xavier Church, Enayam Helen Nagar, S6- Simon Colony Sample, Kodtmunal-Vaniyakudi Road 115 m from St. Jades Church,

Page 3 of 6

S.No.	Parameters	Test Methods	S4	S5	S6
1	pH	IS -2720(Part 26) 1987(RA 2021)	6.36	7.37	7.65
2	Bulk Density, g/cc	FAO Chapter 3, ABCTL/SOIL/SOP 1	1.39	1.54	1.47
3	Electrical Conductivity, mS/cm	IS -14767:2000 (RA 2021)	0.078	0.306	0.209
4	Total Nitrogen, kg/ha	IS -14684:1999, Reaff:2019	118	82	110
5	Available Phosphorous, kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 2	35.6	22.9	27.1
6	Available Potassium, kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 7	334	282	294
7	Exchangeable Calcium as Ca, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 4	15.7	13.6	14
8	Exchangeable Magnesium as Mg, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 5	5.31	4.59	4.36
9	Exchangeable Sodium as Na, m.eq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 6	0.96	1.17	1.30
10	Organic matter (%)	IS 2720 (Part 22):1972, Reaff:2020	1.09	1.14	0.85
15	Copper as Cu, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
16	Zinc as Zn, mg/kg	EPA 3050 B & 7000 B	21.3	13.6	14.2
17	Manganese as Mn, mg/kg	EPA 3050 B & 7000 B	42	19.6	23.7
18	Nickel as Ni, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
19	Iron as Fe, mg/kg	EPA 3050 B & 7000 B	536	287	335
20	Lead as Pb, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
21	Cadmium as Cd, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
22	Antimony as Sb, mg/kg	EPA 3050 B & 6020B	BDL(<2)	BDL(<2)	BDL(<2)
23	Arsenic as As, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
24	Barium as Ba, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
25	Molybdenum as Mo, mg/kg	EPA 3050 B & 7000 B	BDL(<5)	BDL(<5)	BDL(<5)
26	EPA 3050 B & 6020B	EPA 7471 A	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)
27	Boron as B, mg/kg	ABCTL/SOP/S/13	2.54	2.05	1.88

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TEST REPORT

ISSUED TO: The General Manager and Head
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 Department of Atomic Energy
 Manavalakurichi, Kanniyakumari District.

Report number	: ABCTL/IREL/EIA/2022/12/soil/S1-S10
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Page 4 of 6

S. No.	Parameters	Test Methods	S4	S5	S6
28	Chromium as Cr ³⁺ , mg/kg	By Calculation	BDL(<2)	BDL(<2)	BDL(<2)
29	Chromium as Cr ⁶⁺ , mg/kg	EPA 7196 A	BDL(<2)	BDL(<2)	BDL(<2)
30	Cobalt as Co, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)
31	Texture Classification		Sandy Loam	Loamy Sand	Loamy Sand
32	Sand (%)	Robinson Pipette Method	69.7	83.6	81.7
33	Clay (%)		10.8	4.7	3.6
34	Silt (%)		19.5	11.7	14.7

Contd....

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 Quality Manager



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A. Robson Chinnadurai
 Technical Manager

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Date of sampling	: 02-12-2022 TO 12-12-2022
Date of Receipt	: 13-12-2022
Date of Analysis	: 14-12-2022
Report date	: 29-12-2022
Location of Sampling	: S7- Paloor Vattakkottai, 15 m from Paloor Vattakkottai Bus Stand, S8- Rethapuram Sample, Municipality Office Rethapuram Karungal Road, S9- Kollencode Sample, 300m from St. George Shrine, Pazha Uchakkadu -Kanyakumari West Coast Road, S10- Chemmanvillai Sample, 70 m from St. Judes Polytechnic College, Chemmanvillai, Arudesam.

Page 5 of 6

S.No	Parameters	Test Methods	S7	S8	S9	S10
1	pH	IS -2720(Part 26) 1987(RA 2021)	7.77	7.36	6.81	7.60
2	Bulk Density, g/cc	FAO Chapter 3, ABCTL/SOIL/SOP 1	1.45	1.48	1.29	1.17
3	Electrical Conductivity, mS/cm	IS -14767-2000 (RA 2021)	0.239	0.255	0.086	0.502
4	Total Nitrogen, kg/ha	IS -14684:1999, Reaff:2019	108	139	172	198
5	Available Phosphorous, kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 2	37.1	25.8	38.8	43.9
6	Available Potassium, kg/ha	FAO Chapter 3, ABCTL/SOIL/SOP 7	254	286	348	394
7	Exchangeable Calcium as Ca, meq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 4	13.3	13	18.7	21.6
8	Exchangeable Magnesium as Mg, meq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 5	5.02	4.78	5.96	6.74
9	Exchangeable Sodium as Na, meq/100g	FAO Chapter 3, ABCTL/SOIL/SOP 6	1.14	1.27	1.58	1.87
10	Organic matter (%)	IS 2720 (Part 22):1972, Reaff:2020	0.84	0.51	1.26	1.05
15	Copper as Cu, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
16	Zinc as Zn, mg/kg	EPA 3050 B & 7000 B	14.6	16.6	19.5	22.7
17	Manganese as Mn, mg/kg	EPA 3050 B & 7000 B	27.6	30.6	38.7	56.8
18	Nickel as Ni, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
19	Iron as Fe, mg/kg	EPA 3050 B & 7000 B	258	307	412	384
20	Lead as Pb, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
21	Cadmium as Cd, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
22	Antimony as Sb, mg/kg	EPA 3050 B & 6020B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
23	Arsenic as As, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
24	Barium as Ba, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
25	Molybdenum as Mo, mg/kg	EPA 3050 B & 7000 B	BDL(<5)	BDL(<5)	BDL(<5)	BDL(<5)
26	Mercury as Hg, mg/kg	EPA 3050 B & 6020B	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)
27	Boron as B, mg/kg	ABCTL/SOP/S/13	2.41	1.98	2.84	3.25

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TEST REPORT

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Date of Analysis	: 14-12-2022
Report date	: 20-12-2022
Location of Sampling	: S7- Paloor Vattakkottai, 15 m from Paloor Vattakkottai Bus Stand, S8- Rethapuram Sample, Municipality Office Rethapuram Karungal Road, S9- Kollencode Sample, 300m from St. George Shrine, Pazha Uchakkada -Kanyakumari West Coast Road, S10- Chemmanvillai Sample, 70 m from St. Judes Polytechnic College, Chemmanvillai, Arudesam,

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S. No.	Parameters	Test Methods	S7	S8	S9	S10
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29	Chromium as Cr6+, mg/kg	EPA 7196 A	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
30	Cobalt as Co, mg/kg	EPA 3050 B & 7000 B	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
31	Texture Classification	Robinson Pipette Method	Loamy Sand	Loamy Sand	Sandy Clay Loam	Clay
32	Sand (%)		80.7	85.6	51.1	26.8
33	Clay (%)		7.3	5.9	27.8	55.7
34	Silt (%)		12	8.5	21.1	17.5

BDL- Below Detection Limit

....End of report....

S. Dharami
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Quality Manager



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Table 3.23 Physical properties of soil

Sample No.	Texture	Bulk Density
S1	Sandy Loam	1.39
S2	Sandy Loam	1.41
S3	Loamy Sand	1.52
S4	Sandy Loam	1.39
S5	Loamy Sand	1.54
S6	Loamy Sand	1.47
S7	Loamy Sand	1.45
S8	Loamy Sand	1.48
S9	Sandy Clay Loam	1.29
S10	Clay	1.17

Table 3.24 Chemical properties of soil

Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
pH	6.70	6.97	7.67	6.36	7.37	7.65	7.77	7.36	6.81	7.60
Electrical Conductivity ($\mu\text{S/cm}$)	0.153	0.194	0.265	0.078	0.306	0.209	0.239	0.255	0.086	0.502

Table 3.25 Available NPK contents in soil

Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Available Nitrogen (Kg/ha) & Rating	114	132	96	118	82	110	108	139	172	198
Available Phosphorus (Kg/ha) and Rating	39.7	18.2	23.3	35.6	22.9	27.1	37.1	25.8	38.8	43.9
Organic matter (%)	1.58	1.24	0.87	1.09	1.14	0.85	0.84	0.51	1.26	1.05
Available Potassium (Kg/ha) and Rating	302	348	274	334	282	294	254	286	348	394

Rating based on:

Available Nitrogen	<280 - Low;	280- 560 Medium;	>560 - High
Organic carbon	<0.50 - Low;	0.5-0.75 Medium;	> 0.75 - High
Available Phosphorus	<10 - Low;	10 - 25 Medium;	>25 - High
Available Potassium	<120 - Low;	120 - 280 Medium;	>280 - High

Soil pH plays an important role in the availability of nutrients. Soil microbial activity is also dependent on pH. In the study area the soil pH is slightly basic and varied from 6.36 to 7.77.

Electrical conductivity (EC) of the soil is a measure of the concentration of soluble salts and ionic activity in the soil. In the collected soil samples, the conductivity ranged from 0.078 to 0.306 $\mu\text{s}/\text{cm}$.

Phosphorus and nitrogen are limiting nutrients, especially phosphorus. In the tested soil samples availability of phosphorus was observed to be in high concentration in all the samples except S2, S3 and S5. Potassium varied from medium to high ranges in the soil samples. Organic carbon content is found to vary from low to high ranges in the tested soil.

Table 3.26 Exchangeable cations

Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Calcium (meq/100gm)	15.6	16.4	12.7	15.7	13.6	14	13.3	13	18.7	21.6
Magnesium (meq/100gm)	4.11	5.32	3.98	5.31	4.59	4.36	5.02	4.78	5.96	6.74
Sodium (meq/100gm)	1.07	1.24	1.37	0.96	1.17	1.38	1.14	1.27	1.58	1.87

The above results show that among tested soil samples calcium constitute bulk of the exchangeable cations whereas proportion of exchangeable potassium is low as compared to others. Proportion of sodium and magnesium varies from low to medium.

Table 3.27 Available micro-nutrients in soil

Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Copper	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Zinc	14.1	18.6	10.7	21.3	13.6	14.2	14.6	16.6	19.5	22.7
Iron	248	332	187	536	287	335	258	307	412	384
Manganese	23.7	32.2	17	42	19.6	23.7	27.6	30.6	38.7	56.8

Soil micro-nutrients play an important role in plant growth and can act as limiting nutrients. Soil micro-nutrient analysis can be employed as a diagnostic tool for predicting the possibility of deficiency of a nutrient and the profitability of its application. For this, it is essential to fix the critical limits. The critical limit of micro-nutrient in a soil is that content of extractable nutrient at or below which plantation practiced on it will produce a positive response to its application. The critical limits of copper, zinc and iron are BDL<2, 10.7 – 22.7 mg/kg and 187 - 536 mg/kg, respectively.

3.10.6 Terrestrial Ecology

3.10.6.1 Introduction

An ecosystem is a dynamic complex of plant, animal, and microorganism communities and the non-living environment interacting as a functional unit in a given area. It involves the total nutrient and energy economics of the system as well as the organisms involved. Natural ecosystems are invariably richer in species and more stable than those of artificially developed, due to their many inter-dependencies and inter-relationships.

The plant and animal populations in an area from recognizable associations are called Natural communities. These are characterized by a few species called dominants. Natural communities have structure based on the life forms (e.g. grass) of the species



that make them up. The species composition refers to the kinds of species making up to the community. The variety of species and their relative numbers are referred to as species diversity. A community composed of few species is called simple or one of Low diversity. A community composed of many species is called complex or one of high diversity.

Ecosystems can generally be classified into two classes such as natural and artificial. Artificial ecosystems are natural regions affected by man's interferences. They are artificial lakes, reservoirs, townships, and cities. Natural ecosystems are basically classified into two major types. They are aquatic ecosystem and terrestrial ecosystem. Based on the physical setting and the kind of distribution of flora and fauna, the study area can be classified into crop, terrestrial and aquatic ecosystems.

Ecosystem shows complex inter-relationships between biotic and abiotic components leading to dependence, competition and mutualism. Biotic components comprise both plant and animal communities, interacting not only within and between themselves but also with the abiotic components of the environment. Generally, biological communities are good indicators of climatic and edaphic factors because of their strong relationships with them. The studies on the biological aspects of the ecosystem are important in Environment Impact Assessment studies for the suitability of natural flora and fauna. Information on the impact of environment stress on the community structure serves as an inexpensive and efficient early warning system to check the damage on a particular ecosystem.

A change in the composition of biotic communities under stress is reflected through a change in the distribution pattern, density, diversity, frequency, dominance and abundance of natural species of fauna and flora existing in the ecosystem. These changes over a span of times can be quantified and related to the existing environment.

The area of **1144.0618 Ha** falls in 8 villages viz., Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B in Killiyoor Taluk, Kanniyakumari District, Tamil Nadu. The existing Mineral Separation Plant is in Manavalakurichi Village, Kalkulam Taluk, Kanniyakumari District. The distance between the proposed mining lease area of 1144.0618 ha and the existing Mineral Separation Plant at Manavalakurichi village is 12 to 30 km.

3.10.6.2 Objectives

The objectives of ecological study during the study period of EIA study period may be outlined as follows:

- To characterize the environmental components like land, water, flora and fauna;
- To understand their present status;
- To understand carrying capacity of the ecosystem;
- To assess present bio-diversity; and
- To identify susceptible and sensitive areas

3.10.6.3 Regional Biodiversity

Tamil Nadu has a total land area of 1,30,060 sq.km which constitute about 3.96% of the total geographical area of the country.



Physiographically, the State can be divided into four major regions viz Coastal Plains, Eastern Ghats, Central Plateau and Western Ghats. The main rivers of the State are Cauvery, Bhavani, Palar, Vaigai etc. which drain into the Bay of Bengal. Tamil Nadu has a Humid Tropical Climate. Tamil Nadu shares the Western Ghats Biodiversity (one of the 12 Global mega biodiversity Hotspots) with the states of Kerala and Karnataka.

The State is endowed with rich biodiversity, from marine coastal systems in the Gulf of Mannar to the terrestrial evergreen forests in the Western Ghats and temperate forests in the hilly regions. As per the Champion & Seth Classification of Forest Types (1968), the forests in Tamil Nadu belong to nine Forest Group, which are further divided into 39 Forest Types. The Nilgiri Biosphere Reserve represents a unique and threatened ecosystem in the tropics inside the Western Ghats Mountain system and is one of the biodiversity hotspots. Tamil Nadu has been a pioneer State in the biodiversity conservation, particularly in Protected Area management, including conservation of marine fauna. Tamil Nadu is famous for its Teak and Sandalwood forests.

Forest Biodiversity in the State is mainly confined to Western Ghats and Eastern Ghats. Forest Cover of the State is 26,364 km² which is 20.27% of the State's geographical area (GA). In terms of forest canopy density classes, the State has 3,605 km² (2.77% of GA) very dense forest, 11,030 km² (8.48% of GA) moderately dense forest and open forest and 11,729 km² (9.02 % of GA) respectively. There is an increase of 83.02 km² in the forest cover of the state as compared to 2017 assessment (Source: www.forests.tn.gov.in).

The mangrove cover in the State is 44.83 sq.km, which is 0.035% of the State total geographical area. The Very Dense mangrove comprises 1.04 sq.km of the mangrove cover, Moderately Dense mangrove is 27.24 sq.km while open mangroves constitute an area of 16.55 sq.km.

Recorded Forest Area (RFA) in the State is 22,877 sq.km which constitute about 17.59% and 2.99% of the total geographical area of the State and Country respectively, of which 20,293 sq.km is Reserved Forest, 1,782 sq.km is Protected Forest and 802 sq.km is Unclassed Forests. The RFA covers 17.59% of geographical area of the State. The reserved, protected and unclassified forests are 88.70%, 7.79% and 3.51% of the recorded forest area in the State respectively.

Five National Parks, 29 Wildlife Sanctuaries and two Conservation Reserves constitute the Protected Area network of the State covering 4.97% of its geographical area (India State Forest Report, 2019). There are about 3,072 hamlets bordering the forest areas of the state. Tropical dry Deciduous Forest covers an area of 12.23 lakh ha constituting 54.30%, Tropical Thorn Forest covers an area of 5 lakh ha constituting 22.10%, Tropical Moist Deciduous Forest covers an area of 2.60 lakh ha constituting a percentage of 11.10%. The Biodiversity rich forest types are the Tropical Wet Evergreen Forest covering an area of 0.60 lakh ha constituting 2.67%, Tropical Semi Evergreen Forest covering an area of 0.23 lakh ha constituting 1.01%, Subtropical Broad leaved Hill Forest covers an area of 1.14 lakh ha constituting 5.04%, the Tropical Dry Evergreen Forest which is a unique type of Tamil Nadu covers an area of 0.26 lakh ha constituting 1.16%, the mangrove forest covers an area of approximately 0.23 lakh ha constituting 1.01%.

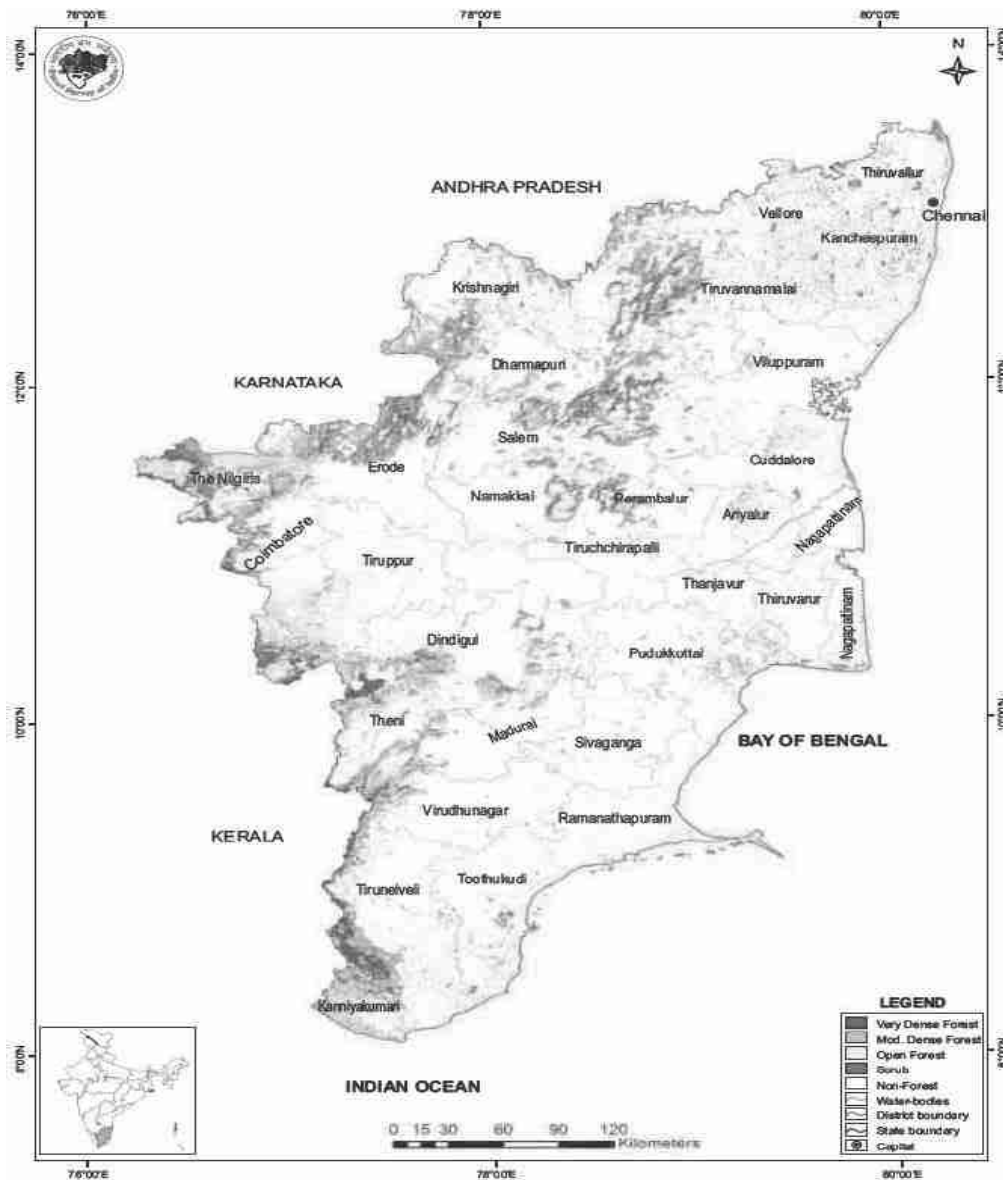


Figure 3.24 Forest Map of Tamil Nadu (Source: Forest Survey of India, 2009)

Habitat fragmentation is the process by which habitats which were once continuous become divided into separate fragments. This mainly happens due to human activities such as agriculture, rural development and urbanization. As cities and civilization grow in size, the fragmentation of habitats causes extinction of many plant and animal species and is the largest threat to biodiversity on earth. Designing with nature can improve the quality of cities for people, plants and animals. In doing so, ecosystem services can be enhanced.

The state's rich biodiversity and the natural resources are facing a serious threat from the growing human encroachments, cattle grazing, collection of fire wood, man-animal conflict, poaching, illicit felling, mass tourism and pilgrimage etc. and from various developmental activities. Biodiversity Conservation has been structured covering the Ecosystem Diversity, Species Diversity and Genetic Diversity. Species Diversity has been structured separately for plants and animals.



Wild plant diversity has been structured on the lines of Red-listed plants, Endemic plants, Medicinal plants, Wild relatives of cultivated plants, allied species of cultivated species and others. Wild Animal diversity has been structured on the lines of Red listed animals, Endemic animals, Flagship species, Keystone species, Pollinators and others. Domesticated species diversity has been structured on the lines of Cultivated Plants and Domesticated animals.

Kanniyakumari District

Kanniyakumari District has a total geographical area of 1672 Sq. km. and has an average elevation of 30 metres. This district has a varied topography with the sea on three sides and the mountains of the Western Ghats bordering the northern side. Except for a small stretch of land to the east of Kanniyakumari town, almost the entire district is sandwiched between the Western Ghats and Sea, the only district in Tamil Nadu state facing the Arabian Sea. Geologically, the landmass of the district is much younger when compared to the rest of the state – faulted as late as 2.5 million years during the Miocene, after which numerous transgressions, as well as regression of sea, had shaped the western coast of the district.

Furthermore, Kanniyakumari is bordered by Tirunelveli district in the east and north side, the Gulf of Mannar in the East, the Indian Ocean in the South, the Arabian Sea in the West, Thiruvananthapuram district (Kerala) in the west and the Laccadive Sea on the southeast, the south and the southwest sides. Kanniyakumari district is often cited as 'Land's End'. The major rivers in this district are Thamirabarani, Valliar, Pazhayar, Ponniavaikal and Paraliyar.

The district's coastal environment forms an interface between land and marine water. This eco-system is valuable to humans from the dawn of civilization. The biological and social needs of human beings are readily met by coastal zone. This district in Tamil Nadu with a land mass of 1672 sq.km has almost all ecosystems; wetlands, forests, freshwater resources, marine, etc. The coastal environment is very important with regard to fish production and fisher folk's employment. The district's coastal ecosystem is 68 Km in length and is studded with forty-four coastal fishing villages. Since this district is located at the extreme south of the Indian subcontinent, the coastline is formed nearly by three seas; the Arabian Sea, the Indian Ocean and the Bay of Bengal while the main part of the coast of Kanyakumari district faces the Arabian Sea.

Of the total district area of 1672 sq. km., government forests occupy an area of 504.86 sq. km. which comes to about 30.2% of the geographical area of the district. The flora and fauna of Kanniyakumari District are vast and diverse. Kanniyakumari district has 4 types of lands except Desert. In which, Forest has a significant place in the district's landscape. The district's forest areas were surrounded by plenty of rivers and falls. Forests also has significant mountainous landscape. The district has forests of 40239.55 Hectares. The district's forests are situated between Kalakkad Mundanthurai Tiger Reserve and Neyyar Forests in Kerala. Kaalikesam, Balamore, Upper Kodayar, Lower Kodayar, Mukkadal are the important places in Forests.

Paddy is the main crop of this district and it is grown in two seasons. While the first crop is sown in April-June, the second crop is raised in the month of September-October. The major crops cultivated in the district are tapioca and oilseeds like



groundnut and coconut apart from the commercial crops like rubber, cashew, fruits and spices.

3.10.6.4 Biogeographic zone, province and Forest type

This study has been carried out during the early January 2023 of study period for the purpose of providing an independent and comprehensive baseline assessment of the flora, terrestrial vertebrate, aquatic fauna and associated habitat values of the site and within 10 km radius area around the project site at villages core and buffer area viz., Near Alanchi, Near Thikkanamcode, Near Paloor, Near Parambu vilai, Near Nithiravilai, Near Kollamkode, Near Kuzhivilai, Near Chadayan kuzhi in Killiyoor Taluk, Kanniyakumari District over an extent of 1144.0618 ha by M/s. IREL (India) Limited (IREL), (A Govt. of India Undertaking – Department of Atomic Energy) and a subsequent assessment of potential ecological impacts.

The study area falls under Western Ghats category as far as the Indian biogeographical zones (Rodger, Panwar, Mathur 2000) are concerned. Under the biogeographical provinces, the study area falls under the category of **8B: Coasts-- East Coast**.

The field investigation and satellite imagery data show that the study area is a mixture of forest land, agricultural and get irrigated by the cannals. There are no agricultural lands are located within the Mining Lease area, beyond the Mining Lease area some agricultural lands are seemed used for Ragi and maize. The detailed study shows the dominance of grasses like *Cyperus rotundus*, *Cyperus difformis*, *Cyanodon dactylon*, *Imperata cylindrica*. Among the tree species *Cocos nucifera*, *Azadirachta indica*, *Acacia auriculiformis*, *Bambusa bambos*, *Tamarindus indica*, *Aegle marmelos*, etc. are most common.

The detailed ecological assessment of the study area has been carried out with the following objectives:

- To establish the present status of ecological conditions surrounding the project location;
- To study the existing anthropogenic stresses on the prevailing ecosystem.
- To identify and predict the likely impacts on the local ecosystem from the proposed activities;
- To list out floral species, terrestrial vertebrate and aquatic flora and fauna present within the study area, and significance status under The Wildlife (Protection) Act, 1972;
- To define ecological/conservation status of each species as per IUCN categories (Red Data List).
- To formulate migratory measures and a sustainable Environmental Management Plan (EMP) basing upon the likely impacts.
- During survey, following aspects were considered for ecological studies:
 - Assessment of present status of flora and fauna;
 - Identification of rare and endangered species of plants and animals (if any);
 - Identification of ecologically sensitive areas within the study area;
 - Assessment of migratory route of wildlife (if any); and
 - Assessment of Aquatic Ecology with specific reference to aquatic birds and fishery resources.

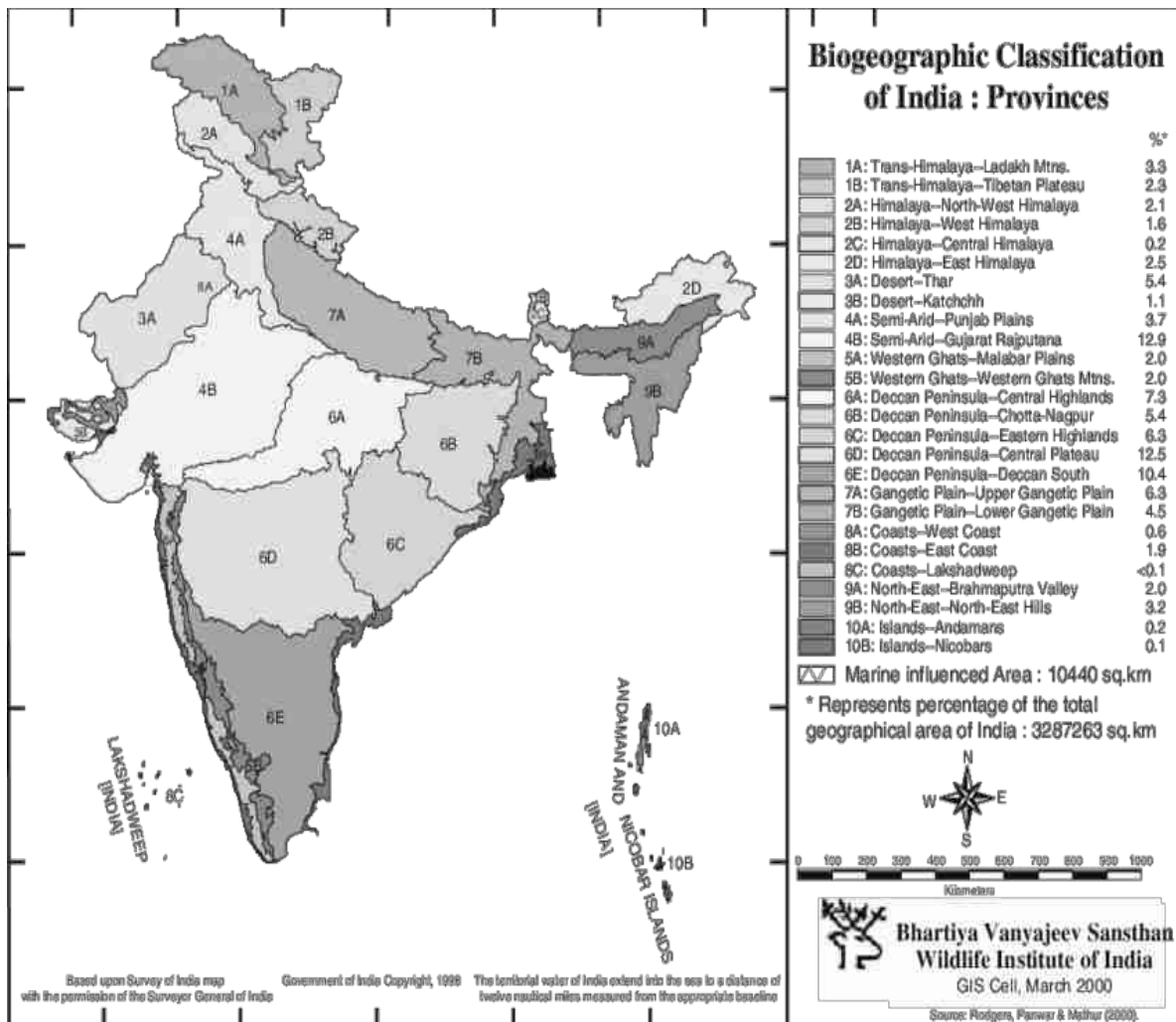


Figure 3.25 Map showing the Bio-geographic Provinces of India

3.10.6.5 Methodology

Terrestrial investigations for flora and fauna records were collected by random field survey and a checklist was prepared. During field survey, discussions with the local people were carried-out to collect information related to local biodiversity in and around the villages. The ecological status of the study area has been assessed based on the following methodology:

- Primary field surveys to establish primary baseline of the study area;
- Compilation of secondary information available in published literatures/ forest working plans, etc.
- Site Verification and finalization in consultation with Project proponent, local inhabitants.
- Vegetation analysis through quadrat method using sampling plots of 30m X 30m.
 - 30m X 30m for tree species (record trees >20 cm in GBHOB /species);
 - 5m X 5m [four plots] was laid along diagonals wherein all the shrubs recorded.

- 1m X 1m [five plots], one at the centre and four at one per quadrat] was laid and herbs, grasses in five plots to be noted.

□ Protocol for Sampling through Quadrat Method

The standard method chosen for the assessment of plant diversity involves the use of square vegetation quadrats ('plots'). These quadrats were used to measure most vegetation attributes in most vegetation types. Quadrat locations marked by pegs or sometimes by grid system.

The study area is demarcated as 10 km from the periphery of mining lease (ML) area based on the MoEF&CC guidelines. After demarcation, the study area is divided into sampling units, i.e. the areas which are approximately true representative of the whole area, and were sampled for the identification of plant and animal species.

A. Floral Study

The assessment of the flora of the study area is done by an extensive field survey of the area of 10 km radius.

- Plants species were identified based on their specific diagnostics characters of family, genus and species using available floral, other related literature.
- Besides the identification of plant species, information was collected on the vernacular names and uses of plants made by local inhabitants.
- Qualitative analysis of vegetation is made by two different methods such as floristic (by simple studying various genera and species of various plant groups i.e. herbs, shrubs, trees etc).

B. Phyto-sociology

A nested quadrats technique was used for sampling the vegetation. All the plots sampled were representative of most common types, sampling 30m X 30m for trees and 5m X 5m for shrubs, 1m X 1m for herbs square meter quadrats were laid. Selection of sites for sampling of vegetation is done by random sampling procedure. However, in general to study the phytosociological attributes, quadrats of 30m X 30m size for tree species are randomly laid out at each site at different elevations. Then the observation on the following parameters is recorded:

1. Name of the species.
2. Number of the occurrence of each species in each quadrat.

The field data for phytosociological studies was collected in the study area. Vegetation data was quantitatively analyzed for frequency, density and dominance using standard methodologies. The relative values of frequency, density, and dominance of all the recorded species was summed up to represent Importance Value Index (IVI). Not only IVI facilitates comparison between species of a community, but also the data collected on dispersion, number and cover can be profitably used in comparing the vegetation structure of two or more stands or of the same stand over a period of time. Vegetation structure with respect of varying environmental factors can also be studied through such studies in sets of varying environmental conditions. The IVI was determined as the sum of the relative frequency, relative density and relative dominance. It thus incorporates three important parameters that measures of productivity and diversity of every species therefore.



$$IVI = \text{Relative frequency} + \text{Relative density} + \text{Relative dominance}$$

C. Faunal Study

Ground surveys are carried out by trekking the study area for identification of important animal groups such as birds, mammals and reptiles for sampling of animals through the following methods.

- For sampling birds/avifauna 'point sampling' along the fixed transects (foot trails) were done to record all the species of birds with the help of binoculars; field guides and photography for more than 1 hour on each transect (n=4).
- For sampling mammals, 'direct count on open width (20 m) transect' were used on the same transects. Besides, information on recent sightings/records of mammals by the locals are also collected from the study areas.
- 'Reptiles' mainly lizards were sampled by 'direct count on open width transects'.
- Secondary information collected from local villagers, published government data etc.

❑ List of the endangered and endemic species as per the schedule of The Wildlife Protection Act, 1972

Emphasis is given to identify avifauna and mammals to determine the presence and absence of Schedule-1 species, listed in The Wildlife Protection Act 1972, as well as in Red List of IUCN. Various methods used for study animals are as follows:

- A. Point Survey Method: Observations were made at each site for 15-20 min duration.
- B. Road Side Counts: The observer travelled by motor vehicles from site to site and all sightings were recorded.

3.10.6.6 Floristic composition within the study area

The ecology and diversity survey were conducted in the 10 km radius in the study area and the surrounding area. It is observed that few human settlements present outside the ML area and within the study area of 10 km radius and many of villages have very high level of plantations. During site assessment several floral species encountered within the 10 km radius area.

The study area does not have any forest land or permanent natural vegetation. The new mining lease area consists mostly of private patta lands. The private patta lands are found with scattered coconut trees. The mining operation over the private lands will be carried out only after obtaining the Consent from the respective land owners and after mining and backfilling, the land will be returned to the respective land owners within 11 months along with payment of Lease Compensation as per the Land Leasing Policy of IREL. On return of land, the land owners predominantly carry out the plantation of Coconut and other fruit bearing trees. The mining would not result in change of ownership of the land. Generally, 70 coconut saplings are planted in one acre of land.

From the primary observation, the tree species recorded outside the ML area in the plantation area were *Cocos nucifera*, *Azadirachta indica*, *Acacia auriculiformis*, *Tamarindus indica*, *Aegle marmelos*, *Syzygium cumini* etc. The survey was conducted in the 10 km radius from the ML area and its surroundings. The locations covered

during the present survey were Near Project site (Alanchi), Near Thikkanamcode, Near Musari, Near Parambu Vilai, Near Nithiravilai, Near Kolamkode, Near Kuzhivilai, Near Irenipuram. The following locations were enlisted within the 10 km radius study area during the field visits as given in Table 3.29.

Table 3.28 Details of locations for plot survey

S.No.	Name of Village	Plot No.	Lattitude	Longitude	Type
1	Near Alanchi	EB1	8°11'43.93"N	77°14'6.60"E	Core
2	Near Thikkanamcode	EB2	8°13'15.01"N	77°16'17.83"E	Buffer
3	Near Paloor	EB3	8°14'27.99"N	77°14'8.34"E	Buffer
4	Near Parambu vilai	EB4	8°13'7.91"N	77°12'17.41"E	Core
5	Near Nithiravilai	EB5	8°16'29.74"N	77° 8'22.98"E	Core
6	Near Kollamkode	EB6	8°17'24.80"N	77° 6'45.03"E	Core
7	Near Kuzhivilai	EB7	8°18'43.21"N	77° 9'40.23"E	Buffer
8	Near Chadayan kuzhi	EB8	8°16'13.33"N	77°12'1.51"E	Buffer



3.10.6.7 Floral Community within Core Area

The project area covering 10 km radial distance reveal that there are no notified/protected ecologically sensitive area including national park, sanctuary, Elephant and Tiger reserves in the project area covering 10 km radial distance. The results of survey within core area exhibited sparsy vegetation with the existence of 86 terrestrial flora. However, Neem, Acacia and coconut trees are abundant widely distributed away from the study area. The following species were encountered from the study area during the field visits as given in Table 3-30.

Table 3.29 Floristic Diversity in the Core Area

S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
Tree				
1	<i>Azadirachta indica</i>	Veppai	Meliaceae	Least Concern
2	<i>Acacia auriculiformis</i>	Katthisavukku	Mimosaceae	Not assessed
3	<i>Cocos nucifera</i>	Tennai	Arecaceae	Not assessed
4	<i>Acacia catechu</i>	Cenkarungali	Mimosaceae	Not assessed
5	<i>Borassus flabellifer</i>	Nonkuppanai	Arecaceae	Not assessed
6	<i>Syzygium cumini</i>	Naval	Myrtaceae	Least Concern
7	<i>Phoenix sylvestris</i>	Paareecham	Arecaceae	Not assessed
8	<i>Prosopis juliflora</i>	Vaelikaruvai	Fabaceae	Not assessed
9	<i>Tamarindus indica</i>	Puli	Fabaceae	Not assessed
10	<i>Acacia leucophloea</i>	Velvelam	Fabaceae	Not assessed
11	<i>Acacia nilotica</i>	Karuvel	Mimosaceae	Not assessed
12	<i>Casuarina equisetifolia</i>	Savukku	Casuarinaceae	Not assessed
13	<i>Albizia lebeck</i>	Siridam	Fabaceae	Not assessed
14	<i>Annona reticulata</i>	Ramachita	Annonaceae	Not assessed
15	<i>Bambusa arundinacea</i>	Kulay-munkil	Poaceae	Not assessed
16	<i>Bauhinia racemosa</i>	Atti	Fabaceae	Not assessed



S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
17	<i>Murraya koenigii</i>	Karivepillai	Rutaceae	Not assessed
18	<i>Musa paradisiaca</i>	Vaazhai	Musaceae	Not assessed
19	<i>Manilkara zapota</i>	Sapota	Sapotaceae	Not assessed
20	<i>Morinda tinctoria</i>	Mannanunai	Rubiaceae	Not assessed
21	<i>Leucaena leucocephala</i>	Subabul	Fabaceae	Not assessed
22	<i>Madhuca longifolia</i>	Illupei	Sapotaceae	Not assessed
23	<i>Mangifera indica</i>	Mamaram	Anacardiaceae	Data Deficient
24	<i>Psidium guajava</i>	Segappu koyyaa	Myrtaceae	Least Concern
25	<i>Phoenix acaulis</i>	Kaattu echam	Arecaceae	Not assessed
26	<i>Cassia siamea</i>	Manjalkonrai	Fabaceae	Not assessed
27	<i>Ficus hispida</i>	Peyatti	Moraceae	Not assessed
28	<i>Gmelina arborea</i>	Kumalaamaram	Lamiaceae	Least Concern
29	<i>Tectona grandis</i>	Thekku	Lamiaceae	Endangered
30	<i>Terminalia catappa</i>	Nattuvaduma	Combretaceae	Least Concern
31	<i>Ziziphus jujuba</i>	Ilanthai	Rhamnaceae	Least Concern
32	<i>Ixora arborea</i>	Koran	Rubiaceae	Not assessed
33	<i>Delonix regia</i>	Cemmayir-konrai	Fabaceae	Least Concern
34	<i>Cassia fistula</i>	Appai	Caesalpiniaceae	Least Concern
Shrub				
1	<i>Lantana camara</i>	Unnichi	Verbenaceae	Not assessed
2	<i>Calotropis gigantea</i>	Erukku	Asclepiadaceae	Not assessed
3	<i>Ziziphus nummularia</i>	Narielandai	Rhamnaceae	Not assessed
4	<i>Calotropis procera</i>	Vellai Erukku	Asclepiadaceae	Not assessed



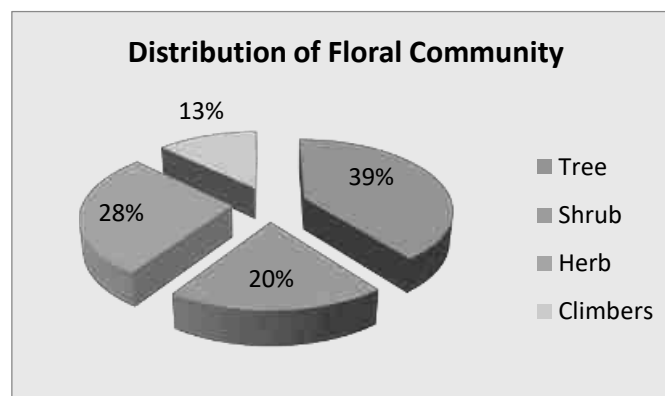
S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
5	<i>Capparis sepiaria</i>	Kattukkattari	Capparaceae	Not assessed
6	<i>Euphorbia tirucalli</i>	Amman-paccarici	Euphorbiaceae	Least Concern
7	<i>Hibiscus sabdariffa</i>	Simaikkasuru	Malvaceae	Not assessed
8	<i>Jatropha curcas</i>	Kattukkottai	Euphorbiaceae	Not assessed
9	<i>Lawsonia inermis</i>	Maruthani	Lythraceae	Not assessed
10	<i>Nerium oleander</i>	Arali	Apocynaceae	Not assessed
11	<i>Tecoma stans</i>	Manjarali	Bignoniaceae	Not assessed
12	<i>Vitex negundo</i>	Nochi	Verbenaceae	Not assessed
13	<i>Sida cordifolia</i>	Arivalmukku	Malvaceae	Not assessed
14	<i>Cassia auriculata</i>	Avaram	Caesalpiniaceae	Not assessed
15	<i>Azanza lampas</i>	Kattupparutti	Malvaceae	Not assessed
16	<i>Clerodendrum inerme</i>	Sangam	Lamiaceae	Not assessed
17	<i>Datura metel</i>	Umathai	Solanaceae	Not assessed
Herb & Grasses				
1	<i>Abutilon indicum</i>	Akatam	Malvaceae	Not assessed
2	<i>Ageratum conyzoides</i>	Aappakkoti	Asteraceae	Not assessed
3	<i>Acalypha indica</i>	Kuppai-meni	Euphorbiaceae	Not assessed
4	<i>Solanum nigrum</i>	Manathakkali	Solanaceae	Not assessed
5	<i>Tridax procumbens</i>	Vettukkaaya-thalai	Astraceae	Not assessed
6	<i>Cynodon dactylon</i>	Arugam pullu	Poaceae	Not assessed
7	<i>Cyperus rotundus</i>	Panni-korai	Cyperaceae	Not assessed
8	<i>Achyranthes aspera</i>	Nayuruvi	Amaranthaceae	Not assessed



S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
9	<i>Aerva lanata</i>	Ciru-pulai	Amaranthaceae	Not assessed
10	<i>Boerhavia diffusa</i>	Mukaratte kirai	Nyctaginaceae	Not assessed
11	<i>Cassia occidentalis</i>	Pei-avarai	Caesalpiniaceae	Not assessed
12	<i>Eclipta prostrata</i>	Karisalanganni	Asteraceae	Not assessed
13	<i>Euphorbia hirta</i>	Amanpatchaiaris	Euphorbiaceae	Not assessed
14	<i>Cassia tora</i>	Taghrai	Caesalpiniaceae	Not assessed
15	<i>Phyllanthus amarus</i>	Keelanelli	Phyllanthaceae	Not assessed
16	<i>Physalis minima</i>	Sodakkuthakkaali	Solanaceae	Not assessed
17	<i>Sida acuta</i>	Karuncaranai	Malvaceae	Not assessed
18	<i>Chloris barbata</i>	Chevvarakupul	Poaceae	Not assessed
19	<i>Vernonia cinerea</i>	Puvamkuruntal	Asteraceae	Not assessed
20	<i>Digera muricata</i>	Thoyya keerai	Amaranthaceae	Not assessed
21	<i>Amaranthus spinosus</i>	Mullukkeerai	Amaranthaceae	Not assessed
22	<i>Evolvulus alsinoides</i>	Vishnukarandi	Convolvulaceae	Not assessed
23	<i>Mimosa pudica</i>	Thottaccurungi	Fabaceae	Least Concern
24	<i>Ocimum sanctum</i>	Thulasi	Lamiaceae	Not assessed
Climbers				
1	<i>Bougainvillea spectabilis</i>	Kakitha poo	Nyctaginaceae	Not assessed
2	<i>Clitoria ternatea</i>	Sangu Poo	Fabaceae	Not assessed
3	<i>Solena amplexicaulis</i>	Pulivanci	Curcubitaceae	Not assessed
4	<i>Abrus precatorius</i>	Kundumani	Fabaceae	Not assessed
5	<i>Coccinia grandis</i>	Kovaikkaai	Cucurbitaceae	Not assessed

S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
6	<i>Ichnocarpus frutescens</i>	Utar-koti	Apocynaceae	Not assessed
7	<i>Ipomoea dissecta</i>	Kakkattan	Convolvulaceae	Not assessed
8	<i>Ipomoea nil</i>	Kotikkakkattan	Convolvulaceae	Not assessed
9	<i>Ipomoea reptans</i>	Vallaikkirai	Convolvulaceae	Not assessed
10	<i>Basella rubra</i>	Pasalakkirai	Basellaceae	Not assessed
11	<i>Tylophora asthmatica</i>	Kalutai-p-palai	Asclepidaceae	Not assessed

The detailed study revealed dominance of *Cocos nucifera*, *Azadirachta indica*, *Acacia auriculiformis*, *Cocos nucifera*, *Acacia catechu* etc. Totally 34 species of trees are found in the study area along with 17 shrub species, 24 herb species, 11 climbers. From the study of core area, *Lantana camara*, *Calotropis gigantea*, *Capparis sepiaria*, *Nerium oleander*, *Datura metel* are found to be the predominant shrub species. Among the herbaceous species *Cynodon dactylon*, *Tridax procumbens*, *Cyperus rotundus*, *Boerhavia diffusa* etc. found to be abundant.



□ Phytosociological Analysis

Phytosociological parameters such as, density, frequency and importance value index of individual species were determined in randomly placed quadrats of different sizes in the study area. Relative frequency, relative basal area and relative density were calculated and the sum of these three represented Importance Value Index (IVI) for various species. For shrubs, herbs and seedlings, the IVI was calculated by summing up relative frequency, relative density and relative abundance.

Sample plots were selected in such a way to get maximum representation of different types of vegetation and plots were laid out in different part of the study area of 10 km radius. Analysis of the vegetation will help in determining the relative importance of each species in the study area and to reveal if any economically valuable species is threatened in the process. Phytosociological analysis of tree species is shown in Table 3-31.



