Annexure 6.4. Stakeholder Engagement Plan

Abbreviations

AFD	:	Agence française de développement
BSRP	:	Bengaluru Suburban Railway Project
BMTC	:	Bangalore Metropolitan Transport Corporation
CBO	:	Community Based Organisation
CPRs	:	Common Property Resources
CPCB	:	Central Pollution Control Board
DPR	:	Detailed Project Report
EHS	:	Environmental Health and Safety
EIA	:	Environmental Impact Assessment
EMP	:	Environmental Management Plan
EMU	:	Environmental Management Unit
ESIA	:	Environmental and Social Impact Assessment
ESF	:	Environmental and Social Framework
ESS	:	Environmental and Social Standards
ESCP	:	Environmental and Social Commitment Plan
ESMP	:	Environmental & Social Management Plan
ESMU	:	Environmental & Social Management Unit
F & A	:	Finance & Administration
FGDs	:	Focus Group Discussions
GAP	:	Gender Action Plan
GIIP	:	Good International Industry Practice
GRC	:	Grievance Redressal Committee
GRM	:	Grievance Redressal Mechanism
KfW	:	Kreditanstalt für Wiederaufbau
K RIDE	:	Rail Infrastructure Development Company (Karnataka) Limited
KIADB	:	Karnataka Industrial Area Development Board
KSDB	:	Karnataka Slum Development Board
L & PC	:	Land & Project Co-ordination
MoEFCC	:	Ministry of Environment, Forest and Climate Change
NGO	:	Non-Governmental Organisation
PAP	:	Project Affected Person
PAH	:	Project Affected Households
PIA	:	Project Implementation Authority
RAP	:	Resettlement Action Plan
RPF	:	Resettlement Policy Framework
R&R	:	Resettlement and Rehabilitation
SC	:	Scheduled Caste
SEP	:	Stakeholder Engagement Plan
SIA	:	Social Impact Assessment
SMS	:	Short Message Service
SMU	:	Social Management Unit
ST	:	Scheduled Tribe
SWR	:	South Western Railway

Abbreviations of Stations

BAND	:	Banaswadi
BAW	:	Chikkabanavara
BNC	:	Bengaluru Cantonment
BNCE	:	Bengaluru East
BYPL	:	Baiyyappanahalli
CSDR	:	Channasandra
DHL	:	Devanahalli
HEB	:	Hebbal
HLE	:	Heelalige
JTJ	:	Jolarpettai
KDGH	:	Kodigehalli
KGI	:	Kengeri
KJM	:	Krishnarajapuram
KQZ	:	Kolar
KSR	:	Kranti Veera Sangolli Rayanna
LOGH	:	Lottegollahalli
MWM	:	Malleswaram
NMGA	:	Nelamangala
NYH	:	Nayandanahalli
RNN	:	Rajanukunte
SBC	:	Bengaluru City
WFD	:	Whitefield
YNK	:	Yelahanka
YPR	:	Yeshawantapur

Table of Contents

List of Tables

List of Figures

Lists of Appendix

1.1. Project Background

Bangalore, officially known as Bengaluru, is the capital and the largest city of the Indian state of Karnataka. It has a population of more than 8 million and a metropolitan population of around 11 million, making it the third most populous city and fifth most populous urban agglomeration in India. Located in southern India on the Deccan Plateau, at a height of about 3,113 feet (948.48 meters) above sea level, Bangalore is known for its pleasant climate throughout the year. Its elevation is the highest among the major cities of India.

Bangalore is widely regarded as the "Silicon Valley of India" (or "IT capital of India") because of its role as the nation's leading information technology (IT) exporter. Indian technological organizations are headquartered in the city. A demographically diverse city, Bangalore is the second fastest-growing major metropolis in India. Recent estimates of the metro economy of its urban area have ranked Bangalore either the fourth- or fifth-most productive metro area of India. It is home to many educational and research institutions. Numerous state-owned aerospace and defence organizations are located in the city. The city also houses the Kannada film industry and is a hub of sporting events. It was ranked the most livable Indian city with a population of over a million under the Ease of Living Index 2020.

Transport in Bangalore consists of several intracity commute modes such as Bengaluru Metropolitan Transport Corporation (BMTC) buses, Namma Metro rail services, taxis and auto rickshaws. At the end of the 2018–19 financial year, Bangalore had more than 80 lakh vehicles registered in the city, the most in India after Delhi[1]. Over 55 lakh two-wheelers (motorcycles) and 15 lakh cars together make up for close to 85 percent of the vehicles[2]. In 2018, Bangalore was reported to have the second highest number of two-wheelers in the country[3]. Bangalore's car density (number of cars for every kilometer of road), however, was found to be 149 – much lower than other major Indian cities[4]. App based rental motorcycles, bicycles and cars are also available for commuting.

The population of Bengaluru has been growing faster. There has been a phenomenal growth in the population of vehicles as well, especially the two wheelers and four wheelers in this period due to rising household incomes. In the absence of adequate public transport system, people are using personalized modes, which is not only leading to congestion on limited road network but also increasing environmental pollution. An average citizen of Bengaluru spends more than 240 hours stuck in traffic every year. Such delays result in loss of productivity, reduced air quality, reduced quality of life, and increased costs for services and goods.

Hence, to overcome the above issue, Rail Infrastructure Development Company (Karnataka) Limited (K RIDE), with its corporate office at # 8, 1st Floor, Samparka Soudha, Dr. Rajkumar Road, opposite Orion Mall, Rajajinagar 1st Block, Bengaluru– 560010, was incorporated as a Joint Venture between Government of Karnataka and Ministry of Railways, is entrusted with the responsibility of execution of Bengaluru Suburban Railway Project (BSRP), a new Suburban Railway Project envisaging construction of 4 dedicated rail corridors in a period of 6 years. It will link Bengaluru to its satellite townships, suburban, surrounding areas and provide a mass rail based rapid transit system.

[1] *The Hindu*. 1 April 2019. Retrieved 15 October2019.
[2] *Deccan Herald*. Retrieved 15 October 2019.
[3] *The Times of India*. Retrieved 17 October2019.
[4] *Business Today*. 25 March 2019. Retrieved 17 October 2019.

1.2. Project Corridors

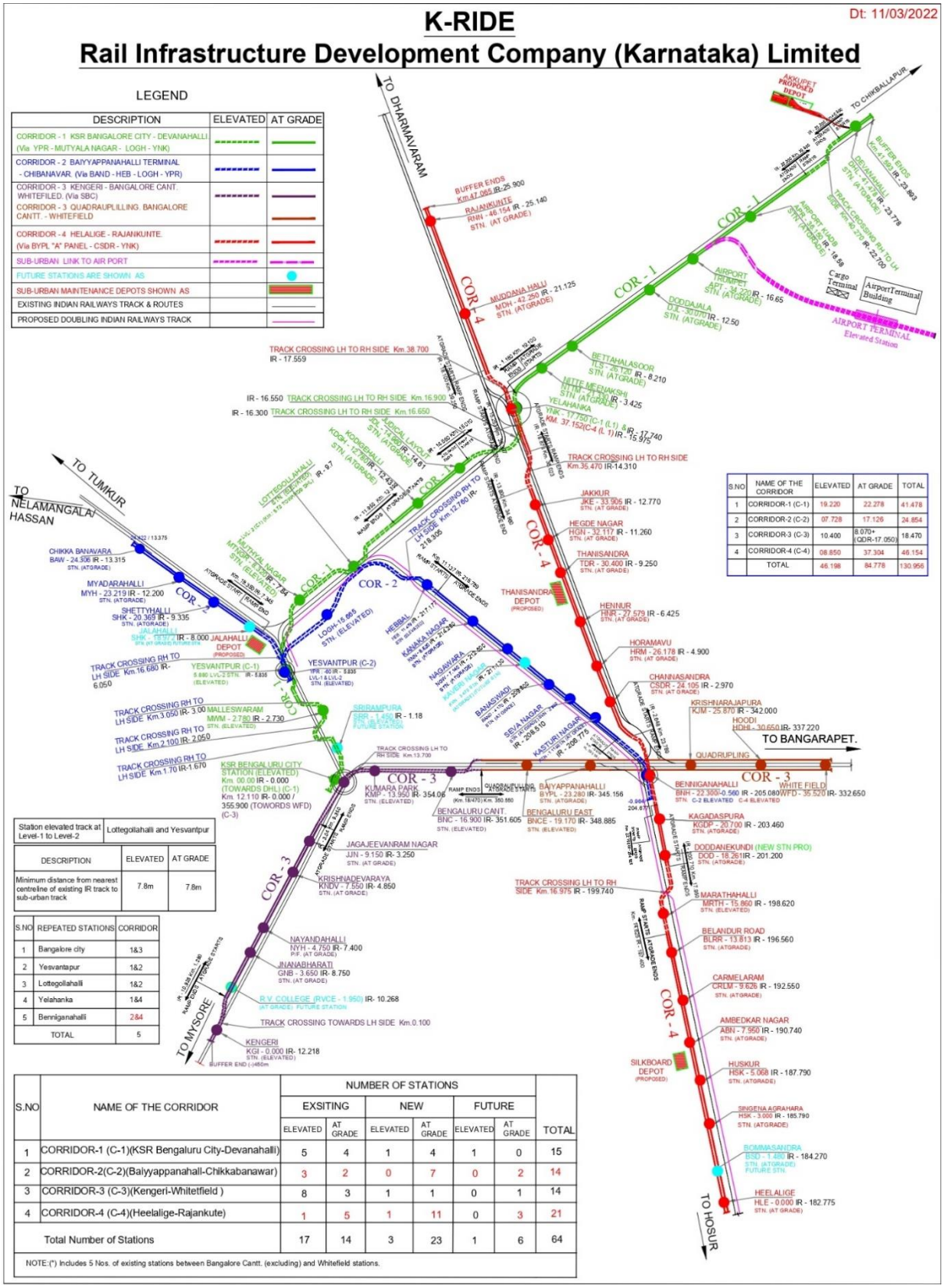


Figure.1. System Map of the Bengaluru Suburban Railway Project Corridor

The following are the four corridors. The system map of the Bengaluru Suburban Railway Project Corridor is shown in **Figure 1**.

1.2.1. Corridor – 1: KSR Bengaluru City to Devanahalli:

Total Length is 41.478 Kms out of which Elevated is 19.220 Km and At-grade is 22.278 Kms. Stations on Corridor 1 are Fifteen (15) out of which Eight (7) Stations are elevated including one future station at Srirampura and Seven (8) Stations are At-grade.

1.2.2. Corridor – 2: Baiyyappanahalli Terminal to Chikkabanavara:

Total Length is 24.854 Kms out of which Elevated is 7.728 Kms and At-grade is 17.126 Kms. Stations on Corridor 2 are Fourteen (14), out of which eleven (11) Stations are At-grade including one future station at Jalahalli and three (03) Stations are elevated.

1.2.3. Corridor – 3: Kengeri to Whitefield:

Total Length is 35.52 Kms out of which the suburban corridor considered for the present study is only between Kengeri and KSR Bengaluru – Bengaluru Cantonment. The length of this section between Kengeri and Bengaluru Cantonment is 18.47 Kms, of which Elevated is 10.400 Kms and At-grade is 8.070 Kms. The stretch of 17.05 Kms (at grade) between Bengaluru Cantonment and Whitefield is being taken up by SWR for quadrupling. Once this is completed and becomes operational, two lines of the same shall be utilized for the Suburban services. Stations on Corridor 3 are Fourteen (14) out of which nine (09) Stations are elevated and five (05) Stations are At-grade including one future station at RV College. Five (05) stations are in quadrupling section.

1.2.4. Corridor – 4: Heelalige to Rajanukunte:

Total Length is 46.154 Kms out of which Elevated is 8.850 Kms, At-grade is 37.304 Kms. Stations on Corridor-4 are Twenty one (21) out of which Two (2) Stations are elevated and Nineteen (19) Stations are At-grade including two future stations at Bommasandra and Kaveri Nagar. Yelahanka is an inter-change station.

1.3. Adverse Impact of the Project.

1.3.1. Land Requirement

In order to minimize private land acquisition and involuntary resettlement, around 50% of the BSRP alignments are located within the railway /government land along the existing railway line. But, at certain locations (wherever railway land is not sufficient to accommodate the design) private land acquisition has been proposed. Corridor wise private land acquisition is presented in below table.

Table 1: Corridor Wise Private Land Acquisition.

Corridors		From	To	Total Length (Km)	Total Area (Sqm)	Vacant Land (Sqm)	Built Up (Sqm)
Corridor - 1	SBC-YPR-LOGH-YNK-DHL	0	41.4	41.4	48974	42340	6634
Corridor - 2	BAW-YPR-LOGH-BYPL (T)	0	25.01	25.01	115713	82166	33547
Corridor - 3	KGI-SBC-BNC (WFD)	0	18.47	18.47	83830	43091	40739

Corridors		From	To	Total Length (Km)	Total Area (Sqm)	Vacant Land (Sqm)	Built Up (Sqm)
Corridor - 4	HLE-BENNIGANAHALLI-CSDR-YNK-RNN	0	46.24	46.24	163055	118793	44262
Total				**131.12**	411572	**286390**	**125182**
Total Area in Acres					**41.16**	**28.63**	**12.51**

Source: BSRP - Feasibility Report

The above data shows that, the design has been made to keep land requirements to the barest minimum possible by utilizing the railway land.

1.3.2. Number of Affected Structures

Table No 2 indicates the impact of project on the different types of structures i.e. residential, commercial, residential cum commercial and other structures. This table also includes the structures which are both partially and fully affected. It is observed from the table that out of the total 551 structures 371 (67.33%) are residential, 57 (10.34%) commercial, 13 (2.36%) residential cum commercial and remaining 77 (13.97%) are other structures. 33 (5.99%) CPR's also affecting. Majorly the residential structures are affected in all the corridors. A total of 52 structures are affected in Corridor-1, 339 structures are affected in Corridor-2, 81 structures are affected in Corridor-3 and 79 structures are affected in Corridor 4. Apart from the below stated structures around 111 structures to be surveyed, which is on hold due to non-cooperation from the dwellers, details are listed in table 3

Table 2: Number of Affected Structures

Partially & fully affected structures	C1	C2	C3	C4	Total	Percentage
Residential	43	225	47	56	371	67.33
Commercial	4	34	14	5	57	10.34
Resi cum commercial	1	8	4	0	13	2.36
Other minor structures	3	51	10	13	77	13.97
CPRs[5]	1	21	6	5	33	5.99
Total	52	339	81	79	551	100

Table 3: Census and Socio economic survey pending location.

Sl No	Location	Corridor	Number of likely displaced houses
1	Near Yesvantpur Railway Station	1	33
2	Krishnadevaraya halt	3	28
3	KSR Railway Station	3	35
4	Belandur Road	4	15
Total			**111**

[5] *Includes school, public toilet, temple, mosque, bus stop, govt. offices, community structures etc.*

1.3.3. Number of Project Affected Tenants and Employees Households

Apart from the structures affected households 194 tenants and 87 employees would also be affected. Tenants are found in both titleholder's and non-titleholders' buildings. The corridor wise affected tenants and employees is presented in below table. The number of open land (land only) affected households would be identified during joint measurement survey and the RAPIC would do the socio-economic survey during project implementation to update the RAP.

Table 4: Corridor Wise Number of Affected Tenants and Employees Households

Corridor	Number of Tenants	Employees
C 1	9	16
C 2	124	11
C 3	31	27
C 4	30	33
Total	194	87[6]

1.3.4. Vulnerable Households

As regards vulnerability among PAHs, there are 186 PAHs belonging to vulnerable category. Out of these 16 PAHs are women headed households, 68 PAHs are below poverty line, 15 PAHs having disability and old age persons. Apart from that, 76 and 11 PAHs belong to Scheduled Caste and Scheduled Tribes respectively (Table 5). Both Scheduled Castes and Scheduled Tribes are considered as vulnerable group because the Scheduled Castes (SCs) and Scheduled Tribes (STs) falls under the provisions of Constitution of India and get preferential treatment in the government benefits because these people are traditionally vulnerable. The vulnerable households do not include the PAHs whose both house and commercial activities are impacted due to the proposed metro rail project.

Table 5: Corridor Wise Affected Vulnerable Households

Vulnerability	Number of Households					
	C1	C2	C3	C4	Total HH	Percentage
Women Headed Household	0	11	3	2	16	8.60
Below Poverty Line	7	47	13	1	68	36.56
Family with disability or old age	1	12	1	1	15	8.06
Scheduled Castes	0	70	3	3	76	40.86
Scheduled Tribes	7	3	0	1	11	5.91
Total	**15**	**143**	**20**	**8**	**186**	**100**

[6] *During survey the employer was hesitant to provide the details of the employees.*

1.3.5. Number of Affected Community Property Resources

Corridor wise details of the affected common property resource are listed shown in below table. No heritage building is affected due to development of BSRP. Majority (63.64%) of the affected CPRs are religious structures.

Table 6: Corridor Wise Affected CPRs

Description	CPRs					
	C1	C2	C3	C4	Total	Percentage
School & Collage	0	0	0	0	0	0
Community Toilet	0	1	0	0	1	3.03
Religious centers	1	14	4	2	21	63.64
Hospital	0	1	0	0	1	3.03
Railway Gate,Water Tank,CW,Shed/Building	0	5	2	3	10	30.30
Total	**1**	**21**	**6**	**5**	**33**	**100**

1.4. Stakeholder Engagement Plan

"Stakeholder Engagement Plan" (SEP) forms a part of preparation of ESIA, in accordance with the safeguard compliance requirements (ESS-10) of Environmental and Social Framework (ESF), 2018 of the World Bank. The ESS recognizes the importance of open and transparent engagement between the KRIDE and project stakeholders as an essential element of good international practices with an aim to improve the environmental and social sustainability of the project. It enhances project acceptance and make significant contribution to successful project design and implementation. It seeks to define a technically and culturally appropriate approach to consultation and disclosure. The prime objective of SEP is to improve and facilitate decision making and create an atmosphere of understanding consultation process, that actively involves likely project-affected people and other stakeholders in a timely manner, so that these groups are provided sufficient opportunity to voice their opinions and concerns that may influence decisions in Project design. The SEP shall serve following purposes:

- To understand the stakeholder engagement requirements of Karnataka State and Government of India (GoI) legislations.
- To provide guidance for stakeholder engagement;
- To identify key stakeholders that are affected, and/or able to influence the Project and its activities;
- To identify the most effective methods, timings and structures through which to share project information and to ensure regular, accessible, transparent and appropriate consultation;
- To develop a stakeholder (s) engagement process that provides stakeholders with an opportunity to proactively participate and influence project planning and design;
- To establish formal grievance/resolution mechanisms;
- To define roles and responsibilities for the implementation of the SEP; and
- To define reporting and monitoring measures to ensure the effectiveness of the SEP and periodical reviews of the SEP based on findings.
- To make SEP as a useful tool for managing communications between KRIDE and its stakeholders for the Project.
- Achieve approvals on time.
- Maintain a live stakeholder Management register to support K RIDE – BSRP

1.5. Applicable Legal and Regulatory Framework and World Bank ESF

This SEP takes into account the existing institutional and regulatory framework within the context of the following GoI and Government of Karnataka legal instruments as well as the Safeguard Compliance Requirements of Environmental and Social Framework (ESF), 2018 of the World Bank as mentioned below.

- The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013
- The Karnataka Industrial Area Development Act (KIADA), 1966
- The Right to Information Act, 2005,
- ESS 10: Stakeholder Engagement and Information Disclosure, ESF 2018, World Bank

In the context of involuntary resettlement, the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 and the Karnataka Industrial Area Development Act 1966 maintains the ethos and culture of public participation through social impact assessment.

The Right to Information Act, 2005 provides for setting out the practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority.

The ESS-10, Stakeholder engagement and information disclosure mandates stake holder engagement is an inclusive process conducted throughout the project life cycle. The World Bank's Environmental and Social Framework (ESF)'s Environmental and Social Standards (ESS) 10, "Stakeholder Engagement and Information Disclosure", recognizes "the importance of open and transparent engagement between the Borrower and project stakeholders as an essential element of good international practice" (World Bank, 2017: 97). Specifically, the requirements set out by ESS10 are the following:

- "Borrowers will engage with stakeholders throughout the project life cycle, commencing such engagement as early as possible in the project development process and in a timeframe that enables meaningful consultations with stakeholders on project design. The nature, scope and frequency of stakeholder engagement will be proportionate to the nature and scale of the project and its potential risks and impacts.
- The Borrower will maintain and disclose as part of the environmental and social assessment, a documented record of stakeholder engagement, including a description of the stakeholders consulted, a summary of the feedback received and a brief explanation of how the feedback was taken into account, or the reasons why it was not.

1.6. Stakeholder Identification and Analysis for Proposed SEP

Stakeholders include persons or groups directly or indirectly affected by a project, as well as those who may have interest in a project and/or the ability to influence its outcome, either positively or negatively. In order to develop an effective SEP, it is necessary to first identify who the stakeholders are, their groupings and sub- groupings.

Table 7 below identifies the key stakeholder groups that may have interest in this project and/or the ability to influence its outcome, either positively or negatively. This list of stakeholders is likely to expand/change in composition as the project moves and since the SEP is a "living document" it will be updated regularly throughout the project life as appropriate.

Table 7: Stakeholders Group with Interest in BSRP

Types of Stakeholders	Description
Government Institution	Rail Infrastructure Company (Karnataka) Limited (K RIDE)
	Indian Railways, Govt of India
	Karnataka State Pollution Control Board (KSPCB)
	Karnataka Slum Development Board (KSDB)
	Karnataka Industrial Area Development Board (KIADB)
	Deputy Commissioner, Bengaluru Urban & Rural Districts
	Public Works Department, Govt of Karnataka Bengaluru Urban & Rural Districts
	Police Department, Bengaluru Urban & Rural Districts
	Bangalore Development Authority (BDA)
	Bruhat Bengaluru Mahanagara Palike (BBMP)
	Bengaluru Metropolitan Transport Corporation (BMTC)
	Karnataka State Disaster Management Authority
	Bangalore Electricity Supply Company Limited (BESCOM)
	Bangalore Water Supply and Sewerage Board (BWSSB)
	Archaeological Survey of India (ASI)

Types of Stakeholders	Description
	Karnataka Tank Conservation and Development Authority (KTCDA)
Lenders	AFD and KFW
Community/Associations	Project Affected People (PAP)
	Inhabitants and trade people in the project affected areas
	Residential Welfare Associations in the project influenced area.
NGOs/Trust	To be identified
Public & Academic Institutions	To be identified
Print & TV media representatives	To be identified

1.7. Preliminary Stakeholder Consultation

As a part of environmental and social impact assessment, iDeCK's team has conducted stakeholder's consultation at local level. Relevant stakeholders were consulted and participated during social and environmental impact assessment. The consultations were conducted between November 2021 and March 2022. The consultations were based on informal unstructured interviews and meetings with the people available at project area during baseline surveys. The focus group discussions were conducted based on the availability of the stakeholders. The objective of this consultation was to disseminate the project information and ascertain stakeholder's views on probable environmental and social impacts that may arise with the implementation of the proposed project.

During consultation variety of views as well as valuable suggestions of public were received which were very important to develop mitigation measures to address the impacts.

Based on suggestions received, a mitigation plan to reduce the impact of the project was proposed. The mitigation plan proposed in planning phase of the project will help to reduce the cost and time to mitigate the impacts. Details on preliminary stakeholder consultations are presented in **Appendix -1**. These stakeholder consultations and inputs have been incorporated in the project identification and design.

Major findings of the preliminary stakeholder consultations on environmental and social issues are summarised as under:

Major findings of consultation on environmental issues are:

Positive Comments:

- About 64 % of the public participated in FGD's/ Public interactions are supported the BSRP project.
- Publics strongly believed that, introduction of suburban rail will facilitate them to access other parts of the city in safe and shorter time.
- Publics are in the opinion that, Suburban rail will enhance the environmental condition of their region.

Request/Suggestions:

- Requested for appropriate noise control measures also suggested to not to honk within the city limit.
- Suggested to provide adequate drainage system along the BSRP corridors to avoid inundation/ water logging during rainy seasons and proper maintenance of the same.
- Demanded for adequate underpasses to cross railway from one side to another side.

- Requested for proper fencing at road junctions to avoid dumping of construction waste and garbage along the alignment.
- Demanded to minimise the tree felling and undertake tree plantation and landscaping along the railway track to enhance the green cover and to improve aesthetics of the region.
- Suggested to complete the construction of suburban rail project quickly within a given time frame.
- Proposed improvement should be limited and to be minimum impact to their land and their property.
- Demanded for appropriate compensation for loss of land property and livelihood.

Major findings of consultation on social issues are:

Positive Comments:

- The project will provide better connectivity between the suburban areas of Bengaluru with the city centers of Bengaluru, which will control the concentration of settlements in the city centers.
- Lower income families can stay in affordable houses in suburban areas of Bengaluru and commute to the city for their source of livelihood at affordable travel cost, which will have control on developing new slum settlements also.
- Travel time reduces as suburban railway project caters the people from the outskirts of the city without traffic block. People believe that suburban railway project will enhance the aesthetic looks of the city, as the migration to city centers would be reduced.
- People do not have any problem in surrendering their land and assets if better rates are given for their affected assets. The proposed suburban railway project would be an efficient and effective transport facility for the people settled in the outskirts of the city for their day to day travel. It will also reduce air pollution, save fuel and road accidents.
- The proposed suburban railway project will lead to diverse ways of livelihood opportunities for people also savings on their expenditure on day to day travel. People told that, due to the high expense on the travel cost and time delay they are completed to stay in city in unhygienic atmosphere, once the BSRP is operational they can move to the outskirts and travel for their work.
- The BSRP would be a reliable mode of transport with high safety to the vulnerable sections of the society, hence the mobility of women would be increased. Women in Indian scenario need to travel along with aged parents (medical purpose) or with minor children, travelling in public bus will always be difficult for them. They feel that the BSRP will be a more comfortable travel mode for them.
- The suburban railway project will provide more livelihood opportunities for small and marginal farmers, those who cultivating vegetables, fruits and flowers in the outskirts of the city, as suburban railway project will provide good access to these people to the market for their produces.
- Few households based small poultry farmers shared their opinion that, the BSRP may give better opportunities for them also, as there is a high demand for 'Natti Muttai' (country hen egg) in Bangalore city but taking the eggs in buses are always risky.
- The women face a lot of difficulties while travelling on public buses. However, they feel that Suburban railway would be a safe mode of transport for them. The women demanded for separate coach reserved for them on the train, at least in peak hours and guarded coach in late evenings and early mornings.

- The business (mainly the developers) groups found to be very enthusiastic because they feel that the proposed project will bring a lot of business opportunities for them.

Request/Suggestions:

- Lack of end to end connectivity is the main issue of the commuters, hence they are forced to travel by private vehicle. If KRIDE provides sufficient facilities for parking, mainly at the stations located outside the city would be beneficial for the commuters.
- Integration of BMTC with BSRP: BMTC may operate feeder bus services from outskirts settlements to the nearest BSRP stations on a regular basis, which will make BSRP more inclusive.
- Adequate compensation needs to be provided for Project Affected Families.
- Toilet facilities may be provided at all the stations.
- Station design must be differently abled people friendly.
- The affected households are required to be relocated properly by the KRIDE, if land acquisition/clearance of slum settlements takes place for the construction of the proposed Suburban railway project. The relocation sites should be decided in such a place where the households can have access to existing basic facilities like school, hospital, drinking water, sanitation, park, local market along with other services. The local government authorities should be sensitive and has an integrated plan for relocation of the PAHs.
- Replacement value and resettlement allowance to be provided for the loss of commercial units or shops. For fixing the compensation and R&R assistances the compensation and R&R policy of BMRCL may be adopted in this project also.
- The households will lose their commercial as well as residential units, which in turn will have an effect on income. However, the livelihood opportunity of the PAHs would be very much dependent on available relocation options. The KRIDE should come up with an integrated plan for R&R sites, ensuring active participation of PAHs and other stakeholders
- The daily wage labourers should get work opportunity during the construction of the project. The qualified individuals should get employment opportunities during operation of the BSRP (reservation may be given to the member of the project displaced families). Further, it should also create an opportunity for the poor and vulnerable (including women headed households, SC & ST families, etc.,) people to open a shop and small businesses in suburban stations.
- Certain people may lose their access to their properties (at certain locations middle portion of the existing road/access are in the proposed land acquisition area – hence the connectivity of the road may lose).
- People are worried about the stability of the certain old buildings located very close to the proposed alignment during construction (due to piling or heavy machinery movement), compensation and resettlement assistances to be done by KRIDE for structural damages, if any during construction.
- The residential squatters demanded for resettlement prior to the commencement of civil works.
- Certain multi storied buildings are getting affected for less than 1 meter width, owners of such buildings requested to avoid acquisition of their buildings, if not full valuation for the entire building.
- There are declared and non-declared slum settlements in within the corridor of impact of the project. KSDB is the agency responsible for development of declared slum settlements. While KRIDE will have to develop strategies for resettling the residents of the undeclared slum settlement in coordination with KSDB.

1.8. Purpose and Timing of Proposed Stakeholder Engagement Program

This SEP is designed to establish an effective platform for productive interaction with the potentially affected parties and others with interest in the implementation outcome of the BSRP. Meaningful stakeholder engagement throughout the project cycle will:

- Solicit feedback to inform project design, implementation, monitoring and evaluation.
- Clarify project objectives, scope and manage expectations.
- Assess and mitigate project environmental and social risks and impacts.
- Enhance project outcomes and benefits.
- Build constituencies and collaboration.
- Disseminate project information/ materials.
- Address project grievances.

Adequate stakeholder consultations will require effective timing and advanced planning. To ensure information is readily accessible to affected stakeholders, and adequate representation and participation of the different groups in the process, the KRIDE will adopt strategies and different methods and techniques based on an assessment of stakeholder needs. The strategies that will be adopted to conduct stakeholder engagement process are given in Table 8. Methods for stakeholder engagement are listed in Table 9. The stakeholder engagement program is given in table 10.

Table 8: Stakeholder Engagement Strategies

Sl. No	Stages	Project with Significant Risks and Diverse Stakeholder Issues
1	Engagement at the project concept stage	• Interviews with stakeholder representative, key informants and government officials • Stakeholder planning forum
2	Engagement during ESIA studies	• Community liaison officers recruited and accompanying environmental and social specialists on ESIA studies • Interviews with stakeholder representatives and key informants • Participatory techniques used to consult with focus groups on impact-specific topics • Participatory techniques used to consult with stakeholders most disadvantaged by the project • Stratified sample interviews • Public meetings • Newsletters • Open houses, in field office and project HQ • Radio and TV notifications
3	Engagement during construction and operations	• Participatory monitoring • Annual/quarterly targeted consultation, e.g. with specific stakeholder groups • Use of internet and other means to disseminate monitoring data • Annual/ quarterly stakeholder perception surveys and follow-up • Annual/ quarterly stratified sample interviews

Sl. No	Stages	Project with Significant Risks and Diverse Stakeholder Issues
		• Newsletters • Open houses, in field office and project HQ • Radio and TV notifications
4	Engagement on new stakeholder issues and concerns that may arise	• Grievance mechanisms • Annual/quarterly household questionnaires with project affected people • Annual/quarterly interviews with key informants and stakeholder representatives • Annual stakeholder events and gatherings

Source: Stakeholder Engagement: A Good Practice Handbook for Companies doing Business in Emerging Market, IFC, 2007

Table 9: BSRP Stakeholder Engagement Methods

Sl No	Engagement Technique	Description and use	Target audience
1	Websites	• DPR, EIA, SIA, GAP and SEP will be published on official websites of KRIDE, the AFD &KFW. • Overview of project, impacts and mitigation, and project updates through project leaflets, posters etc.	• All stakeholders
2	Media announcements	• Advance announcements of commencement of major project activities, project Grievance Redress Mechanism, and other outreach needs of the project.	• Project affected communities
3	Information Centre and Information Boards	• Advance announcement of commencement and progress for major project activities.	• Project affected communities
4	Community /public meetings	• These interactive platforms will be used to convey general information on the project detailed discussions on sub project activity that is planned by the project, project environmental and social risks and impacts and mitigation measures and to provide regular updates on implementation progress to all stakeholders. Meeting will also enable stakeholders to express their views, demands, constraints etc.	• Project affected stakeholders and communities
5	Correspondence by phone/email/ written letters	• Distribute project information to government officials, organizations, agencies, NGOs, CBOs, Trusts, companies, community/Associations and Development Partners etc and invite stakeholders to share their views, concerns, demands etc.	• Government officials, NGOs, CBOs, Trusts Community/Associations, Development Partners etc.

Sl No	Engagement Technique	Description and use	Target audience
6	Printed media advertisement	• This will be used to disseminate and disclose project documents(e.g. ESMP, ESCP) intended for general readers and audience.	• General public
7	Distribution of printed public materials: project information leaflets, brochures, fact sheets etc.,	• This will be used to convey general information on the project and to provide regular updates on its progress to local, regional and national stakeholders.	• General public
8	Internet/ Digital Media	• Use of the official websites of implementing Ministries and Agencies to promote various information and updates on the overall project, impact assessment and impact management process, procurement, employment opportunities, as well as on project's engagement activities with the public and to invite all stakeholders to share their views, concerns, demands etc., through internet resources.	• Project stakeholders and other interested parties that have access to the internet resources.
9	One-on-one interviews	• This will be used to solicit views and opinions on project impacts and solutions.	• Vulnerable individuals, NGOs, Trusts Associations, women groups, PAPs, etc.,
10	Workshops	• This channel will be used to: (i) Present project information to a group of stakeholders; (ii) Allow the group of stakeholders to provide their views and opinions; (iii) Use participatory exercises to facilitate group discussion brainstorm issues, analyse information and develop recommendations and strategies; and (iv) Recording of responses.	• Government officials/agencies, NGOs, Trusts Associations, women groups, PAPs, etc.,
11	Focus group meetings	• This will be used to facilitate discussion on specific issues such as gender based violence, disability inclusion, etc., that merit collective examination with various groups of stakeholders using Focus Group Meetings.	• Vulnerable, women groups, etc
12	Surveys / Independent evaluations	• Surveys will be used to gather beneficiary opinions and views about project interventions. Civil society could also be engaged to support citizen feedback surveys for the project.	• Project beneficiaries

Based on the ESIAs of the four corridors, the following groups of stakeholders have been identified.

Table 10: BSRP Stakeholder Engagement Program

Target stakeholders	Information to be disclosed	Tools of engagement & mode of disclosure	Frequency	Responsibilities
PRE-CONSTRUCTION STAGE (PLANNING AND SURVEY)				
People residing in project area/general communities	✓ Project scope and design details, design alternatives for impact minimization ✓ Grievance mechanism process ✓ Community Safety measures during project implementation ✓ Relocation of Common Property Resources (CRPs) ✓ Damages (cracks, landslides, etc.,) to assets/structures during construction (mainly to the buildings located close to the project site) ✓ Temporary impact to the access to the properties	✓ Consultations, focus group discussions ✓ Written information (one pagers/flyers) ✓ GRM Helpline number through display at project locations.	✓ At least twice ✓ Preliminary screening, ✓ Household level census socio-economic survey and consultations towards preparation of SIA.	K RIDE through, SIA, DPR and RAP implementation agency/officers.
Karnataka Slum Development Board	✓ Resettlement of slum dwellers	Tri-party meeting (K RIDE, KSDB and Slum Residents)	Regular till completion of resettlement of slum dwellers.	K RIDE
Land Acquisition Officer, KIADB	✓ Land acquisition	As per Act provisions	As per Act provisions, till completion of disbursement of replacement value for the lost assets.	K RIDE & KIADB
Other Interested Parties (External) – Government departments ✓ Forest Department ✓ Revenue Department ✓ State Pollution Control Board	✓ Project scope and design details. ✓ Land acquisition and Compensation process ✓ Secondary baseline information on environmental and social aspects; ✓ Project's induced environmental and social risks; ✓ Impact mitigation and enhancement measures; ✓ Resettlement and Rehabilitation	Face-to-face meetings	As per requirement for obtaining necessary clearances/ permissions.	K RIDE through, SIA, DPR and RAP implementation agency/officers

Target stakeholders	Information to be disclosed	Tools of engagement & mode of disclosure	Frequency	Responsibilities
✓ Police Department ✓ District Administration	✓ Grievance mechanism process ✓ Gender related issues due to labour inflex ✓ Design intervention for physically challenged people.			
IMPLEMENTATION STAGE				
People residing in Project area/general communities	✓ Project scope and design details, ✓ Contractor establishment details i.e. labour camps, plants area etc., ✓ Grievance mechanism process ✓ Relocation of CPRs ✓ Provisions for assessment of reported damages (cracks, landslides, etc.,) to assets/structures during construction and payment, if applicable.	✓ Consultations, FGDs and meetings with communities ✓ GRM Helpline number through display at project locations and on flyers	✓ Bi-monthly ✓ As reported	KRIDE through ✓ District administration ✓ Civil works contractor
Civil works contractor	✓ Orientation on ESHS provisions; ✓ Sexual harassment provisions, ✓ Labour related aspects as provided in the Labour Management Procedures	✓ Provisions in Bid/Contract documents & also through Pre- bid conference	✓ During contract signing ✓ Periodic as part of worker's joining	KRIDE & Civil works contractor
Other Interested Parties (Internal) ✓ General Consultant ✓ Supervision Consultants ✓ Contractors, sub-contractors, service providers, suppliers, and their workers.	✓ Project information: scope and rationale and E&S principles ✓ Training in RPF and RAP requirements and other management plans ✓ Grievance mechanism process ✓ Feedback on consultant/ contractor reports	✓ Face-to-face meetings ✓ Trainings/workshops	As per requirement	KRIDE

The K RIDE website (www. kride.in) will be used to disclose project documents, including those on environmental and social safeguard implementation performance. This will begin with disclosure of this draft EIA/EMP & draft SIA/RAP. Besides the draft disclosure documents (and the final documents in future), project brochures and updates will be posted. An easy-to-understand guide to the terminology used in the environmental and social reports or documents will also be posted on the website. In addition, the site will provide details about the Grievance Redress Mechanism and contact details. KRIDE will update and maintain the website regularly.

1.9. Proposed Strategy to Incorporate the Views of Vulnerable

The principle of inclusiveness will guide the stakeholder engagements, particularly with respect to vulnerable individuals and groups. In cases where vulnerable status may lead to people's reluctance or physical incapacity to participate in large-scale community meetings, the project will hold separate small group discussions with them at an easily accessible venue. This way, the project will reach out to groups who, under normal circumstances, may be insufficiently represented at general community gatherings. Some strategies to be adopted to reach out to these groups include:

- Identify leaders of vulnerable and marginalized groups to reach-out to these groups
- Engage community leaders, CBOs and NGOs working with vulnerable groups
- Organize face-to-face focus group discussions with these populations

1.10. Strategy to Conduct Stakeholder Engagement in Pandemic Context

COVID-19 has become a global issue and declared as pandemic by World Health Organization (WHO). Over the last two years, the whole world is collectively fighting against this pandemic to keep people safe. With the intent to contain the spread of COVID-19, GoI announced a nationwide complete lockdown on 25th March, 2020 and this lockdown continued till 31st May 2020. The pandemic has affected the country in different ways, with many states implemented border closures, other movement and social restrictions. Bangalore district lies in the state of Karnataka was also followed the same guidelines issued by Government of India. The situation is normal today and restrictions are withdrawn substantially.

The WHO expecting another wave of a variant of COVID 19 in June 2022. During the pandemic situation, movement and physical interaction would not be possible to conduct face to face interview, Focus Group Discussions, community meetings on the ground. In such situation, KRIDE may conduct consultations with various stakeholders using appropriate virtual platforms.

1.11. Resources and Responsibilities for Implementing Planned SEP Activities

1.11.1. Resources and Responsibilities

The Project Implementation Authority (PIA) headed by Managing Director has overall responsibility for stakeholder consultation and involvement. The proposed staffing complement from the ESIA management framework is given in Figure 2.

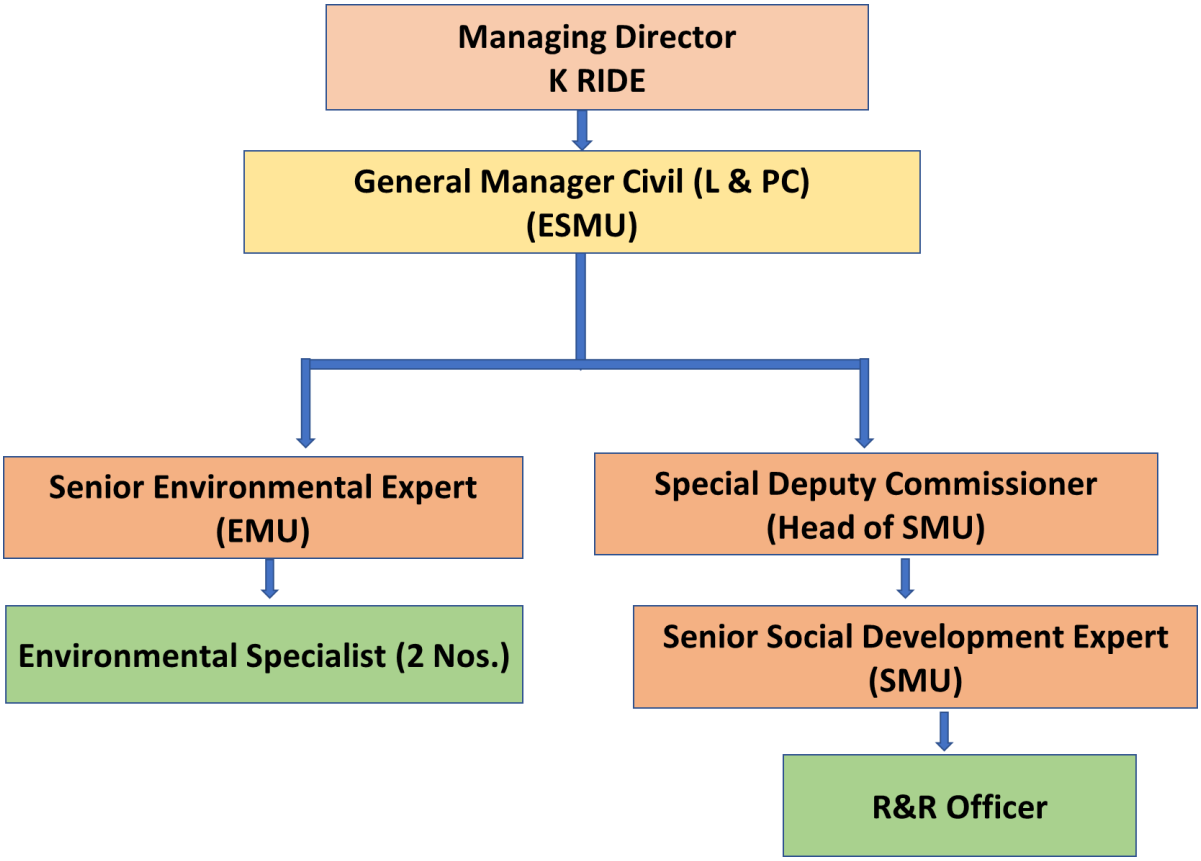


Figure.2. Organization Structure of PIA's Environmental & Social Management Unit

1.11.2. Social Management Unit

KRIDE will set up a Social Management Unit (SMU) which shall coordinate with the SLAO KIADB on land acquisition and undertake the resettlement and rehabilitation activities and stakeholder consultation and involvement. This SMU would be supported by a RAP Implementation Consultant (RAPIC). The roles and responsibilities of SMU are given below;

- Updating of RAP based on the revalidation of the census and socio economic survey and on completion of land acquisition activities.
- Implementation of R&R activities of BSRP;
- Land acquisition and R&R activities in the field;
- Ensure availability of budget for R&R activities;
- Liaison with SLAO , KIADB and district administration for support for land acquisition and implementation of R&R;
- Monitor land acquisition and progress of R&R implementation;
- Develop and implement a public consultation program and communication strategy for disclosure of RAP;
- Liaison with district administration for government's income generation and development programs for the PAPs;

- Monitor physical and financial progress on land acquisition and R&R activities;
- Provide support for the affected persons on problems arising out of LA/ property acquisition

Special Deputy Commissioner would be the administrative head of the SMU. A Senior Social Development Expert (Sr.SDE) with educational background of post-graduation in Social Work or Sociology will be appointed in SMU as full time by KRIDE to assist Special Deputy Commissioner. A Resettlement and Rehabilitation Officer (RRO) with background of social science would be appointed (full time) in this SMU to supervise and monitor overall activities of resettlement implementation and consultation with project affected people and other stakeholder and he/she will report day to day progress to Sr.SDE. A civil engineer with a background of building valuation would be appointed to verify and approve the valuation of the non-titleholder, which would be prepared by the RAPIC. The KRIDE may hire more professionals if necessary during project implementation to support the Sr.SDE. The flow chart of organization setup for SMU is shown in Figure-3.

The duties of Sr. Social Development Expert will involve but are not limited to:

- Reporting to Special Deputy Commissioner (SDC);
- Support the special DC to management of Social Management Unit;
- Management all community/field related tasks in the field office;
- Review of community development plan based on mitigation proposed in RAP in coordination with RAPIC;
- Implement community engagement strategy and oversee all community liaison related matters;
- Manage the grievance mechanism set up for the project affected areas;
- Oversee implementation and monitoring of RAP;
- Establish a monitoring and evaluation plan and other tools established such as the grievance register, commitment register and consultation register;
- Provide reports to General Manager for onward submittal to Managing Director, K RIDE and AFD & KfW.

The duties of R&R Officer will involve but are not limited to:

- Reporting to Sr. Social Development Officer;
- Supervise and monitor overall activities of RAP & SEP;
- Perform community engagement;
- Provide liaison between community development programme measures and implementing partner-agency, if any;
- Manage arising community matters;

- Perform monitoring and evaluation to track progress of implementation of mitigation measures and assess if progress and performance of mitigation actions being undertaken by the K RIDE to ensure objectives are met. Liaise with appropriate K RIDE personnel to ensure that grievances are tracked, reported and responded accordingly as necessary.

The duties of the Civil Engineer will involve but are not limited to:

- Verify the structure valuation prepared by the RAPIC;
- Guide and provide technical assistance to the structure affected PAPs on re-establishing the affected buildings utilising the salvaged materials.
- Support the Special DC to address the grievance of the structure affected PAPs.

The implementation activities will be scheduled as per the overall project implementation and included in individual RAPs for each section. All activities related to the land acquisition and resettlement will be planned to ensure that compensation is paid prior to displacement and commencement of civil works. Public consultation, internal monitoring and grievance redress will be undertaken intermittently throughout the project duration.

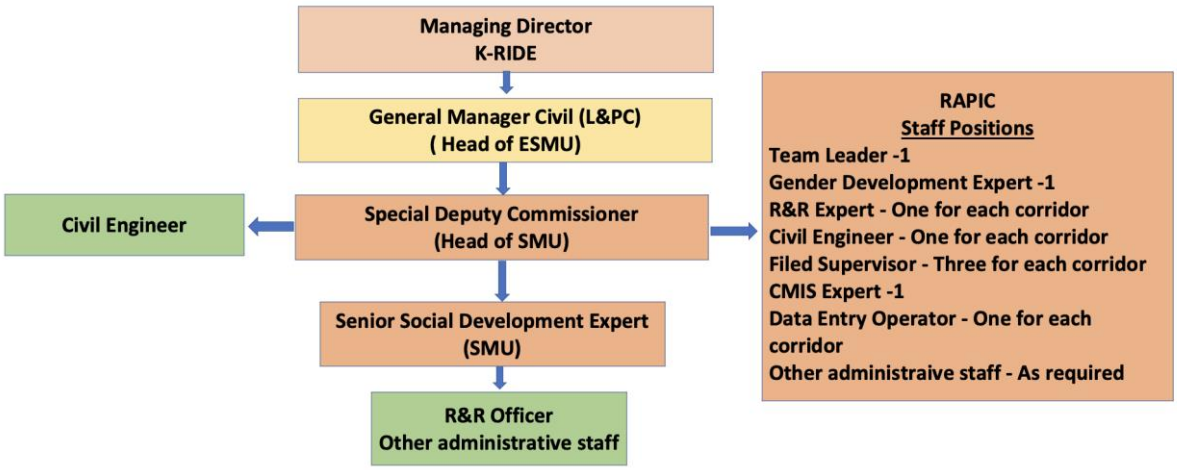


Figure.3.Organisation Setup of Social Management Unit

1.11.3. Environmental Management Unit

KRIDE will set up an Environmental Management Unit (EMU) which shall look after the monitoring and implementation of the environmental mitigation measures in the EMP and address the grievances of environmental and social issues of the project and ensure compliances with World Bank Frameworks, guidance note, General EHS guidelines and Railway specific EHS Guidelines and GIIPs and applicable State and National laws.

Senior Environmental Expert (Sr.EE) of EMU reports to General Manager Civil (L&PC) (ESMU) who is responsible for management of environmental and social issues of the project. Sr. Environmental Expert of EMU will be assisted by Environmental Specialist (2 nos), who shall be responsible to look after all the environment issues related to the project during the project preparation, implementation and operation periods. Environmental and Social Management Unit will be supported by the technical

and field staffs for the project implementation with the assistance of the Environmental Specialist of Design Consultant & Contractor. Organisation structure of EMU is presented in **Figure 4**.

It is envisaged that the Environmental Management Unit will be responsible for:

- Ensuring approvals/permission/NOC obtained from regulatory bodies/authorities for various components at different project stages
- Monitoring implementation of the EMP measures in consonance with the timeline for the project as per the approved budget;
- Maintaining interaction with the stakeholders, public and various statutory authorities pertaining to environment, land acquisition, rehabilitation and resettlement of K RIDE project;
- Interacting regularly with the Environmental Expert of Design Consultant & Contractor on the status of the environmental mitigation and enhancement measures;
- Inspecting project site on regular basis to monitor the mitigation measures being implemented by the Contractor;
- Document and disseminate good practices, minimize and resolve bottlenecks during the implementation of EMP.

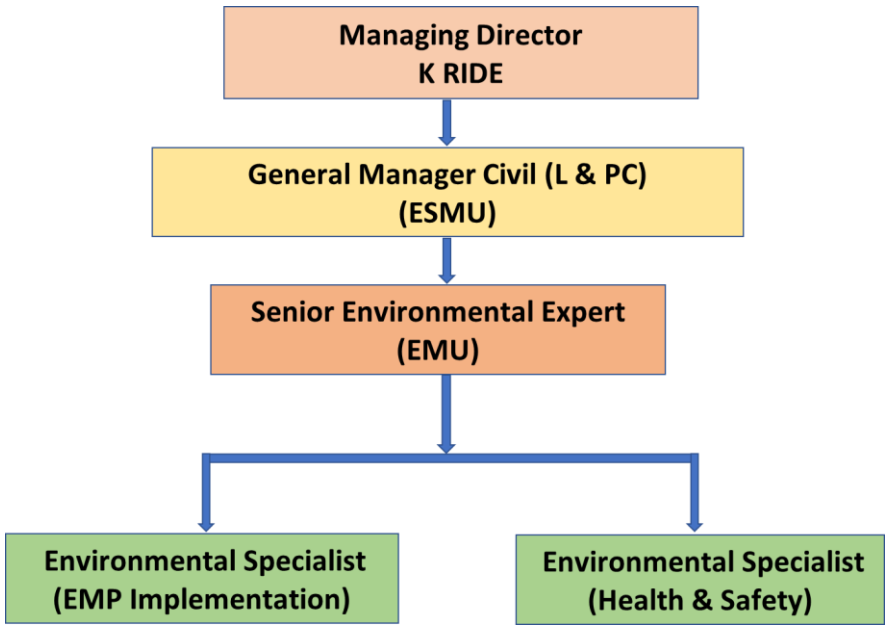


Figure.4.Organisation Setup of Environmental Management Unit

Responsibility of Senior Environmental Expert:

He is familiar with the Indian environmental legislation, environmental monitoring, EMP implementation aspects etc. The Environmental specialist shall oversee day to day implementation of the environmental management plans pertaining to the construction contract for various BSRP Corridors and is also responsible for monitoring reports to World Bank. Additional recruitment if needed will be undertaken as necessary on contract basis. He will be responsible for obtaining regulatory clearances. He will coordinate with PIA to conduct necessary training program for the workers, engineers and office staffs. Briefing the Contractor about the requirements of the Environmental Specification and/ or EMP, as applicable, advising the Engineer about the

interpretation, implementation and enforcement of the Environmental Specification and other related environmental matters, monitoring and reporting on the performance of the contractor/project in terms of environmental compliance with the EMP to the GM (L&PC) and MD KRIDE and KfW & AFD and providing technical advice relating to environmental issues are also the responsibility of the Senior Environmental Expert.

Responsibility of Environmental Specialist (EMP Implementation);

The main duties of the Environmental Specialists will include:

- Collection and dissemination of relevant environmental documents including amendments to environmental protection acts issued by the Government and various agencies such as the World Bank and other organisations.
- Co-ordination with non-government organisations (NGOs), community groups, government departments, etc. on environmental issues and obtaining the necessary clearances from the regulatory authorities.
- Monitoring the environmental aspects of the project during construction to ensure that the environmental requirements of the contract and the mitigation measures proposed in the EMP are implemented.
- Development of guidelines or a code of good practice on low-cost environmental measures that can be implemented in the railway construction and maintenance programs for the PIA.
- Development of environmental training activities for contractors and supervisory consultants staff.
- Assistance to local governments in the restoration of the environmentally degraded portions of any existing Right-of-Way, which may revert to their control due to the construction of realignments.
- Promotion of the policies adopted for the development of aesthetics of stations, depots & along rail alignments.
- Coordinating with the EO of PIA and report to GM (L&PC) on all matters related to implementation of the Environmental Management Plan.
- Laison with institutional stakeholders such as Forest Dept., Pollution Control board, Ground Water Dept., Urban Local Body, Lake Authority etc., for approvals and smooth implementation of Environmental Management Plan.
- Issuing completion certificate for constructed railway works (Stations, Deports & suburban Railway alignments) for payment.

Responsibility of Environmental Specialist (Health & Safety);

The main duties of the Environmental Specialists will include:

- Collection and dissemination of relevant health and safety documents issued by the Ministry of Railways and other funding agencies such as the World Bank, KfW and other organisations.

- Co-ordination with non-government organisations (NGOs), community groups, government departments, etc. on environmental health and safety issues and addressing suitable manner.
- Advising the Engineer and preparing the environmental health and safety inputs for the monthly progress report.
- Development of guidelines or a code of good practice on low-cost environmental health and safety measures that can be implemented in the railway construction and maintenance programs for the PIA.
- Development of environmental training activities for contractors and supervisory consultants staff.
- Assistance to local governments in the restoration of the environmentally degraded portions of any existing Right-of-Way, which may revert to their control due to the construction of realignments.
- Assistance with the rail safety components (Stations, Deports & suburban Railway alignments).
- Ensuring and reporting of construction health and safety, labour health and safety and community health and safety as per WB's Environmental Health and Safety guidelines at railway construction site, stations, depots, sub-stations and project associated facilities such as batching mix plant, disposal sites, etc.,

1.12. Budget

Funding for the SEP implementation will be included as part of project cost, and this will be financed by KRIDE. The project allocates an annual budget of INR 44 Lakh for stakeholder engagement activities in the initial phase of the project. This includes the cost of printing, documentation, advertisement, venue, transportation, refreshment and other miscellaneous. Stakeholder engagement budget will increase gradually commensurate with project development. Breakup of the budget is given in below table.

Table 11: Cost for SEP

Sl No	Description	Amount (INR)
1	Cost for two consultations covering priority corridors	10,00,000.00
2	Cost for two consultations covering nonpriority corridors	10,00,000.00
3	Consultations at community level	20,00,000.00
4	Miscellaneous @ 10% of the total cost	4,00,000.00
Total		**44,00,000.00**

1.13. Grievance Redressal Mechanism

1.13.1. Need for a Grievance Redress Mechanism

GRM is a key tool through which local communities and other stakeholders exercise their voice. They are a way to mitigate, manage, and resolve potential or realized negative impacts, and to ensure that the project proponent (KRIDE) meet their obligations in terms of international human rights law. GRM enables project proponent to learn about and resolve concerns related environmental and social aspects including implementation of mitigation measures, ensuring workers and community health and safety, payment of compensation, resettlement and rehabilitation, restoration of loss of

livelihood activities, assistance to the vulnerable people, replacement of common property resources, etc., as stated in the Environmental Management Plan (EMP) & Resettlement Action Plan (RAP) before they escalate. GRMs should permit a peaceful and timely resolution of problems, assuring stakeholders that their concerns have been heard and that the institutionalized mechanism will yield a fair and impartial outcome.

1.13.2. Grievance Redressal Mechanism in the BSRP Project

The land acquisition for the project is being done by the special land acquisition officer, Karnataka Industrial Areas Development Board (KIADB), Bangalore as per the KIADB Act. KIADB act as Competent Authority in addressing land and property ownership issues. All grievances related environmental and social issues (implementation of EMP measures & compensation for land and resettlement assistance) will be addressed by the General Manager (Land & Project Co-ordination), KRIDE. Grievances received at the corporate office of KRIDE, will be sorted according to subject matter and will be informed the respective offices/agencies to resolve it.

Grievance redress will be carried out at two levels: namely first level and the appellate level. Grievances of affected persons will be first brought to the attention of KRIDE (through contractor, Environmental and social field officers of KRIDE, Environmental monitoring consultant, Resettlement Plan implementation Consultant, etc) and land acquisition office, KIADB. At this level, the time taken to address a matter may vary from 15 days to one month, depending on the matter. Land related cases take longer than one week as it may require providing legal documents, change of alignment or dropping the properties from acquisition etc. All these matters require consultation with planning and design section, before a decision can be reached, thus the process can extend upto a month.

In cases where the affected person is not satisfied with the decision of the land acquisition office or the field level office / corporate office of the KRIDE, the person can approach the Grievance Redress Committee (GRC). The GRC will convene within 15 days of receiving the matter. The grievance redress process is given in Figure 5. The composition of the GRC is:

Director (Projects and Planning),	Chairman
General Manager (L & PC)	Convener
General Manager (F & A)	Member
Chief Public Relations Officer	Member
Chief Engineer of concerned Reach	Member
Tahsildar	Member
Community Representative (PAP - Male)	Member
Community Representative (PAP – Female)	Member
Team Leader of Resettlement Plan Implementation Consultant	Member
Team Leader of Environmental Monitoring Consultant	Member

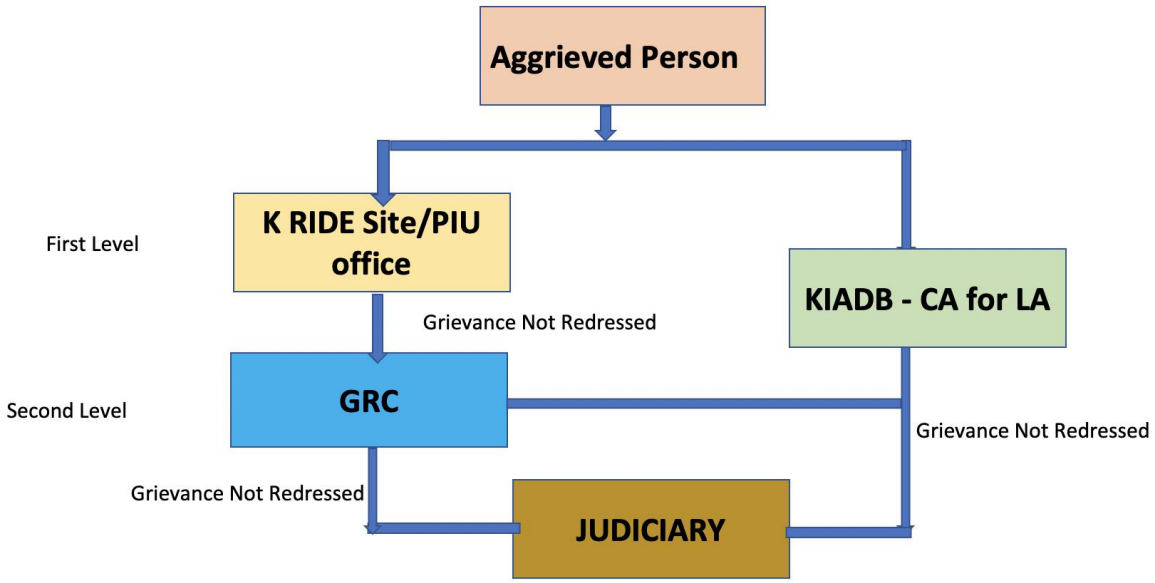


Figure.5.Grievance Redress Process

The main responsibilities of the GRC are:

- to provide support to affected persons on problems arising out of eligibility provided entitlements compensation and assistance provided;
- to record the grievance of the disadvantage community & PAPs and resolve them within the stipulated time frame;
- to report to the aggrieved parties about the development regarding their grievances and decision of KRIDE;
- address problems and complaints arising out of land acquisition and relocation of utilities;

Registration of Grievances

Grievances can be submitted as the written application in English or Kannada at the KRIDE field office, corporate office, or land acquisition officer. Careful documentation of the name of the complainant, date of receipt of the complaint, address/contact details of the person, location of the problem area, and how the problem was resolved will be undertaken. The Project Management Unit (PMU), KRIDE will have the overall responsibility for timely grievance redress on environmental & social safeguards issues and for registration of grievances, related disclosure, and communication with the aggrieved party. The aggrieved person also has the option of opting for judicial review/intervention by the courts at any point in time.