Table 3.30 Phytosociological Analysis Of Tree Species

S. No.	Scientific Name	Local Name	Q1	Q2	Q3	Q4	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
Tree Species																
1	<i>Azadirachta indica</i>	Veppai	1	2	1	2	6	4	4	1.50	6.32	100.0	4.5	1.50	0.06	10.92
2	<i>Acacia auriculiformis</i>	Katthisavukku	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
3	<i>Cocos nucifera</i>	Tennai	2	2	2	2	8	4	4	2.00	8.42	100.0	4.5	2.00	0.08	13.05
4	<i>Acacia catechu</i>	Cenkarungali	1	1	2	1	5	4	4	1.25	5.26	100.0	4.5	1.25	0.05	9.86
5	<i>Borassus flabellifer</i>	Nonkuppanai	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
6	<i>Syzygium cumini</i>	Naval	1		1	1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
7	<i>Phoenix sylvestris</i>	Paereecham	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
8	<i>Prosopis juliflora</i>	Vaelikaruvai	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
9	<i>Tamarindus indica</i>	Puli	1	1		1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
10	<i>Acacia leucophloea</i>	Velvelam	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
11	<i>Acacia nilotica</i>	Karuvel	1		1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
12	<i>Casuarina equisetifolia</i>	Savukku	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
13	<i>Albizia lebeck</i>	Siridam	1		1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
14	<i>Annona reticulata</i>	Ramachita	1	1	1		3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
15	<i>Bambusa arundinacea</i>	Kulay-munkil	1			1	2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
16	<i>Bauhinia racemosa</i>	Atti	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
17	<i>Murraya koenigii</i>	Karivepillai	1		1	1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
18	<i>Musa paradisiaca</i>	Vaazhai	1	1		1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
19	<i>Manilkara zapota</i>	Sapota	1		1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
20	<i>Morinda tinctoria</i>	Mannanunai		1	1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
21	<i>Leucaena leucocephala</i>	Subabul		1			1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
22	<i>Madhuca longifolia</i>	Illupei		1	1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha
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S. No.	Scientific Name	Local Name	Q1	Q2	Q3	Q4	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
23	Mangifera indica	Mamaram		1			1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
24	Psidium guajava	Segappu koyyaa			1	1	2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
25	Phoenix acaulis	Kaattu echam			1		1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
26	Cassia siamea	Manjalkonrai	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
27	Ficus hispida	Peyatti		1			1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
28	Gmelina arborea	Kumalaamaram		1	1	1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
29	Tectona grandis	Thekku				1	1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
30	Terminalia catappa	Nattuvaduma			1		1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
31	Ziziphus jujuba	Ilanthai		1	1	1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
32	Ixora arborea	Koran			1		1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
33	Delonix regia	Cemmayir-konrai				1	1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
34	Cassia fistula	Appai				1	1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
	Total		21	23	27	24	95	88	136							
Shrub Species																
1	Lantana camara	Unnichedi	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
2	Calotropis gigantea	Erukku	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
3	Ziziphus nummularia	Narielandai	1	1		1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
4	Calotropis procera	Vellai Erukku	1		1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
5	Capparis sepiaria	Kattukkattari	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
6	Euphorbia tirucalli	Amman-paccarici	1		1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha
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S. No.	Scientific Name	Local Name	Q1	Q2	Q3	Q4	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
7	Hibiscus sabdariffa	Simaikkasuru	1		1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
8	Jatropha curcas	Kattukkottai	1		1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
9	Lawsonia inermis	Maruthani	1			1	2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
10	Nerium oleander	Arali	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
11	Tecoma stans	Manjarali	1			1	2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
12	Vitex negundo	Nochi			1	1	2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
13	Sida cordifolia	Arivalmukku		1			1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
14	Cassia auriculata	Avaram		1		1	2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
15	Azanza lampas	Kattupparutti		1		1	2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
16	Clerodendrum inerme	Sangam		1	1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
17	Datura metel	Umathai	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
	Total		12	10	11	11	44	44	68						0.46	
Herb Species																
1	Abutilon indicum	Akatam	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
2	Ageratum conyzoides	Aappakkoti	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
3	Acalypha indica	Kuppai-meni	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
4	Solanum nigrum	Manathakkali	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
5	Tridax procumbens	Vettukkaaya-thalai	1	2	1	2	6	4	4	1.50	6.32	100.0	4.5	1.50	0.06	10.92
6	Cynodon dactylon	Arugam pullu	4	4	3	3	14	4	4	3.50	14.74	100.0	4.5	3.50	0.15	19.43
7	Cyperus rotundus	Panni-korai	1	1	2	1	5	4	4	1.25	5.26	100.0	4.5	1.25	0.05	9.86
8	Achyranthes aspera	Nayuruvi	1	2	1		4	3	4	1.00	4.21	75.0	3.4	1.33	0.04	7.66
9	Aerva lanata	Ciru-pulai	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80



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S. No.	Scientific Name	Local Name	Q1	Q2	Q3	Q4	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
10	Boerhavia diffusa	Mukaratte kirai	1	1	1	2	5	4	4	1.25	5.26	100.0	4.5	1.25	0.05	9.86
11	Cassia occidentalis	Pei- avarai	1	1	1	1	4	4	4	1.00	4.21	100.0	4.5	1.00	0.04	8.80
12	Eclipta prostrata	Karisalangan ni	1	1		1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
13	Euphorbia hirta	Amanpatchai arisi	1	1		1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
14	Cassia tora	Taghrai	1	1	1	2	5	4	4	1.25	5.26	100.0	4.5	1.25	0.05	9.86
15	Phyllanthus amarus	Keelanelli	1		1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
16	Physalis minima	Sodakkuthakk aali	1		1	1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
17	Sida acuta	Karuncaranai	1		1	1	3	3	4	0.75	3.16	75.0	3.4	1.00	0.03	6.60
18	Chloris barbata	Chevvarakupul		1	1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
19	Vernonia cinerea	Puvamkuruntal		1		1	2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
20	Digera muricata	Thoyya keerai			1	1	2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
21	Amaranthus spinosus	Mullukkeerai	1				1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
22	Evolvulus alsinoides	Vishnukarandi			1		1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
23	Mimosa pudica	Thottaccurungi				1	1	1	4	0.25	1.05	25.0	1.1	1.00	0.01	2.20
24	Ocimum sanctum	Thulasi		1	1		2	2	4	0.50	2.11	50.0	2.3	1.00	0.02	4.40
	Total		21	22	22	23	88	72	96						0.93	

The interpretation vegetation study results of the study area are presented in the following Table 3-32.

Table 3.31 Interpretation of Vegetation Results in the Core Area

<i>Relative density</i>	Relative density is found to be maximum for <i>Cocos nucifera</i> about 8.42	Density of the primary species is found to be much higher in comparison with the other species.
<i>Relative frequency</i>	Maximum RF found to be 4.5 in case of <i>Cocos nucifera</i> .	Vegetation community is heterogenous in nature
<i>Relative Abundance</i>	Maximum value observed in case of <i>Cocos nucifera</i> about 0.08	<i>Cocos nucifera</i> the most common species found in the area.
<i>Importance Value Index (IVI)</i>	The maximum IVI value observed in case of <i>Cocos nucifera</i> is about 13.05	The dominant species are <i>Cocos nucifera</i>

Biodiversity Indices

Biodiversity index is a quantitative measure that reflects how many different type of species, there are in a dataset, and simultaneously takes into account how evenly the basic entities (such as individuals) are distributed among those types of species. The value of biodiversity index increases both when the number of types increases and when evenness increases. For a given number of type of species, the value of a biodiversity index is maximized when all type of species are equally abundant. Interpretation of Vegetation results in the study area is given in Table 3-33.

Table 3.32 Interpretation of Vegetation results in the Core Area

Community	Biodiversity indices		
	Shannon-Wiener Index (H)	Simpson Diversity Index (1/D)	Species Evenness
Tree	3.37	0.97	0.39
Shrub	1.64	0.95	0.29
Herb	2.84	0.95	0.40

From Table 3.33, it can be interpreted that tree community has higher diversity. While the shrub community shows less diversity. It is also observed that most of the quadrates have controlled generation of plant species with older strands. Higher tree species diversity can be interpreted as a greater number of successful species and a more stable ecosystem where more ecological niches are available and the environment is less likely to be hostile, environmental change is less likely to be damaging to the ecosystem as a whole.

3.10.6.8 Floral Community within Buffer Area

The project area covering 10 km radial distance reveal that there are no notified/protected ecologically sensitive area including national park, sanctuary, Elephant and Tiger reserves in the project area covering 10 km radial distance. The results of survey within buffer area exhibited moderate vegetation with the existence of 211 terrestrial flora. However, Neem, Acacia and coconut trees are abundant widely distributed away

from the study area. The following species were encountered from the study area during the field visits as given in Table 3-34.

Table 3.33 FLORISTIC DIVERSITY IN THE BUFFER AREA

S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
Tree Species				
1	<i>Acacia auriculiformis</i>	Katthisavukku	Mimosaceae	Not assessed
2	<i>Ailanthus excels</i>	Perumaram	Simaroubaceae	Not assessed
3	<i>Albizia amara</i>	Arappumaram	Fabaceae	Not assessed
4	<i>Albizia lebeck</i>	Siridam	Fabaceae	Not assessed
5	<i>Bombax ceiba</i>	Sittan	Malvaceae	Not assessed
6	<i>Borassus flabellifer</i>	Nonkuppanai	Arecaceae	Not assessed
7	<i>Bridelia retusa</i>	Mullu-Vengai	Phyllanthaceae	Not assessed
8	<i>Buchanania lanzan</i>	Charam	Anacardiaceae	Not assessed
9	<i>Butea monosperma</i>	Palasam	Fabaceae	Not assessed
10	<i>Acacia catechu</i>	Cenkarungali	Mimosaceae	Not assessed
11	<i>Acacia leucophloea</i>	Velvelam	Fabaceae	Not assessed
12	<i>Acacia nilotica</i>	Karuvel	Mimosaceae	Not assessed
13	<i>Aegle marmelos</i>	Vilvam	Rutaceae	Near Threatened
14	<i>Carica papaya</i>	Pappali	Caricaceae	Not assessed
15	<i>Ixora arborea</i>	Koran	Rubiaceae	Not assessed
16	<i>Kydia calycina</i>	Vattakannu	Malvaceae	Not assessed
17	<i>Annona reticulate</i>	Ramachita	Annonaceae	Not assessed
18	<i>Artocarpus heterophyllus</i>	Palaa	Moraceae	Not assessed
19	<i>Azadirachta indica</i>	Veppai	Meliaceae	Least Concern
20	<i>Bambusa arundinacea</i>	Kulay-munkil	Poaceae	Not assessed
21	<i>Bauhinia purpurea</i>	Nilattiruvatti	Fabaceae	Not assessed
22	<i>Albizia saman</i>	Thoongumoonji maram	Fabaceae	Not assessed
23	<i>Anacardium occidentale</i>	Mundiri	Anacardiaceae	Not assessed
24	<i>Ficus benjamina</i>	Vellal	Moraceae	Not assessed
25	<i>Ficus hispida</i>	Peyatti	Moraceae	Not assessed
26	<i>Ficus racemosa</i>	Atthi	Moraceae	Least Concern
27	<i>Ficus religiosa</i>	Arasamaram	Moraceae	Not assessed
28	<i>Gardenia gummifera</i>	Sirukkambil	Rubiaceae	Least Concern

S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
29	<i>Gmelina arborea</i>	Kumalaamaram	Lamiaceae	Least Concern
30	<i>Guazuma tomentosa</i>	Kattu Utharaksham	Sterculiaceae	Least Concern
31	<i>Drypetes sepiaria</i>	Kaayalakkamaram	Putranjivaceae	Not assessed
32	<i>Erythrina variegata</i>	Kalyana murungai	Fabaceae	Least Concern
33	<i>Eucalyptus leptophylla</i>	Neelagiri thailam	Myrtaceae	Not assessed
34	<i>Ficus benghalensis</i>	Alai	Moraceae	Not assessed
35	<i>Leucaena leucocephala</i>	Subabul	Fabaceae	Not assessed
36	<i>Moringa oleifera</i>	Murungai	Moringaceae	Not assessed
37	<i>Morus alba</i>	Kambli chedi	Moraceae	Not assessed
38	<i>Murraya koenigii</i>	Karivepillai	Rutaceae	Not assessed
39	<i>Pongamia pinnata</i>	Pungam	Fabaceae	Least Concern
40	<i>Terminalia bellirica</i>	Thandri	Combretaceae	Not assessed
41	<i>Wrightia tinctoria</i>	Paalai	Apocynaceae	Not assessed
42	<i>Hibiscus tiliaceus</i>	Nirpparutti	Malvaceae	Not assessed
43	<i>Bauhinia racemosa</i>	Atti	Fabaceae	Not assessed
44	<i>Carissa carandas</i>	Kalakkai	Apocynaceae	Not assessed
45	<i>Cassia fistula</i>	Appai	Caesalpiniaceae	Least Concern
46	<i>Prosopis juliflora</i>	Vaelikaruvai	Fabaceae	Not assessed
47	<i>Psidium guajava</i>	Segappu koyyaa	Myrtaceae	Least Concern
48	<i>Mimusops elengi</i>	Magizhamboo	Sapotaceae	Least Concern
49	<i>Terminalia catappa</i>	Nattuvaduma	Combretaceae	Least Concern
50	<i>Terminalia chebula</i>	Kadukkai	Combretaceae	Not assessed
51	<i>Terminalia tomentosa</i>	Marutham	Combretaceae	Not assessed
52	<i>Trema orientalis</i>	Yerralai	Ulmaceae	Not assessed
53	<i>Morinda citrifolia</i>	Nuna	Rubiaceae	Not assessed
54	<i>Cassia siamea</i>	Manjalkonrai	Fabaceae	Not assessed
56	<i>Catunaregam spinosa</i>	Madkarai	Rubiaceae	Not assessed
58	<i>Cocos nucifera</i>	Tennai	Arecaceae	Not assessed
59	<i>Dalbergia sissoo</i>	Shisham	Fabaceae	Not assessed



S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
60	<i>Delonix elata</i>	Perungondrai	Fabaceae	Least Concern
61	<i>Delonix regia</i>	Cemmayir-konrai	Fabaceae	Least Concern
62	<i>Diospyros chloroxylon</i>	Karuvakkanai	Ebenaceae	Not assessed
63	<i>Diospyros ferrea</i>	Irumbili	Ebenaceae	Not assessed
64	<i>Diospyros melanoxylon</i>	Karundumbi	Ebenaceae	Not assessed
65	<i>Ziziphus jujuba</i>	Ilanthai	Rhamnaceae	Least Concern
66	<i>Ziziphus mauritiana</i>	Elandhai	Rhamnaceae	Not assessed
67	<i>Prosopis cineraria</i>	Vanni	Fabaceae	Not assessed
68	<i>Musa paradisiaca</i>	Vaazhai	Musaceae	Not assessed
69	<i>Neolamarckia cadamba</i>	Vellaikkatampu	Rubiaceae	Not assessed
70	<i>Odina wodier</i>	Oti	Anacardiaceae	Not assessed
71	<i>Sapindus emarginatus</i>	Ponnankottai	Sapindaceae	Not assessed
72	<i>Limonia acidissima</i>	Vilamaram	Rutaceae	Not assessed
73	<i>Madhuca longifolia</i>	Illupei	Sapotaceae	Not assessed
74	<i>Mangifera indica</i>	Mamaram	Anacardiaceae	Data Deficient
75	<i>Manilkara zapota</i>	Sapota	Sapotaceae	Not assessed
76	<i>Melia azedarach</i>	Kattu vembhu	Meliaceae	Not assessed
77	<i>Parkinsonia aculeata</i>	Sinia tumana	Fabaceae	Not assessed
78	<i>Phoenix acaulis</i>	Kaattu echam	Arecaceae	Not assessed
79	<i>Phoenix sylvestris</i>	Paereecham	Arecaceae	Not assessed
81	<i>Salvadora oleoides</i>	Peru-kalarva	Salvadoraceae	Not assessed
82	<i>Mesua ferrea</i>	Nagamaram	Calophyllaceae	Not assessed
83	<i>Phyllanthus emblica</i>	Nelli	Euphorbiaceae	Least Concern
84	<i>Pithecellobium dulce</i>	Kodukkappuli	Fabaceae	Least Concern
85	<i>Plumeria rubra</i>	Nela sampangi	Apocynaceae	Not assessed
86	<i>Polyalthia longifolia</i>	Nettilinkam	Annonaceae	Not assessed
87	<i>Tecomella undulata</i>	Malampuluvan	Bignoniaceae	Not assessed
88	<i>Tectona grandis</i>	Thekku	Lamiaceae	Endangered
89	<i>Terminalia arjuna</i>	Marutham	Combretaceae	Not assessed
90	<i>Morinda tinctoria</i>	Mannanunai	Rubiaceae	Not assessed
91	<i>Sesbania sesban</i>	Sithagathi	Fabaceae	Not assessed

S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
92	<i>Strychnos potatorum</i>	Thethankottai	Loganiaceae	Not assessed
93	<i>Syzygium cumini</i>	Naval	Myrtaceae	Least Concern
94	<i>Tamarindus indica</i>	Puli	Fabaceae	Not assessed
Shrub Species				
1	<i>Ammannia baccifera</i>	Kalluruvi	Lythraceae	Least Concern
2	<i>Annona squamosa</i>	Sitapalam	Annonaceae	Not assessed
3	<i>Clerodendrum inerme</i>	Sangam	Lamiaceae	Not assessed
4	<i>Datura metel</i>	Umathai	Solanaceae	Not assessed
5	<i>Dodonaea viscosa</i>	Virali	Sapindaceae	Not assessed
6	<i>Thevetia peruviana</i>	Ponnarali	Apocynaceae	Least Concern
7	<i>Vitex negundo</i>	Nochi	Verbenaceae	Not assessed
8	<i>Xanthium strumarium</i>	Marul-umattai	Asteraceae	Not assessed
9	<i>Ziziphus nummularia</i>	Narielandai	Rhamnaceae	Not assessed
10	<i>Ziziphus oenoplia</i>	Suraimullu	Rhamnaceae	Not assessed
11	<i>Hibiscus rosa-sinensis</i>	Chemparuththi	Malvaceae	Not assessed
12	<i>Hibiscus sabdariffa</i>	Simaikkasuru	Malvaceae	Not assessed
13	<i>Jatropha curcas</i>	Kattukkottai	Euphorbiaceae	Not assessed
14	<i>Jatropha gossypifolia</i>	Siria Amanakku	Euphorbiaceae	Not assessed
15	<i>Euphorbia tirucalli</i>	Amman-paccarici	Euphorbiaceae	Least Concern
16	<i>Glycosmis pentaphylla</i>	Kattukkonci	Rutaceae	Not assessed
17	<i>Capparis decidua</i>	Cirakkoli	Capparaceae	Not assessed
18	<i>Capparis sepiaria</i>	Kattukkattari	Capparaceae	Not assessed
19	<i>Azanza lampas</i>	Kattupparutti	Malvaceae	Not assessed
20	<i>Balanites aegyptiaca</i>	Nanchundan	Zygophyllaceae	Not assessed
21	<i>Oxalis corniculata</i>	Paliakiri	Oxalidaceae	Not assessed
22	<i>Parthenium hysterophorus</i>	Vishachedi	Asteraceae	Not assessed
23	<i>Ricinus communis</i>	Amanakku	Euphorbiaceae	Not assessed
24	<i>Sida cordifolia</i>	Arivalmukku	Malvaceae	Not assessed
25	<i>Solanum incanum</i>	Karimulli	Solanaceae	Not assessed
26	<i>Solanum torvum</i>	Sundaikkai	Solanaceae	Not assessed

S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
27	<i>Calotropis gigantea</i>	Erukku	Asclepiadaceae	Not assessed
28	<i>Calotropis procera</i>	Vellai Erukku	Asclepiadaceae	Not assessed
29	<i>Citrus limon</i>	Elumicchai	Rutaceae	Not assessed
30	<i>Cassia auriculata</i>	Avaram	Caesalpiniaceae	Not assessed
31	<i>Cereus pterogonus</i>	Sippaai kathaalai	Cactaceae	Not assessed
32	<i>Lantana camara</i>	Unnichi	Verbenaceae	Not assessed
33	<i>Lawsonia inermis</i>	Maruthani	Lythraceae	Not assessed
34	<i>Nerium oleander</i>	Arali	Apocynaceae	Not assessed
35	<i>Ochna squarrosa</i>	Kalkuruvi	Ochnaceae	Not assessed
36	<i>Tarenna asiatica</i>	Tharani	Rubiaceae	Not assessed
37	<i>Tecoma stans</i>	Manjarali	Bignoniaceae	Not assessed
Herb Species				
1	<i>Abutilon indicum</i>	Akatam	Malvaceae	Not assessed
2	<i>Acalypha indica</i>	Kuppai-meni	Euphorbiaceae	Not assessed
3	<i>Achyranthes aspera</i>	Nayuruvi	Amaranthaceae	Not assessed
4	<i>Acorus calamus</i>	Vashambu	Acoraceae	Not assessed
5	<i>Aerva lanata</i>	Ciru-pulai	Amaranthaceae	Not assessed
6	<i>Ageratum conyzoides</i>	Aappakkoti	Asteraceae	Not assessed
7	<i>Argemone mexicana</i>	Eliyotti	Papaveraceae	Not assessed
8	<i>Amaranthus spinosus</i>	Mullukkeerai	Amaranthaceae	Not assessed
9	<i>Cyperus rotundus</i>	Panni-korai	Cyperaceae	Not assessed
10	<i>Digera muricata</i>	Thoyya keerai	Amaranthaceae	Not assessed
11	<i>Eclipta prostrata</i>	Karisalanganni	Asteraceae	Not assessed
12	<i>Andrographis paniculata</i>	Nilavempu	Acanthaceae	Not assessed
13	<i>Apluda mutica</i>	Moongil pul	Poaceae	Not assessed
14	<i>Commelina benghalensis</i>	Kanang-karai	Comllinaceae	Not assessed
15	<i>Cymbopogon citratus</i>	Karppurappul	Poaceae	Not assessed
16	<i>Cynodon dactylon</i>	Arugam pullu	Poaceae	Not assessed
17	<i>Cyperus exaltatus</i>	Wara-pullu	Cyperaceae	Not assessed
18	<i>Aristida setacea</i>	Thudaippam pul	Poaceae	Not assessed
19	<i>Asystasia gangetica</i>	Miti-kirai	Acanthaceae	Not assessed
20	<i>Boerhavia diffusa</i>	Mukaratte kirai	Nyctaginaceae	Not assessed

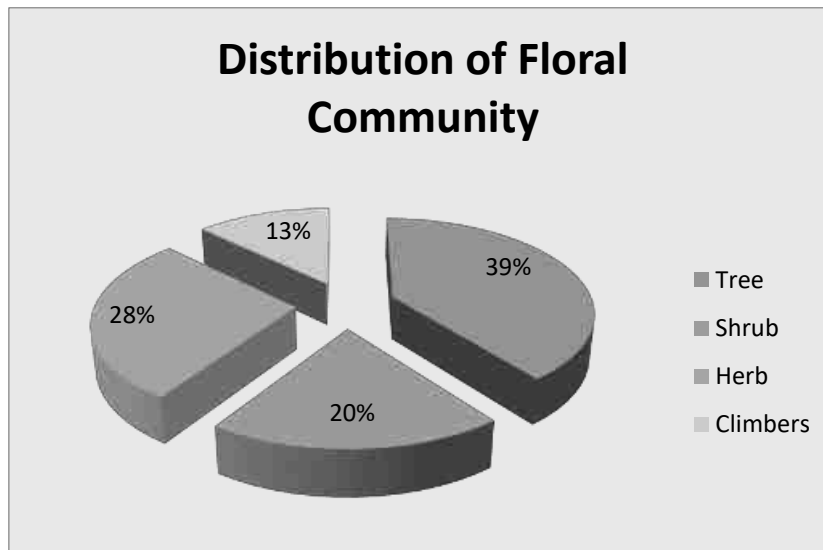


S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
21	<i>Cassia occidentalis</i>	Pei- avarai	Caesalpiniaceae	Not assessed
22	<i>Cassia tora</i>	Taghrai	Caesalpiniaceae	Not assessed
23	<i>Catharanthus roseus</i>	Nithyakalyani	Apocynaceae	Not assessed
24	<i>Cenchrus biflorus</i>	Kollukattai pul	Poaceae	Not assessed
25	<i>Chloris barbata</i>	Chevvarakupul	Poaceae	Not assessed
26	<i>Coleus aromaticus</i>	Karpurvalli	Lamiaceae	Not assessed
27	<i>Ocimum basilicum</i>	Sweet basil	Lamiaceae	Not assessed
28	<i>Ocimum sanctum</i>	Thulasi	Lamiaceae	Not assessed
29	<i>Leucas cephalotes</i>	Thumbai	Lamiaceae	Not assessed
30	<i>Mimosa pudica</i>	Thottaccurungi	Fabaceae	Least Concern
31	<i>Mirabilis jalapa</i>	Andhi mandhaarai	Nyctaginaceae	Not assessed
32	<i>Momordica charantia</i>	Pagarkkai	Cucurbitaceae	Not assessed
33	<i>Physalis minima</i>	Sodakkuthakkaali	Solanaceae	Not assessed
34	<i>Oxalis corniculata</i>	Pulivayilai	Oxalidaceae	Not assessed
35	<i>Parthenium hysterophorus</i>	Gajar ghas	Asteraceae	Not assessed
36	<i>Phyla nodiflora</i>	Poduthalai	Verbenaceae	Least Concern
37	<i>Phyllanthus amarus</i>	Keelanelli	Phyllanthaceae	Not assessed
38	<i>Aloe vera</i>	Katrazhai	Liliaceae	Not assessed
39	<i>Alternanthera sessilis</i>	Ponnanganni	Amaranthaceae	Not assessed
40	<i>Amaranthus viridis</i>	Kuppaikkirai	Amaranthaceae	Not assessed
41	<i>Solanum pubescens</i>	Kaattu sundai kaai	Solanaceae	Not assessed
42	<i>Tephrosia purpurea</i>	Kolinchi	Fabaceae	Not assessed
43	<i>Tribulus lanuginosus</i>	Nerungi	Zygophyllaceae	Not assessed
44	<i>Trichodesma indicum</i>	Kavizh-thumbai	Boraginaceae	Not assessed
45	<i>Tridax procumbens</i>	Vettukkaaya-thalai	Astraceae	Not assessed
46	<i>Vernonia cinerea</i>	Puvamkuruntal	Asteraceae	Not assessed
47	<i>Sida acuta</i>	Karuncaranai	Malvaceae	Not assessed
48	<i>Sida rhombifolia</i>	Chitramutti	Malvaceae	Not assessed
49	<i>Solanum nigrum</i>	Manathakkali	Solanaceae	Not assessed
50	<i>Euphorbia hirta</i>	Amanpatchaiarisi	Euphorbiaceae	Not assessed

S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
51	<i>Evolvulus alsinoides</i>	Vishnukarandi	Convolvulaceae	Not assessed
52	<i>Gomphrena globosa</i>	Vadamalli	Amaranthaceae	Not assessed
53	<i>Hemidesmus indicus</i>	Nannaari	Asclipadaceae	Not assessed
54	<i>Indigofera oblongifolia</i>	Avuri	Fabaceae	Not assessed
Climbers				
1	<i>Abrus precatorius</i>	Kundumani	Fabaceae	Not assessed
2	<i>Aristolochia bracteolata</i>	Aduthinarpalai	Aristolochiaceae	Not assessed
3	<i>Bougainvillea spectabilis</i>	Kakitha poo	Nyctaginaceae	Not assessed
4	<i>Cissus quadrangularis</i>	Perandai	Vitaceae	Not assessed
5	<i>Citrullus colocynthis</i>	Kumatti	Cucurbitaceae	Not assessed
6	<i>Luffa cylindrica</i>	Peerkankai	Cucurbitaceae	Not assessed
7	<i>Pergularia daemia</i>	Velipparuthi	Apocynaceae	Not assessed
8	<i>Pueraria tuberosa</i>	Nilapoosani	Fabaceae	Not assessed
9	<i>Coccinia grandis</i>	Kovaikkaai	Cucurbitaceae	Not assessed
10	<i>Cyclea peltata</i>	Pon-mucuttai	Menispermaceae	Not assessed
11	<i>Clitoria ternatea</i>	Sangu Poo	Fabaceae	Not assessed
12	<i>Ipomoea nil</i>	Kotikkakkattan	Convolvulaceae	Not assessed
13	<i>Ipomoea obscura</i>	Siruthalai	Convolvulaceae	Not assessed
14	<i>Ipomoea pes-caprae</i>	Attukkal	Convolvulaceae	Not assessed
15	<i>Ipomoea reptans</i>	Vallaikkirai	Convolvulaceae	Not assessed
16	<i>Gloriosa superba</i>	Sengandhal	Liliaceae	Not assessed
17	<i>Hemidesmus indicus</i>	Nannari	Apocynaceae	Not assessed
18	<i>Ichnocarpus frutescens</i>	Utar-koti	Apocynaceae	Not assessed
19	<i>Ipomoea dissecta</i>	Kakkattan	Convolvulaceae	Not assessed
20	<i>Basella rubra</i>	Pasalakkirai	Basellaceae	Not assessed
21	<i>Solena amplexicaulis</i>	Pulivanci	Cucurbitaceae	Not assessed
22	<i>Tragia involucrata</i>	Kanchori	Euphorbiaceae	Not assessed

S. No.	Scientific Name	Local Name	Family	IUCN Conservation Status
23	<i>Trichosanthes cucumerina</i>	Pudalankaai	Curcubitaceae	Not assessed
24	<i>Tylophora asthmatica</i>	Kalutai-p-palai	Asclepidaceae	Not assessed
25	<i>Tylophora indica</i>	Nachchuruppam	Asclipedaceae	Not assessed
26	<i>Tylophora asthmatica</i>	Kalutai-p-palai	Asclepidaceae	Not assessed

The detailed study revealed dominance of *Cocos nucifera*, *Azadirachta indica*, *Acacia auriculiformis*, *Leucaena leucocephala*, etc. Totally 94 species of trees are found in the study area along with 37 shrub species, 54 herb species, 26 climbers. From the study of core area, *Lantana camara*, *Calotropis gigantea*, *Calotropis procera*, *Hibiscus rosa-sinensis*, *Datura metel*, *Tecoma stans* are found to be the predominant shrub species. Among the herbaceous species *Cynodon dactylon*, *Tridax procumbens*, *Cyperus rotundus*, *Commelina benghalensis*, *Vernonia cinerea*, *Sida acuta*, *Digera muricata*, *Argemone Mexicana*, etc. found to be abundant.



□ Phytosociological Analysis

Phytosociological parameters such as, density, frequency and importance value index of individual species were determined in randomly placed quadrats of different sizes in the study area. Relative frequency, relative basal area and relative density were calculated and the sum of these three represented Importance Value Index (IVI) for various species. For shrubs, herbs and seedlings, the IVI was calculated by summing up relative frequency, relative density and relative abundance.

Sample plots were selected in such a way to get maximum representation of different types of vegetation and plots were laid out in different part of the study area of 10 km radius. Analysis of the vegetation will help in determining the relative importance of each species in the study area and to reveal if any economically valuable species is threatened in the process. Phytosociological analysis of tree species is shown in Table 3-35.



Table 3.34 Phytosociological Analysis of Tree Species

S. No.	Scientific Name	Local Name	Q1	Q2	Q3	Q4	Total No.	Total no. of quad	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
Tree Species																
1	<i>Acacia auriculiformis</i>	Katthisavukku	1	1	1	1	4	4	4	1.00	2.60	100.0	2.7	1.00	0.03	5.29
2	<i>Ailanthus excelsa</i>	Perumaram	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
3	<i>Albizia amara</i>	Arappumaram	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
4	<i>Albizia lebeck</i>	Siridam	1				1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
5	<i>Bombax ceiba</i>	Sittan	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
6	<i>Borassus flabellifer</i>	Nonkuppanai	1	1			2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
7	<i>Bridelia retusa</i>	Mullu-Vengai	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
8	<i>Buchanania lanzan</i>	Charam		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
9	<i>Butea monosperma</i>	Palasam	1		1	1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
10	<i>Acacia catechu</i>	Cenkarungali		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
11	<i>Acacia leucophloea</i>	Velvelam	1	1	1		3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
12	<i>Acacia nilotica</i>	Karuvel		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
13	<i>Aegle marmelos</i>	Vilvam	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
14	<i>Carica papaya</i>	Pappali		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
15	<i>Ixora arborea</i>	Koran	1				1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
16	<i>Kydia calycina</i>	Vattakannu		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
17	<i>Annona reticulata</i>	Ramachita			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
18	<i>Artocarpus heterophyllus</i>	Palaa		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
19	<i>Azadirachta indica</i>	Veppai	1	1	2	1	5	4	4	1.25	3.25	100.0	2.7	1.25	0.03	5.95
20	<i>Bambusa arundinacea</i>	Kulay-munkil	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
21	<i>Bauhinia purpurea</i>	Nilattiruvatti		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
22	<i>Albizia saman</i>	Thoongumoonji maram	1				1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
23	<i>Anacardium occidentale</i>	Mundiri		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
24	<i>Ficus benjamina</i>	Vellal			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha
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S. No.	Scientific Name	Local Name	Q1	Q2	Q3	Q4	Total No.	Total no. of quad	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
25	<i>Ficus hispida</i>	Peyatti	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
26	<i>Ficus racemosa</i>	Atthi		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
27	<i>Ficus religiosa</i>	Arasamaram		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
28	<i>Gardenia gummifera</i>	Sirukkambil				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
29	<i>Gmelina arborea</i>	Kumalaamaram		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
30	<i>Guazuma tomentosa</i>	Kattu Utharaksham	1				1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
31	<i>Drypetes sepiaria</i>	Kaayalakkamaram		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
32	<i>Erythrina variegata</i>	Kalyana murungai			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
33	<i>Eucalyptus leptophylla</i>	Neelagiri thailam	1	1			2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
34	<i>Ficus benghalensis</i>	Alai		1	1	1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
35	<i>Leucaena leucocephala</i>	Subabul	1	1	1	1	4	4	4	1.00	2.60	100.0	2.7	1.00	0.03	5.29
36	<i>Moringa oleifera</i>	Murungai		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
37	<i>Morus alba</i>	Kambli chedi			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
38	<i>Murraya koenigii</i>	Karivepillai		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
39	<i>Pongamia pinnata</i>	Pungam			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
40	<i>Terminalia bellirica</i>	Thandri				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
41	<i>Wrightia tinctoria</i>	Paalai	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
42	<i>Hibiscus tiliaceus</i>	Nirpparutti		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
43	<i>Bauhinia racemosa</i>	Atti			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
44	<i>Carissa carandas</i>	Kalakkai				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
45	<i>Cassia fistula</i>	Appai	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
46	<i>Prosopis juliflora</i>	Vaelikaruvai		1	1	1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
47	<i>Psidium guajava</i>	Segappu koyyaa	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
48	<i>Mimusops elengi</i>	Magizhamboo		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
49	<i>Terminalia catappa</i>	Nattuvaduma			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
50	<i>Terminalia chebula</i>	Kadukkai		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32



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S. No.	Scientific Name	Local Name	Q1	Q2	Q3	Q4	Total No.	Total no. of quad	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
51	<i>Terminalia tomentosa</i>	Marutham	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
52	<i>Trema orientalis</i>	Yerralai		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
53	<i>Morinda citrifolia</i>	Nuna			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
54	<i>Cassia siamea</i>	Manjalkonrai		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
55	<i>Catunaregam spinosa</i>	Madkarai		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
56	<i>Cocos nucifera</i>	Tennai	1	1	2	2	6	4	4	1.50	3.90	100.0	2.7	1.50	0.04	6.60
57	<i>Dalbergia sissoo</i>	Shisham			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
58	<i>Delonix elata</i>	Perungondrai		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
59	<i>Delonix regia</i>	Cemmayir-konrai	1				1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
60	<i>Diospyros chloroxylon</i>	Karuvakkanai			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
61	<i>Diospyros ferrea</i>	Irumbili		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
62	<i>Diospyros melanoxylon</i>	Karundumbi	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
63	<i>Ziziphus jujuba</i>	Ilanthai		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
64	<i>Ziziphus mauritiana</i>	Elandhai				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
65	<i>Prosopis cineraria</i>	Vanni	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
66	<i>Musa paradisiaca</i>	Vaazhai	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
67	<i>Neolamarckia cadamba</i>	Vellaikkatampu		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
68	<i>Odina wodier</i>	Oti				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
69	<i>Sapindus emarginatus</i>	Ponnankottai			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
70	<i>Limonia acidissima</i>	Vilamaram	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
71	<i>Madhuca longifolia</i>	Illupei			1	1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
72	<i>Mangifera indica</i>	Mamaram		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
73	<i>Manilkara zapota</i>	Sapota	1		1	1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
74	<i>Melia azedarach</i>	Kattu vembhu		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
75	<i>Parkinsonia aculeata</i>	Sinia tumana				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
76	<i>Phoenix acaulis</i>	Kaattu echam			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha
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77	<i>Phoenix sylvestris</i>	Paareecham	1	1		1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
78	<i>Salvadora oleoides</i>	Peru-kalarva			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
79	<i>Mesua ferrea</i>	Nagamaram		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
80	<i>Phyllanthus emblica</i>	Nelli				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
81	<i>Pithecellobium dulce</i>	Kodukkappuli			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
82	<i>Plumeria rubra</i>	Nela sampangi	1	1			2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
83	<i>Polyalthia longifolia</i>	Nettilinkam			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
84	<i>Tecomella undulata</i>	Malampuluvan				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
85	<i>Tectona grandis</i>	Thekku		1		2	3	2	4	0.75	1.95	50.0	1.3	1.50	0.02	3.30
86	<i>Terminalia arjuna</i>	Marutham			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
87	<i>Morinda tinctoria</i>	Mannanunai		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
88	<i>Sesbania sesban</i>	Sithagathi				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
89	<i>Strychnos potatorum</i>	Thethankottai	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
90	<i>Syzygium cumini</i>	Naval	1	1	1		3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
91	<i>Tamarindus indica</i>	Puli	1	1		1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
	Total		34	42	46	32	154	150	364							
Shrub Species																
1	<i>Ammannia baccifera</i>	Kalluruvi	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
2	<i>Annona squamosa</i>	Sitapalam	1	1		1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
3	<i>Clerodendrum inerme</i>	Sangam	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
4	<i>Datura metel</i>	Umathai	1	1	2	2	6	4	4	1.50	3.90	100.0	2.7	1.50	0.04	6.60
5	<i>Dodonaea viscosa</i>	Virali	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
6	<i>Thevetia peruviana</i>	Ponnarali		1			1	2	4	0.25	0.65	50.0	1.3	0.50	0.01	1.99
7	<i>Vitex negundo</i>	Nochi	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
8	<i>Xanthium strumarium</i>	Marul-umattai		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
9	<i>Ziziphus nummularia</i>	Narielandai	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha
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10	<i>Ziziphus oenopia</i>	Suraimullu		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
11	<i>Hibiscus rosa-sinensis</i>	Chemparuththi	1		2	2	5	3	4	1.25	3.25	75.0	2.0	1.67	0.03	5.28
12	<i>Hibiscus sabdariffa</i>	Simaikkasuru		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
13	<i>Jatropha curcas</i>	Kattukkottai	1		1	1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
14	<i>Jatropha gossypifolia</i>	Siria Amanakku		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
15	<i>Euphorbia tirucalli</i>	Amman-paccarici	1		1	1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
16	<i>Glycosmis pentaphylla</i>	Kattukkonci		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
17	<i>Capparis decidua</i>	Cirakkoli	1				1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
18	<i>Capparis sepiaria</i>	Kattukkattari			1	1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
19	<i>Azanza lampas</i>	Kattupparutti		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
20	<i>Balanites aegyptiaca</i>	Nanchundan	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
21	<i>Oxalis corniculata</i>	Paliakiri	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
22	<i>Parthenium hysterophorus</i>	Vishachedi		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
23	<i>Ricinus communis</i>	Amanakku		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
24	<i>Sida cordifolia</i>	Arivalmukku	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
25	<i>Solanum incanum</i>	Karimulli		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
26	<i>Solanum torvum</i>	Sundaikkai	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
27	<i>Calotropis gigantea</i>	Erukku	1	1	1	1	4	4	4	1.00	2.60	100.0	2.7	1.00	0.03	5.29
28	<i>Calotropis procera</i>	Vellai Erukku	1	2	1	1	5	4	4	1.25	3.25	100.0	2.7	1.25	0.03	5.95
29	<i>Citrus limon</i>	Elumicchai			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
30	<i>Cassia auriculata</i>	Avaram	1		1	1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
31	<i>Cereus pterogonus</i>	Sippaai kathaalai	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
32	<i>Lantana camara</i>	Unnichedi	2	2	2	2	8	4	4	2.00	5.19	100.0	2.7	2.00	0.05	7.91
33	<i>Lawsonia inermis</i>	Maruthani		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
34	<i>Nerium oleander</i>	Arali		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
35	<i>Ochna squarrosa</i>	Kalkuruvi	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65



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S. No.	Scientific Name	Local Name	Q1	Q2	Q3	Q4	Total No.	Total no. of quad	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
36	<i>Tarenna asiatica</i>	Tharani		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
37	<i>Tecoma stans</i>	Manjarali	1	1	1	1	4	4	4	1.00	2.60	100.0	2.7	1.00	0.03	5.29
	Total		23	21	23	24	91	83	148						0.59	
Herb Species																
1	<i>Abutilon indicum</i>	Akatam	1		1	1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
2	<i>Acalypha indica</i>	Kuppai-meni	1	1			2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
3	<i>Achyranthes aspera</i>	Nayuruvi	1		1	1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
4	<i>Acorus calamus</i>	Vashambu	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
5	<i>Aerva lanata</i>	Ciru-pulai	1	1		1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
6	<i>Ageratum conyzoides</i>	Aappakkoti	1	1		1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
7	<i>Argemone mexicana</i>	Eliyotti	1	1	1	1	4	4	4	1.00	2.60	100.0	2.7	1.00	0.03	5.29
8	<i>Amaranthus spinosus</i>	Mullukkeerai	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
9	<i>Cyperus rotundus</i>	Panni-korai		2	1	2	5	3	4	1.25	3.25	75.0	2.0	1.67	0.03	5.28
10	<i>Digera muricata</i>	Thoyya keerai	2	1		1	4	3	4	1.00	2.60	75.0	2.0	1.33	0.03	4.62
11	<i>Eclipta prostrata</i>	Karisalanganni		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
12	<i>Andrographis paniculata</i>	Nilavempu	1	1		1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
13	<i>Apluda mutica</i>	Moongil pul	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
14	<i>Commelina benghalensis</i>	Kanang-karai	1	1	2	1	5	4	4	1.25	3.25	100.0	2.7	1.25	0.03	5.95
15	<i>Cymbopogon citratus</i>	Karppurappul		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
16	<i>Cynodon dactylon</i>	Arugam pullu	3	3	4	2	12	4	4	3.00	7.79	100.0	2.7	3.00	0.08	10.54
17	<i>Cyperus exaltatus</i>	Wara-pullu		2	2		4	2	4	1.00	2.60	50.0	1.3	2.00	0.03	3.96
18	<i>Aristida setacea</i>	Thudaippam pul	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
19	<i>Asystasia gangetica</i>	Miti-kirai		1	2		3	2	4	0.75	1.95	50.0	1.3	1.50	0.02	3.30
20	<i>Boerhavia diffusa</i>	Mukaratte kirai	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
21	<i>Cassia occidentalis</i>	Pei-avarai		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
22	<i>Cassia tora</i>	Taghrai	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65



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23	<i>Catharanthus roseus</i>	Nithyakalyani		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
24	<i>Cenchrus biflorus</i>	Kollukattai pul				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
25	<i>Chloris barbata</i>	Chevvarakupul		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
26	<i>Coleus aromaticus</i>	Karpurvalli	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
27	<i>Ocimum basilicum</i>	Sweet basil		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
28	<i>Ocimum sanctum</i>	Thulasi			1	1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
29	<i>Leucas cephalotes</i>	Thumbai	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
30	<i>Mimosa pudica</i>	Thottaccurungi		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
31	<i>Mirabilis jalapa</i>	Andhi mandhaarai			1	1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
32	<i>Momordica charantia</i>	Pagarkkai	1				1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
33	<i>Physalis minima</i>	Sodakkuthakkaali		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
34	<i>Oxalis corniculata</i>	Pulivayilai	1			1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
35	<i>Parthenium hysterophorus</i>	Gajar ghas			1		1	4	4	0.25	0.65	100.0	2.7	0.25	0.01	3.32
36	<i>Phyla nodiflora</i>	Poduthalai		1		1	2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
37	<i>Phyllanthus amarus</i>	Keelanelli	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
38	<i>Aloe vera</i>	Katrazhai			2		2	1	4	0.50	1.30	25.0	0.7	2.00	0.01	1.98
39	<i>Alternanthera sessilis</i>	Ponnanganni		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
40	<i>Amaranthus viridis</i>	Kuppaikkirai	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
41	<i>Solanum pubescens</i>	Kaattu sundai kaai			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
42	<i>Tephrosia purpurea</i>	Kolinchi	1				1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
43	<i>Tribulus lanuginosus</i>	Nerungi			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
44	<i>Trichodesma indicum</i>	Kavizh-thumbai		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
45	<i>Tridax procumbens</i>	Vettukkaaya-thalai	2	2	2	3	9	4	4	2.25	5.84	100.0	2.7	2.25	0.06	8.57
46	<i>Vernonia cinerea</i>	Puvamkuruntal	1	2	1	1	5	4	4	1.25	3.25	100.0	2.7	1.25	0.03	5.95
47	<i>Sida acuta</i>	Karuncaranai	1		2	1	4	3	4	1.00	2.60	75.0	2.0	1.33	0.03	4.62
48	<i>Sida rhombifolia</i>	Chitramutti		2	1		3	2	4	0.75	1.95	50.0	1.3	1.50	0.02	3.30



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha
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S. No.	Scientific Name	Local Name	Q1	Q2	Q3	Q4	Total No.	Total no. of quad	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
49	<i>Solanum nigrum</i>	Manathakkali		1			1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
50	<i>Euphorbia hirta</i>	Amanpatchaiarisi	1	1		1	3	3	4	0.75	1.95	75.0	2.0	1.00	0.02	3.97
51	<i>Evolvulus alsinoides</i>	Vishnukarandi	1		1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
52	<i>Gomphrena globosa</i>	Vadamalli		1	1		2	2	4	0.50	1.30	50.0	1.3	1.00	0.01	2.65
53	<i>Hemidesmus indicus</i>	Nannaari				1	1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
54	<i>Indigofera oblongifolia</i>	Avuri			1		1	1	4	0.25	0.65	25.0	0.7	1.00	0.01	1.32
	Total		32	35	42	27	136	115	216						0.88	

The interpretation vegetation study results of the study area are presented in the following Table 3-36.

Table 3.35 Interpretation of Vegetation Results in the Buffer Area

<i>Relative density</i>	Relative density is found to be maximum for <i>Cocos nucifera</i> about 3.9	Density of the primary species is found to be much higher in comparison with the other species.
<i>Relative frequency</i>	Maximum RF found to be 2.7 in case of <i>Cocos nucifera</i> .	Vegetation community is heterogenous in nature
<i>Relative Abundance</i>	Maximum value observed in case of <i>Cocos nucifera</i> about 0.04	<i>Cocos nucifera</i> the most common species found in the area.
<i>Importance Value Index (IVI)</i>	The maximum IVI value observed in case of <i>Cocos nucifera</i> is about 6.6	The dominant species are <i>Cocos nucifera</i>

Biodiversity Indices

Biodiversity index is a quantitative measure that reflects how many different type of species, there are in a dataset, and simultaneously takes into account how evenly the basic entities (such as individuals) are distributed among those types of species. The value of biodiversity index increases both when the number of types increases and when evenness increases. For a given number of type of species, the value of a biodiversity index is maximized when all type of species are equally abundant. Interpretation of Vegetation results in the study area is given in Table 3-37.

Table 3.36 Interpretation of Vegetation results in the Core Area

Community	Biodiversity indices		
	Shannon-Wiener Index (H)	Simpson Diversity Index (1/D)	Species Evenness
Tree	4.38	0.99	0.29
Shrub	2.17	0.98	0.21
Herb	3.45	0.98	0.25

From Table 3.37, it can be interpreted that tree community has higher diversity. While the shrub community shows less diversity. It is also observed that most of the quadrates have controlled generation of plant species with older strands. Higher tree species diversity can be interpreted as a greater number of successful species and a more stable ecosystem where more ecological niches are available and the environment is less likely to be hostile, environmental change is less likely to be damaging to the ecosystem as a whole.

3.10.6.9 Economically important Flora of the study area

Agricultural crops: Major crops cultivated in the study area are coconut trees, fruit crops like mango, banana, jack and aonla, vegetables like tomato, brinjal, bhendi and tapioca, spices and plantation crops like areca nut and cashew and flowers like jasmine, pitchi and crossandra.



Medicinal plant species: The nearby area is also endowed with the several medicinal plants which are commonly available in the shrubs and waste lands. The common medicinal plants of the region are *Azadirachta indica* (Neem), *Withania somnifera*, etc.

3.10.6.10 Faunal Communities

Both direct (sighting) and indirect (evidences) observations methods were used to survey the faunal species around the study area. Additionally, reference of relevant literatures (published/ unpublished) and dialogues with local villagers were also carried out to consolidate the presence of faunal distribution in the area (*Smith 1933-43, Ali and Ripley 1983, Daniel 1983, Prater 1993, Murthy and Chandrasekhar 1988*).

Mammals: No wild mammalian species was directly sighted during the field survey. But conversation with local villagers around the study area confirm presence of some wild animal in that area. Bonnet Macaque, Common Grey Langur, Five striped squirrel, Three striped Palm Squirrel, Nilgai, Short nosed fruit bat, Chital, Large bandicoot Rat, Indian Grey Mongoose, Indian Field Mouse, Indian Hare, Common house Rat, Indian Crested Porcupine, Small India civet, House Shrew, Common otter, Home mouse, Indian Wild Boar, Indian Fox, Mole rat etc. were observed during primary survey. No Schedule 1 Mammals recorded within study area.

Avifauna: Since birds are considered to be the indicators for monitoring and understanding human impacts on ecological systems (*Lawton, 1996*) attempt was made to gather quantitative data on the avifauna by walk through survey within the entire study area and surrounding areas. From the primary survey, a total of 81 species of avifauna were identified and recorded in the study area. The diversity of avifauna from this region was found to be quite high and encouraging.

Others: The tree lizard and common garden lizards are also seen. Variety of butterflies (like Bright babul blue, Common Pierrot, Forget-me-not, Indian Sunbeam, Common tiger, Red-spot Jezebel, Common crow, Small Grass Yellow, Green-spotted triangle, Common Banded Awl, Great Eggfly, Danaid eggfly, Chestnut Bob, Common bushbrown, Common sailor, Crimson rose, Lime butterfly, Common Mormon, Indian Skipper, Indian Palm Bob, Southern birdwing, Dark Grass Blue) is spotted in abundance in the study zone.

List of animals present in the study area are given in Table 3-38.