The project may be established a grievance redressal cell at PMU headed by a Public Relation Officer solely responsible for handling the grievance of the people. The team will be responsible for directing the aggrieved person to the concerned official through appropriate mode of communication. On receiving any complaints, a unique number may be generated (MIS based) which will be the reference number for the caller, and s/he can trace the progress of his/her grievance / query through that number. Any complaint lodged will be addressed within 15 days of receiving the complaint. The system may have escalation matrix, i.e. if the grievance / query remains unattended or there is no response from the concern officer for a specified period of time than the system will escalate the grievance / query to the next level and the notification will be sent to the Public Relation officer and the petitioner.

The project will also commit itself to proactive disclosure and sharing of information with the key stakeholders, including the communities/beneficiaries. The environmental monitoring and resettlement plan implementation consultants (would be appointed by KRIDE) staff will be responsible for assisting illiterate community members and other stakeholders in registering their grievances.

1.13.3. Process Flow of Grievance Redressal Mechanism

The grievance redress mechanism will be planned around the following process flow.

Step 1: Grievance is received by the redressal officer at field level or PMU and the officer will enter the details of the complainant.

Step 2: A confirmation will be sent through auto generated SMS, with a reference number to the person on receipt of the complaint.

Step 3: Once the complaint is registered, the concerned officer/consultants will receive an SMS notification, with a deadline of 15 days to resolve the grievance. The public relation officer will monitor the complaint status by option of choosing the following actions:

a) View (Complaint will be viewed)

b) Action (what are the actions that have been taken to resolve the complaint)

c) Assign / forward (the action will be forwarded)

d) Resolve (The Problem is solved in the stipulated timeperiod)

e) Escalate (The complaint will be escalated to the appropriate authority)

Step 4 - Taking Action: A window of 15 days will be provided to the field level officers of KRIDE/consultant/Contractors site representative concerned to resolve the issue and submit their responses. In case of non-response, SMS alert will be issued to remind the officers about the action pending.

Step 5 - Resolving the grievance: Once the grievance is addressed and updated information is placed in the software, the grievance is labelled as resolved. An SMS will be accordingly issued to the complainant. If any grievance is not resolved within 15 days an SMS alert will be issued to the Public Relation Officer, PMU and the concerned officer will take appropriate action (elevate the same for the consideration of GRC) to solve the grievance.

Meetings and decision-making process of the committee: It is suggested that grievance committee shall meet regularly (at least twice in a month) on a pre-fixed date. The committee will fix responsibilities to implement the decisions of the committee. This will not only help proper assessment of the situation but also in suggesting corrective measures at the field level itself. The committee shall deliver its decision within seven days of the sitting.

1.13.4. Functions of GRC

Field Level Complaint Handling System

The complaints received from community members and other stakeholders of any concerns or complaints, or grievances should be taken up in the grievance redressal process. The concerned officer should maintain a register of all petitions received with details of date of receipt of the petition, the date of hearing, if any, date when it was considered by the committee, along with nature of

complaint/concern, action taken, and date of communication sent to petitioner. Communication in writing should be sent to the aggrieved person about the date, time and venue of the GRC sitting and make it known that s/he is entitled for personal hearing and that representation through the proxy will not be entertained. Communication will also be sent through Environmental & Resettlement Plan Implementation Consultants so as to ensure that the petitioner is informed about the date of GRC sitting.

Copies of petitions received 1-week prior to the committee's sitting should be sent to the Chairman and the member along with an explanatory note from appropriate authority and/or environmental and resettlement plan implementation consultants, as the case may be, to enable the Chairman and member to scrutinize the petitions in detail. Petitions received during the week of the committee's sitting, shall be taken up during the sitting and resolved.

Response Time

The GRC will hear grievances once in 15 days. The GRC will inform the complainant of their decision within three days of the hearing of the grievance.

There is no cost involved in approaching the project authorities or the GRC in registering grievances. The grievance redress mechanism is accessible to not only the affected persons, but the community as a whole.

Detail address of Grievance Redressal Officer is given below.

Rail Infrastructure Development Company (Karnataka) Ltd.,
"Samparka Soudha", 1st Floor, (Opp. Orion Mall),
Dr. Rajkumar Road, Rajajinagar 1st Block,
Bengaluru – 560 010,
Karnataka.
E-mail:
Toll Free No.:

1.13.5. GRM during Covid-19 & Omicron Pandemic Situation

Covid-19 and Omicron pandemic has severely affected the global economy from the year 2020 onwards. Many countries imposed lockdown to regulate the spreading of the virus to its people. Still the situation is grim where many countries are fighting against it. Recently World Health Organisation has cautioned the world on increasing cases in European and Central Asia countries. Again, spreading of Covid-19 or Omicron viruses cannot be ruled out in India. In such cases, if lockdown imposed by State Govt., project authority should come up with mechanism to receive the grievances in online and address the same through either telephone discussions or virtual meetings.

1.14. Monitoring and Evaluation

Monitoring stakeholder engagement process is new to the project. A process of establishing monitoring criteria is an initial phase of development. The results to be analysed will provide background for planning better initiatives for the operation, closure and rehabilitation project stage. The following SEP activities require monitoring and evaluation from assigned personnel and team in the project:

- Implementation of BSRP stakeholder engagement strategy that includes activities to be carried out in different phases of the project.

- Implementation of Grievance Mechanism as part of SEP which includes dissemination of Grievance Mechanism, grievance logging and tracking, action taken, effectiveness of grievance management, confidentiality of the grievance raised, and number of grievances solved. A sample of stakeholder log is attached at Appendix-2.
- Evaluation of SEP implementation will be carried out at least annually. Evaluation is essential to provide feedback to improve Project SEP and enhance Project- stakeholder's relationship.

1.15. Reporting

Monthly Reports: The Public Relation Officer will prepare brief monthly reports on stakeholder engagement activities for the Managing Director, KRIDE, which includes:

- Activities conducted during each month;
- Public outreach activities (meetings with stakeholders and newsletters);
- Entries to the grievance register;
- Entries to the commitment and concerns register;
- Number of visits to the information centre;
- Progress on other social development activities
- Plans for the next month and longer term plans.

Monthly, quarterly and semi-annual reports will be used to develop annual reports reviewed by senior managers of PIA. These reports will be shared with AFD & KfW.

Annual Reports: The office of the Project Director will compile a report summarizing SEP result on an annual basis. The report will provide summary of all public consultation issues, grievances and resolutions. The report will provide a summary of relevant public consultation findings from informal meetings held at community level. These evaluation reports should be presented to the concerned senior officer of KRIDE. The evaluation report should be published to a wider audience in a transparent way through public domain documents and websites such KRIDE's website, annual report, newsletters, articles, local media and other outreach tools.

A yearly evaluation should be conducted by an independent consultant/agency using a perception survey, which uses that same set of questions over time to achieve continuity. The first survey to assess stakeholder perceptions should be conducted before commencement of major construction work to provide a baseline for community perceptions.

Appendices

Appendix 1: Minutes of the Stakeholder Consultations

Sl No	Stakeholders	Stake in the project	Date of the consultation /discussion	Venue of the consultation	Number of participants	Points Discussed	Suggestions/Opinion of the participants
1	Karnataka Slum Development Board	Certain declared and undeclared slums are falling in the alignment. Development of the declared slum in Karnataka is in the scope of the Karnataka Slum Development Board.	17.3.22	At the office of the Commissioner, Karnataka Slum Development Board, Bangalore	3	The resettlement of the residents of the Mr. Jayaram Colony, Mathikere	• Commissioner KSDB has suggested to have a joint meeting with the KSDB, K RIDE officials and elected representatives of the slum located constituency (Malleswaram Constituency)
2	Special Land Acquisition Officer, Karnataka Industrial Area Development Board, Zonal Office	Land acquisition for the project is being done by KIADB as per the KIAD Act 1966.	25.3.22	Office of the Special Land Acquisition Officer, Karnataka Industrial Area Development Board, Zonal Office	2	Land acquisition and disbursement of compensation and Resettlement and Rehabilitation assistances	• The land acquisition is being done as per the Karnataka Industrial Area Development Act (KIADA), 1966 and the compensation and R&R benefits will be estimated as per the RFCTLARR Act 2013. In response to the question about the resettlement assistance for non-tilted holder, he has stated that the same to be paid by K RIDE, based on the entitlement matrix of the project
3	Residential and Residential cum commercial owners of Corridor 2	Physical and economical displaced Families	17.3.22	Mohan Nagar	9	Compensation and R&R activities	• All are welcomed the project at the same time they are concerned about the compensation packages, they suggested for the prevailing market rate for the affected land and building. The tenants of the buildings requested for sufficient advance notice to find out a suitable location to shift their

Sl No	Stakeholders	Stake in the project	Date of the consultation /discussion	Venue of the consultation	Number of participants	Points Discussed	Suggestions/Opinion of the participants
							activities. The PAPs requested to maintain transparency in acquisition procedures and fixing of compensation.
4	Residential owners of declared slum	Physical Displaced Families	18.3.22	Mr. Jayaram Colony, Mathikare, Corridor 2	12	R&R activities	• There are two different opinions on relocating from this location to another site. Certain people are ready to relocate if they get 'Patta land' (legal ownership) for at least the same area of which they presently enjoying in the current location. Few people suggested that the resettlement site should be near to the existing location.
5	Residential owners of undeclared slum	Physical Displaced Families	25.3.22	Nayandahalli, Near Railway Gate, Vinayaka Extension, corridor 3	14	R&R activities	• The people at this location did not cooperate with the social survey. They stated that without a proper plan for rehabilitation they will not cooperate with the survey. Consultation is in progress with the affected community as well as with the community leaders.
6	Displaced Employees of commercial building	Loss of livelihood	14.3.22	Yelahanka (Near Railway Station)		Loss of livelihood assistance	• Last 20 years they are working as power looms operators, and they are earning around Rs. 3000 per week. Once they get displaced from the existing job it would be difficult for them to get a job in a new place, as it is not clear that the same owner would continue the business after the demolition of the structure. Even if he

Sl No	Stakeholders	Stake in the project	Date of the consultation /discussion	Venue of the consultation	Number of participants	Points Discussed	Suggestions/Opinion of the participants
							is interested to reestablish the same at new place it may take some time. Hence, they demanded for some resettlement assistances for the period actual job loss
7	Residential and Residential cum commercial owners.	Physical and economical displaced Families	14.3.22	Yelahanka (Near Railway Station)	8	Compensation and R&R activities	• All are welcomed the project at the same time they are concerned about the displacement from their houses. They have requested to limit the project implementation in the land owned by the railway. If it is necessary to acquire their land sufficient compensation and resettlement assistances to be provided. They will lose both their houses as well as the source of income.
8	Displaced **Residential Tenants.**	Affected Families	15.3.22	Mahadevapura	9	Relocation to new houses	• They are worried on getting the deposited amount (advance paid to the owner) back and another suitable house within this rent at nearby areas, as their children are studying in nearby schools also their source of livelihood activities are nearby. They requested for sufficient advance notice and assistance to transport their household item to new location
9	Displaced aged **Residential Owner**	Physical and economical (income for rent) displaced vulnerable household	15.3.22	Mahadevapura	5	Compensation and Resettlement	• A resident for the area is staying in his own house for last 23 years. He is around 63 aged old. He is staying in the

Sl No	Stakeholders	Stake in the project	Date of the consultation /discussion	Venue of the consultation	Number of participants	Points Discussed	Suggestions/Opinion of the participants
						and Rehabilitation	ground floor house of a G+1 building, and he has rented out the 1st floor houses. He is a retired employee of a private firm, his sole source of livelihood is income from the rented buildings, which is around Rs.15000/month. He and his spouse are staying in the house, they don't have children and other family members to take care of them. He has demanded that; he must get an alternate house and good compensation for his land and building (preferably as per the Bangalore Metro Rail Corporation's compensation package)
10	Community members (Random survey and face to face discussion)	Probable commuters of BSRP (beneficiaries)	20. 03.2022 to 8 .04.2022	At the proposed station locations	1000	Various aspects on BSRP and public transport	• The project will provide better connectivity between the suburban areas of Bengaluru with the city centers of Bengaluru, which will control the concentration of settlements in the city centers. • Lower income families can stay in affordable houses in suburban areas of Bengaluru and commute to the city for their source of livelihood at affordable travel cost, which will have control on developing new slum settlements also. • Travel time reduces as suburban railway project caters the people from

Sl No	Stakeholders	Stake in the project	Date of the consultation /discussion	Venue of the consultation	Number of participants	Points Discussed	Suggestions/Opinion of the participants
							the outskirts of the city without traffic block. People believe that suburban railway project will enhance the aesthetic looks of the city, as the migration to city centers would be reduced. • People do not have any problem in surrendering their land and assets if better rates are given for their affected assets. The proposed suburban railway project would be an efficient and effective transport facility for the people settled in the outskirts of the city for their day to day travel. It will also reduce air pollution, save fuel and road accidents. • The proposed suburban railway project will lead to diverse ways of livelihood opportunities for people also savings on their expenditure on day to day travel. People told that, due to the high expense on the travel cost and time delay they are compelled to stay in city in unhygienic atmosphere, once the BSRP is operational they can move to the outskirts and travel for their work. • The BSRP would be a reliable mode of transport with high safety to the vulnerable sections of the society, hence the mobility of women would be increased. Women in Indian scenario

Sl No	Stakeholders	Stake in the project	Date of the consultation /discussion	Venue of the consultation	Number of participants	Points Discussed	Suggestions/Opinion of the participants
							need to travel along with aged parents (medical purpose) or with minor children, travelling in public bus will always be difficult for them. They feel that the BSRP will be a more comfortable travel mode for them. • The suburban railway project will provide more livelihood opportunities for small and marginal farmers, those who cultivating vegetables, fruits and flowers in the outskirts of the city, as suburban railway project will provide good access to these people to the market for their produces. • Few households based small poultry farmers shared their opinion that, the BSRP may give better opportunities for them also, as there is a high demand for 'Natti Motte' (country eggs) in Bangalore city but taking the eggs in buses are always risky. • The women face a lot of difficulties while travelling on public buses. However, they feel that Suburban railway would be a safe mode of transport for them. The women demanded for separate coach reserved for them on the train, at least in peak hours and guarded coach in late evenings and early mornings.

Sl No	Stakeholders	Stake in the project	Date of the consultation /discussion	Venue of the consultation	Number of participants	Points Discussed	Suggestions/Opinion of the participants
							• The business (mainly the developers) groups found to be very enthusiastic because they feel that the proposed project will bring a lot of business opportunities for them. • Lack of end to end connectivity is the main issue of the commuters, hence they are forced to travel by private vehicle. If KRIDE provides sufficient facilities for parking, mainly at the stations located outside the city would be beneficial for the commuters. • Integration of BMTC with BSRP: BMTC may operate feeder bus services from outskirts settlements to the nearest BSRP stations on a regular basis, which will make BSRP more inclusive. • Adequate compensation needs to be provided for Project Affected Families. • Toilet facilities may be provided at all the stations. • Station design must be differently abled people friendly. • The daily wage labourers should get work opportunity during the construction of the project. The qualified individuals should get employment opportunities during operation of the BSRP (reservation may be given to the member of the project displaced families). Further, it should

Sl No	Stakeholders	Stake in the project	Date of the consultation /discussion	Venue of the consultation	Number of participants	Points Discussed	Suggestions/Opinion of the participants
							also create an opportunity for the poor and vulnerable (including women headed households, SC & ST families, etc.,) people to open a shop and small businesses in suburban stations. • Certain people may lose their access to their properties (at certain locations middle portion of the existing road/access are in the proposed land acquisition area – hence the connectivity of the road may lose). • People are worried about the stability of the certain old buildings located very close to the proposed alignment during construction (due to piling or heavy machinery movement), compensation and resettlement assistances to be done by KRIDE for structural damages, if any during construction. • The residential squatters demanded for resettlement prior to the commencement of civil works.

Appendix 2: Sample of stakeholder log

Sl No	Date	Venue/Place	K RIDE staff in attendance.	Contact Persons/ organization	Meeting Summary/ Key Issues Raised	Follow-up Actions

Annexure 8.1. Drinking Water Quality Standards (IS 10500:2012)

Sl. No.	Characteristic	Requirement (Acceptable Limit)	Permissible limit in the absence of alternate source	Remarks
Essential Characteristics				
1	Colour, Hazen units, Max	5	15	Extended to 15 only, if toxic substances are not suspected in absence of alternate source
2	Odour	Agreeable	Agreeable	a) Test cold and when heated b) Test at several dilutions
3	pH Value	6.5 to 8.5	No relaxation	-
4	Taste	Agreeable	Agreeable	Test to be conducted only after safety has been Established.
5	Turbidity NTU, max	1	5	-
6	Total dissolved solids, mg/l, Max	500	2000	-
7	Aluminium (as Al), mg/l Max	0.03	0.2	-
8	Ammonia (as total ammonia-N), mg/l Max	0.5	No relaxation	-
9	Anionic detergents (as MBAS), mg/l, Max	0.2	1.0	-
10	Barium (as Ba), mg/l, max	0.7	No relaxation	-
11	Boron (as B), mg/l Max	0.5	1.0	-
12	Calcium (as Ca) mg/l, Max	75	200	-
13	Chloramines (as Cl_2), mg/l, Max	4.0	No relaxation	-
14	Chloride (as Cl) mg/l, Max	250	1000	-
15	Copper (as Cu) mg/l, Max	0.05	1.5	-
16	Fluoride (as F) mg/l, Max	1.0	1.5	-
17	Free residual Chlorine, mg/l, Min	0.2	1	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/l
18	Iron (as Fe) mg/l, max	0.3	No relaxation	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3mg/l
19	Magnesium (as Mg) mg/l, Max	30	100	-
20	Manganese (as Mn) mg/l, Max	0.1	0.3	-

Sl. No.	Characteristic	Requirement (Acceptable Limit)	Permissible limit in the absence of alternate source	Remarks
21	Mineral oil, mg/l Max	0.5	No relaxation	-
22	Nitrate (as NO_3) mg/l, Max	45	No relaxation	-
23	Phenolic compounds (as C_6H_5OH) mg/l, Max	0.001	0.002	-
24	Selenium (as Se), mg/l, Max	0.01	No relaxation	-
25	Silver (as Ag), mg/l, Max	0.1	No relaxation	-
26	Sulphate (as SO_4) mg/l, Max	200	400	May be extended to 400 provided that Magnesium does not exceed 30
27	Sulphide (as H_2S) mg/l, max	0.05	No relaxation	-
28	Total alkalinity as calcium carbonate, mg/l Max	200	600	-
29	Total Hardness (as $CaCO_3$) mg/l, Max	200	600	-
30	Zinc (as zn), mg/l, Max	5	15	-
31	Cadmium (as Cd), mg/l, Max	0.003	No relaxation	-
32	Cyanide (as CN), mg/l, Max	0.05	No relaxation	-
33	Lead (as Pb), mg/l, Max	0.01	No relaxation	-
34	Mercury (as Hg) mg/l, Max	0.001	No relaxation	-
35	Molybdenum (as Mo) mg/l, max	0.07	No relaxation	-
36	Nickle (as Ni), mg/l, max	0.02	No relaxation	-
37	Polychlorinated biphenyls, mg/l, max	0.0005	No relaxation	-
38	Polynuclear aromatic hydrocarbons (as PAH) mg/l, Max	0.0001	No relaxation	-
39	Total Arsenic (as As), mg/l, Max	0.01	0.05	-
40	Total Chromium (as Cr) mg/l, Max	0.05	No relaxation	-
41	Trihalomethanes Bromoform, mg/l, max Dibromochloromethane, mg/l, max Bromodichloromethane, mg/l, max Chloroform, mg/l, max	 0.1 0.1 0.06 0.2	 No relaxation No relaxation No relaxation No relaxation	-
42	Radioactive materials a) Alpha emitters Bq/l max b) Beta emitters pci/l, Max	 0.1 1.0	 No relaxation No relaxation	-

Annexure 8.2. Effluent Discharge Standards

Sl. No.	Parameter	Unit	Effluent Discharge Standards (Inland Surface Water), GOI	Treated Sanitary Sewage Discharges by IFC
1	Colour &Odor	--	All efforts should be made to remove colour and unpleasant odor as far as practicable.	-
2	Suspended Solids Max.	mg/l	100	50
3	Particle size of Suspended Solids	--	Shall pass 850 micron IS Sieve	-
4	pH value	--	5.5 to 9.0	6.0-9.0
5	Temperature, Max.	°C	Shall not exceed 5□C above the receiving water temperature	-
6	Oil and grease, Max.	mg/l	10.0	10.0
7	Total residual Chlorine, Max.	mg/l	1.0	-
8	Ammoniacal Nitrogen (as N), Max.	mg/l	50	-
9	Total Kjeldahl Nitrogen (as N), Max.	mg/l	100	-
10	Free Ammonia (as NH_3), Max.	mg/l	5	-
11	Biochemical Oxygen Demand (5 days at 20°C), Max.	mg/l	30	30
12	Chemical Oxygen Demand Max.	mg/l	250	125
13	Arsenic (as As), Max.	mg/l	0.2	-
14	Mercury (as Hg), Max.	mg/l	0.01	-
15	Lead (as Pb), Max.	mg/l	0.1	-
16	Cadmium (as Cd), Max.	mg/l	2.0	-
17	Hexavalent Chromium (as Cr^{+6}), Max.	mg/l	0.1	-
18	Total Chromium (as Cr) Max.	mg/l	2.0	-
19	Copper (as Cu), Max.	mg/l	3.0	-
20	Zinc (as Zn), Max.	mg/l	5.0	-
21	Selenium (as Se), Max.	mg/l	0.05	-
22	Nickel (as Ni), Max.	mg/l	3.0	-
23	Cyanide (as CN), Max.	mg/l	0.2	-
24	Fluorides (as F), Max.	mg/l	2.0	-
25	Dissolved phosphates (as P), Max.	mg/l	5.0	-
26	Sulphides (as S), Max.	mg/l	2.0	-
27	Phenolic compounds (as C_6H_5OH), Max.	mg/l	1.0	-
28	Radioactive Materials □ Emitters, □curie/ml, Max. □ Emitters, □curie/ml, Max.	mg/l	10-7 10-6	-
29	Bio-assay test	mg/l	90% survival of fish after 96 hours in 100% effluent	-
30	Manganese (as Mn)	mg/l	2.0	-
31	Iron (as Fe)	mg/l	3.0	-
32	Vanadium (as V)	mg/l	0.2	-
33	Nitrate Nitrogen	mg/l	10.0	-
34	Total Nitrogen	mg/l	-	10.0
35	Total phosphorus	mg/l	-	2.0

Annexure 8.3. Tolerance Limits for Inland Surface Water Quality

Characteristic	Designated Use Class of Inland Waters				
	A	B	C	D	E
pH value	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.0 to 8.5
Dissolved Oxygen, mg/l, Min.	6	5	4	4	-
Biochemical Oxygen Demand (5 days at 20^0C), mg/l	2	3	3	-	-
Total coliform organisms, MPN/100 ml. Max.	50	500	5000	-	-
Colour Hazen units	10	300	300	-	-
Chlorides (as Cl), mg/l Max.	250	-	600	-	600
Sodium Adsorption ratio Max.	-	-	-	-	26
Boron (as B), mg/l. Max.	-	-	-	-	2
Sulphates (as SO_4), mg/ l	400	-	400	-	1000
Nitrates (as NO), mg/l Max.	20	-	50	-	-
Free Ammonia (as NH_3), mg/l	-	-	-	1.2	-
Conductivity at 25° C microhm / cm Max.	-	-	-	1000	2250
Arsenic (as As), mg/l. Max.	0.05	0.2	0.2	-	-
Iron (as Fe), mg/l	0.3	-	50	-	-
Fluorides (as F), mg/l	1.5	1.5	1.5	-	-
Lead (as Pb), mg/l. Max.	0.1	-	0.1	-	-
Copper (as Cu), mg/l	1.5	-	1.5	-	-
Zinc (as Zn) mg/l/ Max.	1.5	-	1.5	-	-
Manganese (as Mn), mg/l	0.5	-	-	-	-
Total Dissolved Solids, mg/l	500	-	1500	-	2100
Total Hardness ($CaCO_3$), mg/l	300	-	-	-	-
Magnesium (as Mg), mg/l	100	-	-	-	-
Chlorides (as Cl), mg/l	250	600	-	-	600
Cyanides (as CN), mg/l	0.05	0.05	0.05	-	-

Annexure 8.4. National Ambient Air Quality Standards

Pollutant	National Ambient Air Quality Standards,GOI			Air Quality Standards by IFC	
	Time Weighted Average	Industrial, Residential, Rural & Other Area	Ecologically Sensitive Area(notified by Central Government)	Averaging Period	GuidelineValue in µg/m3
Sulphur Dioxide (SO_2), µg/m^3	Annual	50	20	10 minute	500
	24 Hours**	80	80	24-Hour	20
Nitrogen Dioxide as NO_2, µg/m^3	Annual	40	30	1-Year	40
	24 Hours**	80	80	1-Hour	200
Particulate Matter (size less than 10µm) or PM_{10} µg/m^3	Annual	60	60	1-Year	20
	24 Hours**	100	100	24-Hour	50
Particulate Matter (size less than 2.5µm) or PM2.5 µg/m^3	Annual *	40	40	1-Year	10
	24 Hours**	60	60	24-Hour	25
Ozone (O3) µg/m^3	8 hours**	100	100	8-Hour daily maximum	100
	24 Hours**	180	180	-	-
Lead (Pb µg/m^3	Annual *	0.50	0.50	-	-
	24 Hours**	1.0	1.0		
Carbon Monoxide (CO) mg/m^3	8 Hours**	02	02	-	-
	1 Hour**	04	04		
Ammonia (NH_3) µg/m^3	Annual *	100	100	-	-
	24 Hours**	400	400		
Benzene (C_6H_6) µg/m^3	Annual *	05	05	-	-
Benzo (a) pyrene (BaP) particulate phase only ng/m^3	Annual *	01	01	-	-
Arsenic (AS) ng/m^3	Annual *	06	06	-	-
Nickle (Ni) ng/m^3	Annual *	20	20	-	-

Source: Central Pollution Control Board Notification dated 18th November 2009, GOI and General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality, IFC, 2007

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

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

Annexure 8.5. National Ambient Noise Level Standards

Category of Zones	National Ambient NoiseStandards, GOI		Noise Standards by IFC	
	Leq in dB (A)		One Hour LAeq (dBA)	
	Day Time 6.00 AM to 10.00 PM	Night Time 10.00 PM to 6.00 PM	Day Time 7.00 AM to 10.00 PM	Night Time 10.00 PM to 7.00 PM
Industrial	75	70	70	70
Commercial	65	55		
Residential	55	45	55	45
Silence Zone: Institutional, Educational	50	40		

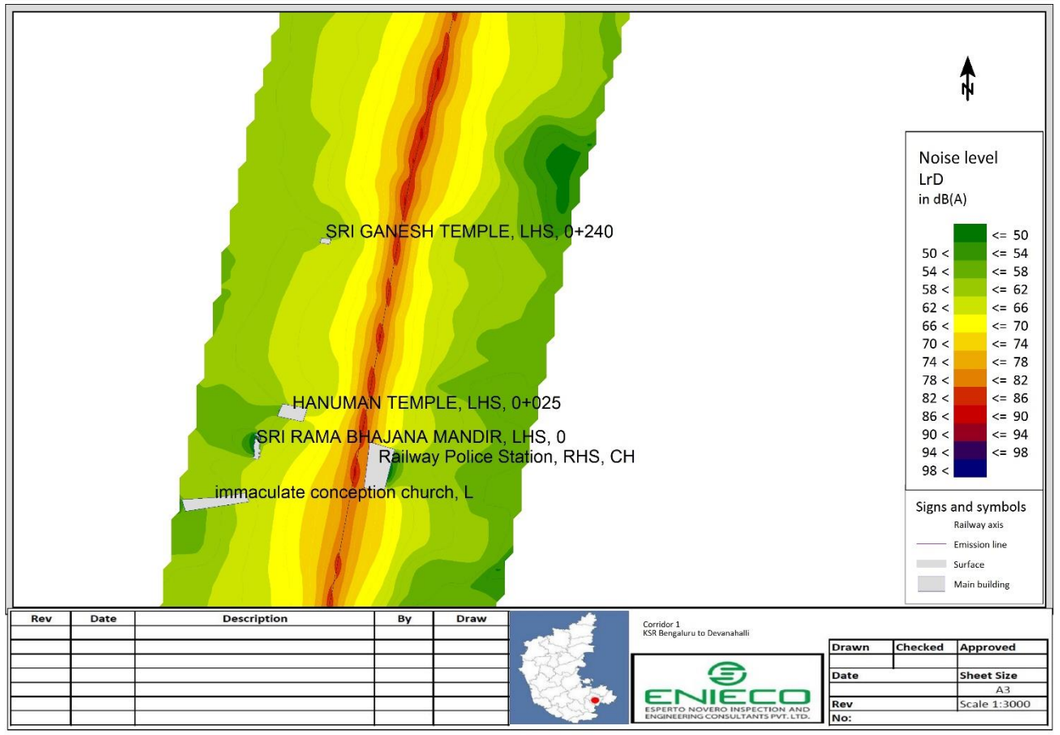
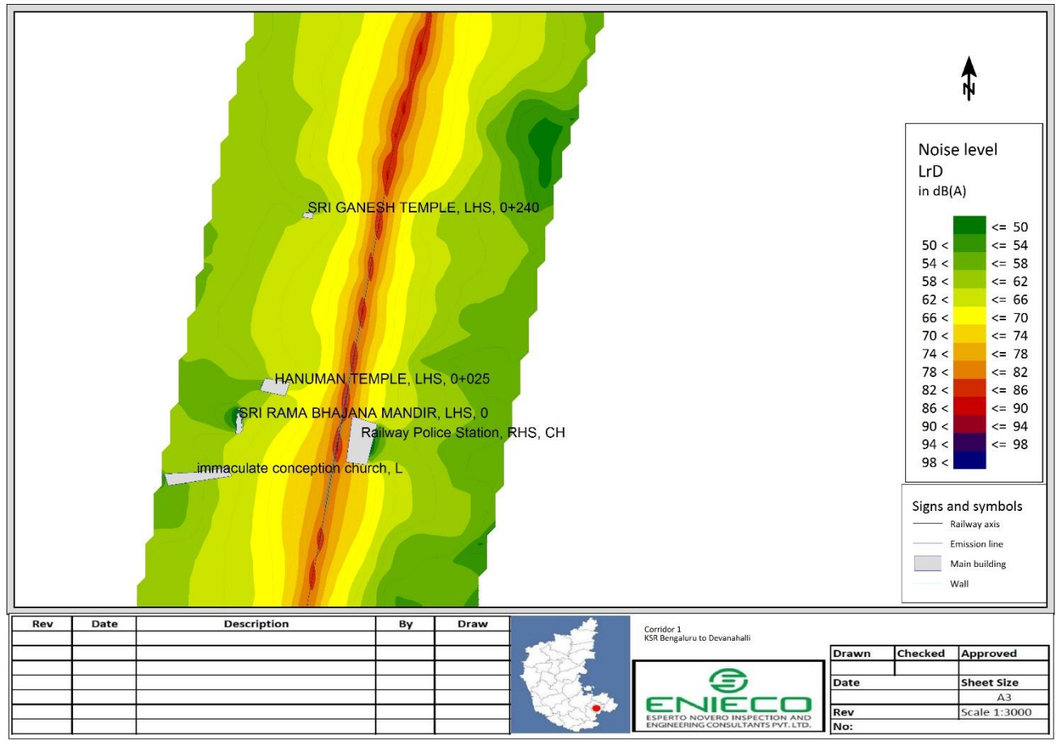
Source: Central Pollution Control Board, GOI and
General EHS Guidelines: Environmental Noise Management, IFC, 2007

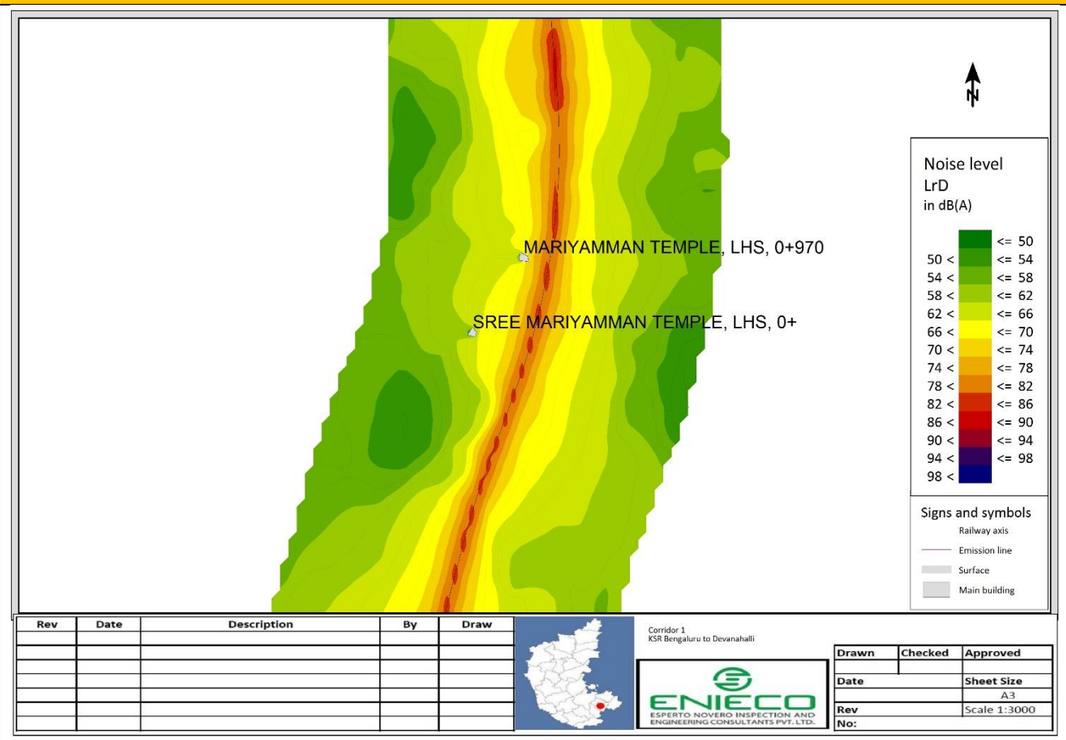
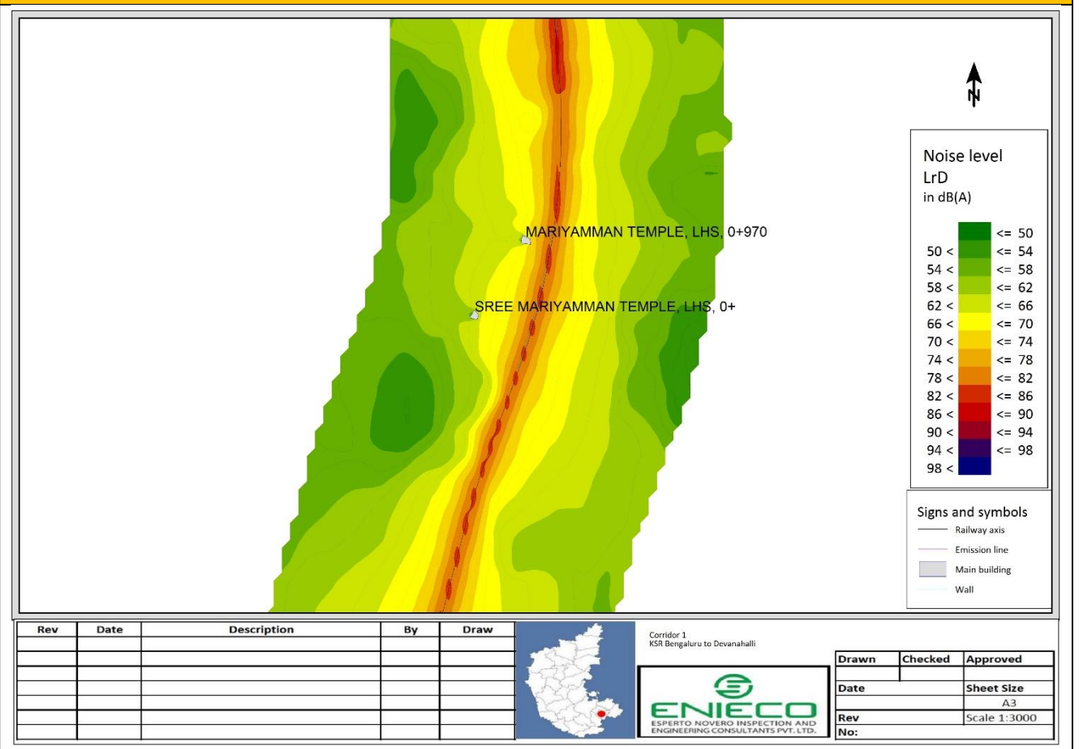
- *Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religiousplaces or any other area which is declared as such by the competent authority*
- *Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.*

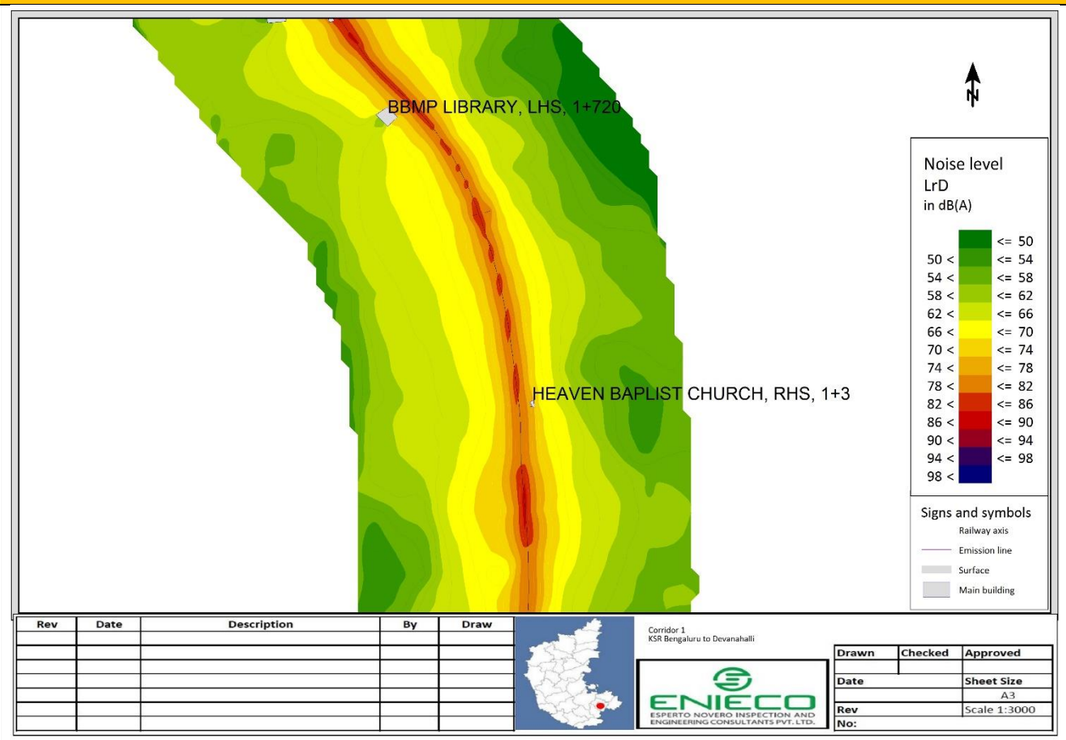
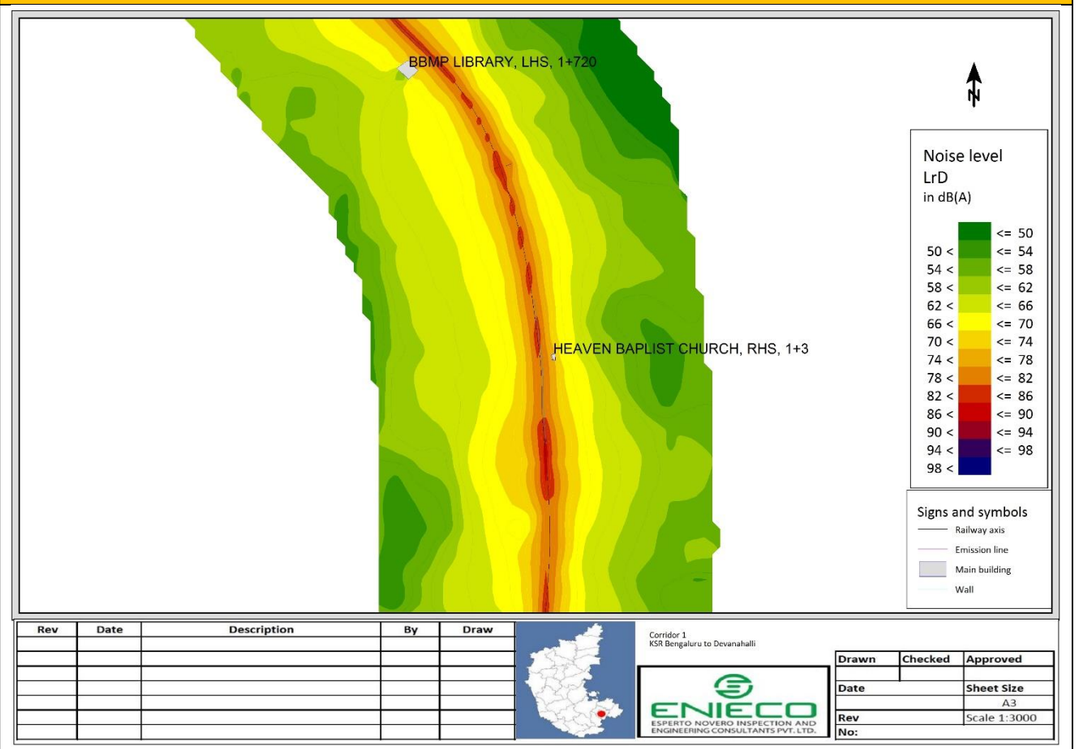
- *dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.*
- *A "decibel" is a unit in which noise is measured.*
- *"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.*
- *Leq: It is an energy mean of the noise level over a specified period*

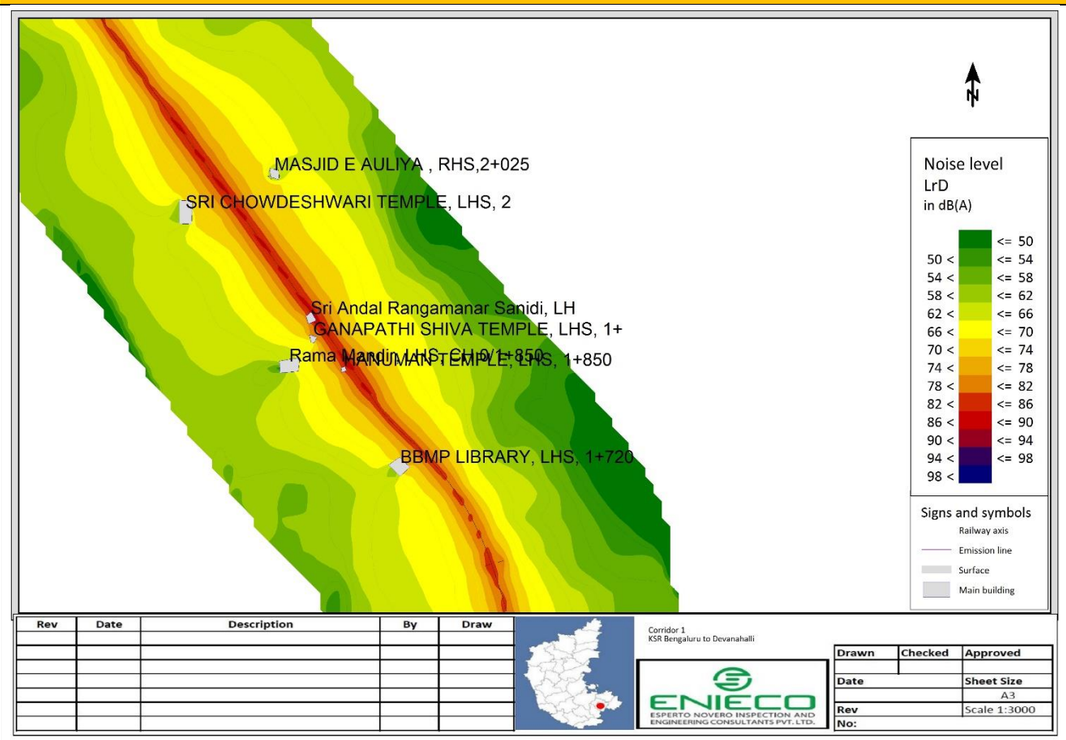
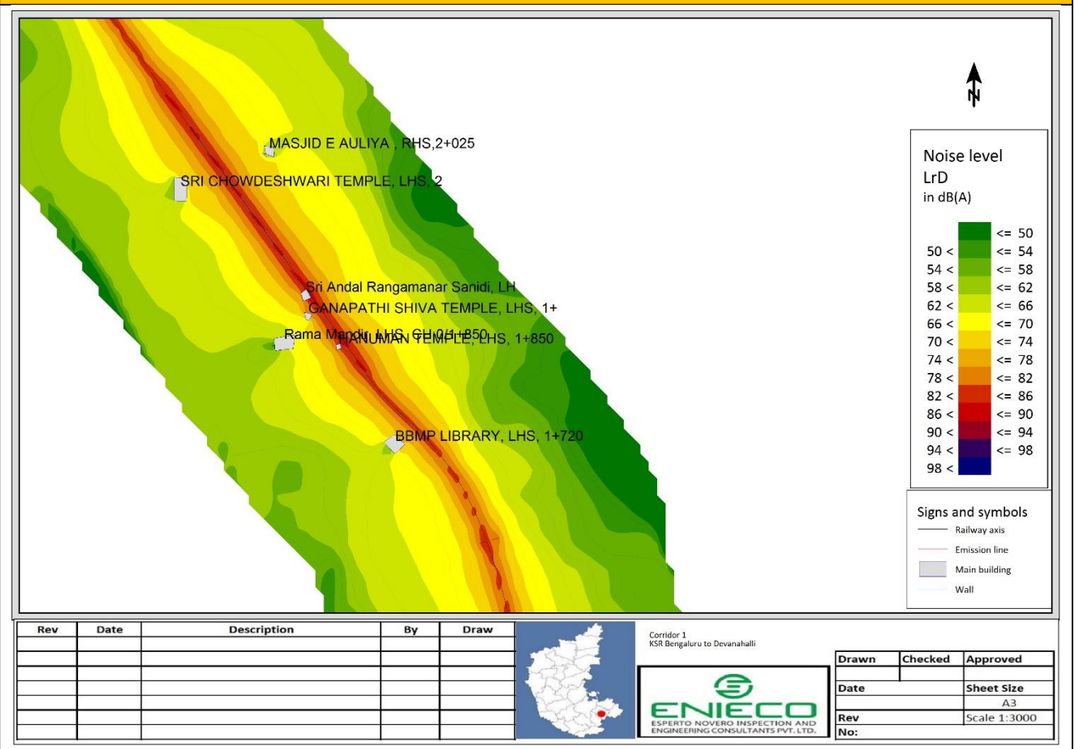
Annexure 8.6. Noise Contour Maps Showing Environmental Features including Sensitive Receptors for With Barrier and Without Barrier Scenario for the Projected Year 2025, 2031 and 2041 for BSRP Corridors

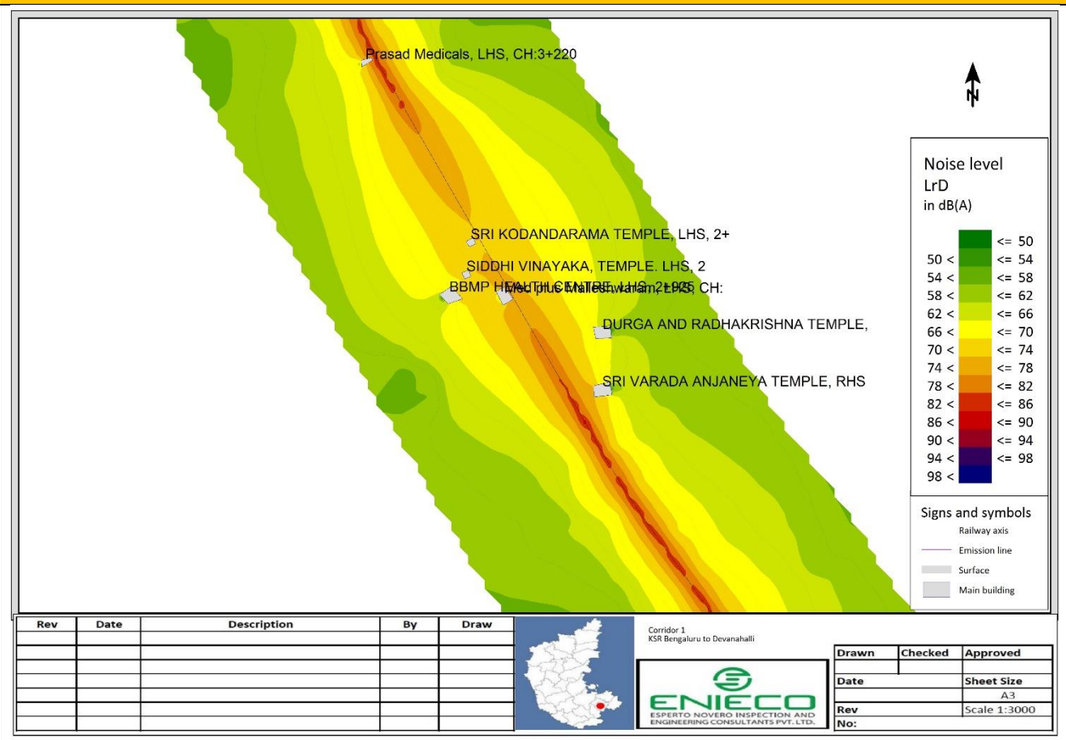
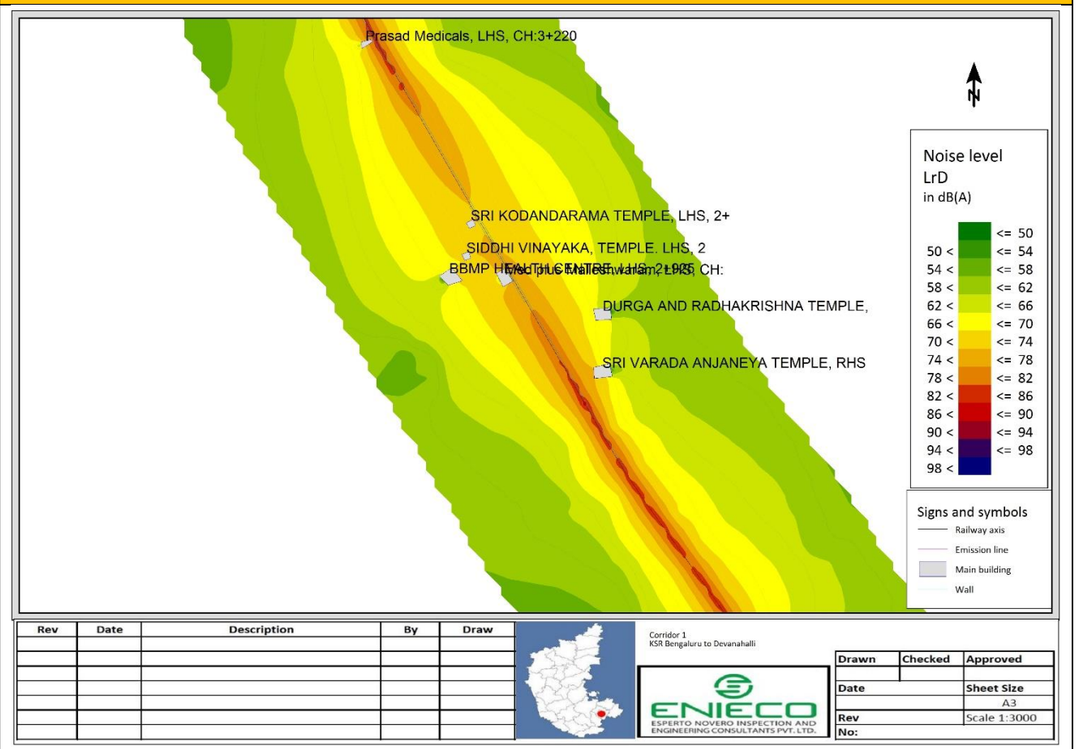
A. Noise contours for Corridor 1 for the Year 2025

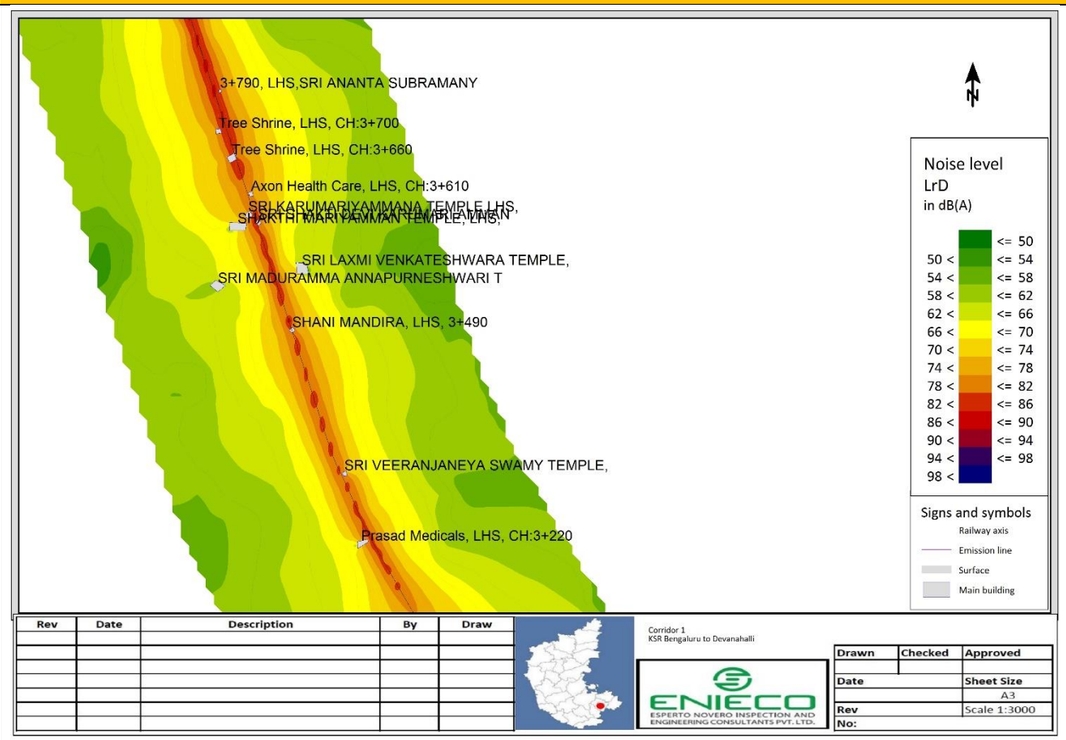
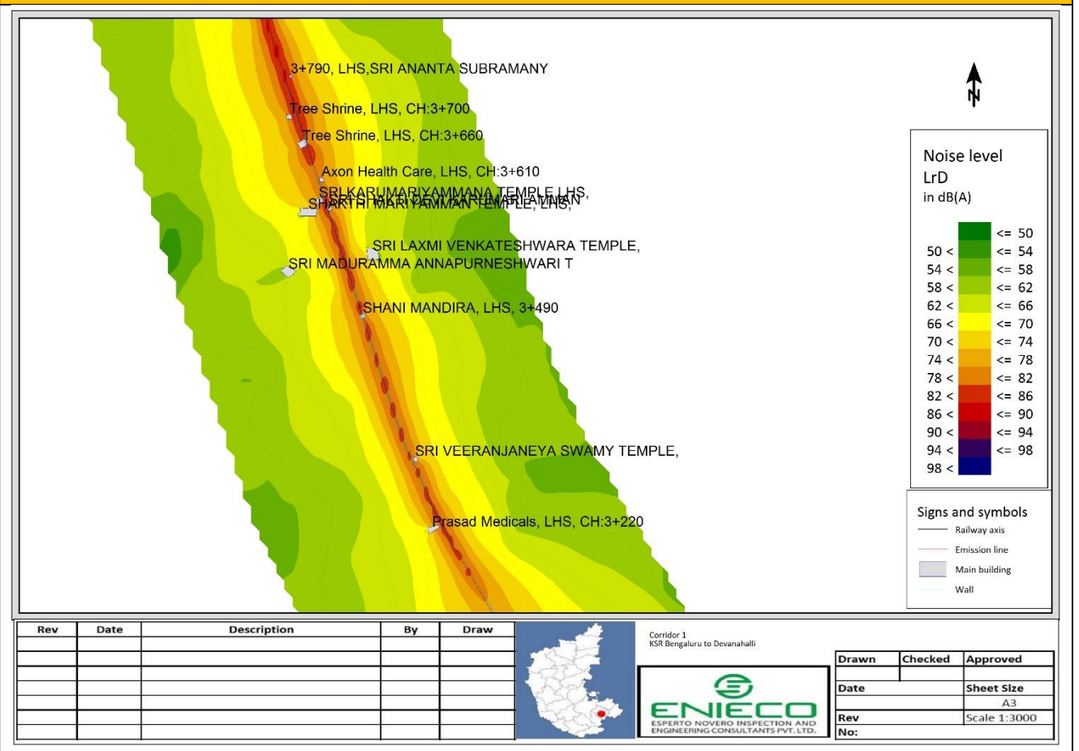
S.No	Without Barrier	With Barrier
1.		