Table 3.37 Fauna Recorded from the Primary Survey in the Study Area and their Conservation Status

S. No.	Scientific Name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
Mammals					
1	<i>Semnopithecus entellus</i>	Common Grey Langur	II	Least Concern	DS
2	<i>Funambulus pennantii</i>	Five striped squirrel	--	Least Concern	DS
3	<i>Funambulus palmarum</i>	Three striped Palm Squirrel	--	Least Concern	DS
4	<i>Boselaphus tragocamelus</i>	Nilgai	Appendix III	Least Concern	DS
5	<i>Canis aureus</i>	Jackal	Appendix III	Least Concern	NS
6	<i>Cynopterus sphinx</i>	Short nosed fruit bat	--	Least Concern	DS
7	<i>Axis axis</i>	Chital	II	Least Concern	DS
8	<i>Bandicota indica</i>	Large bandicoot Rat	--	Least Concern	DS
9	<i>Herpestes edwardsii</i>	Indian Grey Mongoose	Appendix III	Least Concern	DS
10	<i>Mus booduga</i>	Indian Field Mouse	--	Least Concern	DS
11	<i>Lepus nigricollis</i>	Indian Hare	II	Least Concern	DS
12	<i>Rattus rattus</i>	Common house Rat	--	Least Concern	DS
13	<i>Viverricula indica</i>	Small India civet	Appendix III	Least Concern	DS
14	<i>Suncus murinus</i>	House Shrew	--	Least Concern	DS
15	<i>Mus musculus</i>	Home mouse	--	Least Concern	DS
16	<i>Sus scrofa</i>	Indian Wild Boar	II	Least Concern	NS
17	<i>Vulpes bengalensis</i>	Indian Fox	Appendix III	Least Concern	NS
18	<i>Bandicota bengalensis</i>	Mole rat	--	Least Concern	DS
Birds					
1	<i>Acridotheres tristis</i>	Common myna	II	Least Concern	DS
2	<i>Ardeola grayii</i>	Pond heron	II	Least Concern	DS
3	<i>Artamus fuscus</i>	Ashy swallow shrike	II	Least Concern	DS
4	<i>Athene brama</i>	Southern Spotted owlet	II	Least Concern	DS



S. No.	Scientific Name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
5	<i>Bubulcus ibis</i>	Cattle egret	II	Least Concern	DS
6	<i>Centropus sinensis</i>	Crow pheasant	II	Least Concern	DS
7	<i>Ceryle rudis</i>	Pied Kingfisher	II	Least Concern	DS
8	<i>Charadrius dubius</i>	Little ringed plover	II	Least Concern	DS
9	<i>Charadrius leschenaultii</i>	Large sand plover	II	Least Concern	DS
10	<i>Chlidonias hybrida</i>	Indian whiskered tern	II	Least Concern	DS
11	<i>Acrocephalus dumetorum</i>	Blyth's reed warbler	II	Least Concern	DS
12	<i>Alcedo atthis</i>	Small blue kingfisher	II	Least Concern	DS
13	<i>Amaurornis phoenicurus</i>	White-breasted waterhen	II	Least Concern	DS
14	<i>Anas poecilorhyncha</i>	Indian spot-billed duck	II	Least Concern	DS
15	<i>Anastomus oscitans</i>	Asian open billed stork	II	Least Concern	DS
16	<i>Anthus hodgsoni</i>	Tree pipit	II	Least Concern	DS
17	<i>Apus apus</i>	Common swift	II	Least Concern	DS
18	<i>Ardea alba</i>	Large egret	II	Least Concern	DS
19	<i>Ardea cinerea</i>	Grey heron	II	Least Concern	DS
20	<i>Ardea intermedia</i>	Intermediate egret	II	Least Concern	DS
21	<i>Ardea purpurea</i>	Purple heron	II	Least Concern	DS
22	<i>Columba livia</i>	Blue rock pigeon	--	Least Concern	DS
23	<i>Cuculus canorus</i>	Cuckoo	II	Least Concern	DS
24	<i>Cuculus micropterus</i>	Indian cuckoo	II	Least Concern	DS
25	<i>Dendrocitta leucogastra</i>	Southern tree pie	II	Least Concern	DS
26	<i>Elanus caeruleus</i>	Black-winged Kite	II	Least Concern	DS
27	<i>Eudynamys scolopaceus</i>	Indian koel	II	Least Concern	DS
28	<i>Ficedula albicilla</i>	Red-throated flycatcher	II	Least Concern	DS
29	<i>Francolinus pondicerianus</i>	Grey Francolin	II	Least Concern	DS



S. No.	Scientific Name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
30	<i>Gallinula chloropus</i>	Common Moorhen	II	Least Concern	DS
31	<i>Dicaeum agile</i>	Thick-billed flowerpecker	II	Least Concern	DS
32	<i>Dicrurus adsimilis</i>	Fork-tailed drongo	II	Least Concern	DS
33	<i>Coracias benghalensis</i>	South Indian roller	II	Least Concern	DS
34	<i>Corvus macrorhynchos</i>	Indian jungle crow	II	Least Concern	DS
35	<i>Corvus splendens</i>	House crow	--	Least Concern	DS
36	<i>Dicrurus macrocercus</i>	Black drongo	II	Least Concern	DS
37	<i>Dryocopus javensis</i>	Great black woodpecker	II	Least Concern	DS
38	<i>Ducula aenea</i>	Green imperial pigeon	II	Least Concern	DS
39	<i>Egretta garzetta</i>	Little egret	II	Least Concern	DS
40	<i>Egretta intermedia</i>	Intermediate egret	II	Least Concern	DS
41	<i>Nectarinia minima</i>	Small sunbird	II	Least Concern	DS
42	<i>Nectarinia zeylonica</i>	Indian Purple rumped sunbird	II	Least Concern	DS
43	<i>Milvus migrans</i>	Common pariah kite	II	Least Concern	DS
44	<i>Oriolus chinensis</i>	Black naped oriole	II	Least Concern	DS
45	<i>Hirundo rustica</i>	Common eastern swallow	II	Least Concern	DS
46	<i>Hydrophasianus chirurgus</i>	Pheasant-tailed Jacana	II	Least Concern	DS
47	<i>Lanius cristatus</i>	Brown shrike	II	Least Concern	DS
48	<i>Lanius schach</i>	Long-tailed Shrike	II	Least Concern	DS
49	<i>Megalaima zeylanica</i>	Brown-headed barbet	II	Least Concern	DS
50	<i>Merops orientalis</i>	Small green bee-eater	II	Least Concern	DS
51	<i>Tringa ochropus</i>	Green sandpiper	II	Least Concern	DS
52	<i>Gallus sonneratii</i>	Grey jungle fowl	Appendix II	Least Concern	DS
53	<i>Monticola solitarius</i>	Blue rock thrush	II	Least Concern	DS
54	<i>Nectarinia asiatica</i>	Purple sunbird	II	Least Concern	DS



S. No.	Scientific Name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
55	<i>Nectarinia lotenia</i>	Loten's sunbird	II	Least Concern	DS
56	<i>Turdoides caudatus</i>	Common babbler	II	Least Concern	DS
57	<i>Turdoides striatus</i>	Jungle Babbler	II	Least Concern	DS
58	<i>Vanellus indicus</i>	Red-wattled lapwing	II	Least Concern	DS
59	<i>Pycnonotus cafer</i>	Red-vented bulbul	II	Least Concern	DS
60	<i>Saxicoloides fulicata</i>	Indian robin	II	Least Concern	DS
61	<i>Nycticorax nycticorax</i>	Night heron	II	Least Concern	DS
62	<i>Halcyon smyrnensis</i>	White-breasted kingfisher	II	Least Concern	DS
63	<i>Streptopelia chinensis</i>	Spotted dove	II	Least Concern	DS
64	<i>Surniculus lugubris</i>	Drongo Cuckoo	II	Least Concern	DS
65	<i>Tachybaptus ruficollis</i>	Little grebe	II	Least Concern	DS
66	<i>Oriolus oriolus</i>	Golden oriole	II	Least Concern	DS
67	<i>Orthotomus sutorius</i>	Tailor bird	II	Least Concern	DS
68	<i>Parus major</i>	Great Tit	II	Least Concern	DS
69	<i>Pellorneum ruficeps</i>	Spotted babbler	II	Least Concern	DS
70	<i>Perdica asiatica</i>	Jungle bush quail	II	Least Concern	DS
71	<i>Phalacrocorax niger</i>	Little cormorant	II	Least Concern	DS
72	<i>Pitta brachyura</i>	Indian pitta	II	Least Concern	DS
73	<i>Ploceus philippinus</i>	Baya weaver bird	II	Least Concern	DS
74	<i>Pluvialis squatarola</i>	Grey plover	II	Least Concern	DS
75	<i>Psittacula krameri</i>	Rose-ringed parakeet	II	Least Concern	DS
76	<i>Tephrodornis pondicerianus</i>	Common wood shrike	II	Least Concern	DS
77	<i>Tringa glareola</i>	Spotted sandpiper	II	Least Concern	DS
78	<i>Tringa hypoleucos</i>	Common sandpiper	II	Least Concern	DS
Reptiles & Amphibians					

S. No.	Scientific Name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
1	<i>Ahaetulla nasuta</i>	Green whip snake	--	Least Concern	DS
2	<i>Boiga dightoni</i>	Pirmad Cat Snake	--	Not assessed	DS
3	<i>Bungarus caeruleus</i>	Common krait	--	Not assessed	DS
4	<i>Naja naja</i>	Common cobra	Appendix II	Not assessed	NS
5	<i>Macropisthodon plumbicolor</i>	Green keel back	--	Not assessed	NS
6	<i>Calotes rouxii</i>	Roux's forest lizard	--	Least Concern	DS
7	<i>Calotes versicolor</i>	Common Garden Lizard	--	Least Concern	NS
8	<i>Cnemaspis littoralis</i>	Coastal day gecko	--	Data Deficient	NS
9	<i>Hemidactylus flaviviridis</i>	House Gecko	--	Not assessed	DS
10	<i>Hemidactylus frenatus</i>	Common house gecko	--	Least Concern	DS
11	<i>Hemidactylus giganteus</i>	Giant Gecko	--	Least Concern	DS
12	<i>Polypedates maculatus</i>	Tree frog	--	Least Concern	NS
13	<i>Duttaphrynus melanostictus</i>	Common toads	--	Least Concern	DS
14	<i>Euphlyctis cyanophlyctis</i>	Skipper frog	II	Least Concern	DS
Butterflies					
1	<i>Azanus ubaldus</i>	Bright babul blue	--	Not assessed	DS
2	<i>Castalius rosimon</i>	Common Pierrot	--	Not assessed	DS
3	<i>Catochrysops strabo</i>	Forget-me-not	--	Not assessed	DS
4	<i>Curetis thetis</i>	Indian Sunbeam	--	Not assessed	DS
5	<i>Danaus genutia</i>	Common tiger	--	Not assessed	DS
6	<i>Delias descombesi</i>	Red-spot Jezebel	--	Not assessed	DS
7	<i>Euploea core</i>	Common crow	--	Least Concern	DS
8	<i>Eurema brigitta</i>	Small Grass Yellow	--	Not assessed	DS
9	<i>Graphium agamemnon</i>	Green-spotted triangle	--	Not assessed	DS
10	<i>Hasora chromus</i>	Common Banded Awl	--	Not assessed	DS
11	<i>Hypolimnas bolina</i>	Great Eggfly	--	Not assessed	DS
12	<i>Hypolimnas misippus</i>	Danaid eggfly	--	Least Concern	DS
13	<i>Iambrix salsala</i>	Chestnut Bob	--	Not assessed	DS
14	<i>Mycalesis perseus</i>	Common bushbrown	--	Not assessed	DS
15	<i>Neptis hylas</i>	Common sailor	--	Not assessed	DS
16	<i>Pachliopta hector</i>	Crimson rose	--	Not assessed	DS
17	<i>Papilio demoleus</i>	Lime butterfly	--	Not assessed	DS
18	<i>Papilio polytes</i>	Common mormon	--	Not assessed	DS
19	<i>Spialia galba</i>	Indian Skipper	--	Not assessed	DS



S. No.	Scientific Name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
20	<i>Suastus gremius</i>	Indian Palm Bob	--	Not assessed	DS
21	<i>Troides minos</i>	Southern birdwing	--	Least Concern	DS
22	<i>Zizeeria karsandra</i>	Dark Grass Blue	--	Least Concern	DS

From the above diagramme, it is evident that avifauna found to be abundant (55%) within the study area and less number of mammals (26%) and reptiles/amphibians (11%) observed during field study.

Apart from agriculture locals of the villages were involved in livestock keeping and each of the individual had a substantial number of cattle. Livestock like cattle, goat, poultry, duck are reared for dairy products, meat, egg and for agriculture purpose. Majority of cattle are of local variety. Backyard poultry farms are mostly common in this area; however, some commercial poultry farms are also recorded in the study area.

None of the sighted animal species can be assigned endemic species category of the study area. The study area is marked with moderate population of flora and fauna. With reference to the Wildlife Protection Act 1972 (Last Updated 1-4-2023) total number of wildlife tabulated in this study can be characterized as given in the Table 3-39.

**Table 3.38 Characterization of Fauna In The Study Area
(As Per W.P Act, 1972; Last Updated 1-4-2023)**

S. No.	Schedule of Wildlife Protection Act 1972	No. of species	Remark
1	Schedule I	0	-
2	Schedule II	80	-
3	Appendix I	0	-
4	Appendix II	2	-
5	Appendix III	5	-

The detailed interpretation of flora and fauna identified within 10 km radius of the project site are tabulated in Table 3-40.

Table 3.39 Description of Flora and Fauna

S. No.	Type of Species	Scientific Name	Common Name
Flora			
1	Endangered species	<i>Tectona grandis</i>	Thekku
		<i>Borassus flabellifer</i>	Nonkuppanai
2	Threatened species	None	-
3	Near Threatened species	<i>Aegle marmelos</i>	Vilvam
4	Vulnerable species	None	-
Fauna			
1	Endangered species	None	-
2	Threatened species	None	-



S. No.	Type of Species	Scientific Name	Common Name
3	Near Threatened species	<i>Lutra lutra</i>	Common otter
4	Vulnerable species	None	-
5	Migratory Corridors & Flight Paths	No corridors & flight paths	-
6	Breeding & Spawning grounds	None	-

A comprehensive Central Legislation namely Wild Life (Protection) Act was enforced in 1972 to provide protection to wild animals. Schedule-I of this act contains the list of rare and endangered species, which are completely protected throughout the country. The list of faunal species and their conservation status as per Wild Life Protection Act 1972 (Last Updated 1-4-2023) presented in Table 3-39 reveals that 80 species belongs to Schedule-II, 2 species belongs to Appendix-II and 5 species belongs to Appendix-III.

3.10.7 Marine Environment

3.10.7.1 Bed Sediment Quality

Sediment samples were collected from 10 locations within 10 Km radius of the project site and securely sealed for further analysis. The location of the sediment collection given in following Table 3-41.

Table 3.40 Bed sediment sampling locations

Location Code	Geographical location	
	Latitude	Longitude
MS1	08°15'23.20"N	77° 07'27.67E
MS2	08°11'41.83"N	77° 12'13.46 E
MS3	08°16'39.78"N	77° 04'25.12E
MS4	08°13'49.34"N	77° 07'54.26"E
MS5	08°12'22.61"N	77° 09'49.30"E
MS6	08°09'14.27"N	77° 14'11.88"E
MS7	08°14'51.11"N	77° 04'34.30"E
MS8	08°13'39.67"N	77° 06'19.54"E
MS9	08°11'13.81"N	77° 09'21.90"E
MS10	08°09'14.14"N	77° 12'13.42"E

3.10.7.2 Results & Observations

The collected Marine sediment samples were analyzed and results of sediment analysis are given in Table 3.42.

- **pH:** The pH value of all Marine sediment samples ranges from 7.68 to 8.15.
- **Texture:** Texture is clay and silty clay for all the samples.
- **Total Organic Carbon:** Total Organic Carbon content in Marine sediment samples ranges from 2.74 to 5.22 %.
- **Phosphorus:** Phosphorus content in Marine sediment samples ranges from 148 to 334 mg/kg.

- **Iron:** Iron content in Marine sediment samples ranges from 378 to 612 mg/kg.
- **Zinc:** Zinc content in Marine sediment samples ranges from 64 to 114 mg/kg.
- **Manganese:** Manganese content in Marine sediment samples ranges from 84 to 216 mg/kg.

Cadmium, Nickel, Mercury, Selenium, Total Arsenic, Total Petroleum Hydrocarbon in all IT sediment samples were found below detection limit (BDL).

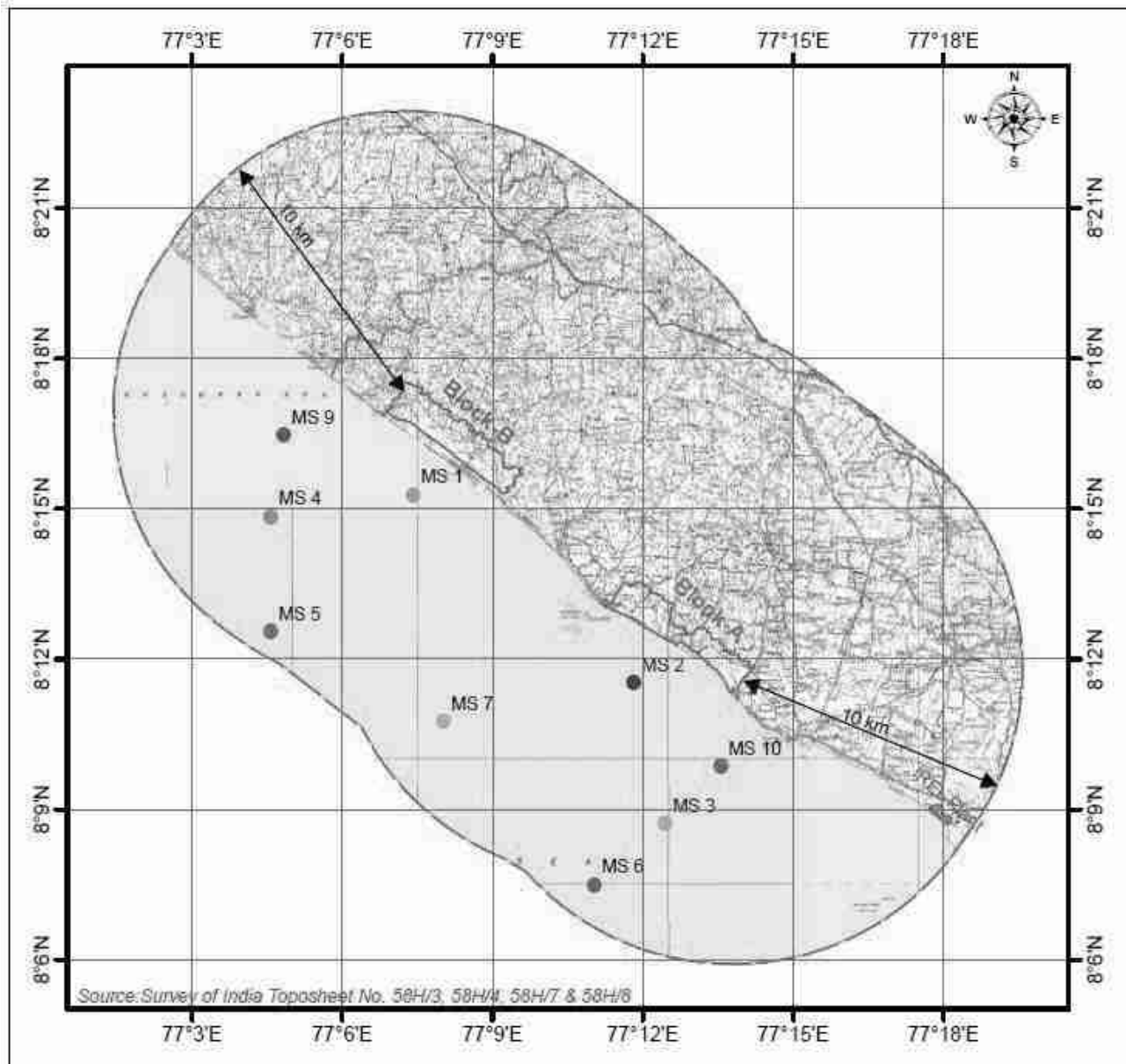


Figure 3.26 Sampling Locations



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TEST REPORT

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

Report number	: ABCTL/IREL/EIA/2022/12/MS1-MS10
Sample Drawn by	: ABC Techno Labs India Private Limited
Sampling method	: APHA 23 rd Edition
Sample description	: Marine Sediment Analysis
Project Name	: Mining of Atomic Minerals at Keezhmidalam -A, Midalam -B, Enayampurbenthurai, Ezhodesam -A, B & C and Kollencode A & B Villages of Killiyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 15-12-2022
Date of Receipt	: 17-12-2022
Date of Analysis	: 18-12-2022
Report date	: 28-12-2022 Page 1 of 3
MS1- 08°15'23.20"N, 77° 07'27.67E, MS2- 08°11'41.83"N, 77° 12'13.46 E, MS3- 08°16'39.78"N, 77° 04'25.12E, MS4- 08°13'49.34"N, 77° 07'54.26E	

S. No	Parameter	Unit	Results				Test procedure
			MS1	MS2	MS3	MS4	
1	pH	-	7.68	7.87	7.93	8.11	IS-2720(Part 26)1987(RA 2021)
2	Texture	%	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Robinson Pipette Method
3	Total Organic Carbon as C	%	3.11	2.74	3.18	3.48	IS 2720 (Part 22):1972 (RA 2020)
4	Phosphorous as P	mg/kg	170	148	164	202	EPA 3050 B & FAO Chapter 3/ ABCTL/SOIL SOP02
5	Iron as Fe	mg/kg	438	511	378	456	USEPA 3050B & USEPA 7000B
6	Zinc as Zn	mg/kg	72	96	69	102	USEPA 3050B & USEPA 7000B
7	Manganese as Mn	mg/kg	132	84	118	148	USEPA 3050B & USEPA 7000B
8	Lead as Pb	mg/kg	4.78	6.32	7.13	6.11	USEPA 3050B & USEPA 7000B
9	Cadmium as Cd	mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
10	Chromium as Cr	mg/kg	11	13.1	10.7	15.8	USEPA 3050B & USEPA 7000B
11	Nickel as Ni	mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
12	Copper as Cu	mg/kg	20.6	25.4	32.8	41.6	USEPA 3050B & USEPA 7000B
13	Mercury as Hg	mg/kg	BDL(<1)	BDL(<1)	BDL(<1)	BDL(<1)	USEPA 3050B & USEPA 7471B
14	Selenium as Se	mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
15	Total Arsenic as As	mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
16	Total Petroleum Hydrocarbon	mg/kg	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)	ABCTL/INS/SOP/31

BDL - Below Detection Limit

Contd. ---

S. Dharami
Quality Manager



A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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TEST REPORT

ISSUED TO: The General Manager and Head
IREL India Limited
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Report number	: ABCTL/IREL/EIA/2022/12/MS1-MS10
Sample Drawn by	: ABC Techno Labs India Private Limited
Sampling method	: APHA 23 rd Edition
Sample description	: Marine Sediment Analysis
Project Name	: Mining of Atomic Minerals at Kaezhmidalam -A, Midalam -B, Enayamputhenthurai, Ezhudesam -A, B & C and Kollencode A & B Villages of Killiyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 15-12-2022
Date of Receipt	: 17-12-2022
Date of Analysis	: 18-12-2022
Report date	: 28-12-2022

Page 2 of 3

MSS- 08°12'22.61"N, 77° 09'49.30E, MS6-08°09'14.27"N, 77° 14'11.88E, MS7- 08°14'51.11"N, 77° 04'34.30E
MS8- 08°13'39.67"N, 77° 06'19.54E,

S.No	Parameter	Unit	Results				Test procedure
			MSS	MS6	MS7	MS8	
1	pH	-	7.81	7.71	7.94	8.06	IS -2720(Part 26)1987(RA 2021)
2	Texture	%	Clay	Clay	Clay	Clay	Robinson Pipette Method
3	Total Organic Carbon as C	%	4.56	4.13	5.07	4.71	IS 2720 (Part 22):1972 (RA 2020)
4	Phosphorous as P	mg/kg	334	278	302	264	EPA 3050 B & FAO Chapter 3/ ABCTL/SQL SOP02
5	Iron as Fe	mg/kg	505	396	451	612	USEPA 3050B & USEPA 7000B
6	Zinc as Zn	mg/kg	77	104	91	64	USEPA 3050B & USEPA 7000B
7	Manganese as Mn	mg/kg	178	216	168	152	USEPA 3050B & USEPA 7000B
8	Lead as Pb	mg/kg	8.13	5.08	4.11	6.36	USEPA 3050B & USEPA 7000B
9	Cadmium as Cd	mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
10	Chromium as Cr	mg/kg	13.3	17.1	11.5	9.3	USEPA 3050B & USEPA 7000B
11	Nickel as Ni	mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
12	Copper as Cu	mg/kg	35.6	23.6	42	31.4	USEPA 3050B & USEPA 7000B
13	Mercury as Hg	mg/kg	BDL(<1)	BDL(<1)	BDL(<1)	BDL(<1)	USEPA 3050B & USEPA 7471B
14	Selenium as Se	mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
15	Total Arsenic as As	mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
16	Total Petroleum Hydrocarbon	mg/kg	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)	BDL (<0.05)	ABCTL/INS/SOP/31

BDL - Below Detection Limit

Contd

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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TEST REPORT

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

Report number	: ABCTL/IREL/EIA/2022/12/MS1-MS10
Sample Drawn by	: ABC Techno Labs India Private Limited
Sampling method	: APHA 23 rd Edition
Sample description	: Marine Sediment Analysis
Project Name	: Mining of Atomic Minerals at Keezhmidalam -A, Midalam -B, Enayamputhenthurai, Ezhudesam -A,B & C and Kollencode A & B Villages of Killiyoor Taluk in Kanniyakumari district, Tamil Nadu
Date of sampling	: 15-12-2022
Date of Receipt	: 17-12-2022
Date of Analysis	: 18-12-2022
Report date	: 28-12-2022

Page 3 of 3

MS9- 08°11'13.81"N, 77° 09'21.90E, MS10-08°09'14.14"N, 77° 12'13.42E,

S.No	Parameter	Unit	Results		Test procedure
			MS9	MS10	
1.	pH	-	7.94	8.15	IS-2720(Part 26):1987(RA 2021)
2.	Texture	%	Clay	Clay	Robinson Pipette Method
3.	Total Organic Carbon as C	%	5.22	4.82	IS 2720 (Part 22):1972 (RA 2020)
4.	Phosphorous as P	mg/kg	311	270	EPA 3050 B & FAO Chapter 3/ ABCTL/SOIL SOP02
5.	Iron as Fe	mg/kg	410	604	USEPA 3050B & USEPA 7000B
6.	Zinc as Zn	mg/kg	114	84	USEPA 3050B & USEPA 7000B
7.	Manganese as Mn	mg/kg	181	142	USEPA 3050B & USEPA 7000B
8.	Lead as Pb	mg/kg	5.36	4.33	USEPA 3050B & USEPA 7000B
9.	Cadmium as Cd	mg/kg	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
10.	Chromium as Cr	mg/kg	10.1	12.8	USEPA 3050B & USEPA 7000B
11.	Nickel as Ni	mg/kg	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
12.	Copper as Cu	mg/kg	24.8	37.8	USEPA 3050B & USEPA 7000B
13.	Mercury as Hg	mg/kg	BDL(<1)	BDL(<1)	USEPA 3050B & USEPA 7471B
14.	Selenium as Se	mg/kg	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
15.	Total Arsenic as As	mg/kg	BDL(<2)	BDL(<2)	USEPA 3050B & USEPA 7000B
16.	Total Petroleum Hydrocarbon	mg/kg	BDL (<0.05)	BDL (<0.05)	ABCTL/INS/SOP/31

BDL - Below Detection Limit

...End of Report...

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorized Signatory

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Table 3.41 Marine Sediment Quality Results

Sl. No	Parameters	Unit	Test Method	MS1	MS2	MS3	MS4	MS5	MS6	MS7	MS8	MS9	MS10
1	pH	-	IS -2720(Part 26)1987(RA 2016)	7.68	7.87	7.93	8.11	7.81	7.71	7.94	8.06	7.94	8.15
2	Texture	%	Robinson Pipette Method	Silty Clay	Silty Clay	Silty Clay	Silty Clay	Clay	Clay	Clay	Clay	Clay	Clay
3	Total Organic Carbon as C	%	IS 2720 (Part 22):1972 (RA 2015)	3.11	2.74	3.18	3.48	4.56	4.13	5.07	4.71	5.22	4.82
4	Phosphorous as P	mg/kg	EPA 3050 B & FAO Chapter 3/ ABCTL/SOIL SOP02	170	148	164	202	334	278	302	264	311	270
5	Iron as Fe	mg/kg	USEPA 3050B & USEPA 7000B	438	511	378	456	505	396	451	612	410	604
6	Zinc as Zn	mg/kg	USEPA 3050B & USEPA 7000B	72	96	69	102	77	104	91	64	114	84
7	Manganese as Mn	mg/kg	USEPA 3050B & USEPA 7000B	132	84	118	148	178	216	168	152	181	142
8	Lead as Pb	mg/kg	USEPA 3050B & USEPA 7000B	4.78	6.32	7.13	6.11	8.13	5.08	4.11	6.36	5.36	4.33
9	Cadmium as Cd	mg/kg	USEPA 3050B & USEPA 7000B	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
10	Chromium as Cr	mg/kg	USEPA 3050B & USEPA 7000B	11	13.1	10.7	15.8	13.3	17.1	11.5	9.3	10.1	12.8
11	Nickel as Ni	mg/kg	USEPA 3050B & USEPA 7000B	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
12	Copper as Cu	mg/kg	USEPA 3050B & USEPA 7000B	20.6	25.4	32.8	41.6	35.6	23.6	42	31.4	24.8	37.8
13	Mercury as Hg	mg/kg	USEPA 3050B & USEPA 7471B	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
14	Selenium as Se	mg/kg	USEPA 3050B & USEPA 7000B	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
15	Total Arsenic as As	mg/kg	USEPA 3050B & USEPA 7000B	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
16	Total Petroleum Hydrocarbon	mg/kg	ABCTL/INS/SOP/31	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

3.10.7.3 Sea and Harbour Water Quality

Temperatures, Salinity, DO, BOD, Nitrate, Nitrite, Ammonia, Total Nitrogen, Inorganic Phosphate were monitored. All parameters were estimated following standard methods. Biological variables have also been studied and this includes planktons (both Phyto and Zooplankton), productivity and benthos (macro & meio). Marine water samples were collected from 10 locations within 10 Km radius of the project site. The collected samples were securely stored and analyzed in laboratory for various parameters (Table 3.43).

Table 3.42 Marine water sampling locations

Location Code	Geographical location	
	Latitude	Longitude
MW1	08°15'23.20"N	77° 07'27.67E
MW2	08°11'41.83"N	77° 12'13.46 E
MW3	08°16'39.78"N	77° 04'25.12E
MW4	08°13'49.34"N	77° 07'54.26"E
MW5	08°12'22.61"N	77° 09'49.30"E
MW6	08°09'14.27"N	77° 14'11.88"E
MW7	08°14'51.11"N	77° 04'34.30"E
MW8	08°13'39.67"N	77° 06'19.54"E
MW9	08°11'13.81"N	77° 09'21.90"E
MW10	08°09'14.14"N	77° 12'13.42"E

Source: ABC Techno Labs India Pvt. Ltd.

3.10.7.4 Results:

The collected marine water samples were analyzed and results of marine water analysis are given in Table 3.44.

Physical Parameters

- **Salinity:** Salinity in marine water samples ranges from 33.1 ppt to 35.6 ppt.
- **Turbidity:** The turbidity of marine water samples was found in the range 1.3 to 3.3 NTU.
- **pH:** The pH value of all marine water samples ranges from 8.11 to 8.31.
- **Total Suspended Solids:** TSS in marine water samples ranges from 2 to 6 mg/l.

Chemical Parameters

- **Nitrite:** Nitrite content in marine water samples ranges from 0.05 mg/l to 0.10 mg/l.
- **Nitrate:** Nitrate content in marine water samples ranges from 1.5 mg/l to 3.2 mg/l.
- **Phosphate:** Phosphate content in marine water samples ranges from 0.07 mg/l to 0.21 mg/l.
- **Iron:** The iron content in all marine water sample found to be BDL (<0.05) mg/l.
- **Zinc:** Zinc content in all marine water samples found to be 0.08 mg/l to 0.16 mg/l.
- **Dissolved Oxygen (DO):** The DO level of the marine samples found to be in the range between 6.4 mg/l to 6.6 mg/l.
- **Bio-chemical Oxygen Demand (BOD):** The BOD level of the marine samples found to be <2 mg/l.

Other Parameters

Manganese, Lead, Cadmium, Nickel, Chromium, Copper, Mercury, Selenium, Total Arsenic, Cyanide, Total Petroleum Hydrocarbon in all Marine water samples were found below detection limit (BDL).



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TEST REPORT

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

Report number	: ABCTL/TTDC/EIA/2023/04/MW1-MW3
Sample Drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622 -1981
Sample description	: Marine Water Analysis
Project Name	: Mining of Atomic Minerals at Keezhmidalam -A, Midalam -B, Enayamputhenthoral, Ezhudesam -A,B & C and Kollencode A & B Villages of Killiyoor Taluk in Kanyakumari district, Tamil Nadu
Date of sampling	: 15-12-2022
Date of Receipt	: 17-12-2022
Date of Analysis	: 18-12-2022
Report date	: 28-12-2022

Page 1 of 6

MW1- 08°15'23.20"N, 77° 07'27.67E, MW2- 08°11'41.83"N, 77° 12'13.46 E, MW3- 08°16'39.78"N, 77° 04'25.12E,

S. No	Parameter	Unit	Results			Test procedure
			MW1	MW2	MW3	
1	Temperature	°C	26.6	26.1	26.9	APHA 23 rd Edn -2550B
2	Salinity	ppt	33.6	33.1	34.1	APHA 23 rd Edn-Electrometric Method
3	pH	-	8.11	8.21	8.26	IS: 3025 Part 11-1983 (Reaff: 2017)
4	Total Suspended Solids	mg/l	6	4	3	IS:3025 Part 17-1984(Reaff:2017)
5	Turbidity	mg/l	2.8	3.3	2.5	IS : 3025 Part 10-1984 (Reaff: 2017)
6	Dissolve Oxygen as O ₂	mg/l	6.5	6.5	6.4	IS:3025:Part-38:1989(Reaff: 2019)
7	Bio-Chemical Oxygen Demand	mg/l	<2	<2	<2	IS:3025:Part-44:1993(Reaff: 2019)
8	Nitrite as NO ₂	mg/l	0.05	0.06	0.10	APHA 23 rd Edn - 4500-NO ₂ -B.
9	Nitrate as NO ₃	mg/l	1.8	2.2	1.8	APHA 23 rd Edn -4500-NO ₃ - B
10	Phosphate as PO ₄	mg/l	0.11	0.17	0.21	IS:3025:Part-31:1988 (Reaff:2019)
11	Total Nitrogen as N	mg/l	3	3.1	2.8	APHA 23 rd Edn -4500- Norg B
12	Iron as Fe	mg/l	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	APHA 23 rd Edn -3111 B
13	Zinc as Zn	mg/l	0.13	0.16	0.08	APHA 22 nd Edn -3111 B
14	Manganese as Mn	mg/l	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	APHA 23 rd Edn -3111 B
15	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	APHA 23 rd Edn -3111 B
16	Cadmium as Cd	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	APHA 23 rd Edn -3111 B

Contd ...

S.Dharani
Quality Manager



A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

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TEST REPORT

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manayalukurichi, Kanyakumari District.

Report number	: ABCTL/IREL/EIA/2022/12/MW1-MW3
Sample description	: Marine Water Analysis
Report date	: 28-12-2022 Page 2 of 6

S No	Parameter	Unit	Results			Test Procedure
			MW1	MW2	MW3	
17	Nickel as Ni	mg/l	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	APHA 23 rd Edn -3111 B
18	Chromium as Cr	mg/l	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)	APHA 23 rd Edn -3111 B
20	Copper as Cu	mg/l	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)	APHA 23 rd Edn -3111 B
19	Mercury as Hg	mg/l	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	APHA 23 rd Edn -3112 B
20	Selenium as Se	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	APHA 23 rd Edn -3113 B
21	Total Arsenic as As	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	APHA 23 rd Edn -3113 B
22	Cyanide as CN	mg/l	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	APHA 23 rd Edn -4500-CN E
23	Total Petroleum Hydrocarbon	mg/l	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	APHA 23 rd Edn -6440 B

BDL - Below Detection Limit.

Contd ...

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Quality Manager



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Technical Manager

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EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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TEST REPORT

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

Report number	: ABCTI/ETDC/EIA/2023/04/MW4-MW6
Sample Drawn by	: ABC Techno Labs India Private Limited
Sampling method	: IS: 3025 Part 1 - 1987 & IS: 1622 - 1981
Sample description	: Marine Water Analysis
Project Name	: Mining of Atomic Minerals at Keezhmidalam -A, Midalam -B, Enayamputhenthurai, Ezhudesam -A,B & C and Kollencode A & B Villages of Killiyoor Taluk in Kanniyakumari district, Tamil Nadu.
Date of sampling	: 15-12-2022
Date of Receipt	: 17-12-2022
Date of Analysis	: 18-12-2022
Report date	: 28-12-2022 Page 3 of 6
MW4- 08°13'49.34"N, 77° 07'54.26E, MW5- 08°12'22.61"N, 77° 09'49.30E, MW6-08°09'14.27"N, 77° 14'11.88E	

S. No	Parameter	Unit	Results			Test procedure
			MW4	MW5	MW6	
1	Temperature	°C	26.1	27.1	27	APHA 23 rd Edn -2550B
2	Salinity	ppt	34.6	34.8	35.1	APHA 23 rd Edn-Electrometric Method
3	pH	-	8.19	8.24	8.31	IS: 3025 Part 11-1983 (Reaff: 2017)
4	Total Suspended Solids	mg/l	3	2	2	IS:3025 Part 17-1984(Reaff:2017)
5	Turbidity	mg/l	2.2	2.1	1.7	IS : 3025 Part 10-1984 (Reaff: 2017)
6	Dissolve Oxygen as O ₂	mg/l	6.6	6.5	6.6	IS:3025-Part-38-1989(Reaff: 2019)
7	Bio-Chemical Oxygen Demand	mg/l	<2	<2	<2	IS:3025:Part-44:1993(Reaff: 2019)
8	Nitrite as NO ₂	mg/l	0.05	0.06	0.09	APHA 23 rd Edn - 4500-NO ₂ -B.
9	Nitrate as NO ₃	mg/l	1.8	1.9	2.2	APHA 23 rd Edn -4500-NO3- B.
10	Phosphate as PO ₄	mg/l	0.09	0.08	0.10	IS:3025-Part-31:1988 (Reaff:2019)
11	Total Nitrogen as N	mg/l	2.5	3	2.7	APHA 23 rd Edn -4500- Norg B
12	Iron as Fe	mg/l	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	APHA 23 rd Edn -3111 B
13	Zinc as Zn	mg/l	0.07	0.10	0.08	APHA 22 nd Edn -3111 B
14	Manganese as Mn	mg/l	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	APHA 23 rd Edn -3111 B
15	Lead as Pb	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	APHA 23 rd Edn -3111 B
16	Cadmium as Cd	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	APHA 23 rd Edn -3111 B

Contd ...

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinadurai
A. Robson Chinadurai
Technical Manager

Verified by

Authorized Signatory

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TEST REPORT

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanniyakumari District.

Report number	: ABCTL/IREL/EIA/2022/12/MW4-MW6
Sample description	: Marine Water Analysis
Report date	: 28-12-2022 Page 4 of 6

S. No	Parameter	Unit	Results			Test Procedure
			MW4	MW5	MW6	
17	Nickel as Ni	mg/l	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	APHA 23 rd Edn -3111 B
18	Chromium as Cr	mg/l	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	APHA 23 rd Edn -3111 B
28	Copper as Cu	mg/l	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	APHA 23 rd Edn -3111 B
19	Mercury as Hg	mg/l	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	APHA 23 rd Edn -3112 B
20	Selenium as Se	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	APHA 23 rd Edn -3113 B
21	Total Arsenic as As	mg/l	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	APHA 23 rd Edn -3113 B
22	Cyanide as CN	mg/l	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	APHA 23 rd Edn -4500-CN E
23	Total Petroleum Hydrocarbon	mg/l	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	APHA 23 rd Edn -6440 B

BDL - Below Detection Limit

Contd ...

S.Dharani
Quality Manager



A. Robson Chinnadurai
Technical Manager

Verified by

Authorised Signatory

Terms and conditions

This test results valid only to the items tested. • The test report shall not be reutilized in full or part without the written approval of ABCTL. • The test items which are retained for more than 15 days from the date of issue of test report for Non-Petroleum samples and in the case of Petroleum samples and items will be retained for five days after date of issue of report. The laboratory's responsibility under this report is limited to proper work engagement and will not exceed more than the stated amount. • The test report is issued for the purpose of identifying the characteristics and not intended to indicate any possibility of future performance.



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



ABC Techno Labs India Private Limited

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TEST REPORT

ISSUED TO: The General Manager and Head
IREL India Limited
Department of Atomic Energy
Manavalakurichi, Kanyakumari District.

Report number	: ABCTL/IREL/EIA/2022/12/MW7-MW10
Sample description	: Marine Water Analysis
Report date	: 28-12-2022 Page 6 of 6

S. No.	Parameter	Unit	Results				Test Procedure
			MW7	MWB	MW9	MW10	
17	Nickel as Ni	mg/l	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	APHA 23 rd Edn -3111 B
18	Chromium as Cr	mg/l	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)	APHA 23 rd Edn -3111 B
28	Copper as Cu	mg/l	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)	BDL (<0.03)	APHA 23 rd Edn -3111 B
19	Mercury as Hg	mg/l	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	APHA 23 rd Edn -3112 B
20	Selenium as Se	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	APHA 23 rd Edn -3113 B
21	Total Arsenic as As	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	APHA 23 rd Edn -3113 B
22	Cyanide as CN	mg/l	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	APHA 23 rd Edn -4500-CNE
23	Total Petroleum Hydrocarbon	mg/l	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	APHA 23 rd Edn -6440 B

BDL - Below Detection Limit

...End of Report...

S. Dharani
S.Dharani
Quality Manager



A. Robson Chinnadurai
A. Robson Chinnadurai
Technical Manager

Verified by

Authorized Signatory

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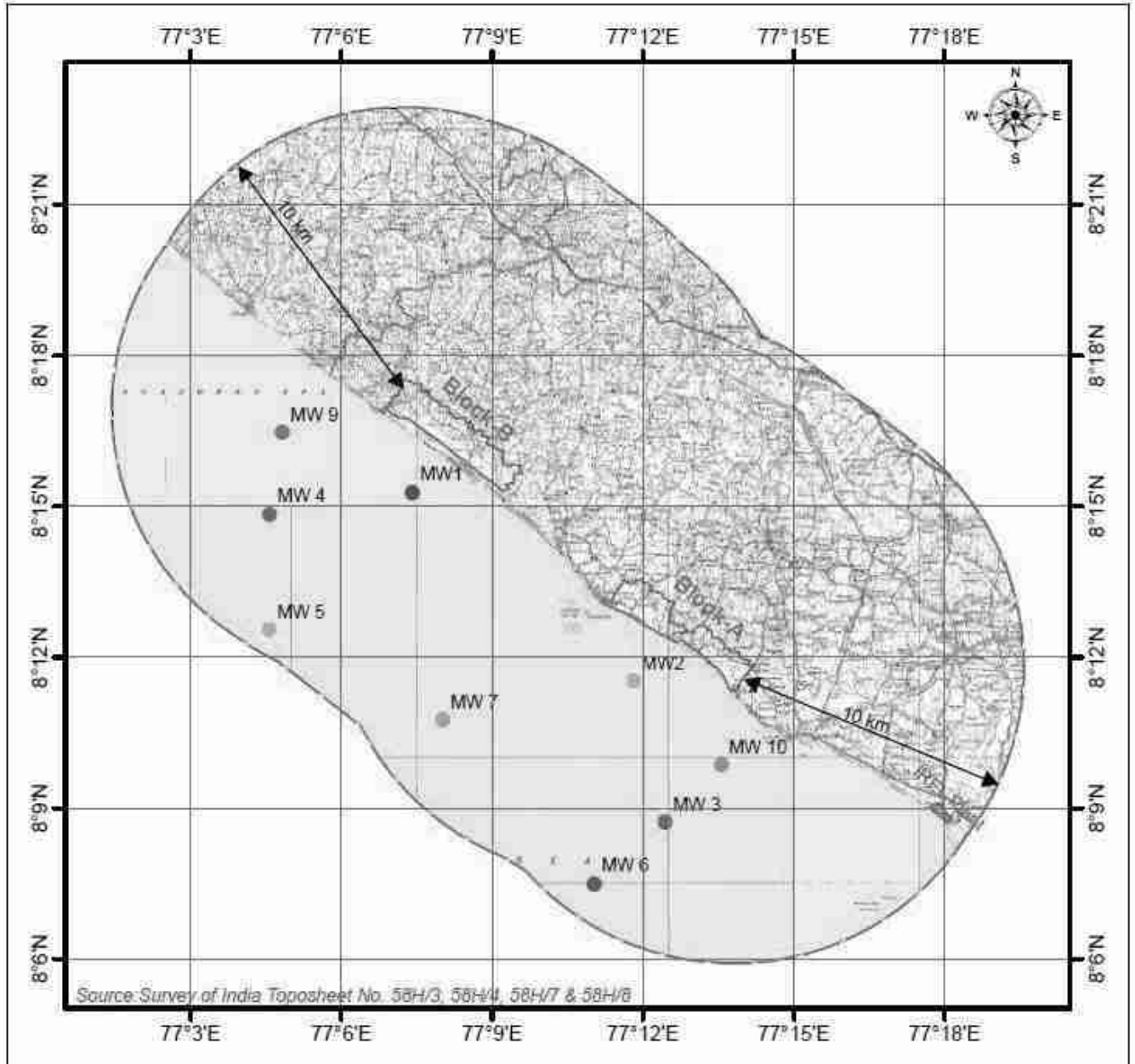


Figure 3.27 Sampling Locations

Table 3.43 Results for marine water analysis

S. No	Parameters	Unit	MW1	MW2	MW3	MW4	MW5	MW6	MW7	MW8	MW9	MW10
1	Temperature	°C	26.6	26.1	26.9	26.1	27.1	27	26.6	27.1	26.2	27.3
2	Salinity	ppt	33.6	33.1	34.1	34.6	34.8	35.1	34.9	34.8	35	35.6
3	pH	-	8.11	8.21	8.26	8.19	8.24	8.31	8.24	8.22	8.31	8.29
4	Total Suspended Solids	mg/l	6	4	3	3	2	2	3	2	2	3
5	Turbidity	NTU	2.8	3.3	2.5	2.2	2.1	1.7	1.7	1.3	2.2	3
6	Dissolve Oxygen	mg/l	6.5	6.5	6.4	6.6	6.5	6.6	6.5	6.4	6.4	6.6
7	Bio-Chemical Oxygen Demand	mg/l	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
8	Nitrite as NO ₂	mg/l	0.05	0.06	0.10	0.05	0.06	0.09	0.05	0.05	0.07	0.08
9	Nitrate as NO ₃	mg/l	1.8	2.2	1.8	1.8	1.9	2.2	3.2	2.1	1.5	2.9
10	Phosphate as PO ₄	mg/l	0.11	0.17	0.21	0.09	0.08	0.10	0.08	0.07	0.07	0.10
11	Total Nitrogen as N	mg/l	3	3.1	2.8	2.5	3	2.7	3.1	1.9	2.2	3.4
12	Iron as Fe	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
13	Zinc as Zn	mg/l	0.13	0.16	0.08	0.07	0.10	0.08	0.08	0.10	0.09	0.11
14	Manganese as Mn	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
15	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
16	Cadmium as Cd	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
17	Nickel as Ni	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
18	Chromium as Cr	mg/l	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
19	Copper as Cu	mg/l	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
20	Mercury as Hg	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
21	Selenium as Se	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
22	Total Arsenic as As	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
23	Cyanide as CN	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
24	Total Petroleum Hydrocarbon	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

3.11 Marine Ecology and Biodiversity

3.11.1 Introduction

Evaluation of the biological impulses on potential coastal development site is an integral part of an environmental impact assessment as the consequences of perturbations in the environment ultimately may affect the habitat. Development zones should be selected avoiding areas of intense breeding/nursery grounds of economically important living resources. Though organisms have evolved to withstand the change within certain limits, they may not be well adapted to manmade stresses. Thus, the monitoring programme should sufficiently target the entire potential at risk. Critical biological variables covering productivity at different trophic levels should be identified. Biological productivity has to be evaluated on the basis of phytoplankton pigments/cell counts as a measure of renewable primary resources; zooplankton standing stock in terms of biomass and population density and community structure; benthic population, biomass and group diversity at intertidal and sub tidal zones to evaluate benthic productivity associated with the sediment; information on larval stages of fish to evaluate probable occurrence of breeding grounds of economically important fish species and microbial examination to investigate the extent of contamination by pathogens as a measure of human influence.



While considering assessment of aquatic pollution and its implications, it must be realized that, despite many changes in the physico-chemical properties of the water body and seabed sediment, the ultimate consequences of pollutants may be reflected inevitably on the biological system. Hence, the investigations of an ecosystem and particularly of its communities constitute an integral part of any ecological assessment. This can be achieved by selecting a few reliable parameters from a complex community structure. The parameters considered have phytoplankton (cell count, and generic diversity), zooplankton (standing stock i.e., faunal groups), macro benthos (population and faunal groups) and status of fishery and mammals as well as birds. The first two reflects the productivity of a water column at the primary and secondary levels, respectively. Benthic organisms being sedentary animals associated with the seabed, provide information regarding the integrated effects of stress, if any, and hence serve as good indicators of early warnings of potential damages. Ultimate commercial interest being fisheries, the status of the exploitable fishery resources was assessed. Information on larval stages of fishes and decapods was used to evaluate probable occurrence of spawning and breeding grounds of economically important species.

To assess the planktonic profile of Phytoplankton and Zooplankton, 4 water samples from estuary region, intertidal zone and coastal water were collected at sub surface level. The marine ecological study was conducted in different water bodies of the study area and the flora and fauna was recorded.

The biological parameters considered in the present study are chlorophyll, primary production, abundance of phytoplankton, abundance of zooplankton and macro and meio benthic population. Phytoplankton and zooplankton reflect the productivity of a water column at primary and secondary levels. Benthic organisms being associated with the seabed, provide information regarding the integrated effects of stress due to disturbances, if any, and hence are good indicators of early warning of potential damage.

Table 3.44 Marine Sampling Locations

Location Code	Geographical Location		Distance from Project Site
	Latitude	Longitude	
Marine Water			
MR1	8°11'5.27"N	77°13'35.24"E	0.6
MR2	8°12'50.47"N	77°11'5.12"E	0.55
MR3	8°15'6.35"N	77° 8'45.01"E	0.5
MR4	8°16'35.54"N	77° 6'42.23"E	0.7

and nutrients for growth, but some other factors such as water depth, water temperature, wind and grazers also play a significant role. Primary productivity varies from freshwater to estuarine and from estuarine to marine water bodies. Its major components are net and gross primary production.

The results indicate that the area is moderately productive, and the values varied from 422 to 473 mgC/m³/day (Table 3-47).

Table 3.46 Primary productivity and chlorophyll concentration

Station	Gross Photosynthetic activity	Net Photosynthetic activity	Primary production mgC/m ³ /day
S1	1.6	1.12	455
S2	1.7	0.91	465
S3	1.5	0.72	426
S4	1.8	0.83	473

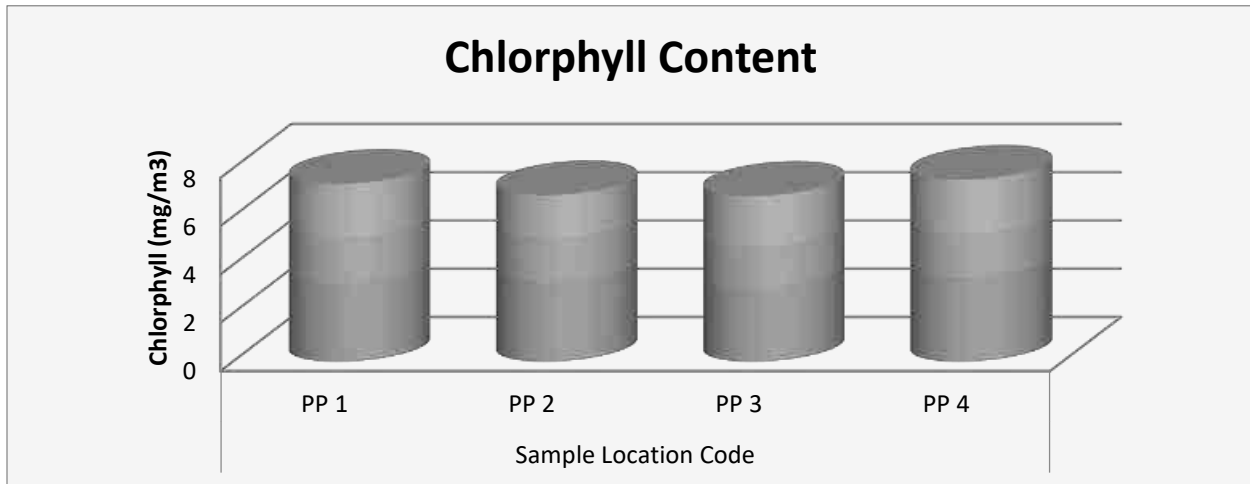
Source: ABC Techno Labs India Pvt. Ltd.

3.11.4 Chlorophyll

Chlorophyll, in various forms, is bound within the living cells of algae and other phytoplankton found in surface water. Chlorophyll-containing organisms are the first step of production in the most food chains, and the health and abundance of these primary producers affect the integrity of the other trophic levels. It is a key biochemical component in the molecular apparatus that is responsible for photosynthesis, the critical process in which the energy from sunlight is used to produce life-sustaining oxygen. In the photosynthetic reaction below, carbon dioxide is reduced by water, and chlorophyll assists this transfer. The results indicate that the area is moderately productive, and the values of Chlorophyll-a varied from 2.98 to 3.45 mg/m³, Chlorophyll-b varied from 1.76 to 1.92 mg/m³ and Chlorophyll-c varied from 1.77 to 2.25 mg/m³. (Table 3-48).

Table 3.47 Chlorophyll Concentration

S. No.	Chlorophyll (mg/m ³)	Sample Location Code			
		PP 1	PP 2	PP 3	PP 4
1	Chl-a	3.21	3.26	2.98	3.45
2	Chl-b	1.92	1.85	1.76	1.82
3	Chl-c	2.22	1.77	2.11	2.25
	Total Chlorophyll	7.35	6.88	6.85	7.52



Source: ABC Techno Labs India Pvt. Ltd.

3.11.5 Plankton

3.11.5.1 Phytoplankton

Phytoplankton is the major primary producers of organic matter in the aquatic ecosystem and especially oceans whose 90% productivity is from the planktons. Phytoplankton samples were collected without filtering the water. To preserve, 0.3 mL lugol's solution was added to 100 ml sample. Subsequently, phytoplankton were concentrated by centrifugation and analysed microscopically in laboratory. Identification of phytoplankton was done using standard taxonomic keys.

The Lackey Drop (microtransect) method (Lackey 1938) is a simple method for obtaining counts of considerable accuracy (APHA 2017).

Chemicals/reagents used: Lugol's iodine

Equipments used: Centrifuge tubes of 15ml capacity, cover slips, glass slides, dropper, plastic bottles (100 ml capacity)

Instruments used: Centrifuge and Microscope.

- **Shannon Wiener Diversity index**

The most commonly accepted index in past few decades have been Shannon and Wiener equation which is based on both the number of taxon present and the relative abundance of each taxon. The Shannon Wiener diversity index is usually used to calculate species diversity but comparisons are also made using the different taxonomic levels (Hellawell 1978). This index (H) is a useful measure of community diversity.

$$H = \text{Sum} [(P_i) \times \ln (P_i)]$$

Sum: Summation

P_i: proportion of total samples represented by species- i

ln: Log of P_i

Species composition - A total of 48 species of phytoplankton belonging to 22 species of class Bacillariophyceae, 7 species of class Chlorophyceae, 6 species of class



Cyanophyceae and 5 species of class Dinophyceae were identified during the net haul. The phytoplankton density varies from 0.163 to 0.194 No/1000 ml species at sampling area (stns. PP1 to PP4). Bacillariophyceae (Diatoms) formed the major group followed by Dinophyceae (Dinoflagellates) and Cyanophyceae (blue green algae). Phytoplankton species composition in coastal waters is given in Table 3-49.

Table 3.48 Analysis Result of Phytoplankton

S. No.	Species	Class	Phyto Plankton Count (No.*10 ² /L)			
			PP 1	PP 2	PP 3	PP 4
1	<i>Achnanthes</i> sp.	Bacillariophyceae	6	6	7	8
2	<i>Anabaena</i> sp.	Cyanophyceae	3	4	3	3
3	<i>Anacystis</i> sp.	Cyanophyceae	13	12	12	12
4	<i>Ankistrodesmus spiralis</i>	Chlorophyceae	6	11	12	17
5	<i>Asterionella</i> sp.	Bacillariophyceae	2	4	2	4
6	<i>Azolla</i> sp.	Polypodiopsida	3	3	1	1
7	<i>Bacillaria paxillifer</i>	Bacillariophyceae	1	3	3	3
8	<i>Bellerochea malleus</i>	Bacillariophyceae	13	15	16	12
9	<i>Ceratium furca</i>	Dinophyceae	3	3	2	8
10	<i>Ceratium macroceros</i>	Dinophyceae	1	2	3	2
11	<i>Chaetoceros</i> sp.	Bacillariophyceae	12	15	16	11
12	<i>Chlamydomonas</i> sp.	Chlorophyceae	14	12	12	8
13	<i>Chlorella vulgaris</i>	Trebouxiophyceae	6	11	12	11
14	<i>Chlorococcum</i> sp.	Chlorophyceae	2	2	2	12
15	<i>Coscinodiscus centralis</i>	Bacillariophyceae	3	3	1	3
16	<i>Coscinodiscus subbulliens</i>	Bacillariophyceae	4	3	1	2
17	<i>Cyclotella</i> sp.	Bacillariophyceae	2	5	3	5
18	<i>Cylindrospermum</i> sp.	Cyanophyceae	1	1	0	0
19	<i>Dinophysis caudate</i>	Dinophyceae	1	1	0	1
20	<i>Ditylum</i> sp.	Bacillariophyceae	1	1	1	1
21	<i>Gloeotrichia</i> sp.	Cyanophyceae	2	2	2	2
22	<i>Gracilaria</i> sp.	Rhodophyceae	12	15	16	3
23	<i>Navicula</i> sp.	Bacillariophyceae	14	12	12	2
24	<i>Nitzschia</i> sp.	Bacillariophyceae	6	11	12	5
25	<i>Odontella mobiliensis</i>	Bacillariophyceae	1	1	0	0
26	<i>Oocystis</i> sp.	Trebouxiophyceae	1	1	0	1
27	<i>Pediastrum duplex</i>	Chlorophyceae	4	3	1	2
28	<i>Pediastrum simplex</i>	Chlorophyceae	2	5	3	2
29	<i>Phormidium</i> sp.	Cyanophyceae	1	1	0	1
30	<i>Planktoniella sol</i>	Bacillariophyceae	1	1	0	0
31	<i>Pleurosigma elongatum</i>	Bacillariophyceae	1	1	1	0
32	<i>Pleurosigma</i> sp.	Bacillariophyceae	1	1	1	2



S. No.	Species	Class	Phyto Plankton Count (No.*10 ² /L)			
			PP 1	PP 2	PP 3	PP 4
33	<i>Prorocentrum micans</i>	Dinophyceae	1	2	2	2
34	<i>Protoperdinium sp.</i>	Dinophyceae	2	3	1	2
35	<i>Rhizosolenia alata</i>	Bacillariophyceae	2	5	3	5
36	<i>Rhizosolenia sp.</i>	Bacillariophyceae	1	1	0	0
37	<i>Skeletonema costatum</i>	Bacillariophyceae	1	1	0	1
38	<i>Synedra sp.</i>	Bacillariophyceae	1	1	1	1
39	<i>Tabellaria sp.</i>	Fragilariophyceae	1	1	1	1
40	<i>Tetrastrum sp.</i>	Chlorophyceae	1	2	0	1
41	<i>Thalassiosira subtilis</i>	Bacillariophyceae	3	2	2	1
42	<i>Thalassiothrix frauenfeldii</i>	Bacillariophyceae	4	2	1	2
43	<i>Triceratium sp.</i>	Bacillariophyceae	1	1	0	0
44	<i>Trichodesmium sp.</i>	Cyanophyceae	2	0	0	0
45	<i>Ulothrix sp.</i>	Ulvophyceae	1	1	0	1
46	<i>Volvox sp.</i>	Chlorophyceae	0	0	0	1
47	<i>Westella sp.</i>	Chlorophyceae	1	0	0	1
48	<i>Zygnema sp.</i>	Zygnematophyceae	0	1	0	0
TOTAL			165	194	168	163
Density (No/1000 ml)			0.165	0.194	0.168	0.163

Source: ABC Techno Labs India Pvt. Ltd.

3.11.5.2 Zooplankton

Zooplankton plays a key role in marine food web dynamics and biogeochemical cycling. Spatial distribution of zooplankton is an important factor in determining the fish stock. Hence, any decline in zooplankton population may affect ecosystem functioning. Zooplankton dynamics is largely controlled by different environmental factors. Hence, any change in ambient water quality significantly affect zooplankton population, which in turn can affect larval survival and in turn fishery. Seasonal plankton succession is a process mainly regulated by temperature and salinity conditions. Copepods constitute a major composition of zooplankton in most of regions of the world ocean. The result of the zooplankton analysis is tabulated in Table 3-50.

Table 3.49 Analysis Result of Zooplankton

S. No.	Species	Class	Zoo Plankton Count (No.*10 ² /L)			
			ZP1	ZP2	ZP3	ZP4
1	<i>Acartia danae</i>	Maxillopoda	1	1	1	1
2	<i>Acartia erythraea</i>	Copepoda	1	1	1	0
3	<i>Acartia spinicauda</i>	Maxillopoda	2	1	0	0
4	<i>Acrocalanus sp.</i>	Copepoda	3	2	0	0
5	<i>Aspidisca sp.</i>	Spirotrichea	2	2	0	1
6	<i>Brachionus sp.</i>	Monogononta	2	1	0	0
7	<i>Centropages furcatus</i>	Copepoda	3	2	0	0



S. No.	Species	Class	Zoo Plankton Count (No.*10 ² /L)			
			ZP1	ZP2	ZP3	ZP4
8	<i>Corycaeus catus</i>	Copepoda	2	2	0	1
9	<i>Cyclops</i> sp.	Maxillopoda	2	1	0	1
10	<i>Daphnia</i> sp.	Branchiopoda	3	2	0	1
11	<i>Dictyocha</i> sp.	Dictyochophyceae	2	2	0	1
12	<i>Eucalanus</i> sp.	Copepoda	2	1	0	0
13	<i>Euterpina</i> sp.	Copepoda	3	2	0	1
14	<i>Evadne</i> sp.	Branchiopoda	2	1	0	2
15	<i>Epinebalia</i> sp.	Malacostraca	3	2	0	2
16	<i>Favella</i> sp.	Oligotrichea	2	2	0	1
17	<i>Keratella cochlearis</i>	Monogononta	2	1	0	2
18	<i>Lucifer</i> sp.	Malacostraca	3	2	0	2
19	<i>Microsetella</i> sp.	Copepoda	2	1	0	0
20	<i>Monostyla</i> sp.	Monogononta	3	2	0	0
21	<i>Oithona</i> sp.	Copepoda	2	2	0	2
22	<i>Oithona similis</i>	Copepoda	2	1	0	2
23	<i>Paracalanus parvus</i>	Maxillopoda	3	2	0	1
24	<i>Penilia avirostris</i>	Branchiopoda	2	2	0	0
25	<i>Philodina</i> sp.	Bdelloidea	3	2	0	0
26	<i>Proales</i> sp.	Monogononta	2	2	0	1
27	<i>Sagitta</i> sp.	Sagittoidea	1	1	2	0
28	<i>Temora discaudata</i>	Copepoda	1	1	1	0
29	<i>Trichocerca</i> sp.	Monogonta	2	0	0	1
30	<i>Diaptomus</i> sp.	Copepoda	2	0	0	1
31	<i>Euglena</i> sp.	Euglenoidea	1	0	1	1
32	<i>Moina</i> sp.	Branchiopoda	1	0	2	2
33	<i>Chydorus sphaericus</i>	Branchiopoda	1	1	0	0
34	<i>Alona pulchella</i>	Branchiopoda	1	1	1	1
TOTAL			69	46	9	28
Density (No/1000 ml)			0.069	0.046	0.009	0.028

Source: ABC Techno Labs India Pvt. Ltd.



Diversity indices of Plankton

Table 3.50 Plankton Biodiversity Indices results

Community	Biodiversity indices		
	Shannon-Wiener Index (H)	Simpson Diversity Index (1/D)	Species Evenness
Phytoplankton	3.344	1.000	0.864
Zooplankton	3.487	0.998	0.989

Source: ABC Techno Labs India Pvt. Ltd.

Conclusion

In general, it may be mentioned that the values of the Index <1.0 , $1.0-2.0$ and > 2.0 indicate maximum impact of pollution, medium impact of pollution and lowest impact of pollution respectively.

12 major groups of zooplankton, namely, Maxillopoda, Copepoda, Spirotrichea, Monogononta, Branchiopoda, Dictyochophyceae, Malacostraca, Oligotrichea, Sagittoidea, Euglenoidea etc. were found to inhabit the water bodies. The Shannon Wiener Index was found to be 3.334 for phytoplankton and 3.487 for Zooplankton. The diversity of phytoplankton indicates about lowest impact of pollution level in all the sampling locations and as result zooplankton diversity found to be high. The diversity value of the water is an illustration of the level of pollution of water which is measured by the content of nutrients and pollutants. Increasing nutrient content to the estuary area of the river can lead to phytoplankton blooms which result in increased water turbidity. However, sufficient nutrient content will increase phytoplankton productivity. Increasing phytoplankton productivity will support increased productivity of other organisms that have higher trophic levels. Each type of organism will occupy certain aquatic and its existence is determined by the waters quality, namely the physical properties and chemical properties of the waters.

3.11.6 Benthos

The macrobenthic organisms can be analyzed from a high index of biological diversity. These are represented by a large number of animalphyla, while dominated groups are represented by polychaetes, crustaceans, mollusk and echinodermata. Macrobenthos in marine sediments play an important role in ecosystem processes such as mineralization, promoted and mixing of sediments, the flux of oxygen into sediments, nutrients cycling, dispersion and burial and secondary production. It is providing key linkage between primary producers and higher tropic levels.

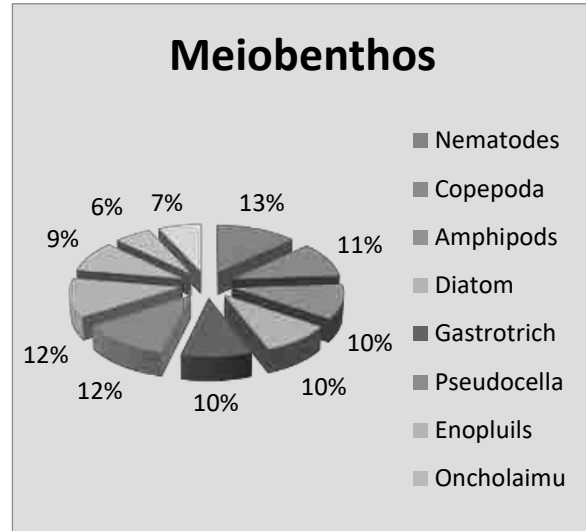
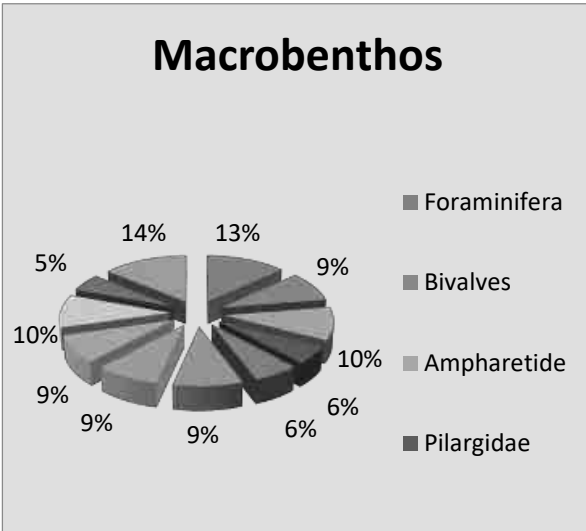
Sediment samples were collected from the sampling and reference stations using a van Veen grab (0.1 m² area). The meiobenthic samples were collected using a plastic core (10 cm length; 4.5 cm dia.) and sieved through 0.045 mm mesh sieve. The meiobenthic organisms were preserved in 5% Rose Bengal formalin solution. The macrobenthic samples were sieved through a 0.5 mm mesh sieve and preserved in 5% Rose Bengal-formalin solution. Biomass (wet weight) of macrofauna was determined on an electronic balance and is expressed as g.m⁻². The taxonomic composition of both meio and macrofauna were



analysed in the laboratory under stereo-zoom microscope and the meiofauna is expressed as No. (10 cm²)⁻¹ and macrofauna as No.m⁻².

Table 3.51 Sub tidal and inter tidal benthic population

S. No.	Groups	Types	Population Density (No./m ²)			
			MW1	MW2	MW3	MW4
1	Foraminifera	Macrobenthos	3	2	4	8
2	Bivalves	Macrobenthos	4	2	2	4
3	Ampharetide	Macrobenthos	2	2	3	6
4	Pilargidae	Macrobenthos	2	1	2	2
5	Onuphidae	Macrobenthos	1	2	3	2
6	Sabellidae	Macrobenthos	2	1	4	5
7	Capitellidae	Macrobenthos	1	3	2	5
8	Spionidae	Macrobenthos	2	3	5	1
9	Fish eggs	Macrobenthos	2	2	6	3
10	Polycheates Larvae	Macrobenthos	2	1	2	2
11	Crustacean eggs	Macrobenthos	4	4	5	5
	Total		25	23	38	43
1	Nematodes	Meiobenthos	14	14	18	22
2	Copepoda	Meiobenthos	11	15	14	16
3	Amphipods	Meiobenthos	10	12	15	18
4	Diatom	Meiobenthos	11	9	16	14
5	Gastrotrich	Meiobenthos	12	8	15	15
6	Pseudocella	Meiobenthos	14	12	21	16
7	Enopluids	Meiobenthos	12	10	21	18
8	Oncholaimu	Meiobenthos	14	9	14	12
9	Laimella	Meiobenthos	8	8	8	7
10	Comesoma	Meiobenthos	10	8	9	9
	Total		116	105	151	147



3.11.7 Fish & Other Marine Community

The fish and other marine species reported from the study area are tabulated in Table 3-53.

Table 3.52 Fish and Marine Species reported

S. No.	Scientific Name	Common Name	Family
1	<i>Channa gachua</i>	Dwarf snakehead	Channidae
2	<i>Channa marulius</i>	Great snakehead	Channidae
3	<i>Channa punctata</i>	Green snakehead	Channidae
4	<i>Etroplus maculatus</i>	Orange chromide	Cichlidae
5	<i>Euthynnus affinis</i>	Mackerel tuna	Scombridae
6	<i>Gambusia affinis</i>	Western mosquitofish	Poeciliidae
7	<i>Garra mullya</i>	Mullya garra	Cyprinidae
8	<i>Heteropneustes fossilis</i>	Stinging catfish	Heteropneustidae
9	<i>Lepturacanthus savala</i>	Ribbon fish	Trichiuridae
10	<i>Lepidocephalichthys guntea</i>	Guntea loach	Cobitidae
11	<i>Megalaspis cordyla</i>	Torpedo scad	Carangidae
12	<i>Mugil sp.</i>	Flathead mullet	Mugilidae
13	<i>Mystus bleekeri</i>	Day's mystus	Bagaridae
14	<i>Mystus vittatus</i>	Striped Dwarf Catfish	Bagaridae
15	<i>Nemipterus sp.</i>	Threadfin bream	Nemipteridae
16	<i>Notopterus notopterus</i>	Asiatic knifefish	Notopteridae
17	<i>Oreochromis mossambicus</i>	Mozambique tilapia	Cichlidae
18	<i>Osphronemus goramy</i>	Giant gourami	Osphronemidae
19	<i>Platycephalus biomacula</i>	Flat head fish	Platycephalidae
20	<i>Puntius amphibius</i>	Scarlet-banded barb	Cyprinidae
21	<i>Puntius arenatus</i>	Arenatus barb	Cyprinidae
22	<i>Puntius conchoniis</i>	Rosy barb	Cyprinidae
23	<i>Puntius filamentosus</i>	Black-spot barb	Cyprinidae

S. No.	Scientific Name	Common Name	Family
24	<i>Puntius sarana</i>	Olive barb	Cyprinidae
25	<i>Puntius sophore</i>	Pool barb	Cyprinidae
26	<i>Puntius ticto</i>	Ticto Barb	Cyprinidae
27	<i>Puntius vittatus</i>	Greenstripe barb	Cyprinidae
28	<i>Rasbora daniconius</i>	Black-line rasbora	Cyprinidae
29	<i>Rastrelliger kanagurta</i>	Indian mackerel	Scombridae
30	<i>Salmostoma bacaila</i>	Large razorbelly minnow	Cyprinidae
31	<i>Sardinella sp.</i>	Ray-finned fish	Clupeidae
32	<i>Scomberomorus sp.</i>	Ray-finned bony fish	Scombridae

3.11.8 Seaweeds and Sea Grasses

Sea grasses: During the survey period, absence of sea grass around the 10 km radius.

Sea weeds: Apart from the patchy occurrences of *Gracilaria Salicornia* and *Polysiphonia brodiei*, no major seaweed communities were observed in the coastal stretch in Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B in Killiyoor Taluk, Kanniyakumari District, Tamil Nadu.

3.11.9 Mangroves

No major Mangroves patches have been reported at the project region.

3.11.10 Corals

No corals have been reported at the project region.

3.11.11 Marine protected area

The project region is devoid of marine protected area.

3.11.12 Marine mammals

Apart from the occasional sightings of *Stenella longirostris* and *Lutrogale perspicillata* in the coastal waters and open waters, no other marine mammals are noticed in the region.

3.11.13 Endangered species

No endangered species were reported around the 10 km radius of the project region.

3.12 Traffic Scenario

Traffic density analysis has been carried at two (2) strategic locations namely Nithiravilai (T1) and Midalam (T2).



3.12.1.1 Traffic Density analysis frequency

Monitoring was carried out once during study period. At each traffic density analysis location, traffic density was recorded at hourly intervals for 24 hours during a week day & week end for assessing the average traffic volume.

Results

For assessing the baseline status, the traffic survey based on Indian Road Congress-IRC: 106-1990 guidelines were carried out at Midalam Road and Nithravilai Road Junctions. The existing traffic volume at Nithravilai was found to be 5017 PCU/day and at Midalam 4441 PCU/day i.e. 209 PCU/hr. at Nithravilai and 185 PCU/hr. at Midalam near MSP with average 197 PCU/hr.

The observation of traffic density analysis near Nithravilai (T1) is given in Table 3.54 and that of near Midalam (T2) is given in Table 3.55.

Table 3.53 Traffic Density near Nithravilai (T1) during Study period

Time (Hours)	Towards Separation Plant				Towards Block B				
	Two wheeler	LMV	HMV	PCU	Time (Hours)	Two wheeler	LMV	HMV	PCU
00 - 01	25	40	15	98	00 - 01	28	43	17	108
01 - 02	79	49	25	164	01 - 02	68	31	22	131
02 - 03	77	56	20	155	02 - 03	42	42	18	117
03 - 04	33	50	23	136	03 - 04	26	43	26	134
04 - 05	35	48	13	105	04 - 05	37	23	17	93
05 - 06	86	35	19	135	05 - 06	62	31	28	146
06 - 07	90	60	21	168	06 - 07	57	49	13	117
07 - 08	62	25	22	122	07 - 08	68	33	9	94
08 - 09	52	18	28	128	08 - 09	62	14	27	126
09 - 10	30	9	21	87	09 - 10	43	11	24	105
10 - 11	36	7	28	109	10 - 11	29	3	15	63
11 - 12	10	4	29	96	11 - 12	13	6	30	103
12 - 13	0	4	12	40	12 - 13	0	4	14	46
13 - 14	0	8	17	59	13 - 14	0	3	28	87
14 - 15	0	7	19	64	14 - 15	0	12	23	81
15 - 16	2	11	9	39	15 - 16	3	13	11	48
16 - 17	17	29	18	92	16 - 17	15	19	15	72
17 - 18	86	41	20	144	17 - 18	43	27	23	118
18 - 19	88	47	17	142	18 - 19	62	35	25	141
19 - 20	79	43	18	137	19 - 20	52	48	11	107
20 - 21	62	32	10	93	20 - 21	59	30	15	105
21 - 22	69	40	16	123	21 - 22	63	41	9	100
22 - 23	21	38	18	103	22 - 23	18	40	11	82
23 - 00	37	37	13	95	23 - 00	26	32	8	69
Max.	90	60	29	192	Max.	68	49	30	173
Min.	0	4	9	31	Min.	0	4	8	28
Avg.	45	31	19	111	Avg.	37	27	19	103
Total	1076	738	451	2629	Total	876	633	439	2388

Classified traffic volume count observed at survey location T1 reveals that the traffic density is maximum for Two Wheeler (1952 per day), followed by LMV (1371 per day) and HMV (890 per day).

Table 3.54 Traffic Density near Midalam (T2) during study period

Time (Hours)	Towards Separation Plant				Towards Block A				
	Two wheeler	LMV	HMV	PCU	Time (Hours)	Two wheeler	LMV	HMV	PCU
00 - 01	48	40	20	124	00 - 01	49	28	18	107
01 - 02	50	48	18	127	01 - 02	31	43	23	128
02 - 03	21	44	20	115	02 - 03	23	26	21	101
03 - 04	27	36	11	83	03 - 04	25	28	16	89
04 - 05	43	50	21	135	04 - 05	41	39	24	132
05 - 06	53	21	18	102	05 - 06	40	23	7	64
06 - 07	46	18	28	125	06 - 07	39	13	27	114
07 - 08	31	10	20	86	07 - 08	48	9	23	102
08 - 09	22	9	25	95	08 - 09	23	13	12	61
09 - 10	25	8	29	108	09 - 10	17	5	20	74
10 - 11	7	6	31	103	10 - 11	15	3	29	98
11 - 12	0	4	12	40	11 - 12	0	4	14	46
12 - 13	0	6	15	51	12 - 13	0	4	26	82
13 - 14	0	8	21	71	13 - 14	0	11	23	80
14 - 15	0	15	11	48	14 - 15	2	17	11	51
15 - 16	5	29	18	86	15 - 16	8	19	15	68
16 - 17	40	40	20	120	16 - 17	20	47	22	123
17 - 18	47	45	18	123	17 - 18	41	35	23	125
18 - 19	50	44	18	123	18 - 19	30	46	11	94
19 - 20	42	33	10	84	19 - 20	42	24	15	90
20 - 21	39	30	16	98	20 - 21	48	33	10	87
21 - 22	17	25	20	94	21 - 22	14	28	12	71
22 - 23	15	31	13	78	22 - 23	27	27	8	65
23 - 00	18	35	13	83	23 - 00	20	37	17	98
Max.	53	50	31	170	Max.	49	47	29	159
Min.	0	4	10	34	Min.	0	3	7	24
Avg.	27	27	19	98	Avg.	26	24	18	91
Total	646	635	446	2296	Total	603	562	427	2145

At T2 also the traffic density is maximum for Two-wheeler (1249 per day), followed by LMV (1197 per day) and HMV (873 per day). The traffic carrying capacity of two-way undivided arterial road is 2400 PCU/hr as per IRC 106-1990.

Level of Service (LOS): Capacity Standards of Roads are fixed in relation with the LOS which is commonly designated from 'A' (best operating condition) to 'F' (forced or breakdown flow). Normally LOS-C will be adopted for smooth traffic flow in Urban/Rural Areas (Table 3.56). Ratio of existing Volume of PCU on road (V) and its Capacity (C) with corresponding LOS and their performance is given in Table 3.57.

Table 3.55 Level of Service & Performance of a Road (IRC:64-1990 Norms)

Volume/Capacity Ratio	Level of Service	Performance of the Road
0-0.2	A	Excellent
0.2-0.4	B	Very Good
0.4-0.6	C	Good/Average/Fair
0.6-0.8	D	Poor
0.8-1.0	E	Very Poor

Proposed Traffic:

The proposed transportation of 5000 TPD one way by 30T Tippers – 167 trucks one way, 334 trucks per day in two ways which is about 735 PCU/day i.e. 31 PCU/hr. It is worked to be only 16% volume addition to the existing traffic volume.

Table 3.56 Predicted Traffic Scenario at the Junction

Road	Volume PCU/hr	Capacity of the Road PCU/hr	V/C Ratio	Level Service of	Performance of the Road
Existing					
Midalam Road	197	2400	0.08	A	Excellent
Proposed					
Midalam Road	228	2400	0.095	A	Excellent

The Volume/Capacity (V/C) ratio for existing and proposed traffic volume is found to be 0.08 and 0.095 and the Level of Service (LOS) is found to be “A” – Excellent. Hence, the existing highway is adequate to handle the proposed volume due to the proposed project.

3.13 Socio – Economic Study

Mining projects have always been matter of concern for the environmental and social experts because of huge socio economic impact. Mining projects bring handful of benefits to the people in the form of employment, skill up-gradation, development of infrastructure etc. Nevertheless, the possibility of some adverse impact cannot be ruled out. Overall impact of a mining project may be marginal or non-marginal depending on the extent of change caused by the project to alter the existing equilibrium of the socio economic system. The project is expected to have significant impact with respect to social and economic dimensions in the study area. With this background, the present socio economic impact assessment of the project has been carried out with respect to the following objectives:

- To assess the impact of the project on the agricultural situation
- To assess the impact of the project on the pattern of demand
- To estimate employment and income effects of the project
- To ascertain the impact of the project on the consumption behaviour
- To explore the impact of the project on educational status in the locality
- To analyse peoples' perception regarding the project



3.13.1 Demographic pattern

The mining lease area of IREL is located at Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B Villages, Killiyoor Taluk, Kanniyakumari District, Tamilnadu.

3.13.2 Demographic pattern of district

Kanniyakumari District ranks 19th place in terms of population size among the districts. The district has recorded second largest urban population of 82.3% to the total population among the districts.

According to the 2011 Census, Kanniyakumari had population of 1,870,374 of which male and female were 926,345 and 944,029 respectively. In 2001 census, Kanniyakumari had a population of 1,676,034 of which males were 832,269 and remaining 843,765 were females.

Sl.no	Description	2011	2001
1.	Population	18,70,374	16.76,034
2.	Male	9,26,345	8,32,269
3.	Female	9,44,029	8,43,765
4.	Population Growth	11.60%	4.73%
5.	Area Sq.km	1,672	1,672
6.	Density/sq.km	1,111	995
7.	Proportion to Tamil nadu population	2.59%	2.69%
8.	Sex ratio (1000)	1019	1014
9.	Child Sex ratio (0-6 age)	964	968
10.	Average literacy	91.75	87.55
11.	Male literacy	93.65	90.37
12.	Female literacy	89.90	84.79
13.	Total Child population (0-6 age)	1,82,350	1,81,719

Table 3.57 Population within 5 km Radius

Village	Distance in Km	Population
Kurumpanai	0.4 Km	9500
Midalam	Within the Project Site	2000



Village	Distance in Km	Population
Melmidalam	Within the Project Site	2200
Helan Nager	Within the Project Site	1900
Enayam	0.2 Km	9500
Alanchi	Within the Project Site	8500
Thoothur	Within the Project Site	6500
Ezhudesam	Within the Project Site	11000
Kollencode	Within the Project Site	17500

Table 3.58 Population within 10 km radius

Sl.No.	Village Name	Population	Male	Female	Literacy Rate	SC/ST
1.	Poovar	35,21,153	17,67,859	17,53,294	93.02%	3,758
2.	Colachel	23,227	11,767	11,460	80.52%	5,485
3.	Thingal Nagar	13,567	6,729	6,838	93.36%	3,252
4.	Thikkanamcod	14,086	7,031	7,055	92.7%	2,485
5.	Vattavilai	13,582	6,758	6,824	92.50%	1,583
6.	Karungal	16,691	8,030	8,661	91.99%	1,826
7.	Arumanoor	3,482	1,758	1,724	84.98%	120
8.	Palliyadi	15,720	7,819	7,901	89.62	1,958
9.	Marthandam	29,741	14,690	15,051	91	1,622
10.	Puthukadai	9,909	4,862	5,047	91.12%	175
11.	Kappukadu	18,263	9,023	9,240	89.35	2,569
12.	Kuzhithurai	21,307	10,539	10,768	94.07%	308
13.	Pedndhalmoodu	19,538	9,603	9,935	93.64%	294
14.	Nadaikavu	8,727	4,369	4,358	92.87%	133
15.	Kadukavilai	15,625	7,753	7,872	90.65 %	226
16.	Valliyur	4,319	2,092	2,227	92.94%	98
17.	parasalu	6,931	3,474	3,457	91.80%	286
18.	Cheruvarakkonam	6,241	3,087	3,154	91.70%	254



Sl.No.	Village Name	Population	Male	Female	Literacy Rate	SC/ST
19.	Kollencode	38,385	19,273	19,112	86.72%	683
20.	Medhukammal	19,417	9,513	9,904	91.47%	297
21.	Kulathoor	32,394	16,017	16,377	86.36%	2,281
22.	Keezhamakkam	13,097	6,650	6,447	88.21%	955
23.	Arudesam	2,383	1,158	1,225	94.92%	260
24.	Mandaikadu	13,317	6,611	6,706	90.03%	234
25.	Thengapatnam	4,361	2,112	2,249	91.23%	243
26.	Karode	31,918	15,651	16,267	89.43%	2,311
27.	Uchakada	9,413	4,605	4,808	93.30%	723
28.	Pozhiyur	17,785	8,719	9,066	92.87%	456

Nearest Habitations:

Pozhiyoor- 3.04 km (NW)
Poovar- 6.21 km (NW)
Kanjiramkulam- 10.61 km (NW)
Parassala-6.48 km (NNE)
Karungal-3.58 km (NNE)
Thuckalay-10.23 km (ENE)
Nirugudi-0.99 km (ENE)
Colachel-3 km (SE)
Kaliyakkavilai-7.06 km (NNE)

The mining lease area is well connected by tar road. The amenities such as Schools, Communications facilities, commercial centers are already available in the mining lease area as well as in the area adjacent to the mining lease area.



Schools/ Colleges:

- Govt. High school at Udayamarthandam
- St. Joseph Primary at Midalam
- St. Bernadette's Higher Secondary School at Mangalakkuntu
- C.S.I primary School at Devikodu.
- Don Bosco Matric Higher Secondary School at Midalacadu.
- CBSC School at Amanattantheri at Melmidalam.
- St. Judes College at Thoothur
- St. Antony's Nursing College Holy Angel's School at Chentharai.
- Bethlehem School at Karingal
- Bethlehem Engineering College at Velliyavilai (on Karungal - Colachel Road)
- St. Alphonsa's Arts College at Kakkavilai (on Karingal- Kurumbanai Road).

Public Places (Workshops/Hospitals, etc.):

- Churches at Alanchi, Midalam, Melmidalm, Helan Nager Devicode, Puthurai, Enayam, Eraviputhendurai and Devicode.
- Temples at Thoppuvilai, Enayamputhendurai, Karungal
- Government Hospital at Killiyoor
- Government Hospital at Thengapattinam
- Government Hospital at Karungal
- Dr. Gunam Hospital at Palapallam
- Pushpavin Hospital at Alanchi
- Bala Hospital at Enayam
- Bus Stop at Alanchi, Midalam, Melmidalm, Helan Nager Devicode, Puthurai, Enayam, Eraviputhendurai, Devicode, etc.,

Govt. Offices/Institutes

- Colachel and Kollencode municipality office
- Keezhkulam, Karungal, Palapallam Town Panchayat
- Midalam, Thoothur Panchayats.



3.14 Radioactivity – Background Status

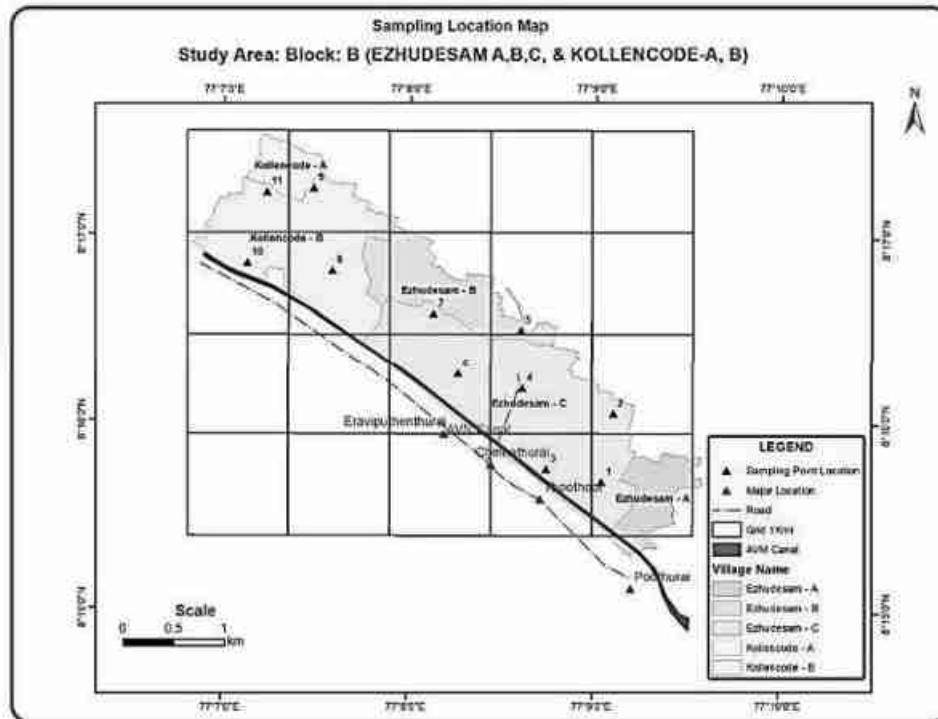
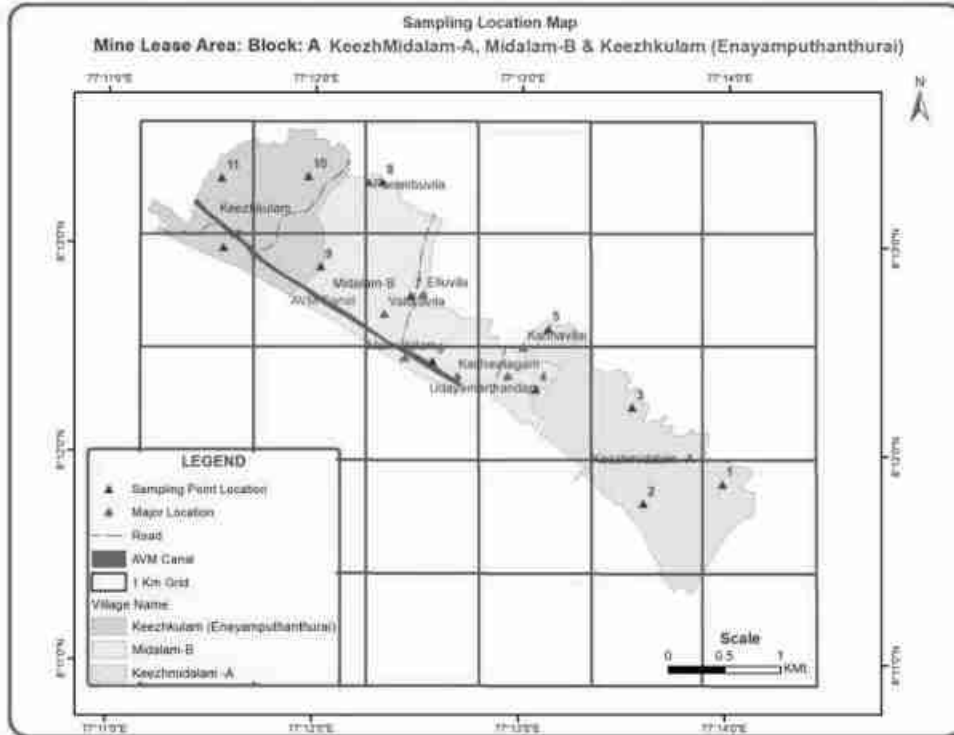
Comprehensive Radiological Monitoring and Mapping: The Terms of References set by the MoEF&CC require grid based study of the proposed areas. Radiological monitoring was carried out by Health Physics Division, Health, Safety and Environment Group, Bhabha Atomic Research Centre during March, April and May 2023 months. Entire Report is annexed and Excerpts from the Report are appended below:

Digital map of these areas were generated and monitoring grid patterns with dimension 1 x 1 km were developed using ArcGIS Version:10 software. The Block A was divided into 12 grids whereas Block B was divided into 11 grids. An accessible location near the centre of each grid was chosen as preferred reference spot for radiological monitoring. Similarly, the buffer areas with dimension 5 x 5 km were demarcated around core zone and sampling locations were identified at the centre of each grid.

The radiological monitoring carried out at core blocks and buffer areas include (1) Ambient outdoor gamma dose rate (2) Air activity measurements of long lived (^{232}Th) radio nuclides (3) Air activity measurements of Radon (^{222}Rn), Thoron (^{220}Rn) and progenies (4) Gross dust load in air (5) Gross alpha and gross beta activity in ground water (6) Measurement of Uranium and Thorium concentration in ground water (7) Measurement of thorium and uranium activity in the soil (8) measurement of gross alpha and gross beta activity in foodstuff (9) estimation of external dose received by general public and (10) Conventional water quality parameters like i) TDS ii) pH iii) Arsenic & Fluoride. All measurements were carried using calibrated instruments and standard protocols.

External dose due to gamma photons emitted from thorium and uranium daughter products present in the soil is the major dose contributor in the proposed study area. The ambient outdoor external dose rate [denoted as $\dot{H}_p(10)$] at selected outdoor locations were measured using BARC make INERTS Survey Meter and Mirion RDS-31 Survey meter.

The maps of sampling points are shown below.



Ten readings at one metre height from ground were taken from each location and average value in $\mu\text{Sv}\cdot\text{h}^{-1}$ was taken as the representative data for that area. The minimum detection limit (MDL) of the system used for the dose rate measurement is $0.01 \mu\text{Sv}\cdot\text{h}^{-1}$. Ambient outdoor external dose rate [$\dot{H}_p(10)$] at Block A and Block B tabulated month wise is given below.

Table 3.59 Ambient Outdoor External Dose Rate [$\dot{H}_p(10)$], $\mu\text{Sv}\cdot\text{h}^{-1}$ at Block A

Block	Ambient outdoor external dose rate [$\dot{H}_p(10)$] $\mu\text{Sv}\cdot\text{h}^{-1}$			
	March	April	May	Range
A1	9.5 - 12.7	9.7 - 11.5	9.5 - 12.7	9.5 - 12.7
A2	9.8 - 12.9	10.4 - 12.9	10.1 - 13.0	9.8 - 13.0
A3	9.7 - 12.8	10.5 - 12.8	10.2 - 12.7	9.7 - 12.8
A4	4.5 - 7.3	4.8 - 7.3	4.9 - 7.1	4.5 - 7.3
A5	4.7 - 6.2	4.9 - 6.4	4.8 - 6.1	4.7 - 6.4
A6	3.9 - 5.2	3.9 - 5.5	3.9 - 5.5	3.9 - 5.5
A7	5.5 - 8.2	5.9 - 8.4	5.8 - 8.1	5.5 - 8.4
A8	5.7 - 8.2	6.1 - 7.8	6.1 - 8.0	5.7 - 8.2
A9	10.5 - 13.7	11.1 - 13.7	11.5 - 13.2	10.5 - 13.2
A10	9.7 - 13.1	10.5 - 13.4	10.2 - 13.1	9.7 - 13.4
A11	1.8 - 3.1	1.8 - 3.4	2.1 - 4.8	1.8 - 4.8
A12	6.8 - 8.1	6.6 - 8.5	6.4 - 8.5	6.4 - 8.5

GIS based Dose rate profile / contour of the block A is displayed below.

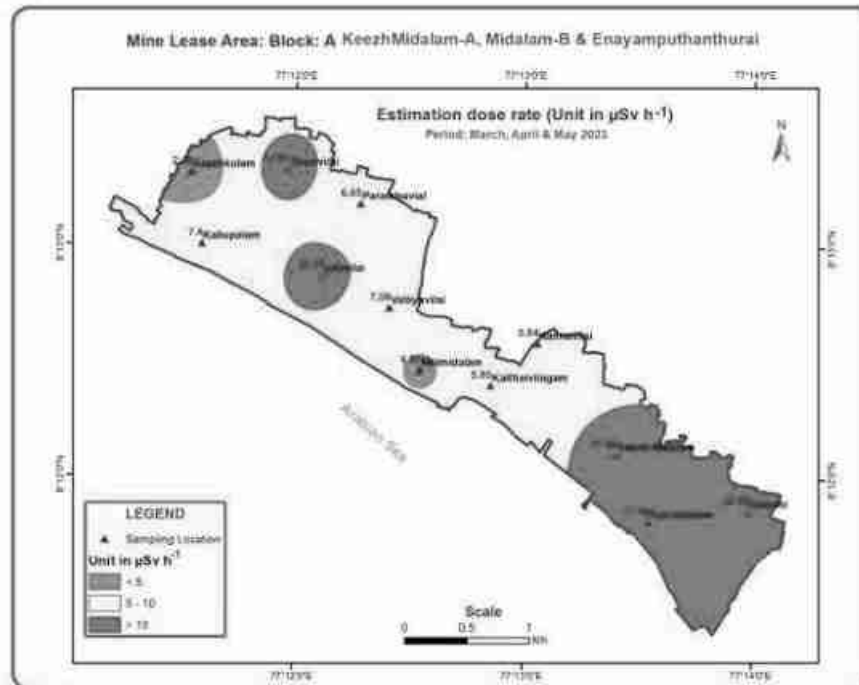
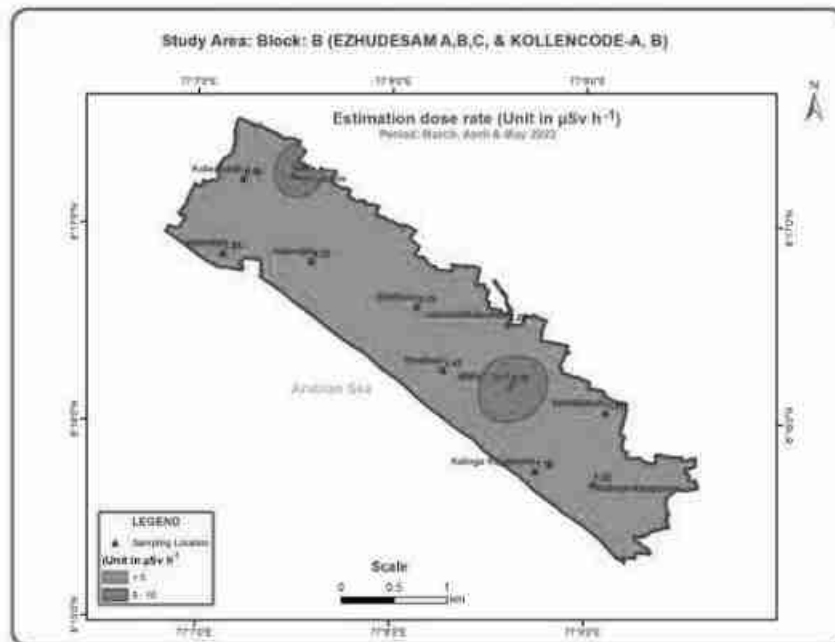


Table 3.60 Ambient Outdoor External Dose Rate [$\dot{H}_p(10)$], $\mu\text{Sv h}^{-1}$ at Block B

Block	Ambient outdoor external dose rate [$\dot{H}_p(10)$] $\mu\text{Sv h}^{-1}$			
	March	April	May	Range
B1	1.1 - 2.0	1.1-2.1	1.1 - 2.1	1.1 – 2.1
B2	0.9 -1.8	0.9-1.5	1.1 - 1.6	0.9 – 1.8
B3	1 - 1.8	1.2 - 1.8	1.1 - 1.8	1.0 – 1.8
B4	7.7 - 9.5	7.5 -9.6	7.8 - 9.5	7.5 – 9.6
B5	1.8 - 2.7	2 - 2.7	1.8 - 3.5	1.8 – 3.5
B6	1 - 1.8	1.2 - 1.8	1.4 - 1.8	1.0 – 1.8
B7	3.4 - 4.4	3.1 - 4.4	3.4 - 4.4	3.1 – 4.4
B8	0.4 - 1.5	0.4 - 1.4	0.4 - 1.5	0.4 – 1.5
B9	5.7 - 7.5	5.7 - 7.5	6 - 7.5	5.7 – 7.5
B10	1 - 1.6	1.1 - 1.6	1 - 1.6	1.0 – 1.6
B11	0.3 - 0.7	0.4 - 0.8	0.4 - 0.7	0.3 – 0.8

GIS based dose rate profile/ contour map was made with slightly modified legends to accommodate all data points.