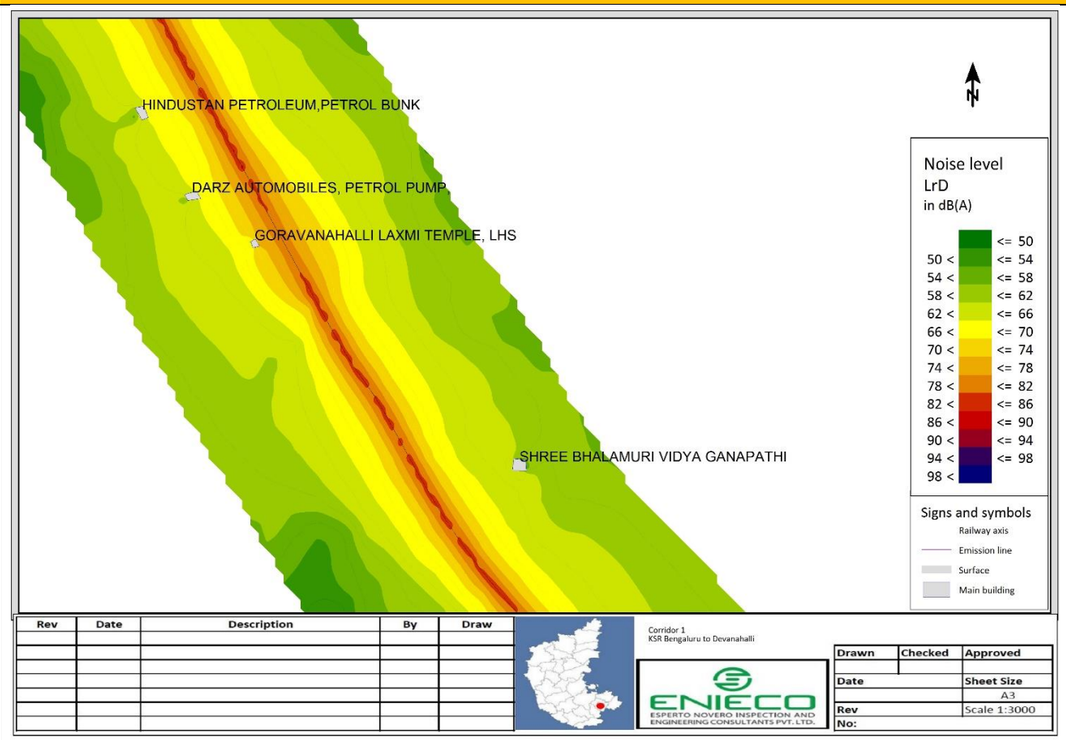
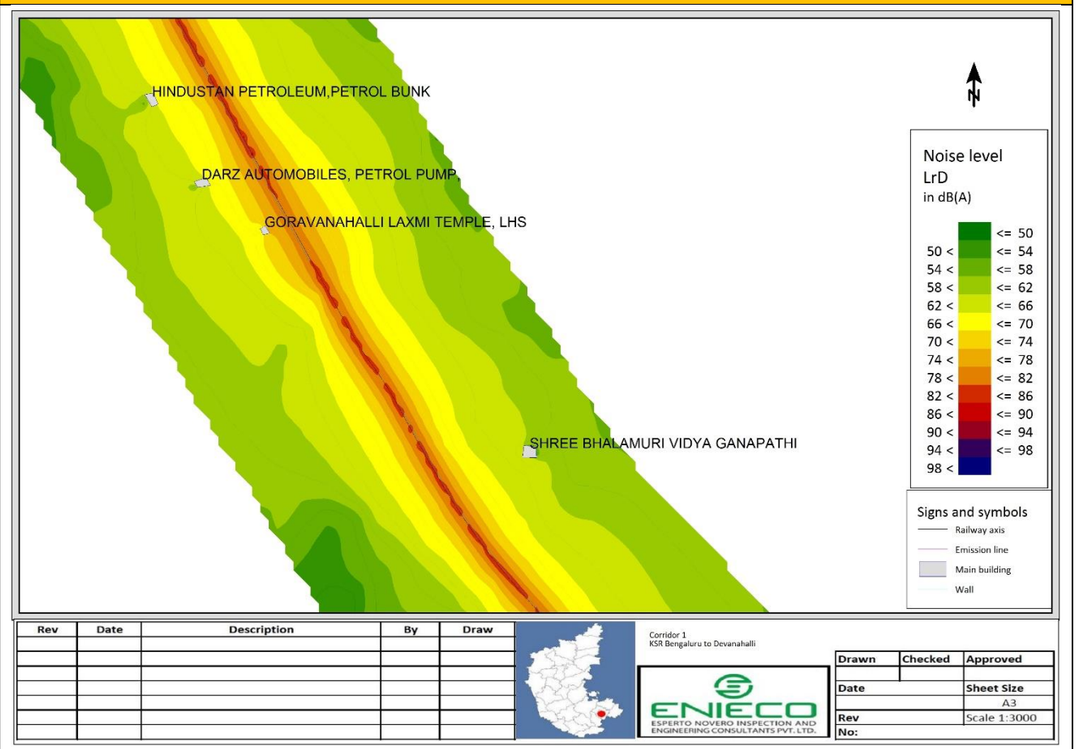
S.No	Without Barrier	With Barrier
2.		

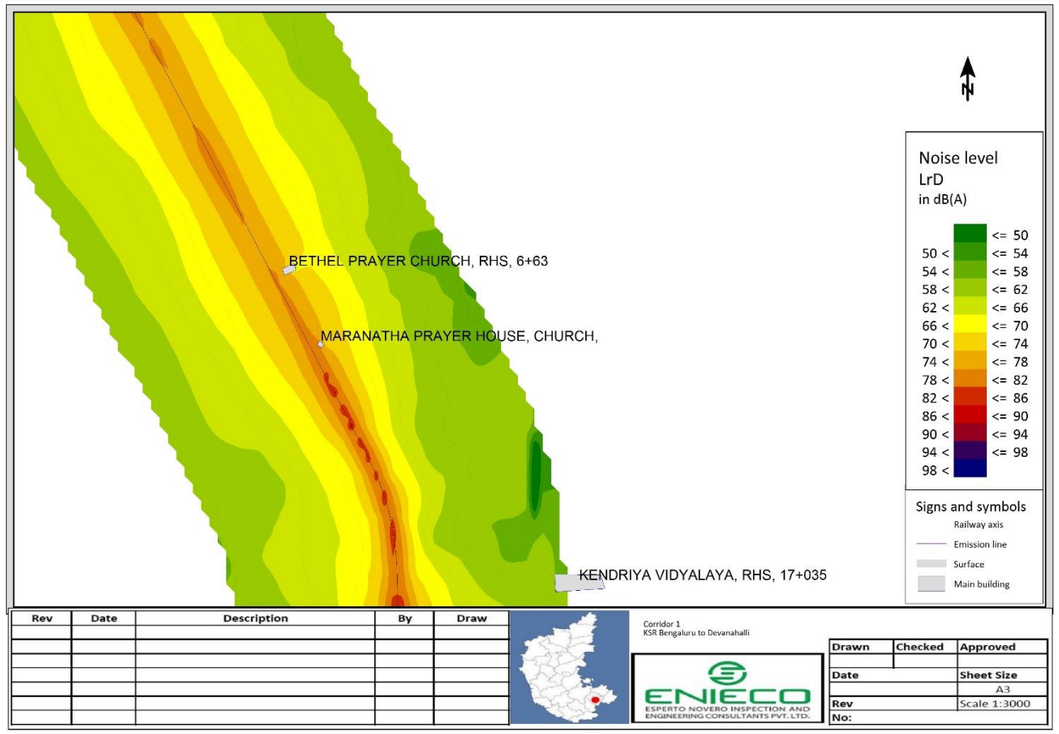
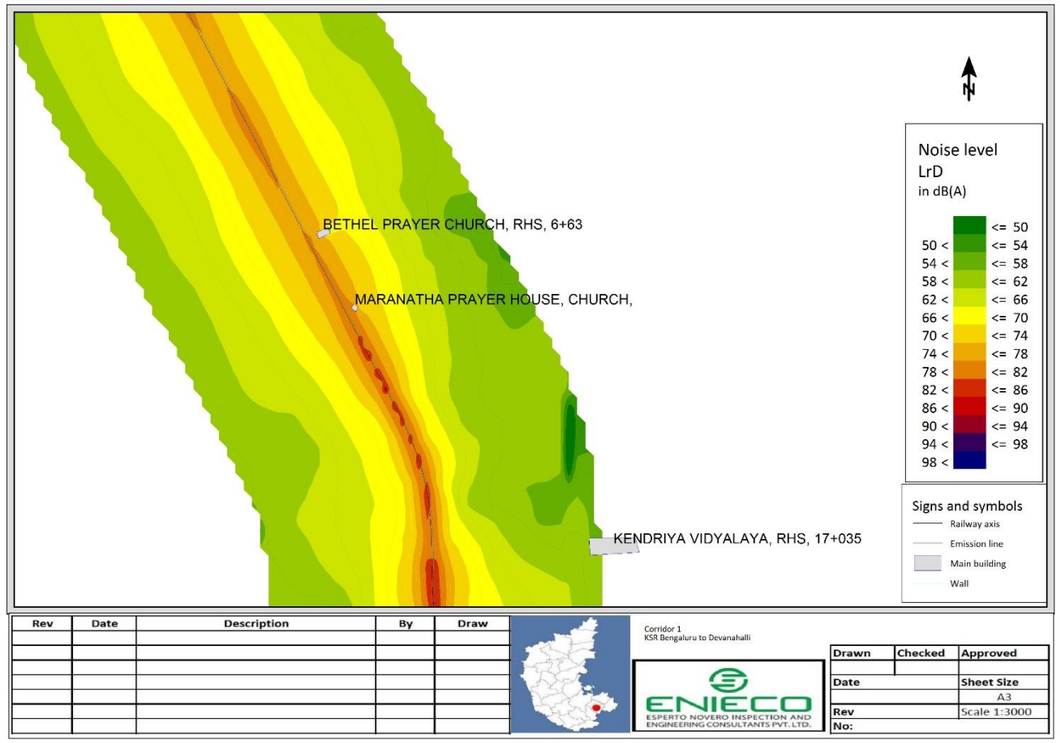
S.No	Without Barrier	With Barrier
3.		

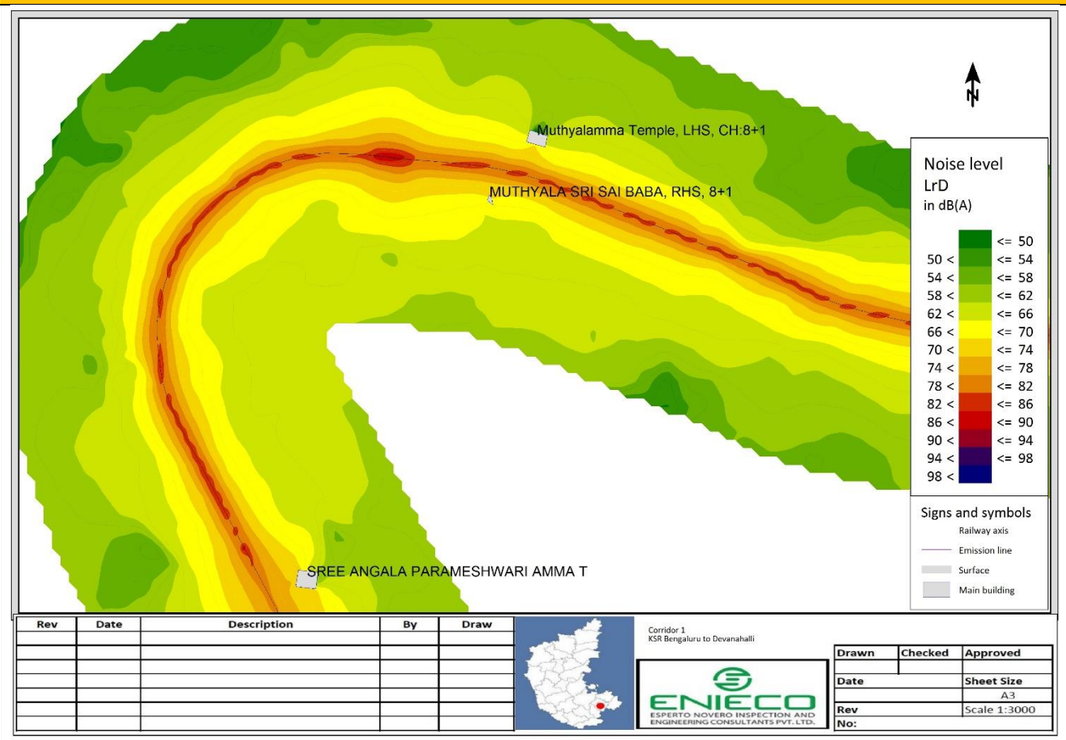
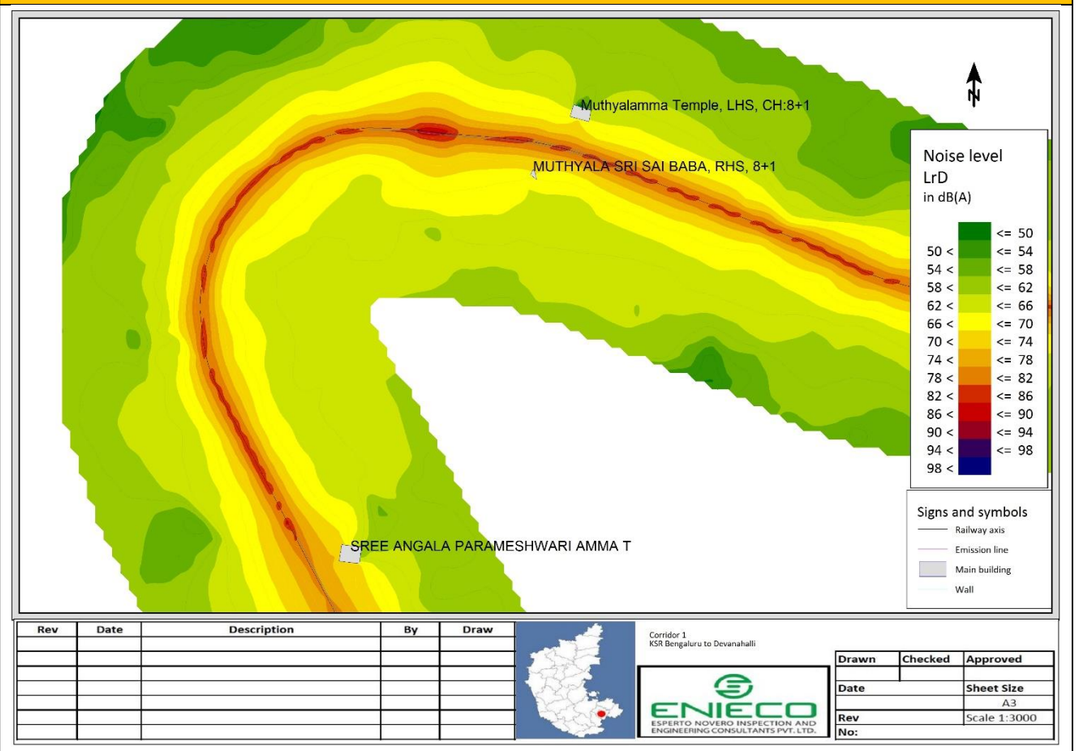
S.No	Without Barrier	With Barrier
4.		

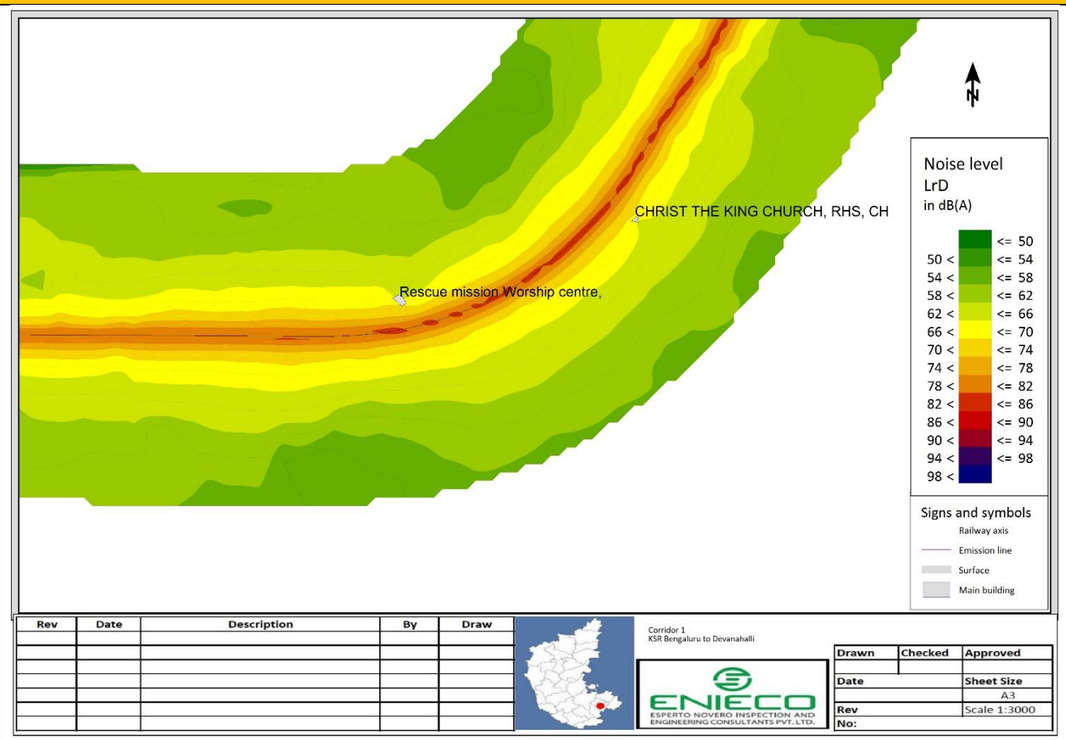
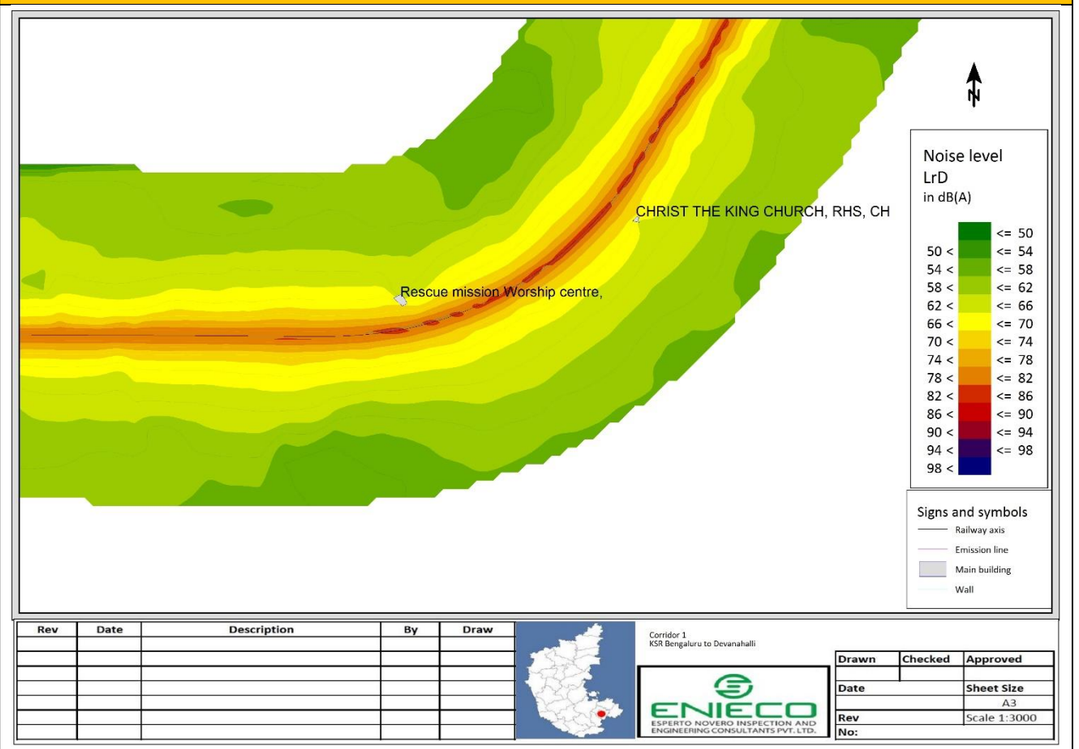
S.No	Without Barrier	With Barrier
5.		

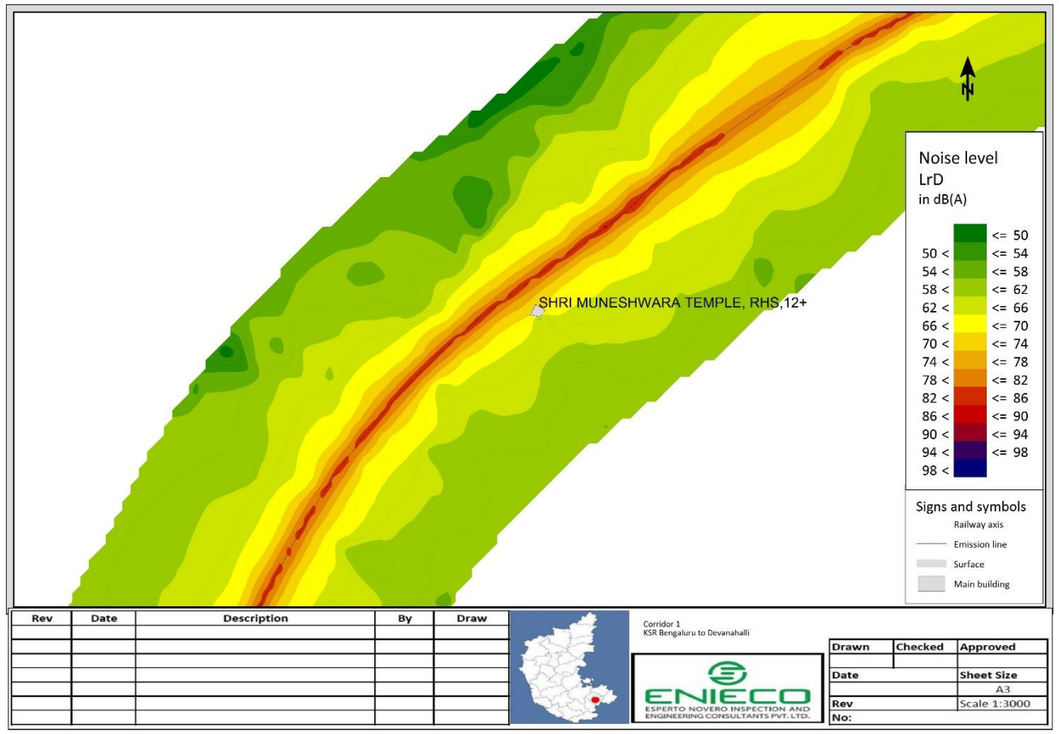
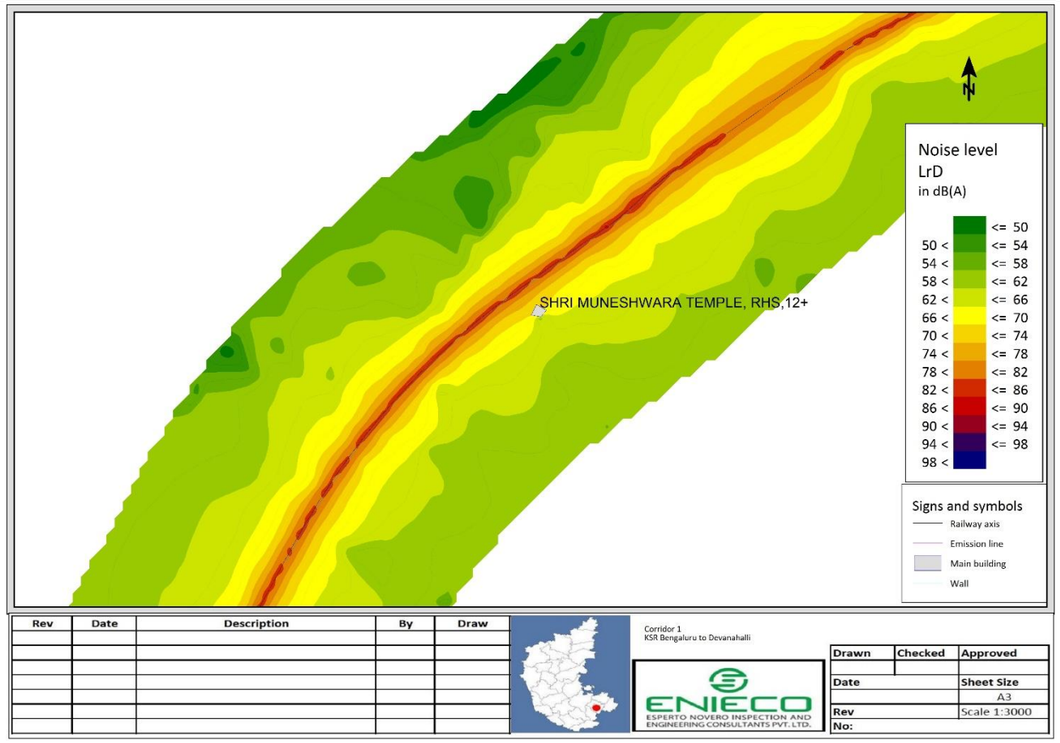
S.No	Without Barrier	With Barrier
6.		

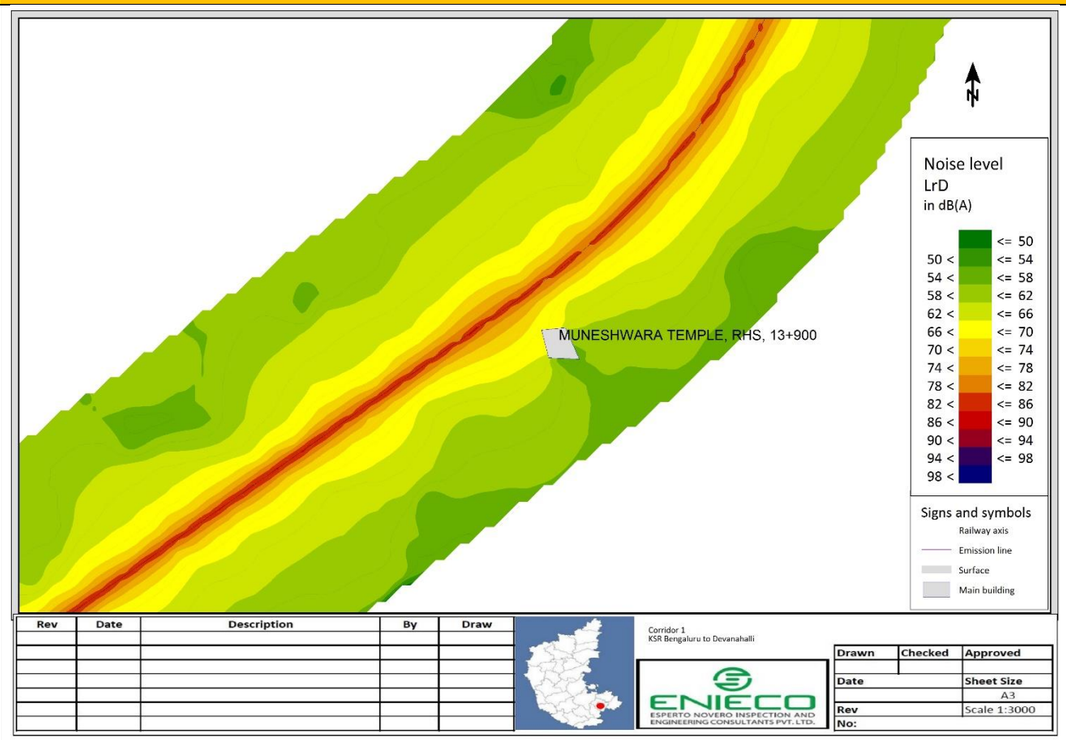
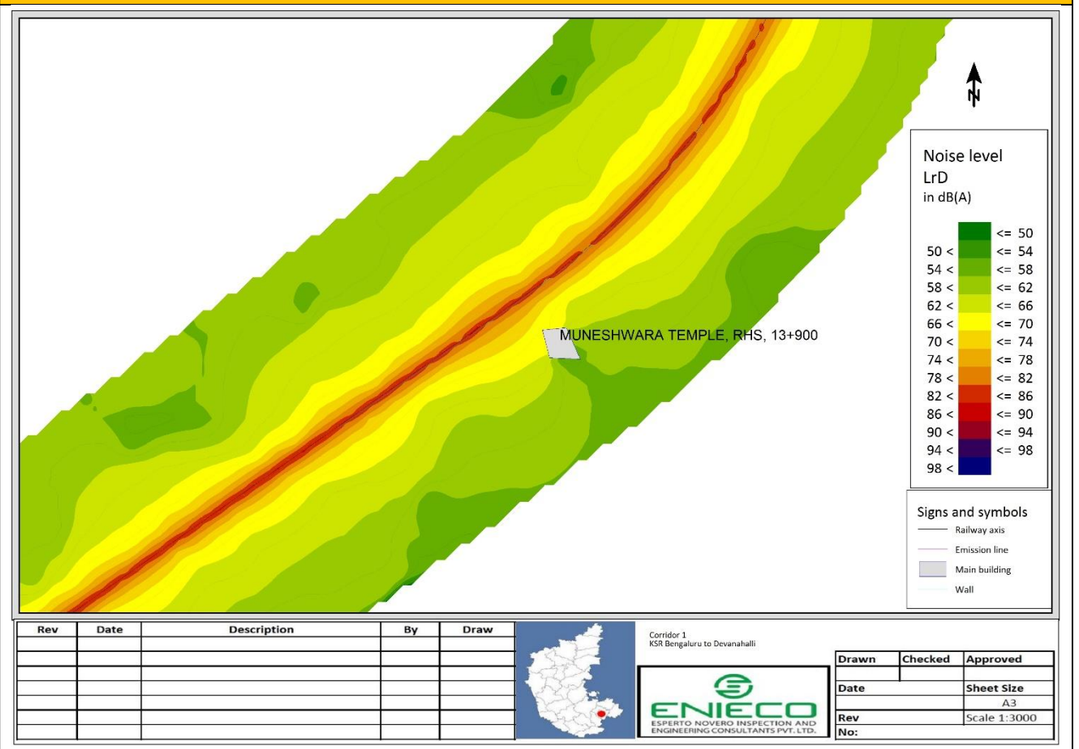
S.No	Without Barrier	With Barrier
7.		

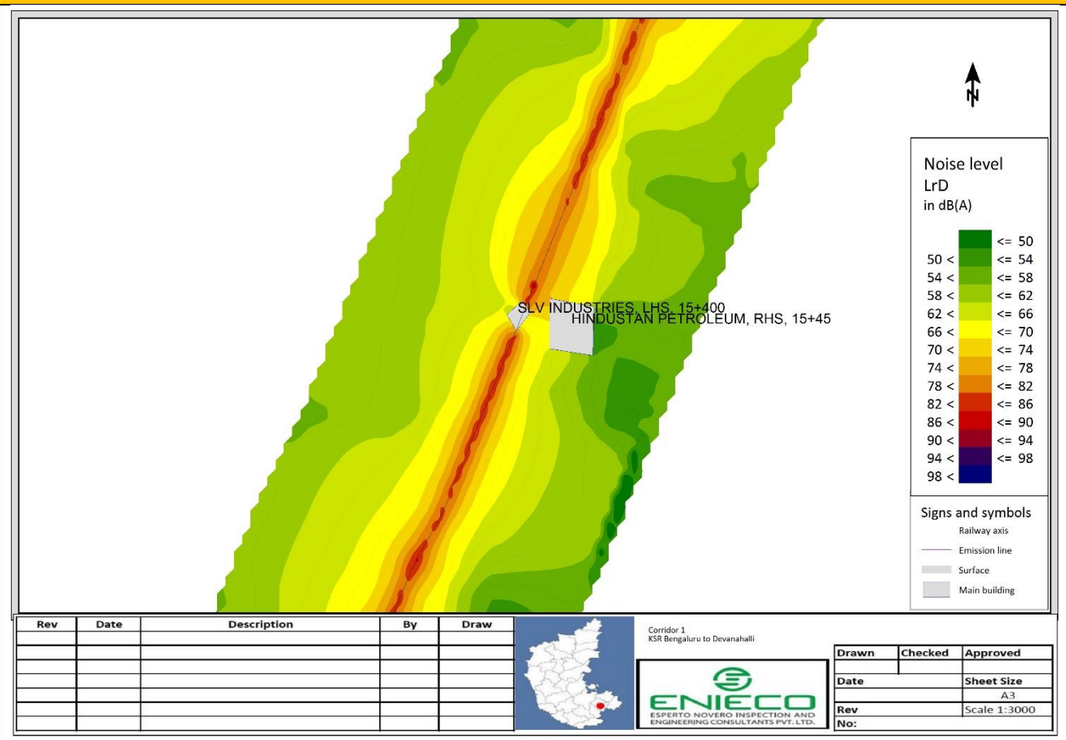
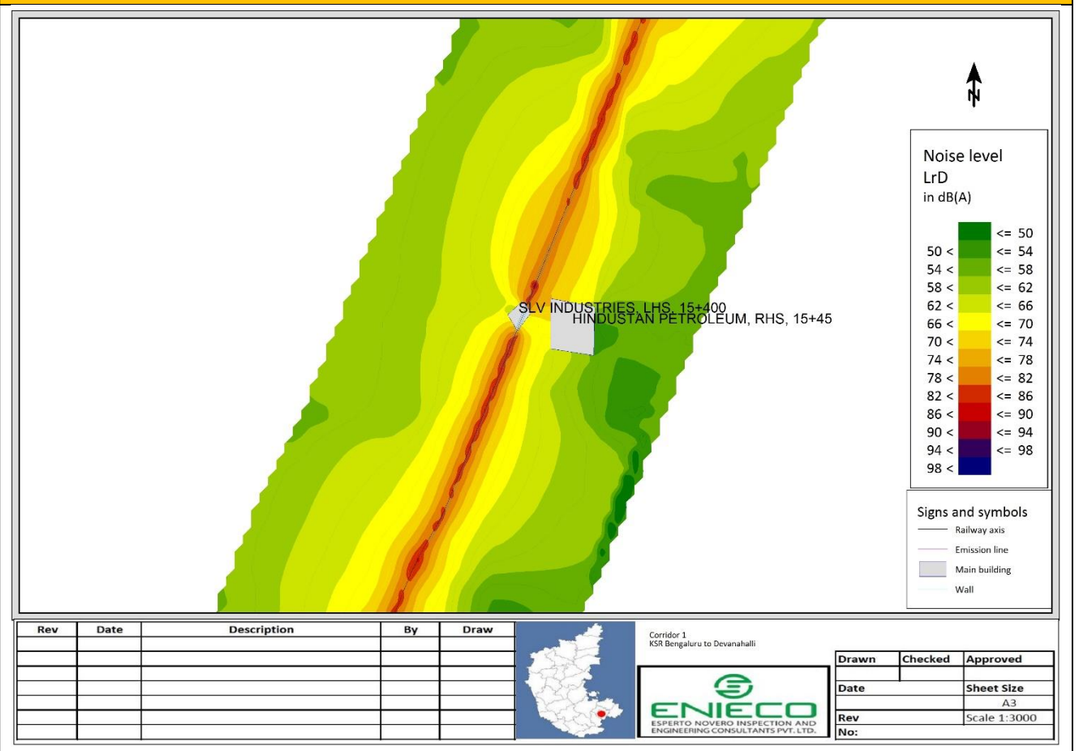
S.No	Without Barrier	With Barrier
8.		

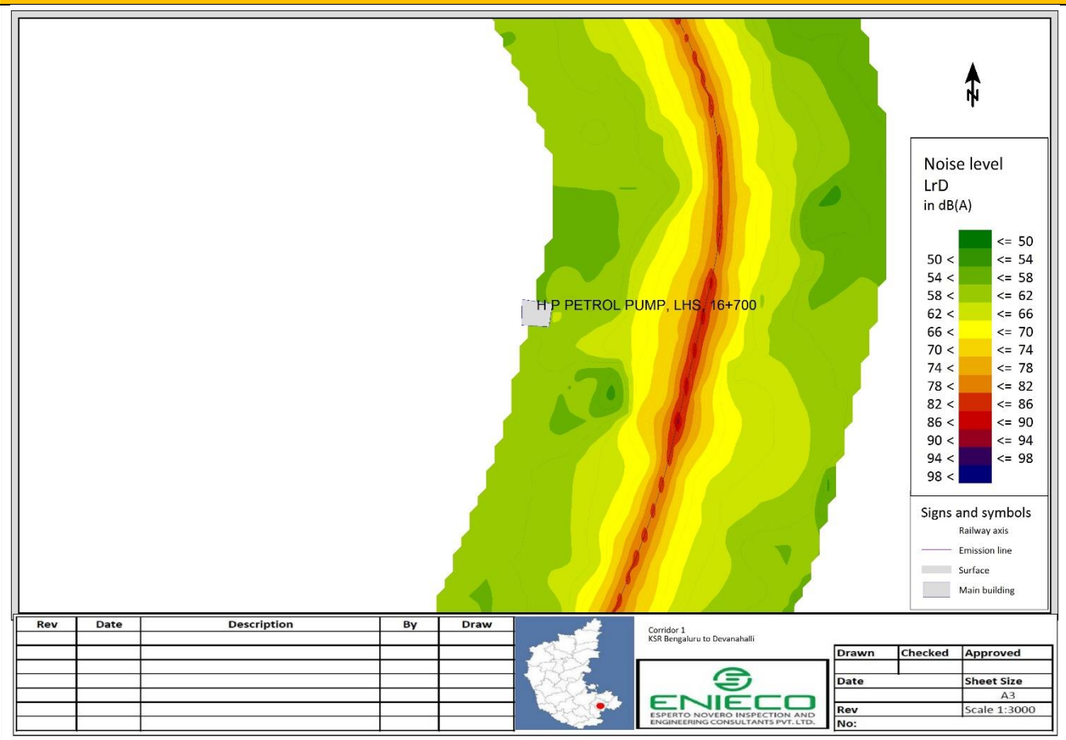
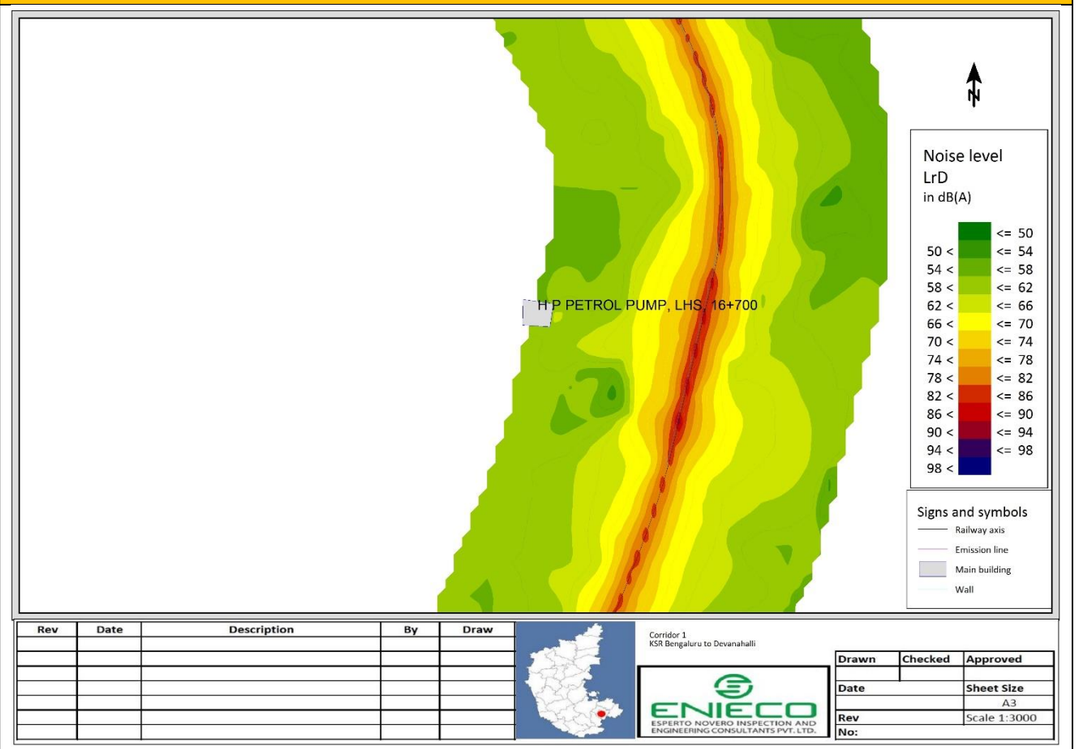
S.No	Without Barrier	With Barrier
9.		

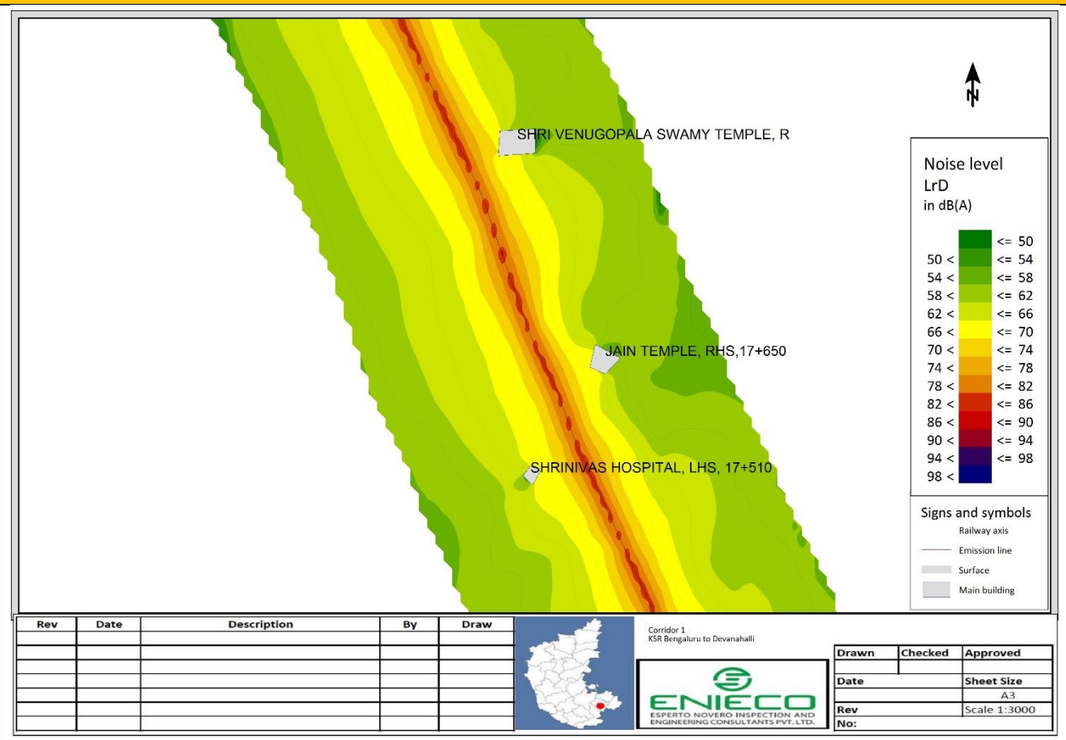
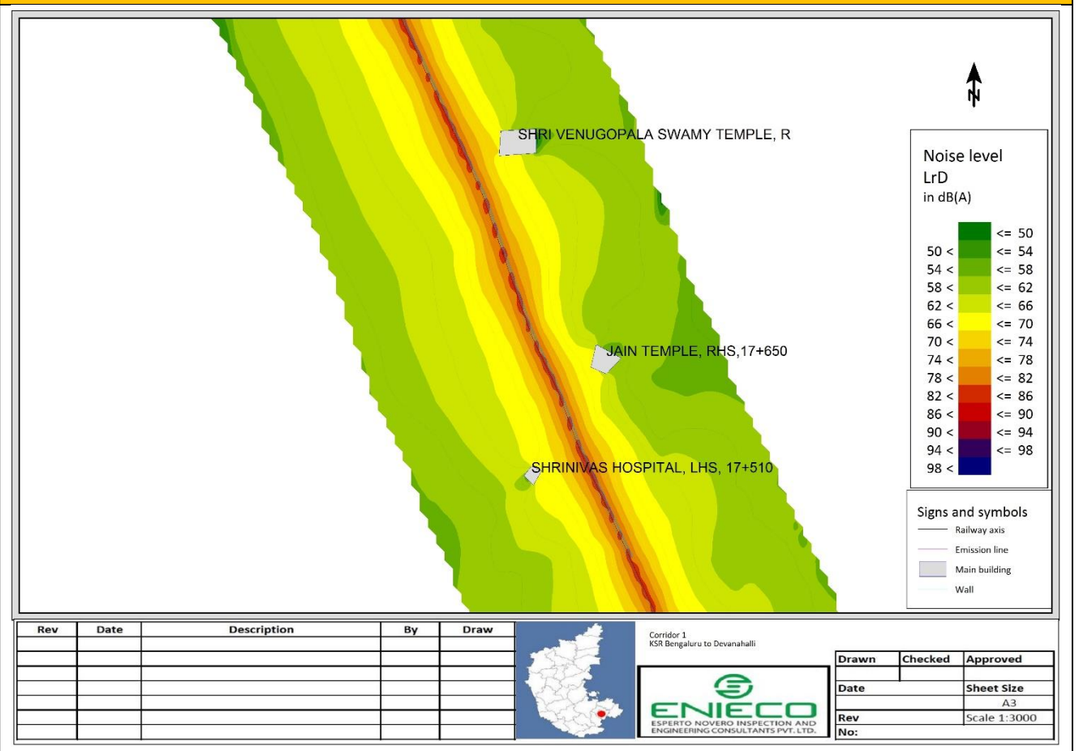
S.No	Without Barrier	With Barrier
10.		

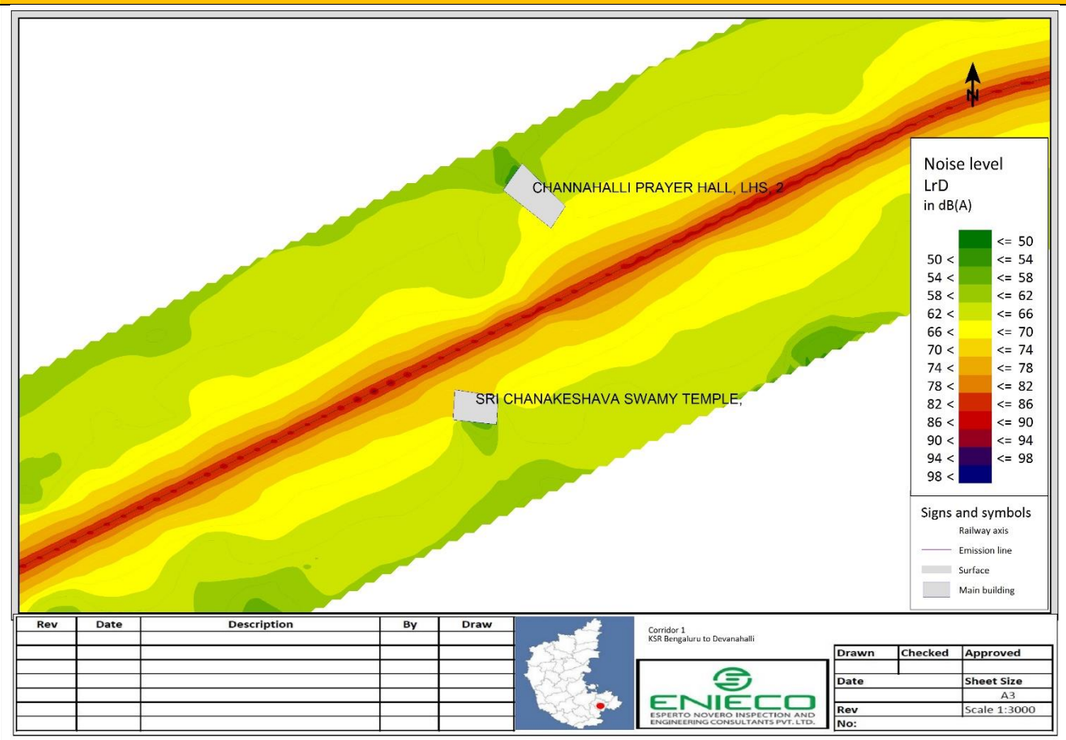
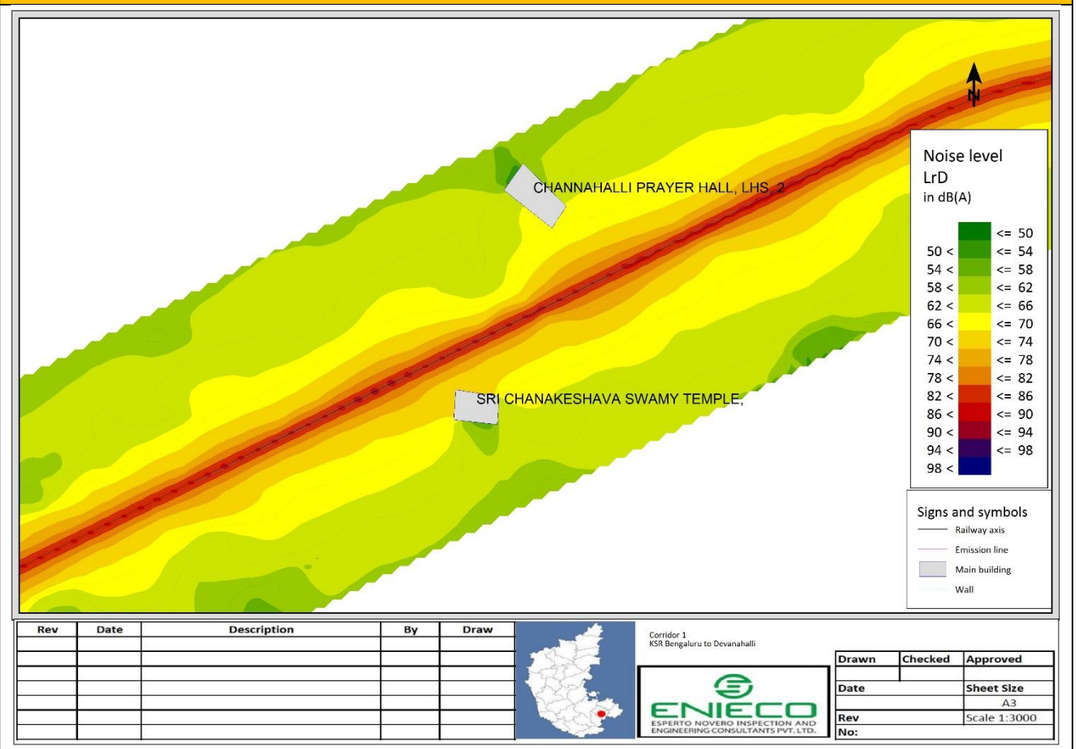
S.No	Without Barrier	With Barrier
11.		

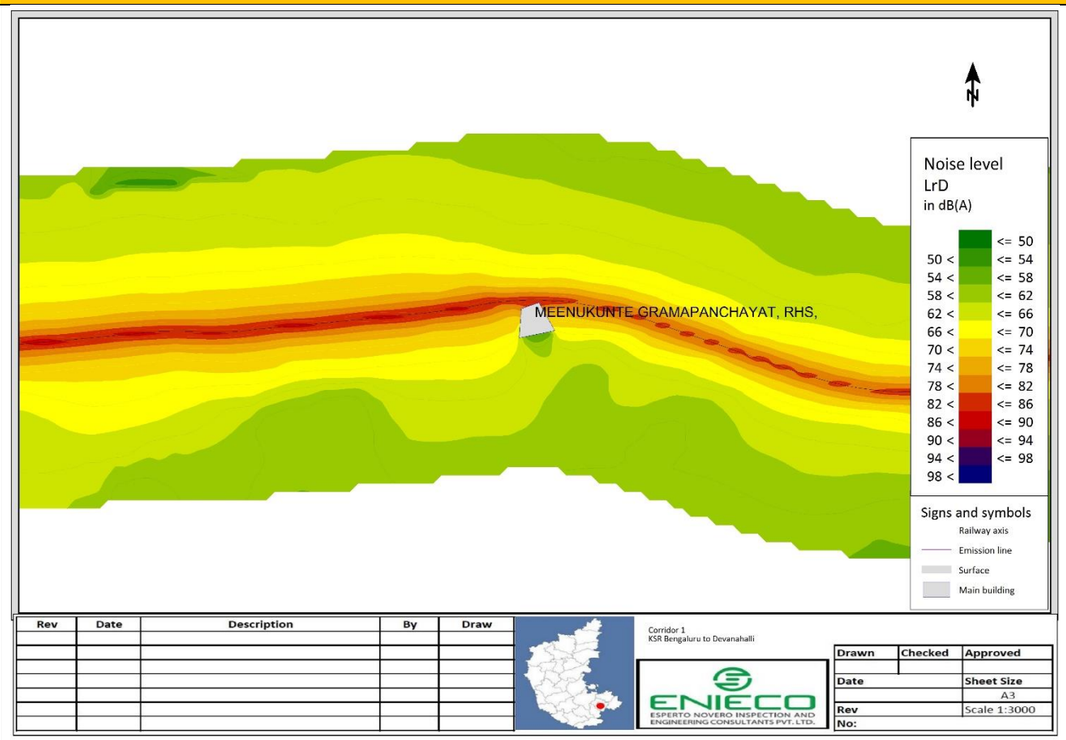
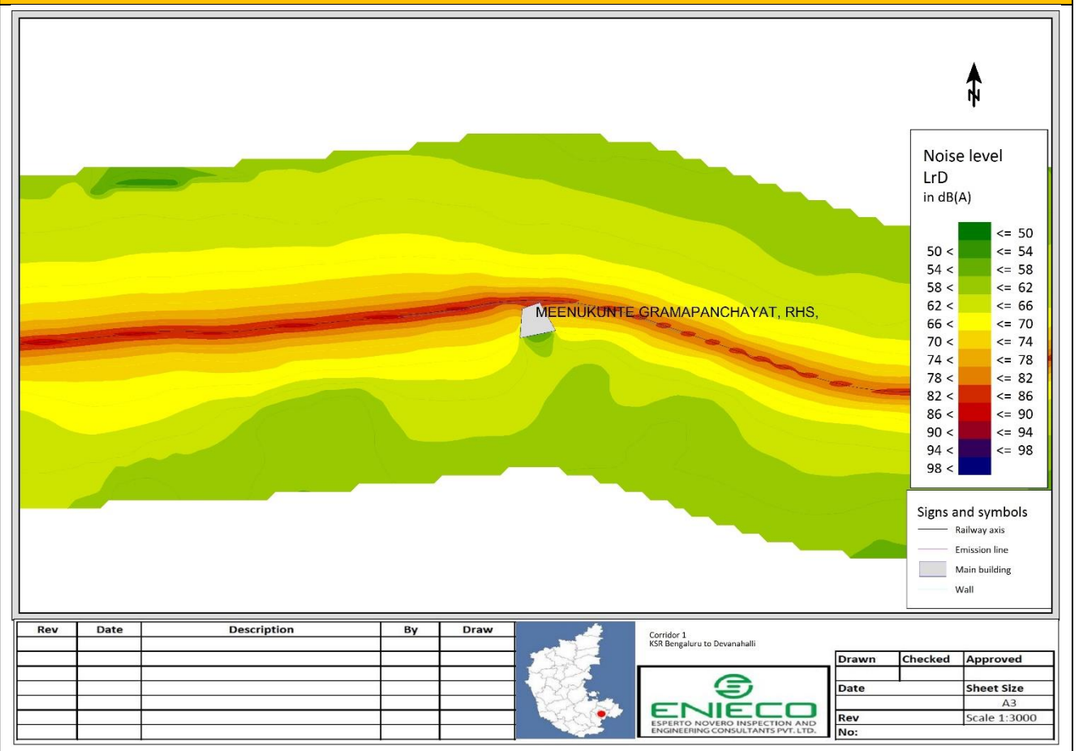
S.No	Without Barrier	With Barrier
12.		

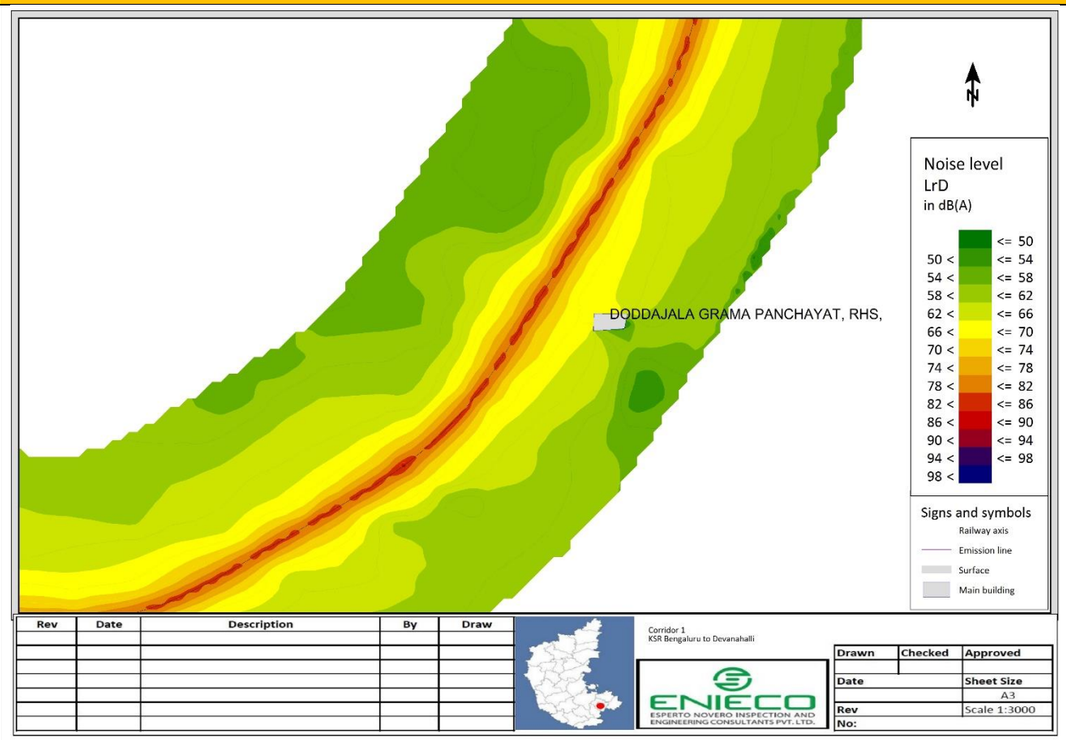
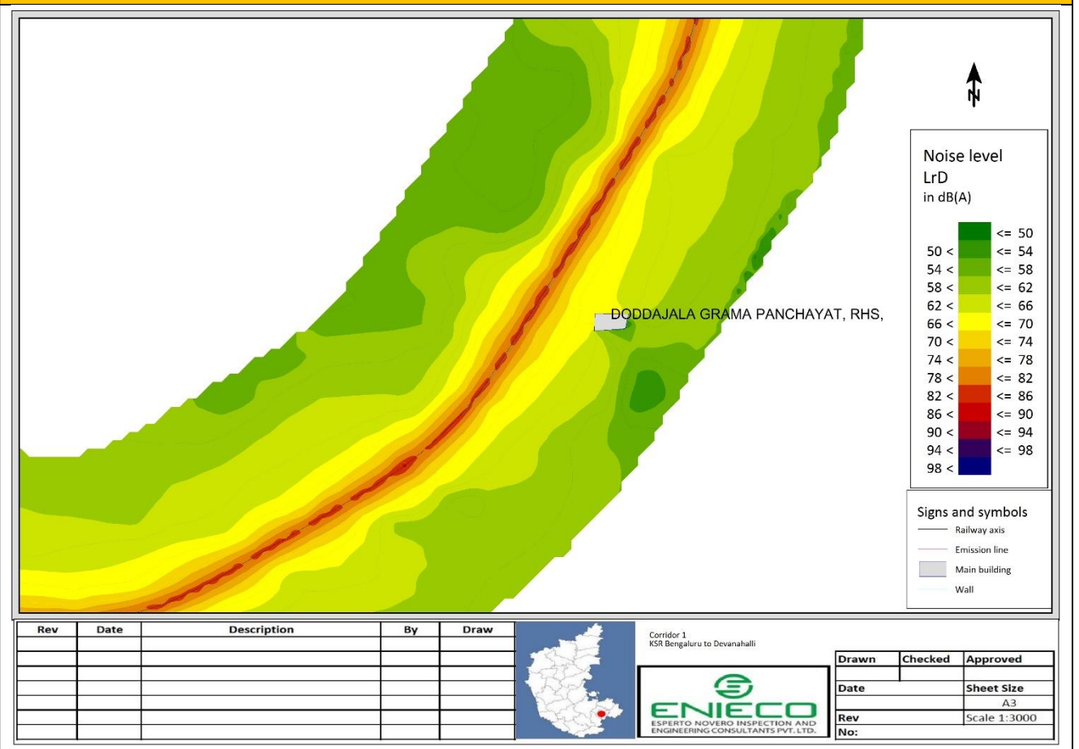
S.No	Without Barrier	With Barrier
13.		