Ambient dose rate at different locations within buffer zone was measured and tabulated below:

Table 3.61 Ambient Outdoor External Dose Rate [$\dot{H}_p(10)$], $\mu\text{Sv h}^{-1}$ – Buffer Zone

Block	Ambient outdoor external dose rate [$\dot{H}_p(10)$] $\mu\text{Sv h}^{-1}$			
	March	April	May	Range
BU 1	0.2 - 0.3	0.3 - 0.5	0.3 - 0.4	0.2 – 0.5
BU 2	0.2 - 0.4	0.2 - 0.5	0.2 - 0.4	0.2 – 0.5
BU 3	0.8 - 4.8	0.8 - 4.9	0.8 - 4.5	0.8 – 4.9
BU 4	0.1 - 0.2	0.2 - 0.3	0.2 - 0.3	0.1 – 0.3
BU 5	0.2 - 0.4	0.2 - 0.4	0.2 - 0.4	0.2 – 0.4
BU 6	0.2 - 0.6	0.2 - 0.7	0.2 - 0.8	0.2 – 0.8
BU 7	0.2 - 0.6	0.2 - 0.5	0.2 - 0.5	0.2 – 0.6
BU 8	0.2 - 0.3	0.2 - 0.3	0.2 - 0.3	0.2 – 0.3
BU 9	0.1 - 0.2	0.1 - 0.2	0.2 - 0.3	0.1 – 0.3
BU 10	0.2 - 0.3	0.2 - 0.4	0.2 - 0.4	0.2 – 0.4
BU 11	0.6 - 0.8	0.7 - 1.0	0.6 - 0.9	0.6 – 1.0
BU 12	0.1 - 0.4	0.1 - 0.4	0.2 - 0.5	0.1 – 0.5
BU 13	0.1 - 0.2	0.1 - 0.2	0.1 - 0.2	0.1 – 0.2
BU 14	0.1 - 0.2	0.1 - 0.2	0.1 - 0.2	0.1 – 0.2
BU 15	0.1 - 0.2	0.1 - 0.2	0.1 - 0.2	0.1 – 0.2
BU 16	0.1 - 0.2	0.1 - 0.2	0.1 - 0.2	0.1 – 0.2
BU 17	0.2 - 0.4	0.2 - 0.4	0.2 - 0.4	0.2 – 0.4
BU 18	0.2 - 0.4	0.2 - 0.4	0.2 - 0.4	0.2 – 0.4
BU 19	0.1 - 0.3	0.1 - 0.3	0.1 - 0.3	0.1 – 0.3
BU 20	0.2 - 0.4	0.2 - 0.4	0.2 - 0.4	0.2 – 0.4
BU 21	0.5 - 1.6	0.5 - 1.6	0.5 - 1.6	0.5 – 1.6
BU 22	0.4 - 1.8	0.4 - 1.8	0.4 - 1.8	0.4 – 1.8

Table 3.62 Comparison of estimated external dose rate at mined and un-mined locations

Location of the residence			Dose rate $\mu\text{Sv h}^{-1}$		Annual dose mSv y^{-1}	Mining status
Village	Latitude	Longitude	Indoor	Outdoor		
Chinnavilai	8°08'38.267"	77°18'09.367"	3.63	6.61	37.02	Un-mined
Chinnavilai	8°08'38.098"	77°18'12.323"	3.65	5.54	35.28	Un-mined
Chinnavilai	8°08'38.094"	77°18'12.708"	0.32	0.42	2.98	Mined out
Chinnavilai	8°08'38.141"	77°18'12.658"	0.41	0.53	3.80	Mined out
Pillayarkovil	8°09'04.039"	77°18'05.814"	1.70	3.88	18.71	Un-mined
Pillayarkovil	8°08'58.470"	77°18'05.814"	0.45	0.62	4.23	Mined out

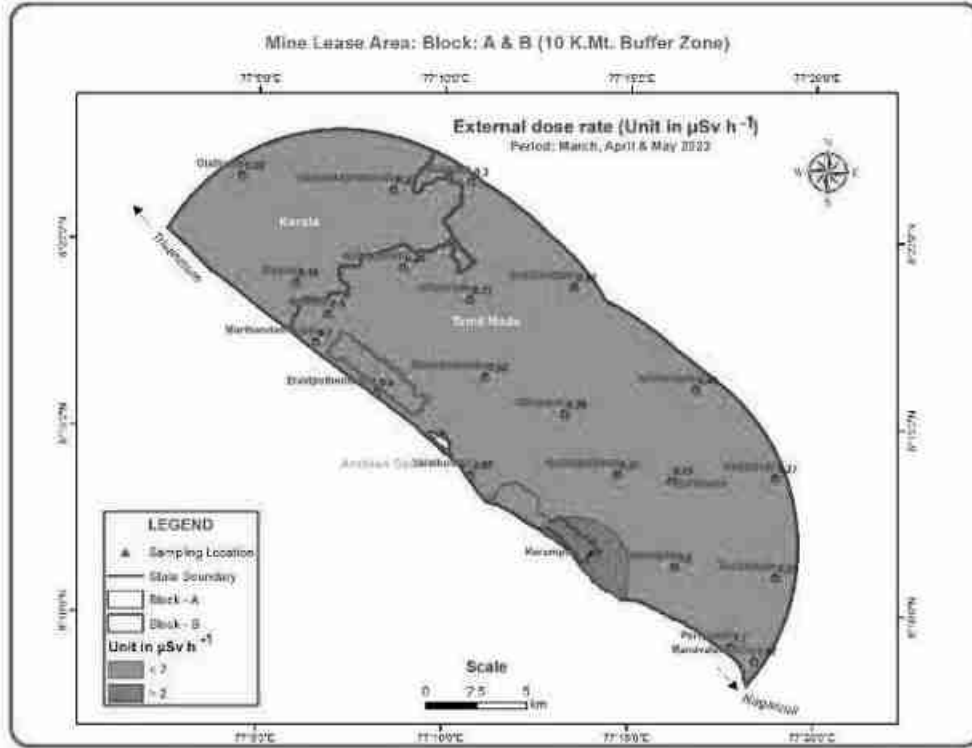
In addition to grid survey points, 27 beach location points along intertidal zone of western coast were surveyed for dose rate and values are tabulated below :

Table 3.63 Ambient outdoor external dose rate at intertidal regions along western coast of Kanyakumari

S.No	Location	Latitude (N)	Longitude (E)	Dose rate (μSvh^{-1})
1	Valliyar river mouth	8° 08' 18.682"	77° 18' 13.705"	30 ± 14
2	Chinnavilai(Cruzparai)	8° 08' 26.905"	77° 18' 11.664"	0.6 ± 0.3
3	Chinnavilai	8° 08' 38.598"	77° 18' 05.083"	0.3 ± 0.1
4	Periavilai	8° 08' 58.322"	77° 17' 46.183"	1.30 ± 0.5
5	Puthoor cemetery area	8° 09' 29.289"	77° 17' 06.871"	2.4 ± 0.9
6	Kootumangalam	8° 09' 26.838"	77° 17' 06.021"	2.8 ± 1
7	Mandaikadu	8° 09' 40.086"	77° 16' 41.728"	1.8 ± 0.7
8	Vetumadai	8° 09' 50.223"	77° 16' 26.086"	2.7 ± 1.2
9	Kottilpadu	8° 10' 09.458"	77° 15' 46.976"	0.3 ± 0.1
10	Colachel	8° 10' 21.248"	77° 15' 19.699"	0.15 ± 0.1
11	Simancolony	8° 10' 33.146"	77° 14' 37.712"	0.25 ± 0.1
12	Kurumpanai Village	8° 11' 18.135"	77° 13' 46.833"	0.35 ± 0.1
13	Kurumpanai mining area 1	8° 11' 43.944"	77° 13' 28.236"	9.0 ± 2
14	Kurumpanai mining area 2	8° 11' 49.708"	77° 13' 24.781"	5.5 ± 1
15	Kurumpanai mining area 3	8° 11' 49.927"	77° 13' 24.691"	20.0 ± 5
16	Midalam	8° 12' 10.915"	77° 12' 52.722"	11.0 ± 3.6
17	Melmidalam	8° 12' 31.042"	77° 12' 16.693"	1.5 ± 0.5
18	Melmidalam	8° 12' 00.424"	77° 12' 08.938"	4.2 ± 1.6
19	Helan nagar	8° 12' 51.865"	77° 11' 38.922"	0.50 ± 0.1
20	Enayam	8° 13' 00.192"	77° 11' 22.111"	0.75 ± 0.1
21	Ramanthurai	8° 13' 47.665"	77° 10' 37.779"	0.30 ± 0.1
22	Thengapattinam	8° 14' 11.018"	77° 10' 18.764"	0.25 ± 0.1
23	Eranyanthurai	8° 14' 54.045"	77° 09' 27.216"	0.45 ± 0.1
24	Eraviputhanthurai	8° 16' 03.147"	77° 07' 56.751"	0.21 ± 0.1
25	Vallavilai	8° 16' 45.418"	77° 06' 55.429"	0.25 ± 0.1
26	Eeordi	8° 17' 20.094"	77° 06' 07.815"	0.25 ± 0.1
27	S.Kollancode	8° 17' 52.357"	77° 05' 26.322"	0.10 ± 0.1

GIS based dose rate profile/ contour map was made for buffer zone. The data include survey results from core A, core B, buffer zone and intertidal region.

Ambient outdoor external dose rate in Block A & B is above general background in other areas due to the presence of extraordinary rich deposits of monazite mineral. A few locations within Buffer Zone are also showing above normal radiation field indicating the presence of Monazite. An order of difference in radiation level variation has been observed in Block B indicating the heterogeneous characteristics of the presence of monazite. These areas are ideal for mining for recovering Monazite. Both intertidal zones as well as hinterland shows high monazite content. This region is generally considered NHBRA of Manavalakurichi.



Air activity measurements of long lived (^{232}Th) Radionuclide:

Monazite contains 8 to 9% Th along with about 0.3% U besides the rare earth elements. ^{228}Th and ^{232}Th are two isotopes that occur in natural thorium mineral. Both are alpha emitters and have half-life of 1.91 y and 1.41×10^{10} years, respectively. ^{232}Th has the lowest specific activity (among Th isotopes) of $4.07 \times 10^3 \text{ Bqg}^{-1}$.

Air samples are collected from each location using electricity operated air sampler of flow rate 50 litre per minute (lpm). Gross air-borne dust containing radioactive particles is collected on a glass fiber filter paper. Approximately 1m^3 of ambient air is sampled through the air sampler mounted at 1.5m above ground. The filter paper with deposited air borne dust is subjected for a delay counting for 30 days for removal of shortlived elements. Gross alpha activity is measured using ZnS (Ag) based scintillation counter with known counting efficiency. The efficiency has been deduced using the standard alpha electroplated source of 1215 Bq of ^{241}Am source.

Table 3.64 Long lived gross alpha air activity at Block A locations

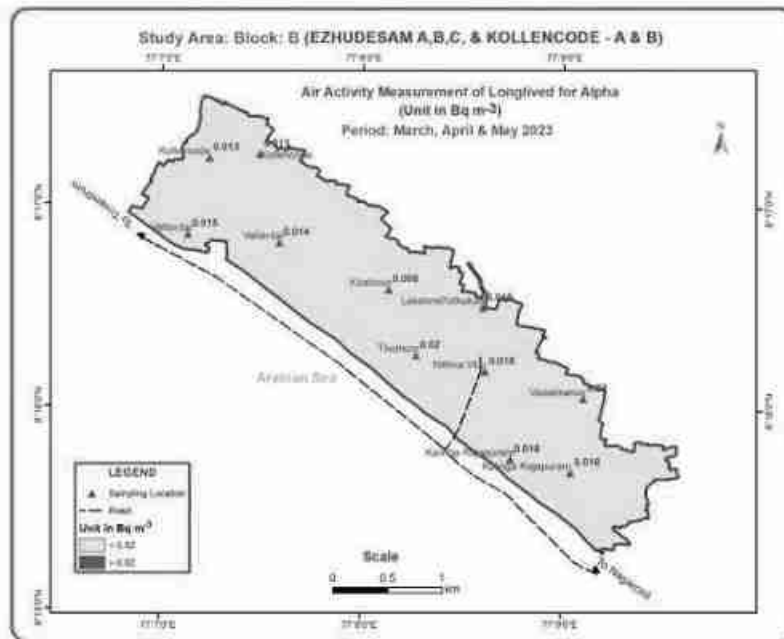
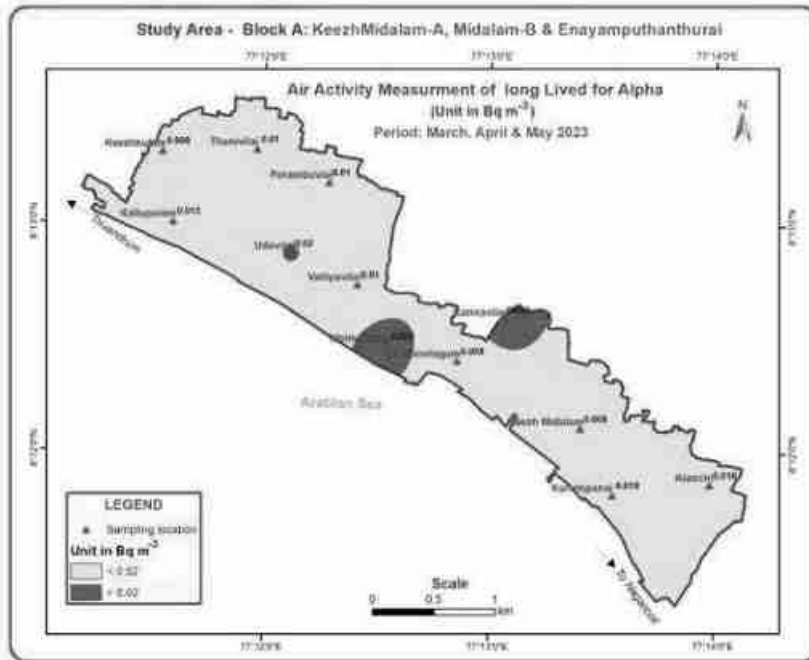
Block	March	April	May	Average (Bqm ⁻³)
A1	0.015	0.023	0.027	0.022 ± 0.005
A2	0.023	0.028	0.033	0.028 ± 0.005
A3	0.008	0.011	0.016	0.012 ± 0.002
A4	0.011	0.015	0.021	0.016 ± 0.003
A5	0.031	0.036	0.041	0.036 ± 0.005
A6	0.034	0.038	0.046	0.039 ± 0.006
A7	0.008	0.015	0.022	0.015 ± 0.004
A8	0.008	0.011	0.015	0.011 ± 0.004
A9	0.023	0.029	0.036	0.029 ± 0.005
A10	0.008	0.015	0.023	0.015 ± 0.004
A11	0.013	0.021	0.029	0.021 ± 0.003
A12	0.015	0.019	0.026	0.020 ± 0.001

Gross beta was found less than MDA hence not mentioned in the report

Table 3.65 Long lived gross alpha air activity at Block B locations

Block	March	April	May	Average (Bqm ⁻³)
B1	0.015	0.023	0.028	0.022 ± 0.005
B2	0.015	0.023	0.029	0.022 ± 0.005
B3	0.023	0.036	0.041	0.033 ± 0.005
B4	0.015	0.023	0.03	0.023 ± 0.005
B5	0.008	0.015	0.023	0.015 ± 0.008
B6	0.015	0.021	0.023	0.020 ± 0.009
B7	0.008	0.019	0.022	0.016 ± 0.001
B8	0.019	0.031	0.036	0.029 ± 0.006
B9	0.008	0.021	0.023	0.017 ± 0.009
B10	0.023	0.045	0.048	0.039 ± 0.008
B11	0.015	0.028	0.031	0.025 ± 0.004

Gross beta was found less than MDA hence not mentioned in the report





Monazite being heavier and denser mineral as compared with silica sand, monazite content in airborne dust is significantly lower than typical soil of study area. Therefore, the long-lived alpha activity is not significantly high which is the case in NHBRA due to Monazite. Among the sampling locations, BU4 (Kudukachivilai, Mathicode Panchayat) is showing comparatively elevated long-lived alpha among other locations in Buffer Zone and, the same is attributed to resuspension of dust particles due to anthropogenic activities.

Monazite is a heavy mineral of high strength and grain integrity. Typical radon & thoron emanation rate from monazite sand is less than 1%. Outdoor locations in NHBRA have slightly higher levels of radon and thoron concentrations in air as compared to other locations. However, presence of natural ventilation also influences radon and thoron concentrations at outdoor locations. The values observed at Block A, Block B and Buffer Zones are within range of readings characteristic to monazite rich areas.

Dust load in air for most of the study locations of Block A, Block B and Buffer Zone are higher than 0.1 mg m⁻³, standards set by the Central Pollution Control Board. This is due to resuspension of dust. The values obtained are comparable to the dust load in air in this region.

Water sampling and radiochemical analysis of ground water at core and buffer zone locations were done. Though the entire study area consists of thorium and uranium rich mineral deposits, the gross alpha and gross beta activity in ground water is comparable to other locations in the areas outside the study area and significantly lower than the WHO drinking water limits of 0.5 Bq l⁻¹ for gross alpha activity and 1 Bq l⁻¹ for gross beta activity.

The soil at study area contains thorium and uranium bearing minerals. However, none of our ground water samples indicated any significant level of these two naturally occurring radioactive elements. The levels are comparable to levels outside the study area. The values obtained for uranium were much lower than the WHO recommended Guidelines of 30 ppb (µg l⁻¹) or AERB recommended Guideline of 60 ppb (µg l⁻¹) or for drinking water.

Though the soil contains higher levels of thorium as compared to uranium, thorium content in ground water is again significantly lower than uranium. This is due to low leachability and solubility of thorium compounds under the given environmental conditions. The associated chemistry is unfavourable for the dissolution of thorium and the levels are far less than that of the uranium (one to two orders of magnitude lower). Uranium dissolution in the environmental conditions is greatly influenced by the physicochemical conditions such as pH, redox potential, complexation behaviour and role of ions.

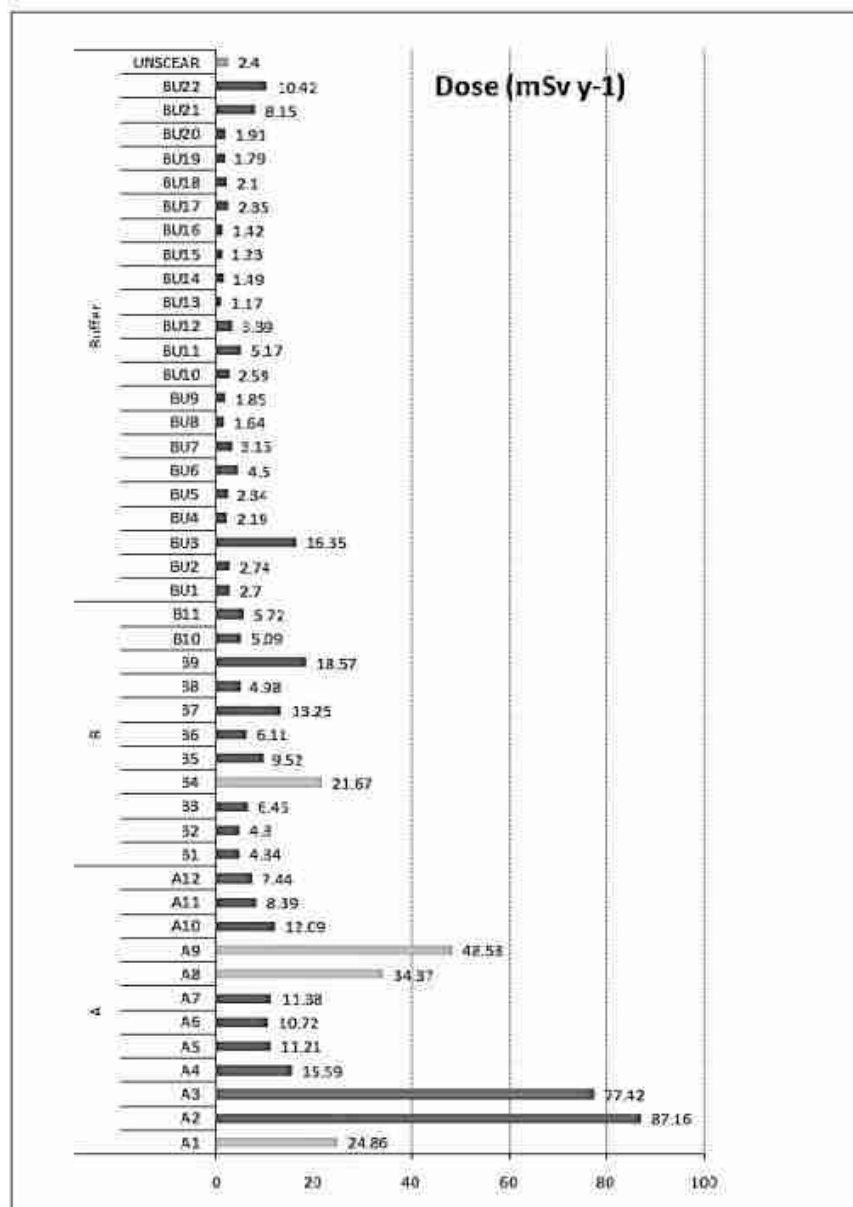
The study locations are a part of the identified NHBRA of Manavalakurichi with higher content of Monazite that is a thorium rich mineral. Some hinterland locations have monazite content in the soil up to 10%. The measured values of thorium and uranium are well within the range observed in the NHBRA locations.

Though the study area consists of monazite and zircon rich locations, no significant uptake of thorium and its progeny or uranium and its progeny were observed in the locally grown

foodstuffs. Gross alpha activity in the most common foodstuff that is coconut is comparable with those specimens grown in areas outside the study area. However, since the studied biota, coconut seed is rich in potassium, significant contribution from ^{40}K is observed in gross beta activity. For better understanding of distribution of radioactivity in biota, a few samples were collected from selected locations from Kerala and Tamil Nadu.

Comparison of dose received by the residents at entire study area with USCEAR reported world average shows that, residents of Block A, Block B and Buffer Zone receive higher doses as compared with average dose for the world population.

Comparison of Estimated external dose to the Residents with USCEAR reported world average



Non-Radiological Measurements - estimation of TDS, pH, fluoride and arsenic in ground water

Apart from monitoring of major environmental radiological parameters, other water quality parameters like total dissolved salts (TDS), pH, arsenic and fluoride in ground water also monitored. Arsenic and fluoride in ground water were measured at accredited private laboratories. None of the locations showed Arsenic above MDL value of 0.1 mg l⁻¹. The results for Block A locations are tabulated below.

Table 3.66 Estimation of Arsenic and Fluoride in ground water (mg l⁻¹) at Block-A

Block	March		April		May		Average	
	Arsenic	Fluoride	Arsenic	Fluoride	Arsenic	Fluoride	Arsenic	Fluoride
A1	<MDL	0.36	<MDL	0.45	<MDL	0.36	<MDL	0.39 ± 0.05
A2	<MDL	0.29	<MDL	0.36	<MDL	0.23	<MDL	0.29 ± 0.07
A3	<MDL	0.35	<MDL	0.20	<MDL	0.51	<MDL	0.35 ± 0.16
A4	<MDL	0.72	<MDL	0.76	<MDL	0.35	<MDL	0.61 ± 0.23
A5	<MDL	0.50	<MDL	0.21	<MDL	0.23	<MDL	0.31 ± 0.16
A6	<MDL	0.37	<MDL	0.23	<MDL	0.22	<MDL	0.27 ± 0.08
A7	<MDL	0.15	<MDL	0.23	<MDL	0.26	<MDL	0.21 ± 0.06
A8	<MDL	0.50	<MDL	0.31	<MDL	0.22	<MDL	0.34 ± 0.14
A9	<MDL	0.26	<MDL	0.44	<MDL	0.59	<MDL	0.43 ± 0.17
A10	<MDL	0.47	<MDL	0.81	<MDL	0.30	<MDL	0.53 ± 0.26
A11	<MDL	0.22	<MDL	0.34	<MDL	0.31	<MDL	0.29 ± 0.06
A12	<MDL	0.37	<MDL	0.34	<MDL	0.25	<MDL	0.32 ± 0.06

Table 3.67 Estimation of Arsenic and Fluoride in ground water (mg l⁻¹) at Block-B

Block	March		April		May		Average	
	Arsenic	Fluoride	Arsenic	Fluoride	Arsenic	Fluoride	Arsenic	Fluoride
B1	<MDL	0.24	<MDL	0.27	<MDL	0.25	<MDL	0.25 ± 0.02
B2	<MDL	0.21	<MDL	0.37	<MDL	0.30	<MDL	0.29 ± 0.08
B3	<MDL	0.33	<MDL	0.66	<MDL	0.26	<MDL	0.42 ± 0.21
B4	<MDL	0.20	<MDL	0.15	<MDL	0.20	<MDL	0.18 ± 0.03
B5	<MDL	0.21	<MDL	BDL	<MDL	0.16	<MDL	0.19 ± 0.04
B6	<MDL	0.23	<MDL	0.12	<MDL	0.28	<MDL	0.21 ± 0.08
B7	<MDL	0.41	<MDL	0.28	<MDL	0.37	<MDL	0.35 ± 0.07
B8	<MDL	0.25	<MDL	0.36	<MDL	0.31	<MDL	0.31 ± 0.06
B9	<MDL	0.29	<MDL	0.39	<MDL	0.21	<MDL	0.30 ± 0.09
B10	<MDL	0.22	<MDL	0.51	<MDL	0.25	<MDL	0.33 ± 0.16
B11	<MDL	0.37	<MDL	0.45	<MDL	0.27	<MDL	0.36 ± 0.09

From the observations of parameters, outdoor gamma dose rate in Block A varied from 1.8 to 13.7 μSvh^{-1} and in Block B it was 1.0 to 9.6 μSvh^{-1} whereas in the Buffer Zone it was 0.1 to 4.9 μSvh^{-1} only. Gamma dose rate mapping was also conducted in 27 locations along the intertidal regions of western coast of Kanyakumari and the highest levels of 20 μSvh^{-1} was observed in Kurumpanai mining area.

Long lived air activity based on gross- α measurements was 0.008 to 0.034 Bqm^{-3} (0.015 Bqm^{-3}) at Block A, 0.008 to 0.030 Bqm^{-3} (0.016 Bqm^{-3}) in Block B and 0.008 to 0.031 Bqm^{-3}



(0.011 Bqm⁻³) in Buffer Zone locations. Outdoor air activity levels of Radon were 7 to 37 Bqm⁻³ (21 Bqm⁻³) for Block A locations, 8 to 20 Bqm⁻³ (12 Bqm⁻³) for Block B locations, 7 to 17 Bqm⁻³ (11 Bqm⁻³) for Buffer Zone locations. Outdoor air activity levels of Thoron were 21 to 100 Bqm⁻³ (47 Bqm⁻³) for Block A locations, 13 to 40 Bqm⁻³ (23 ± 7 Bqm⁻³) for Block B locations, 12 to 33 Bqm⁻³ (19 Bqm⁻³) for Buffer Zone locations. Dust load levels were 0.53 to 1.47 mgm⁻³ (0.97 mgm⁻³) for Block A locations, 0.53 to 1.20 mgm⁻³ (0.85 mgm⁻³) for Block B locations, 0.40 to 1.33 mgm⁻³ (0.88 mgm⁻³) for Buffer Zone locations.

Gross alpha and gross beta activity in ground water samples on radiochemical analysis were in the range of 0.009 to 0.066 Bql-1 (0.018 Bql-1) & 0.063 to 0.152 Bql-1 (0.088 Bql-1) at Block A while 0.003 to 0.046 Bql-1 (0.020 Bql-1) & 0.047 to 0.108 Bql-1 (0.076 Bql-1) at Block B locations where as in Buffer Zone locations they were 0.008 to 0.031 Bql-1 (0.012 Bql-1) and 0.01 to 0.10 Bql-1 (0.03 Bql-1) respectively. Measurements of Uranium and Thorium in soil was carried out using gamma spectrometry and were found to be in the range of 5.2 to 24.7 Bqkg-1 (16.7 Bqkg-1) & 0.52 to 2.48 Bqkg-1 (1.65 Bqkg-1) at Block A locations while 1.2 to 16.6 Bqkg-1 (5.2 Bqkg-1) & 0.12 to 1.72 Bqkg-1 (0.54 Bqkg-1) at Block B locations where as in Buffer Zone locations the observed values were 0.3 to 9.6 Bqkg-1 (1.3 Bqkg-1) and 0.02 to 1.05 Bqkg-1 (0.13 ± 0.19 Bqkg-1) respectively.

The inner flesh of mature Coconut (*Cocos nucifera*) that is widely consumed and locally grown was analysed for Gross Alpha and Gross Beta activity and the results were in the range of 0.04 to 0.13 Bqkg-1 (0.06 Bqkg-1) & 9.2 to 15.9 Bqkg-1 (11.4 Bqkg-1) at Block A while 0.04 to 0.10 Bqkg-1 (0.05 Bqkg-1) & 9.9 to 13.2 Bqkg-1 (11.2 Bqkg-1) at Block B locations where as in Buffer Zone locations they were 0.04 to 0.10 Bqkg-1 (0.07 Bqkg-1) & 3.2 to 17.2 Bqkg-1 (13.4 Bqkg-1) respectively.

Measurements of Uranium in ground water (in ppb) by laser fluorimetry were found to be in the range of 0.50 to 1.15 ppb (0.64 ppb) at Block A locations while 0.51 to 2.50 ppb (0.90 ppb) in Block B Locations whereas in Buffer Zone locations they were 0.50 to 3.15 ppb (0.94 ppb) respectively. A few water samples collected from selected Block A and Block B locations (six locations in each Block) were subjected for Thorium estimation using Inductively Coupled Plasma–Mass Spectrometry (ICP-MS) and the levels were 0.01 to 0.08 ppb (0.03 ppb).

Among all radiological measurements, dose estimation for residents of study area is of high importance and hence indoor and outdoor gamma radiation field were measured (μSvh-1) and the annual external dose in mSvy-1 to the residents were estimated using the standard protocols. The external dose to the residents in mSvy-1 as indoor, outdoor and total were found to be in the range of 0.40 to 10.60 mSvy-1 (2.94 mSvy-1), 0.40 to 19.90 mSvy-1 (8.21 mSvy-1) & 7.44 to 87.16 mSvy-1 (29.10 mSvy-1) at Block A locations while the same in Block B Locations were 0.25 to 1.40 mSvy-1 (2.68 mSvy-1), 0.40 to 9.50 mSvy-1 (2.74 mSvy-1) & 4.80 to 21.67 mSvy-1 (9.18 mSvy-1) where as in Buffer Zone locations they were 0.103 to 1.50 mSvy-1 (0.35 mSvy-1), 0.12 to 4.90 mSvy-1 (0.70 mSvy-1) & 1.17 to 16.35 mSvy-1 (3.56 mSvy-1) respectively. The annual average effective dose from all sources of natural background radiation is approximately 2.4 millisieverts (mSv) worldwide and since the entire studied region are at NHBRA of south-west India, the external dose itself is, on an average five to ten times greater than world average.



4.0 Anticipated Environmental Impact and Mitigation Measures

4.1 Identification of Impacts

Environmental Impacts are categorized as Primary and Secondary Impacts. Primary Impacts are those which are attributed directly to the project and Secondary Impacts are those which are indirectly induced by the Project. Any Project would create impact on the environment in two distinct phases viz. Construction Phase which may be regarded as temporary & short term and Operation Phase which would have long term effects. Identification of all potential environmental impacts due to the Proposal are critically examined and major impacts (both Beneficial & Adverse) are studied.

4.2 Construction Phase

The proposed project does not involve any major establishment or construction. Thus, Construction Phase Impacts are not there for Impact Assessment and Environmental Management Plan (EMP).

Cost-benefit analysis of a separate Mineral Separation Plant (MSP) at the site: -

Due to lack of raw material source, existing MSP at Manavalakurichi is being operated for <40% of its installed capacity for last 10 years or so. To support the Plant (with all required infrastructures) at Manavalakurichi, the New Lease has been proposed. Thus, having a dedicated MSP near the new Lease will not be feasible on techno-economical & environmental angle. Increasing the continued supply of Raw Material to the existing MSP will enhance uninterrupted supply of strategic Minerals to DAE for its operations

4.3 Impact and Mitigation Measures During Operation Phase

The identified impacts due to mining activities throughout the operational and post closure phases have been studied in detail covering the following components:

- Land Environment.
- Traffic Volume.
- Air Quality.
- Noise Levels.
- Water Environment.
- Biological Environment.
- Socio-economics.

4.3.1 Land Environment

Anticipated Impacts: Non-Conventional Mining activities, with no Drilling and Blasting, will be carried out in available/consented pocket lands in the Mining Lease Area of 1144.0618 Ha. Thus, no vibration impact due to mining. Also, there is no Solid Waste generation and thus, no Waste Dump in the Mining Lease area.

After mining, the backfilling would be carried out and surface profile would be maintained at its original RL level (w.r.t. nearest Bench Mark) + 5 to 10% more for compaction. It is an ongoing activity upto life of the mine.

Since this process is an ongoing activity, if any sand deficit occurs in the conceptual stage, appropriate measures will be adopted to backfill the mined out area to the base level. Over and above, if any information is received from the land owners requiring for additional



tailings, IREL will transport the tailings and backfill to the base level. Additional tailings sand will be provided from the tailings generated from the beach washing collection. In the existing mining lease, same method is followed and no sand deficit has been experienced in the mined out and backfilled areas. Also, it is to be highlighted that, backfilling material is tailings (sand) only and hence, compaction is stable unlike clay materials.

About 106.50 Ha is required for Mining during the Plan Period which will be mined out, back filled and handed over to the Land Owners. At the Conceptual Stage, 834.1296 Ha will be the mined out and back filled area. Backfilled area will be used for plantation of Coconut trees and fruit bearing trees and other activities by the respective land owner. Thus, the original landscape will be restored after the mining.

Mitigation Measures

- Mined-out area are to be backfilled simultaneously to restore the topography.
- Plantation are to be carried out in the mined-out areas after backfilling.
- Reclaimed Land will be used for plantation and other activities including construction and thereby ensuring Eco-friendly and Sustainable mining.

4.3.2 Traffic Volume

Anticipated Impacts Mined out mineral from Blocks A & B will be transported by 25/30 Tons Tippers to the existing Mineral Separation Plant (MSP) at Manavalakurichi, which is aerially located at 8.4 km from Block-A and 19.4 km from Block-B in the southeast (road distance 12-17 km from Block-A and 30-35 km from Block-B). MDR and SH-179 will be the Ore Transportation Route from the Mining Lease to MSP at Manavalakurichi which is passing through the Lease area and accessible from both northern as well as southern pockets of Lease Area.

Mineral Transportation: As MDR and SH-179 covers >90% of the transportation route, the RoM transportation from Blocks-A&B to MSP will be through MDR/SH-179. For balance area coverage, vacant land within the Lease will be utilized as Haulage Road to reach the nearest point of MDR/SH-179 and further to MSP. Thus, Mineral transportation will not have any impact on the village roads.

For assessing the baseline status, a detailed traffic assessment was carried out, in compliance with IRC 106-1990 guidelines, at Midalam Road & Nithravilai Road Junctions. The existing traffic volume at Nithravilai was found to be 5017 PCU/day and at Midalam 4441 PCU/day i.e. 209 PCU/hr. at Nithravilai and 185 PCU/hr. at Midalam near MSP with average 197 PCU/hr (Table 3.54 & 3.55). The traffic carrying capacity of two-way undivided arterial road is 2400 PCU/hr as per IRC 106-1990.

In the Post-Project Scenario, there will be an addition of 334 Vehicle (in 2 ways) due to due to the Project. Cumulatively, the traffic volume in the Project vicinity will be 31 PCU/hr. It is worked to be only 16% volume addition to the existing traffic volume. The existing Roads/SH are adequate to handle the proposed traffic volume due to the Project. Thus, the traffic impact due to the Proposal will be minimum to the existing traffic volume in its vicinity. The Volume/Capacity (V/C) ratio for existing and proposed traffic volume is found to be 0.08 and

0.095 respectively and the Level of Service (LOS) is found to be “A” – Excellent. Hence, the existing highway is adequate to handle the proposed volume due to the proposed project.

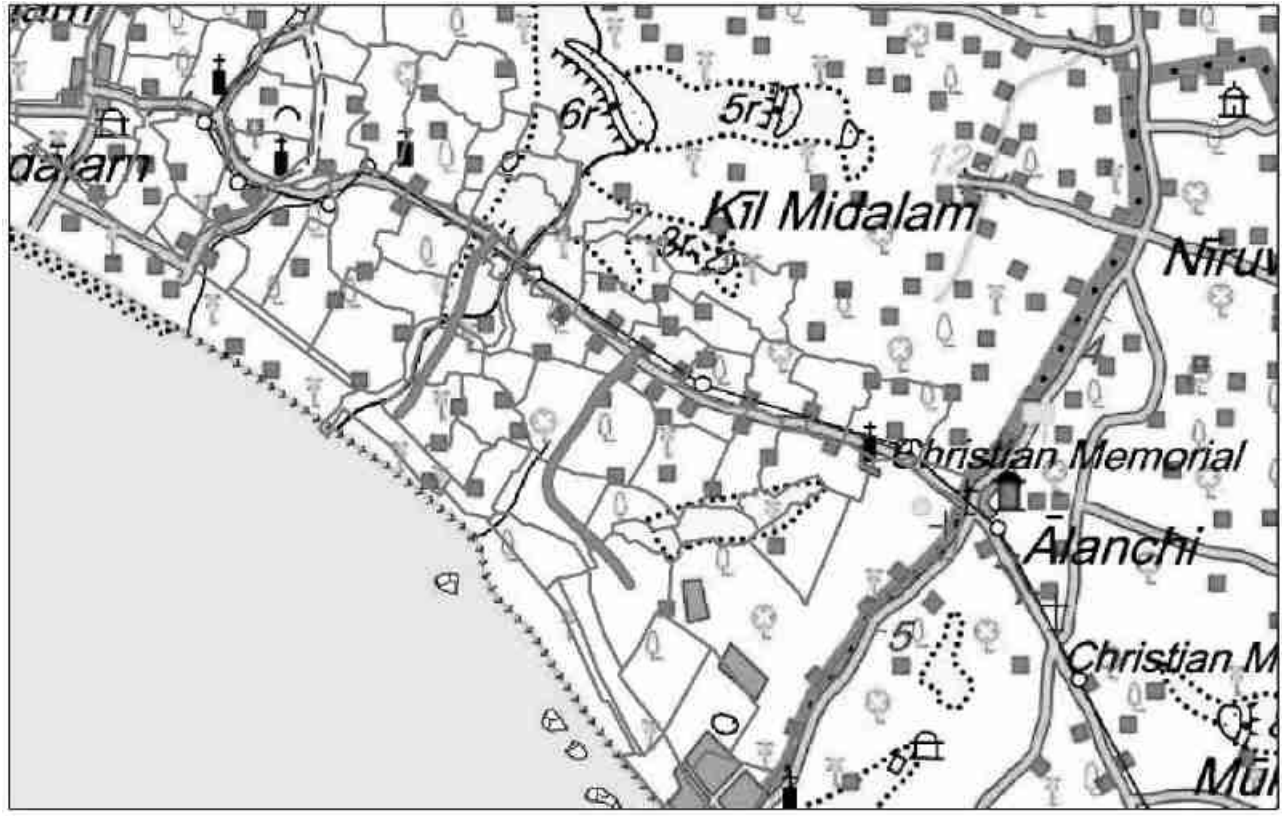


Figure 4.1 Mineral Transportation through the Lease Area

Carbon Emission & Climate Change

Greenhouse gases include carbon dioxide, methane, nitrous oxides, and water vapour. The proposed quarrying and transporting activities will utilise about 7.5 Lakhs Litres HSD/year. By considering the Transport Emission Factors for Medium & Heavy Duty Trucks viz. 0.997 kg CO₂/km, 0.012 g CH₄/km and 0.008 g N₂O/km [as per US EPA 2014 emission factors for Green House Gases (GHGs) Inventories], the gaseous emissions will be as follows:

HSD consumption	: 7.5 LLPA
Total CO ₂ Emissions	: 0.012 Tons/Annum
CO ₂ -e for CH ₄ Emissions	: 0.004 Tons/Annum
CO ₂ -e for N ₂ O Emissions	: 0.029 Tons/Annum.

Thus, total CO₂ Emission due to the Proposal will be 0.045 Tons/Annum.

Mitigating Measures

As an EMP measure, periodical wetting of haul roads with mobile water tankers will be undertaken by IREL to control the emissions due to transportation. Adequate Green Belt will be developed after the Mine closure for carbon sequestration. Carbon sequestration is the long-term storage of carbon in oceans, soils, vegetation (especially forests) and geologic



formations. As trees grow, they store carbon in woody tissues and soil organic matter. Through the process of photosynthesis, plants assimilate carbon and return some of it to the atmosphere through respiration. The carbon that remains as plant tissue is then consumed by animals or added to the soil as litter when plants die and decompose. The primary way that carbon is stored in the soil is as soil organic matter (SOM). SOM is a complex mixture of carbon compounds, consisting of decomposing plant and animal tissue, microbes (protozoa, nematodes, fungi, and bacteria), and carbon associated with soil minerals. It will be ensured that Plant operations do not result in loss of soil biological properties and nutrients. Soil amendments as required will be carried out to improve soil health. Bio remediation using micro organisms will be carried out to restore the soil environment to enable carbon sequestration.

Adequate parking area is provided in the Mine Area. Facilities for drivers (rest room, toilet, etc.) are also provided. Other mitigating Measures are:

- All Tippers are to be fully covered with Tarpaulin to avoid any spillage during transportation.
- Restriction of over loading of Tippers shall be enforced.
- Speed restrictions shall be enforced.
- Restriction of Truck parking in the Highway and Public Roads shall be enforced.
- Regular and preventive maintenance of transport vehicles are to be ensured.
- Compliance to 'Pollution under Control' Certification has to be ensured and to be checked periodically.

4.3.3 Air Quality

Commercial mobile lighting towers will be provided from 7.5 kVA for lighting 30-50 LUX intensity at the working areas for during night operation. The engine capacity will be 16-20 BHP. 2 Nos. of Mobile tower lights backed with 2 x 125 kVA DG sets will be utilized in the mining area for illumination purpose. The DG sets will have acoustic enclosures to control the noise levels. The stack height will be as per CPCB norms to comply with emission norms.

Emissions from Mines: Mining, Loading and Transporting activities would generate both fugitive dust emissions and smoke from HEM Machineries/Equipments & Transporting Tippers. Fugitive emissions are predicted by using standard equations given in 'Indian Mine and Engineering Journal' and suggested by USEPA (Emission Factors as referred in AP-42) for Mining & Allied activities.

The equations for various activities are:

Activity	Equation
Excavation of Ore	23.6 kg/hr particulate matter for every 1,000 Tonnes per hour material handling.
Ore transportation	0.2 kg/vehicle/km.

Accordingly, the computed values of PM Emission for various activities (other Pollutants are in insignificant levels from Mining activities) are:

<u>PM Emissions, g/sec</u>	
Excavation	0.00000005
Loading	0.00000006



Ore Haulage 0.00006596

As site specific mixing heights were not available, mixing heights based on CPCB publication, "Spatial Distribution of Hourly Mixing Depth over Indian Region", PROBES/88/2002-03 has been considered (appended below).

Maximum Mixing Height (meter) with Standard Deviation over Indian Region

Name of Station	Seasons					
	Winter		Pre-monsoon		Post-monsoon	
	Mixing Ht.	Std. Dev.	Mixing Ht.	Std. Dev.	Mixing Ht.	Std. Dev.
Chennai	1063.75	153.92	1274.45	111.79	1010.5	109.39

Prediction Modelling: AERMOD View Software is used for Predicting the maximum Ground Level Concentrations (GLCs) including Transportation Impact. Model Inputs and Outputs are appended. The predicted GLCs are given in Table 4.5.

Table 4.1 PM 2.5 – Input Data

Source Pathway - Source Inputs

AERMOD

Area Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/(s-m ²)]	Length of X Side [m]	Length of Y Side [m]	Orientation Angle from North [deg]	Initial Vertical Dim. [m]
AREA	MLBA	745520.65	908804.66	64.00	1.50	2.16E-8	100.00	50.00	0.00	
		ML Block A								
AREA	MLBB	734989.10	915153.27	33.00	1.50	4.50E-7	100.00	50.00	0.00	
		ML Block B								

Table 4.2 PM 2.5 – Output data

Results Summary

C:\Lakes\AERMOD View\IREL NewMine\IREL NewMine.isc

PM2.5 - Concentration - Source Group: ALL

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
24-HR	1ST	0.72595	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	21-02-2023, 24
24-HR	2ND	0.67804	ug/m ³	734995.42	916072.71	34.00	0.00	34.00	26-01-2023, 24
24-HR	3RD	0.53076	ug/m ³	734995.42	916072.71	34.00	0.00	34.00	29-01-2023, 24
24-HR	4TH	0.43892	ug/m ³	734995.42	916072.71	34.00	0.00	34.00	23-02-2023, 24
24-HR	5TH	0.39787	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	19-02-2023, 24
24-HR	6TH	0.36315	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	08-02-2023, 24
24-HR	7TH	0.32914	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	30-12-2022, 24
24-HR	8TH	0.32483	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	10-02-2023, 24
24-HR	9TH	0.31671	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	20-12-2022, 24
24-HR	10TH	0.31643	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	11-01-2023, 24
PERIOD		0.11286	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	

Table 4.3 PM 10 – Input data

Source Pathway - Source Inputs										
AERMOD										
Area Sources										
Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s or m ³]	Length of X Side [m]	Length of Y Side [m]	Orientation Angle from North [deg]	Initial Vertical Dir. [m]
AREA	MLBA	745520.65	909804.66	64.00	1.50	2.16E-7	100.00	50.00	0.00	ML Block A
AREA	MLBB	734989.10	915153.27	33.00	1.50	4.50E-6	100.00	50.00	0.00	ML Block B

Table 4.4 PM 10 – Output Data

Results Summary									
C:\Lakes\AERMOD View\IREL NM PM 10\IREL NM PM 10.isc									
PM10 - Concentration - Source Group: ALL									
Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
24-HR	1ST	7.25954	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	21-02-2023, 24
24-HR	2ND	6.78037	ug/m ³	734995.42	916072.71	34.00	0.00	34.00	26-01-2023, 24
24-HR	3RD	5.30761	ug/m ³	734995.42	916072.71	34.00	0.00	34.00	29-01-2023, 24
24-HR	4TH	4.38919	ug/m ³	734995.42	916072.71	34.00	0.00	34.00	23-02-2023, 24
24-HR	5TH	3.97872	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	19-02-2023, 24
24-HR	6TH	3.63155	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	08-02-2023, 24
24-HR	7TH	3.29137	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	30-12-2022, 24
24-HR	8TH	3.24828	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	10-02-2023, 24
24-HR	9TH	3.16710	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	20-12-2022, 24
24-HR	10TH	3.16430	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	11-01-2023, 24
PERIOD		1.12860	ug/m ³	736495.42	916072.71	34.00	0.00	34.00	

Table 4.5 Predicted GLCs

Sl. No	Pollutant	Background Concentration (24-hly. Avg.), ug/m ³	Max. Predicted Ground Level Concentration, ug/m ³	Distance from the Plant (max.), km	Total Concentration, ug/m ³	Revised NAAQ Norms ug/m ³	Buffer Available in the Atmosphere (%)
1.	PM 2.5	21.60	0.73	0.8	22.33	60	62.78
2.	PM 10	45.70	7.26	0.8	52.96	100	47.04

The predicted maximum GLC-PM2.5 & PM10 for cumulative operation of Mining activities are 22.33 ug/m³ & 52.96 ug/m³ respectively and found to be confined locally i.e. within 0.8 km radius from the boundaries. Also, adequate Buffer Level available (47-63%) in the Air Environment for the Proposal.

Predicted GLCs for PM2.5 and PM10 are given in Figs. 4.2 & 4.3.