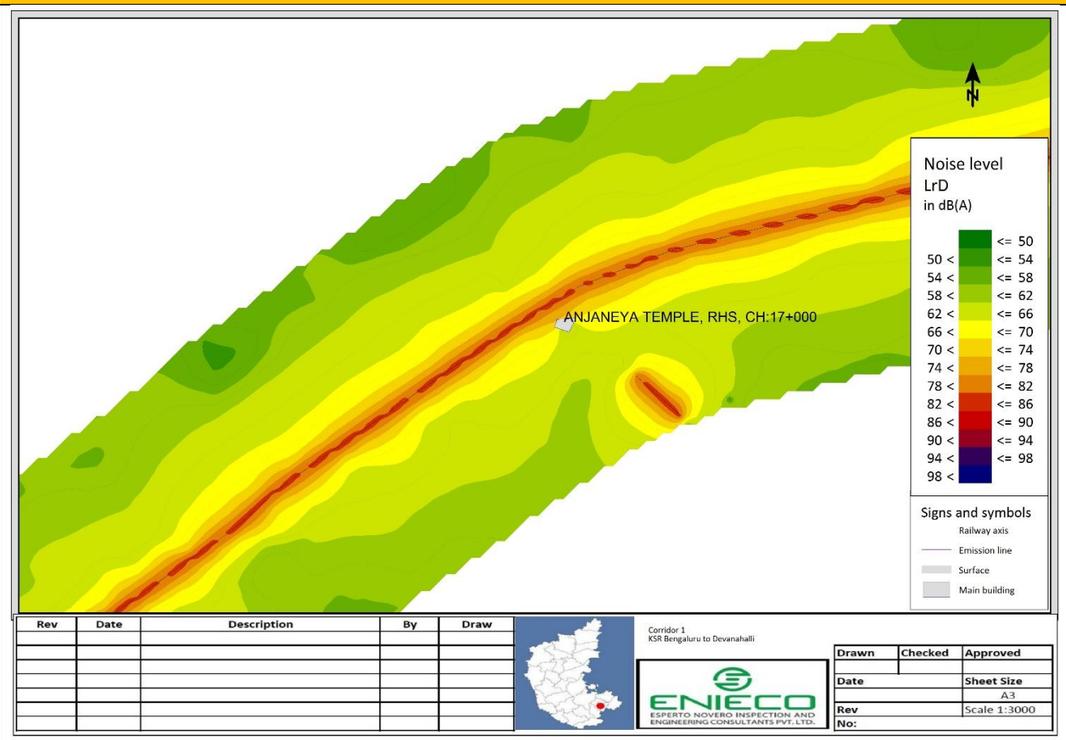
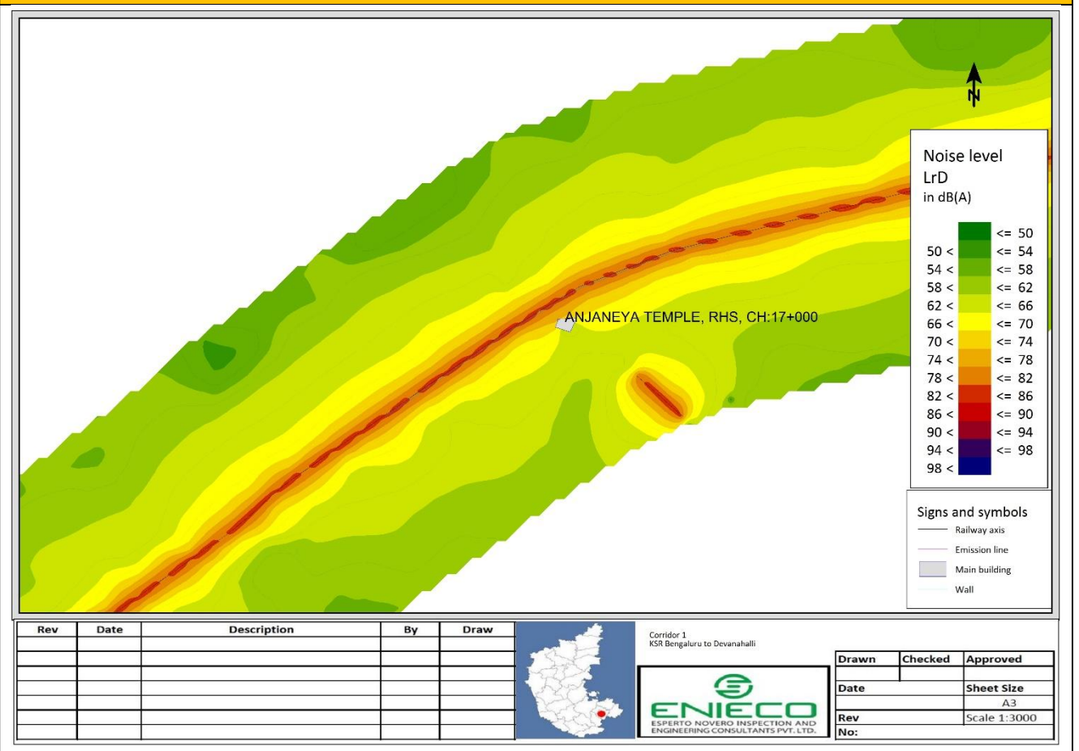
S.No	Without Barrier	With Barrier
14.		

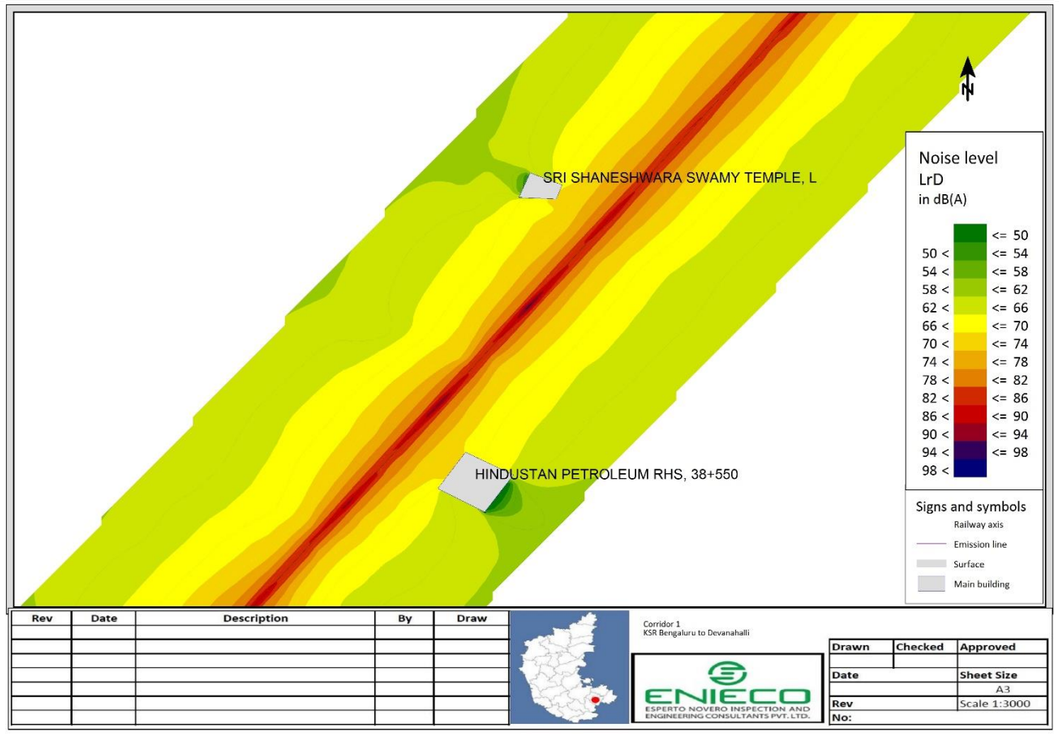
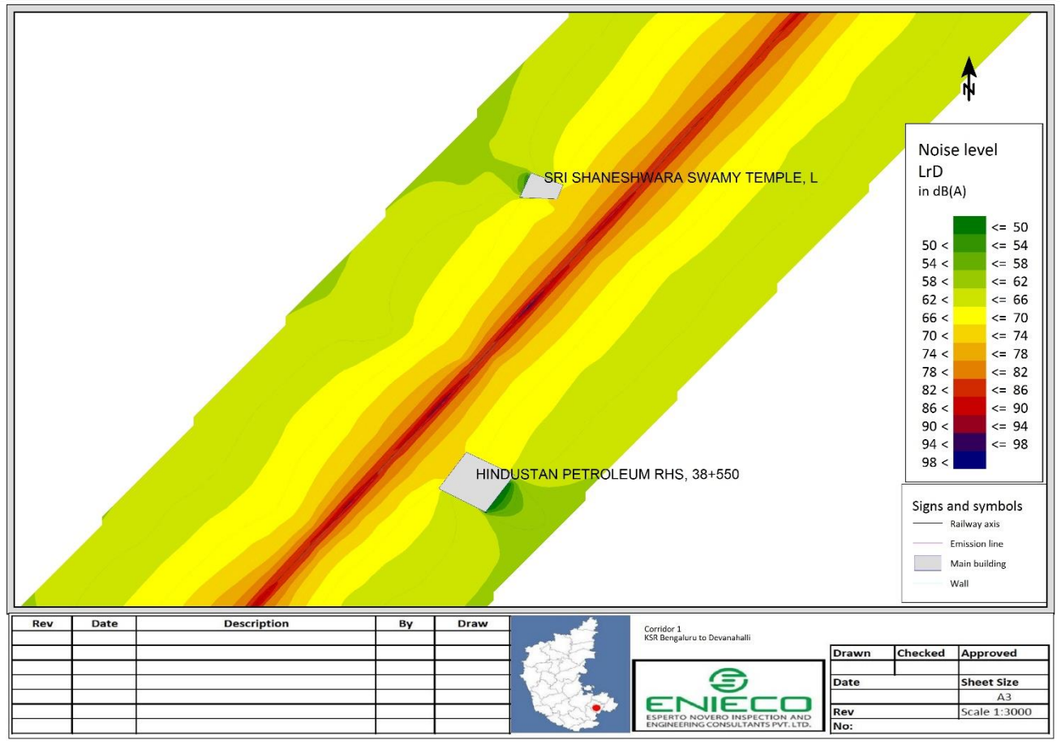
S.No	Without Barrier	With Barrier
15.		

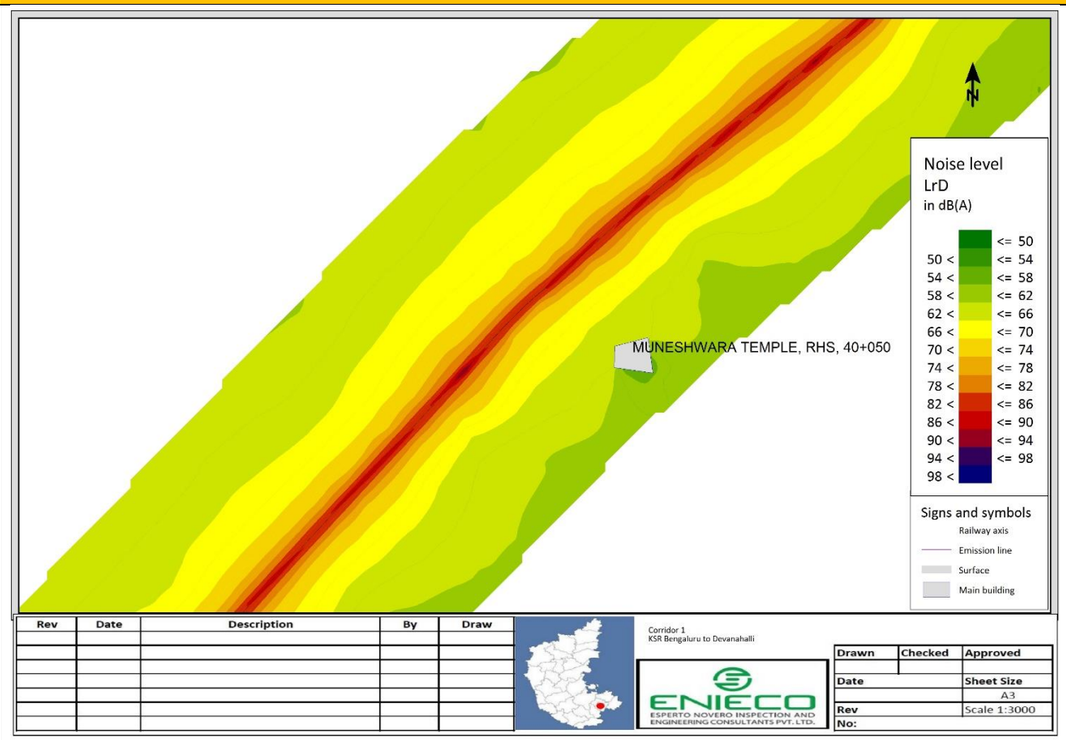
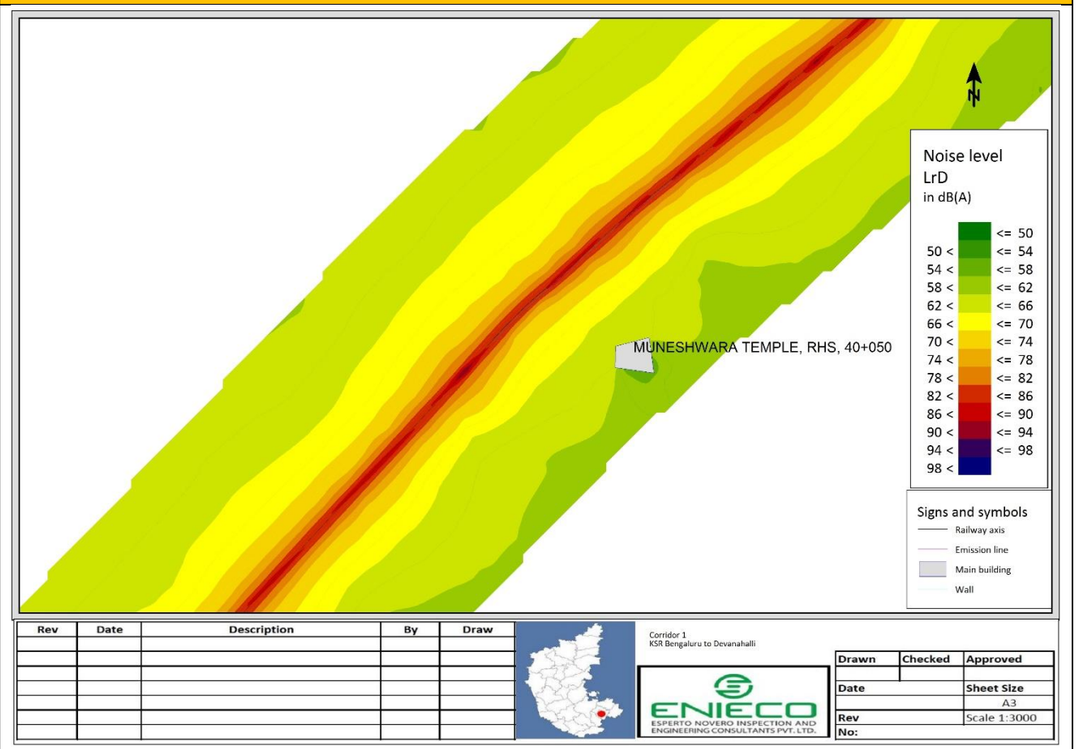
S.No	Without Barrier	With Barrier
16.		

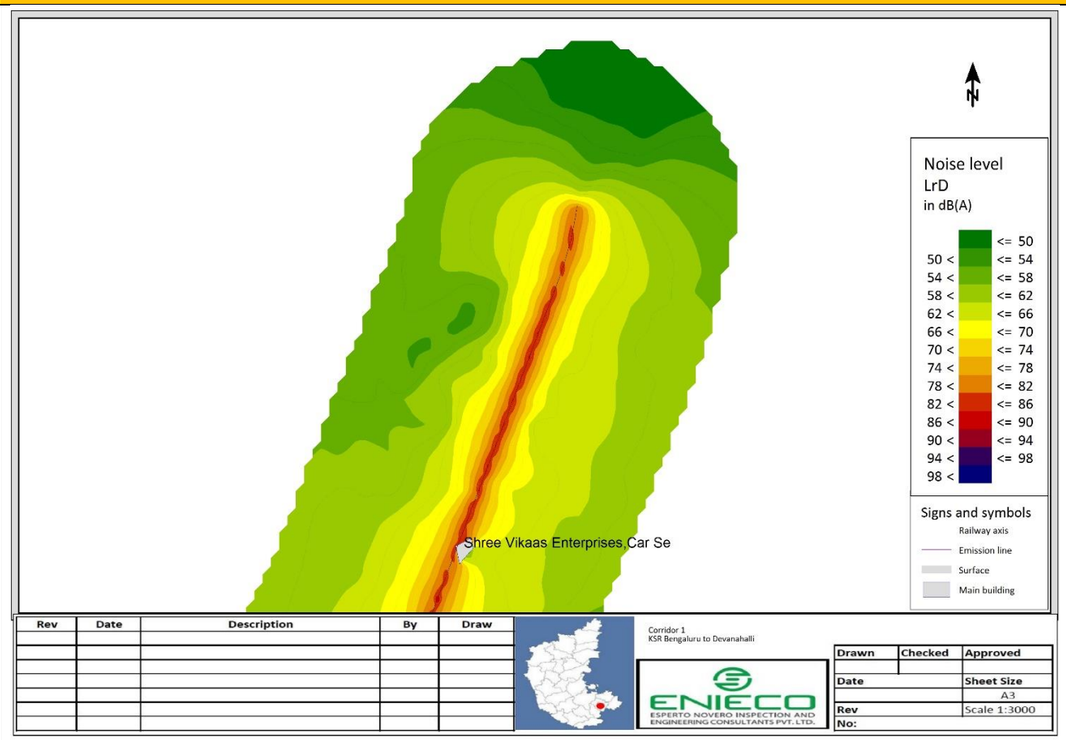
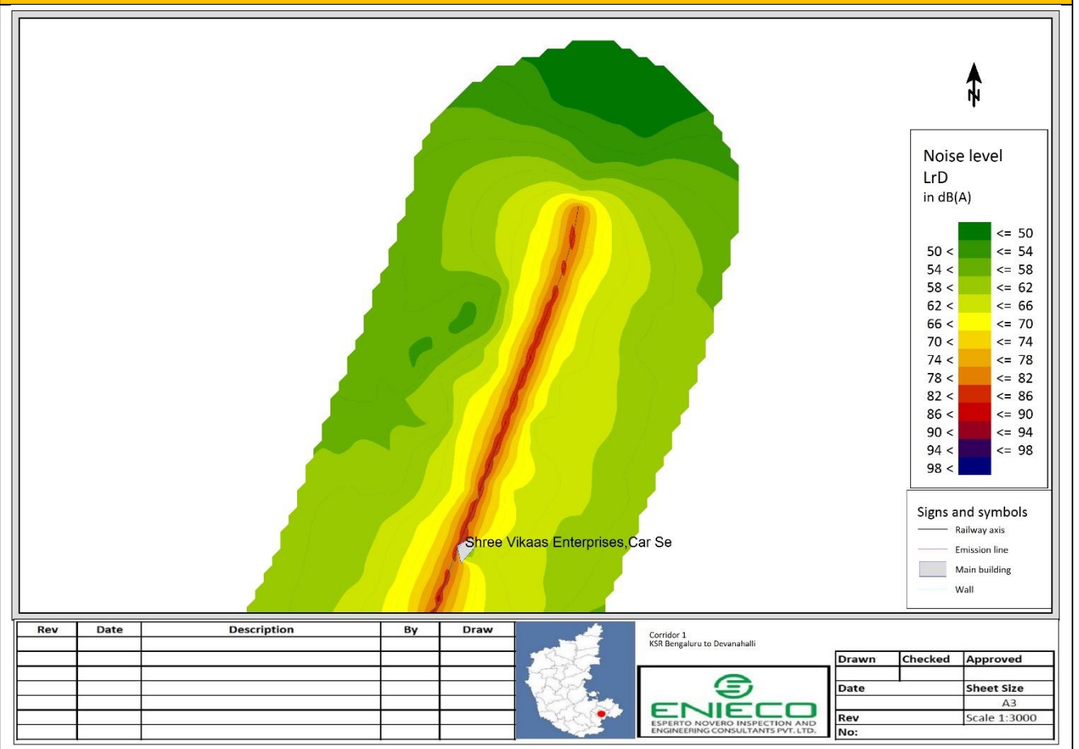
S.No	Without Barrier	With Barrier
17.		

S.No	Without Barrier	With Barrier
18.		

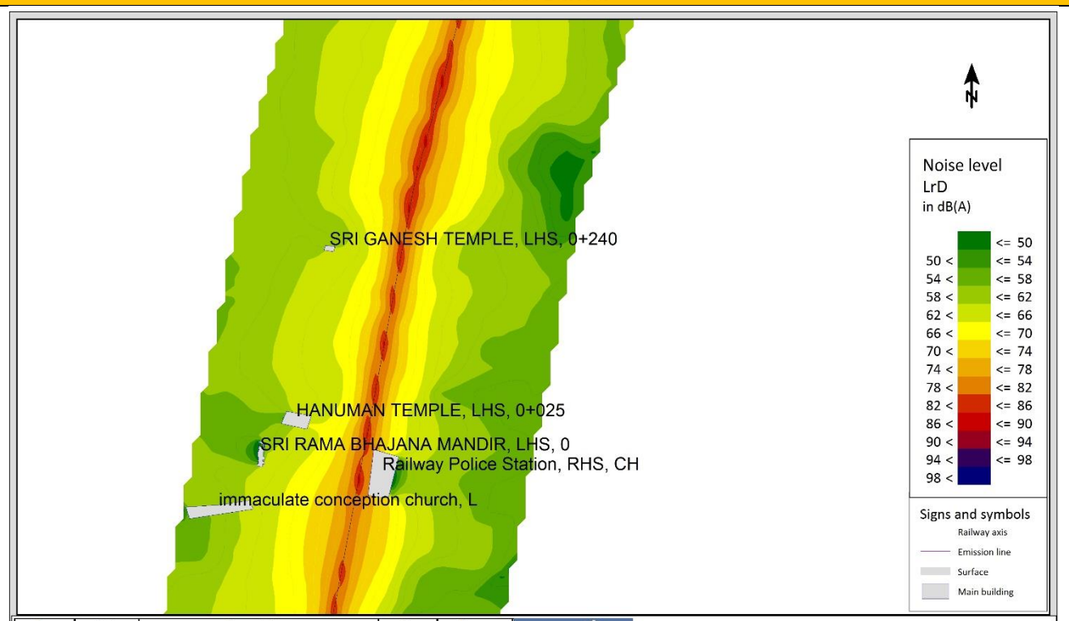
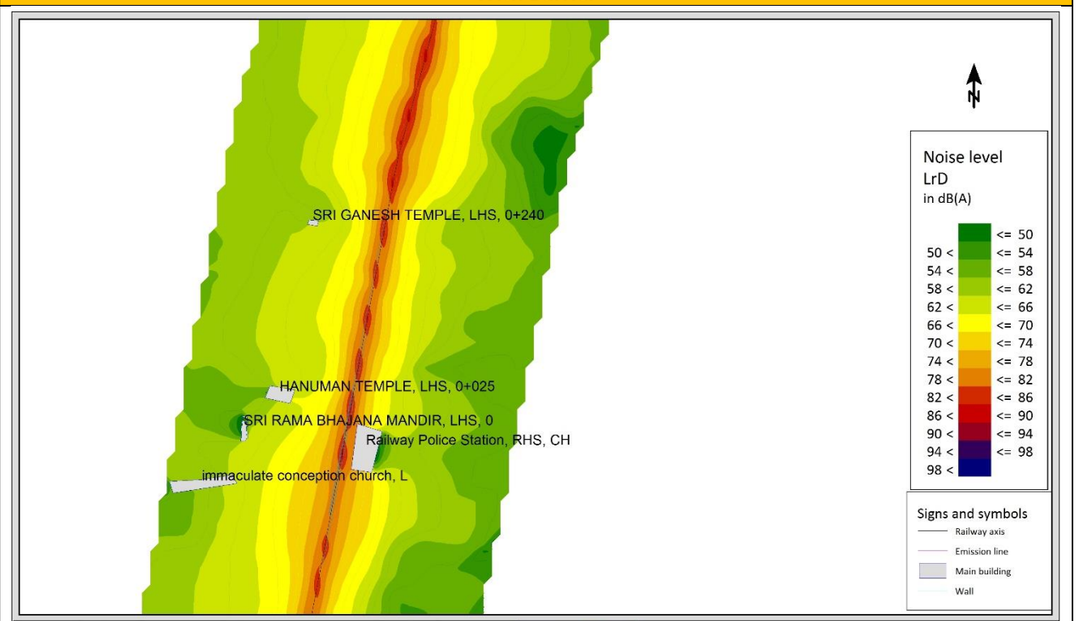
S.No	Without Barrier	With Barrier
19.		

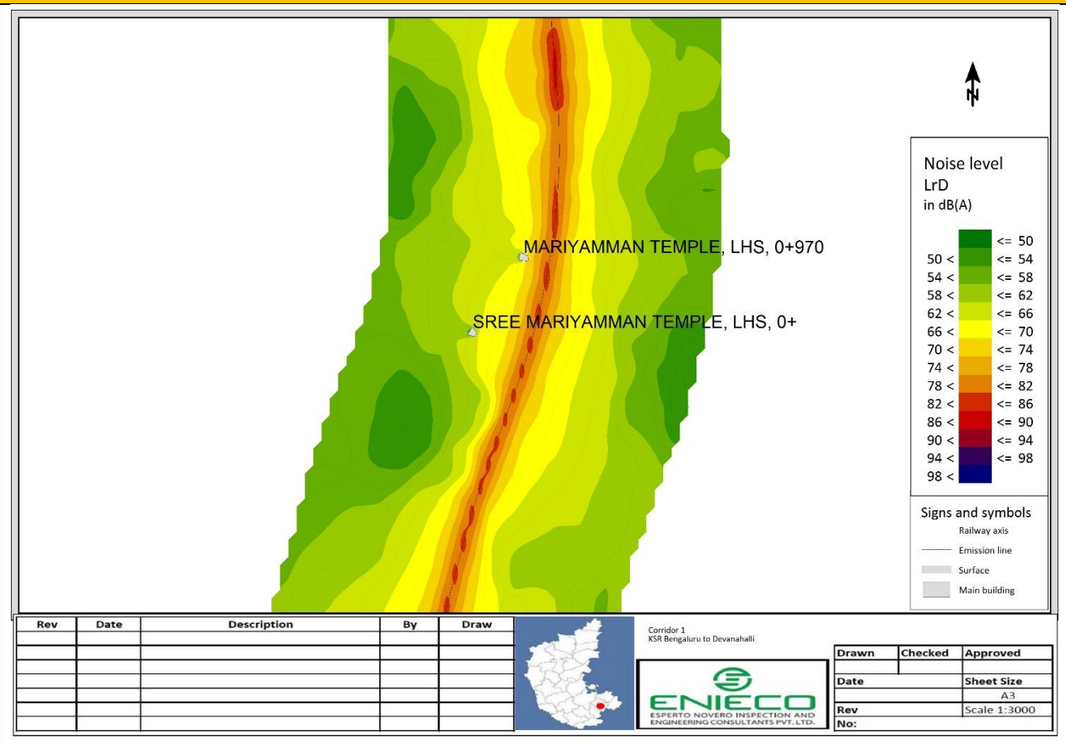
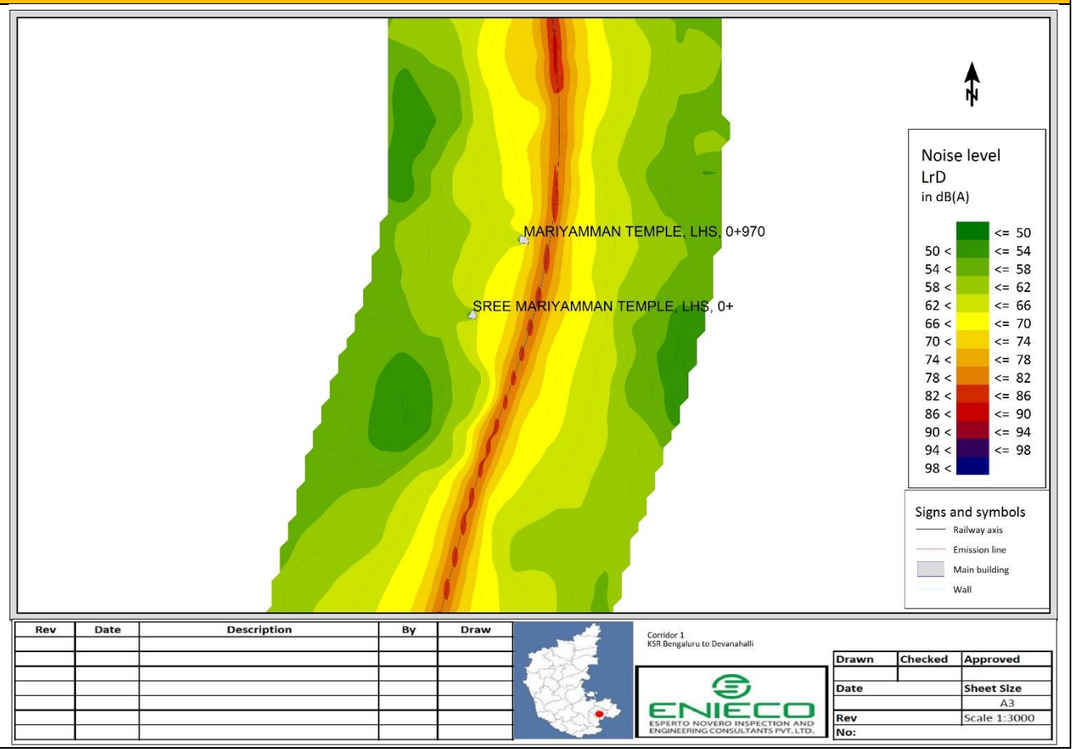
S.No	Without Barrier	With Barrier
20.		

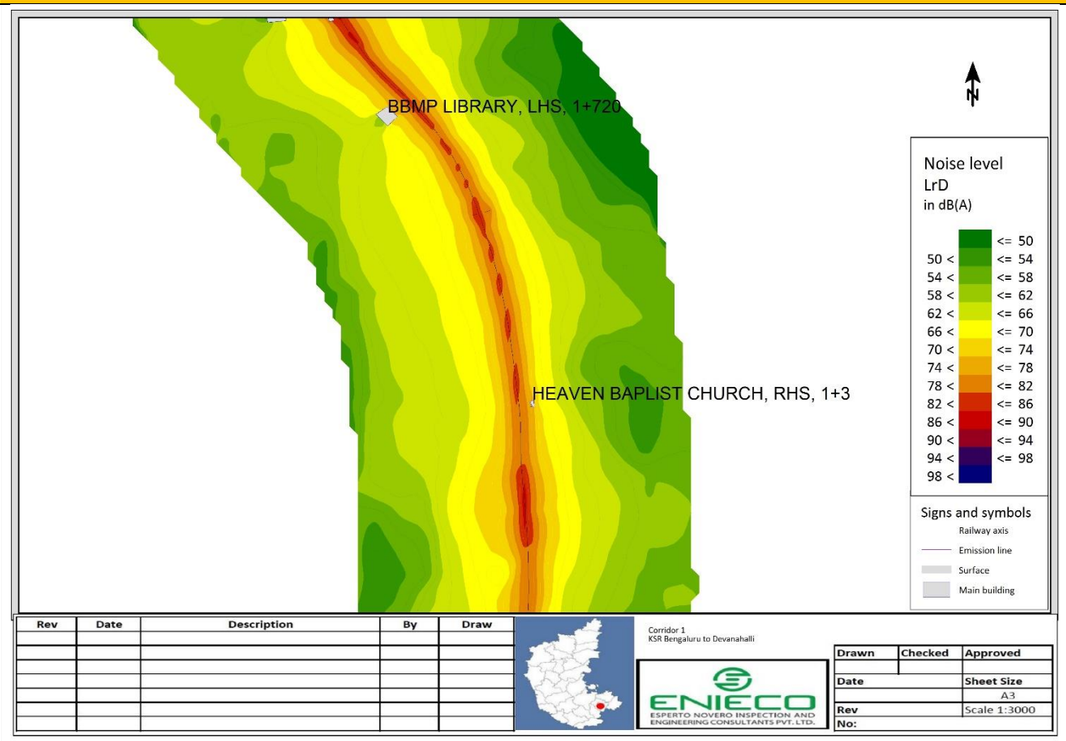
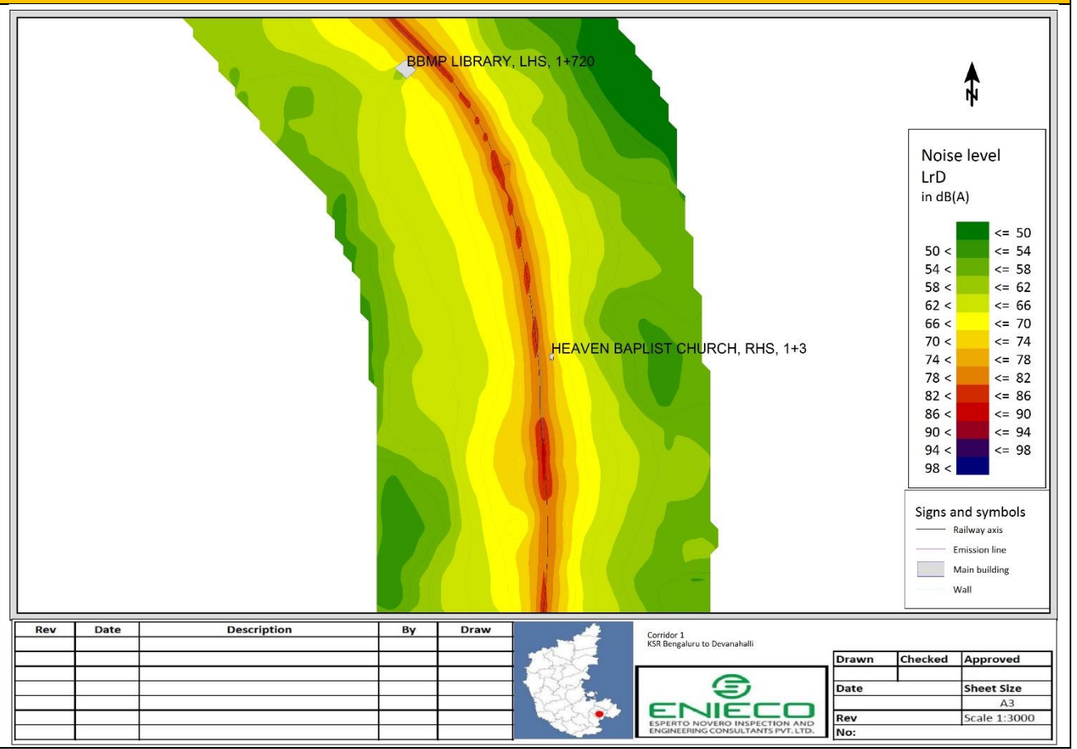
S.No	Without Barrier	With Barrier
21.		

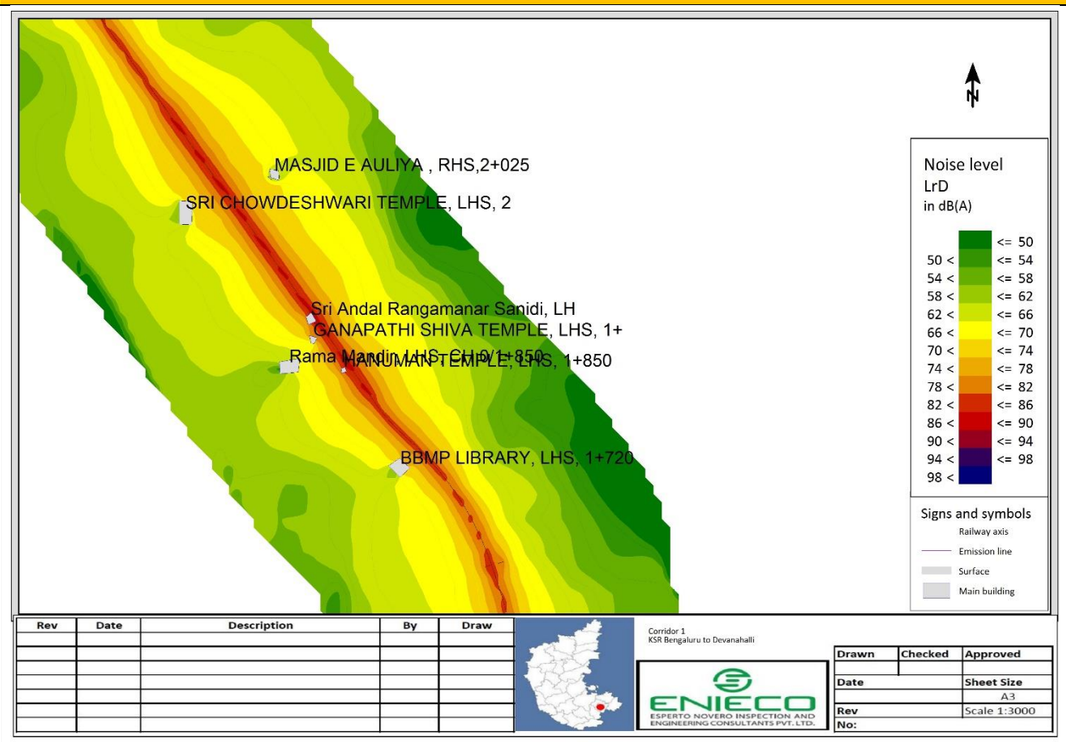
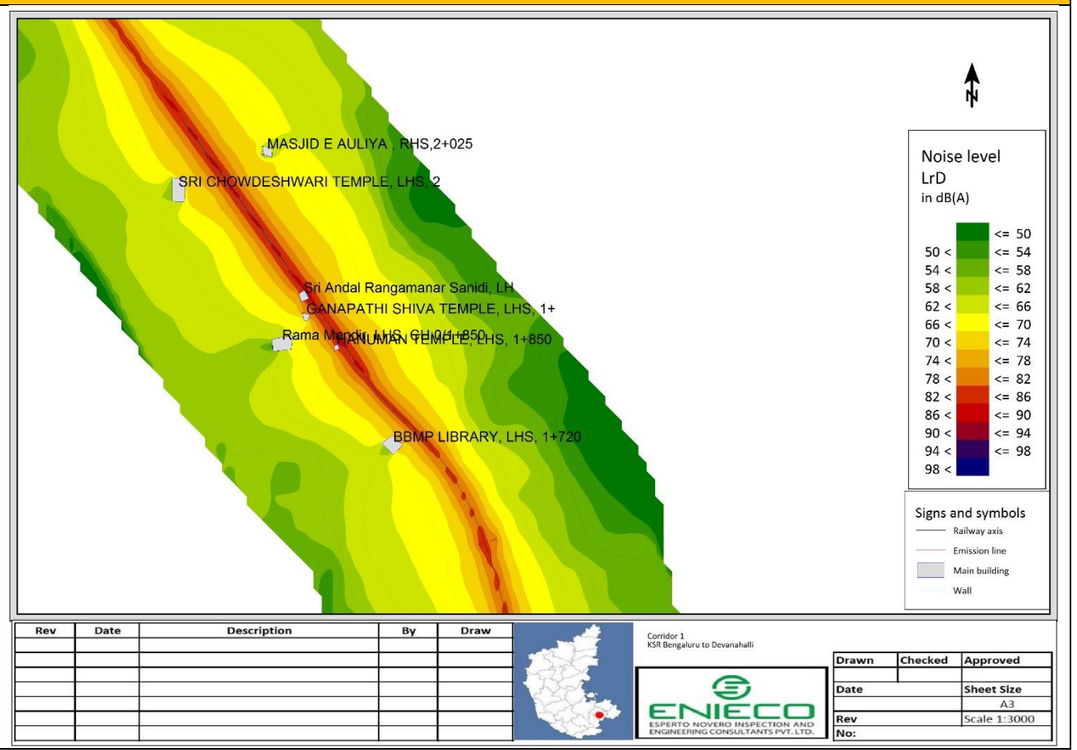
S.No	Without Barrier	With Barrier
22.		

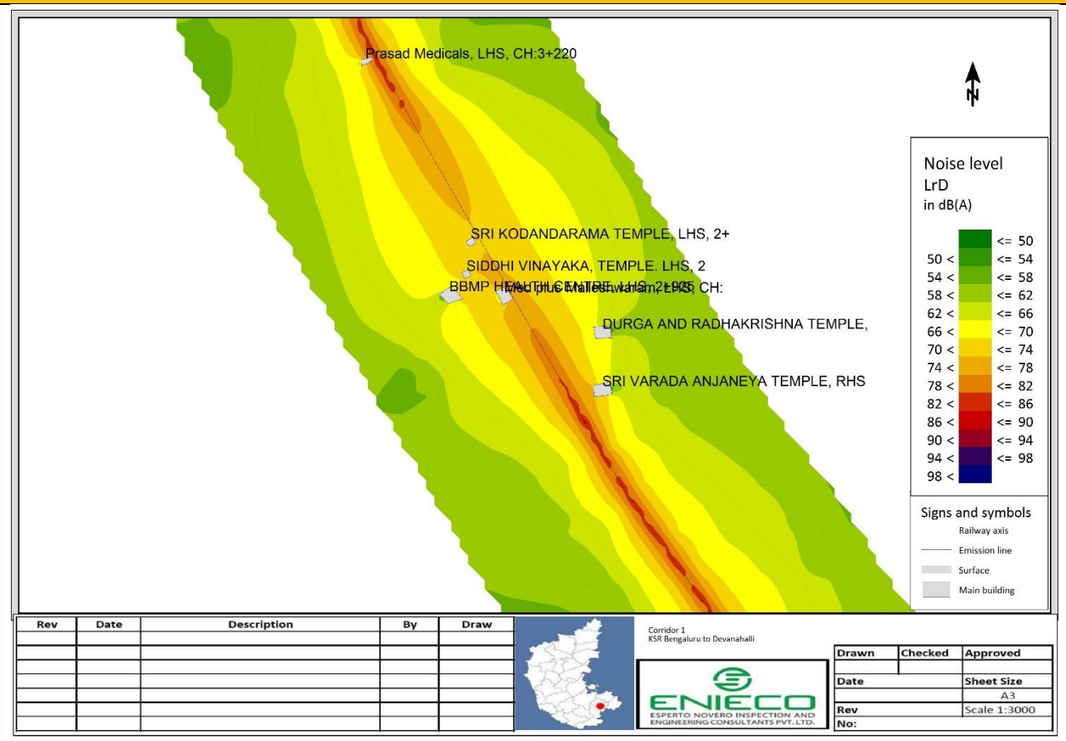
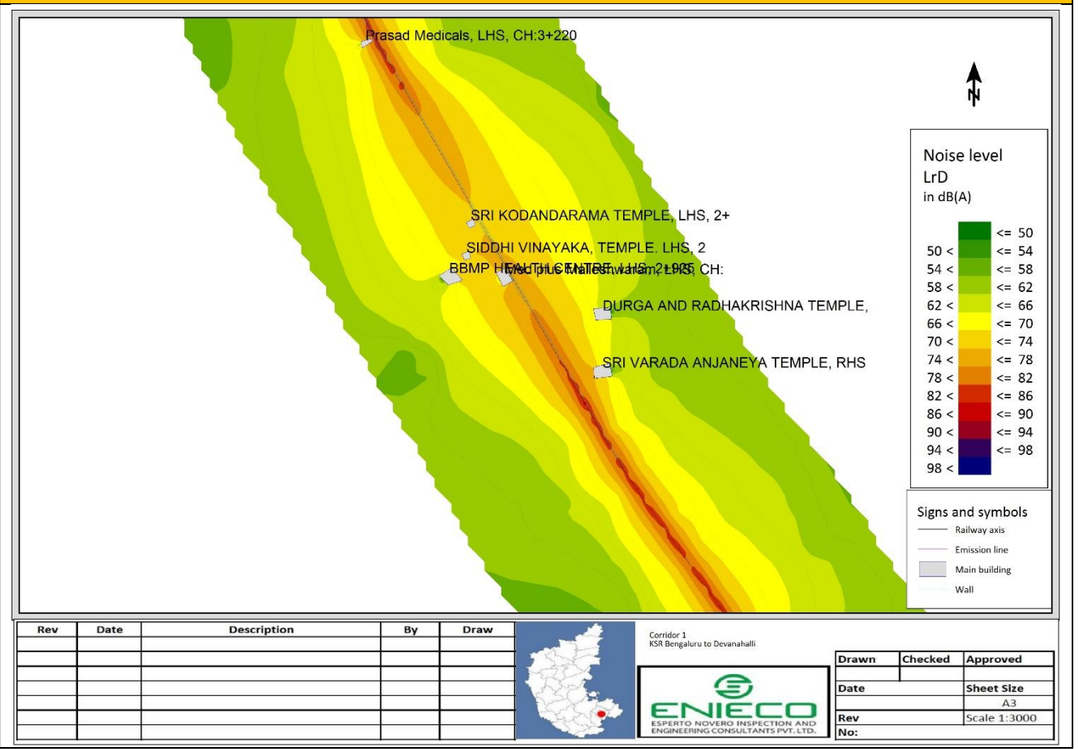
B. Noise contours for Corridor 1 for the Year 2031

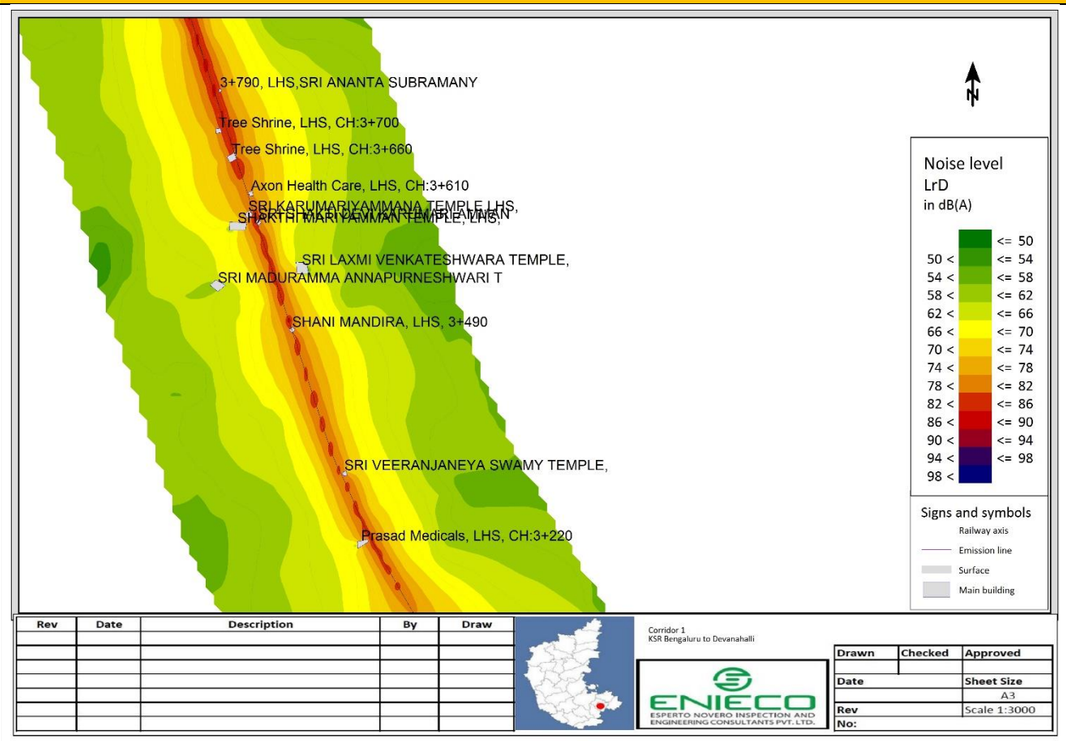
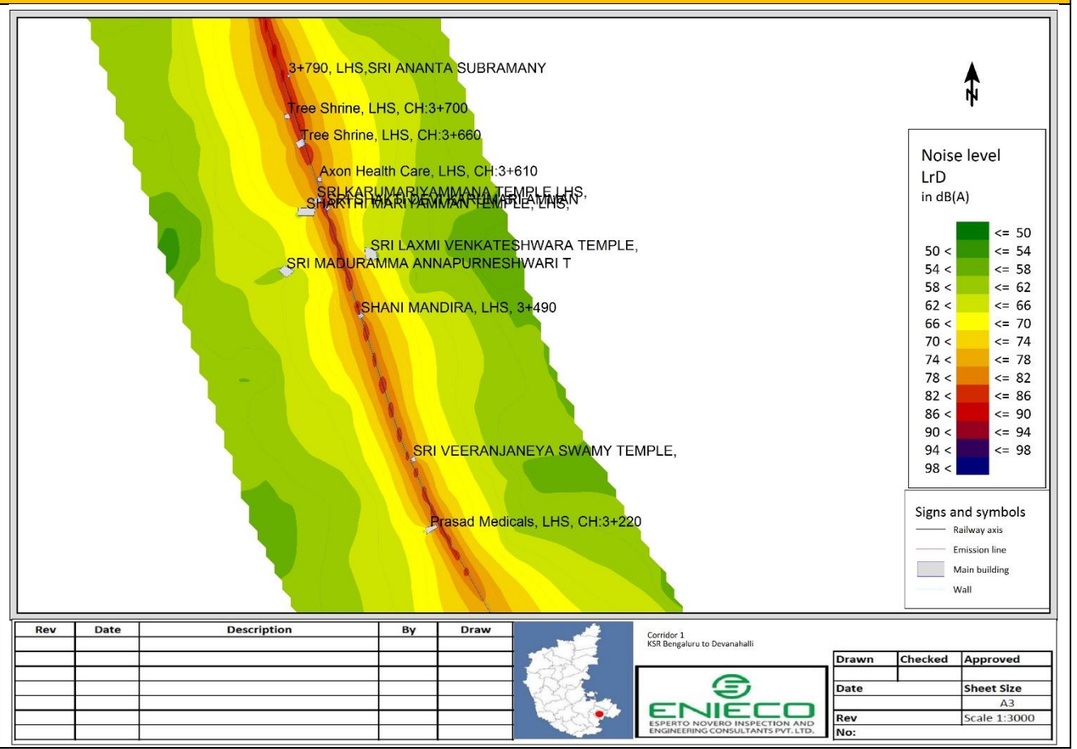
S.No	Without Barrier	With Barrier
1.		

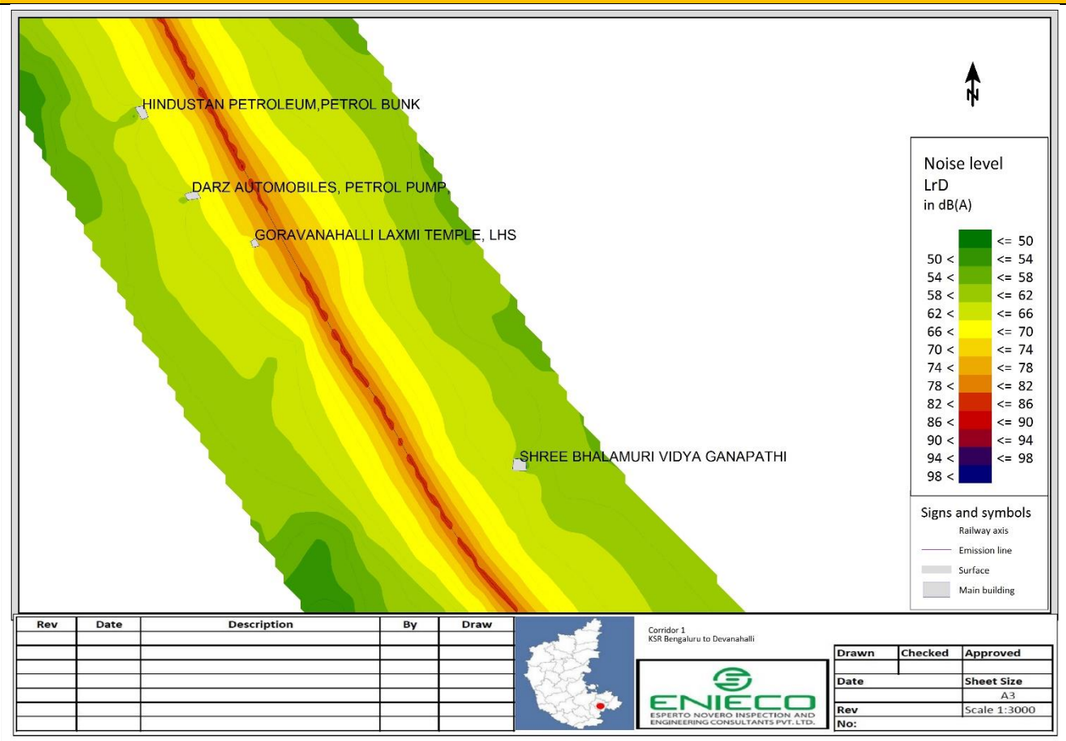
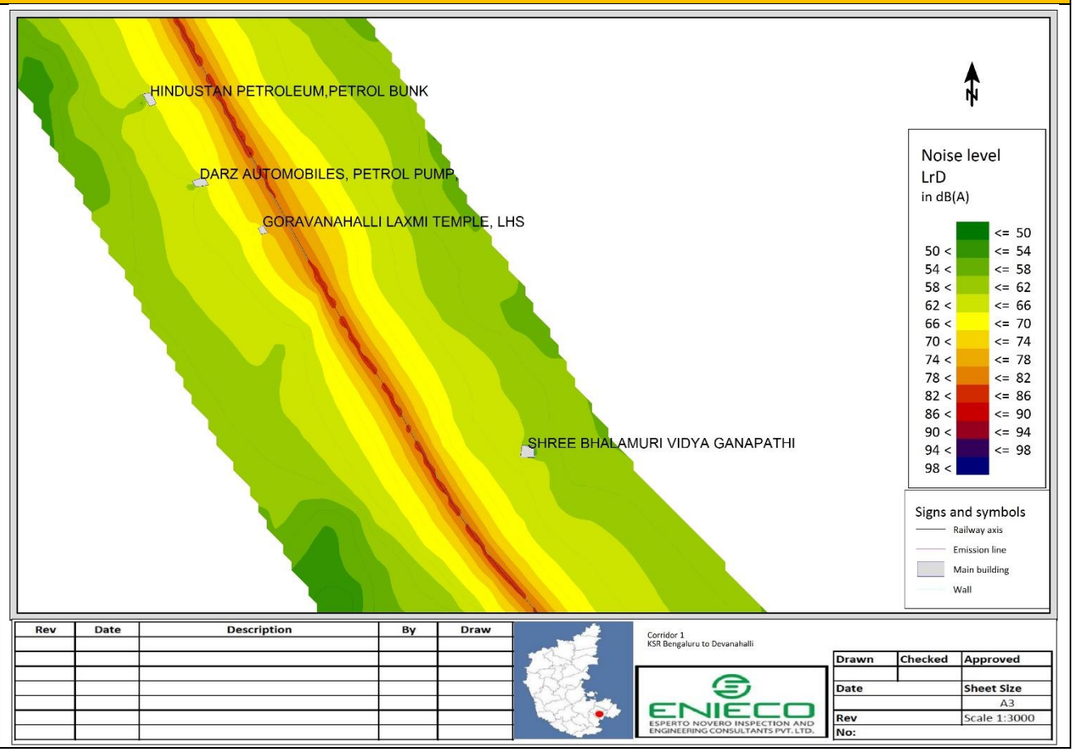
S.No	Without Barrier	With Barrier
2.		

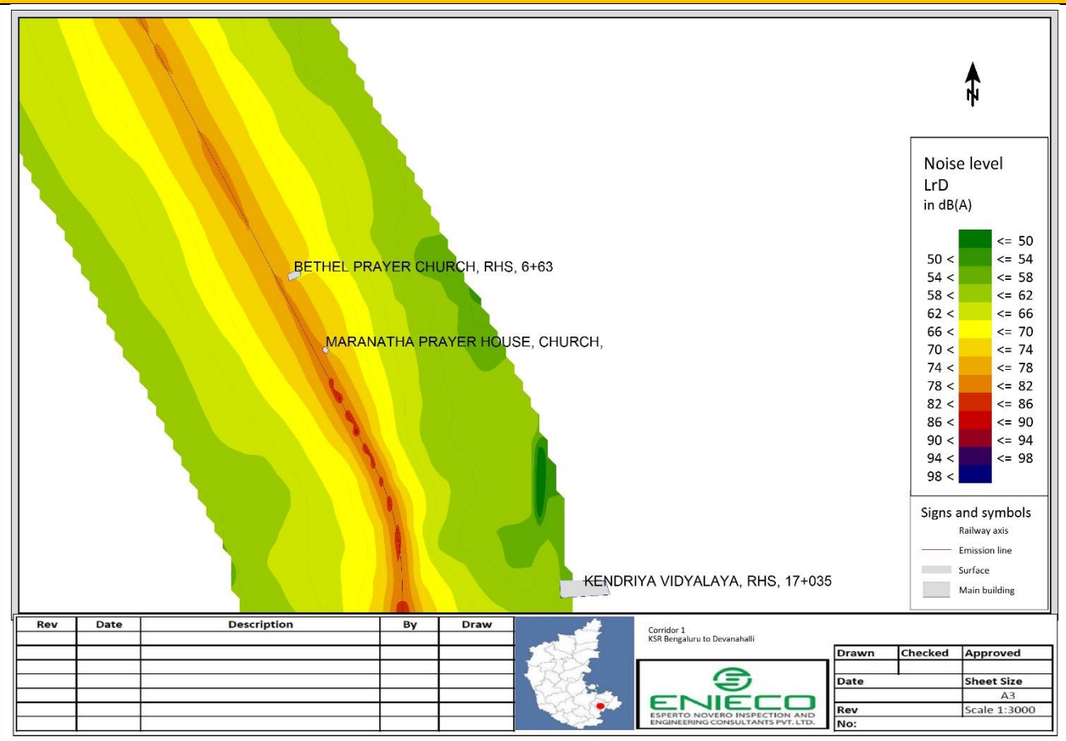
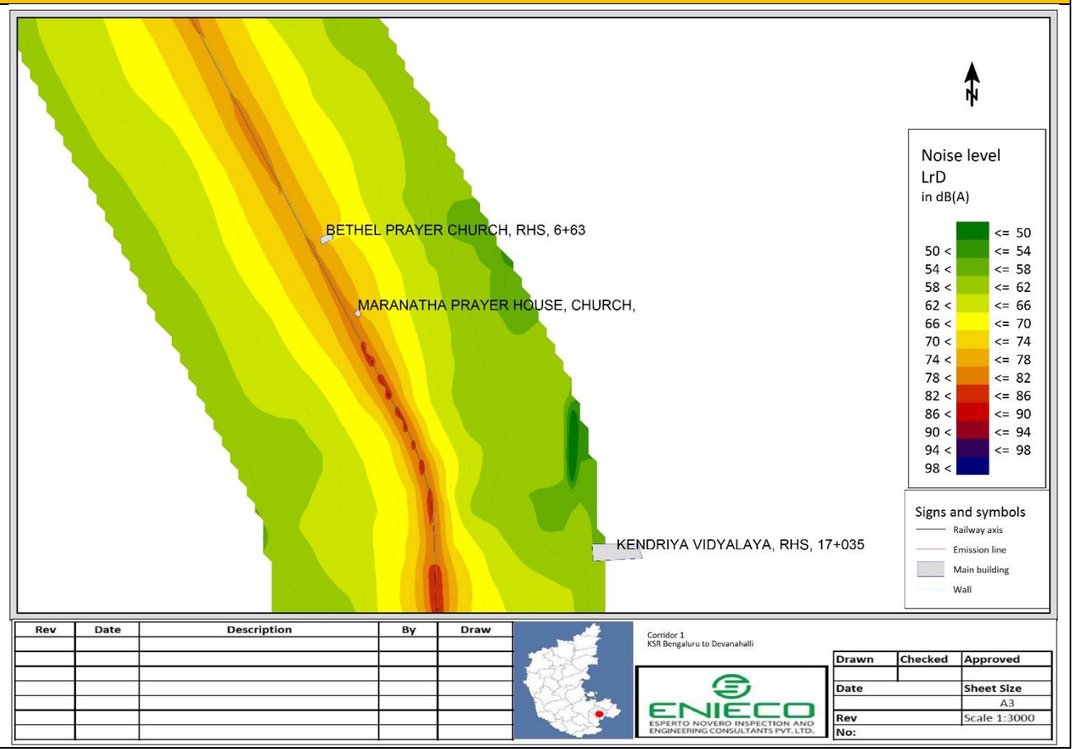
S.No	Without Barrier	With Barrier
3.		