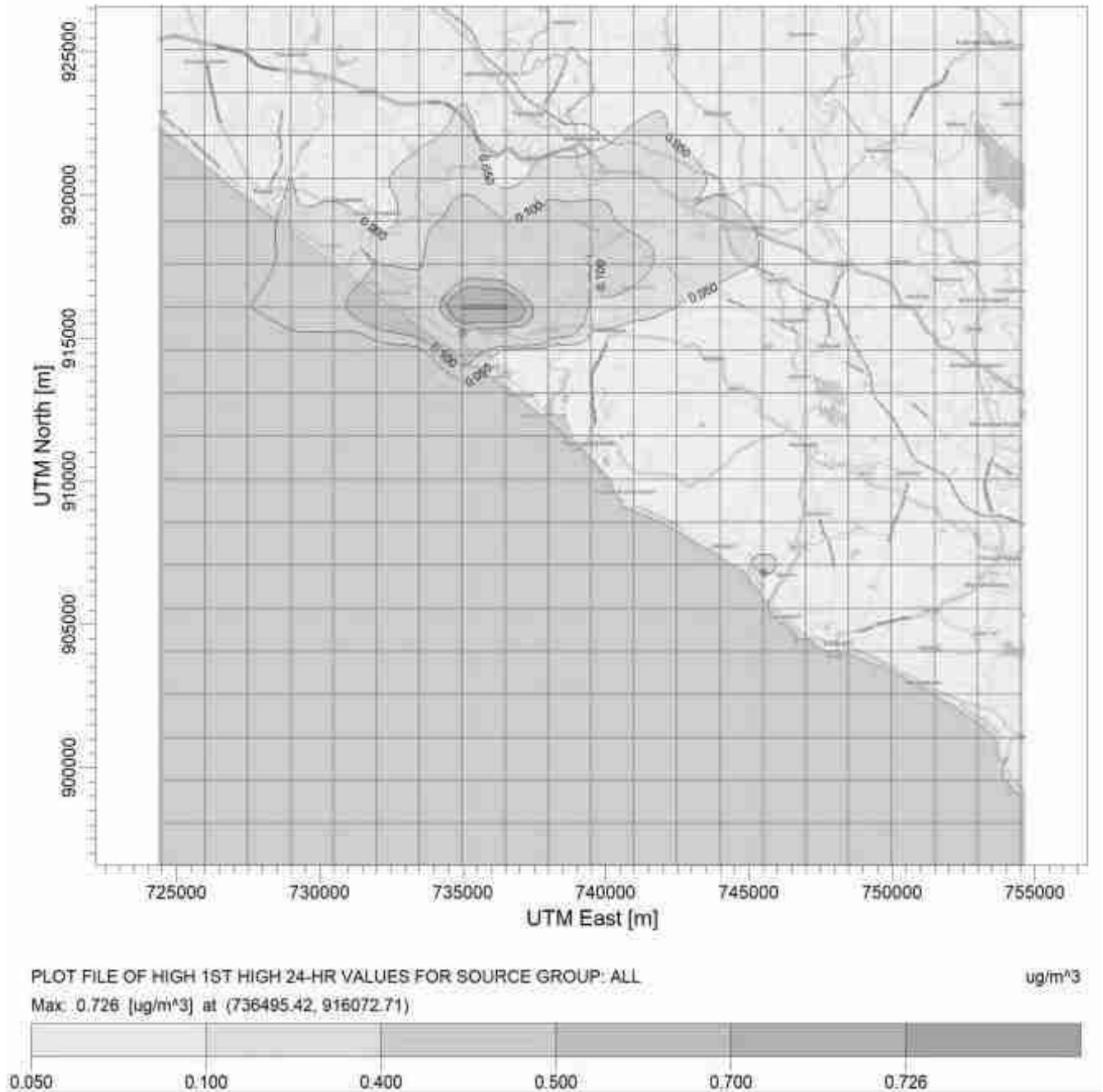


Figure 4.2 Predicted GLCs – PM 2.5

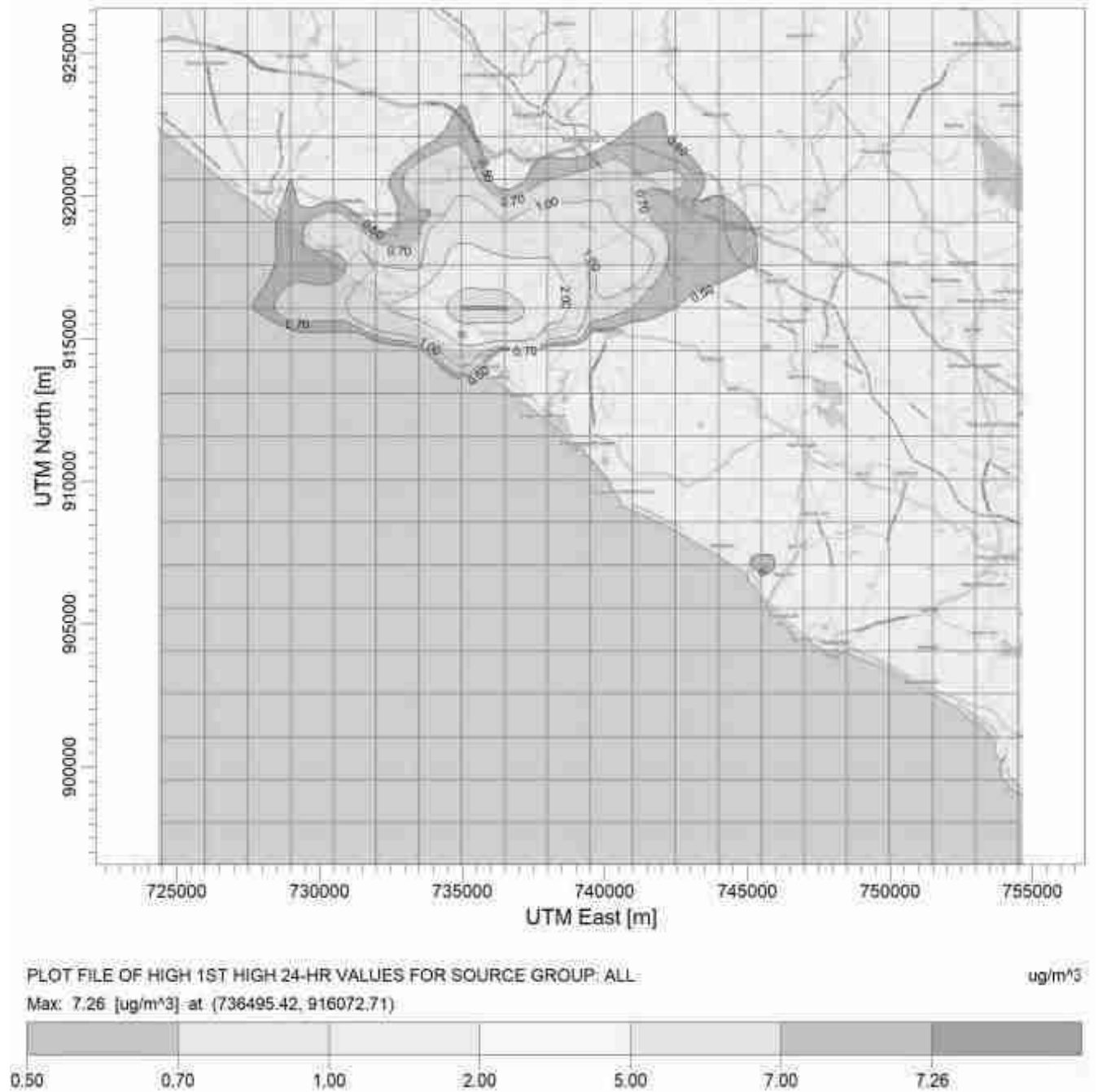


Figure 4.3 Predicted GLCs – PM 10



Mitigating Measures: As mitigative measure to control air pollution, the following measures are to be implemented effectively:

- Water sprinkling on loading point and Haul Roads are to be carried out.
- Covering of Trucks/Tippers with tarpaulin shall be ensured during Ore transportation.
- Over loading of Tippers has to be avoided to control the spillages during transportation.
- Periodical maintenance and replacement of worn out accessories in the mining equipments are to be carried out.
- 'Pollution under Control' Certification has to be ensured and to be checked periodically.
- Periodical monitoring of Ambient Air Quality has to be carried out.

4.3.4 Noise Levels

The mining operations are to be carried out by fully mechanized method with the help of Excavators and Tipper combination. No drilling and blasting is involved. The noise level due to Mining Equipments during operation, is to be maintained at <90 db(A) at a distance of 1.5 m from the sources. In general, noise generated by these sources is to be within the limit of 90 dB(A) as prescribed by the Director General of Mines Safety (DGMS). The work force is exposed to <85 dB(A) levels during the 8-hours Shift.

Table 4.6 Source Noise Levels - Mine Machineries

Equipment	Location	Noise Level (Leq), dB(A)
Excavator	Operator's Position	80-85
Tipper	Operator's Position	70
Tipper	Operating 10 m away	85-90

Ambient Noise Levels (Leqs) will be <55 dB(A) during day time and <45 dB(A) during night time at the boundaries in compliance with MoEF&CC Norms for residential areas.

2 Nos. of Mobile tower lights backed with 2 x 125 kVA DG sets will be utilized in the mining area for illumination purpose.

Mitigating Measures:

The noise generated due to use of machineries can be kept well within the limits. Noise level at the nearest Mining Lease boundary will be <55 dB(A) during day time and <45 dB(A) during night time and which will be within the MoEF&CC Norms for Residential and Rural Areas.

- Deployment of mining equipments shall be with in-built mechanism for reducing noise.
- Providing ear muffs/ear plugs to the workers in high noise zones.
- Operation of the mobile van will be complying the MoEF&CC noise norms of <45 dB(A) during night time for residential areas.

4.3.5 Water Environment

Anticipated Impacts on Surface Water

The mining activities involve the mining of Atomic Minerals (BSM Ore) from the inland deposits. Block-B is does not contain waterbody or stream and there are 2 Nos. streams in Block-A. As described in the approved mining plan, adequate safety barriers will be



maintained at both sides of the nalla course till the end of the mine life. Natural runoff water would not be disturbed due to the mining activity.

As the mined-out areas would be backfilled simultaneously, no surface Runoff generation from the Mining Lease and Pre-Project & Post-Project Runoffs will remain same. Also, there will not be any disturbance due to the mining on the natural drains and rivers in the vicinity. Thus, no impact is anticipated on the surface water bodies due to the mining activities.

Anticipated Impacts on Ground Water

The average working depth in Block – A and Block – B is 6 m only and the maximum depth will be 9 m BGL. The groundwater level in the mining lease area and vicinity is ranging between 10 – 15m BGL as evidenced from the Tamil Nadu Water Supply and Drainage Board (TWAD) and CGWB data base. Thus, the mining activity will not intersect the groundwater table at both the blocks A and B. If the mining is found to be intersecting the water table, further mining activities will not be carried out at that location.

With no permanent facilities proposed in the Mining Lease area and with the moving population of worker/employees during the mining, water demand will be 2.5 KLD which will be sourced from the permitted quantity of 4500 KLD from Valliyar River for the existing MSP at Manavalakurichi. Also, the requirement will be managed through local Drinking Water suppliers. Sewage generation of 2.2 KLD will be biologically treated in a mobile Bio-Toilets and the sludge will be used as manure for the Green Belt development. No Workshop is proposed and thus no trade effluent generation from the Mine. No mine pit will be there and thus no mine drain is envisaged. No impact is anticipated on the ground water sources in the Mining Lease vicinity.

Mitigation Measures

- Natural drains shall be maintained as such.
- Adequate safety barriers will be maintained at both sides of the nalla course in the Lease till the end of the mine life.
- No ground water drawl in the Mining Lease Area as well as CRZ area for the project.
- Periodical monitoring of water table levels and water quality are to be carried out.

4.3.6 Biological Environment

Anticipated Impacts

There are **no Eco Sensitive Areas** like National Parks, Wildlife Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar Sites, Tiger/Elephant Reserves, Reserved Forests, etc. (existing as well as proposed) within 10 km from the Mining Lease Area. Kanniyakumari Wildlife Sanctuary is at 25 km (shortest) distance in northeast.

The study area does not involve any forest land. The private patta lands are found with scattered coconut trees. The major crops cultivated in the study area are coconut trees, fruit crops like mango, banana, jack and aonla. Only domesticated fauna is recorded in the Study Area.



Mitigation measures

- Backfilled areas will be afforested with native tree species.
- Adequate Green Belt will be developed wherever possible.

Green Belt development: The mining will be limited to vacant land available in the mining lease area. Out of total mining lease area of 1144.0618 Ha, the vacant land available for mining of atomic minerals is 834.1296 Ha only. Also, the mining will be carried out in the consented pocket lands given on lease for 11 months by the land owners. After the mining, such pocket lands will be backfilled to its original level and handed over to the land owners. Thus, the land will be in possession of IREL for a short duration of 11 months only and after that the land ownership will not be with IREL. The same scenario would prevail for the entire lease area. IREL will not have any surface right nor land ownership in the entire mining lease area.

In view of this, Greenbelt development in the mining lease area by IREL may not be possible as the ownership of the land vest with land owners. However, IREL will incorporate a clause in the land lease agreement to plant and develop coconut or any other suitable tree plantation @70 Trees per acre in the mined out area (**Table 4-7**).

Towards compensatory afforestation programme, IREL would contribute an amount of Rs. 50 Lakhs to the District Forest Officer (DFO) to develop and maintain 25,000 trees at suitable place near the lease area.

Table 4.7 Green Belt Development

Plan Period	Area, Ha	No.of. Trees (Coconut)
I	103.5	17,700
II	106.5	18,000
III	106.5	18,000
IV	106.5	18,000
V	106.5	18,000
VI	106.5	18,000
VII	106.5	18,000
VIII	91.62	16,000
Total	834.12	1,41,700

In addition to the above, the following native species will also be suitably planted in the available areas:

Acacia nilotica (Babul)
Acacia leucophloea
Aegle marmelos
Azadirachta indica
Cassia fistula
Casuarina equisetifolia
Coccus nucifera
Ficus bengalensis
Ficus religiosa
Mangifera indica
Zizyphus jujuba



Green belt development will be undertaken in consultation with State Forest/Horticulture Department.

4.3.7 Occupational Health and Safety

Anticipated Impacts

Radiation: The coastal areas in Kanniyakumari District including the mining lease area of 1144.0618 ha are having high natural background radiation in the range of 1 to 4 $\mu\text{Svh-1}$ due to presence of Monazite in the BSM Ore. Monazite is a radioactive mineral containing Uranium and Thorium.

On removal of the BSM ore (Run of Mines) containing Monazite and backfilling the mined-out areas with tailings (after removal of minerals), the background radiation in the mined-out area is brought down to 0.2 to 0.4 $\mu\text{Svh-1}$. In other words, there has been 8 to 10-fold reduction in the radiation level in the area where mining & backfilling is carried out by IREL and as such our mining does not affect either environment or people and makes the area free from high background radiation.

IREL will provide and continually improve the occupational health and safety performance. Personal Protective Equipments will be provided to the mine employees. All the workers will be provided with Internal Dosimetry and Medical Surveillance. Maintenance of Pre, during & Post Employment Records will be done. Duly qualified Radiological Safety Officer (RSO) will be appointed. External Radiation Monitoring will be carried out periodically by Health Physics Division, BARC. All the workers will be trained and instructed in radiation safety.

Mitigation measures

Commitment Towards Occupational Health Facilities: The following activities are being carried out by IREL at present also and the same will be followed.

Radiation Monitoring:

Personal Monitoring: Persons working in the mines will be provided with Thermo-Luminescent Dosimeter (TLD). The TLD will be issued on quarterly basis and it will be evaluated by the Nuclear Fuel Complex (NFC), Hyderabad. The dose level will be calculated and the same will be recorded and monitored as per the AERB guidelines.

Work place monitoring: Radiation level survey in work place will be carried out by Radiation survey meter and Radiation survey will be conducted once in a month. Medical examination: All persons to be employed would undergo Initial Medical Examination as per the Mines Act, 1952 and the Atomic Energy (Radiation Protection) Rules, 2004.

Periodical Medical examination will be carried out (i) once in 5 years for persons below the age of 45 years (ii) Once in 3 years for the persons above the age of 45 years and (iii) Once in a year for persons to be deployed in the mining site.

Compulsory Medical examination will be carried out for the persons before 30 days of their retirement.

All the data related to medical will be digitally maintained.

First Aid room will be provided in the mining site and the same will be maintained as per the Mines Act, 1952.



4.3.8 Soil & Agriculture

Anticipated impacts

Loss of agricultural land is not involved as backfilling of mined out voids carried out simultaneously and reclaimed. Also, there will be no mine seepage water disposal or any effluent discharge from the Mining Lease area. No impact will be there due to mining on ground water & surface water sources. Fugitive emissions due to the mining of Atomic Minerals will be Nil/ or insignificant. ROM and tailings transportation will be mainly on the State Highway. Thus, there will be no impact on the Soil as well as Agricultural activities in the vicinity.

4.3.9 Socio Economics

Neither land acquisition nor purchase of land would be done for the Project. The permanent structures will not be disturbed and mining shall not lead to displacement of people. Thus, **no Rehabilitation & Resettlement (R&R) issue due to the Proposal. Also, there is no Litigation against the Proposal.**

The Mine will be operated with the required Statutory Officials and Competent Persons mandatorily appointed as per the provisions of the Mines Act, 1952, Atomic Mineral Concession Rules (AMCR), 2016 and Mineral Conservation Development Rules (MCDR), 2017. Project will employ about 155 persons directly and 250 persons indirectly.

The Project Cost is Rs.31.25 Crores. Royalty, DMF and NMET will be remitted as per the statutory requirement. Adequate CER Budget, as per OM F.No.22-65/2017-IA.III dated 20.10.2020, will be allocated for the benefits of local villages in the Mine vicinity, after taking into account of the concerns raised during Public Hearing.

IREL spends about Rs. 3.00 – 5.00 Crore for CSR activities in the region (Table 4.8)

Table 4.8 CSR Activities in the Region by IREL

CSR Component	CSR Amount Spent (Rupees in lakhs)					Total
	2020-21	2021-22	2022-23	2023-24	2024-25 Allocated	
Health & Nutrition	15.77	76.76	59.39	134.45	127.50	413.87
Education	5.41	3.92	21.77	89.56	166.50	287.16
Rural Development Projects	49.84	28.77	37.64	89.54	150.00	355.79
Promoting Environment		11.79	36.78	15.68	45.00	109.25
Women Empowerment		17.96				17.96
Skill Development			4.06	6.85		2.15
Sports				4.72	11.00	15.72
Total	71.02	139.20	159.64	340.80	500.00	1210.66

CSR Activities by IREL-MK Unit

Contribution to Covid-19 Isolation Centre at Marthandam-60 Beds, 15 Nos. Oxygen Concentrators



Medical Camp conducted at Kurumpanai on 22.07.2023- Beneficiaries - 593 persons



Free Covid-19 Vaccination Camp conducted at BMHS School, Manavalakurichi on 26.08.2021



Eye Camp conducted at Lekshimpuram on 12.08.2023 Beneficiaries - 501 persons



CSR Activities by IREL – MK Unit



Shri H.R. Koushik, Sub-Collector, Padmanabhapuram

IREL handed over 4 nos. of vehicles to Kollencode & Colachel Municipalities, Ezhuthesam Town Panchayat and Thoothoor Village Panchayat in the presence of Shri N. Selvarajan, Chief General Manager & Head and Trade Union Representatives on 13.01.2023 for handling Solid waste in the Municipalities/Panchayat.

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Shri N. Selvarajan, CGM & Head, MK handed over cheque of Rs.14 lakhs and Rs.4.50 lakhs to the Sub-Collector, Padmanabhapuram towards Fishermen Village Development Fund and Medical Assistance Fund respectively on 14.09.2022





The processed mineral products, apart from its usage for strategic purpose in Nuclear Energy, Defence, Space, etc., finds application in number of commercial sectors such as aerospace industry, infrastructure development, ceramics, foundries, oil industries etc., while Rare Earths (RE) are used in niche applications such as consumer electronics, renewable energy, EVs, etc.

The project will generate revenue in terms of royalty and taxes etc. to the state of Tamil Nadu in addition to make available of strategic material. The project will also generate employment to the people and ancillary industries around the area. All these minerals and RE provides input for other industries and plays vital role in global economy. Hence, the project is of utmost importance for the country and the region.

Mitigation measures

- Development of Infrastructure Facilities in the Region.
- Conducting medical camps and extending medical facilities.
- Contribution to Education and skill development.
- Providing drinking water supply.



5.0 Analysis of alternatives (Technology and site)

5.1 Technological alternatives

The method of mining will be **Non-Conventional Opencast Mechanized Mining** by Excavator-Tipper combination with no Drilling & Blasting.

The mineable reserves estimated in the mining lease area of 1144.0618 Ha is 59.88 Million Tonnes. Mineral content in the deposit varies between 10.0% and 22.6% with an average 14.5%.

It is proposed to mine out Atomic Minerals (BSM Ore) @ 5000 Tonnes per day (TPD) ROM and 1.50 Million Tonnes ROM per Annum. Mining operation will be carried out at an average depth of 6 m and a maximum depth of 9 m depending upon the location and mineralization. **No ground water-table intersection** is envisaged.

5.2 Site Options

As the mining is site specific in nature, alternate site for mine is not applicable.

6.0 Environmental Monitoring Programme

6.1 Environment Cell and Compliances

IREL has EMP Monitoring Cell. The quality of air, noise, water, soil, etc. will be monitored periodically at the identified locations as per the MoEF&CC, AMD and TNPCB Norms by appointing an accredited external agency. The Status Reports will be submitted to the Authorities periodically viz. TNPCB monthly, AMD Quarterly and MoEF&CC Monitoring Cell as Half Yearly Status Reports.

6.2 Post Project Monitoring

Radioactivity Monitoring as per AERB Norms and periodical monitoring of Ambient Air Quality (3 locations), Fugitive emissions/Workzone Air Quality (4 locations), Ambient & Workzone Noise Levels (4 locations), Water (4 Surface & 4 Ground waters along with Mine Pit water) and Soil Quality (3 Locations) shall be undertaken and reported to the Authorities. The monitoring details are given in Table 6.1.

Table 6.1 Post Project Monitoring Schedule

Environmental Component					
	Ambient Air Quality	Fugitive Emissions	Noise Levels	Water Quality	Soil Quality
No. of Locations	3 (in & around Mine-Upwind & Downwind directions)	4 (Excavation area, Loading Area, Haul Road & Pit Edge)	Ambient-3 Workzones-4	Surface waters-4 Ground waters-4	3
Frequency	24-hourly once in fortnight continuously for whole year	Two 8-hourly samples, once in a week for 2 weeks in a Season	Once in a month	Surface & Ground Waters-Once in a Season - Monthly once	Once in a Season
No. of Samples	72	64	84	32+12	12
Parameters	All 12 Parameters	PM10, SPM, SO ₂ , NO _x & CO	Day & Night Leq Noise levels dB(A)	Physicochemical & Trace Metals	Physicochemical & Nutrients
Norms to be Complied	NAAQ Norms	AMD Norms	MoEF&CC and DGMS Norms	CPCB/IS:10500 & TNPCB Norms	Soil Fertility
Budget Allotted	Rs.10.50 Lakhs/Annum				

7.0 Additional Studies

7.1 Hazards Identification & Risk Assessment

Hazards Identification & Risk Assessment (HIRA) is the Tool to identify the potential Hazards due to the proposed activities and assessment of the Risks to formulate the Emergency Preparedness Plan (EPP). There is no storage of Hazardous Chemicals in the Mining lease area and thus, no Modelling is required. The Potential Hazards that could have an impact during Operation Phase are given in Table 7.1.

Table 7.1 Potential Hazards due to Proposal

Potential Hazard	Probable Impacts
Manmade:-	
Accident due to Mining Activities	Can occur at any time during the Mining
Natural:-	
Natural Calamities	Can occur at any time.
Others:-	
Medical Emergency	Can occur at any time during the Operational Phase.

7.2 Emergency Preparedness Plan

The hazard scenarios were risk ranked using the Risk Matrix (R) are shown in Table 7.2.

Table 7.2 Risk Matrix (R)

Potential Severity	Risk			
	Low (1)	Medium (2)	High (3)	Continous (4)
Major (4)	2.5	3.0	3.5	4.0
Moderate (3)	2.0	2.5	3.0	3.5
Minor (2)	1.5	2.0	2.5	3.0
Negligible (1)	1.0	1.5	2.0	2.5

The Mining operations are ranked in Low-Major Risks with Score of 1-4. It shall be ensured that Personnel engaged are made aware of the Hazards involved and are trained in responding to the Disasters. First Aid Kits and Medical Supplies will be maintained at the Mining site. All personnel will use Personal Protective Equipment (PPEs) like Safety Shoes, Helmets, etc. They will be trained in Safety Procedures to ensure that accidents and injuries are prevented. Hospitals in the vicinity will be used for any Medical Emergencies.

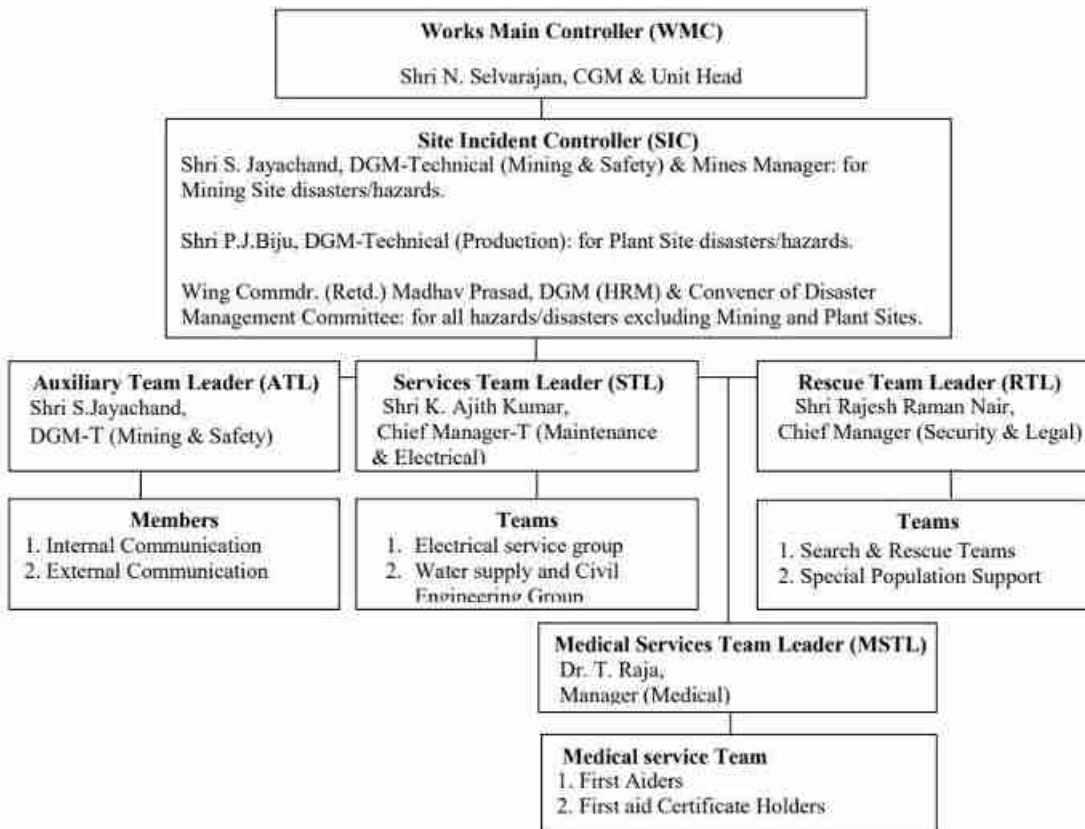
7.3 Disaster Management Plan

IREL is having an effective Disaster Management Plan (DMP)/Emergency Preparedness Plan (EPP) in their Plant and Mines. The same procedure will be adopted/in place for the Proposed Project also. The general scope includes:

- Institutionalize of disaster management system
- Facilitate culture of disaster preparedness
- Vulnerability reduction and disaster mitigation through better planning, training and preparedness

- d. Strengthen mechanism to handle unprecedented events
- e. Facilitate quick response, effective communication & decision making in the event of occurrence of disasters
- f. Better coordination of all line departments (internal/external) in disaster management
- g. Regular update of resources available within organization and outside.

The following organization structure is for responding to any event.



Role of key persons:

Works Main Controller (WMC):

WMC is the Head of the Unit at works and is generally available in the plant except on tour/after office hours. On emergency, he can reach work site at any odd hours within 30 minutes time. In his absence, the Official authorised by him to take over his charge, shall take up the responsibility as Works Main Controller.

On being informed of an incident, he has to:

- a. Rush to the emergency site, collect all information from Site Incident Controller (SIC) and reach Emergency Operating Centre (EOC).
- b. Assess the gravity and decide if emergency is to be declared. Accordingly, advise Site incident Controller (SIC).



- c. Advise Auxiliary Team Leader (ATL) to have the siren blown by security conforming to appropriate code for declaration of emergency.
- d. Through Auxiliary Team Leader (ATL) communicate to the statutory authorities.
- e. If required, the Auxiliary Team Leader (ATL) seeks assistance from mutual aid partners.
- f. Keep the statutory authorities updated through ATL.
- g. Maintain continuous communication with Site Incident Controller (SIC) to review the situation and assess the possible course of action for emergency operations.
- h. Declare normalcy at the end of operation. Security is directed through ATL to blow siren as per the siren code.
- i. Record maintenance in the chronological order of its happening.
- j. Ensure that evidence is preserved for enquiries to be conducted by statutory authorities.
- k. Conduct post disaster analysis and evaluation

Siren code for various emergencies:

Hazard	Siren code
Fire Hazards	Intermittent ON /OFF for the electrical siren which can be heard 2 km surrounding.
Explosion	
Tsunami/flood/cyclone	
Collapse of building, etc	
All clear siren (at the end of operation)	Siren is operated continuously once

Site Incident Controller (SIC):

He is available at the factory or within 20 km at any point of time and on being informed about an accident, he has to:

- a. Intimate WMC and rush to the site.
- b. Take inputs from STL. Assess situation and call RTL and ATL.
- c. He will manage the activities until WMC arrives.
- d. Keep updating WMC at regular intervals and whenever required.
- e. Take necessary steps and provide guidance to the Combat Team, the Rescue Team, and Auxiliary Team Leaders for handling the emergency situation.
- f. Examine major emergency shutdown operation activities, decide safe escape routes and announce the evacuation to the Assembly Point.

Auxiliary Team Leader (ATL):

He is the communication manager for the crisis management. On being informed of the emergency, he should proceed to Emergency Operation Centre (EOC) and:

- a. Keep communication channel live with WMC and SIC.



- b. Inform the Statutory Authorities and District Administration, if required after consulting WMC.
- c. Communicate to Mutual Aid Partners, if required after consulting WMC.
- d. Inform Fire service stations, Hospitals, Police Stations, etc, if required in consultation with WMC.
- e. Inform the relatives of casualties and send them to their residence or hospital as the case may be.
- f. Take care of visit of the authorities to the Emergency site.
- g. Keep update WMC/SIC about status with respect to his areas of activities.

Services Team Leader (STL):

To arrive at the site and coordinate the activities of the Electrical, Water and Civil Service Groups

Electrical Services Group:

- a. Ensure operability of DG sets.
- b. Ensure emergency lighting system with DG.

Water Supply & Civil Engineering Group:

- a. Ensure a minimum of 400 m³ of water is kept in the ground water reservoir. If necessary, curtail water supply to all the plants.
- b. The required numbers of food packs are to be arranged by the team.
- c. Inspect all drainage systems at the plant site and arrange for their de-clogging and proper maintenance.
- d. The required quantity of food packets may be arranged by the group.

Medical Services Group:

- a. Assess the affected persons and render First Aid.
- b. Arrange to send the affected personnel to various referral hospitals.
- c. Supply medicines and kits as per requirement.
- d. Coordinate with HoD (HRM).
- e. The Ambulance and drivers are to be kept ready all the time.

Rescue Team Leader (RTL):

RTL is the person who conducts the rescue operations. On receiving information about the incident, he has to:

- a. Rush to the site of emergency through the safest route.
- b. Ensure presence of all his team members, required implements and gadgets. Take necessary action to arrest/control/mitigate the emergency situation.
- c. Arrange for the safe escape of entrapped persons.
- d. Make necessary arrangements to send the affected persons for immediate medical attention to the hospital as per the advice of the medical officer.
- e. Search for missing persons.
- f. Update SIC on a continuous basis.



Silent Command structure:

The period or the Timing from 4 PM to 8 AM is considered as silent hours. (Sunday is full day). During silent hours, the Shift In charge of the main plant will be responsible for handling the emergency till the main command personnel arrive. Most of the key persons of the main command structure reside within a radius of 25 km.

Plan Management:

Responsible persons by position to prepare, maintain, revise, review following documents:

Disaster Management Plan (Natural calamities & accidents): In charge (Safety) Fire
Emergency Plan: In charge (Fire Protection).

Disaster due to Terrorist, Public unrest, etc.: In charge (Security)

HRVA (Hazard, Risk, Vulnerability Analysis)

A cross functional team for HRVA (Hazard, Risk, Vulnerability Analysis) is at place. The Objectives of the HRVA Cell are:

- a. Conduct and regularly update the HVRA of the unit
- b. Conceptualize and implement early hazard warning systems
- c. Create and maintain the disaster database of the unit
- d. Assess the resource requirement to meet credible disaster conditions
- e. Recommend disaster risk reduction methods
- f. Recommend areas of strengthening through trainings, etc.
- g. Identify areas of vulnerability from the perspective of Disaster Recovery and suggest remedial measures.

The members of the HVRA team consists of representatives from

- a. Mining
- b. Production
- c. Maintenance
- d. Safety
- e. Any other department as decided.

One among the above will be the Coordinator of the committee.

History of disasters

The plant lies in the tropical region on the coast of Arabian Sea. High humidity is felt all round the year, aggressive summer and a good seasonal rainfall characterize the climate of the region. The summer season (March-May) is very hot (to some extent moderated by the sea) followed by Southwest Monsoon, which lasts, from the 1st week of June to the end of August. The Northeast Monsoon in the months of October and November is known as “retreating monsoon period”. Winter is not felt. Maximum annual temperature is around 42° C while the minimum temperature is 20° C.



West coast of South India, on which the Manavalakurichi Unit (MK plant) is located, is less frequently prone to cyclonic storms compared to the east coast but the storms are not totally absent.

- A severe cyclone crossed over Kanyakumari area of Tamil Nadu on 14th November 1992 after a gap of 30 years and resulted in very heavy rains and flash floods. There was no damage to the plant.
- On December 26, 2004, a Tsunami struck the sea coast adjacent to the Plant due to severe earthquake of the order of 9.1 Richter scale off the Sumatran coast of Indonesia. Boundary wall on the sea side collapsed and sea water entered inside some of the sections (stores, mechanical workshop). No other damage occurred.
- On 30th November, 2017, the cyclone Ockhi struck the district of Kanyakumari. Few roof sheets were only damaged.

Hazard risk and vulnerability mapping:

Sl. No.	Type of Hazard (with respect to Disaster)	Probable areas/ persons affected.
1.	Inundation during heavy Flood/Tsunami	HUS, raw sand godown, Main Stores
2.	Threat by terrorists via sea	Plant and employees.
3.	Agitation by nearby locals in case of local problems.	Plant and employees.
4.	Fire in the Plant	MSP/HUS/Diesel Yard/ FO Yard/ LPG storage bank

Area/Plant where different types of emergency situation can arise:

Most credible Disaster scenarios identified from the potential hazards:

- Credible scenario – A : Pool of fire from HSD tank
- Credible scenario – B : Pool of fire from FO tank
- Credible scenario – C : Explosion from LPG cylinders
- Credible scenario – D : Explosion and fire from FBDs/SDs
- Credible scenario – E : Collapse of buildings and structures
- Credible scenario – F : Fire
- Credible scenario – G : Flood/Cyclone/Earth Quake
- Credible scenario – H : Tsunami
- Credible Scenario – I : Electrocution
- Credible Scenario – J : Mine wall collapse
- Credible scenario – K : a combination of the above

Sl. No	Area	Type of Emergency	Consequences
1	Mining sites	Ingress of Sea Water	<ul style="list-style-type: none"> • Inundation • Injury/Loss of life • Destruction of asset
2	Mining sites	Open pit mine collapse	<ul style="list-style-type: none"> • Injury/Loss of life • Destruction of nearby buildings • Burial of people and assets under sand
3	Mining sites/plant sites	Lightening	<ul style="list-style-type: none"> • Electrocutation. Injury/Loss of life • Destruction of asset • Fire
4	Mining sites/plant sites	Tsunami	<ul style="list-style-type: none"> • Inundation • Damage to buildings • Injury/Loss of life • Building collapse • Land/water pollution
5	Mining sites	Fall of Mining equipments	<ul style="list-style-type: none"> • Damage to equipment • Injury/Loss of life
6	Mining sites/plant sites	Cyclone	<ul style="list-style-type: none"> • Falling objects • Inundation • Collapse of building, trees • Land/water pollution
7	Plant sites/godowns/	Fire (can be assisted by FO/HSD/LPG/	<ul style="list-style-type: none"> • Burn • Injury/Loss of life
	Canteen	Grease/Acetylene)	<ul style="list-style-type: none"> • Collapse of buildings • Flying objects/explosion • Land/water pollution
8	Plant sites	Earthquake	<ul style="list-style-type: none"> • Collapse of buildings • Injury /loss of life • Fire • Electrocutation • Explosion • Land/water pollution • Fuel spillage
9	Plant sites	Explosion/fire from driers	<ul style="list-style-type: none"> • Injury/loss of life • Severe burn • Flying objects • Fire • Collapse of buildings



Mitigation

Monitoring of Hazards and Threats:

Perceived threats: The level of threat from the cyclone is perceived based on the guidance from warning system adopted in the nearby Colachel port which can be contacted over phone. Security related threats will be perceived based on intelligence input from local police etc.,

Assess the hazard: Based on the above the information, the severity and impact to our plant will be assessed.

Select control Strategy: Disaster Management committee will decide the strategy to be followed on case to case basis.

Control Hazard: The Hazard will be controlled using the available resources.

Monitor Hazard: Monitoring of the situation and hazard using detectors and other datas.

Prevention & Mitigation

Analyzing the hazard: A comprehensive risk assessment not only evaluates the magnitude and likelihood of potential losses but also provides full understanding of the causes and impact of those losses. Risk assessment, therefore, is an integral part of decision and policy-making processes and requires close collaboration among various stakeholders. As per UNDP (United Nations Development Programme), a comprehensive risk assessment consists of the following steps:

- Step 1:** Understanding current situation, needs and gaps to assess whatever already exists, avoids duplication of efforts, and builds on existing information and capacities. This is done through a systematic inventory and evaluation of existing risk assessment studies, available data and information, and current institutional framework and capabilities
- Step 2:** Hazard assessment to identify the nature, location, intensity and likelihood of major hazards prevailing in a community or society.
- Step 3:** Exposure assessment to identify population and assets at risk and delineate disaster prone areas.
- Step 4:** Vulnerability analysis to determine the capacity (or lack of it) of elements at risk to withstand the given hazard scenarios.
- Step 5:** Loss/impact analysis to estimate potential losses of exposed population, property, services, livelihoods and environment, and assess their potential impacts on society.
- Step 6:** Risk profiling and evaluation to identify cost-effective risk reduction options in terms of the socio-economic concerns of a society and its capacity for risk reduction.
- Step 7:** Formulation or revision of DRR strategies and action plans that include setting up priorities, allocating resources (financial or human) and initiating disaster risk reduction (DRR) programmes.



Determine Prevention Action:

1. Carry out site inspection and take appropriate action to eliminate the potential hazard.
2. Carry out regular housekeeping and maintenance to secure the buildings and surrounding areas.
3. Installation of automatic fire detection and fire alarms system.
4. Special precautions during the building renovation, periodical maintenance, rainy season etc.,

Determine Public warning:

Considering the severity, the warning will be extended to the plant employees and if required to the neighborhood.

Determine Prevention Action Implementation Plan: The preventive actions will be Carried out by In-Charge of Safety and In-Charge of Civil section. Fire protection system will be ensured by In-Charge of Fire section.

Public Warning

Determine the message content: Message content will be determined by the Convener of the Disaster Management Committee in consultation with the concerned members. Any of the following warning system will be adopted.

1. Public address system in MSP and HUS. And converting the office as control room in the respective location.
2. Intermittent ON/ OFF for the electrical siren.
3. Manual Bell warning at the main gate

Disseminate public warning: After getting approval from the Chairman of the Committee, In-charge Security will disseminate the warning.

Identification of Risk

Unit Head will constitute the cross functional team to evaluate and analyze the hazard and risk. The team evaluates the risks and classifies them according to the risk intensity, probability, severity, etc. and prioritize. Appropriate management programs are also made for dealing with such situations.

Coordination - Horizontal and Vertical structure of Manavalakurichi Unit has a well-established coordination plan in accordance with disaster management plan.

Coordination with State Government during any emergency situation developing within the unit. The Emergency operations Control Room (EOC) facility will coordinate with the Responsible Officer /Incident Controller of the affected areas at the local level for implementing response measures in the affected areas. In case of Radiological emergency, the Emergency Response Centre in Manavalakurichi unit will coordinate and take corrective actions.

Budgetary Provisions

Annual budget for DM plan for implementation & management, In-charge (Safety) prepares the annual budget for various activities covered including those on training, mock drill, etc.



The budget is prepared by In-charge by in consultation with other departments and approval is obtained.

Contact Details of Emergency Response Centre:

DAE Unit / STD Code	Name CGM & Head, MK	Tel No./ Fax No.	Residence/ Mobile
IREL / Manavalakurichi	Shri N Selvarajan head-mk@irel.co.in	[04651 537255- 58]	
DAE Unit / STD Code	Name DAE-ERC Coordinator	Tel No./ Fax No.	Residence/ Mobile
Manavalakurichi IREL 04651	K. Sree kumar ois.hpu-mk@irel.co.in ksreekumar@barc.gov.in	[04651 296103]	[8547631752/9443124274]
DAE Unit / STD Code	Name DAE-ERC Alternate Coordinator	Tel No./ Fax No.	Residence/ Mobile
Manavalakurichi IREL	Shri. N. Nagaraj n.nagaraj@irel.co.in	[04651 296103]	[9486758556/9629374656]



8.0 Project Benefits

Social Benefits

Commencement of mining operation over the mining lease area of 1144.06.18 ha will result in overall development of the region in its own way like provision of direct & indirect employment, improvement in the general living standards and knowledge sharing, improved wage level and the living standard of the local people and continual improvements in the amenities and infrastructure facilities for the local populace.

As per the IREL's policy, neither land acquisition nor purchase of land would be done for the project. The Mining operations will be carried out over the private patta lands after obtaining the consent from the respective land owners on lease basis. The land leasing period will be 11 months. Mining and backfilling will be simultaneously carried out within the lease period of 11 months and thereafter the land will be returned to the land owners with lease compensation. Mining in the lease hold areas will not result in any displacement nor change in the ownership of the land. The payment of lease compensation results in significant improvement in quality of life for local populace and economical growth in the region.

Environmental Benefits

The coastal areas in Kanniyakumari District including the mining lease area of 1144.0618 ha are having high natural background radiation in the range of 1 to 4 μSvh^{-1} due to presence of Monazite in the BSM Ore. Monazite is a radioactive mineral containing Uranium and Thorium.

On removal of the BSM Ore (Run of Mines) containing Monazite and backfilling the mined-out areas with tailings (after removal of minerals), the background radiation in the mined-out area is brought down to 0.2 to 0.4 μSvh^{-1} . In other words, there has been 8 to 10 fold reduction in the radiation level in the area where mining & backfilling is carried out by IREL and as such our mining makes the area free from radioactivity and improving the living condition of people.

Financial Benefits

IREL is the only CPSE in the country being authorized to mine and handle "Monazite" and its value-added products. The Zircon produced from Manavalakurichi Unit is directly sent to the Nuclear Fuel Complex (NFC), Department of Atomic Energy for strategic applications.

The processed mineral products, apart from its usage for strategic purpose in Nuclear Energy, Defence, Space etc., finds application in number of commercial sectors such as aerospace industry, infrastructure development, ceramics, foundries, oil industries etc., while Rare Earths are used in niche applications such as consumer electronics, renewable energy, EVs, etc., and also has excellent contribution for sustenance of industries in the value chain of its mineral & rare earth products. The project will generate revenue in terms of royalty and taxes etc. to the state of Tamil Nadu in addition to make available of strategic material. All these minerals and Rare Earth's provides input for other industries and plays a vital role in global economy.



9.0 Environmental Cost Benefits Analysis

The proposed project does not involve any Forest land and it is not applicable.



10.0 Environmental Management Plan

Environmental Management Plan (EMP) is suggested to mitigate the possible negative impacts that may be caused to the various attributes of environment due to the proposed mining operations.

10.1 EMP for Construction Phase

There will be no Construction Phase for the Project.

10.2 EMP for Operation Phase

Mining operations will be carried out scientifically as per approved Mining Plan, stipulated EC & CTO Conditions, DGMS Norms, etc. EMP Measures for Operation Phase are proposed below:

10.2.1 Land Environment

- Mined-out area are to be backfilled simultaneously to restore the topography.
- Plantation are to be carried out in the mined-out areas after backfilling.
- Reclaimed Land will be used for other activities including construction and thereby ensuring Eco-friendly and Sustainable mining.
- Carbon sequestration is the long-term storage of carbon in oceans, soils, vegetation (especially forests) and geologic formations. Adequate Green Belt will be developed around the project for carbon sequestration. As trees grow, they store carbon in woody tissues and soil organic matter.

10.2.2 Traffic Impact

- RoM transportation from Blocks-A&B to MSP will be through Major District Road/SH-179.
- All Tippers are to be fully covered with Tarpaulin to avoid any spillage during transportation.
- Restriction of over loading of Tippers shall be enforced.
- Speed restrictions shall be enforced.
- Restriction of Truck parking in the Highway and Public Roads shall be enforced.
- Regular and preventive maintenance of transport vehicles are to be ensured.
- Compliance to 'Pollution under Control' Certification has to be ensured and to be checked periodically.

10.2.3 Air Environment

- The DG sets will have acoustic enclosures to control the noise levels. The stack height will be as per CPCB norms to comply with emission norms.
- Water sprinkling on loading point and Haul Roads are to be carried out.
- Covering of Trucks/Tippers with tarpaulin shall be ensured during Ore transportation.
- Over loading of Tippers has to be avoided to control the spillages during transportation.
- Periodical maintenance and replacement of worn out accessories in the mining equipments are to be carried out.
- 'Pollution under Control' Certification has to be ensured and to be checked periodically.
- Periodical monitoring of Ambient Air Quality has to be carried out.



10.2.4 Noise Levels

- Deployment of mining equipments shall be with in-built mechanism for reducing noise.
- Operation of the mobile van will be complying the MoEF&CC noise norms of <45 dB(A) during night time for residential areas.
- Providing ear muffs/ear plugs to the workers in high noise zones.
- Periodical Noise Monitoring shall be carried out and Reports submitted to the Authorities.

10.2.5 Water Environment

- Natural drains shall be maintained as such.
- Adequate safety barriers will be maintained at both sides of the nalla course in the Lease till the end of the mine life.
- No ground water drawl in the Mining Lease Area as well as CRZ area for the project.
- Periodical monitoring of water table levels and water quality are to be carried out.

10.2.6 Biological Environment

- IREL will incorporate a clause in the land lease agreement to plant and develop coconut or any other suitable tree plantation @70 Trees per acre in the mined out areas.
- Towards compensatory afforestation programme, IREL would contribute an amount of Rs. 50 Lakhs to the District Forest Officer (DFO) to develop and maintain 25,000 trees at suitable place near the lease area.

10.2.7 Social Measures

- The Project Cost is Rs.31.25 Crores.
- Royalty, DMF and NMET will be remitted as per the statutory requirement. Adequate CER Budget, as per OM F.No.22-65/2017-IA.III dated 20.10.2020, will be allocated for the benefits of local villages in the Mine vicinity, after taking into account of the issues raised during Public Hearing.
- IREL spends about Rs. 3.00 – 5.00 Crore for CSR activities in the region which will be continued.

10.2.8 Occupational Health Measures

- All employees undergo check-up on recruitment and periodically during employment.
- Maintenance of Pre, during & Post Employment Records.
- Provision of all Personal Protective Equipments for the employees at Mines
- Work comfort and its periodic review by a committee.
- Provision of Rest Shelter at mines.

10.2.9 Plastic Waste Management

There will be ban on one-time use and throw away Plastic usage in the Mining site. Encourage the use of eco friendly alternatives such as banana leaf, areca nut palm plate, stainless steel glass, porcelain plates / cups, cloth bag, jute bag etc.

10.3 EMP Budget

The Project Cost is Rs.31.25 Crores. An amount of Rs. 20.00 Lakhs is earmarked as Capital EMP Budget and Rs.10.50 Lakhs per Annum is Operating Cost towards EMP measures including Environmental Monitoring. Also, an amount of Rs.10.00 Lakhs per Annum has been earmarked for Occupational Health & Safety Measures. Also, budget for the Corporate



Environmental Responsibility (CER) Budget will be allocated in compliance with guidelines of MoEF&CC.

10.4 Environmental Policy of IREL

IREL has well laid 'Quality, Environment, Occupational Health & Safety' Policy. There is a hierarchy system established in the Unit to deal with Environmental issues. Any non-compliance will be reported to the Unit Head who will direct the Environment Cell to address the issue and place the action plan report. IREL will ensure the compliance of all Environmental Norms.

IREL (India) Limited
Manavalakurichi

Quality, Environment, Occupational Health & Safety Policy

We are committed towards

- (a) Customer Satisfaction,
- (b) Healthy Environment,
- (c) Occupational Health and Safety of all concerned
through:
 1. Quality products
 2. Continual improvement
 3. Compliance with legal requirements
 4. Conservation of natural resources
 5. Maintenance of safe and healthy work practices
 6. Motivation, Training and creating awareness
 7. Ensuring Employee Consultation and Participation

20.09.2021

GM & Head, MK

IRELMK/ENV-08/2021

Date: 11.05.2021

The Environment Management Cell is hereby reconstituted with the following officials, with immediate effect.

S. No.	Name (S/Shri)	Designation/ Function
1	N. Selvarajan	General Manager & Head, MK -Chairman
2	K.J.M.Babu	HoD (Elec.,Stores & Purchase)
3	S.Jayachand	HoD (Mining) & I/c S&T-Member Secretary
4	P.M. Madhu	HoD (Maint.)
5	D. D. Sahu	HoD (QC and R&D)
6	P. J. Biju	HoD (Prodn.)
7	A. Sivaraj	HoD (Res.)
8	K. Ajith Kumar	CM (Elec.)
9	S. P. Ganesan	SM (Maint.)
10	Dr.T. Raja	DM (Medical)
11	K. Sreekumar	OIC-HPU
12	Deepesh K.G	DM (Mining)-Convenor


(N.Selvarajan)

General Manager & Head, MK

IRELMK/ENV-08/2024

Date: 27.02.2024

The Environment Management Cell is hereby reconstituted with the following officials, with immediate effect.

S. No.	Name (S/Shri)	Designation/ Function
1	N. Selvarajan	Chief General Manager & Head, MK - Chairman
2	K.J.M. Babu	HoD (Stores & Purchase)
3	S. Jayachand	HoD (Mining) & I/c S&T- Member Secretary
4	M. Prasad	HoD (HRM)
5	P. J. Biju	HoD (Prodn. & Civil)
6	D. D. Sahu	HoD (QC and R&D)
7	A. Sivaraj	HoD (Res.)
8	K. Ajith Kumar	HoD (Maint.)
9	Niranjan Sabata	Chief Manager (Prodn.) - Convenor
10	S. P. Ganesan	Chief Manager (Civil & EME)
11	Dr. T. Raja	Manager (Medical)
12	K. Sreekumar	OIC - HPU

This has the approval of Competent Authority.


(S. Jayachand)

Dy. General Manager (Mining & Safety)



Table 10.1 EMP with Monitoring Matrix

Sl.No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Agency	Supervision/ Monitoring
I.	Construction Stage	There will be no Construction Phase for the Project		
II	Operation Stage			
1	Land Environment	<ul style="list-style-type: none"> ➤ Mined-out area are to be backfilled simultaneously to restore the topography. ➤ Plantation are to be carried out in the mined-out areas after backfilling. ➤ Reclaimed Land will be used for other activities including construction and thereby ensuring Eco-friendly and Sustainable mining. ➤ Carbon sequestration is the long-term storage of carbon in oceans, soils, vegetation (especially forests) and geologic formations. Adequate Green Belt will be developed around the project for carbon sequestration. As trees grow, they store carbon in woody tissues and soil organic matter. 	IREL	Environmental expert/Qualified person
2	Traffic Impact	<ul style="list-style-type: none"> ➤ RoM transportation from Blocks-A&B to MSP will be through MDR/SH-179. ➤ All Tippers are to be fully covered with Tarpaulin to avoid any spillage during transportation. ➤ Restriction of over loading of Tippers shall be enforced. ➤ Speed restrictions shall be enforced. ➤ Restriction of Truck parking in the Highway and Public Roads shall be enforced. ➤ Regular and preventive maintenance of transport vehicles are to be ensured. ➤ Compliance to 'Pollution under Control' Certification has to be ensured and to be checked periodically. 	IREL	Environmental expert/Qualified person



Sl.No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Agency	Supervision/ Monitoring
3	Air Environment	<ul style="list-style-type: none"> ➤ The DG sets will have acoustic enclosures to control the noise levels. The stack height will be as per CPCB norms to comply with emission norms. ➤ Water sprinkling on loading point and Haul Roads are to be carried out. ➤ Covering of Trucks/Tippers with tarpaulin shall be ensured during Ore transportation. ➤ Over loading of Tippers has to be avoided to control the spillages during transportation. ➤ Periodical maintenance and replacement of worn out accessories in the mining equipments are to be carried out. ➤ 'Pollution under Control' Certification has to be ensured and to be checked periodically. ➤ Periodical monitoring of Ambient Air Quality has to be carried out. 	IREL	Environmental expert/Qualified person
4	Noise Levels	<ul style="list-style-type: none"> ➤ Deployment of mining equipments shall be with in-built mechanism for reducing noise. ➤ Operation of the mobile van will be complying the MoEF&CC noise norms of <45 dB(A) during night time for residential areas. ➤ Providing ear muffs/ear plugs to the workers in high noise zones. ➤ Periodical Noise Monitoring shall be carried out and Reports submitted to the Authorities. 	IREL	Environmental expert/Qualified person



Sl.No.	Environmental Aspect/Issue	Management Measures	Responsibility	
			Agency	Supervision/Monitoring
5	Water Environment	<ul style="list-style-type: none"> ➤ Natural drains shall be maintained as such. ➤ Adequate safety barriers will be maintained at both sides of the nalla course in the Lease till the end of the mine life. ➤ No ground water drawl in the Mining Lease Area as well as CRZ area for the project. ➤ Periodical monitoring of water table levels and water quality are to be carried out. 	IREL	Environmental expert/Qualified person
6	Biological Environment	<ul style="list-style-type: none"> ➤ IREL will incorporate a clause in the land lease agreement to plant and develop coconut or any other suitable tree plantation @70 Trees per acre in the mined out areas. ➤ Towards compensatory afforestation programme, IREL would contribute an amount of Rs. 50 Lakhs to the District Forest Officer (DFO) to develop and maintain 25,000 trees at suitable place near the lease area. 	IREL	Environmental expert/Qualified person
7	Social Measures	<ul style="list-style-type: none"> ➤ The Project Cost is Rs.31.25 Crores. ➤ Royalty, DMF and NMET will be remitted as per the statutory requirement. Adequate CER Budget will be allocated for the benefits of local villages in the Mine vicinity, after taking into account of the issues raised during Public Hearing. ➤ IREL spends about Rs. 3.00 – 5.00 Crore for CSR activities in the region which will be continued. 	IREL	Environmental expert/Qualified person
8	Occupational Health Measures	<ul style="list-style-type: none"> ➤ All employees undergo check-up on recruitment and periodically during employment. ➤ Maintenance of Pre, during & Post Employment Records. ➤ Provision of all Personal Protective Equipments for the employees at Mines ➤ Work comfort and its periodic review by a committee. ➤ Provision of Rest Shelter at mines. 	IREL	Environmental expert/Qualified person



11.0 Summary Environmental Impact Assessment Report

11.1 Introduction

11.2 Project Proponent

M/s. IREL (India) Limited is a Multi-Unit-Multi-Product Central Public Sector Enterprise (CPSE) incorporated under the Companies Act 1913 and wholly owned by the Government of India, under the Administrative Control of the Department of Atomic Energy. IREL was established in August 1950 and entered into the activities of mining, mineral beneficiation and refining of atomic minerals.

Atomic Minerals (BSM Ore) are suite of 7 minerals viz., Monazite, Zircon, Ilmenite, Sillimanite, Rutile, Leucoxene and Garnet. These seven minerals occur together in nature by virtue of their formation along with coastal stretches/ inland areas near to the shore and in Teri deposits in varying grades in India. IREL is the only CPSE in the country being authorized to mine and handle the **Prescribed Substance, Monazite** and its value-added products.

IREL, Manavalakurichi Unit in Kanniyakumari District of Tamil Nadu has been in operation since 1970, before Environmental Impact Assessment (EIA) & Coastal Regulation Zone (CRZ) Notifications came into force in the Country. The Unit is harnessing Monazite & Zircon along with other associated minerals and supplying the same to the Department of Atomic Energy and other downstream industries in the value chain. The Unit is being operated for an annual consented production capacity of 1,14,600 Tonnes of Atomic Minerals (HM).

IREL has been initially granted with 3 Mining Leases in Kanniyakumari District by the Government of Tamil Nadu. The First Mining Lease granted for 7.06 Ha vide G.O. Ms.No.3707 dated 01.11.1968 (renewed vide GO 3(D) No.6 dated 28.01.2000 & extended vide GO Ms.No.327 dated 01.12.2021) with validity till the mineral is exhausted. The Second Mining Lease granted vide G.O.Ms.No.1085 dated 21.09.1977 was executed on 15.10.1979. The Third Mining Lease for an extent of 141.2269 Ha has been granted vide G.O.Ms.No.1114 dated 12.08.1981 and extended vide G.O.Ms.No.73 dated 11.02.2021 with validity till the mineral is exhausted. The BSM Ore mined out from these Leases are transported and separated for individual atomic minerals at the existing Mineral Separation Plant (MSP) at Manavalakurichi.

Address for correspondence of project proponent:

Name : Shri N. Selvarajan,
Designation: Chief General Manager & Head,
Address: IREL (India) Limited,
Manavalakurichi,
Kanniyakumari District - 629 252
Fax: 04651-237220
Phone: 04651-237325
Email: head.mk@irel.co.in
Website: www.irel.co.in



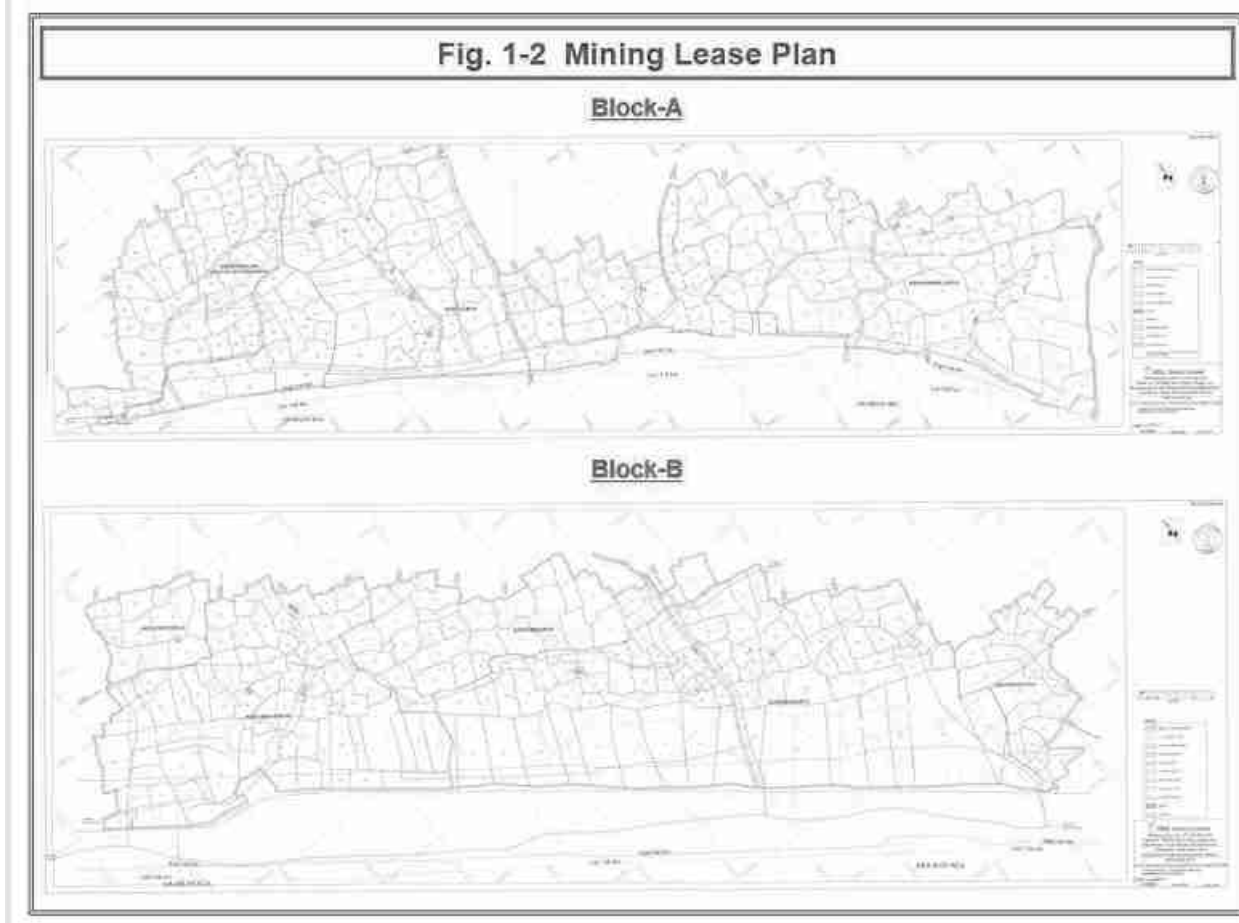
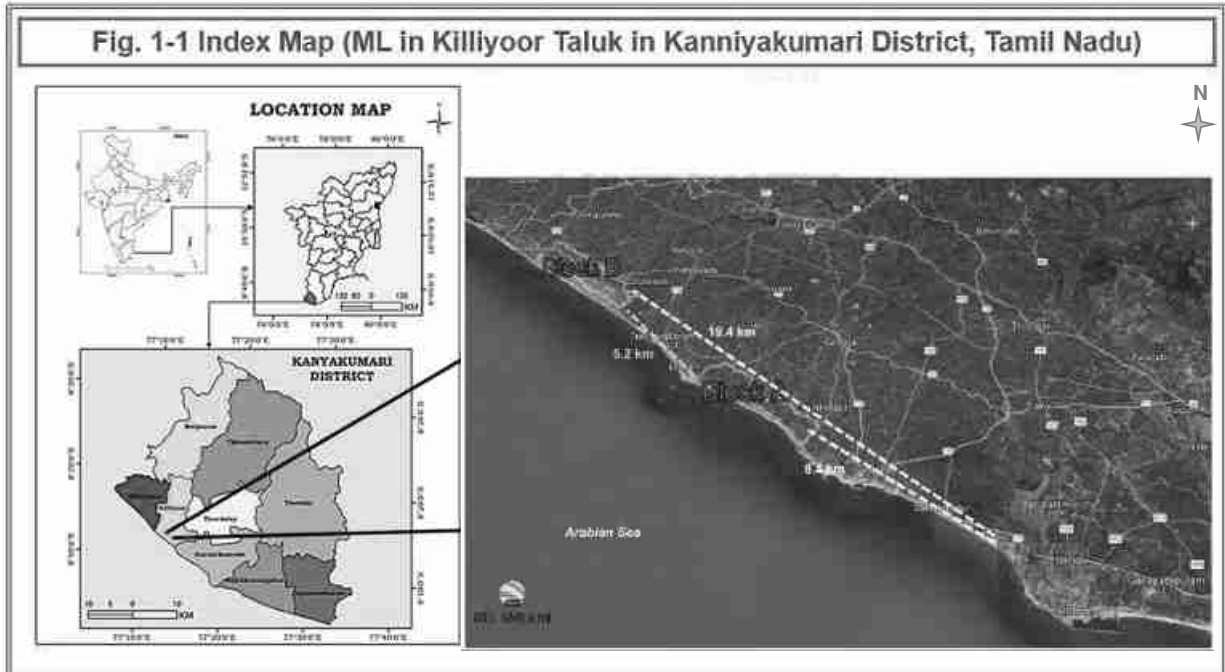
11.3 Project Profile

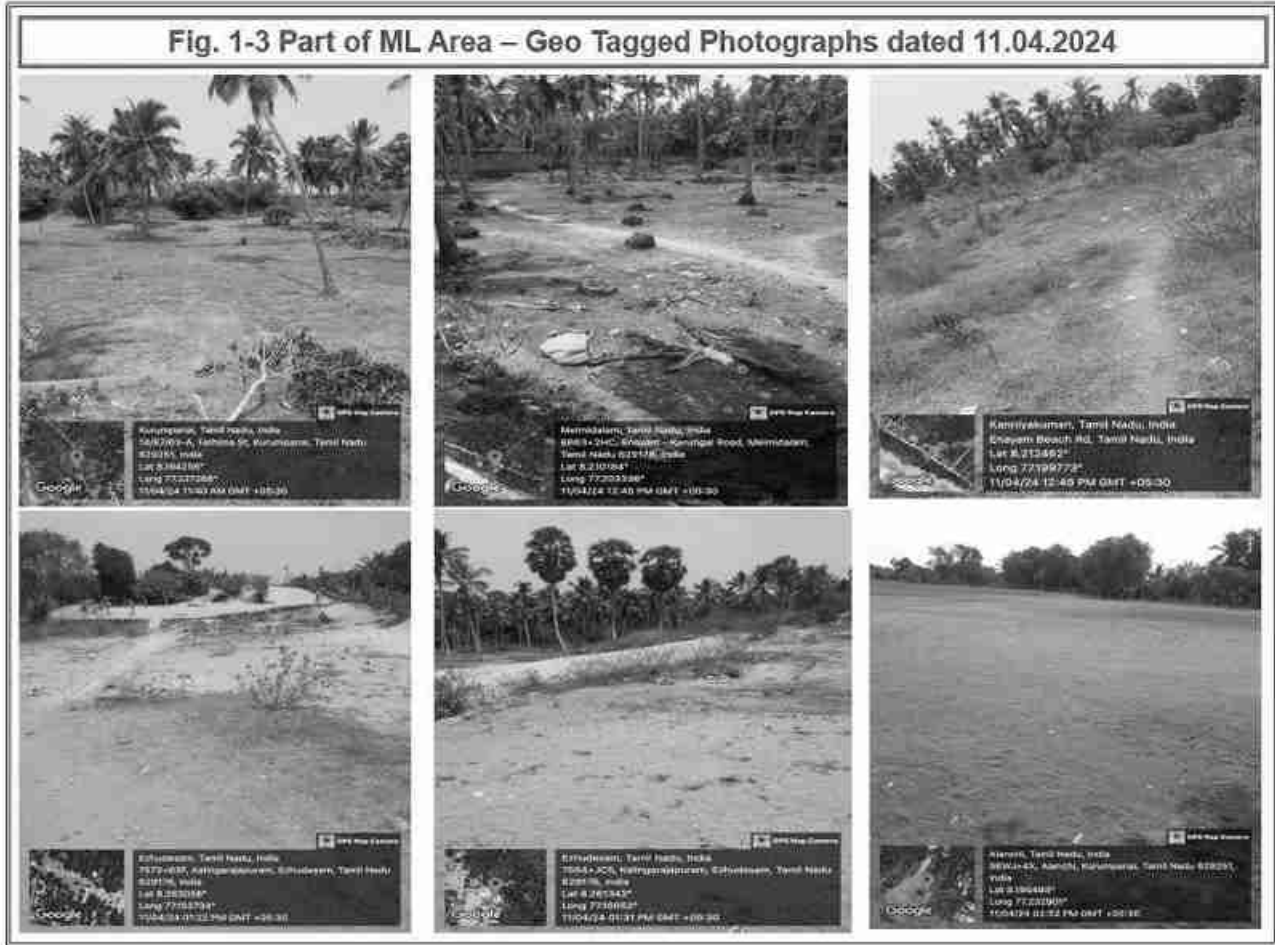
In order to ensure uninterrupted supply of strategic materials i.e., Monazite and Zircon to the Department of Atomic Energy, Defense, Space etc., DAE vide Letter No.3/10(21)/2015-PSU/11010 dated 13.08.2015 sought the concurrence of the Government of Tamil Nadu for reservation of Monazite rich area of 1144.0618 Ha in Kanniyakumari District for the purpose of mining of Atomic Minerals by IREL. Upon concurrence given by the Government of Tamil Nadu vide letter No.12503/MMD.2/2015-12 dated 15.04.2021, the Ministry of Mines, Government of India issued a Notification vide G.S.R.399(E) dated 11.06.2021 reserving the area of 1144.0618 Ha for mining by IREL under section 17A (1A) of the Mines and Minerals (Development and Regulation) Act, 1957. The Government of Tamil Nadu, after obtaining prior approval from the Ministry of Mines, Government of India, issued a Letter of Intent (LOI) No.12503/MMD.2/2015-19 dated 28.06.2022 for mining of Atomic Minerals over an extent of 1144.0618 Ha. The New Mining Lease area of 1144.0618 Ha, in two Blocks A&B, is located in:

- (i) Resurvey Nos. 16-19, 45-54, 55p, 56p, 57p, 58-61, 69-81, 82p, 83p, 84-88, 89p, 90p, 91p, 92-95, 96p, 97-110, 123-124, 126-129, 136-140, 141p in Keezhmidalam-A village (204.0652 Ha).
- (ii) Resurvey Nos. 80,82-101,105-112, 113p, 114, 115p, 116-162, 163p, 166p, 167-169, 170p, 173-175, 176p, 177p, 178p, 179p, 180p, 182p, 183-194, 196, 203 in Midalam-B village (202.9686 Ha).
- (iii) Resurvey Nos. 494p, 495, 496, 529-537, 541-567, 578, 581-582, 585, 587, 588-634 in Enayamputhenthurai village (137.0350 Ha).
- (iv) (Resurvey Nos. 374p, 402-404, 407-413, 448-453, 455-458, 488, 490 in Ezhudesam-A village (41.1000 Ha).
- (v) Resurvey Nos. 139, 146, 149-154, 157, 169-174, 175p, 186-187, 192-207 Ezhudesam-B village (82.9000 Ha).
- (vi) Resurvey Nos. 208-221, 225-226, 228-229, 246-256, 258-259, 261-283, 294-296, 319-320, 322, 327-348, 351-355, 359p in Ezhudesam-C village (275.8280 Ha).
- (vii) Resurvey Nos. 347-348, 354p, 355-358, 362-365 in Kollencode-A village (28.3950 Ha).
- (viii) Resurvey Nos. 585-591, 595-596, 601-621, 623p, 651-652, 655-689 in Kollencode-B village (171.7700 Ha).

of Killiyoor Taluk in Kanniyakumari District, Tamil Nadu (Fig. 1-1). Mining Lease Plan is given as Fig. 1.2 and part of the Lease areas are shown in Fig. 1-3.

Existing Mineral Separation Plant located at Manavalakurichi is aerially located at 8.4 km from Block A and 19.4 km from Block-B in the southeast (road distance: Block A-12 km & Block B- 30 km). Out of the total area of 1144.0618 Ha, 353.4876 Ha area falls under CRZ-I(B), II and III categories. The estimated mineable reserve is 59.88 Million Tonnes. Heavy Mineral (HM) content in the deposit varies between 10.0% and 22.6% with an average HM content of 14.5%. Thus, the New Mining Lease will feed the Manavalakurichi Plant sustainably for 40 Years period @ 1.5 million tonnes per annum (MTPA) RoM.





IREL has formulated a Policy i.e., Concession Option Scheme for taking possession of the Private Patta land on lease for mining. The land leasing period will be 11 months. Mining and backfilling will be simultaneously carried out within the lease period of 11 months and thereafter the land will be returned to the land owners with lease compensation. Neither land acquisition nor purchase of land would be done for the Project. The permanent structures will not be disturbed and mining shall not lead to involuntary displacement of people. Thus, **no Rehabilitation & Resettlement (R&R) is involved in the Proposal.**

The method of mining will be **Non-Conventional Opencast Mechanized Mining** by Excavator-Tipper combination with no Drilling & Blasting. Also, there will be no Developmental activities like Top Soil & Over Burden removal. Thus, there will be **no Dump** in the Mining Lease. It is proposed to mine out Atomic Minerals (BSM Ore) @ 5000 Tonnes per day (TPD) ROM and 1.50 Million Tonnes ROM per Annum.

The mining operation will consist of two-layer operation. The mineralisation occurs from the surface. First, the surface layer up to 2.5-3.0 m from surface is excavated by Tipper & Excavator combination and followed by the excavation in bottom layer. While excavating the bottom layer, backfilling of the mined-out voids by the Tailings from MSP will be carried out simultaneously. Thus, there will be **no bench** formation and **no Mine Pit** in the Mining Lease. Ore: Waste Ratio will be 1:0.



Mining operation will be carried out at an average depth of 6 m and a maximum depth of 9 m depending upon the location and mineralization. **No ground water-table intersection** is envisaged as ground water-table level in the Mining Lease Area ranges between 10-15 m BGL. If the mining is found to be intersecting the water table, further mining activities will not be carried out at that location.

ROM from the new mining lease will be transported and separated for individual atomic minerals at existing Mineral Separation Plant at Manavalakurichi. In the MSP, the ROM is fed to Heavies Upgradation Section (HUS) and subsequently separated using its physical properties viz., Specific Gravity, Conductivity and Magnetic Susceptibility.

In the production quantity of 15.00 Lakhs TPA ROM & with about 70% recovery, the feed to the Mineral Separation Plant can have mineral production of 1,52,250 TPA (Table 1-1). The generation of tailings (after removal of Minerals-Quartz) will be about 13,47,750 Tons per annum which will be transported to the mined-out voids and backfilled. Mining and backfilling will be carried out simultaneously.

Table 1-1 Mine Profile

Description	Area/Capacity
Total Mining Lease area	1144.0618 ha.
Total Mineable Quantity	59.88 Million Tonnes
Annual Production	1.5 Million Tonnes @ 5000 TPD (Max)
No of working days	300 days (3 Shifts)
Life of the Mine	40 Years
Method of Mining	Open cast (without drilling & blasting) – No topsoil & No OB – Excavator and tipper combination upto a maximum depth of 9 m (average 6 m)
	No ground water intersection involved.
	No R&R issue due to the proposal

During the Plan Period, 7.50 Million Tonnes of ROM @ 1.50 MTPA will be mined out and the tailings - Quartz (after removal of Minerals) will be generated from the MSP to the tune of 6.738 Million Tonnes @ 1.347 MTPA, which will be transported back to the Mining Lease Area to backfill the mined-out voids. This process would continue till the Conceptual Stage (Tables 1-2 & 1-3).

ROM Production per annum	:	15,00,000 Tonnes @ 5,000 TPD
Ore: Waste Ratio	:	1:0
No. of days per annum	:	300
No of shifts in a day	:	3
Expected life of the mine	:	40 years

Mining activity is limited to only in mineral deposit area. Hence, ultimate pit limit lies on the mineral deposit area only. The Project Cost is Rs.31.25 Crores.



Table 1-2 Development & Production - Plan Period & Subsequent Periods

Year	Top Soil, Tons	Over Burden, Tons	Mineral Rejects, Tons	ROM Production,		Anticipated Atomic Minerals Production in Tonnes	Wastes (Quartz) from MSP for Backfilling Mined out Voids, Tons
				cu. m	Tonnes		
First Plan / Block Period:							
I Year	0	0	0	9,37,500	15,00,000	1,52,250	13,47,750
II Year	0	0	0	9,37,500	15,00,000	1,52,250	13,47,750
III Year	0	0	0	9,37,500	15,00,000	1,52,250	13,47,750
IV Year	0	0	0	9,37,500	15,00,000	1,52,250	13,47,750
V Year	0	0	0	9,37,500	15,00,000	1,52,250	13,47,750
Total	0	0	0	46,87,500	75,00,000	7,61,250	67,38,750
Subsequent Plan / Block Periods :							
2 nd Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
3 rd Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
4 th Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
5 th Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
6 th Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
7 th Block Period	0	0	0	46,87,500	75,00,000	7,61,250	6,738,750
8 th Block Period (4 Years only)	0	0	0	46,12,500	73,80,000	7,49,070	66,30,930
Grand Total	0	0	0	3,74,25,000	5,98,80,000	60,77,820	5,38,02,180

Table 1-3 Plan Period Production & Expected Mineral Production from ROM

Year	ROM, Tonnes	Anticipated Atomic Minerals Production in Tonnes	Expected Individual Mineral Production, Tonnes					
			Monazite	Zircon	Ilmenite	Rutile	Sillimanite	Garnet
I	15,00,000	1,26,349	7182	5563	92352	2772	11718	6762
II	15,00,000	1,26,349	7182	5563	92352	2772	11718	6762
III	15,00,000	1,26,349	7182	5563	92352	2772	11718	6762
IV	15,00,000	1,26,349	7182	5563	92352	2772	11718	6762
V	15,00,000	1,26,349	7182	5563	92352	2772	11718	6762
Total	75,00,000	6,31,745	35,910	27,815	4,61,760	13,860	58,590	33,810



The Proposal requires prior EC as per EIA Notification under Sl. No.1(a)-Category 'A' as well as under CRZ Notification 2011, as amended. Accordingly, IREL has submitted application to MoEF&CC on 28.12.2022 to obtain the Terms of Reference (ToR) for carrying out the EIA Study. The Proposal was deliberated in 53rd Expert Appraisal Committee (EAC) – Nuclear & Defense (ND) meeting held on 27th January 2023. ToR has been awarded vide F. No. IA-Z-11013/10/2023-IA-I dated 22.02.2023.

Baseline Data (BLD) collected during December 2022-February 2023 representing Winter 2022-23 Season has been utilised for the EIA Study in compliance with MoEF&CC Office Memorandum No. J-11013/41/2006-IA-II(I)(Part) dated 29.08.2017. EIA Report has been prepared in compliance with awarded ToRs and is submitted as per generic structure proposed in Appendix-III of EIA Notification, 2006.

For obtaining TNSCZMA recommendations for the proposal, IREL has submitted the CRZ application to DCZMA, Kanniyakumari on 08.03.2024 and the same is under their perusal. Being a parallel activity, the SCZMA recommendation will be obtained and submitted to the Ministry for awarding the EC.

The EIA Consultant, M/s. ABC Techno Labs India Private Limited, Chennai has been accredited for various Sectors including Sector-1 (Mining Projects) for Category 'A' by the National Accreditation Board for Education & Training (NABET), Quality Council of India vide Certificate NABET/EIA/2225/RA0290 dated 11.06.2023 with Validity till 16.11.2025 (Sl. No. 4 of QCI/NABET List dated 15.07.2024). The ABC Techno Labs India Private Limited Laboratory is accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) vide Certificate No. TC-5770 dated 03.04.2024. The Lab is also recognised by the Ministry of Environment, Forest and Climate Change (MoEF&CC) vide Letter F. No. Q-15018/04/2019-CPW dated 14.10.2019 with validity of 5 years.

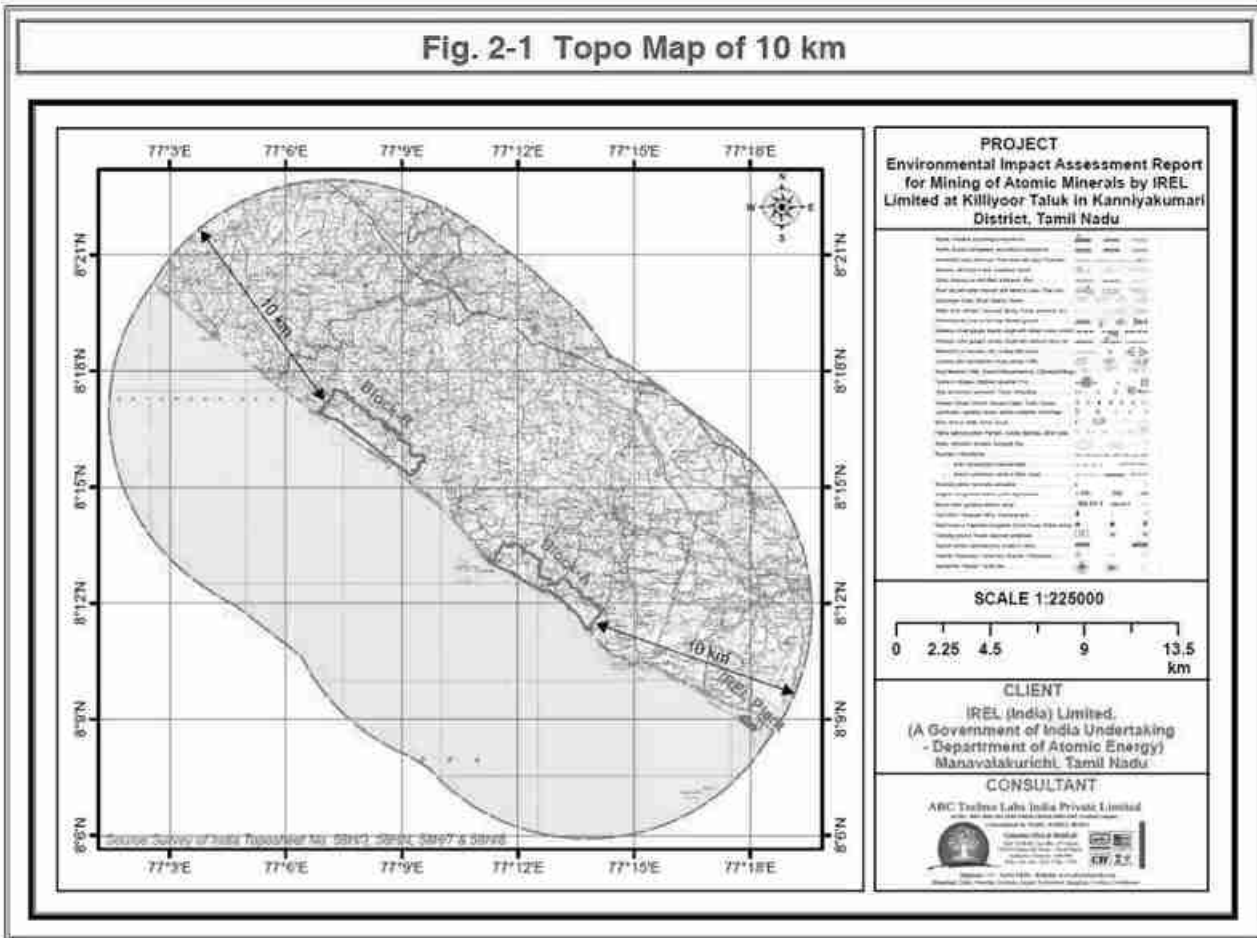
The Proposal was deliberated in the 61st EAC (N&D) Meeting held on 23.04.2024 as Agenda Sl. No. 3.1. The Hon'ble Committee advised to review the request of exemption from Public Hearing in alignment with other such projects wherein Public Hearing was undertaken as deliberated during the meeting. Accordingly, the additional details sought by the committee are addressed in this Report and submitted for Public Consultation & Public Hearing with Summary EIA reports in English and Tamil languages.

11.4 Description of the Environment

11.4.1 Environmental Setting

The study area falls in the Survey of India Topo Sheet No. 58H/3, 58H/4, 58H/7 and 58H/8. Topo map of 10km radius is shown in Fig 2.1. The mining area is accessible by SH-179 (West Coast Road-WCR). Block-A is connected to SH 179 (Kanniyakumari - Pazhaya Uchakada Road) by a series of Major District Roads (MDRs) and Block-B is connected by SH- 179 which is passing through the site.

The ML Block-A is located 08°11'19.78" to 08°13'33.12" North Latitudes and 77°11'13.13" to 77°14'08.82" East Longitudes and Block-B is located between 08°15'17.31" to 08°17'32.23" North Latitudes and 77°06'50.15" to 77°09'34.63" East Longitudes. There are **no Eco Sensitive Areas** like National Parks, Wildlife Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar Sites, Tiger/Elephant Reserves, Reserved Forests, etc. (existing as well as proposed) within 10 km from the Mining Lease Area.



Kanniyakumari Wildlife Sanctuary is at 25 km (shortest) distance in northeast. River Valliar drains the eastern parts of the Study Area and River Thamirabarani drains the central parts of the Study Area which flows adjacent to the Block-B at 0.12 km in the northeast and 4.5 km from Block-A in the northwest. Arabian Sea and its coastline are in southern parts.

Tamil Nadu-Kerala State Boundary is at 1.5 km in the west from Block-B & 12.4 km from Block-A and General Condition applies to this Mining Project. There is no major industry in the Study Area. The mining area does not fall Critically Polluted Areas /Industrial Clusters identified by CPCB. The project area (ML Area) does not fall in the Aravali Range. Part of the Mining Lease Area falls in Coastal Regulation Zone Area and thus, attracts Clearance under CRZ Notification, 2011.

The State Highway SH-179 runs parallel and through the Mining Lease area. Nagercoil-Thiruvananthapuram Section of Southern Railway BG Line runs at a distance of 6.5 - 7.0 km in the north. Nagercoil Junction is at 23 km from the Mining Lease in the east. The nearest airport is Thiruvananthapuram at 28 km in the northwest. Thengapattinam Port is at 2 km in the southeast from Block-B and Colachel Port is at 2.0 km in the southeast from Block-A.

Moderately populated villages such as Kurumpanai, Alanchi, Midalam, Melmidalam, Pallapallam, Enayamputhenthurai, Karungal, Puthukadai, Manavalakurichi, Monday Market, Neyyoor, Kalingarajapuram, Nithiraivilai, Poothurai along with Hospitals, Schools, Churches,

Temples, Mosques, Community Halls, recreation clubs etc. are located within the study area. Municipal Corporations of Colachel and Kollencode are located near the Mining Lease. Kanniyakumari District Head Quarters Nagercoil is at 23 km in the east from Block-A.

There is no litigation, directions or any order passed by any Court of Law or pending against the project.

11.5 Baseline Environmental Status

The environmental components studied and the methodologies followed for the preparation of EIA report are given in Table 2-1 (Fig. 2-2).

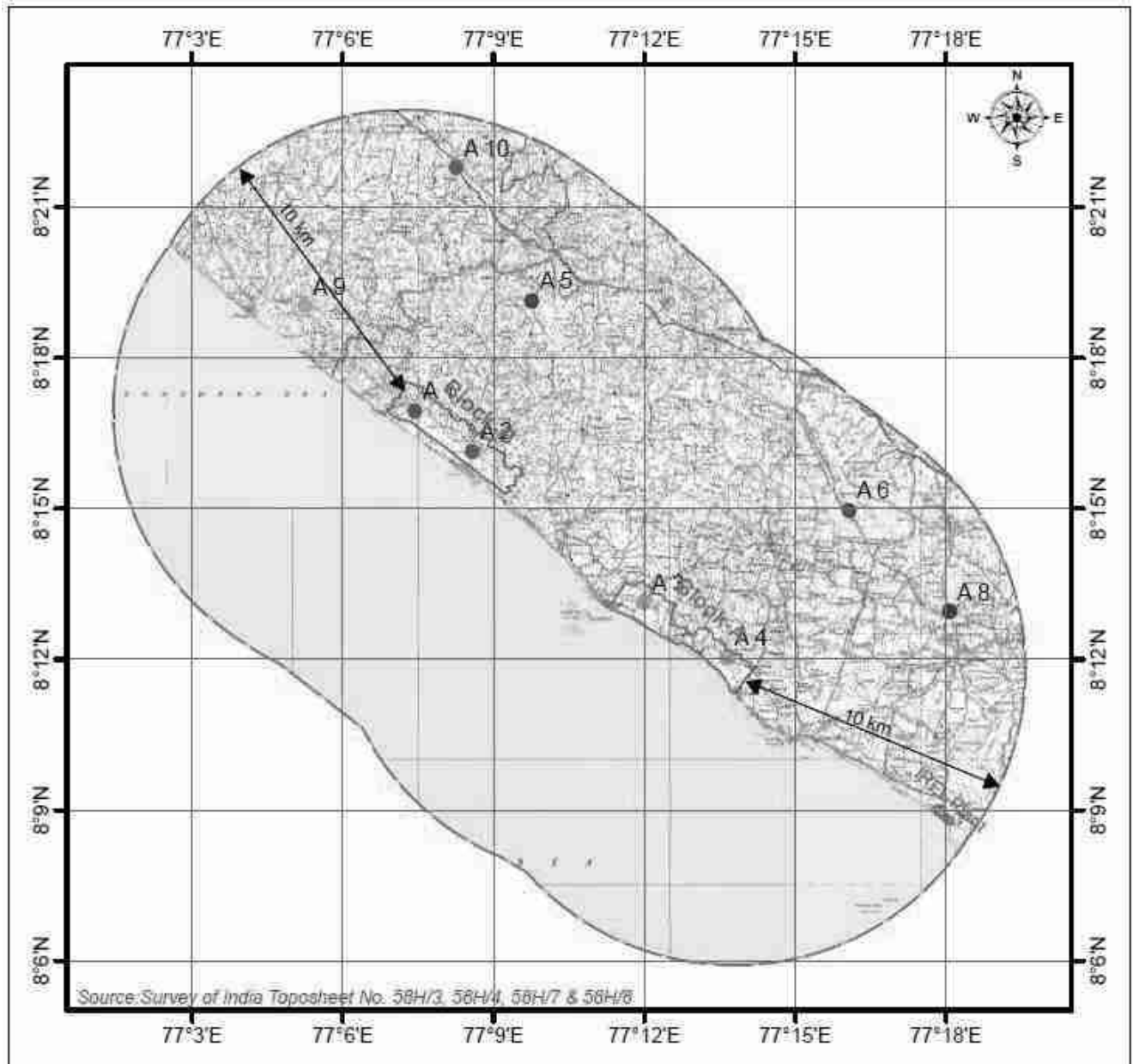


Fig. 2.2: Monitoring locations

Table 2-1 Environmental components and methodologies

Sl.No.	Environmental Components	Area	Parameters	Methodology	Frequency
1	Air	10 locations in Core zone & Buffer zone	Meteorology	Field monitoring/secondary data	Continuous for 3 months
			Ambient Air Quality (all parameters as per NAAQ Norms)		12 of
2	Water	10	Water Quality Surface & Ground (parameters as per IS:10500) Ground water regime (hydrogeology)	Field Monitoring	Once in season
3	Soil	10	Soil Quality – Physical, Nutrients & Trace Metals	Field monitoring	Once in season
4	Noise	10	Noise levels	Field monitoring	Once in season
5	Ecological Features	Core zone & Buffer zone	Flora & fauna	Field study/Secondary data	Once in season
6	Socio-economic Features	Core zone & Buffer zone	Parameters related to socio-economic aspects	Field Study (Public Consultation by questionnaire survey)/ Secondary Data	Once in season
7	Traffic Survey	3	Traffic volume in project site	Field Monitoring	Once in season
8	Land Use	Core & Buffer zones	Land cover categories based on satellite image	Satellite image processing	Once in season



The summary of baseline status is given in **Table 1.5**.

Table 11-5 Environmental Baseline Status

Envl. Component	Main Parameters	Minimum	Maximum	Mean	Desirable Norms
Ambient Air Quality, ug/m ³	PM2.5	17	27	22	60
	PM10	36	56	42	100
	SO ₂	5	8.8	6.9	80
	NO _x	12.5	17.7	15.1	80
Ambient Noise, dB(A)	Leq-Day	48.3	54.1	51.8	55
	Leq-Night	39.8	44.6	42.8	45
Surface Waters	TDS, mg/l	244	1003	623.5	500/2100
Ground Waters	TDS, mg/l	218	844	531	500/2000
Soil Status	EC, mmhos/cm	0.078	0.502	0.29	0.2-0.5

Legend: PM2.5-Particulate Matter size less than 2.5 um; PM10- Particulate Matter size less than 10 um; SO₂-Sulphur dioxide; NO_x-Oxides of Nitrogen; Leq-Day & Leq-Night - Equivalent Noise Levels during Day & Night Times; TDS-Total Dissolved Solids; EC- Electrical Conductivity & SAR-Sodium Absorption Ratio.

The findings of baseline environmental status of the study area are summarized below:

- The collected meteorological data during this season represented the local weather phenomena.
- The monitored ambient air quality in the study area was found to be in compliance with the National Ambient Air Quality (NAAQ) 24-hourly Norms for Industrial, Residential, Rural and other areas.
- Monitored Ambient Noise Levels (Leq) during day and night times were found to be well within the MoEF&CC Norms.
- The water quality of surface water was found to be in compliance with CPCB/BIS Norms.
- The ground water quality was found to be in compliance with the BIS:10500-2012 Norms.
- The soil in the study area would very well support for vegetation.
- The area is moderately populated and basic amenities are available in all villages.

Thus, there is **adequate buffer** for the proposed Proposal in the physical, biological and edaphic environments of the study area.



11.6 Anticipated Environmental Impacts

Any Project would create impact on the environment in two distinct phases viz. Construction Phase which may be regarded as temporary & short term and Operation Phase which would have long term effects. Identification of all potential environmental impacts due to the Proposal are critically examined and major impacts (both Beneficial & Adverse) are studied.

Due to lack of raw material source, existing MSP at Manavalakurichi is being operated for <40% of its installed capacity for last 10 years or so. To support the Plant (with all required infrastructures) at Manavalakurichi, the New Lease has been proposed. Thus, having a dedicated MSP near the new Lease will not be feasible on techno-economical & environmental angle. Increasing the continued supply of Raw Material to the existing MSP will enhance uninterrupted supply of strategic Minerals to DAE for its operations

The proposed project does not involve any major establishment or construction. Thus, Construction Phase Impacts are not there for Impact Assessment and Environmental Management Plan (EMP). The identified impacts due to mining activities throughout the operational and post closure phases have been studied in detail.

Land Environment: Non-Conventional Mining activities, with no Drilling and Blasting, will be carried out in available/consented pocket lands in the Mining Lease Area of 1144.0618 Ha. Thus, no vibration impact due to mining. Also, there is no Solid Waste generation and thus, no Waste Dump in the Mining Lease area. After mining, the backfilling would be carried out and surface profile would be maintained at its original RL level (w.r.t. nearest Bench Mark) + 5 to 10% more for compaction. It is an ongoing activity upto life of the mine.

Since this process is an ongoing activity, if any sand deficit occurs in the conceptual stage, appropriate measures will be adopted to backfill the mined out area to the base level. Over and above, if any information is received from the land owners requiring for additional tailings, IREL will transport the tailings and backfill to the base level.

About 106.50 Ha is required for Mining during the Plan Period which will be mined out, back filled and handed over to the Land Owners. At the Conceptual Stage, 834.1296 Ha will be the mined out and back filled area. Back filled areas will be used for plantation and other purposes by the land owners. Thus, there will not be any significant change to Land Environment due to the Proposal.

Traffic Volume: Mined out mineral from Blocks A & B will be transported by 25/30 Tons Tippers to the existing Mineral Separation Plant at Manavalakurichi, which is aerially located at 8.4 km from Block-A and 19.4 km from Block-B in the southeast (road distance 12-17 km from Block-A and 30-35 km from Block-B). MDR and SH-179 will be the Ore Transportation Route from the Mining Lease to MSP at Manavalakurichi which is passing through the Lease area and accessible from both northern as well as southern pockets of Lease Area.

As SH-179 & MDR covers >90% of the transportation route, the RoM transportation from Blocks-A&B to MSP will be through MDR/SH-179. For balance area coverage, vacant land within the Lease will be utilized as Haulage Road to reach the nearest point of MDR/SH-179 and further to MSP. Thus, Mineral transportation will not have any impact on the village roads.



A detailed traffic assessment has been carried out in compliance with IRC 106-1990 guidelines. It is assessed that the traffic volume at Nithiravilai was found to be 5017 PCU/day and at Midalam 4441 PCU/day i.e. 209 PCU/hr at Nithiravilai and 185 PCU/hr at Midalam with average 197 PCU/hr. The traffic carrying capacity of two-way undivided arterial road is 2400 PCU/hr as per IRC 106-1990. The proposed transportation of 5000 TPD one way by 30T Tippers – 167 trucks one way, 334 trucks per day in two ways which is about 735 PCU/day i.e. 31 PCU/hr. It is worked out to be only 16% volume addition to the existing traffic volume.

The Volume/Capacity (V/C) ratio for existing and proposed traffic volume is found to be 0.08 and 0.095 respectively and the Level of Service (LOS) is found to be “A” – Excellent. Hence, the existing highway is adequate to handle the proposed volume due to the proposed project.

Air Quality: Mining, Loading and Transporting activities would generate both fugitive dust emissions and smoke from HEM Machineries/Equipments & Transporting Tippers. Fugitive emissions are predicted by using standard equations given in ‘Indian Mine and Engineering Journal’ and suggested by USEPA (Emission Factors as referred in AP-42) for Mining & Allied activities.

Accordingly, the computed values of PM Emission for various activities (other Pollutants are in insignificant levels from Mining activities) are:

<u>PM Emissions, g/sec</u>	
Excavation	0.00000005
Loading	0.00000006
Ore Haulage	0.00006596

AERMOD View Software is used for Predicting the maximum Ground Level Concentrations (GLCs) including Transportation Impact (Table 3-1).

Table 3-1 Predicted GLCs

Sl. No	Pollutant	Background Concentration (24-hly. Avg.), $\mu\text{g}/\text{m}^3$	Max. Predicted Ground Level Concentration, $\mu\text{g}/\text{m}^3$	Distance from the Plant (max.), km	Total Concentration, $\mu\text{g}/\text{m}^3$	Revised NAAQ Norms $\mu\text{g}/\text{m}^3$	Buffer Available in the Atmosphere (%)
1.	PM 2.5	21.60	0.73	0.8	22.33	60	62.78
2.	PM 10	45.70	7.26	0.8	52.96	100	47.04

The predicted maximum GLC-PM2.5 & PM10 for cumulative operation of Mining activities are 22.33 $\mu\text{g}/\text{m}^3$ & 52.96 $\mu\text{g}/\text{m}^3$ respectively and found to be confined locally i.e. within 0.8 km radius from the boundaries. Also, adequate Buffer Level available (47-63%) in the Air Environment for the Proposal.

2 Nos. of Mobile tower lights backed with 2 x 125 kVA DG sets will be utilized in the mining area for illumination purpose. The DG sets will have acoustic enclosures to control the noise levels. The stack height will be as per CPCB norms to comply with emission norms.