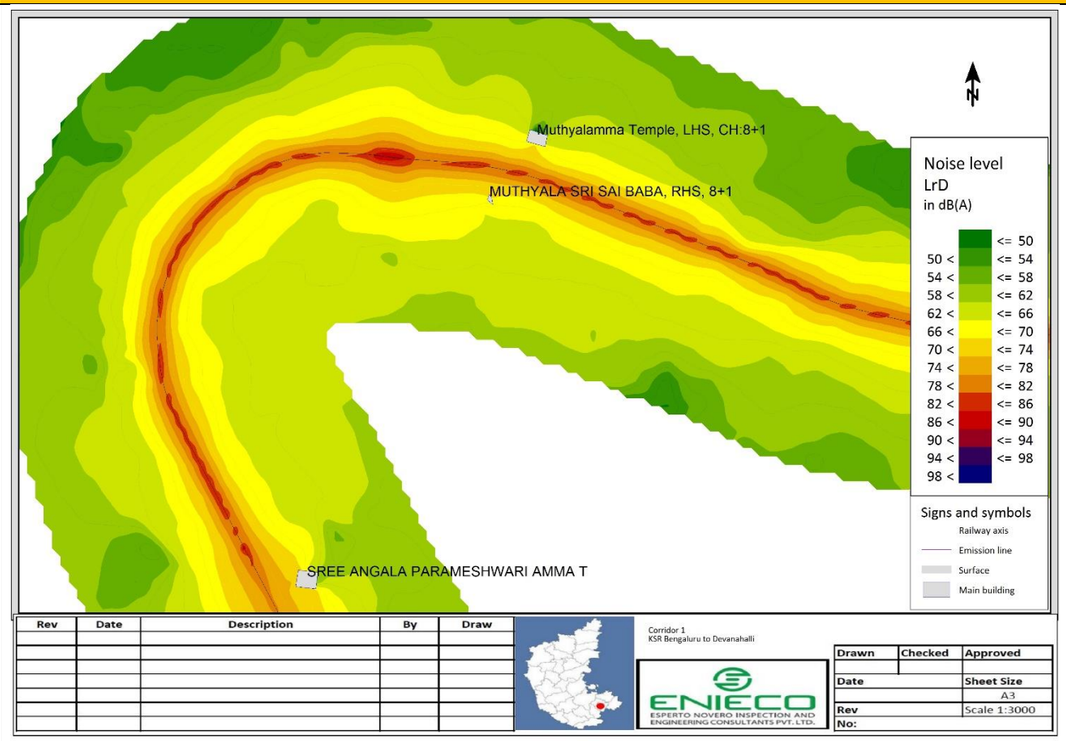
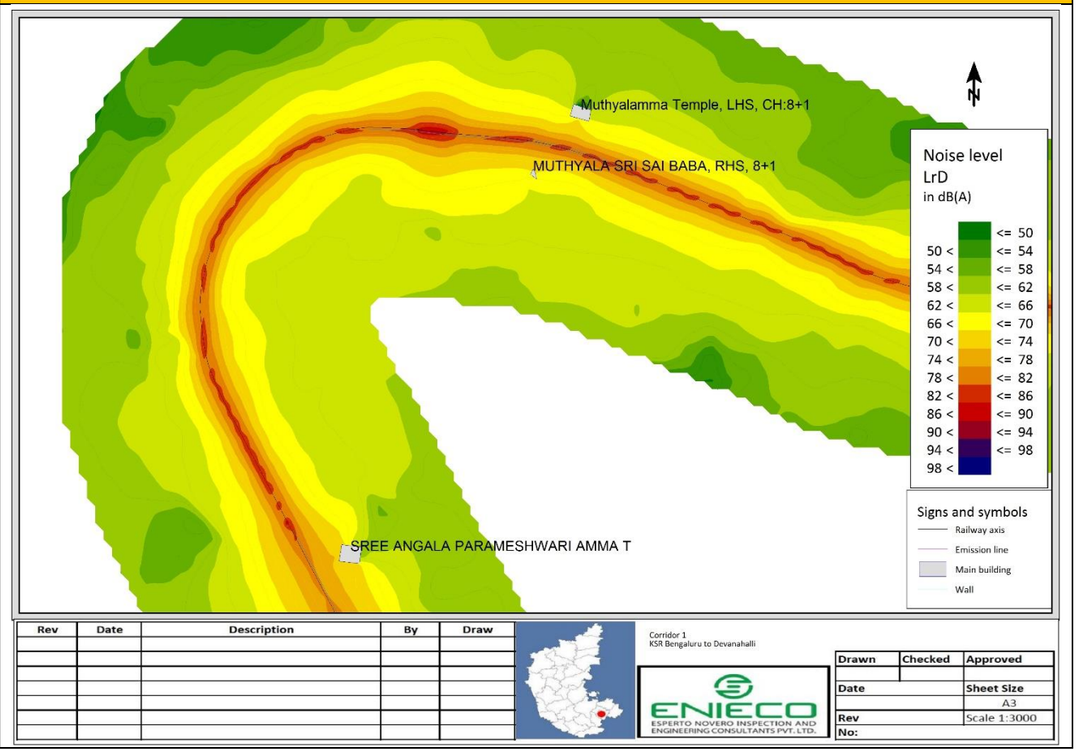
S.No	Without Barrier	With Barrier
4.		

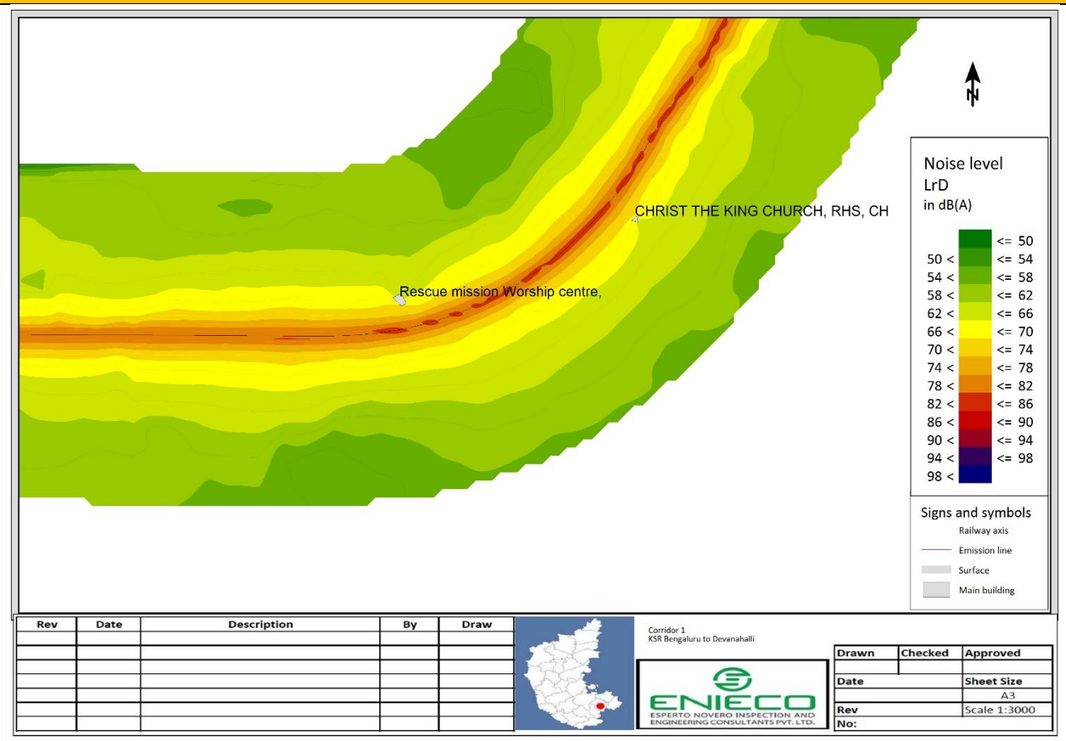
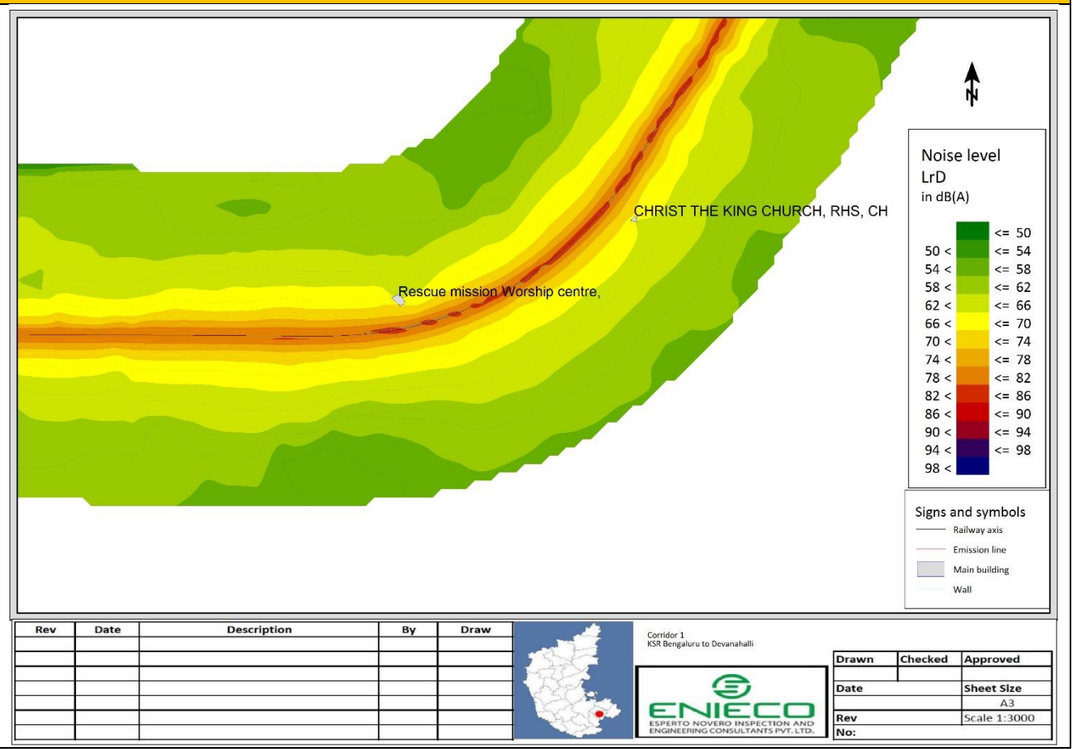
S.No	Without Barrier	With Barrier
5.		

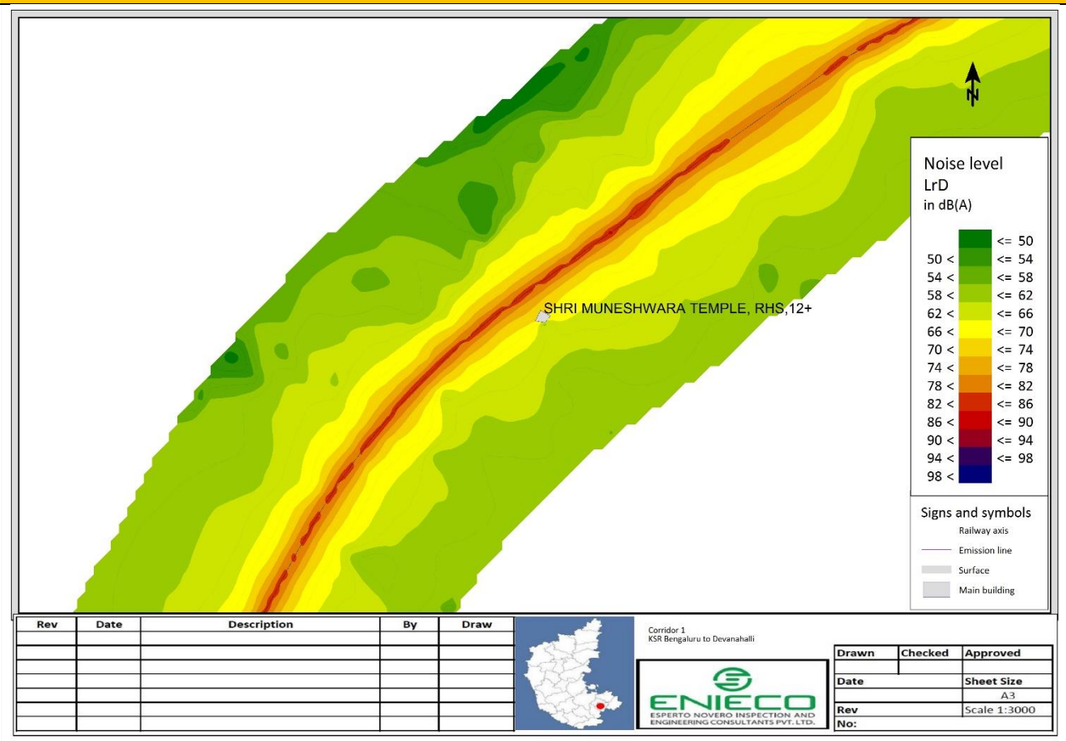
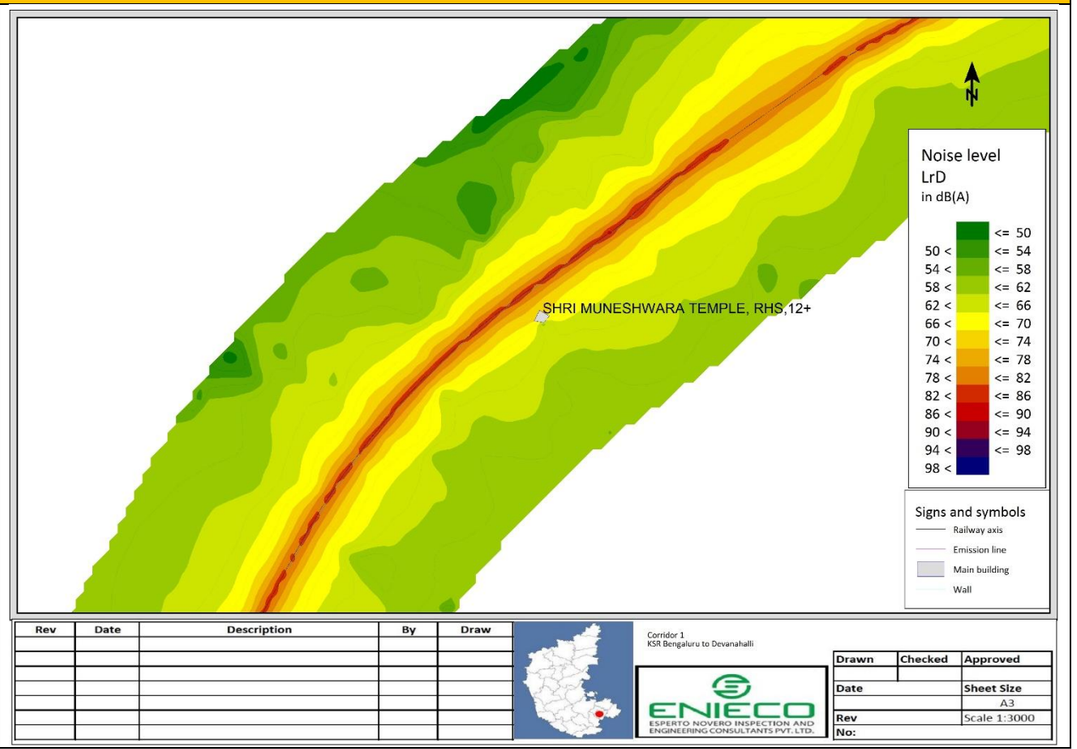
S.No	Without Barrier	With Barrier
6.		

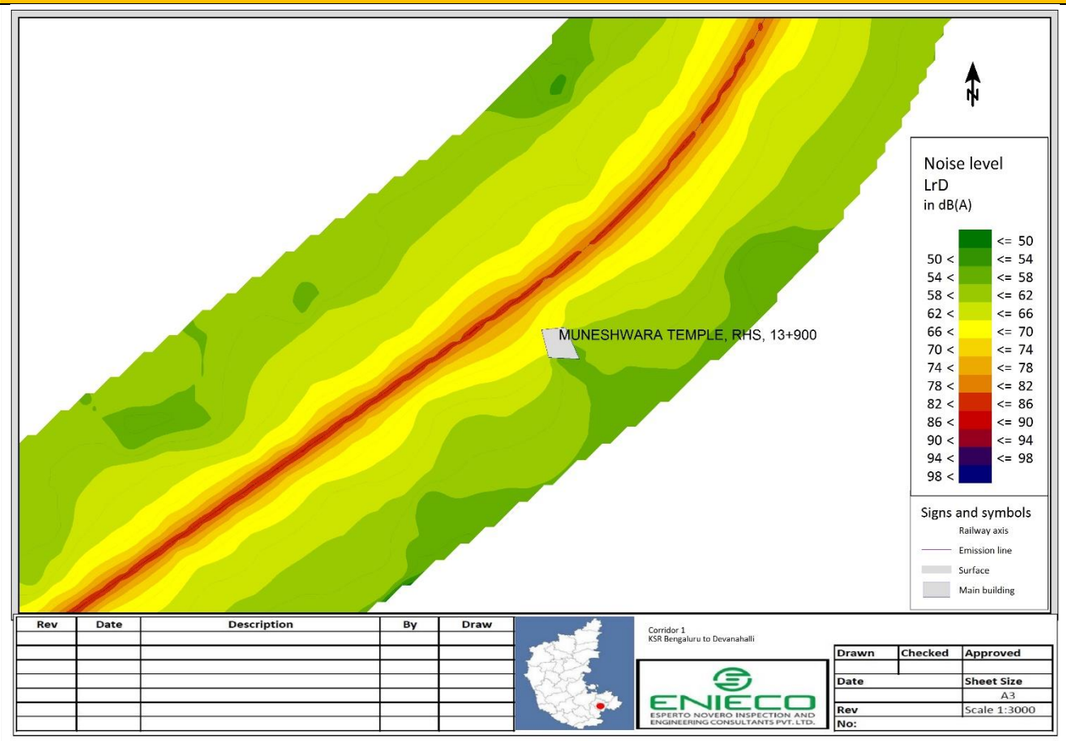
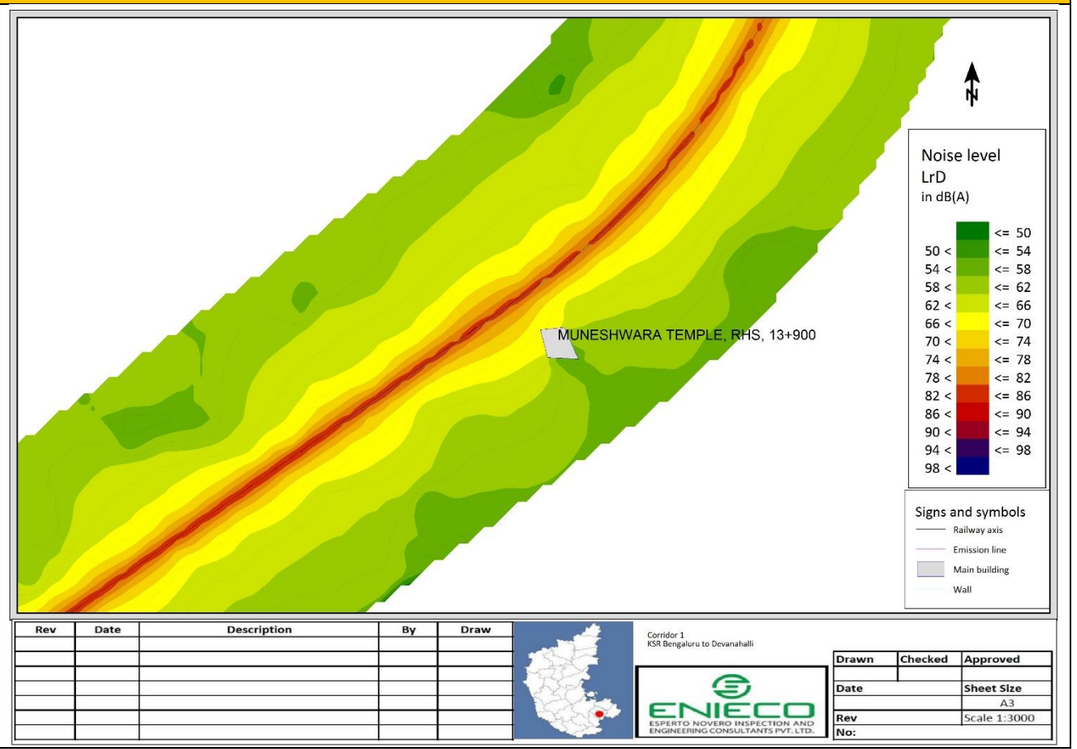
S.No	Without Barrier	With Barrier
7.		

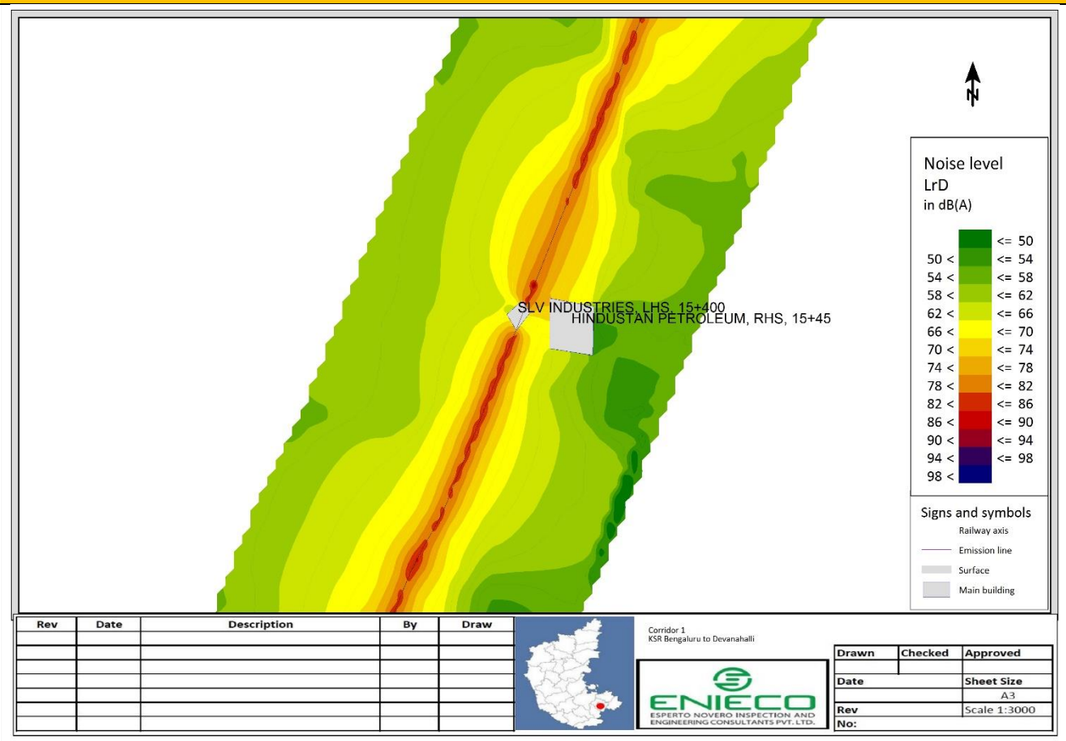
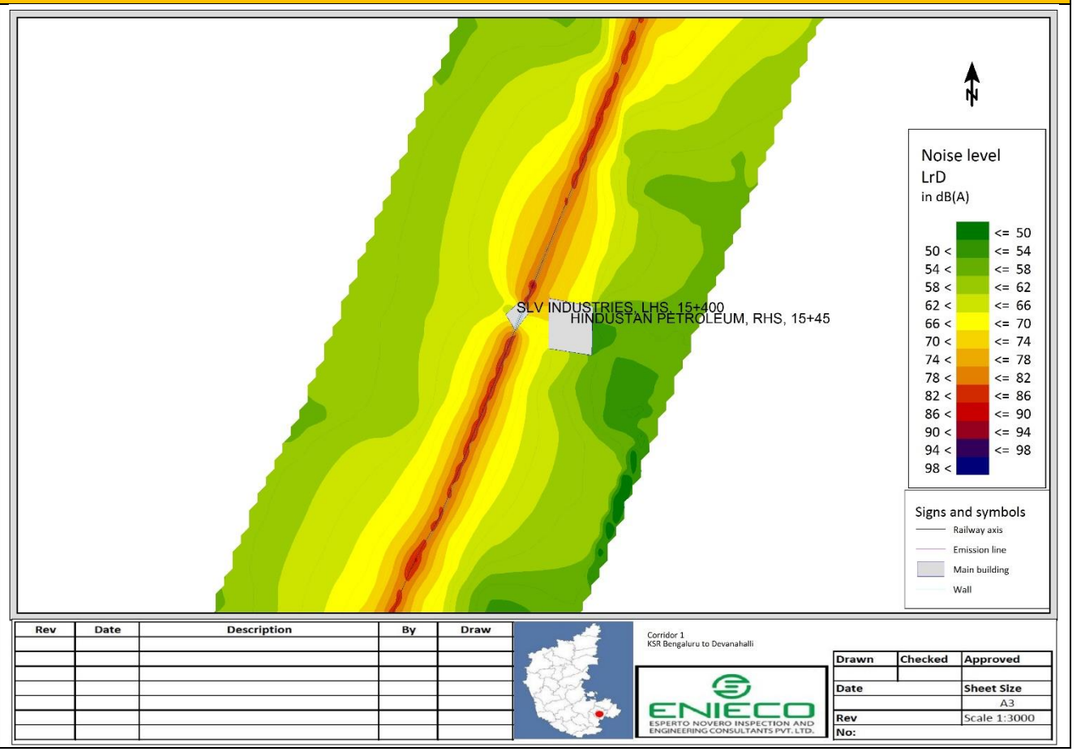
S.No	Without Barrier	With Barrier
8.		

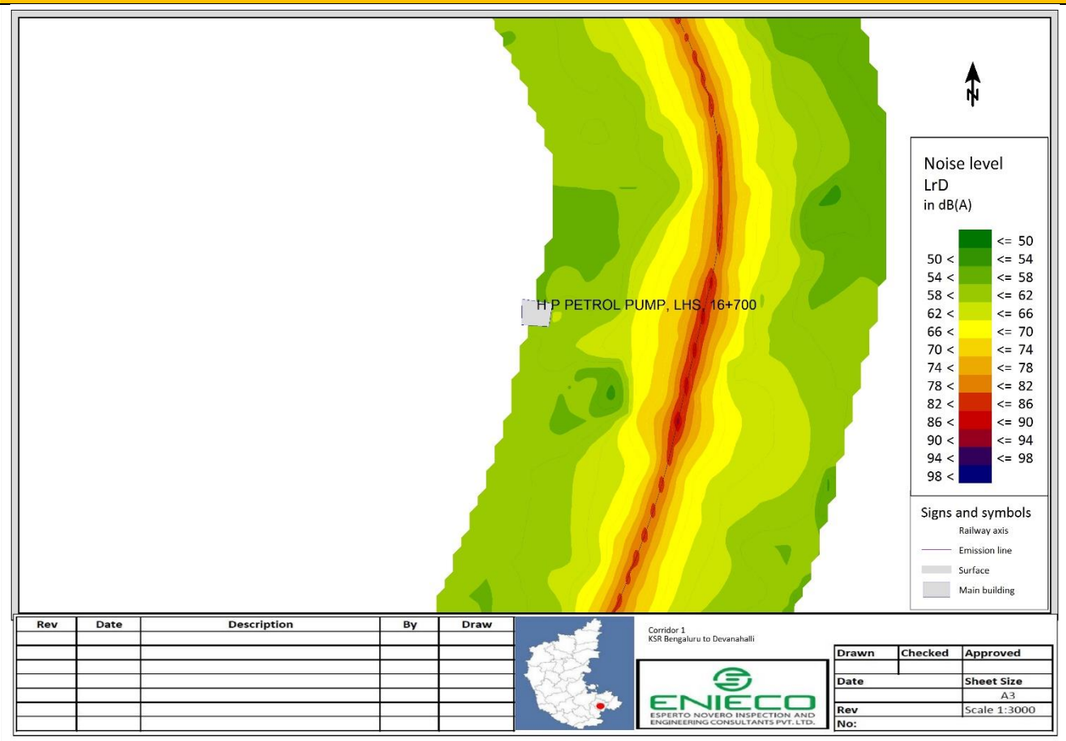
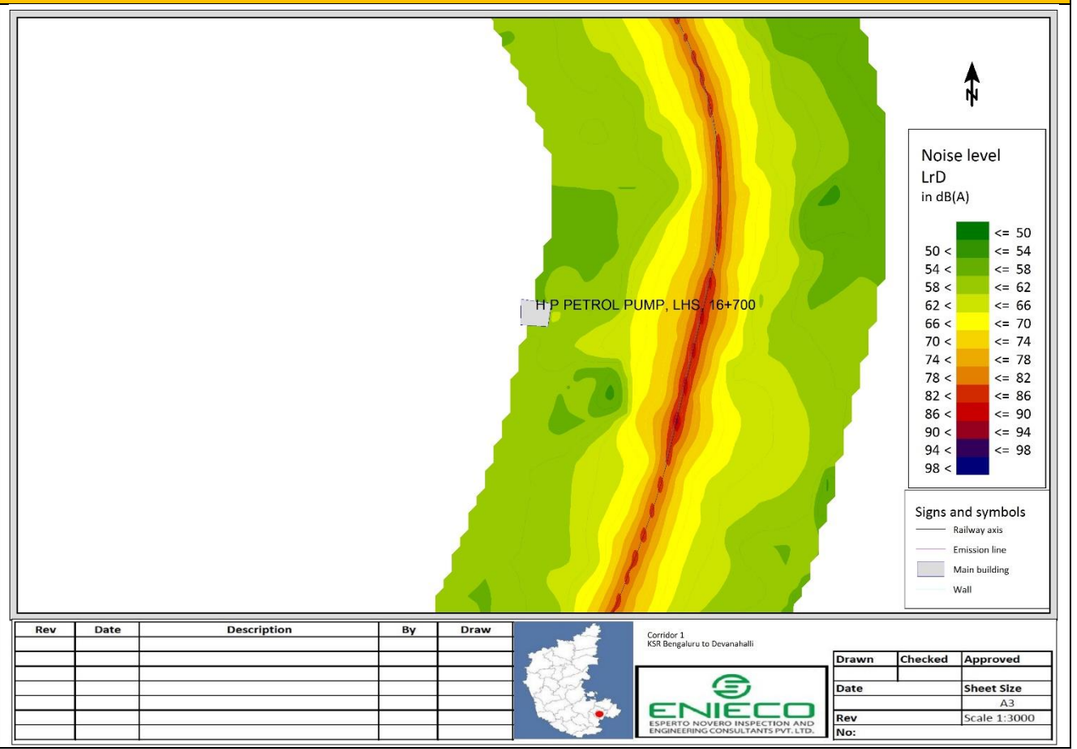
S.No	Without Barrier	With Barrier
9.		

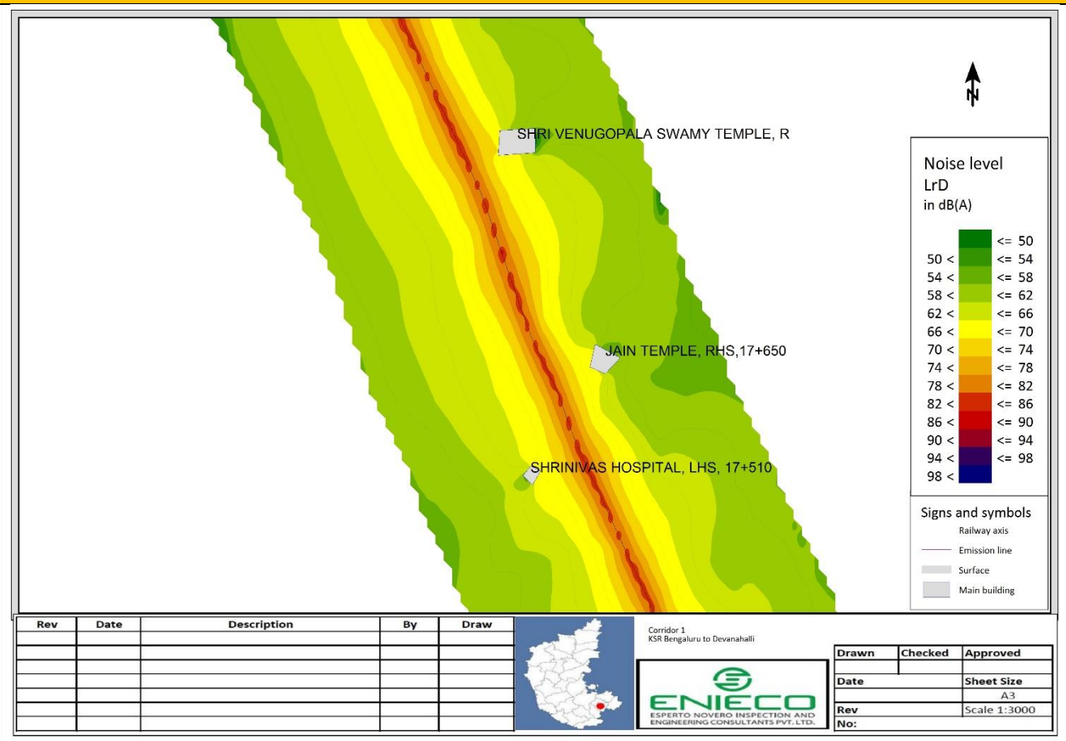
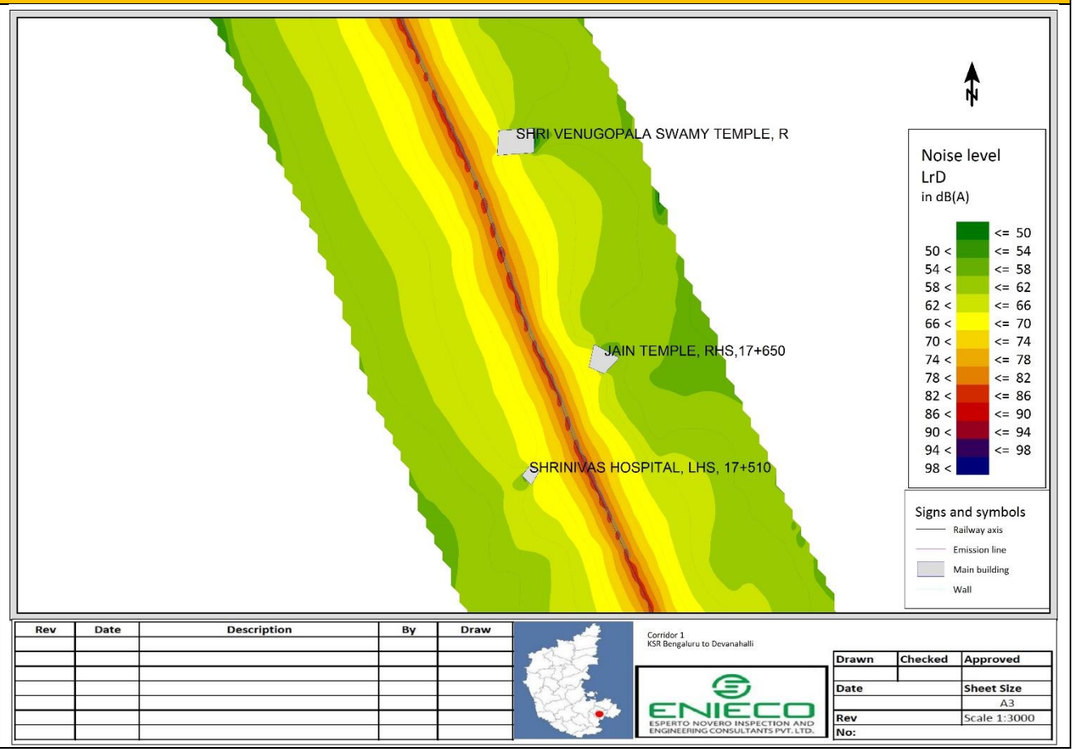
S.No	Without Barrier	With Barrier
10.		

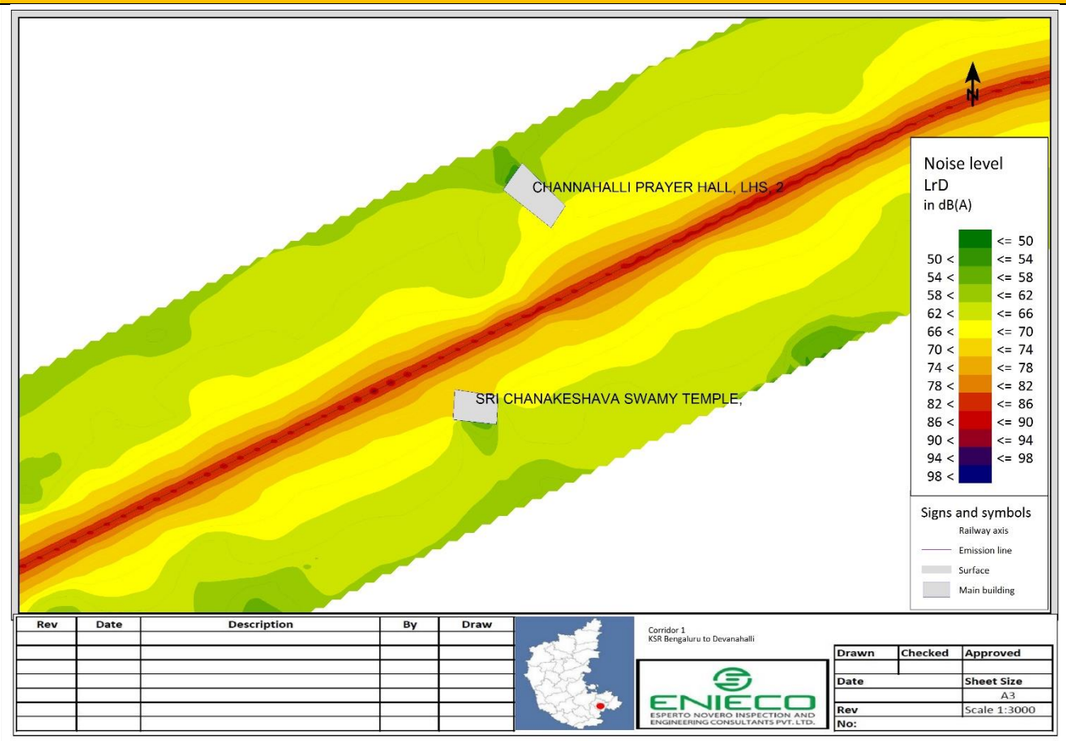
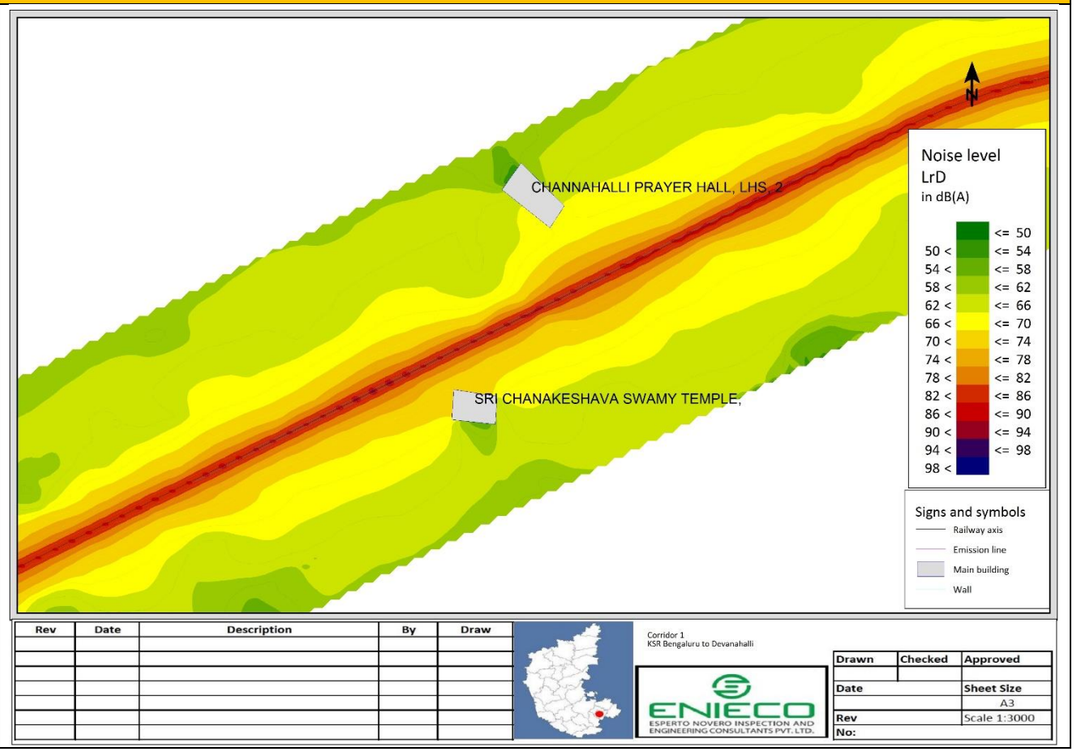
S.No	Without Barrier	With Barrier
11.		

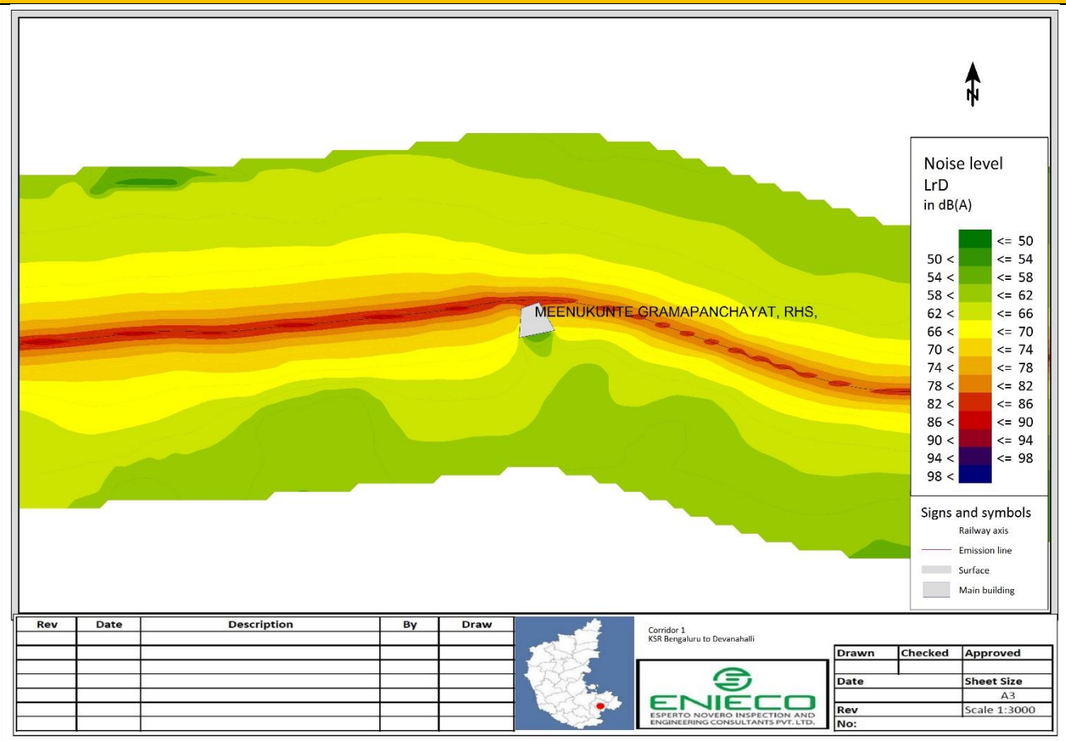
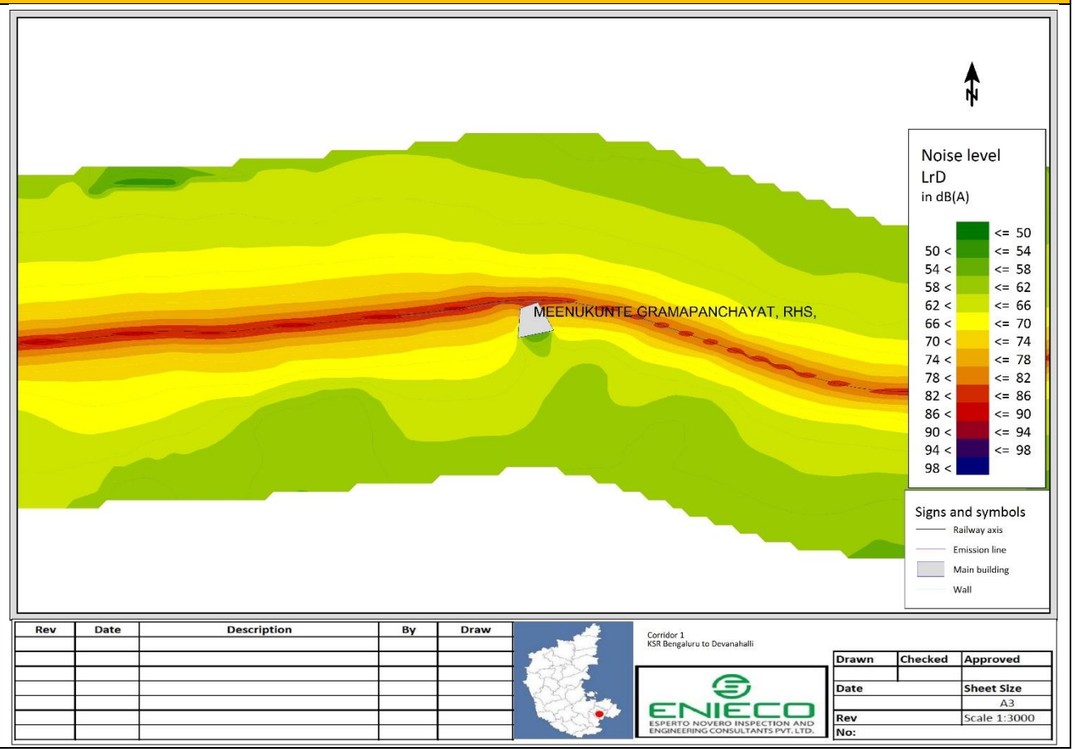
S.No	Without Barrier	With Barrier
12.		

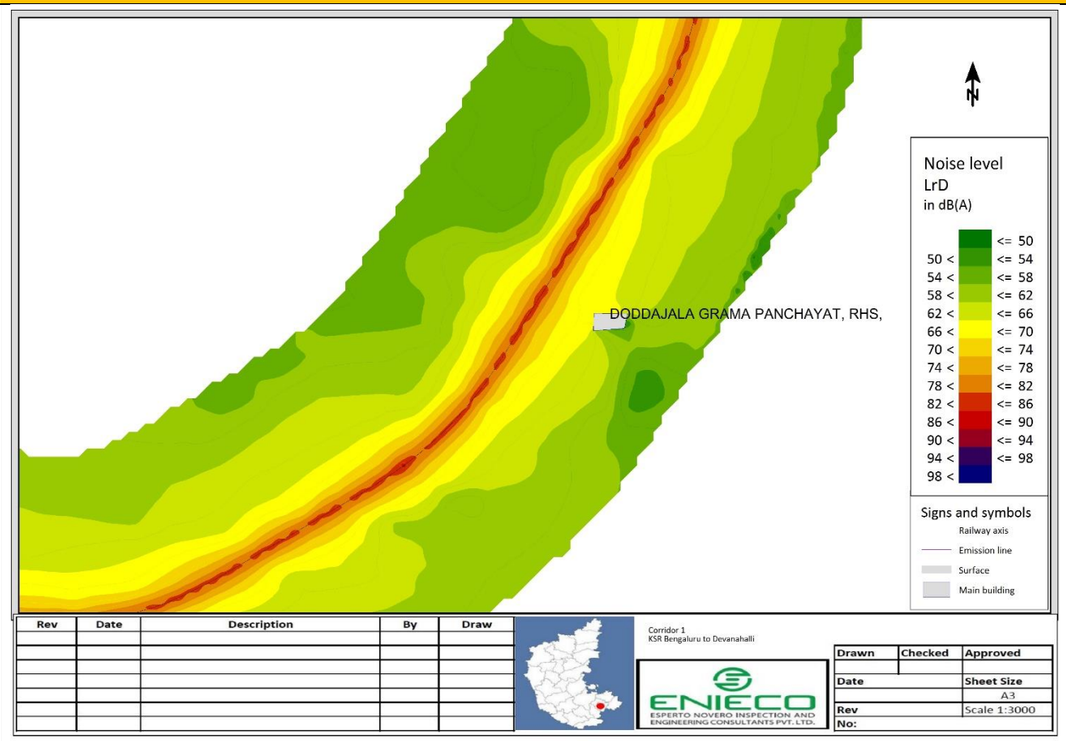
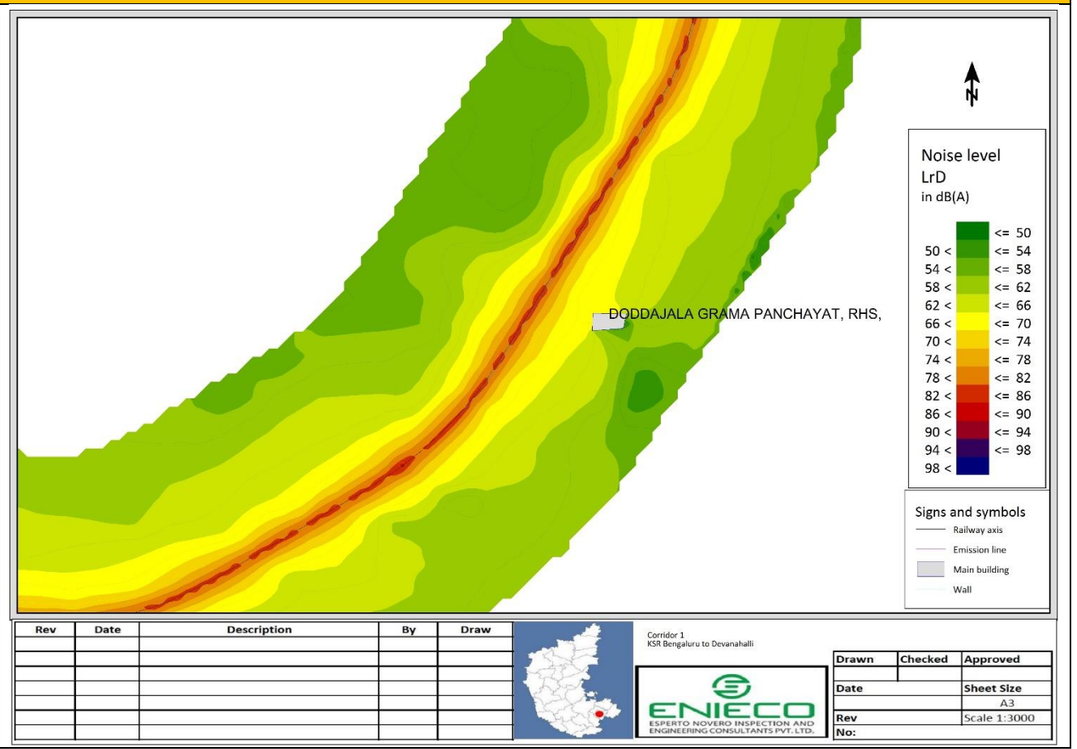
S.No	Without Barrier	With Barrier
13.		

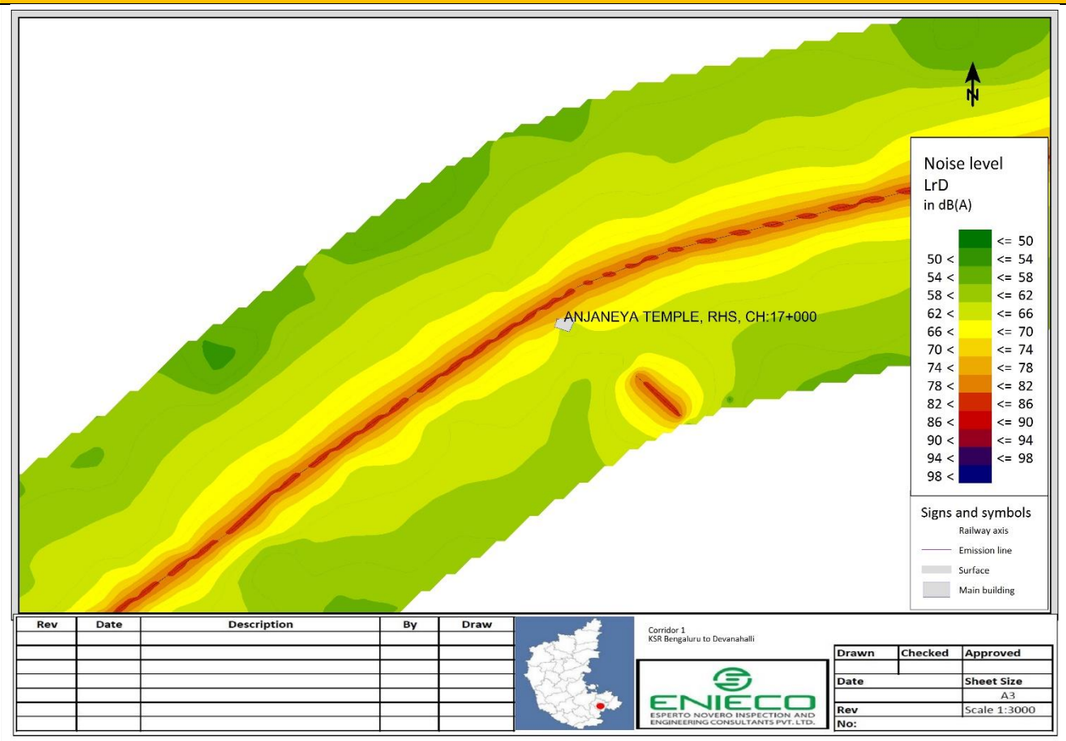
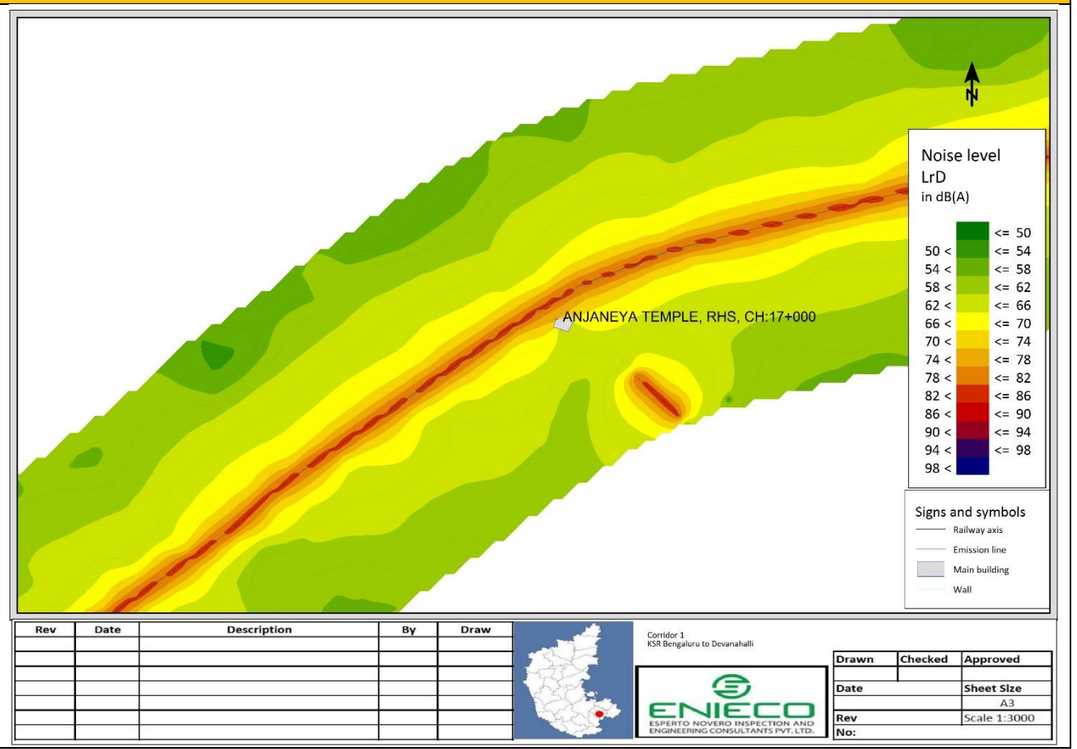
S.No	Without Barrier	With Barrier
14.		

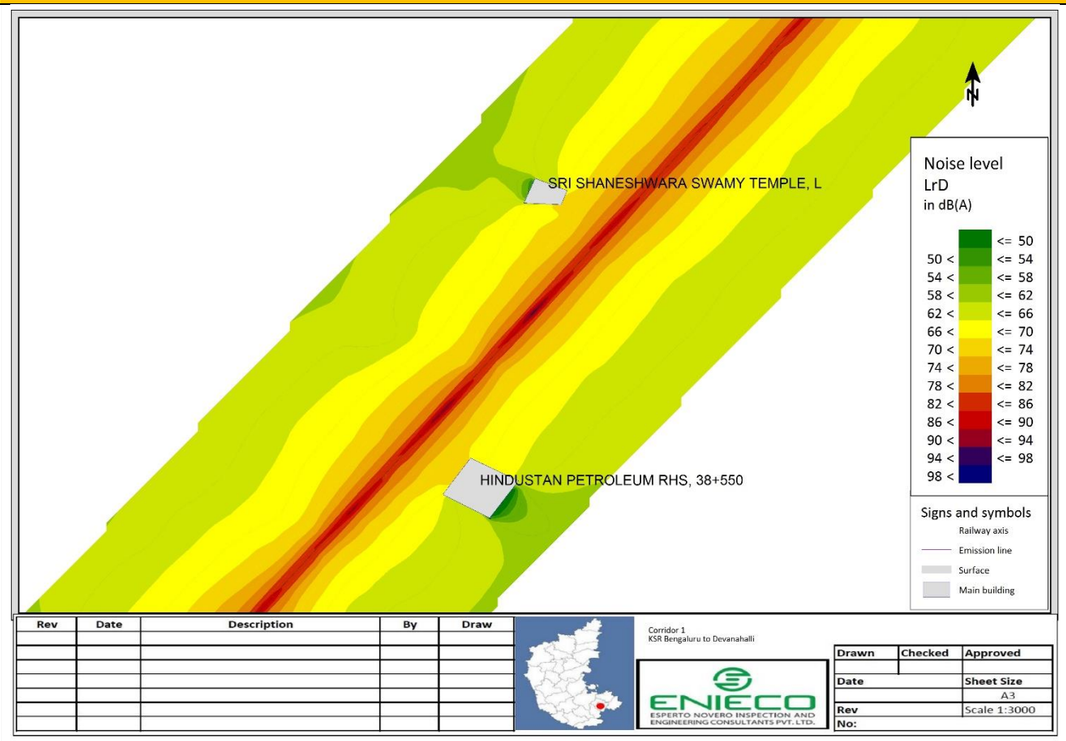
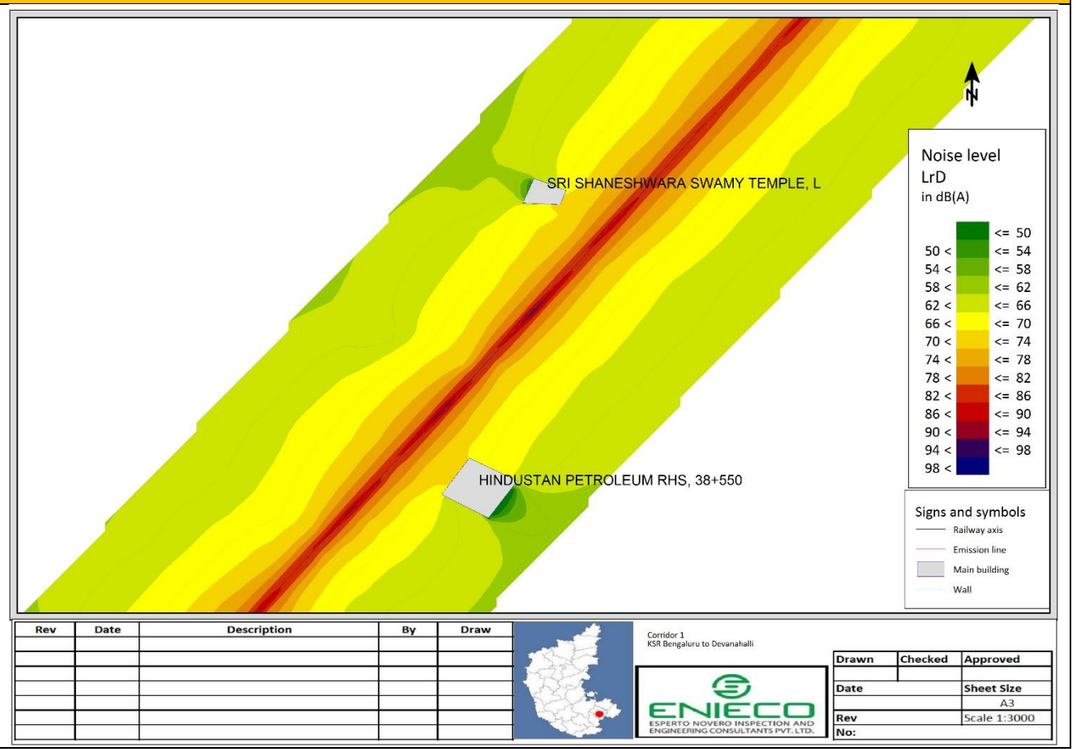
S.No	Without Barrier	With Barrier
15.		