Noise Levels: The mining operations are being carried out by fully mechanized method with the help of Excavators and Tipper combination. No Drilling and Blasting. The noise level due to Mining Equipments during operation, is being maintained at <90 db(A) at a distance of 1.5 m from the sources. In general, noise generated by these sources is within the limit of 90 dB(A) prescribed by Director General of Mines Safety (DGMS). The work force is exposed to <85 dB(A) levels during the 8-hours Shift. Ambient Noise Levels (Leqs) will be <55 dB(A) during day times and <45 dB(A) during night times at the boundaries in compliance with MoEF&CC Norms for Residential Areas. Operation of the mobile van will be complying the MoEF&CC noise norms of <45 dB(A) during night time for residential areas.

Water Environment: The mining activities involve the mining of Atomic Minerals (BSM Ore) from the inland deposits. Block-B is does not contain any river or stream and there are 2 Nos. streams in Block-A. As described in the approved mining plan, adequate safety barriers will be maintained at both sides of the nalla course till the end of the mine life. Natural runoff water would not be disturbed due to the mining activity.

The average working depth in Block – A and Block – B is 6 m only and the maximum depth will be 9 m BGL. The groundwater level in the mining lease area and vicinity is ranging between 10 – 15m BGL as evidenced from the Tamil Nadu Water Supply and Drainage Board (TWAD) and CGWB data base. Thus, the mining activity will not intersect the groundwater table at both the blocks A and B. If the mining is found to be intersecting the water table, further mining activities will not be carried out at that location.

With no permanent facilities proposed in the Mining Lease area and with the moving population of worker/employees during the mining, water demand will be 2.5 KLD which will be sourced from the permitted quantity of 4500 KLD from Valliyar River for the existing MSP at Manavalakurichi. Also, the requirement will be managed through local Drinking Water suppliers. Sewage generation of 2.2 KLD will be biologically treated in a mobile Bio-Toilets and the sludge will be used as manure for the Green Belt development. No Workshop is proposed and thus no trade effluent generation from the Mine. No mine pit will be there and thus no mine drain is envisaged. No impact is anticipated on the ground water sources in the Mining Lease vicinity.

Biological Environment: There are no Eco Sensitive Areas like National Parks, Wildlife Sanctuaries, Biosphere Reserves, Wildlife Corridors, Ramsar Sites, Tiger/Elephant Reserves, Reserved Forests, etc. (existing as well as proposed) within 10 km from the Mining Lease Area. Kanniyakumari Wildlife Sanctuary is at 25 km (shortest) distance in northeast.

The study area does not involve any forest land. The private patta lands are found with scattered coconut trees. The major crops cultivated in the study area are coconut trees, fruit crops like mango, banana, jack and aonla. Only domesticated fauna is recorded in the Study Area.



Green Belt development: The mining will be limited to vacant land available in the mining lease area. Out of total mining lease area of 1144.0618 Ha, the vacant land available for mining of atomic minerals is 834.1296 Ha only. Also, the mining will be carried out in the consented pocket lands given on lease for 11 months by the land owners. After the mining, such pocket lands will be backfilled to its original level and handed over to the land owners. Thus, the land will be in possession of IREL for a short duration of 11 months only and after that the land ownership will not be with IREL. The same scenario would prevail for the entire lease area. IREL will not have any surface right nor land ownership in the entire mining lease area.

In view of this, Greenbelt development in the mining lease area by IREL may not be possible as the ownership of the land vest with land owners. However, IREL will incorporate a clause in the land lease agreement to plant and develop coconut or any other suitable tree plantation @70 Trees per acre in the mined out are.

Towards compensatory afforestation programme, IREL would contribute an amount of Rs. 50 Lakhs to the District Forest Officer (DFO) to develop and maintain 25,000 trees at suitable place near the lease area.

Occupational Health and Safety:

Radiation: The coastal areas in Kanniyakumari District including the mining lease area of 1144.0618 ha are having high natural background radiation in the range of 1 to 4 $\mu\text{Svh-1}$ due to presence of Monazite in the BSM Ore. Monazite is a radioactive mineral containing Uranium and Thorium.

On removal of the BSM ore (Run of Mines) containing Monazite and backfilling the mined-out areas with tailings (after removal of minerals), the background radiation in the mined-out area is brought down to 0.2 to 0.4 $\mu\text{Svh-1}$. In other words, there has been 8 to 10 fold reduction in the radiation level in the area where mining & backfilling is carried out by IREL and as such our mining does not affect either environment or people and makes the area free from high background radiation.

IREL will provide and continually improve the occupational health and safety performance. Personal Protective Equipments will be provided to the mine employees. All the workers will be provided with Internal Dosimetry and Medical Surveillance. Maintenance of Pre, during & Post Employment Records will be done. Duly qualified Radiological Safety Officer (RSO) will be appointed. External Radiation Monitoring will be carried out periodically by Health Physics Division, BARC. All the workers will be trained and instructed in radiation safety.

Socio Economics: Neither land acquisition nor purchase of land would be done for the Project. The permanent structures will not be disturbed and mining shall not lead to displacement of people. Thus, no Rehabilitation & Resettlement (R&R) issue due to the Proposal. Also, there is no Litigation against the Proposal.

The Mine will be operated with the required Statutory Officials and Competent Persons mandatorily appointed as per the provisions of the Mines Act, 1952, Atomic Mineral Concession Rules (AMCR), 2016 and Mineral Conservation Development Rules (MCDR), 2017. Project will employ about 155 persons directly and 250 persons indirectly.

The Project Cost is Rs.31.25 Crores. Royalty, DMF and NMET will be remitted as per the statutory requirement. Adequate CER Budget, as per OM F.No.22-65/2017-IA.III dated 20.10.2020, will be allocated for the benefits of local villages in the Mine vicinity, after taking into account of the concerns raised during Public Hearing. IREL spends about Rs. 3.00 – 5.00 Crore for CSR activities in the region (Table 3-3)

Table 3-3: CSR Activities in the Region by IREL

CSR Component	CSR Amount Spent (Rupees in lakhs)					Total
	2020-21	2021-22	2022-23	2023-24	2024-25 Allocated	
Health & Nutrition	15.77	76.76	59.39	134.45	127.50	413.87
Education	5.41	3.92	21.77	89.56	166.50	287.16
Rural Development Projects	49.84	28.77	37.64	89.54	150.00	355.79
Promoting Environment		11.79	36.78	15.68	45.00	109.25
Women Empowerment		17.96				17.96
Skill Development			4.06	6.85		2.15
Sports				4.72	11.00	15.72
Total	71.02	139.20	159.64	340.80	500.00	1210.66



CSR Activities by IREL – MK Unit



Shri H.R. Koushik, Sub-Collector, Padmanabhapuram

IREL handed over 4 nos. of vehicles to Kollencode & Colachel Municipalities, Ezhuthesam Town Panchayat and Thoothoor Village Panchayat in the presence of Shri N. Selvarajan, Chief General Manager & Head and Trade Union Representatives on 13.01.2023 for handling Solid waste in the Municipalities/Panchayat.

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Shri N. Selvarajan, CGM & Head, MK handed over cheque of Rs.14 lakhs and Rs.4.50 lakhs to the Sub-Collector, Padmanabhapuram towards Fishermen Village Development Fund and Medical Assistance Fund respectively on 14.09.2022



IREL, MK Unit – CSR Activities

Apheresis Unit (Cell Separator) to Government Medical College & Hospital, Asaripallam



Medical camp conducted at Devicode Village

Ultra Sound Scanning machine to Primary Health Centre, Thiruvithamcode



Provided ECG Machine to Primary Health Centre, Edaikode





IREL, MK Unit – CSR Activities

Provided Teaching Aids - Smart Class to Melmidalam Village



Provided Desk and benches to Sacred Heart High School, Kadiapattinam



Construction of Toilet facility to Kalladivilai Village



Construction of Community Hall to Parapattu Village



IREL, MK Unit – CSR Activities

Provided Bus shelter in Manavalakurichi



Provided Steel Cot, Mattress and Pillows to Government Hospital, Kulasekharam



Repair works undertaken in the Anganvadi buildings in Manavalakurichi



Providing X-ray Machine and Retrofit to Government Ayurvedha College and Hospital, Kottar



IREL, MK Unit – CSR Activities

Covid Vaccination camp conducted at Melmidalam



Installation of Highmast Light at Manavalakurichi



Construction of bathing Ghat in Valliyar River



Provided sports items to nearby Villagers



11.7 Environmental Monitoring Programme

IREL has EMP Monitoring Cell. The quality of air, noise, water, soil, etc. will be monitored periodically at the identified locations as per MoEF&CC, AMD & TNPCB Norms by appointing an accredited external agency. The Status Reports will be submitted to the Authorities periodically viz. TNPCB monthly, AMD Quarterly and MoEF&CC Monitoring Cell as Half Yearly Status Reports.

11.8 Additional Studies

Detailed Risk Assessment and mitigative measures are delineated and an effective Disaster Management Plan, for natural and man-made disasters, is also submitted.

11.9 Project Benefits

Social Benefits: Commencement of mining operation over the mining lease area of 1144.06.18 ha will result in overall development of the region in its own way like provision of direct & indirect employment, improvement in the general living standards and knowledge sharing, improved wage level and the living standard of the local people and continual improvements in the amenities and infrastructure facilities for the local populace.



As per the IREL's policy, neither land acquisition nor purchase of land would be done for the project. The Mining operations will be carried out over the private patta lands after obtaining the consent from the respective land owners on lease basis. The land leasing period will be 11 months. Mining and backfilling will be simultaneously carried out within the lease period of 11 months and thereafter the land will be returned to the land owners with lease compensation. Mining in the lease hold areas will not result in any displacement nor change in the ownership of the land. The payment of lease compensation results in significant improvement in quality of life for local populace and economic growth in the region.

Environmental Benefits: The coastal areas in Kanniyakumari District including the mining lease area of 1144.0618 ha are having high natural background radiation in the range of 1 to 4 μSvh^{-1} due to presence of Monazite in the BSM Ore. Monazite is a radioactive mineral containing Uranium and Thorium. On removal of the BSM Ore (Run of Mines) containing Monazite and backfilling the mined-out areas with tailings (after removal of minerals), the background radiation in the mined-out area is brought down to 0.2 to 0.4 μSvh^{-1} . In other words, there has been 8 to 10 fold reduction in the radiation level in the area where mining & backfilling is carried out by IREL and as such our mining makes the area free from radioactivity and improving the living condition of people.

Financial Benefits: IREL is the only CPSE in the country being authorized to mine and handle "Monazite" and its value-added products. The Zircon produced from Manavalakurichi Unit is directly sent to the Nuclear Fuel Complex (NFC), Department of Atomic Energy for strategic applications. The processed mineral products, apart from its usage for strategic purpose in Nuclear Energy, Defense, Space etc., finds application in number of commercial sectors such as aerospace industry, infrastructure development, ceramics, foundries, oil industries etc., while Rare Earths are used in niche applications such as consumer electronics, renewable energy, EVs, etc., and also has excellent contribution for sustenance of industries in the value chain of its mineral & rare earth products. The project will generate revenue in terms of royalty and taxes etc. to the state of Tamil Nadu in addition to make available of strategic material. All these minerals and Rare Earth's provides input for other industries and plays a vital role in global economy

11.10 Environmental Management Plan

Environmental Management Plan (EMP) is suggested to mitigate the possible negative impacts that may be caused to various attributes of environment due to the proposed mining operations.

EMP for Construction Phase: There will be no Construction Phase for the Project.

EMP for Operation Phase:-

Land Environment:

- Mined-out area are to be backfilled simutanoously to restore the topography.
- Plantation are to be carried out in the mined-out areas after backfilling.
- Reclaimed Land will be used for other activities including construction and thereby ensuring Eco-friendly and Sustainable mining.
- Carbon sequestration is the long-term storage of carbon in oceans, soils, vegetation (especially forests) and geologic formations. Adequate Green Belt will be developed



around the project for carbon sequestration. As trees grow, they store carbon in woody tissues and soil organic matter.

Traffic Impact

- RoM transportation from Blocks-A&B to MSP will be through MDR/SH-179.
- All Tippers are to be fully covered with Tarpaulin to avoid any spillage during transportation.
- Restriction of over loading of Tippers shall be enforced.
- Speed restrictions shall be enforced.
- Restriction of Truck parking in the Highway and Public Roads shall be enforced.
- Regular and preventive maintenance of transport vehicles are to be ensured.
- Compliance to 'Pollution under Control' Certification has to be ensured and to be checked periodically.

Air Environment

- The DG sets will have acoustic enclosures to control the noise levels. The stack height will be as per CPCB norms to comply with emission norms.
- Water sprinkling on loading point and Haul Roads are to be carried out.
- Covering of Trucks/Tippers with tarpaulin shall be ensured during Ore transportation.
- Over loading of Tippers has to be avoided to control the spillages during transportation.
- Periodical maintenance and replacement of worn out accessories in the mining equipments are to be carried out.
- 'Pollution under Control' Certification has to be ensured and to be checked periodically.
- Periodical monitoring of Ambient Air Quality has to be carried out.

Noise Levels

- Deployment of mining equipments shall be with in-built mechanism for reducing noise.
- Operation of the mobile van will be complying the MoEF&CC noise norms of <45 dB(A) during night time for residential areas.
- Providing ear muffs/ear plugs to the workers in high noise zones.
- Periodical Noise Monitoring shall be carried out and Reports submitted to the Authorities.

Water Environment

- Natural drains shall be maintained as such.
- Adequate safety barriers will be maintained at both sides of the nalla course in the Lease till the end of the mine life.
- No ground water drawl in the Mining Lease Area as well as CRZ area for the project.
- Periodical monitoring of water table levels and water quality are to be carried out.

Biological Environment

- IREL will incorporate a clause in the land lease agreement to plant and develop coconut or any other suitable tree plantation @70 Trees per acre in the mined out areas.
- Towards compensatory afforestation programme, IREL would contribute an amount of Rs. 50 Lakhs to the District Forest Officer (DFO) to develop and maintain 25,000 trees at suitable place near the lease area.

Occupational Health Measures: Lease area of 1144.0618 ha are having high natural background radiation in the range of 1 to 4 μ Svh-1 due to presence of Monazite in the BSM



Ore. Monazite is a radioactive mineral containing Uranium and Thorium. On removal of the BSM ore (Run of Mines) containing Monazite and backfilling the mined-out areas with tailings (after removal of minerals), the background radiation in the mined-out area is brought down to 0.2 to 0.4 $\mu\text{Svh-1}$. In other words, there has been 8 to 10 fold reduction in the radiation level in the area where mining & backfilling is carried out by IREL and as such our mining does not affect either environment or people and makes the area free from high background radiation.

IREL will provide and continually improve the occupational health and safety performance. Personal Protective Equipments will be provided to the mine employees. All the workers will be provided with Internal Dosimetry and Medical Surveillance. Maintenance of Pre, during & Post Employment Records will be done. Duly qualified Radiological Safety Officer (RSO) will be appointed. External Radiation Monitoring will be carried out periodically by Health Physics Division, BARC. All the workers will be trained and instructed in radiation safety.

Social Measures: The Project Cost is Rs.31.25 Crores. Royalty, DMF and NMET will be remitted as per the statutory requirement. Adequate CER Budget, as per OM F.No.22-65/2017-IA.III dated 20.10.2020, will be allocated for the benefits of local villages in the Mine vicinity, after taking into account of the issues raised during Public Hearing. IREL spends about Rs. 3.00 – 5.00 Crore for CSR activities in the region which will be continued.

Plastic Waste Management: There will be ban on one-time use and throw away Plastic usage in the Mining Lease. Encourage the use of eco friendly alternatives such as banana leaf, areca nut palm plate, stainless steel glass, porcelain plates / cups, cloth bag, jute bag etc.

EMP Budget: The Project Cost is Rs.31.25 Crores. An amount of Rs. 20.00 Lakhs is earmarked as Capital EMP Budget and Rs10.50 Lakhs per Annum is Operating Cost towards EMP measures including Environmental Monitoring. Also, an amount of Rs.10.00 Lakhs per Annum has been earmarked for Occupational Health & Safety Measures. Also, budget for the Corporate Environmental Responsibility (CER) will be allocated in compliance with guidelines of MoEF&CC.



12.0 Disclosure of consultant

ABC Techno Labs India Private Limited (formerly ABC Environ Solutions Pvt. Ltd.) is an ISO 9001, ISO 14001 & OHSAS 18001 Certified Company & leading Environmental Engineering & Consultancy Company constantly striving towards newer heights since its inception in 2006. Our Company is dedicated to providing strategic services in the areas of Environment, Infrastructure, Energy, Engineering and Multi lab.

It is the first firm to be accredited by NABET (National Accreditation Board for Education and Training), Quality Council of India, as an EIA Consultant, approved for carrying out EIA studies and obtaining environmental clearance for various sectors such as Thermal Power Plants, Infrastructure, Industrial Estates/Complexes/Areas, Mining, Township & area development and Building construction projects etc. ABC Techno Labs is equipped with in-house, spacious laboratory, accredited by NABL (National Accreditation Board for Testing & Calibration Laboratories), Department of Science & Technology, Government of India.

ABC has been accredited for various Sectors including Sector-1 (Mining) for Category 'A' by the National Accreditation Board for Education & Training (NABET), Quality Council of India vide Certificate NABET/EIA/2225/RA 0290 with validity extended till 16.11.2025 (SI. No. 4 of QCI/NABET List dated 15.07.2024). ABC Techno Labs India Private Limited Laboratory is accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) vide Certificate No. TC-5770 dated 03.04.2024. The Lab is also recognized by the Ministry of Environment, Forest and Climate Change (MoEF&CC) vide Letter F. No. Q-15018/04/2019-CPW dated 14.10.2019 with validity of 5 years.

Since establishment ABC Techno Labs focus on sustainable development of Industry and Environment based on sound engineering practices, innovation, quality, R&D and most important is satisfying customers need. The company has successfully completed more than 100 projects of a variety of industries, in the field of pollution control and environmental management solutions. The company is also dealing in the projects of waste minimization and cleaner production technology.

12.1 Services of ABC Techno Labs India Pvt Ltd

Environmental Services

- Environmental Impact Assessment (EIA)
- Environmental Management Plan (EMP)
- Social Impact Assessment (SIA)
- Environmental Baseline data collection for Air, Meteorology, Noise, Water, Soil, Ecology, Socio-Economic and Demography etc;
- Environmental Monitoring
- Socio-Economic Studies
- Resettlement & Rehabilitation Plan
- Ecological & Human Health Risk Assessment Studies
- Ecological Impact Assessment
- Environmental Management Framework
- Solid Waste Management
- Hazardous Waste Management
- Internship & Training



Turnkey Projects

- Water Treatment Plants
- Sewage Treatment Plant
- Recycling & Water Conservation Systems
- Zero Discharge System

Other Services

- Operation & Maintenance of Water & Waste Water Plants
- Water & Waste Water Treatment Chemicals
- Pilot Plant studies
- Feasibility studies & preparation of budgetary estimates

Laboratory Services

- Chemical Testing
- Environmental Testing
- Microbiological Testing
- Food Testing
- Metallurgical Testing



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ABC Techno Labs India Private Limited, Chennai

ABC Tower, 400, 13th Street, SIDCO Industrial Estate, North Phase, Ambattur, Chennai 600098

The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals including opencast/ underground mining	1	1 (a) (i)	A
2	Offshore and onshore oil and gas exploration, development & production	2	1 (b)	A
3	River Valley projects	3	1 (c)	A
4	Thermal power plants	4	1 (d)	A
5	Mineral beneficiation including pelletisation	7	2 (b)	A
6	Metallurgical industries (ferrous & non-ferrous)	8	3 (a)	A
7	Cement Plants	9	3(b)	A
8	Petroleum refining industry	10	4 (a)	A
9	Leather/skin/hide processing industry	15	4 (f)	A
10	Chemical fertilizers	16	5 (a)	A
11	Petro-chemical complexes	18	5 (c)	A
12	Petrochemical based processing	20	5 (e)	A
13	Synthetic organic chemicals industry	21	5 (f)	A
14	Distilleries	22	5 (g)	A
15	Integrated paint industry	23	5 (h)	B
16	Sugar Industry	25	5 (j)	B
17	Oil & gas transportation pipeline, passing through national parks/ sanctuaries/coral reefs / ecologically sensitive areas including LNG terminal	27	6 (a)	A
18	Airports	29	7 (a)	A
19	Industrial estates/ parks/ complexes/ Areas, export processing zones (EPZs), Special economic zones (SEZs), Biotech parks, Leather complexes	31	7 (c)	A
20	Ports, harbours, break waters and dredging	33	7 (e)	A
21	Highways	34	7 (f)	A
22	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
23	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)	B
24	Building and construction projects	38	8 (a)	B
25	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated June 09, 2023 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/23/2795 dated July 13, 2023. The accreditation needs to be renewed before the expiry date by ABC Techno Labs India Private Limited, Chennai following due process of assessment.



Sr. Director, NABET
Dated: July 11, 2023

Certificate No.
NABET/EIA/2225/RA 0290

Valid up to
Nov 16, 2025

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





ANNEXURES

Doc 1- Precise Area Letter



Industries (MMD.2) Department,
Secretariat, Chennai – 600 009.

Letter No.12503/MMD.2/2015-19, dated 28.06.2022

From
Thiru S.Krishnan, I.A.S.,
Additional Chief Secretary to Government.

To
The General Manager and Head,
Tvl.IREL (India) Limited,
Manavalakurichi,
Kanyakumari District – 629 252.

Sir,

Sub: Industries - Mines and Minerals – Atomic Minerals/Beach Sand Minerals – Area of an extent of 1144.06.18 hectares of Government and Private lands reserved by the Central Government in Kanyakumari District, Tamil Nadu for undertaking prospecting or mining operations through Tvl.IREL (India) Limited – Mining Lease application preferred by Tvl.IREL (India) Limited – Communication of precise area/Letter of Intent – Regarding.

- Ref: 1. Government of India, Ministry of Mines Notification No.G.S.R.399 (E), dated 11.06.2021.
2. Mining lease application preferred by the General Manager & Head, Manavalakurichi, Tvl.IREL (India) Limited (Formerly Indian Rare Earths Limited), dated 24.06.2021.
3. Government letter No.12503/MMD.2/2015-14, dated 08.12.2021 and 20.04.2022 addressed to the Government of India, Ministry of Mines.
4. From the Government of India, Ministry of Mines, Order No.M.IV-7/74/2021-Mines IV, dated 21.04.2022.
5. From the Government of India, Ministry of Mines, letter No.M.IV-7/74/2021-Mines IV, dated 22.04.2022.

I am directed to invite attention to the references cited. In the reference 5th cited, the Government of India, Ministry of Mines has conveyed its previous approval for grant of mining lease in favour of Tvl.IREL (India) Limited under the proviso to Section 5(1) and proviso to section 17A(2A) of the Mines and Minerals (Development and Regulation) Act, 1957 in respect of Beach Sand Minerals (BSM) over an extent of 1144.06.18 hectares in Keezhmidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B Villages in Killiyoor Taluk, Kanyakumari District.

(p.t.o.)

..2..

2: Accordingly, under rule 6(5) of the Atomic Minerals Concession Rules, 2016, I am directed to request you to submit the Approved Mining Plan and other necessary clearances from the concerned Government agencies as required for grant of mining lease under section 17A(2A) of the Mines and Minerals (Development and Regulation) Act, 1957 for mining Beach Sand Minerals (BSM) over an extent of 1144.06.18 hectares comprised in survey numbers as annexed to this letter in Keezhmidalam-A, Midalam-B, Enayamputhenthural, Ezhudesam-A, Ezhudesam-B, Ezhudesam-C, Kollencode-A and Kollencode-B Villages in Killiyoor Taluk, Kanyakumari District for a period until the entire reserves of the Beach Sand Minerals are exhausted subject to the following conditions:-

- (i) Tvl.IREL (India) Limited should submit an undertaking or an affidavit stating that consent of the private land owner or surface rights will be obtained and furnished in a phased manner to the State Government prior to entering into the private lands for mining, and no mining shall be carried out in private lands not owned by IREL without obtaining the consents or surface rights.
- (ii) Mining operations shall not cause any hindrance to the local public and adjoining pattadars.
- (iii) All conditions prescribed under Rule 10 of Atomic Minerals Concession Rules, 2016 shall be strictly adhered to.
- (iv) The applicant company is required to obtain a licence from the Atomic Energy Regulatory Board (AERB), Mumbai under Rule 3 of Atomic Energy (Radiation Protection) Rules, 2004.
- (v) The applicant company is required to obtain a licence from the Department of Atomic Energy under Rule 3 of the Atomic Energy (Working of the Mines, Minerals and Handling of Prescribed Substances) Rules, 1984.
- (vi) The applicant company should prepare a Mining Plan and obtain approval (including Progressive Mine Closure Plan) from the Atomic Minerals Directorate for Exploration and Research approved by the AMD, Hyderabad within a period of twelve months from the date of issuance of the communication from the Government.
- (vii) The applicant company shall obtain environmental clearance from the Ministry of Environment, Forest and Climate Change.
- (viii) The applicant company shall obtain CRZ clearance from the Competent Authority.
- (ix) The applicant company should provide a performance security to the State Government in the form of a bank guarantee or as a security deposit for an amount equivalent to 0.50 percent of the value of estimated resources as per Rule 6(6)(b) of AMCR 2016.

(contd..)

..3..

- (x) The applicant company should sign a Mine Development and Production Agreement with the State Government as per the format specified by the Central Government after compliance of conditions specified in clauses (a), (b), (c) and (d) of rule 6(6) of AMCR 2016.
- (xi) The applicant company should obtain approval or permit or no-objection or the like from the concerned Government authorities as may be required under applicable laws for commencement of mining operations.

Yours faithfully,

Dr. S. V. Srinivas
28/06/2022
for Additional Chief Secretary to Government
S. V. Srinivas

Copy to:

The Secretary to Government of India,
Ministry of Mines,
Shastri Bhavan,
Dr. Rajendra Prasad Road,
New Delhi - 110 001.

The Secretary to Government of India,
Department of Atomic Energy,
Anushakti Bhavan,
C.S.M.Marg, Mumbai-400 001.

The Commissioner of Geology and Mining,
Guindy, Chennai - 600 032.

The District Collector,
Kanyakumari,
Nagercoil - 629 001.



Doc – 2. Mining Plan Approval by AMD



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in
Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.



भारत सरकार Government of India
परमाणु ऊर्जा विभाग Department of Atomic Energy
परमाणु खनिज अन्वेषण एवं अनुसंधान निदेशालय
Atomic Minerals Directorate for Exploration and Research

1-10-153/156, बेगम्पेट Begumpet,
हैदराबाद Hyderabad-500 016
दिनांक: Date: 21.02.2024

संख्या No. AMD/MRG-4/6/2/2(8A)

विषय: मेसर्स आईआरईएल (इंडिया) लिमिटेड, मनावालाकुरिची के पक्ष में ग्राम कील मिदालम-ए, मिदालम-बी, इनयम्पुथेथुराई, एलहदसम-ए, बी & सी, एवं कोल्लेकोडे- ए & बी, जिला : कन्नियाकुमारी, तमिल नाडु में क्षेत्रफल 1144.0618 हेक्टेयर की सीमा में खनन योजना और प्रगामी खान बंदीकरण योजना के अनुमोदन के संदर्भ में।

Sub: Approval of Mining Plan and Progressive Mine Closure Plan over an extent of 1144.0618 ha in Keezhimidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode- A & B villages, Kanniyakumari district, Tamil Nadu in favour of M/s IREL (India) Limited, Manavalakurichi – Reg.

संदर्भ Ref : पत्र संख्या Letter No. IREL/MK/ 1144.0618 Ha /2024/107, दिनांक dated 02.02.2024

खान और खनिज (विकास और विनियमन) अधिनियम, 1957 के धारा 5 के उपधारा (2) के परंतुक (बी) और परमाणु खनिज रियायत नियमावली, 2016 के नियम 8(1) के द्वारा प्रदत्त शक्तियों का उपयोग करते हुए निदेशक, प.ख.नि. द्वारा मेसर्स आईआरईएल (इंडिया) लिमिटेड (आईआरईएल), के पक्ष में ग्राम कील मिदालम-ए, मिदालम-बी, इनयम्पुथेथुराई, एलहदसम-ए, बी & सी, एवं कोल्लेकोडे-ए & बी, जिला : कन्नियाकुमारी, तमिल नाडु में क्षेत्रफल 1144.0618 हेक्टेयर की सीमा में खनन योजना और प्रगामी खान बंदीकरण योजना निम्नलिखित शर्तों के तहत अनुमोदित किया जाता है:

In exercise of the powers conferred by clause (b) of sub-section (2) of Section 5 of the Mines and Minerals (Development and Regulation) Act, 1957 and Rule 8 (1) of the Atomic Minerals Concession Rules, 2016, the Mining Plan and Progressive Mine Closure Plan in Keezhimidalam-A, Midalam-B, Enayamputhenthurai, Ezhudesam-A, B & C and Kollencode- A & B villages, Kanniyakumari district, Tamil Nadu, extending over 1144.0618 ha is approved by the Director, AMD in favour of M/s IREL (India) Limited (IREL), subject to the following conditions:

- खनन योजना और प्रगामी खान बंदीकरण योजना तटीय बालू खनिज नामतः इलमेनाइट, रुटाइल, जिरकान, मोनाजाइट, गार्नेट और सिलिमेनाइट के संबंध में अनुमोदित है जिसे खान और खनिज (विकास और विनियमन), 1957 की प्रथम अनुसूची के भाग-ख के अधीन 'परमाणु खनिज' के रूप में अधिमूचित किया गया है।
The Mining Plan and Progressive Mine Closure Plan is approved in respect of beach sand minerals viz. ilmenite, rutile, zircon, monazite, garnet and sillimanite which are notified as 'Atomic Minerals' under Part B of First Schedule of Mines and Minerals (Development & Regulation) Act, 1957.
- यह अनुमोदन खनन पट्टा विलेख के निष्पादन और अन्य वैधानिक मंजूरी प्राप्त करने के बाद वर्ष I से वर्ष V तक पांच वर्ष की योजना अवधि के लिए वैध है।
This approval is valid for the five-year plan period from Year I to Year V after the execution of mining lease deed and obtaining other statutory clearances.
- आईआरईएल एएमसीआर, 2016 के प्रावधानों के अनुसार प्रत्येक पाँच वर्ष में खनन योजना की समीक्षा करेगा और इन नियमों के अंतर्गत विनिर्दिष्ट समय सारणी के अनुसार प.ख.नि. के अनुमोदन के लिए उसे प्रस्तुत करेगा।
IREL shall review the mining plan for every five-year as per the provisions of AMCR, 2016 and submit the same for approval of AMD as per the time schedule specified under these Rules.
- यह अनुमोदन खनन कार्यों के लिए आवश्यक केंद्रीय और राज्य प्राधिकरणों / विभाग से अन्य वैधानिक मंजूरी की पूर्ति के अधीन है।
This approval is subject to fulfillment of other statutory clearances from the Central and the State Authorities / Department(s) required for mining operations.



5. आईआरईएन परमाणु ऊर्जा (खान, खनिज कार्यकरण और विहित पदार्थ उठाई-धराई) नियमावली, 1984 के प्रावधानों के अनुसार अनुमानित मात्रा के प्रहसन/खनन का उल्लेख करते हुए, परमाणु ऊर्जा विभाग से लाइसेंस प्राप्त करे तथा संबंधित लाइसेंस में यथानिर्णित निर्बंधन एवं शर्तों का पालन करे। इसकी एक प्रतिलिपि प.ख.नि. के रिकार्ड हेतु भेजी जाए।
IREL shall obtain License from DAE to handle/mine the estimated quantities of prescribed substances as per the provisions of Atomic Energy (Working of Mines, Minerals and Handling of Prescribed Substances) Rules, 1984 and comply with the terms and conditions stipulated in the said License. A copy of the same may be submitted to AMD for records.
6. परमाणु ऊर्जा (विकिरण संरक्षण) नियम, 2004 (दिनांक 09.05.2009 के स्था.आदेश सं. 1210) के प्रावधानों के अनुसार, आईआरईएन आईआरबी से लाइसेंस प्राप्त करेगा। इसकी एक प्रतिलिपि प.ख.नि. के रिकार्ड हेतु भेजी जाए।
IREL shall obtain License from AERB as per the provisions of Atomic Energy (Radiation Protection) Rules, 2004 (vide S. O. No. 1210 dated 09.05.2009). A copy of the same may be submitted to AMD for records.
7. परमाणु ऊर्जा नियमांक परिषद के निदेशानुसार खनिज पृथक्करण संयंत्र से उत्पादित मोनाज़ाइट समृद्ध भारी खनिज मांद्रन का भंडारण अलग से किया जाए। उत्पादित मोनाज़ाइट का भंडारण/निपटान पद्धति एवं आईआरबी के लाइसेंस की शर्तों के अतिरिक्त एमएमडीआर अधिनियम, 1957 के अंतर्गत प्रावधानों के अधीन होगा।
The monazite-rich heavy mineral concentrate produced from the mineral separation plant shall be stored separately as per the directions from AERB. The storage/disposal of monazite recovered shall be subjected to the conditions of licenses issued by DAE and AERB and also the provisions specified under MMDR Act, 1957.
8. भारत सरकार, राज्य सरकार अथवा किसी अन्य प्राधिकारी द्वारा तैयार, समय-समय पर खान/क्षेत्र पर निदेशित / अधिनूचित किसी कानून के तहत बिना किसी पूर्वग्रह के खान योजना तथा प्रगामी खान बंदीकरण योजना का अनुमोदन किया जाता है।
That the Mining Plan and Progressive Mine Closure Plan is approved without any prejudice to any other laws applicable to the mine/area from time to time whether made by the Government of India, State Government, or any other authority.
9. खनन योजना (प्रगामी खान बंदीकरण योजना सहित) का यह अनुमोदन किसी भी तरह से खान एवं खनिज (विकास एवं विनियम) अधिनियम, 1957 अथवा परमाणु खनिज रियायत नियम, 2016 अथवा वन (संरक्षण) अधिनियम, 1960, पर्यावरण संरक्षण अधिनियम, 1986 और उसके तहत बनाये गये नियमों का किसी भी अन्य प्रावधानों के संदर्भ में सरकार के अनुमोदन का संकेत नहीं देता है।
That this approval of the Mining Plan (including Progressive Mine Closure Plan) does not in any way imply the approval of the Government in terms of any other provisions of the Mines and Minerals (Development and Regulation) Act, 1957 or the Atomic Minerals Concession Rules, 2016 or any other law including Forest (Conservation) Act 1960, Environment Protection Act, 1986 and the rules made thereunder.
10. खान एवं खनिज (विकास एवं विनियम) अधिनियम, 1957 के प्रावधानों तथा उसके अंतर्गत बनाए गए नियमों का और अन्य वैधानिक प्रावधानों का अनुपालन किया जाए।
That the provisions of the Mines and Minerals (Development and Regulation) Act, 1957 and Rules made thereunder and other statutory provisions shall be complied with.
11. खान को प्रारंभ करने की सूचना, प्रबंधक तथा अन्य वैधानिक प्राधिकारियों की नियुक्ति सहित और खान अधिनियम, 1952 के प्रावधानों तथा उसके अंतर्गत बनाए गए नियमों और विनियमों के अनुपालन को सुनिश्चित किया जाए।
That the provisions of the Mines Act, 1952 and Rules and Regulations made thereunder including submission of notice of opening, appointment of manager and other statutory officials shall be complied with.
12. इस खनन योजना (प्रगामी खान बंदीकरण योजना सहित) का अनुमोदन किसी अन्य आदेश या सक्षम क्षेत्राधिकार रखने वाले किसी न्यायालय के निर्देशों पर पूर्वग्रह के बगैर किया गया है।
That this Mining Plan (including Progressive Mine Closure Plan) is approved without prejudice to any other order or direction from any court of competent jurisdiction.

13. खनन योजना (प्रगामी खान बंदीकरण योजना सहित) का निष्पादन, यदि कोई प्रतिबंधन आदेश/नोटिस हो तो उसके निरस्त होने की शर्त पर किया जाएगा।
The execution of Mining Plan (including Progressive Mine Closure Plan) shall be subjected to vacation of prohibitory orders/notices, if any.
14. यदि खनन योजना (प्रगामी खान बंदीकरण योजना सहित) और सुधार प्रस्ताव की विषय-वस्तु में किसी ऐसे तथ्य को छिपाया हुआ पाया जाता है जिसे की खान अधिनियम, 1952 के अंतर्गत खुलासा करना अनिवार्य है, तो इस अनुमोदन को तत्काल प्रभाव से निरस्त समझा जाए।
If anything is found to have been concealed, which otherwise is required to be disclosed under the Mines Act, 1952 and MMDR Act, 1957 or the Rules made under the said Acts, in the contents of the Mining Plan (including Progressive Mine Closure Plan) and the proposals for rectification, the approval shall be deemed to have been withdrawn with immediate effect.
15. यदि किसी चरण में यह पता चलता है कि दस्तावेज में दी गई जानकारी असत्य है या किसी तथ्य को गलत ढंग से प्रस्तुत किया गया है, तो इस प्रलेख का अनुमोदन तत्काल प्रभाव से वापस ले लिया जायेगा।
If at any stage, it is observed that the information furnished in the document is incorrect or misrepresent facts, the approval of the document shall be revoked with immediate effect.
16. खनन प्रचालन और उससे संबंधित गतिविधियों के लिए अनुमोदन केवल खनन पट्टा क्षेत्र (तमिल नाडु सरकार द्वारा मखा अनुमोदित) में दिया गया है। खनन पट्टा क्षेत्र वह होगा जो अनुमोदित खनन योजना के अधीन पट्टेदार/ आर्हित व्यक्ति/अवेदक द्वारा सांविधिक योजनाओं में दिखाया गया है। आवेदक/पट्टेदार द्वारा प्रस्तुत पट्टे का नक्शा और अन्य योजनाओं के तहत प्रस्तुत जानकारी के संदर्भ में स्थल पर पट्टे क्षेत्र की परिमीमा (वाउड्री) की सत्यता के संबंध में प.ख.नि. की कोई जिम्मेदारी नहीं होगी।
This approval of mining operations and associated activities is restricted to the mining lease area (as approved by the Government of Tamil Nadu) only. The mining lease area is as shown on the statutory plans in the approved mining plan submitted by the lessee/qualified person/applicant. AMD does not take any responsibility regarding correctness of the boundaries of the lease shown on the ground with reference to the lease map and other plans furnished by the applicant/lessee.
17. आईआरईएल राज्य सरकार द्वारा दिए गए खनन पट्टे का विवरण या उसमें किए गए संशोधनों की सूचना निदेशक, प.ख.नि. को रिकार्ड के लिए भेजे।
IREL shall furnish the details of grant of lease or modifications in mining lease by State Government to Director, AMD for record.
18. खनन योजना (प्रगामी खान बंदीकरण योजना सहित) के क्रियान्वयन के दौरान, राज्य सरकार द्वारा खनन पट्टे की मंजूरी पर विचार करते समय विनिर्दिष्ट शर्तों पालन किया जाए।
The conditions stipulated by the State Government, if any, while considering the grant of mining lease shall be taken care of while implementing the Mining Plan (including Progressive Mine Closure Plan).
19. यदि खान के प्रचालन के दौरान किसी भी समय यह पाया जाता है कि मौजूदा कानूनों का पालन नहीं किया जा रहा है तो निदेशक, प.ख.नि. लिखित रूप में संबंधित कारण बताते हुए अनुमोदन को निलंबित कर सकते हैं।
That if anytime, during the operation of mines, it is found that the existing laws are not being followed, Director, AMD may suspend the approval accorded by giving the relevant reasons in writing.
20. मुख्य नियंत्रक खनन, आईबीएम नागपुर द्वारा उनके दिनांक 06.04.2010 के पत्रांक: 11013/3/एमपी/90-सीसीओएम बाल्युम VII द्वारा जारी किये गये परिपत्रांक 2/2010 की अंतर्वस्तु का अनुपालन किया जाए और पत्रांक को इसकी प्रति पृष्ठांकित की जाए।
The contents of circular No. 2/2010 issued by the Chief Controller of Mines, IBM, Nagpur vide his letter No. 11013/3/MP/90-CCoM Vol VII dated 06.04.2010 shall be complied with and a copy endorsed to AMD.
21. यदि खनन/प्रक्रमण पद्धति में कोई बड़ा परिवर्तन होता है तो तत्संबंधी सूचना निदेशक, प.ख.नि., हैदराबाद को प्रस्तुत की जाए तथा खनन योजना में आवश्यकतानुसार और भी संशोधन किए जाए।

That if there is any drastic change in the method of mining/processing, the information in this regard shall be submitted to Director, AMD, Hyderabad and the mining plan may be subjected to further revision as per requirement.

22. खनन योजना के कार्यान्वयन की निरीक्षण / मानिट्रिंग के लिए परमाणु खनिज अन्वेषण एवं अनुसंधान निदेशालय के सक्षम प्राधिकारी या प्राधिकृत अधिकारी को पूर्ण सुविधाएँ प्रदान की जाएंगी।
Full facilities shall be accorded to the Competent Authority or the Authorised Officer of the Atomic Minerals Directorate for Exploration and Research for inspection/monitoring of implementation of mining plan.
23. विद्यमान नियमों के अनुसार सभी सांविधिक विवरणियों और सूचनाओं की प्रतियाँ राज्य सरकार और निदेशक, प.ख.नि. को रिकार्ड हेतु प्रस्तुत किए जाएँ।
Copies of all statutory returns and notices as per rules in vogue shall be submitted to the State Government and the Director, AMD, Hyderabad for record.

उपरोक्त शर्तों की पूर्ति के अधीन तटीय बालू खनिज नामतः इलमेनाइट, रुटाइल, जिरकन, मोनाज़ाइट, गार्नेट और सिलिमनाइट के संबंध में अनुमोदित खनन योजना की दो प्रतियाँ संलग्न हैं।

Two copies of approved Mining Plan in respect of beach sand minerals viz. Ilmenite, Rutile, Zircon, Monazite, Garnet and Sillimanite subject to fulfilment of above conditions are enclosed.

(Handwritten Signature)
21/2/2014

(भास्करन सरवजन 'B' Saravanan)
निदेशक/Director
निदेशक, प.ख.नि./DIRECTOR, AMD

सेवा में To

श्री एन सेल्वाराजन, मुख्य महाप्रबंधक एवं प्रमुख, आईआरईएल (इंडिया) लिमिटेड, मनावालाकुरिची, जिला : कन्नियाकुमारी, तमिल नाडु - 629 252	Shri N Selvarajan, Chief General Manager & Head, IREL (India) Ltd., Manavalakurichi, Kanniyakumari district, Tamil Nadu- 629 252
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सूचनार्थ प्रति प्रेषित Copy for information to:

- संयुक्त सचिव (आई एंड एम), परमाणु ऊर्जा विभाग, पञ्चवि सचिवालय, अणुशक्ति भवन, सीएसएम मार्ग, मुंबई-400001.
Joint Secretary (I&M), Department of Atomic Energy, DAE Secretariat, Anushakti Bhavan, Chatrapati Shivaji Maharaaj Marg, Mumbai- 400001
- चेयरमैन, रेग्युलट्री बोर्ड, नियामक भवन, अणुशक्ति नगर, चेम्बूर ईस्ट, मुंबई - 400094
The Chairman, Atomic Energy Regulatory Board, Niyamak Bhavan, Anushakti Nagar, Chembur East, Mumbai- 400094
- अध्यक्ष एवं महाप्रबंधक, वेसर्स आई आर ई एल (इंडिया) लिमिटेड, प्लॉट नं 1207, वीर सावरकर मार्ग, प्रभादेवी, मुंबई - 400028.
Chairman and Managing Director, M/s IREL (India) Ltd., Plot No. 1207, Veer Savarkar Marg, Prabhadevi Mumbai-400028.



EIA for Mining of Atomic Minerals over an extent of 1144.0618 Ha in
Kanniyakumari District, Tamil Nadu by IREL (India) Ltd.

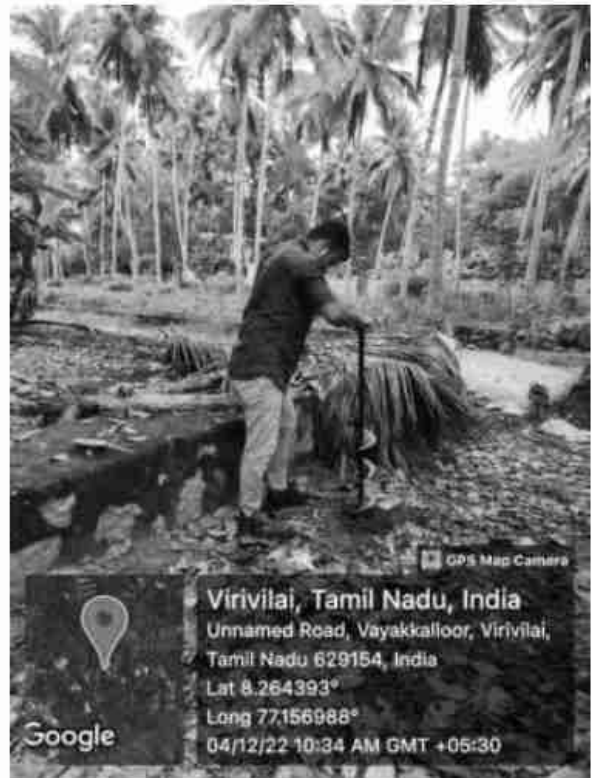


4. मुख्य खान नियंत्रक, भारतीय खान ब्यूरो, 6वां तल, 'डी' -ब्लॉक, इंदिरा भवन, सिविल लाइन्स, नागपुर-440001.
The Chief Controller of Mines, Indian Bureau of Mines, 6th Floor, Block 'D', Indira Bhavan, Civil Lines, Nagpur-440001.
5. क्षेत्रीय खान नियंत्रक, भारतीय खान ब्यूरो, राजाजी भवन, C -4 A, सीजीओ कॉम्प्लेक्स, बेसंत नगर, चेन्नई - 600 090.
The Regional Controller of Mines, Indian Bureau of Mines, Rajaji Bhavan, C-4A, CGO Complex, Besant Nagar, Chennai – 600 090.
6. आयुक्त, भूविज्ञान और खनन आयुक्तालय, खान एवं भूविज्ञान विभाग, औद्योगिक एस्टेट, गिन्दी, चेन्नई – 600 032.
The Commissioner, Commissionerate of Geology and Mining, Department of Mines and Geology, Industrial Estate, Guindy, Chennai – 600 032.
7. निदेशक, खान सुरक्षा महानिदेशालय, चेन्नई क्षेत्र, तीसरी मंजिल, बाएं विंग, नया अतिरिक्त भवन, सीजीओ कॉम्प्लेक्स, शास्त्री भवन, नुंगम्बक्कम, चेन्नई - 600 006.
The Director, Directorate General of Mines Safety, Chennai Region, 3rd Floor, Left Wing, New Additional Building, CGO Complex, Shastri Bhawan, Nungambakkam, Chennai- 600 006.

(भास्करन सरवणन B. Saravanan)
निदेशक Director



Doc 3- Baseline Monitoring Photographs







Doc 4- Hydrogeology: Gorund Water Level Data - Monitored during 24- 25.05.2024

Hydrogeology: Gorund Water Level Data - Monitored during 24-25.05.2024

Sampling Point	Location	Latitude	Longitude	Ground Water Level-BGL, m
1	Kodimunai	8° 10' 50.178" N	77° 14' 17.963" E	10.7
2	Panavilai	8° 11' 1.878" N	77° 14' 5.395" E	10.5
3	Kurumpanai	8° 11' 13.859" N	77° 13' 52.475" E	11.7
4	Kurumpanai	8° 11' 51.972" N	77° 13' 30.169" E	13.7
5	Midalam	8° 12' 19.519" N	77° 12' 57.377" E	18.2
6	Palappallam	8° 12' 32.245" N	77° 13' 0.955" E	14.6
7	Karungal	8° 13' 18.278" N	77° 12' 6.998" E	16.4
8	Melmidalam	8° 12' 47.376" N	77° 12' 31.572" E	14.6
9	Karungal	8° 13' 18.444" N	77° 12' 7.128" E	10.8
10	Enayam	8° 13' 24.254" N	77° 11' 9.679" E	15.5
11	kikulam	8° 13' 59.520" N	77° 11' 3.336" E	12.1
12	Thengapattanam	8° 14' 19.082" N	77° 10' 22.130" E	19.1
13	Ezhudesam	8° 15' 21.330" N	77° 8' 58.175" E	10.9
14	Ezhudesam	8° 15' 40.320" N	77° 9' 3.132" E	16.1
15	Ezhudesam	8° 16' 1.956" N	77° 8' 10.212" E	13.7
16	Kirathoor	8° 16' 32.340" N	77° 8' 17.952" E	13.7
17	Vallavilai	8° 16' 36.840" N	77° 7' 26.677" E	10.4
18	Painkulam	8° 15' 58.910" N	77° 10' 39.310" E	17.0
19	Vallavilai	8° 16' 59.408" N	77° 6' 58.205" E	14.6
20	Kollamkode	8° 17' 32.435" N	77° 7' 13.771" E	12.1
21	Kollamkode	8° 17' 22.787" N	77° 6' 33.073" E	12.4
22	Methukummal	8° 18' 7.398" N	77° 7' 43.122" E	10.4
23	Poramcode	8° 17' 57.408" N	77° 8' 26.016" E	10.1
24	Nadaikavu	8° 17' 31.081" N	77° 8' 50.802" E	16.1
25	Arudesam	8° 16' 43.673" N	77° 9' 29.653" E	12.4
26	Kikulam	8° 14' 42.853" N	77° 11' 30.127" E	14.2
27	Thozhicode	8° 13' 38.820" N	77° 12' 37.620" E	17.3
28	Ritapuram	8° 11' 23.471" N	77° 15' 2.275" E	13.8
29	Karungal	8° 14' 22.276" N	77° 14' 28.709" E	18.1
30	Kamplar	8° 15' 10.793" N	77° 12' 57.442" E	10.8