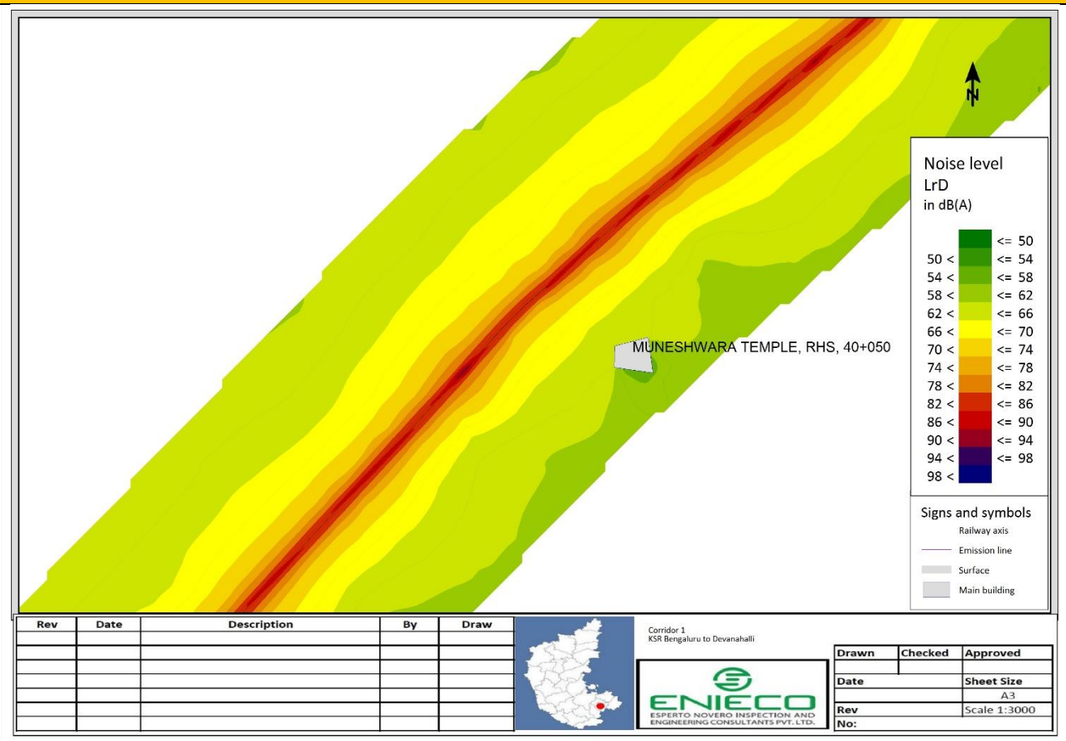
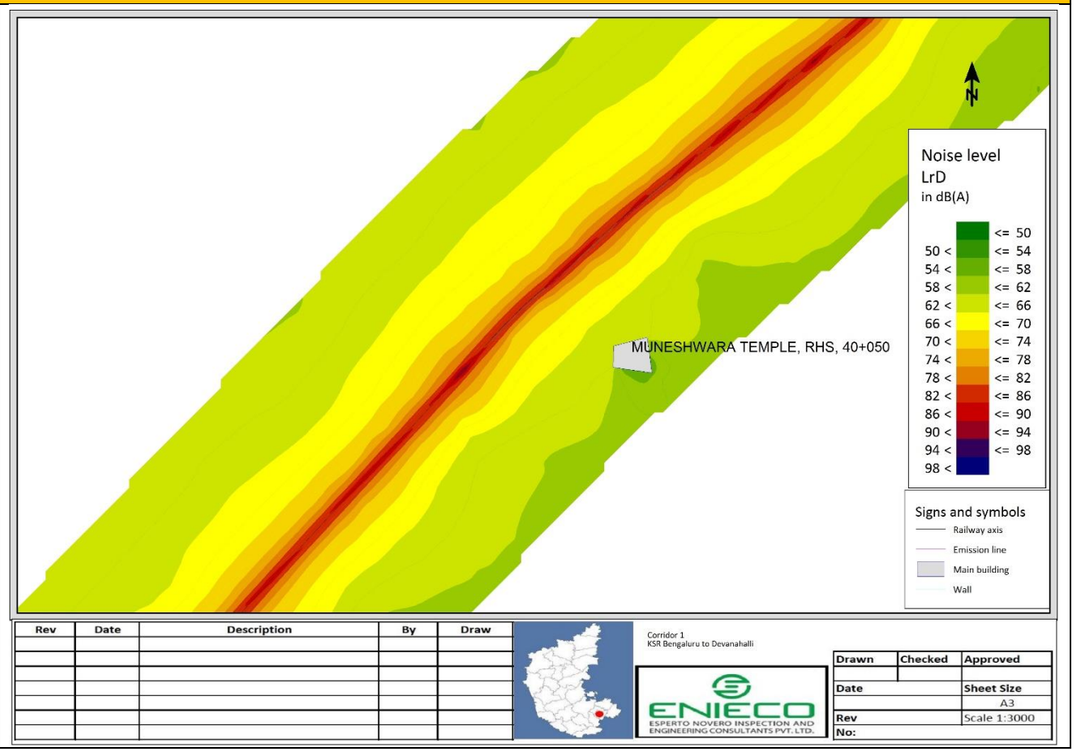
S.No	Without Barrier	With Barrier
16.		

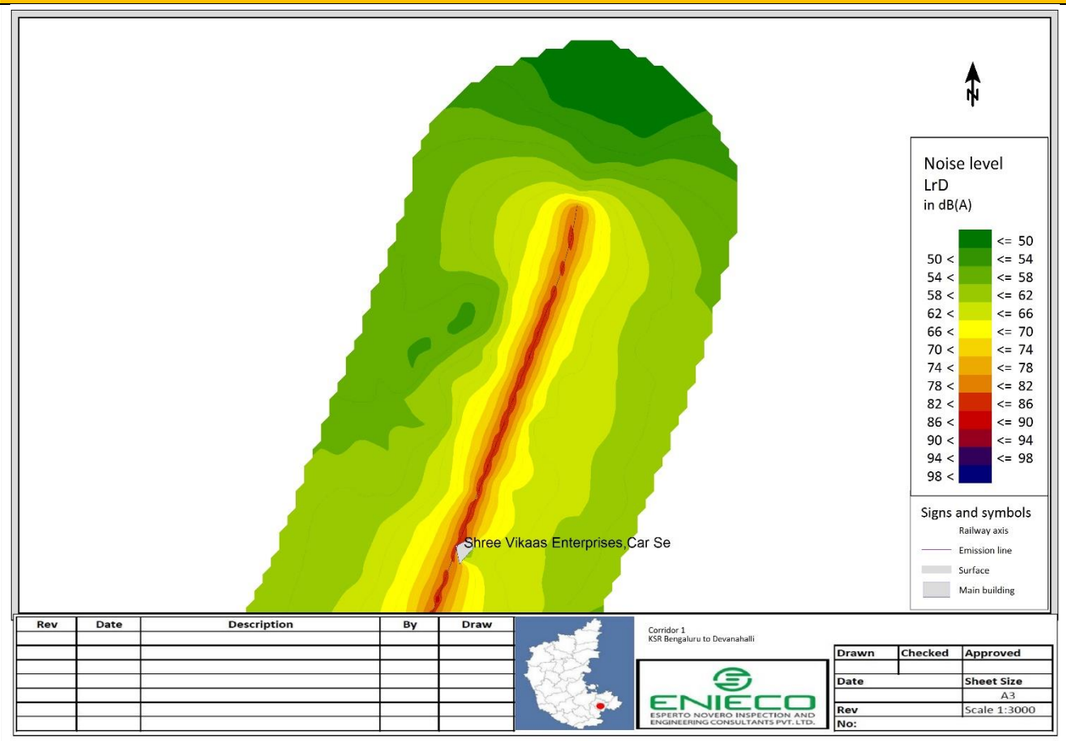
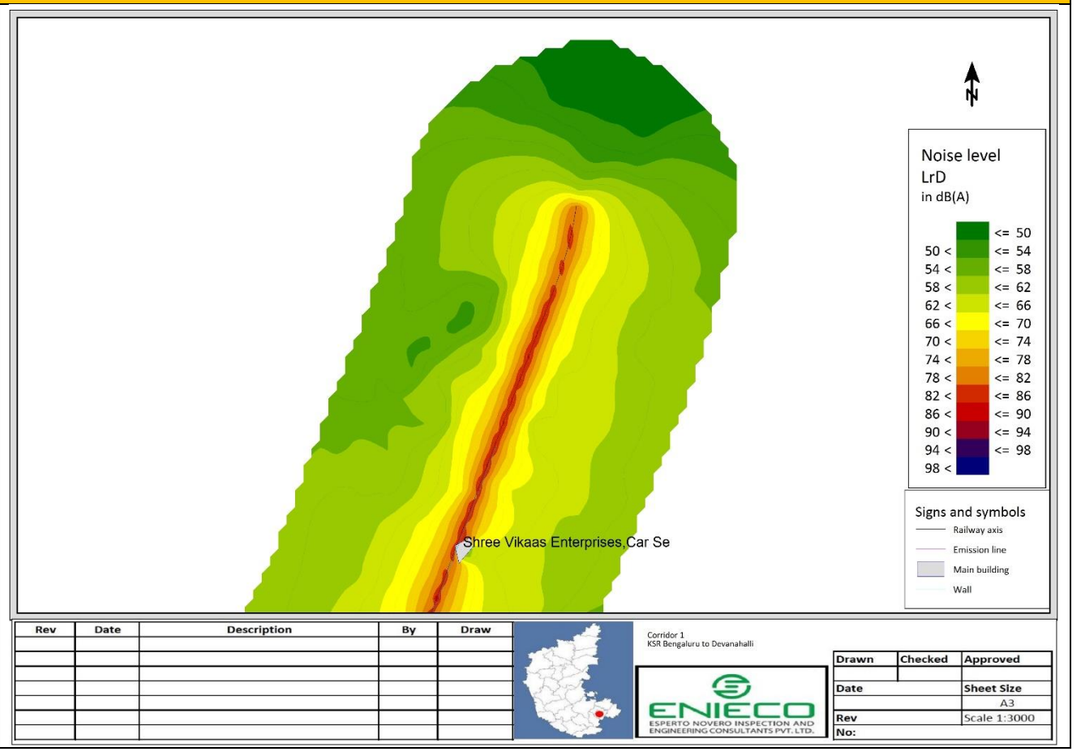
S.No	Without Barrier	With Barrier
17.		

S.No	Without Barrier	With Barrier
18.		

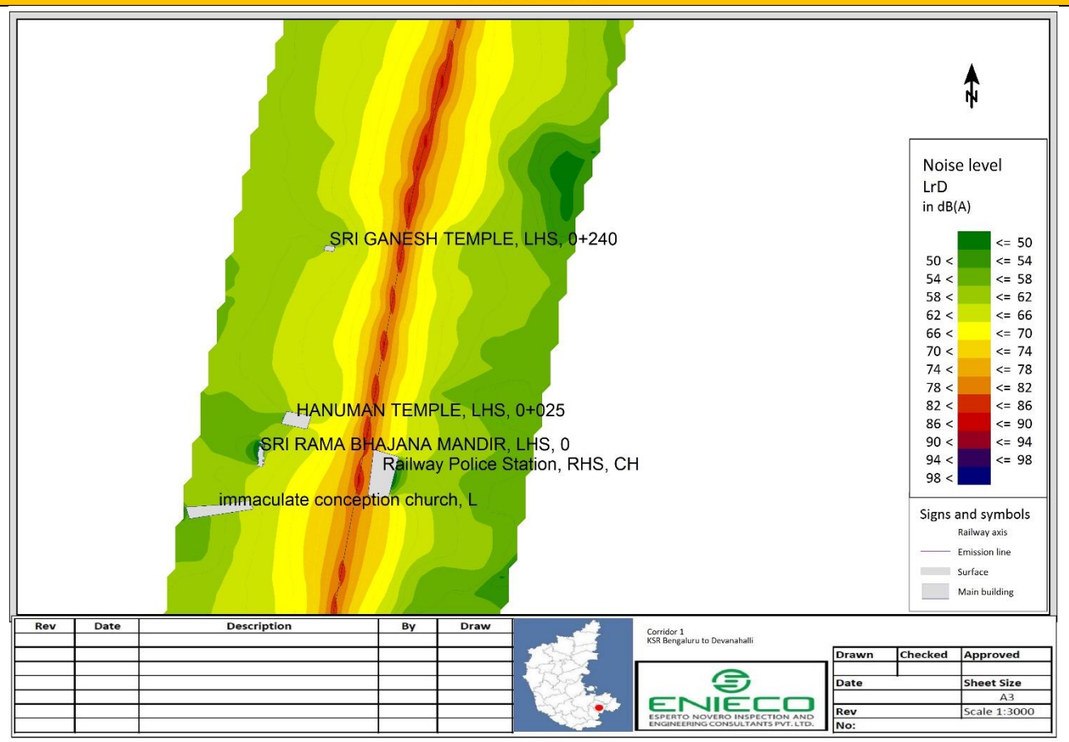
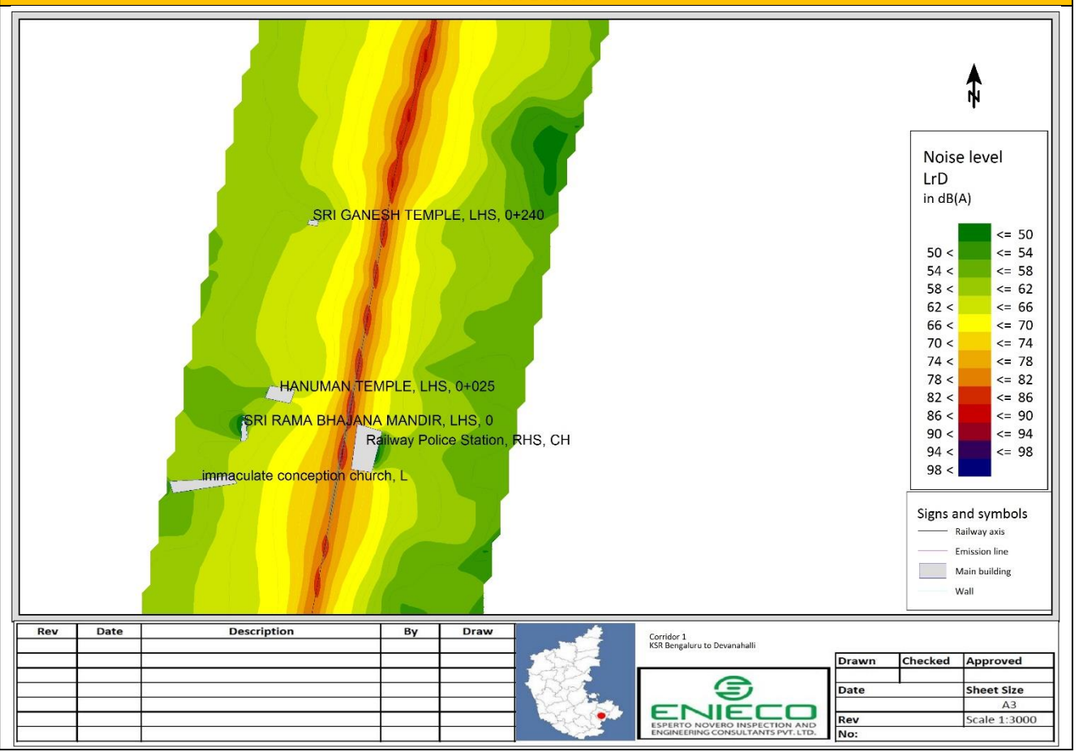
S.No	Without Barrier	With Barrier
19.		

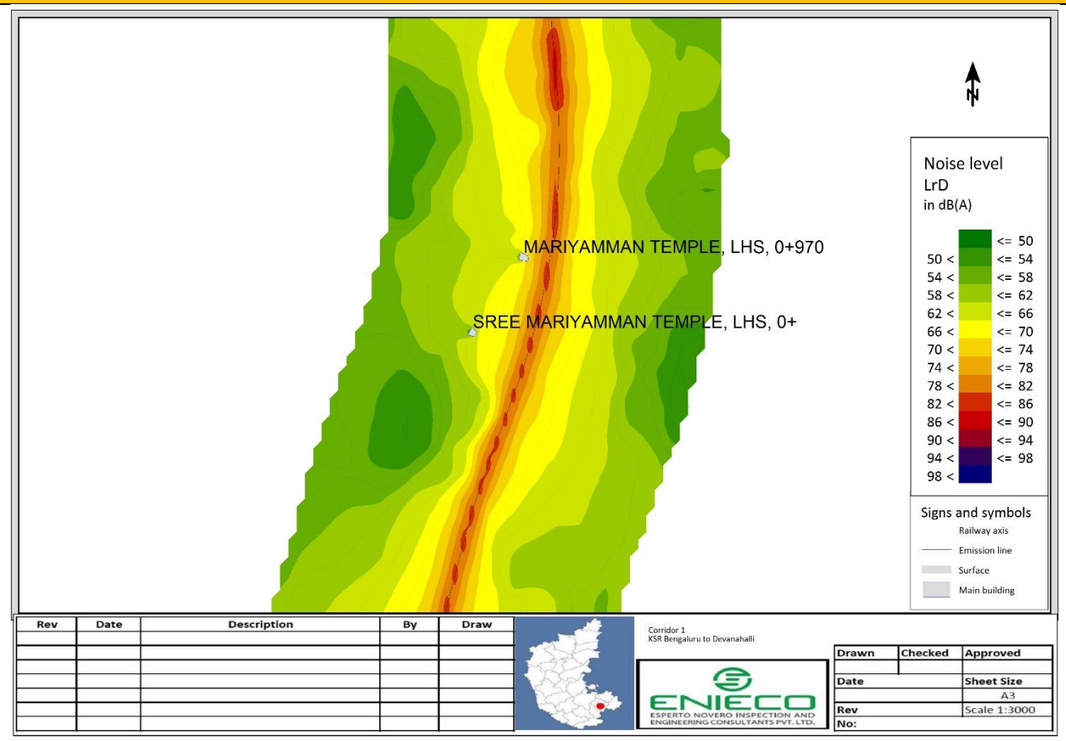
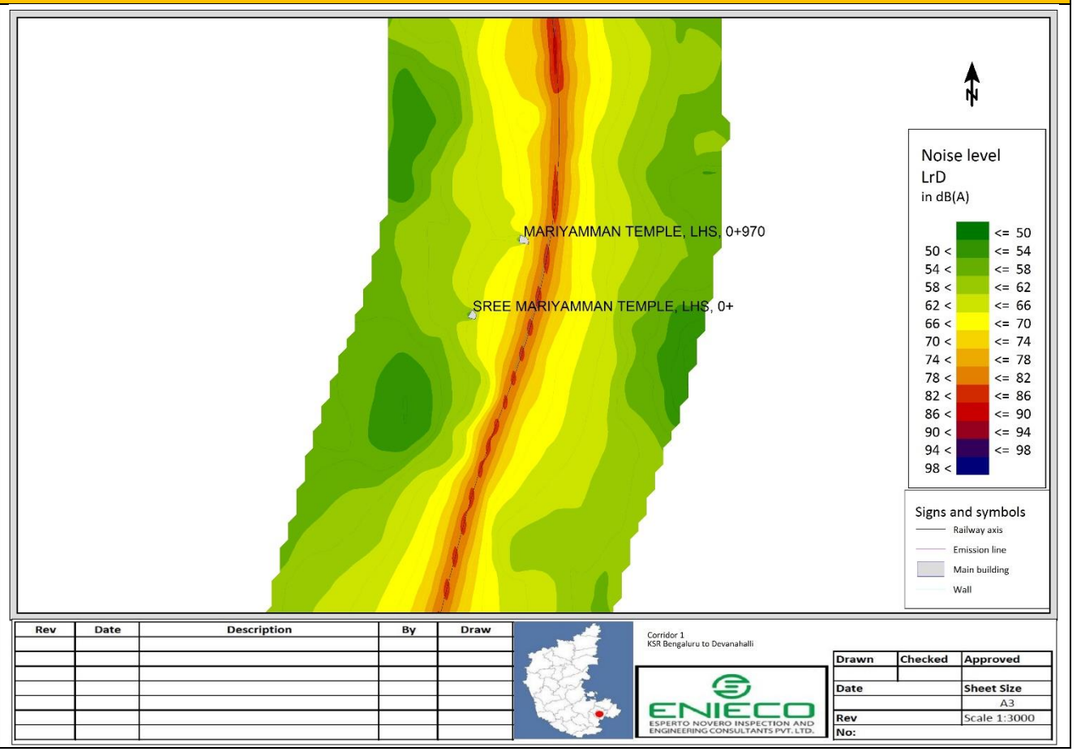
S.No	Without Barrier	With Barrier
20.		

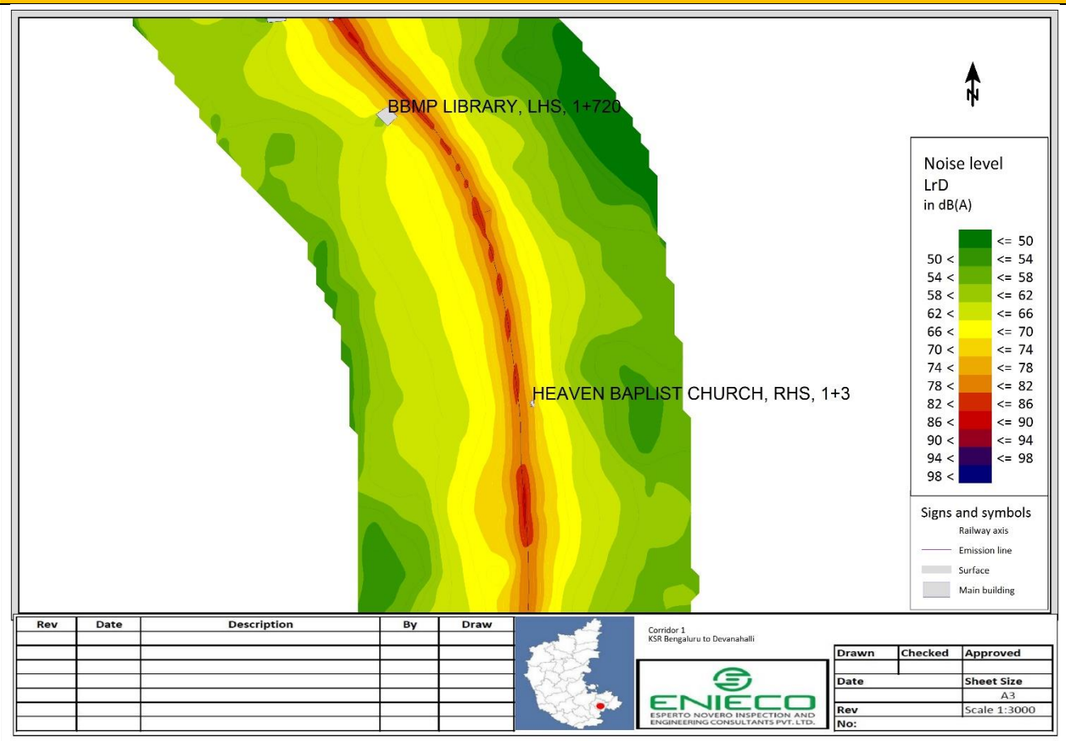
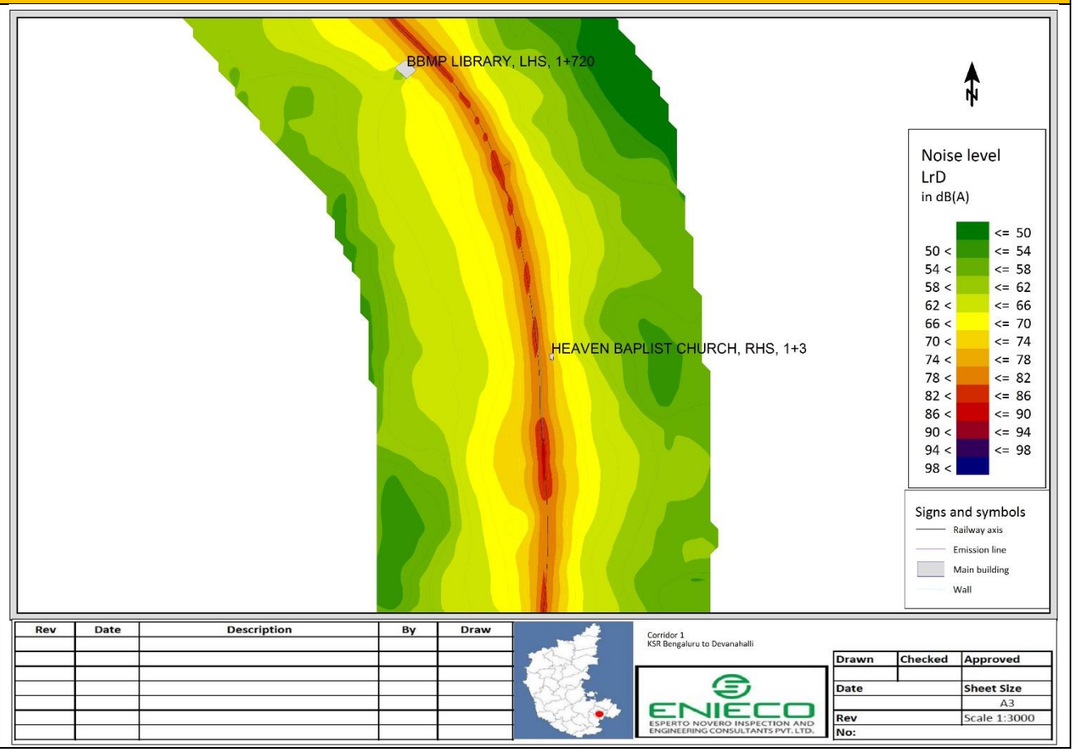
S.No	Without Barrier	With Barrier
21.		

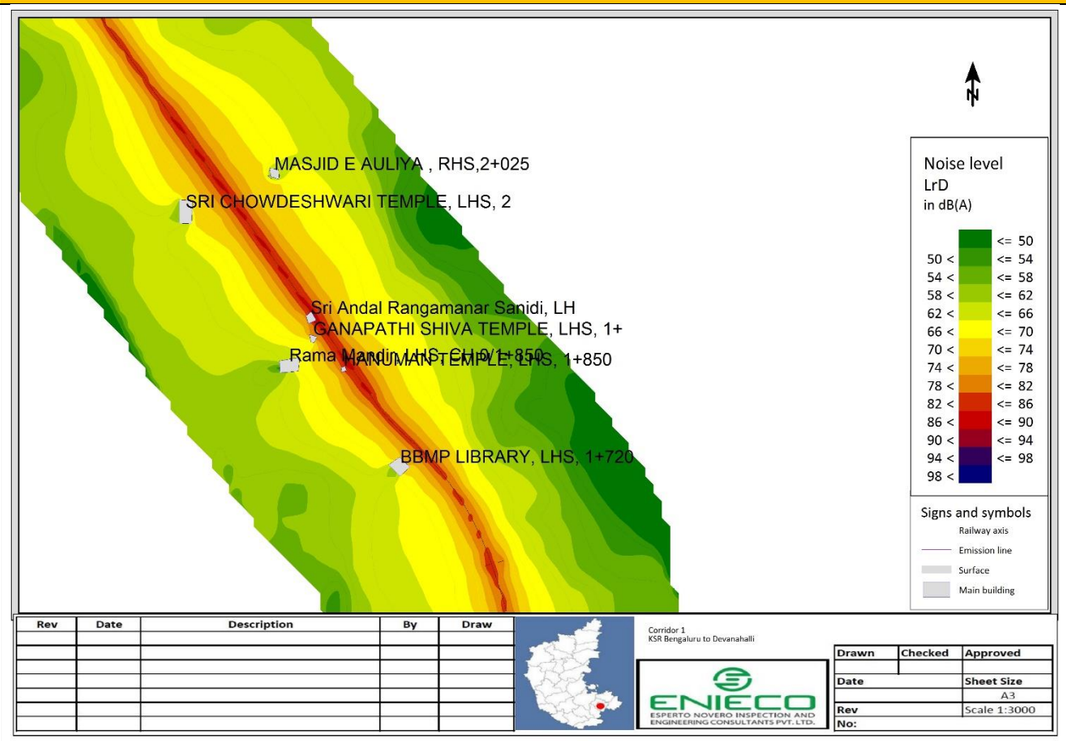
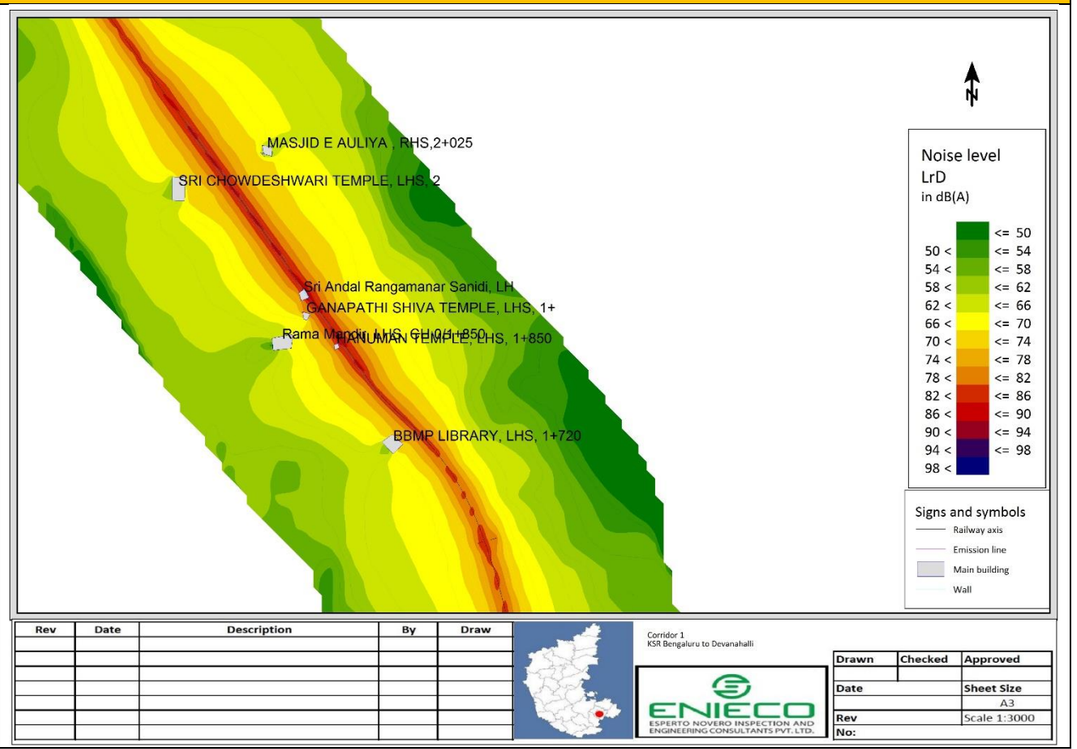
S.No	Without Barrier	With Barrier
22.		

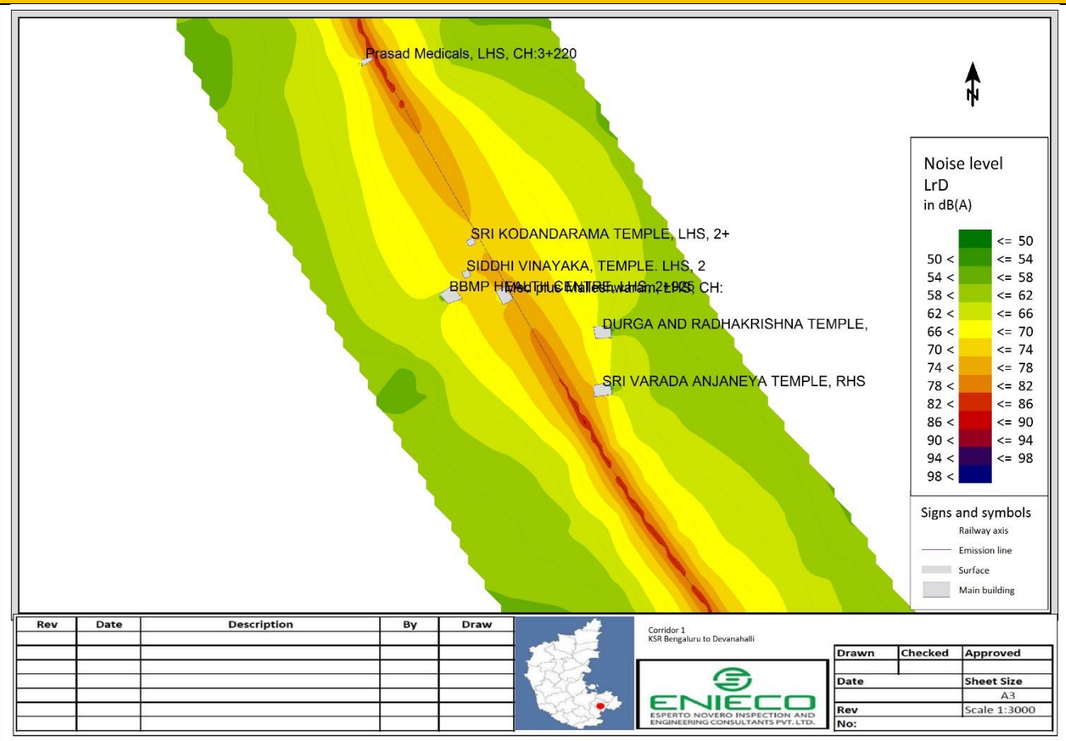
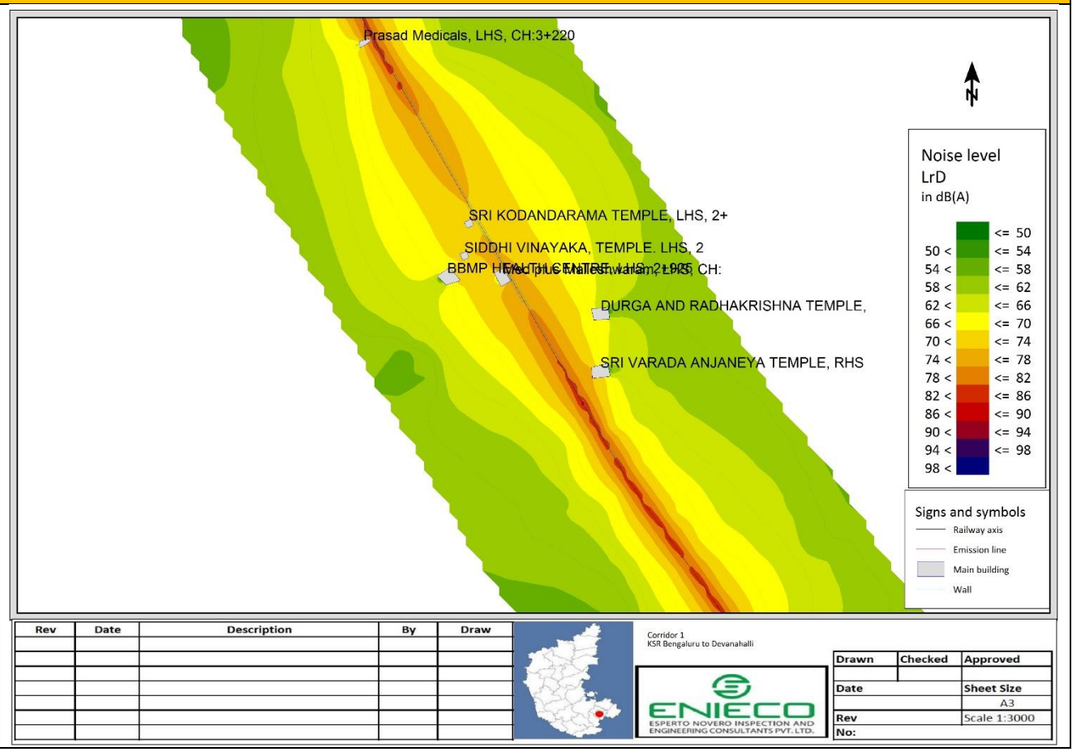
C. Noise contours for Corridor 1 for the Year 2041

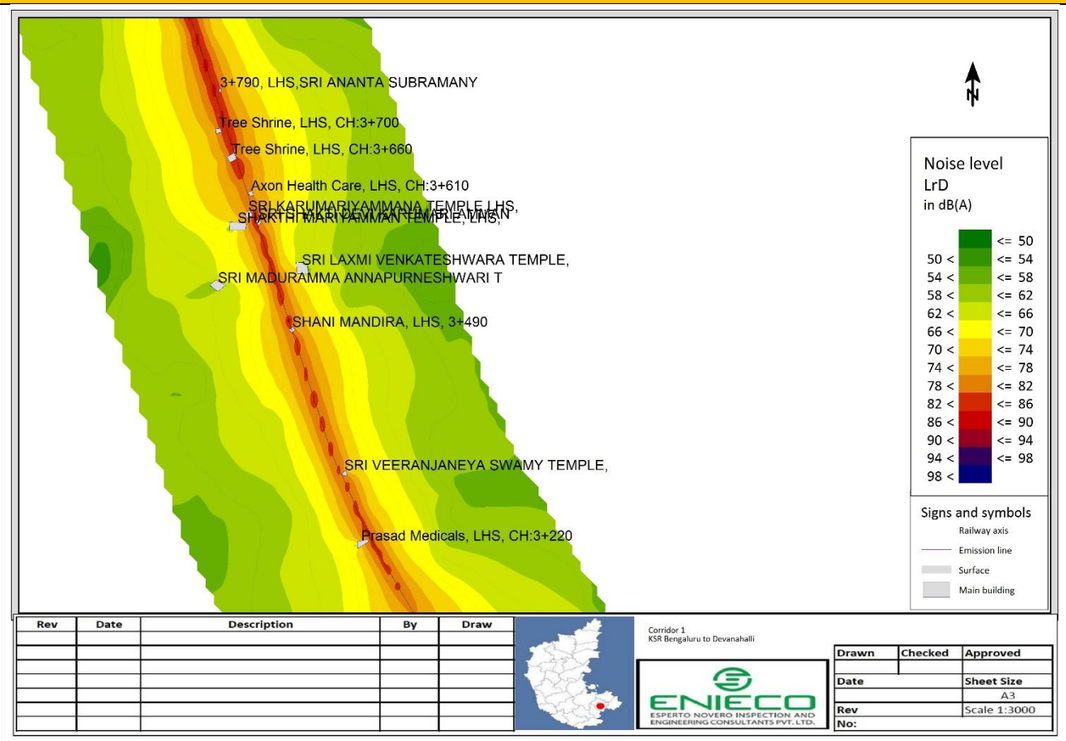
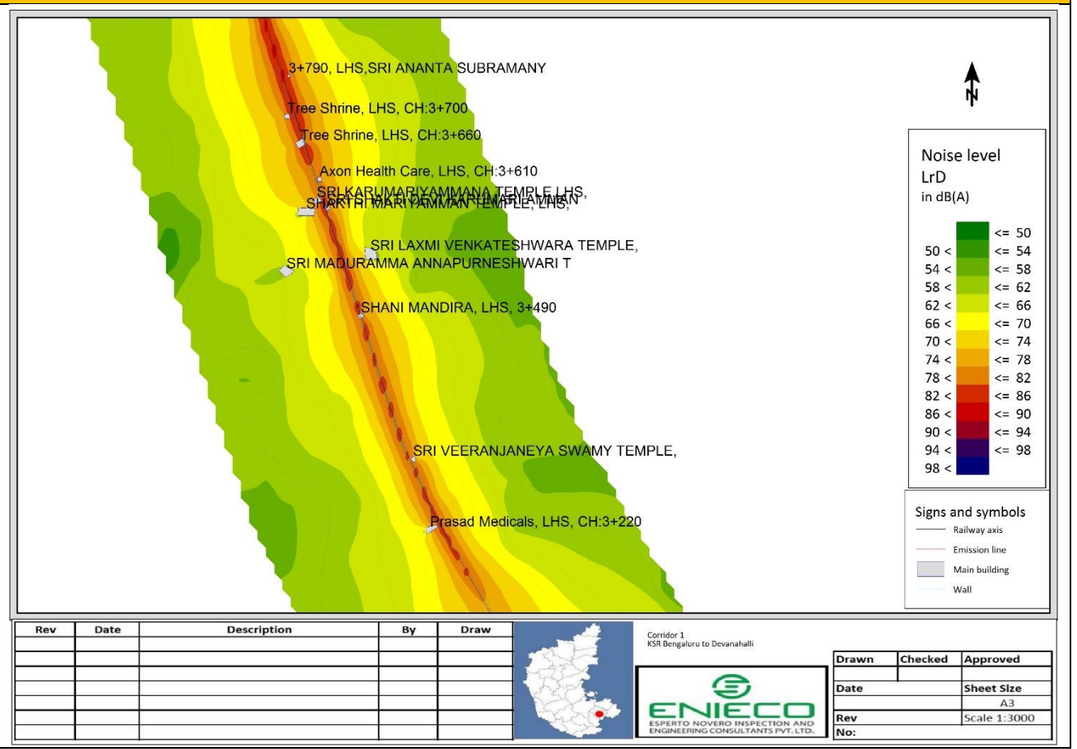
S.No	Without Barrier	With Barrier
1.		

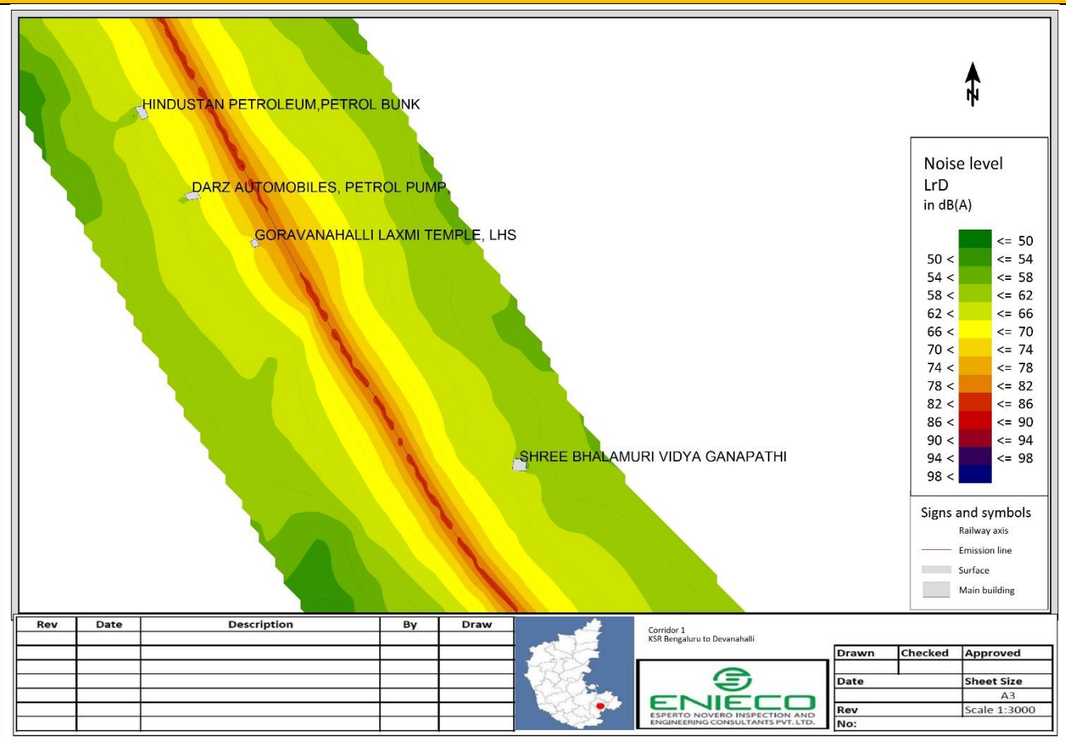
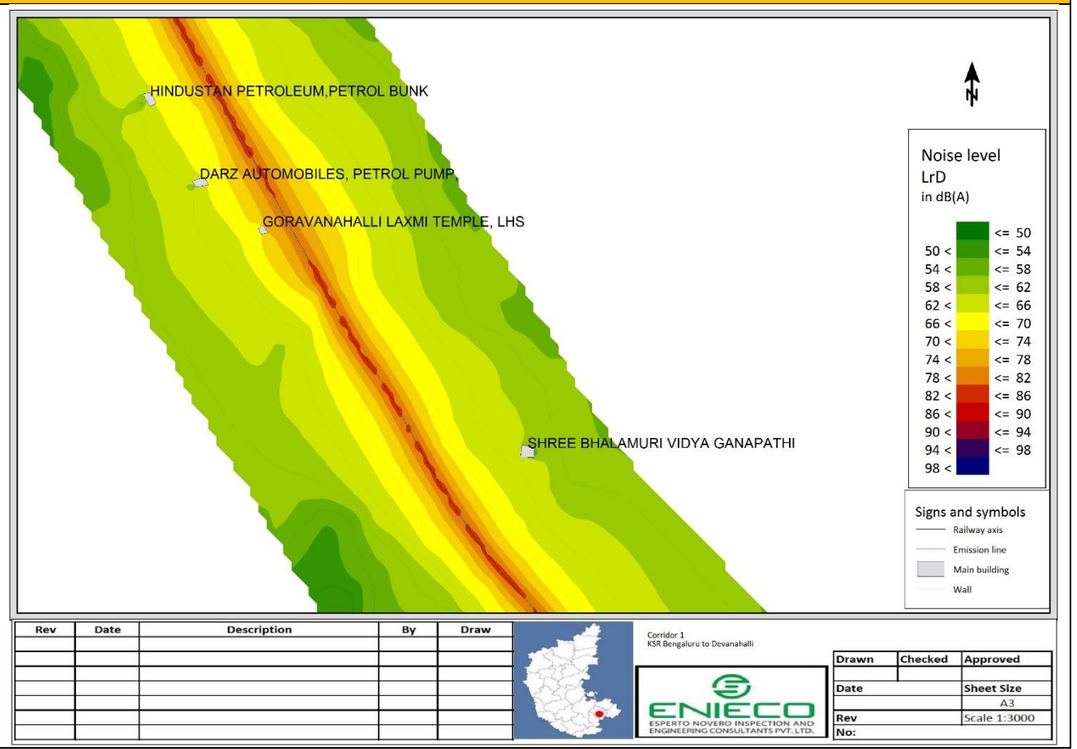
S.No	Without Barrier	With Barrier
2.		

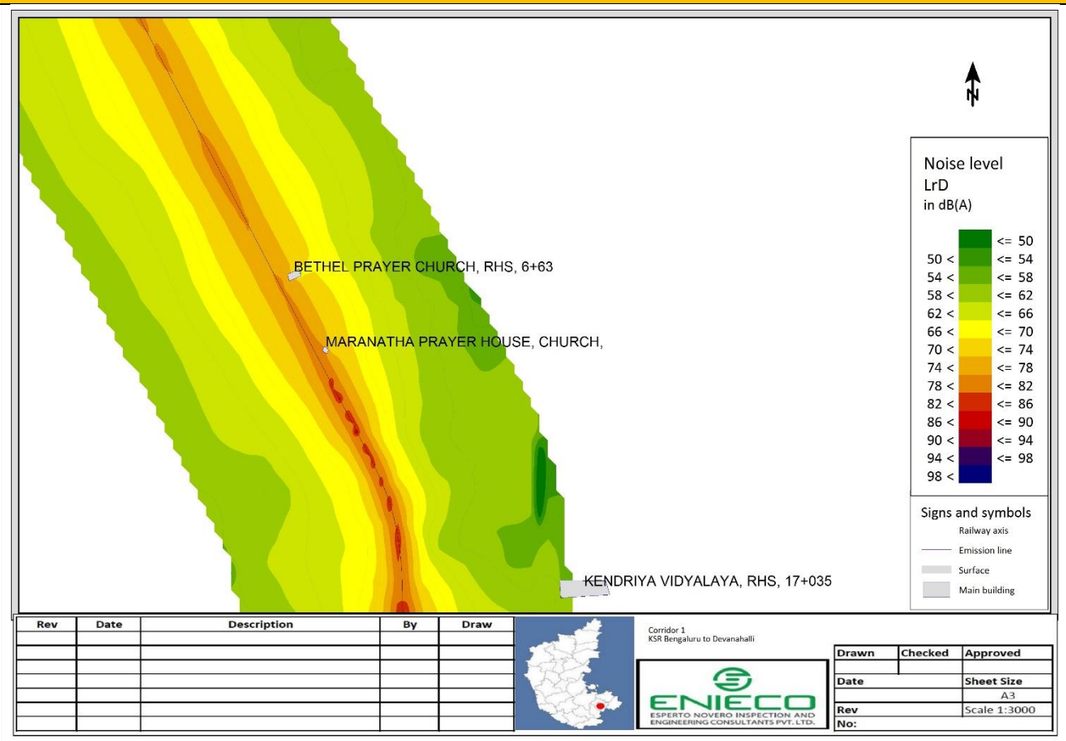
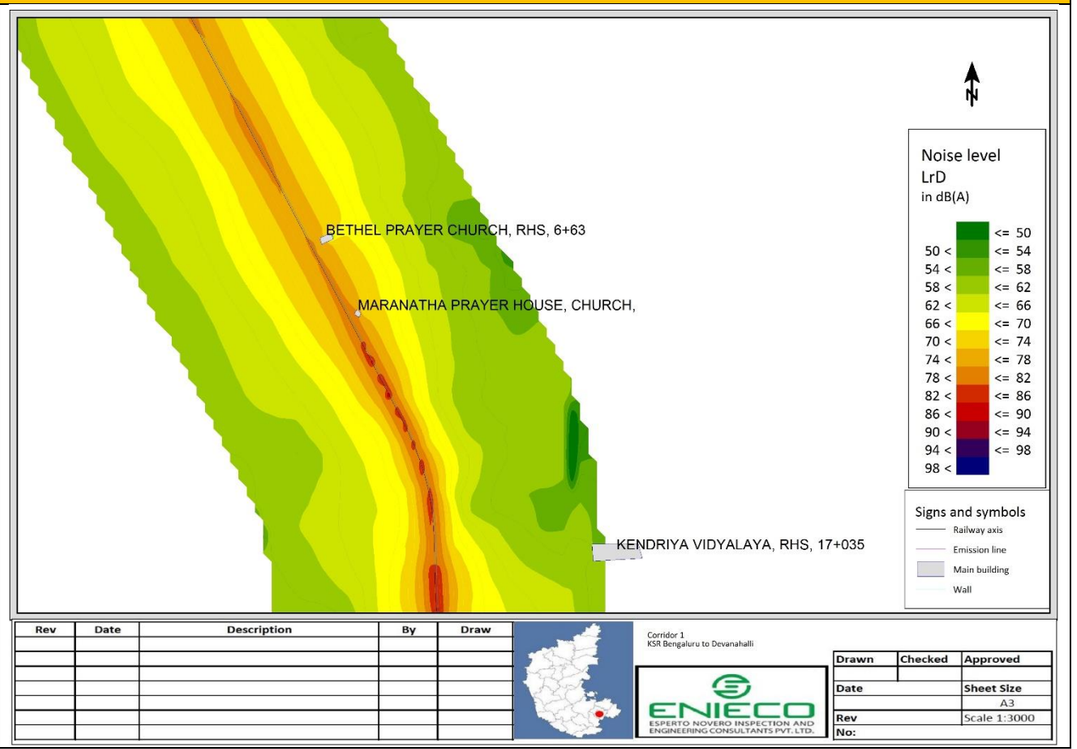
S.No	Without Barrier	With Barrier
3.		

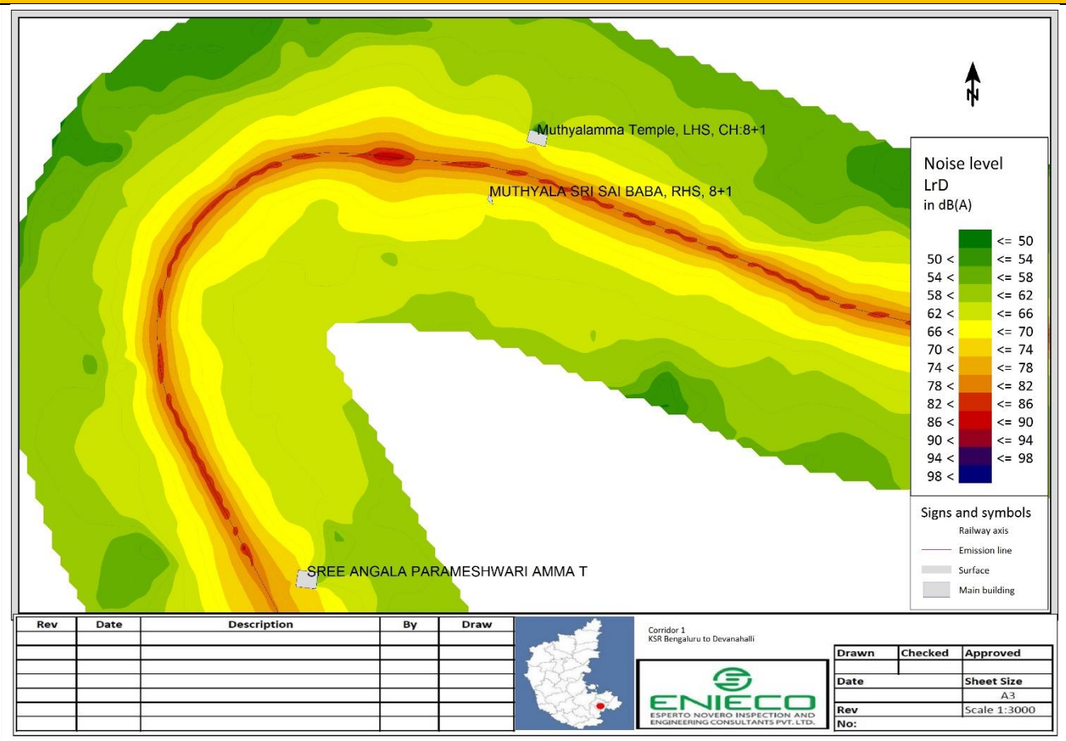
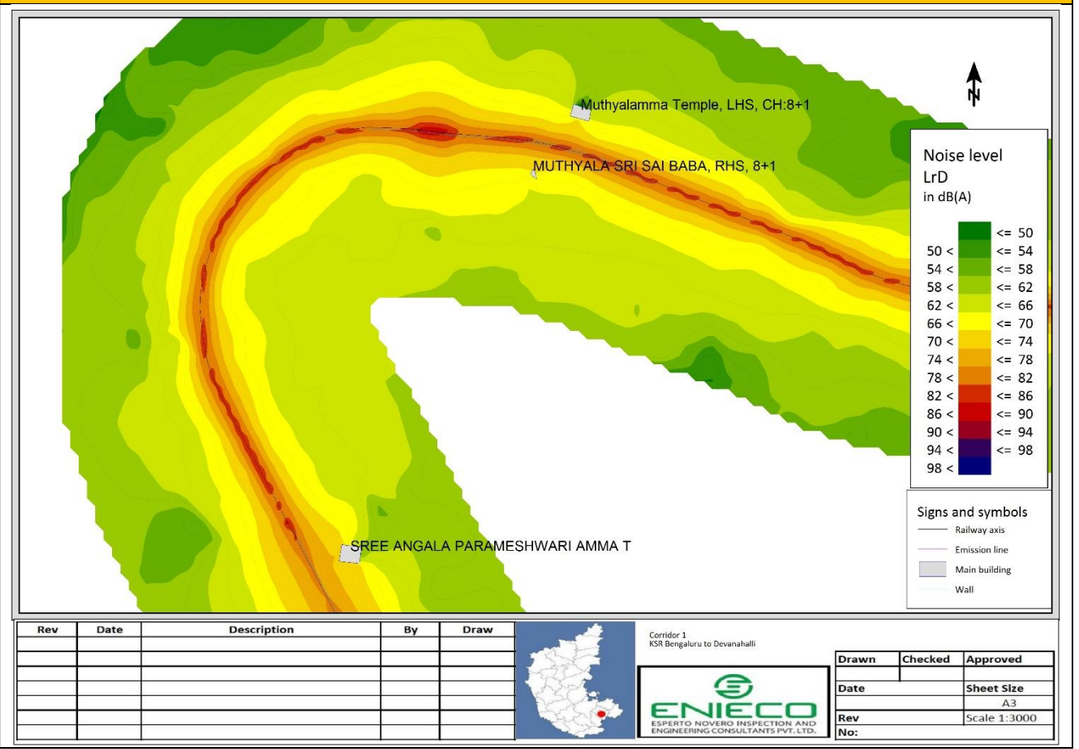
S.No	Without Barrier	With Barrier
4.		

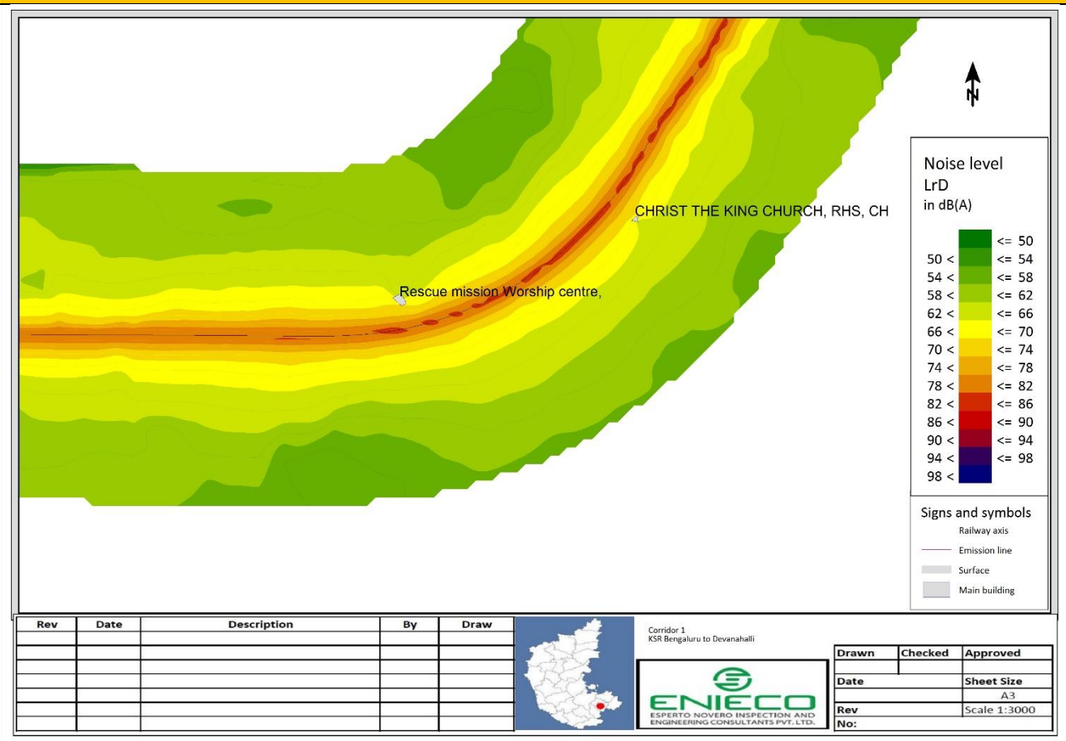
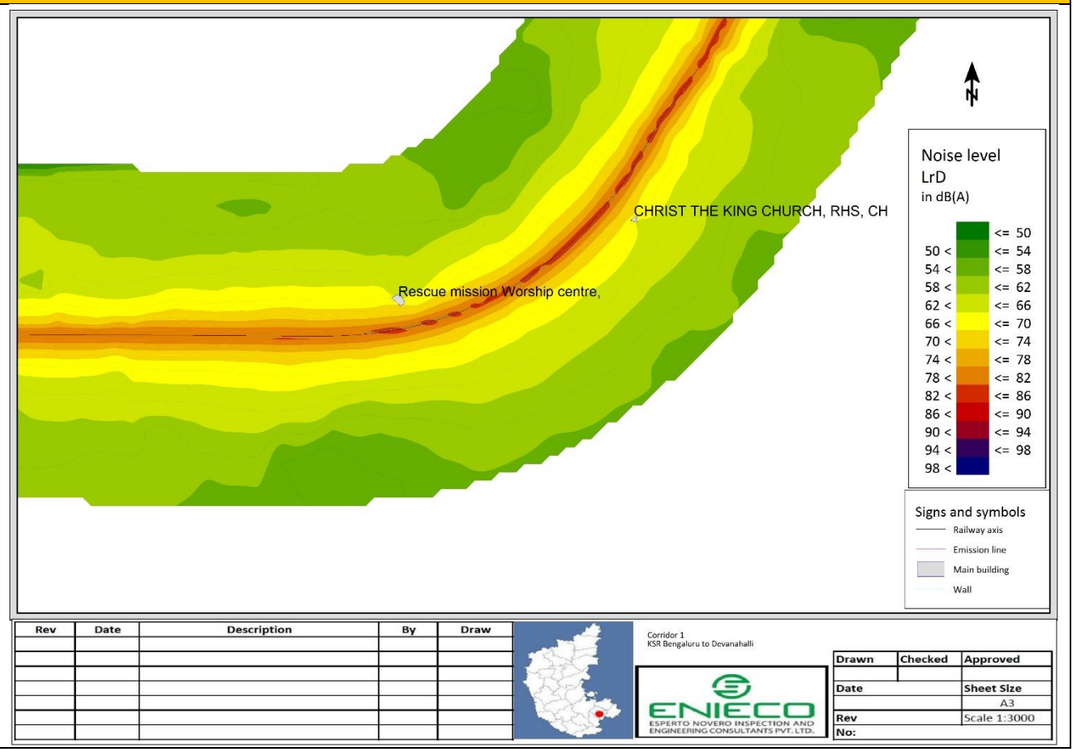
S.No	Without Barrier	With Barrier
5.		

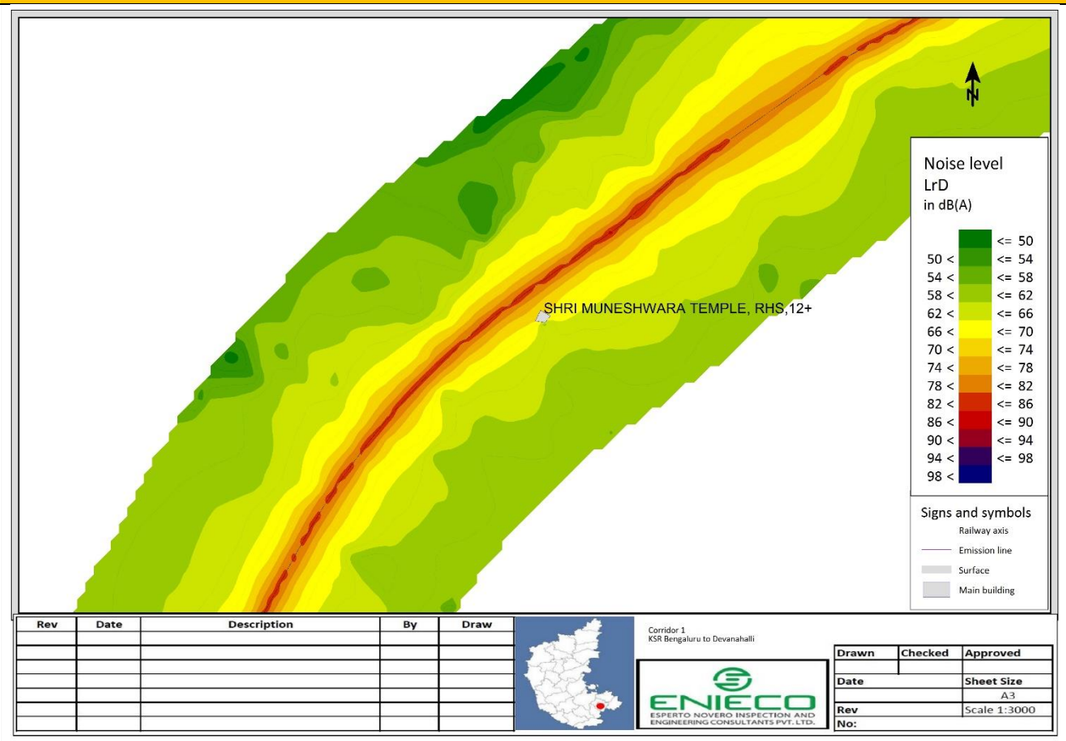
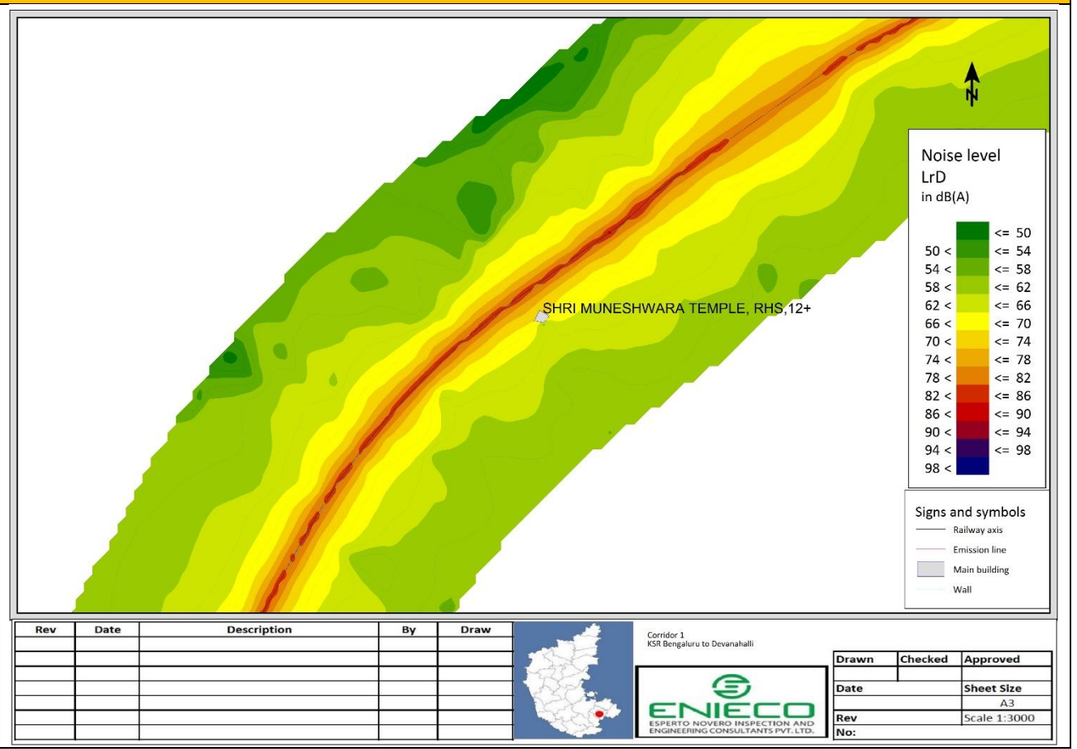
S.No	Without Barrier	With Barrier
6.		

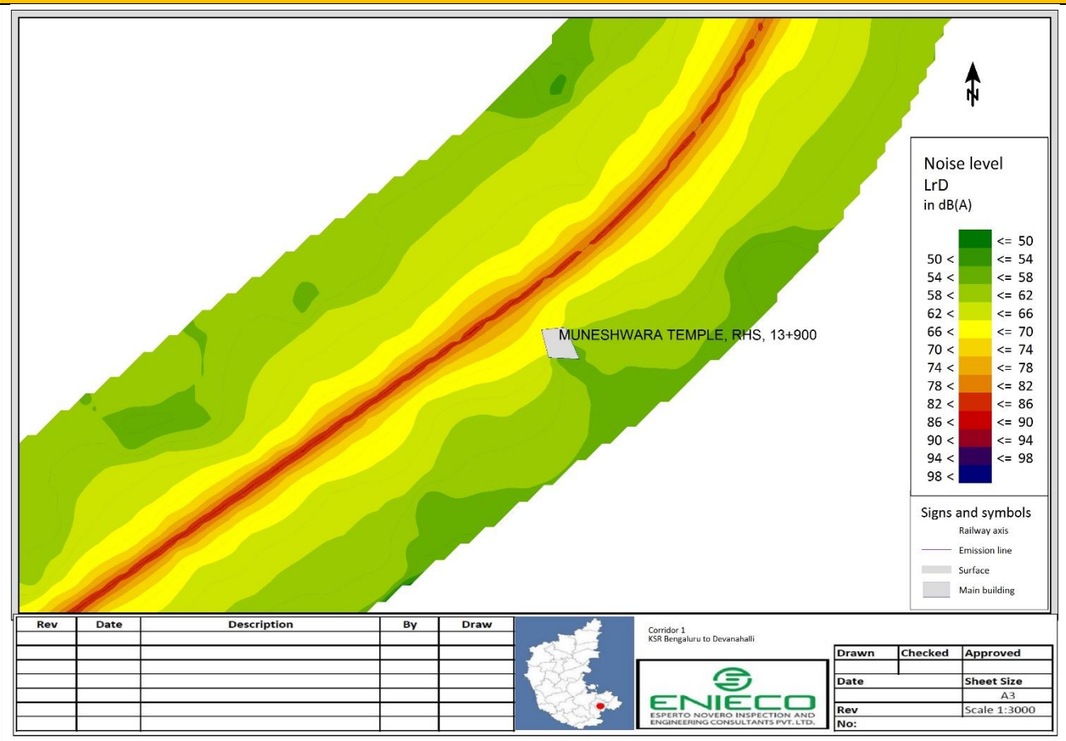
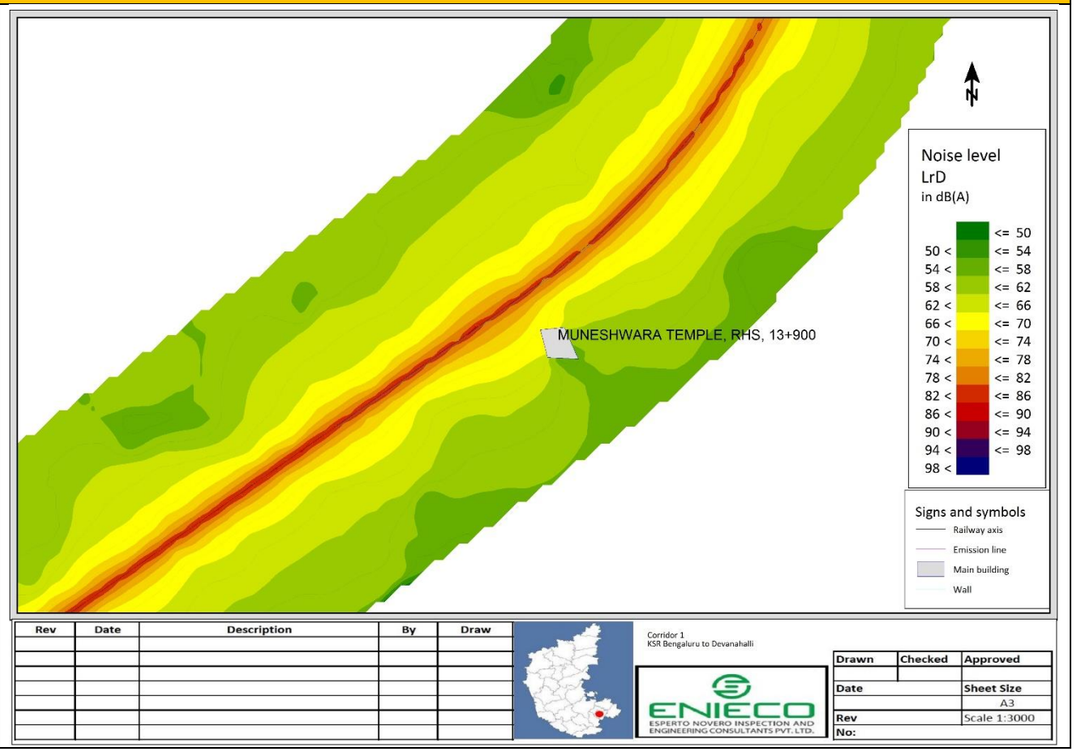
S.No	Without Barrier	With Barrier
7.		

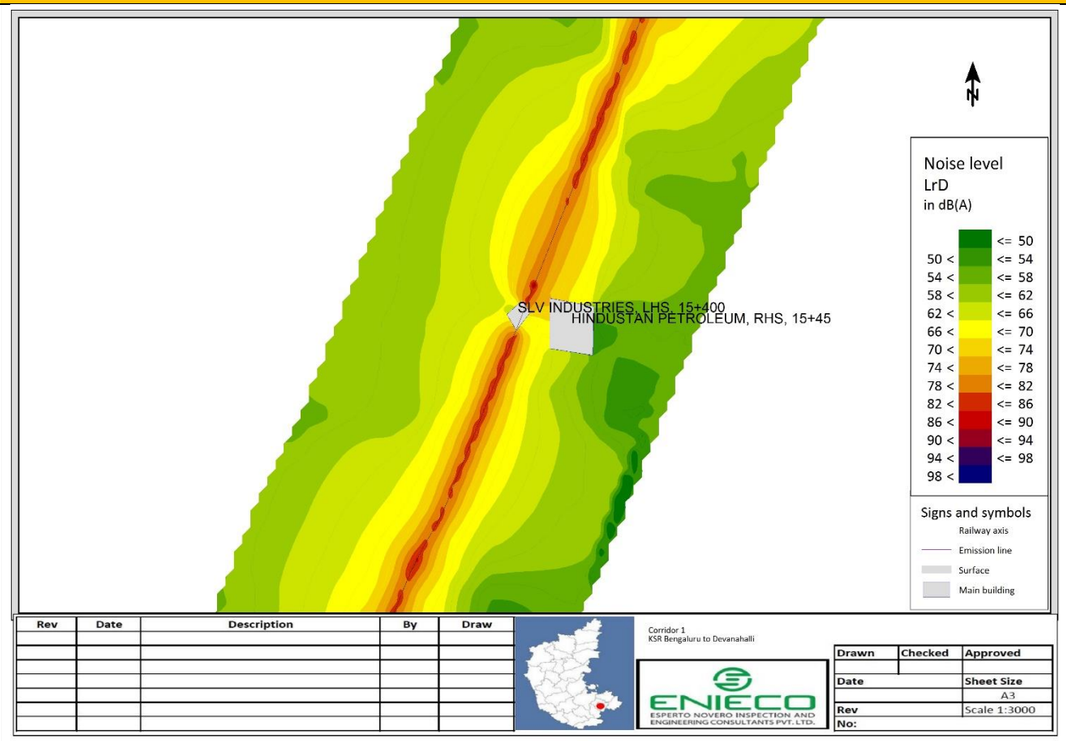
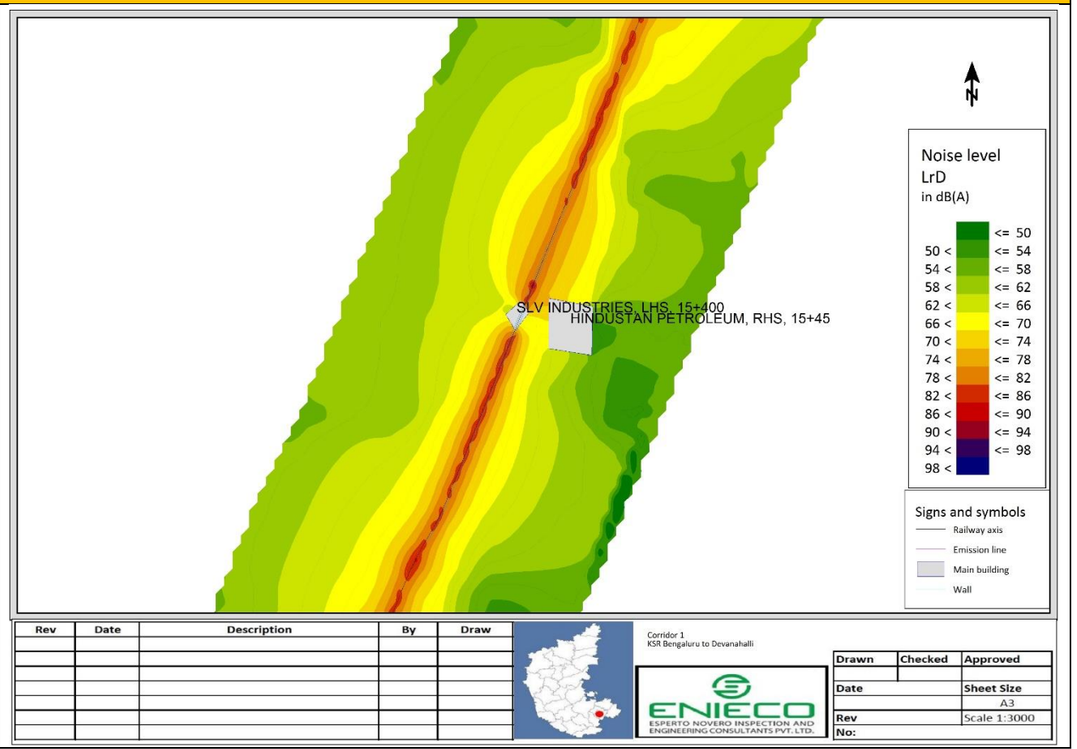
S.No	Without Barrier	With Barrier
8.		

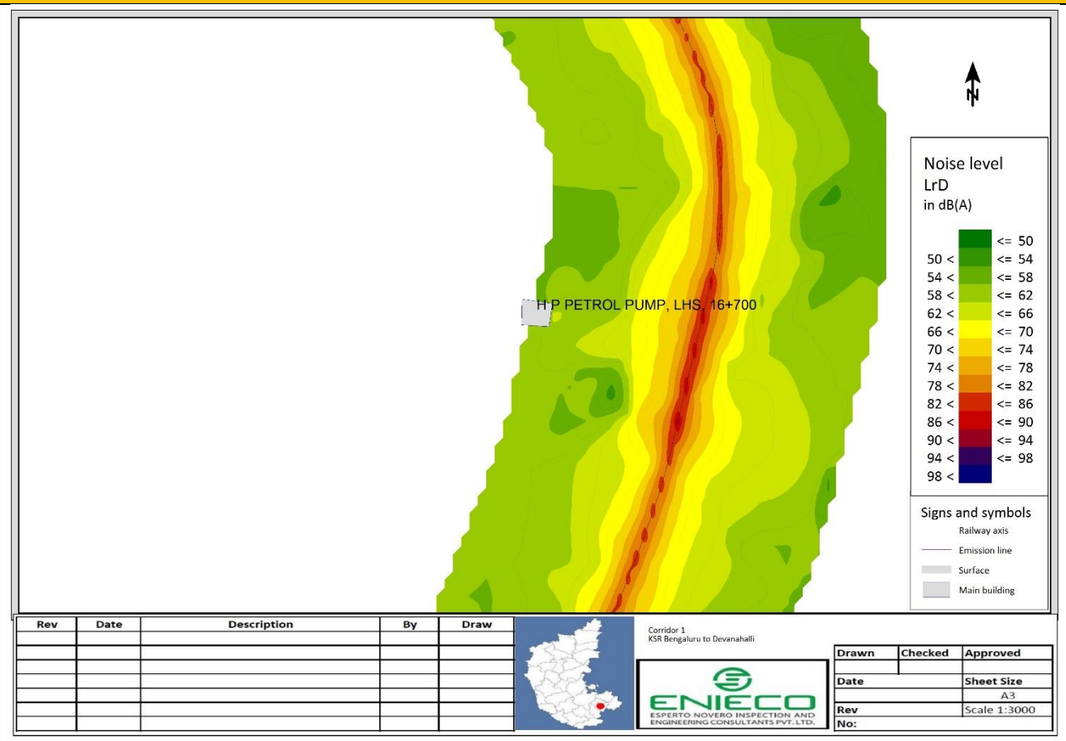
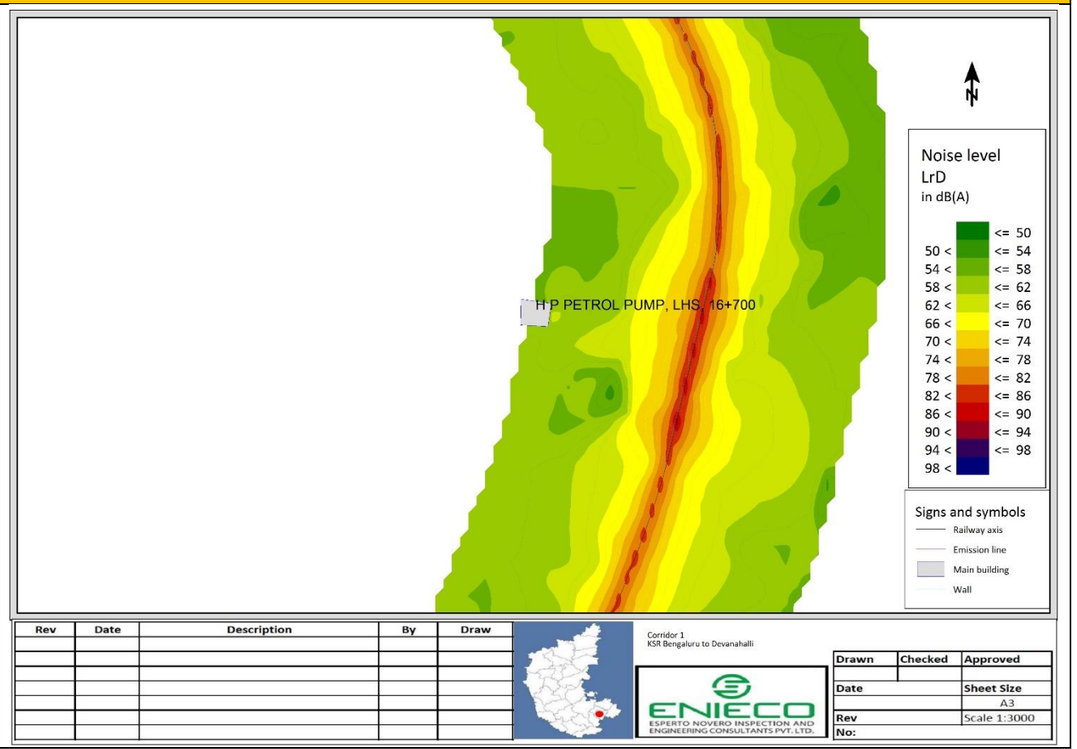
S.No	Without Barrier	With Barrier
9.		

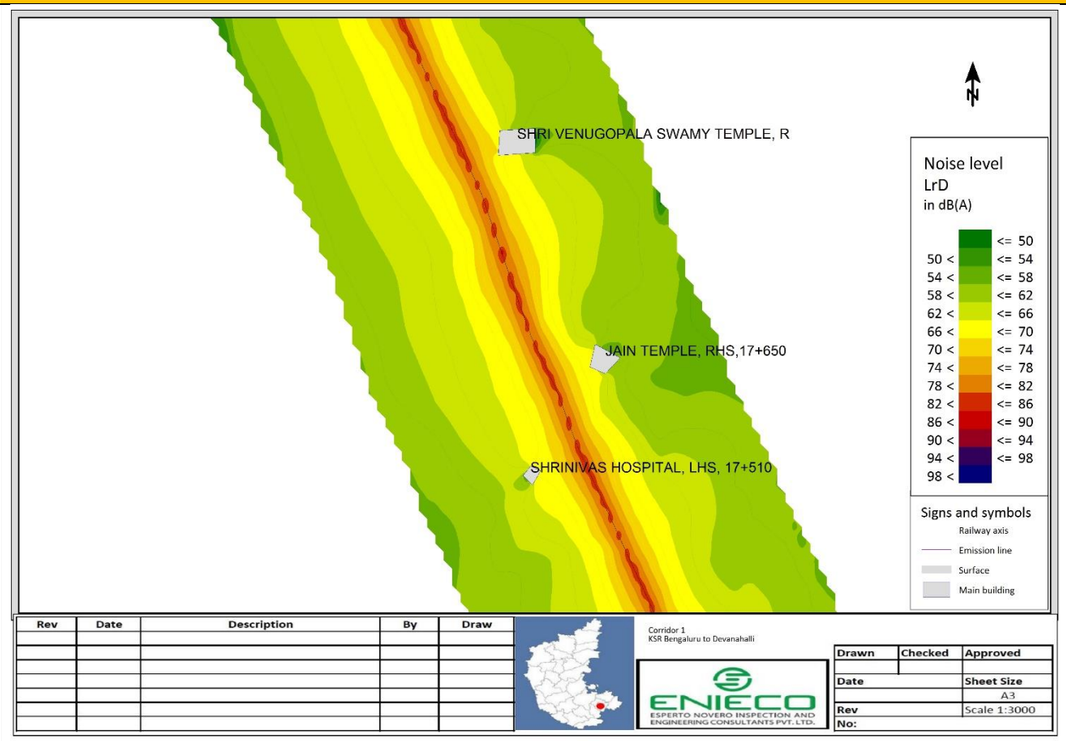
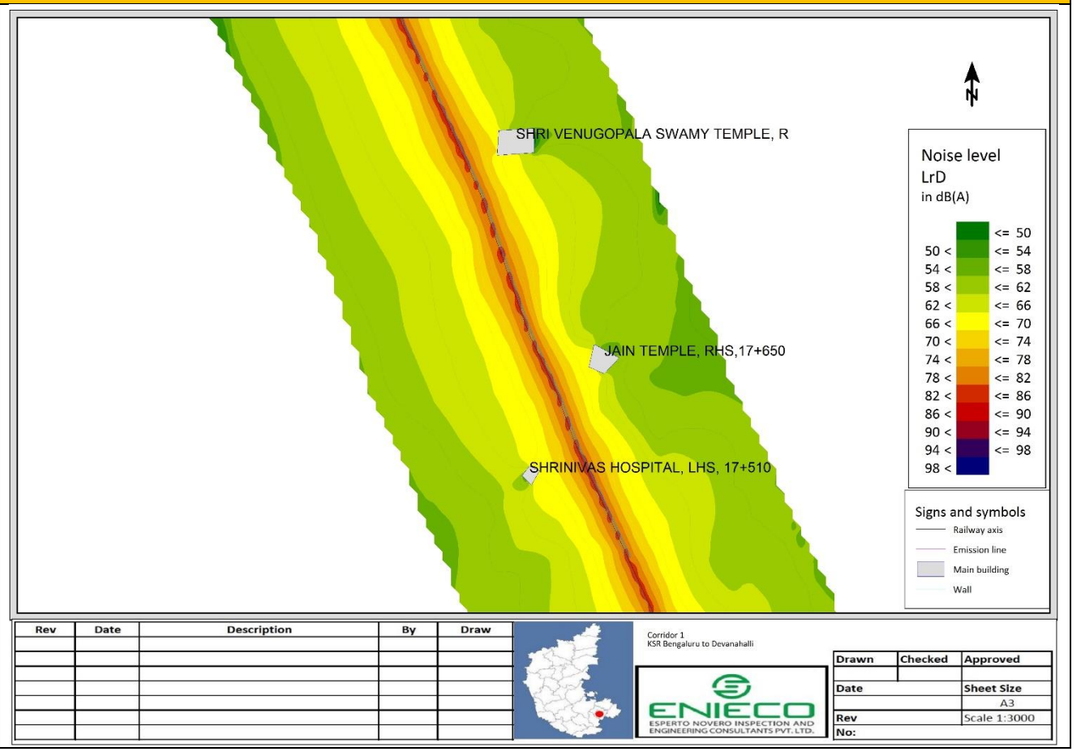
S.No	Without Barrier	With Barrier
10.		

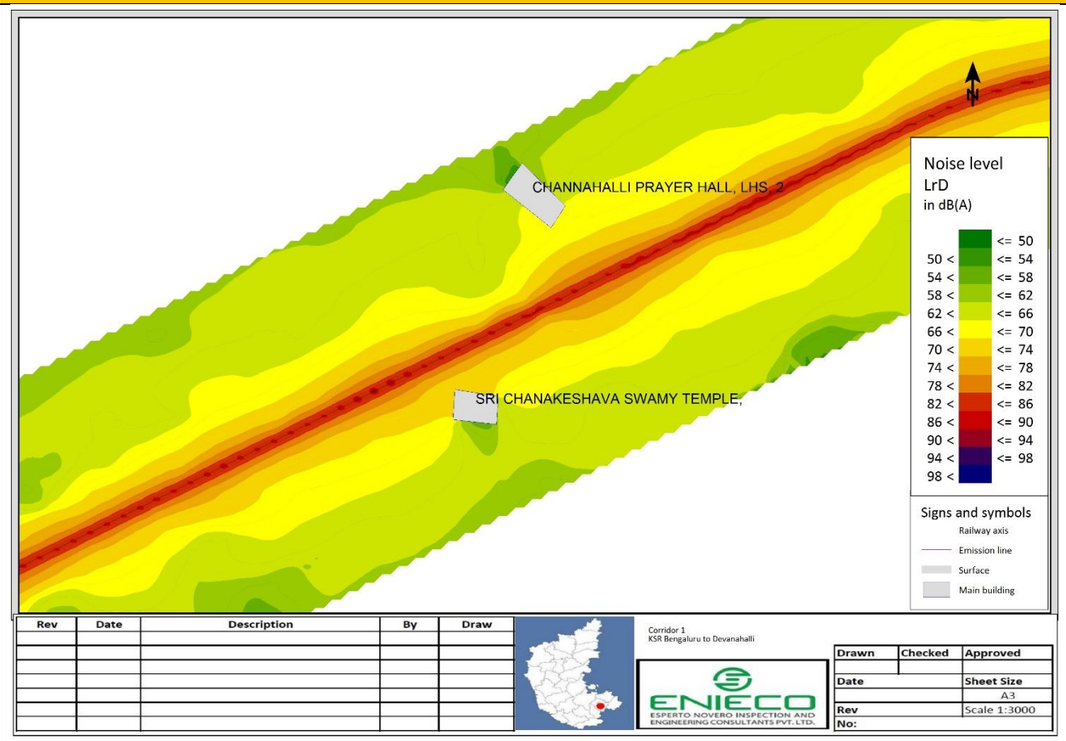
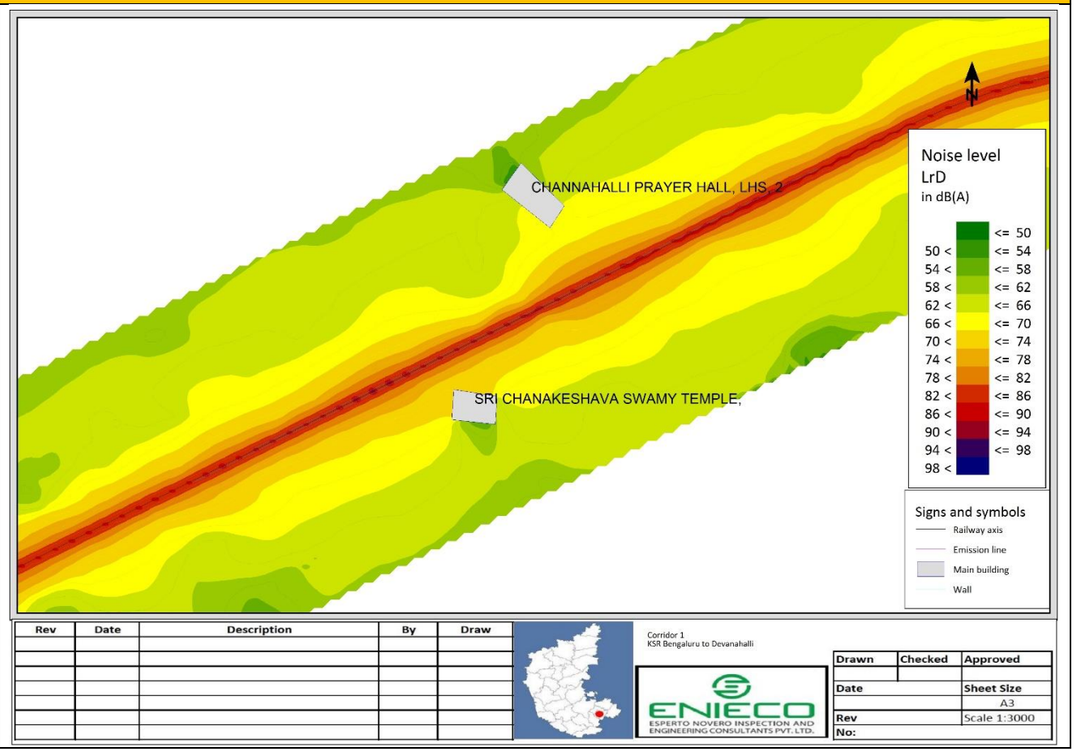
S.No	Without Barrier	With Barrier
11.		

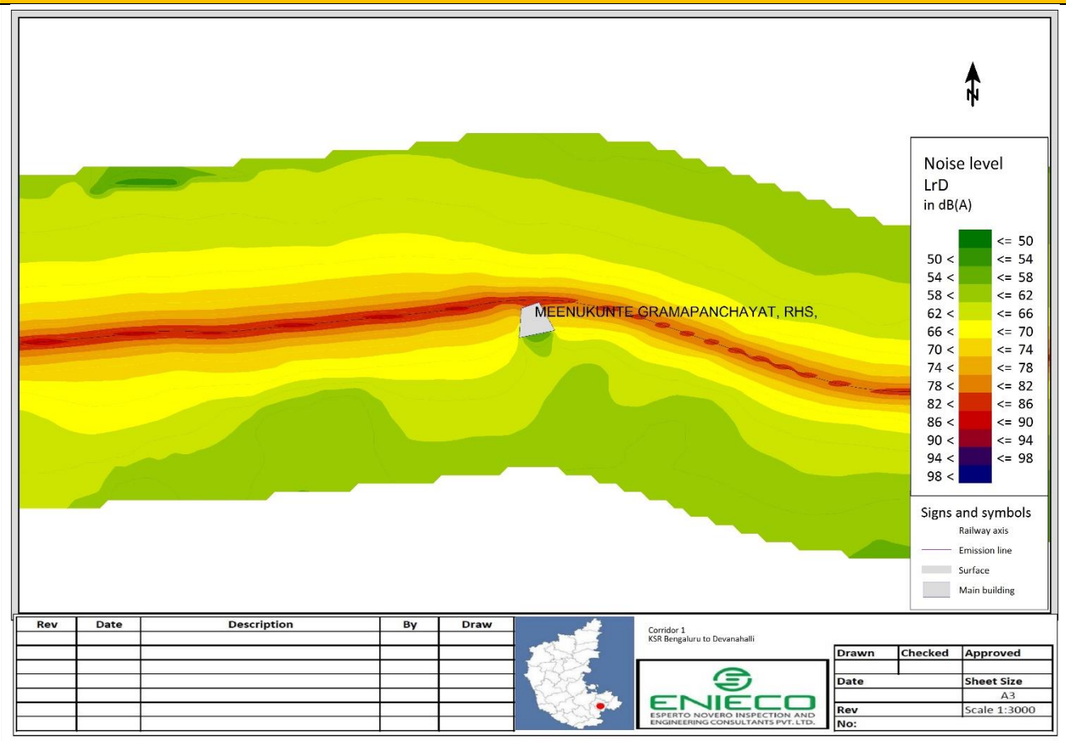
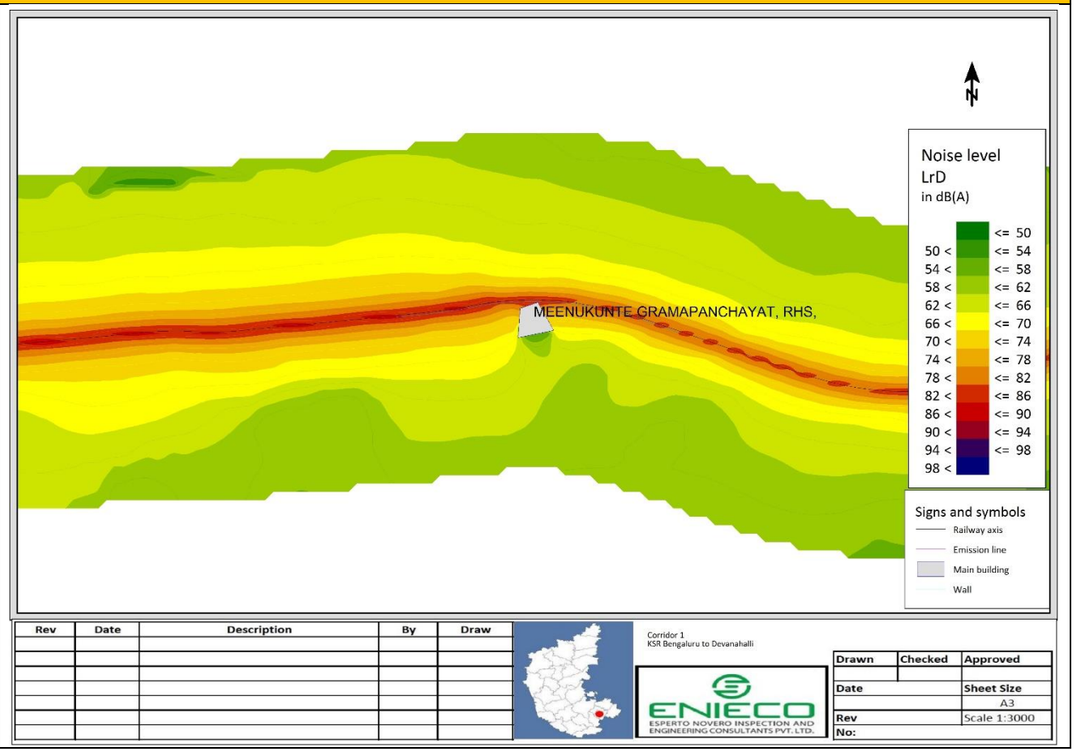
S.No	Without Barrier	With Barrier
12.		

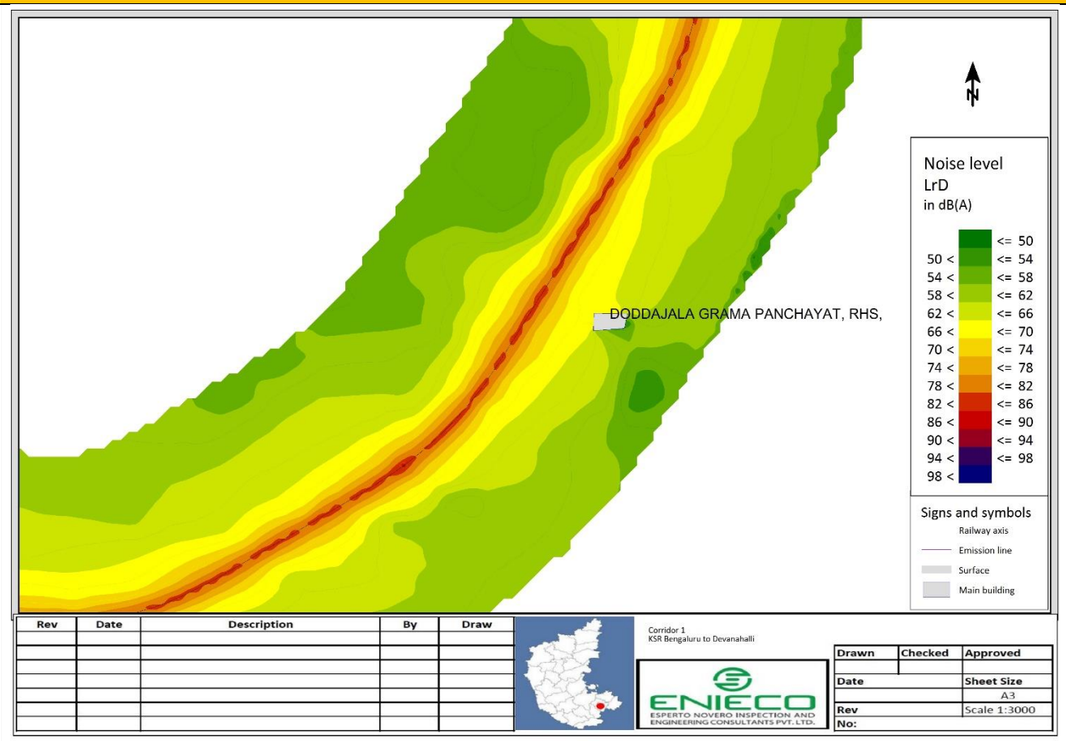
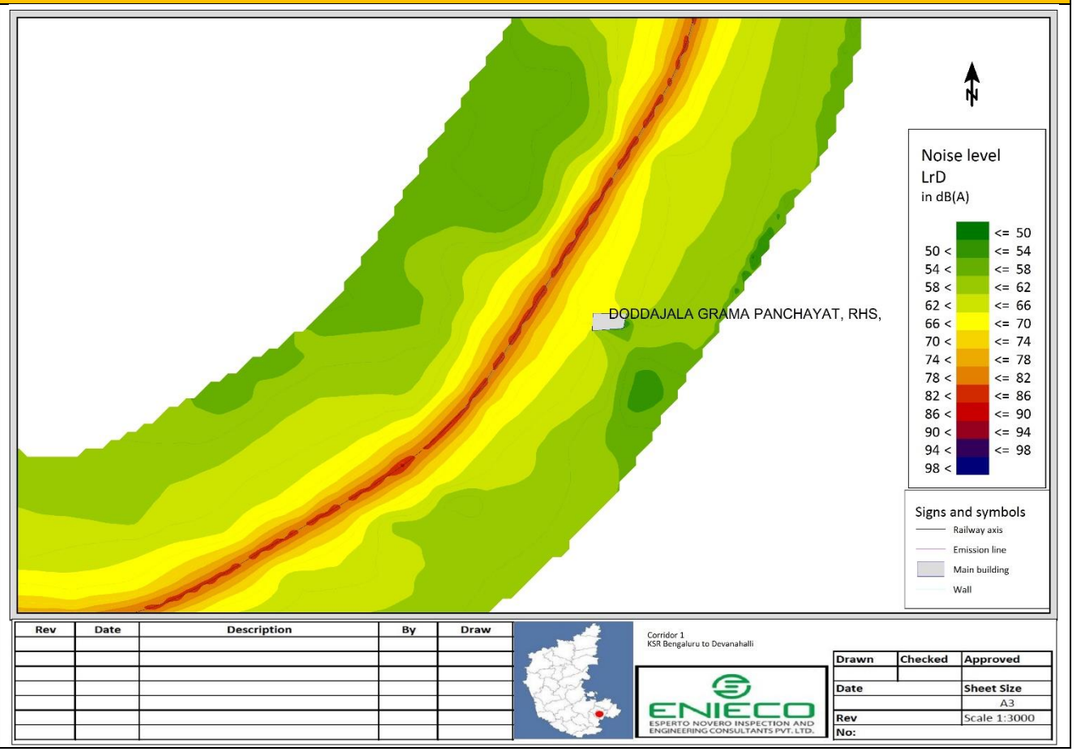
S.No	Without Barrier	With Barrier
13.		

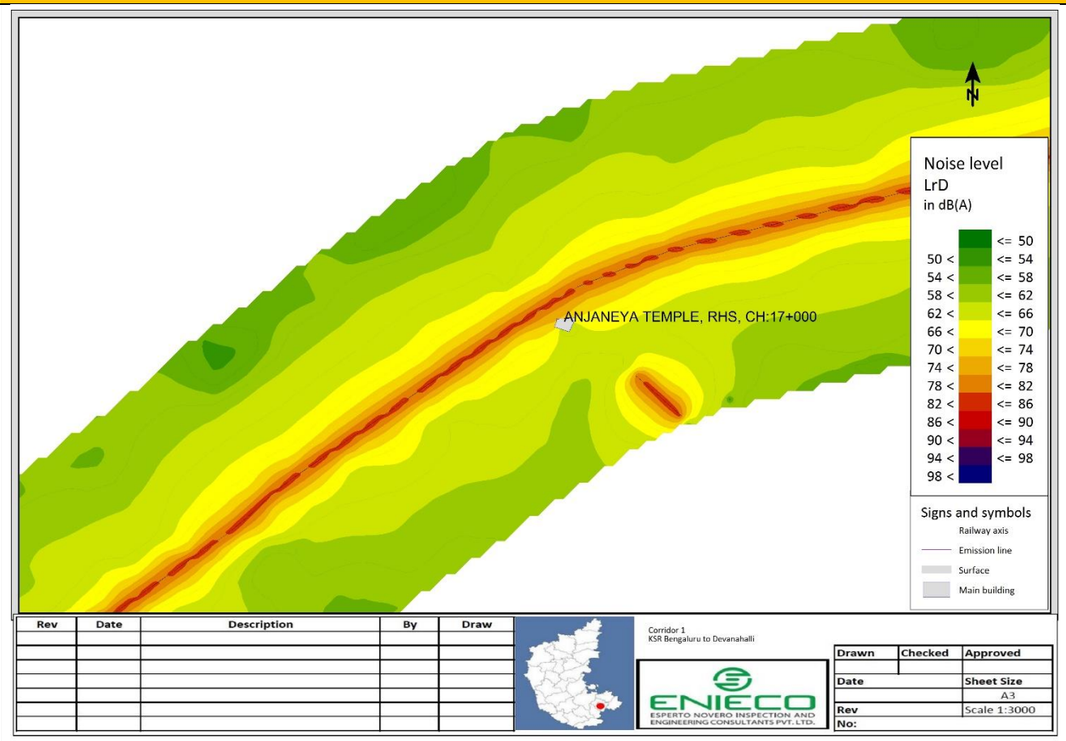
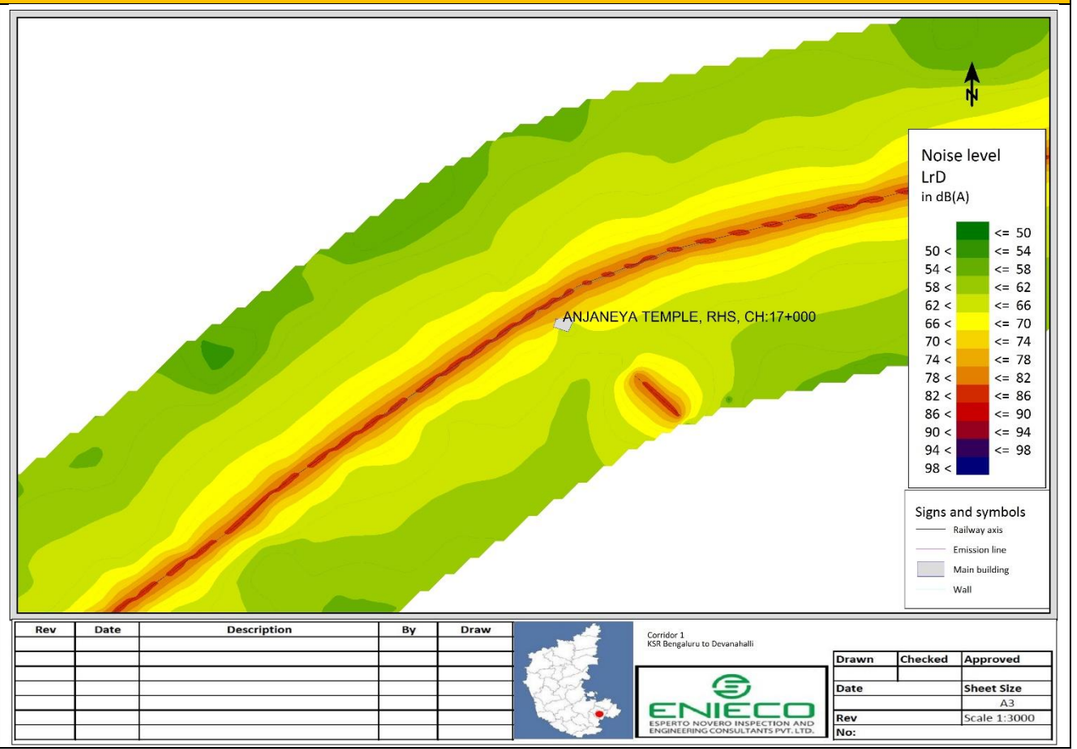
S.No	Without Barrier	With Barrier
14.		

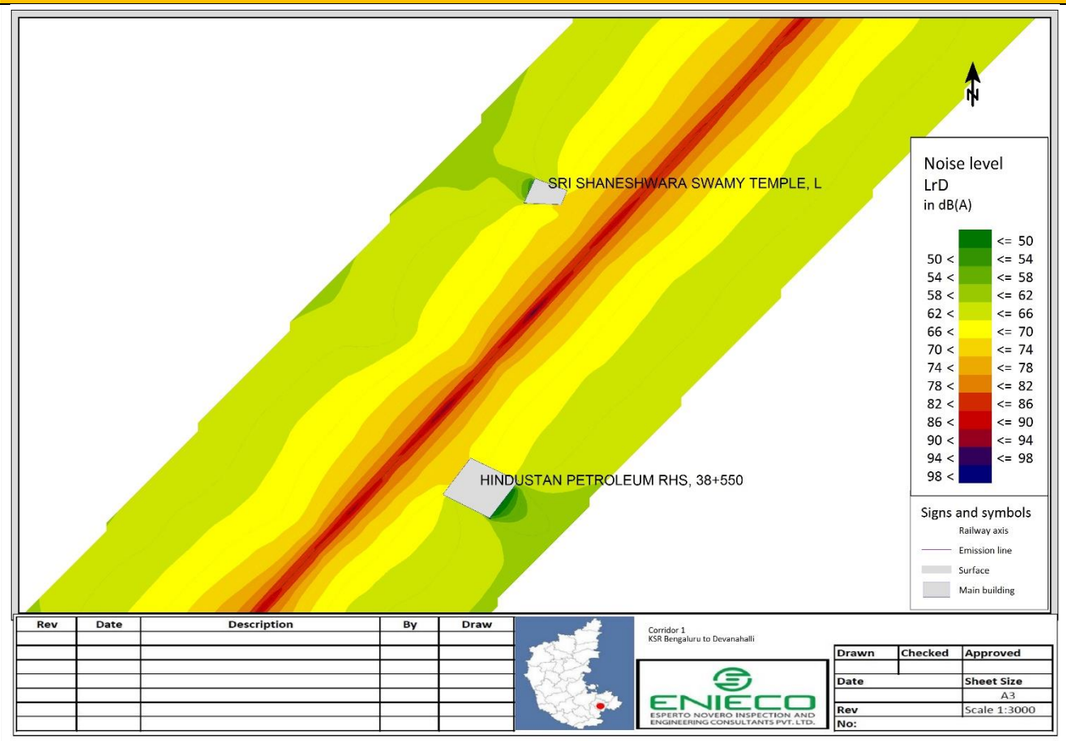
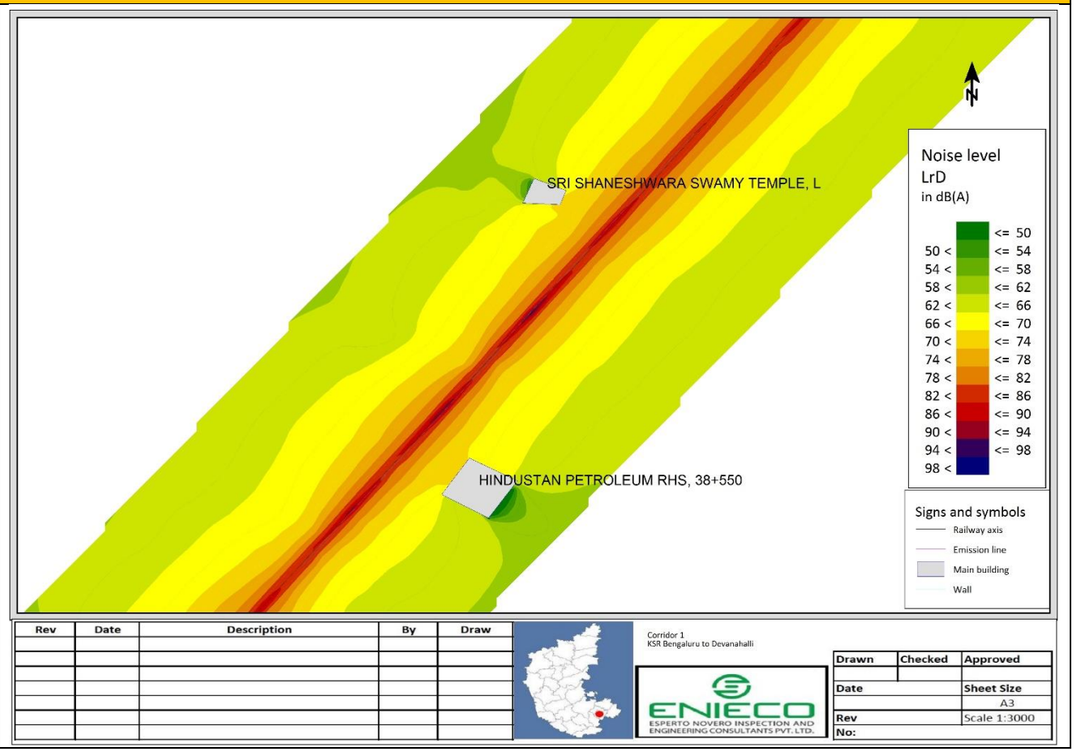
S.No	Without Barrier	With Barrier
15.		

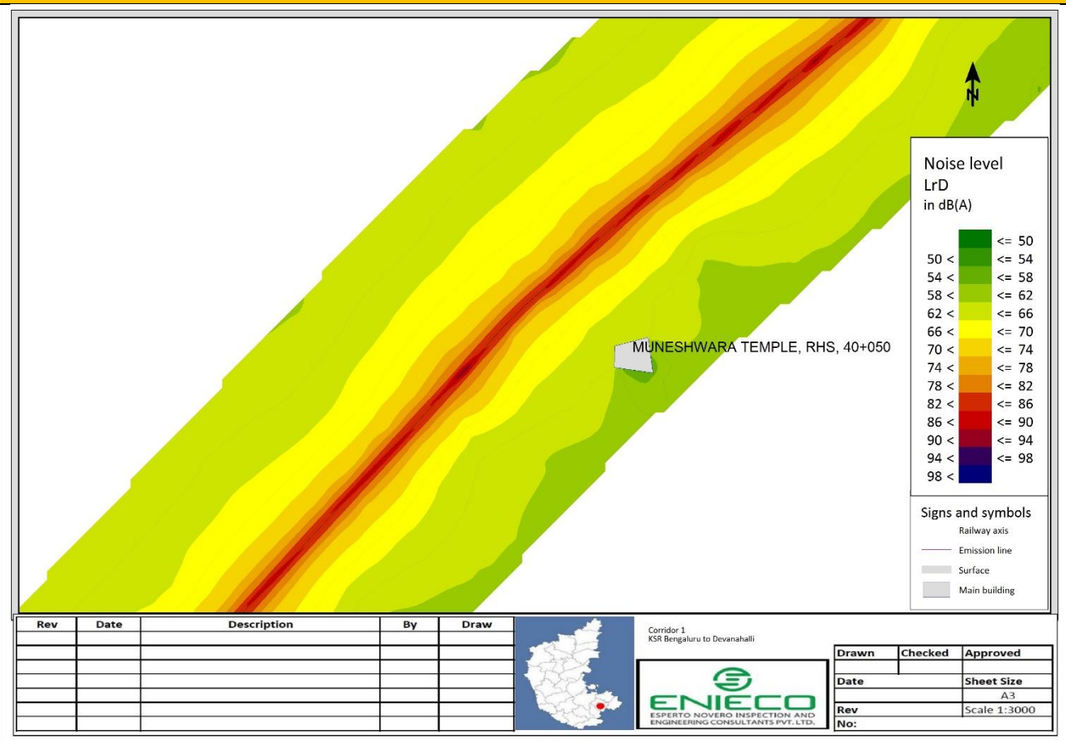
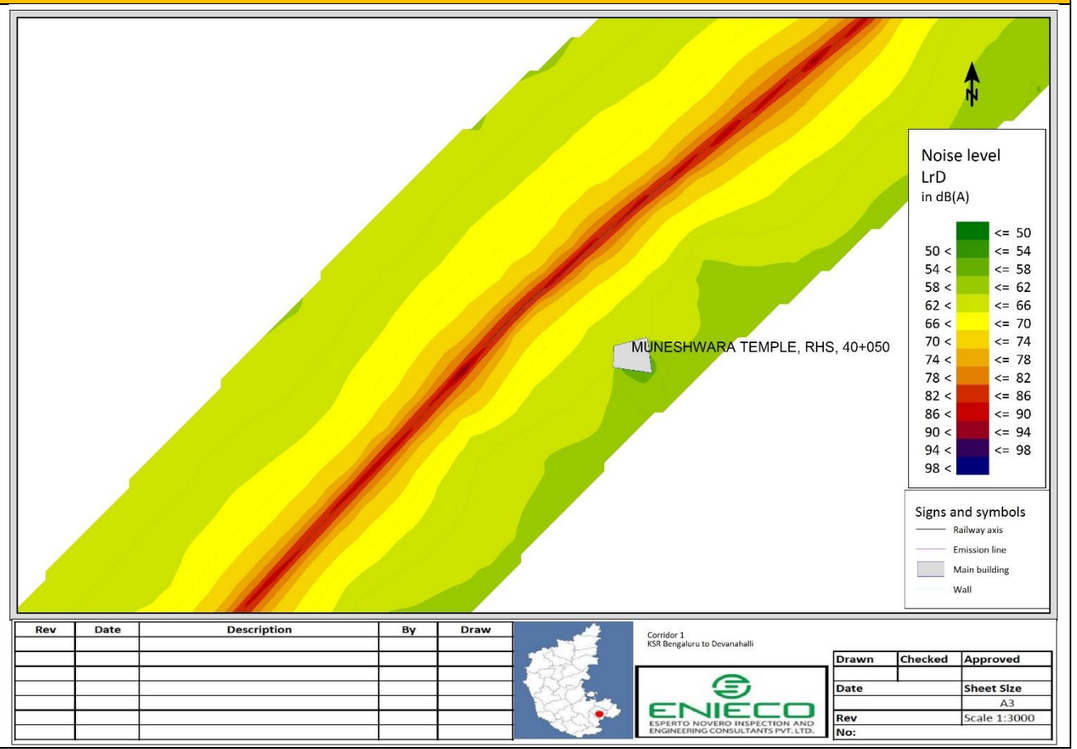
S.No	Without Barrier	With Barrier
16.		

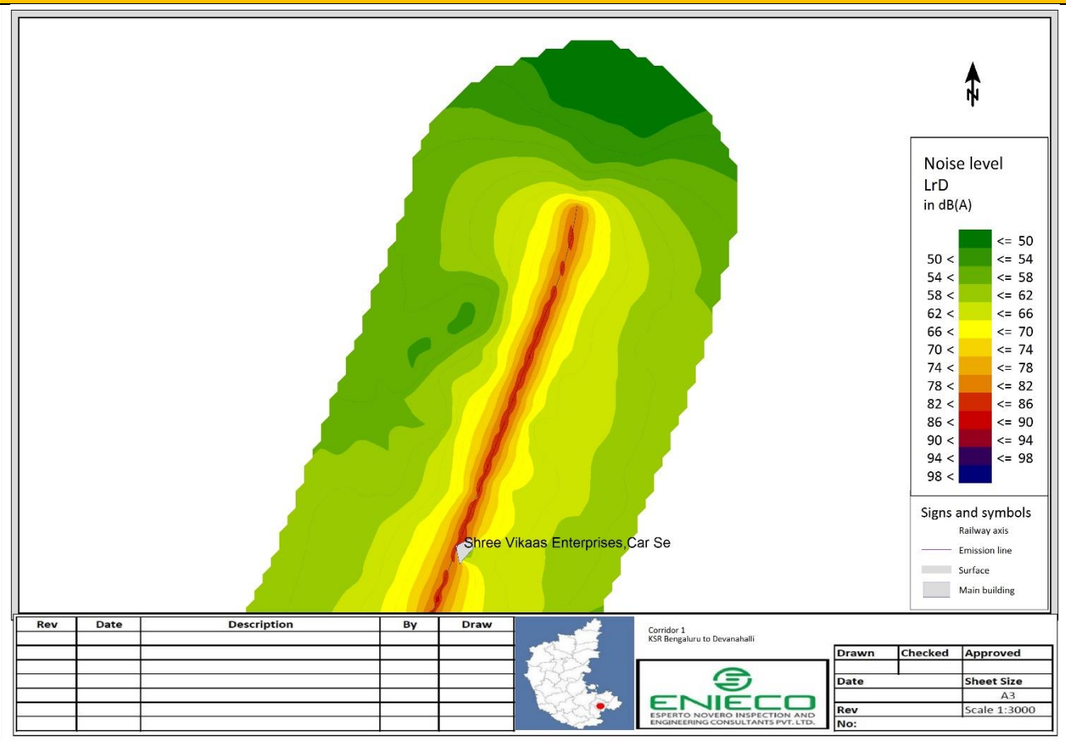
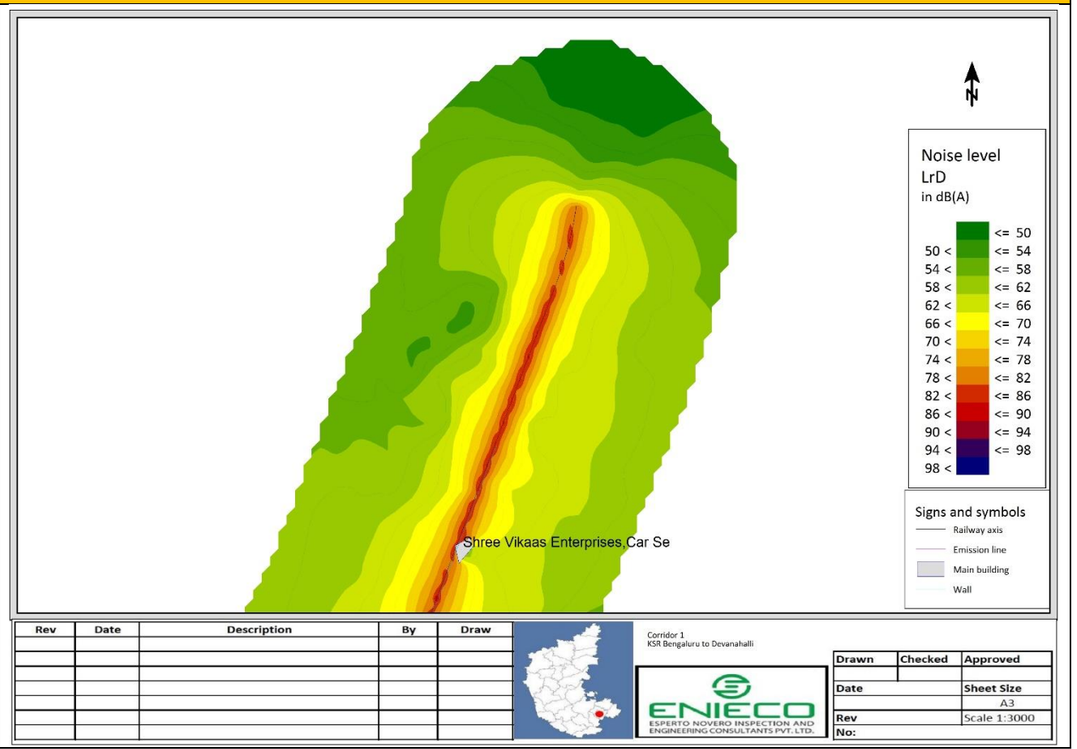
S.No	Without Barrier	With Barrier
17.		

S.No	Without Barrier	With Barrier
18.		

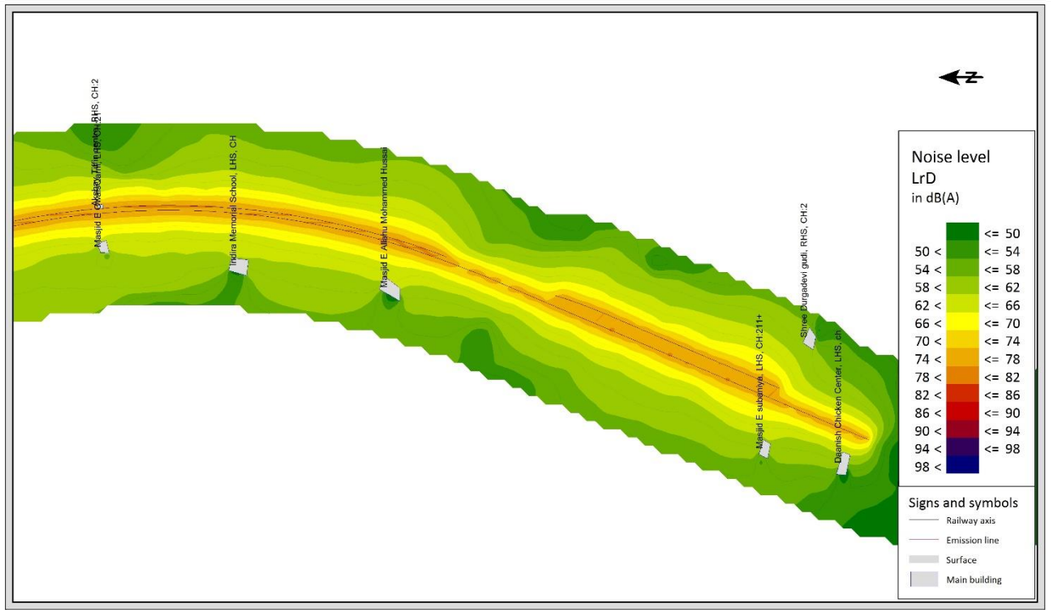
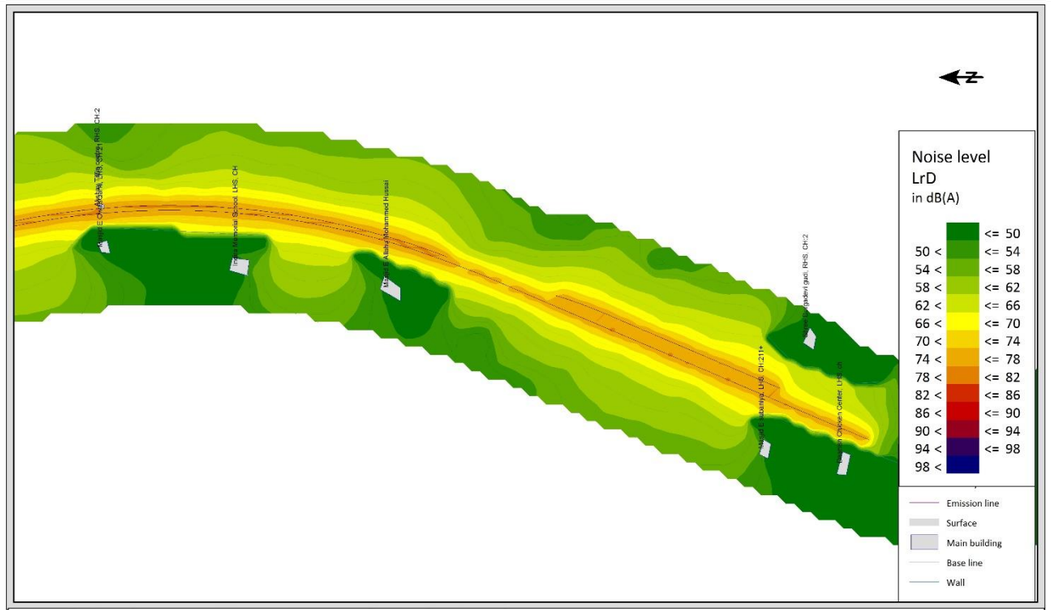
S.No	Without Barrier	With Barrier
19.		

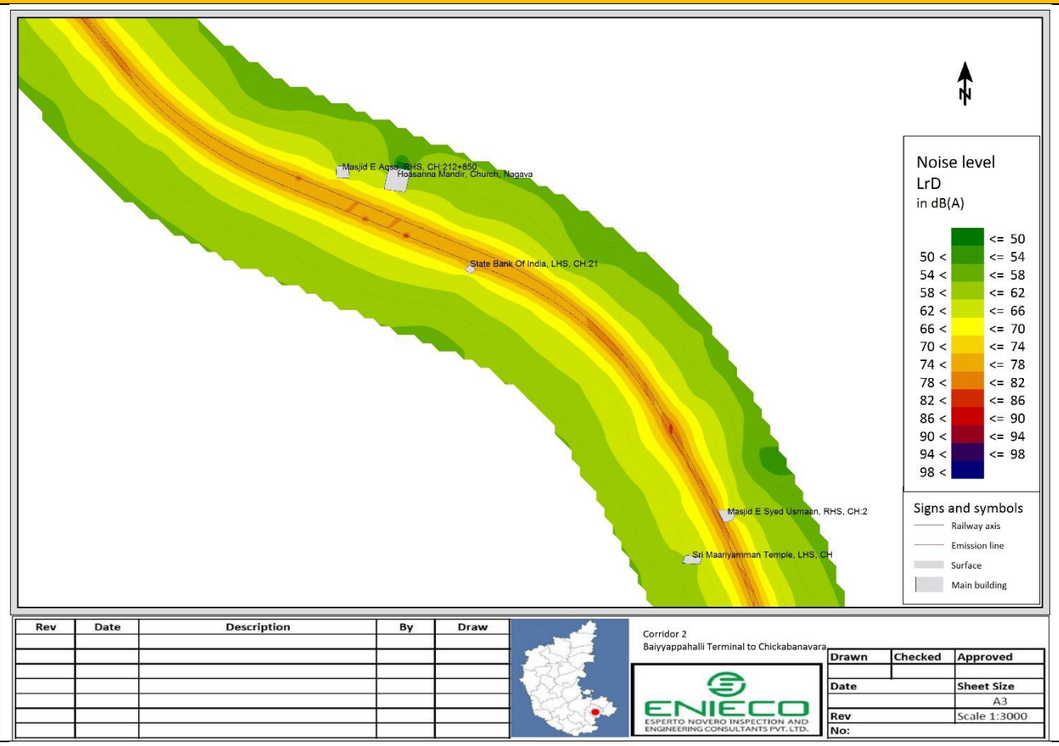
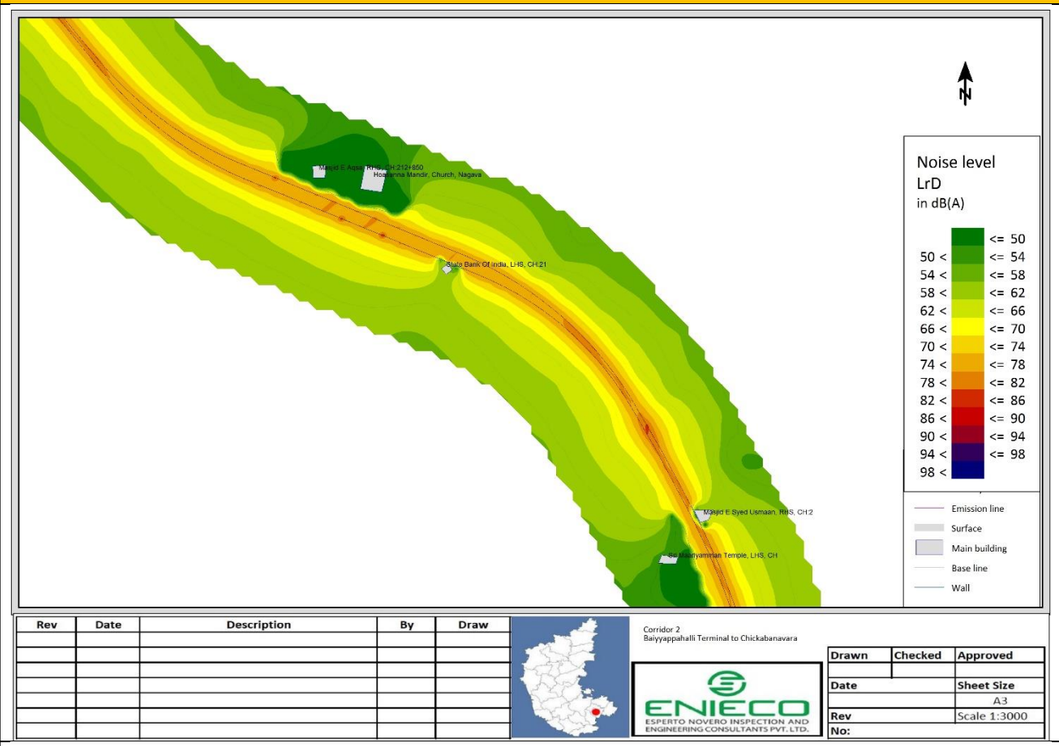
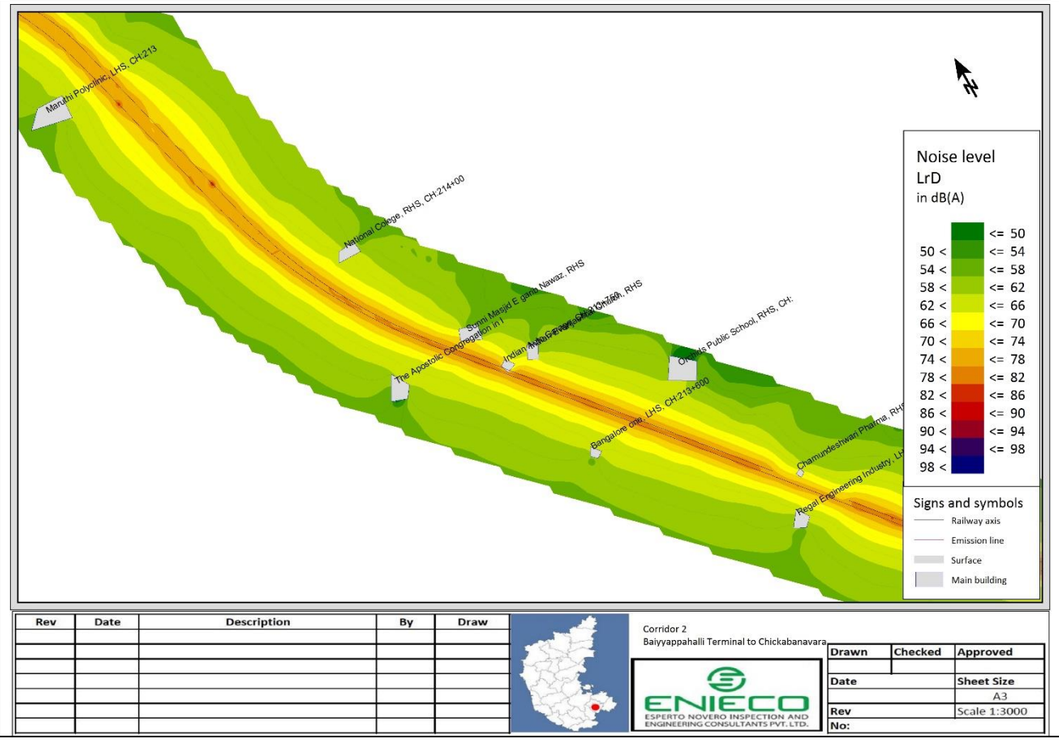
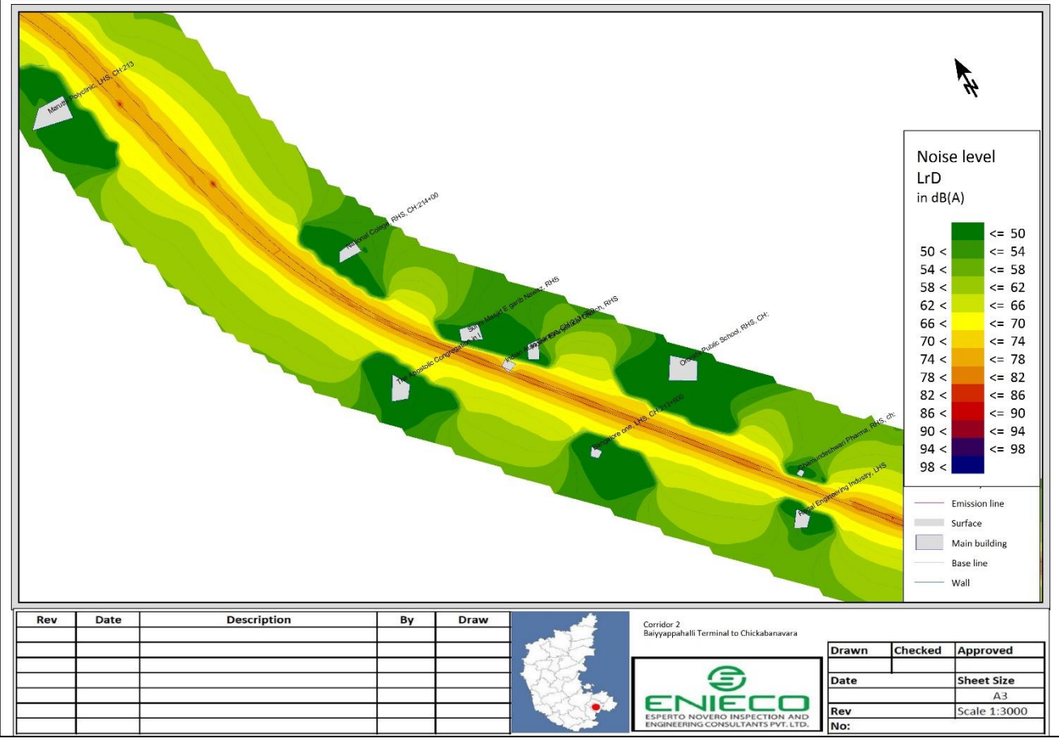
S.No	Without Barrier	With Barrier
20.		

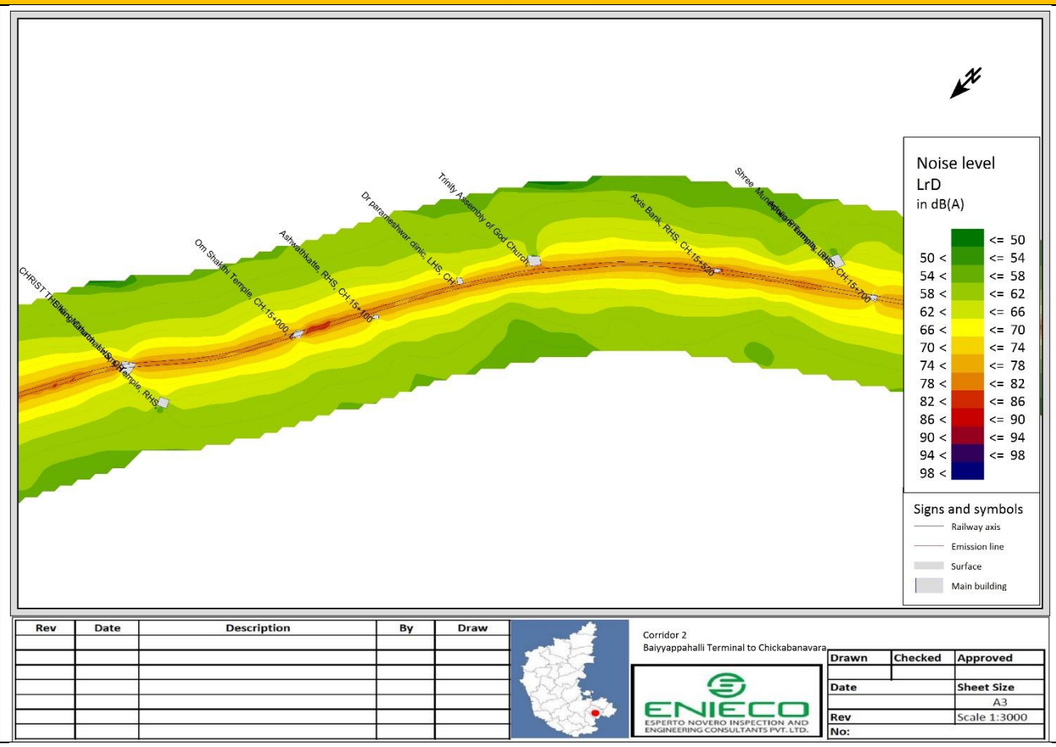
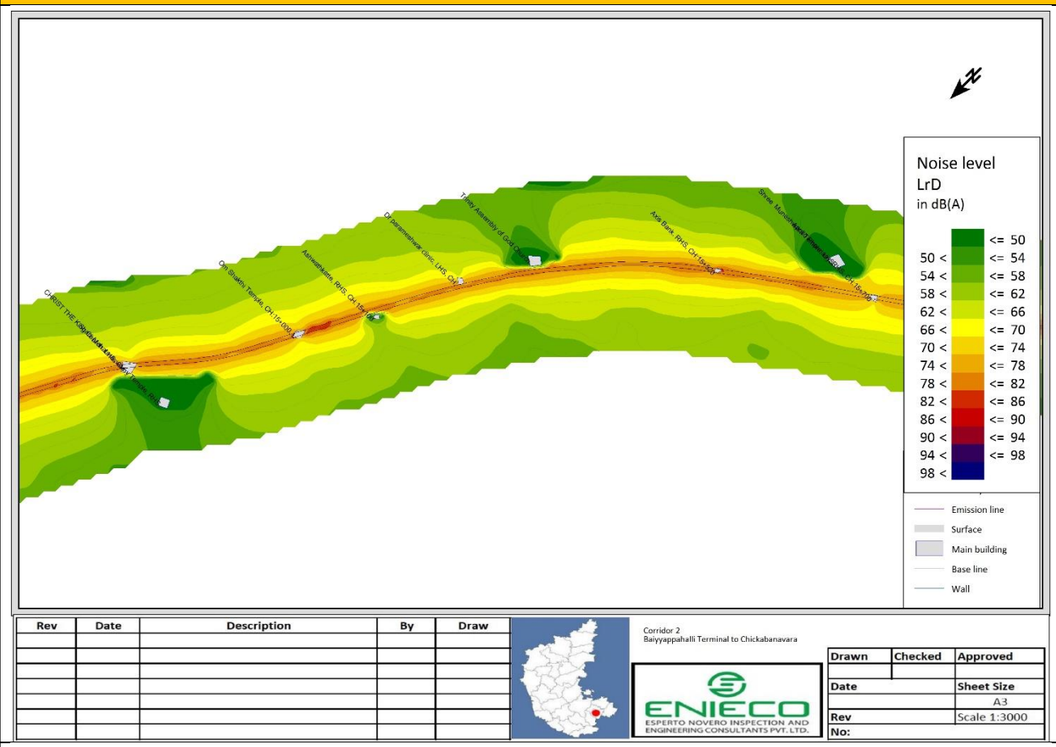
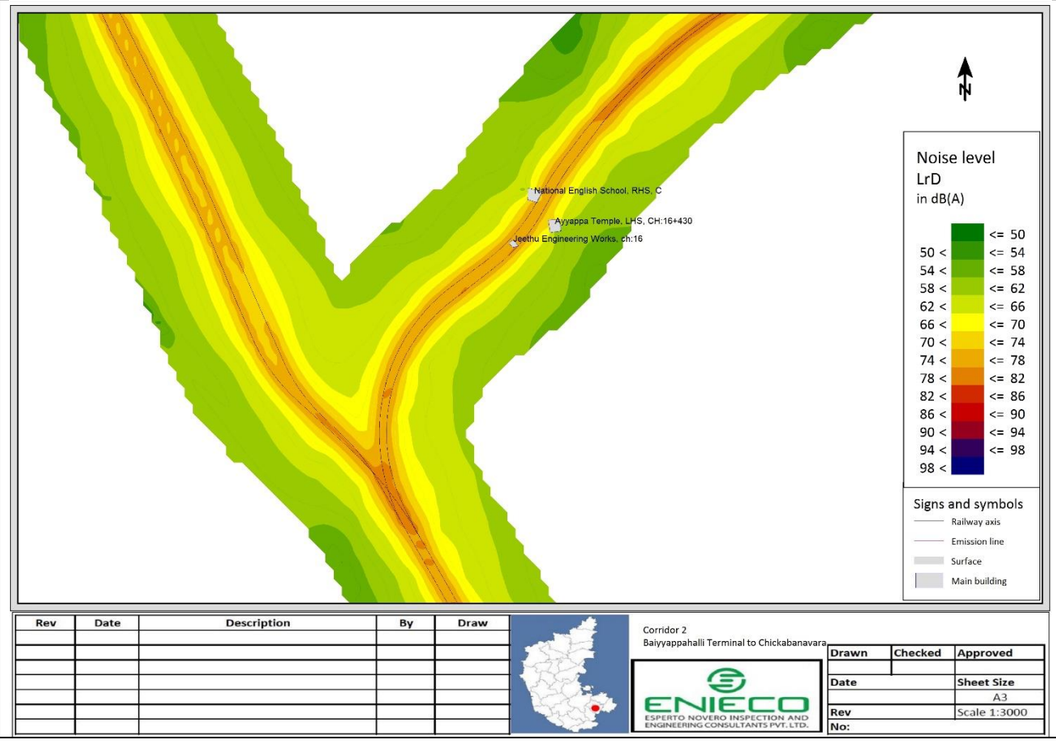
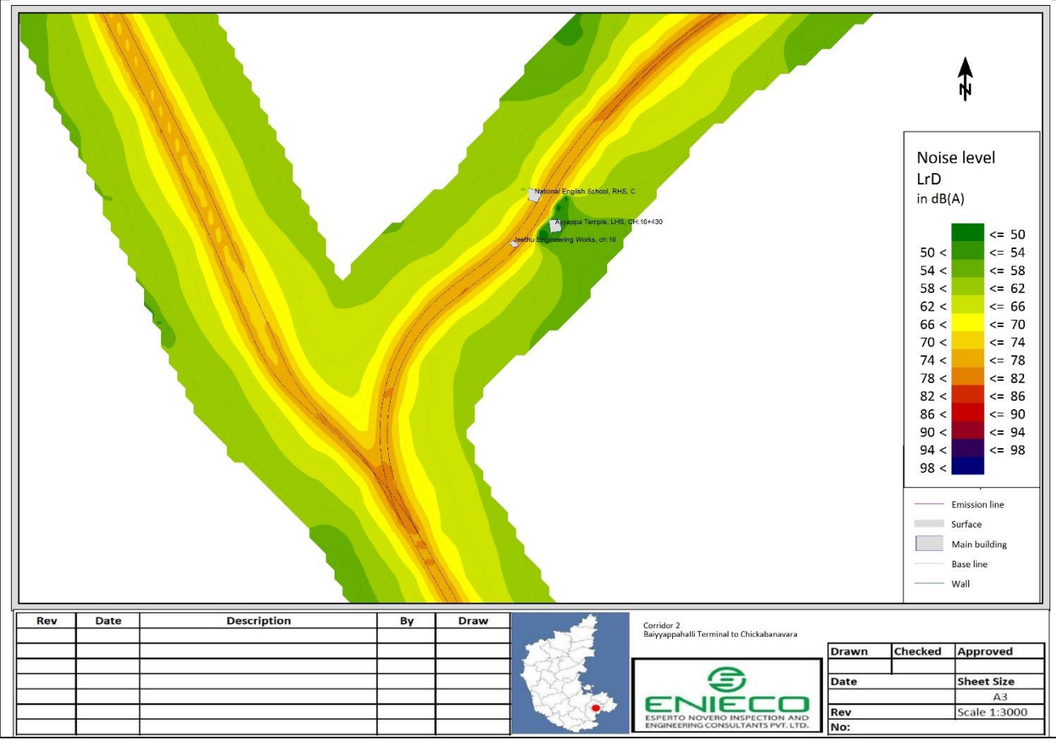
S.No	Without Barrier	With Barrier
21.		

S.No	Without Barrier	With Barrier
22.		

A. Noise contours for Corridor 2 for the Year 2025

S.No	Without Barrier	With Barrier
1.		

S.No	Without Barrier	With Barrier
2.		
3.		

S.No	Without Barrier	With Barrier
4.		
5.		

Rev	Date	Description	By	Draw

Corridor 2
Baiyyappahalli Terminal to Chickabanavara

Drawn	Checked	Approved
Date		Sheet Size
		A3
Rev		Scale 1:3000
No:		

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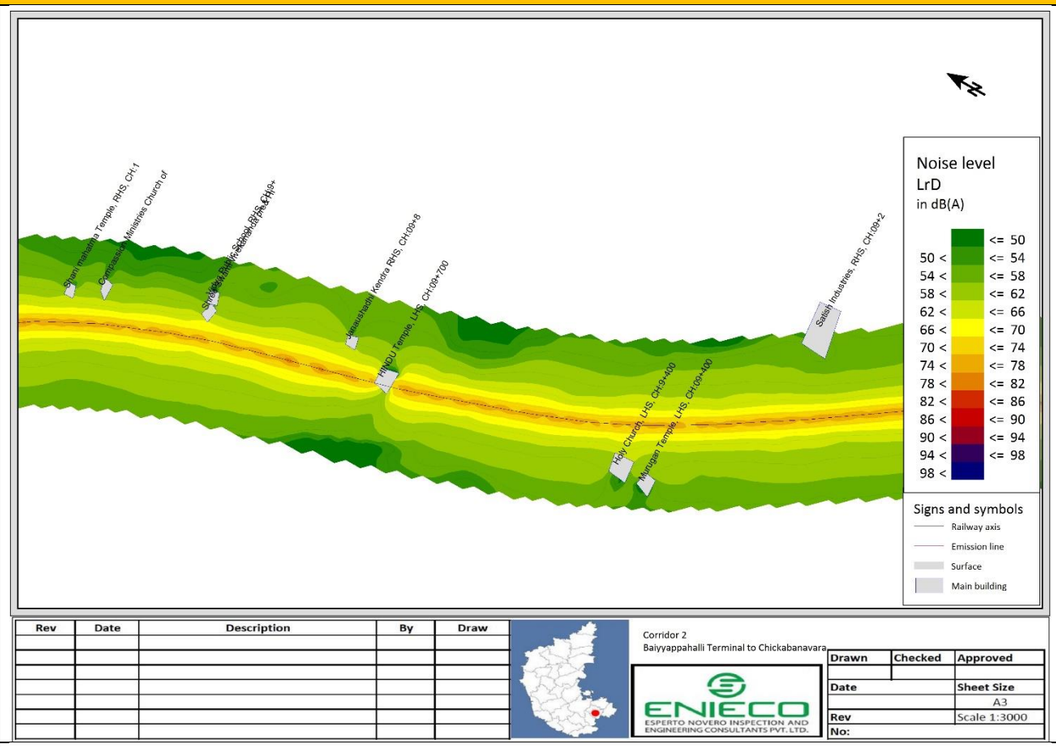
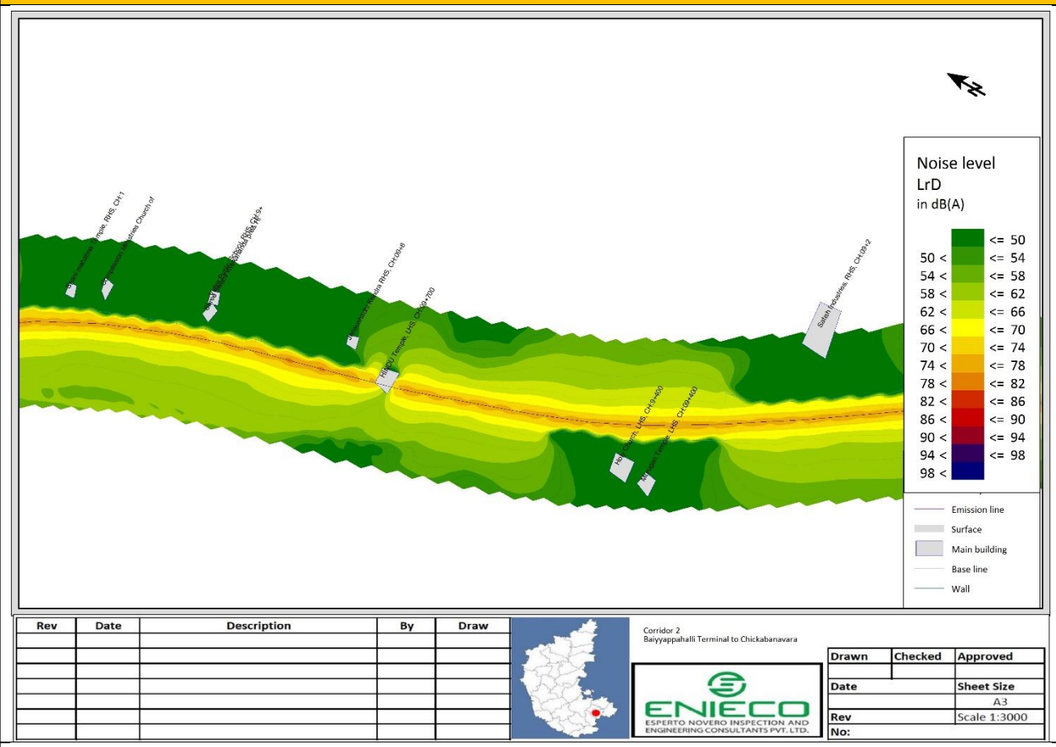
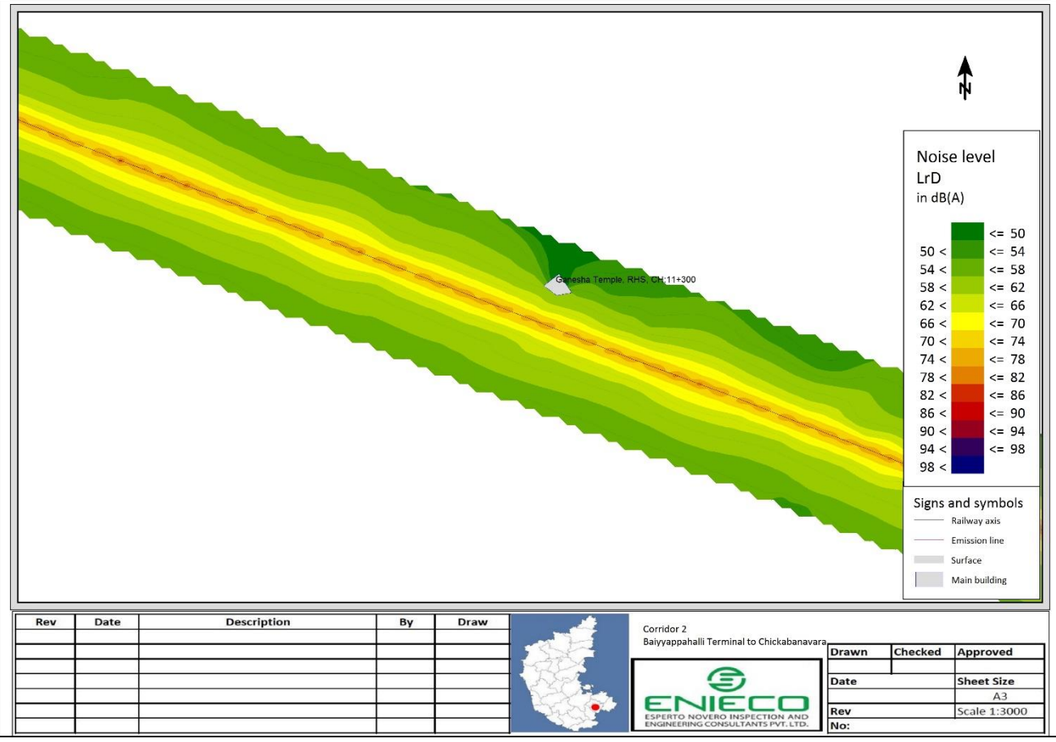
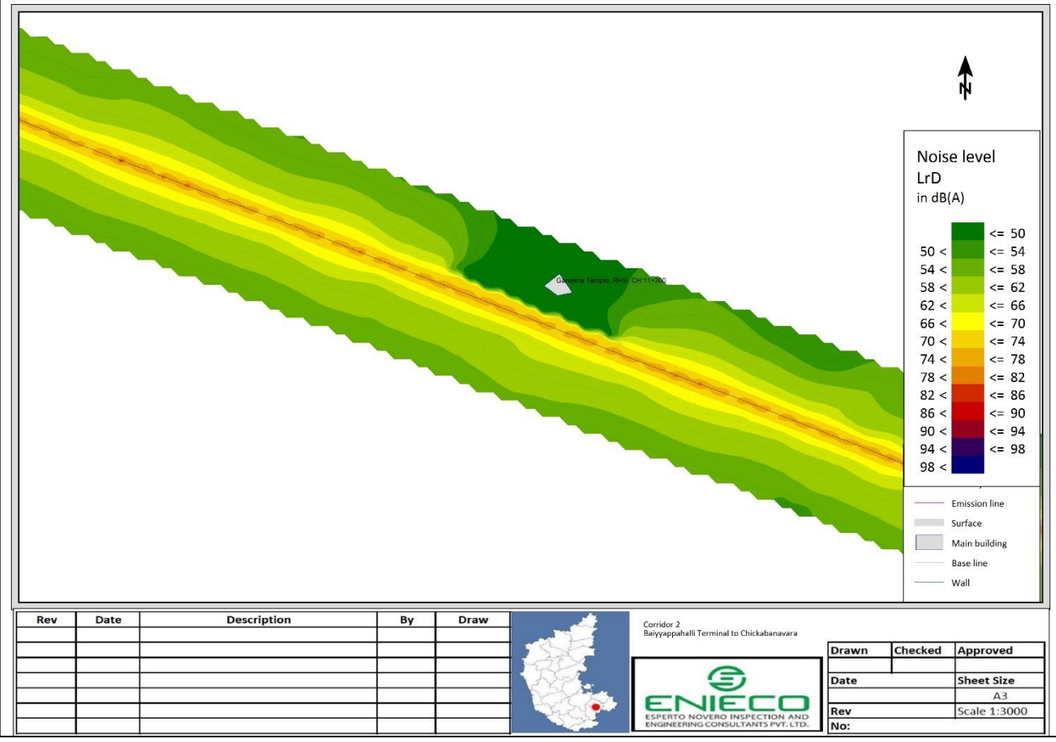
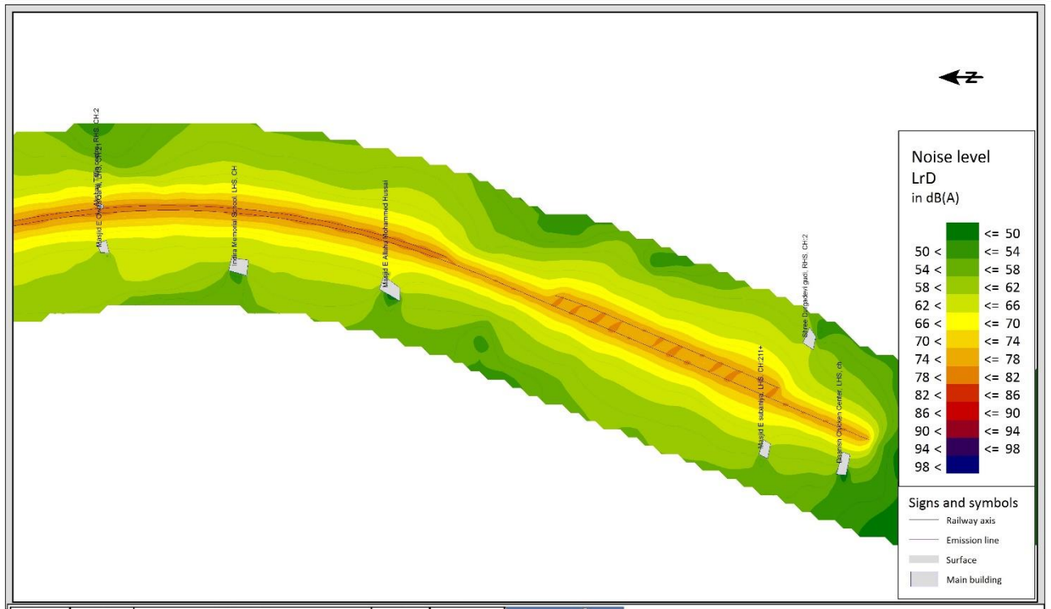
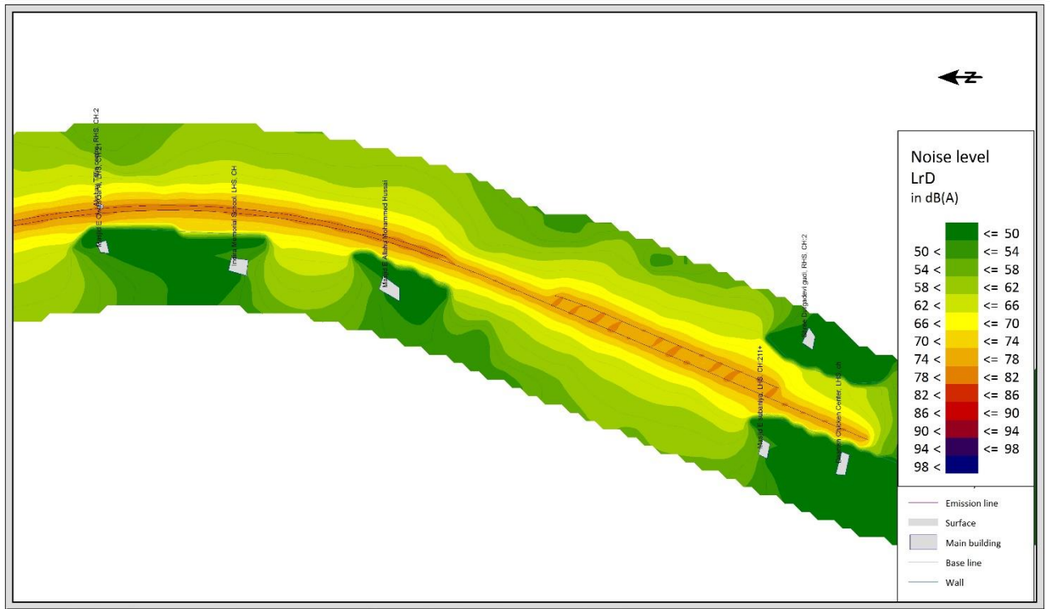
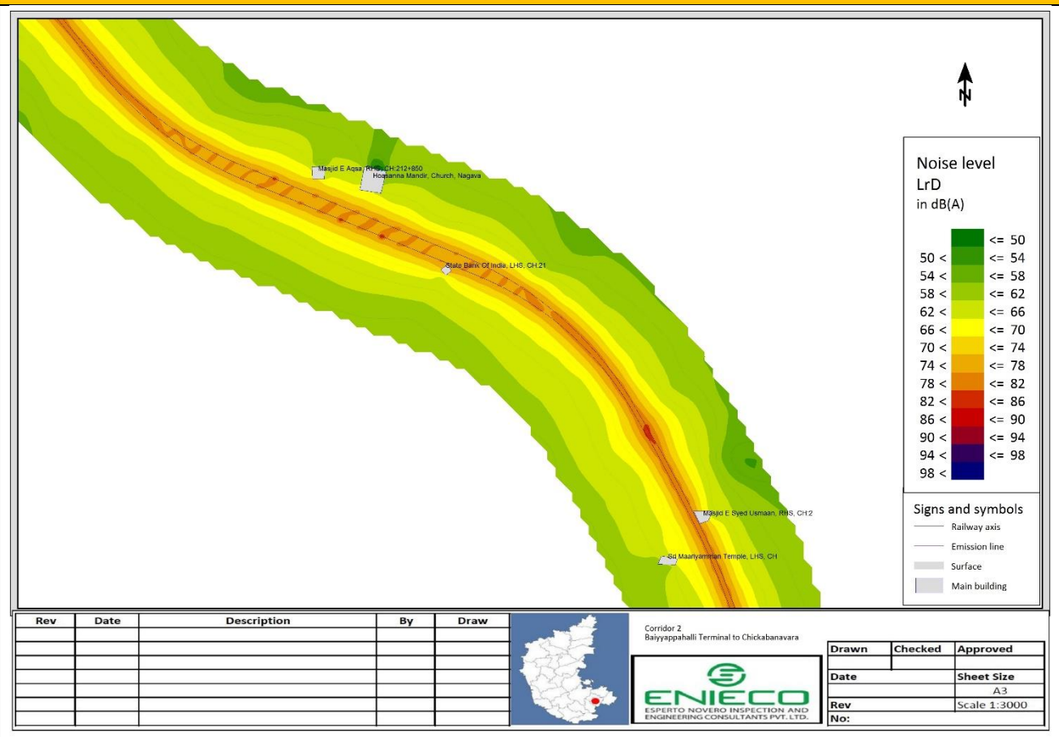
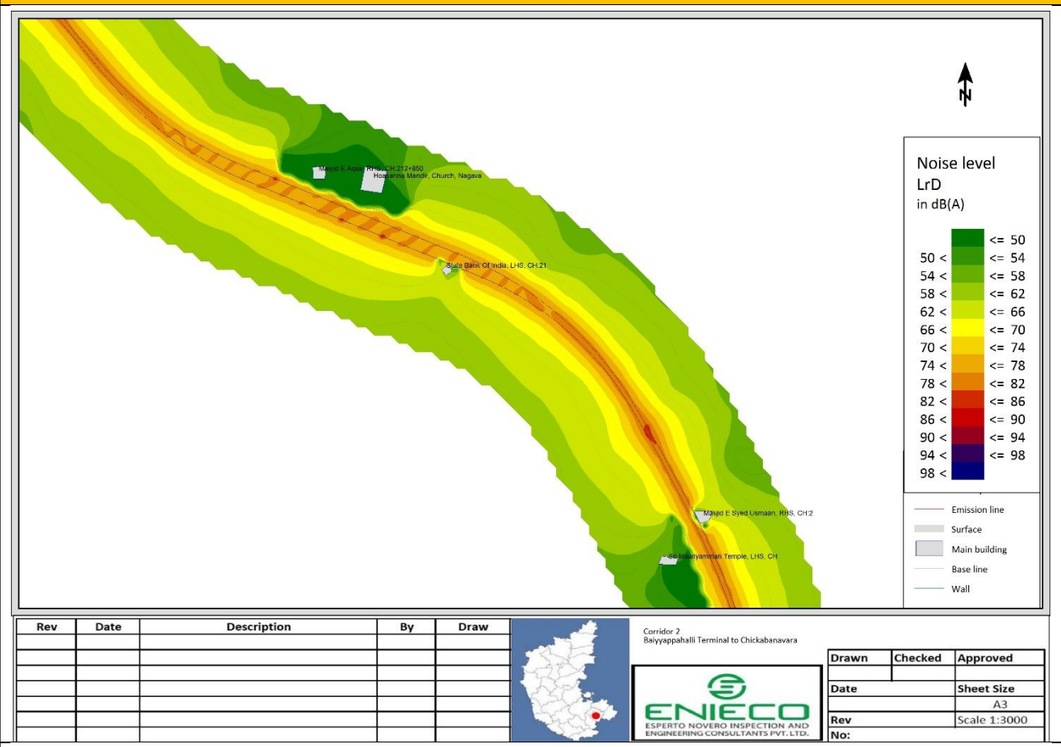
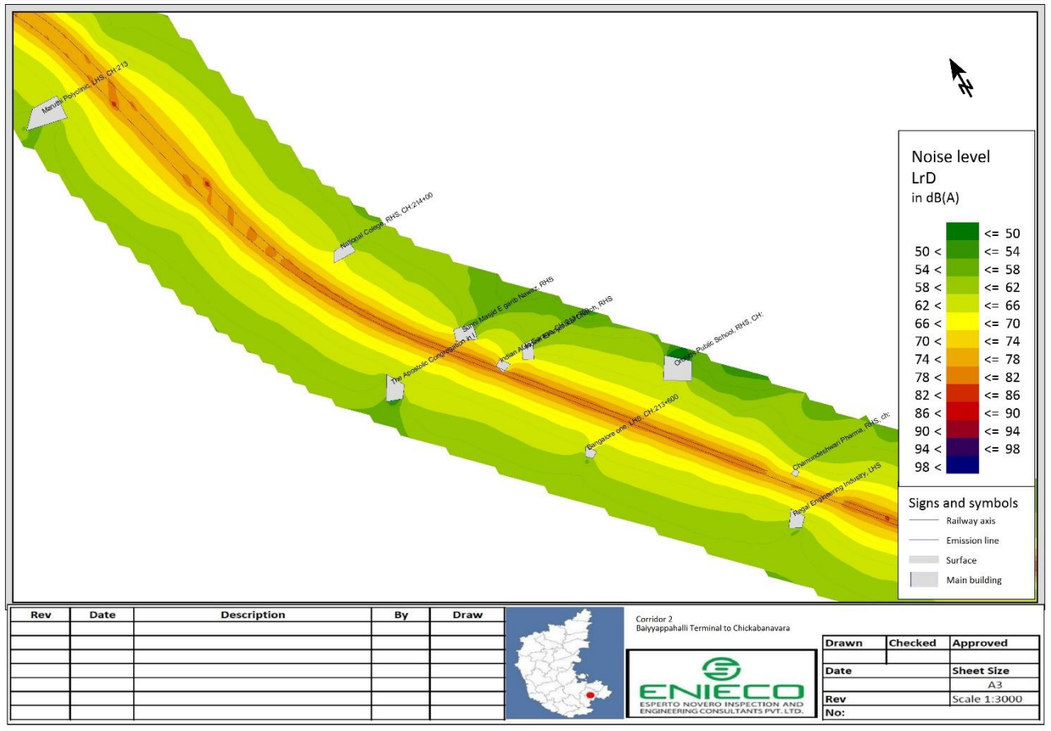
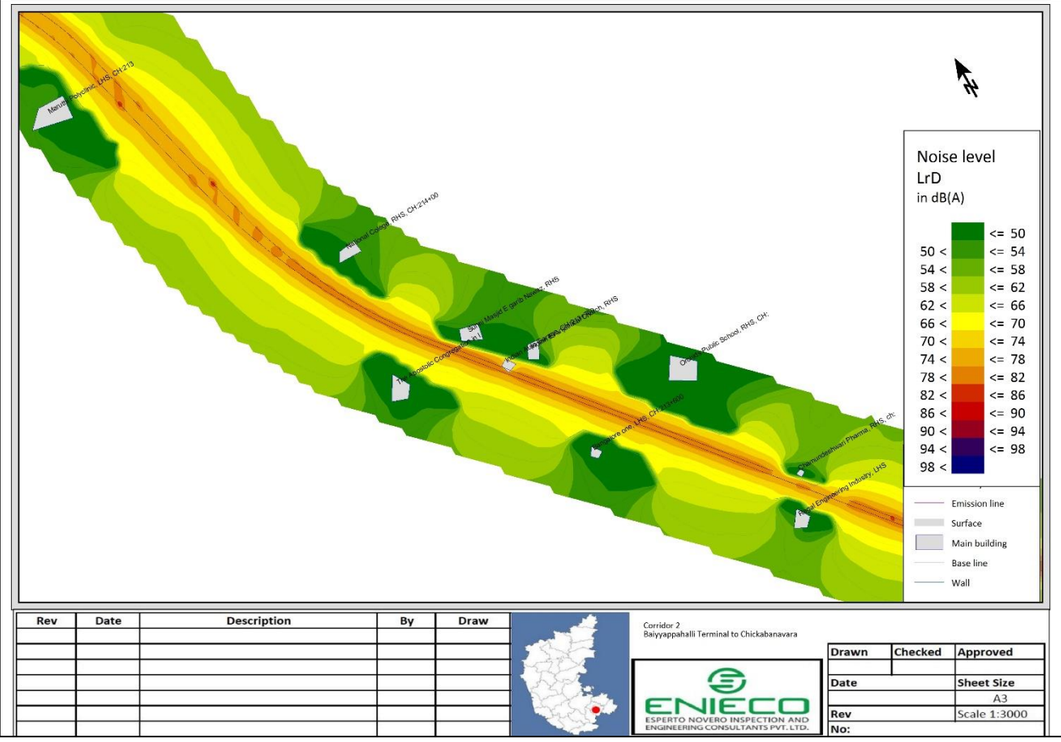
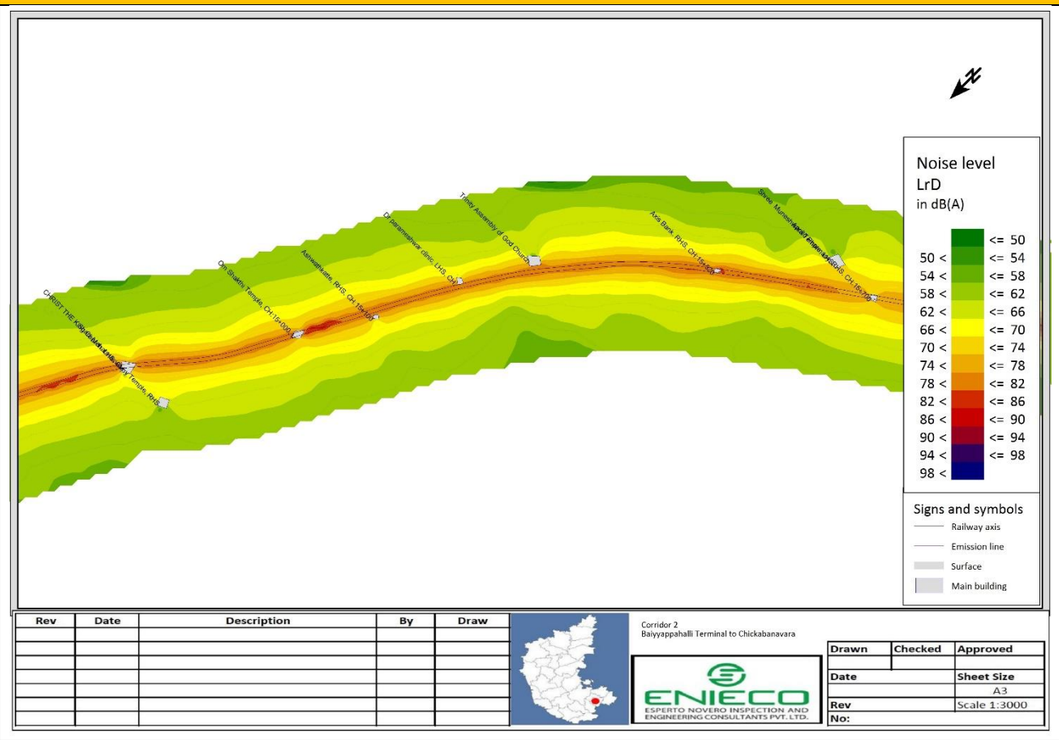
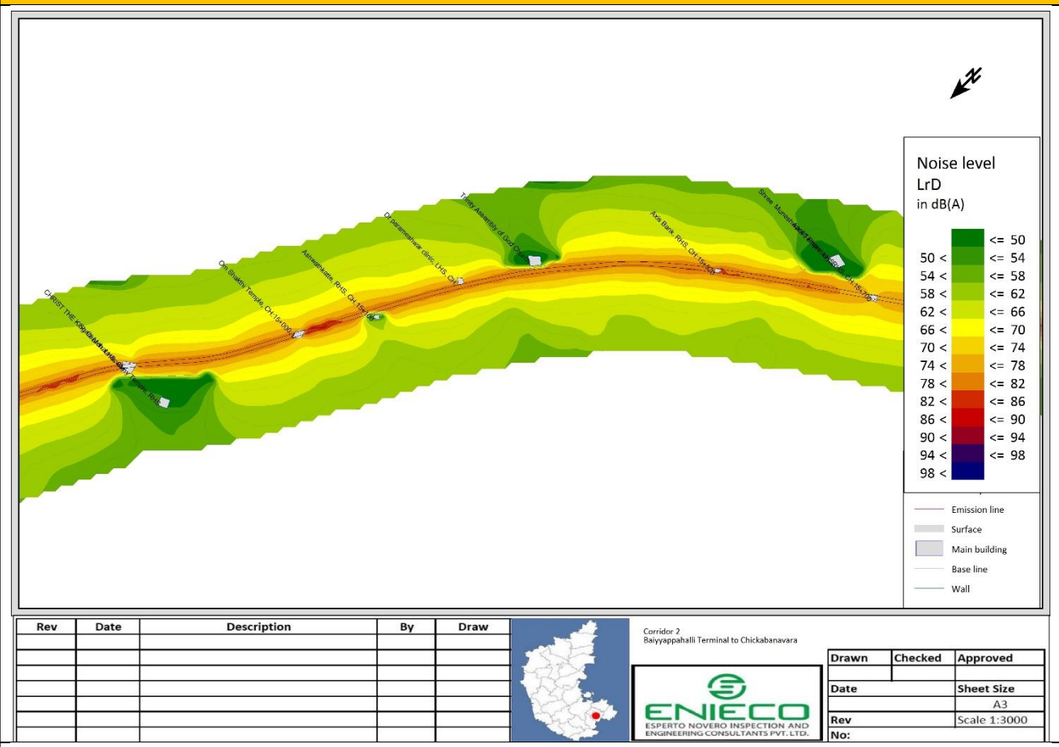
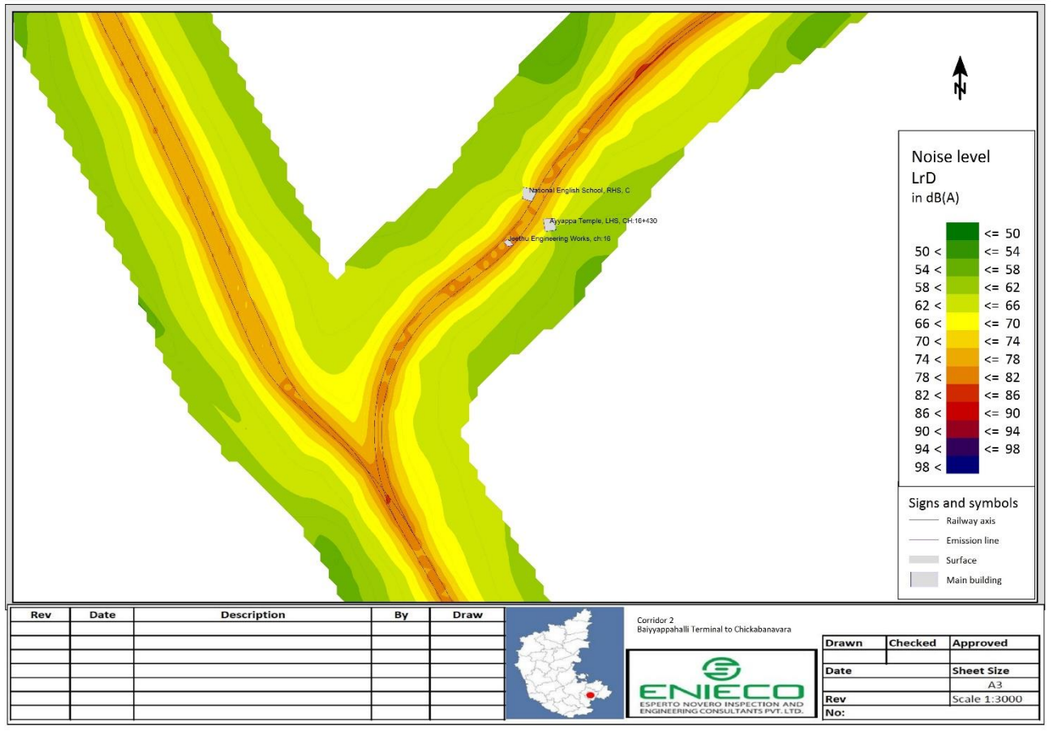
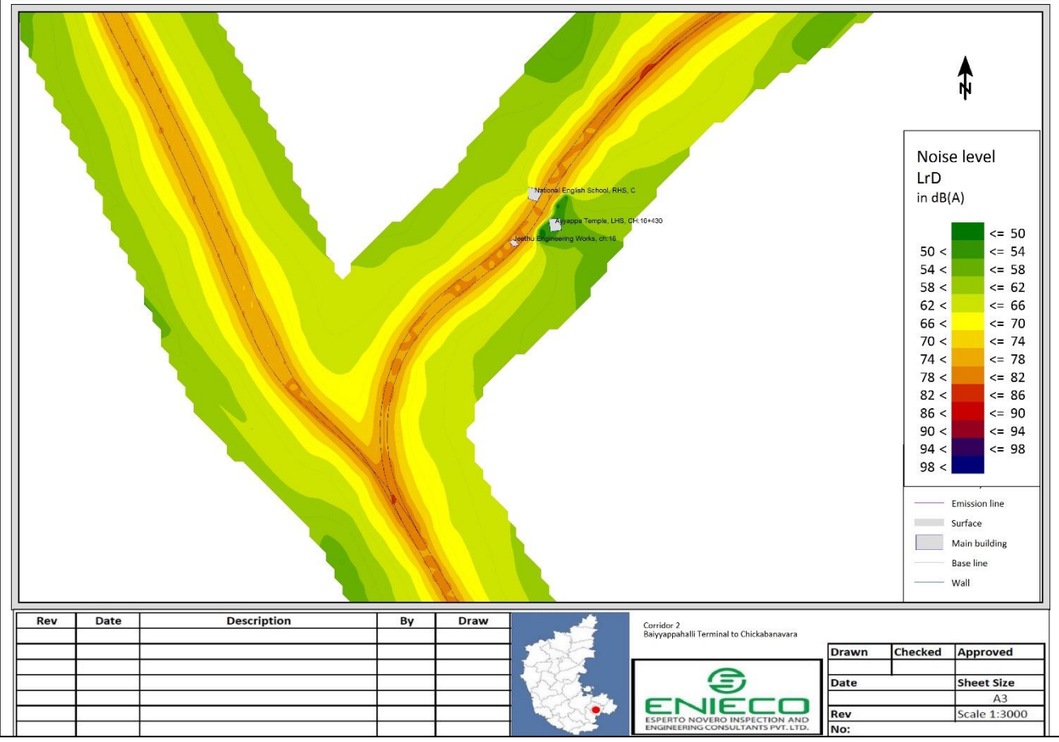
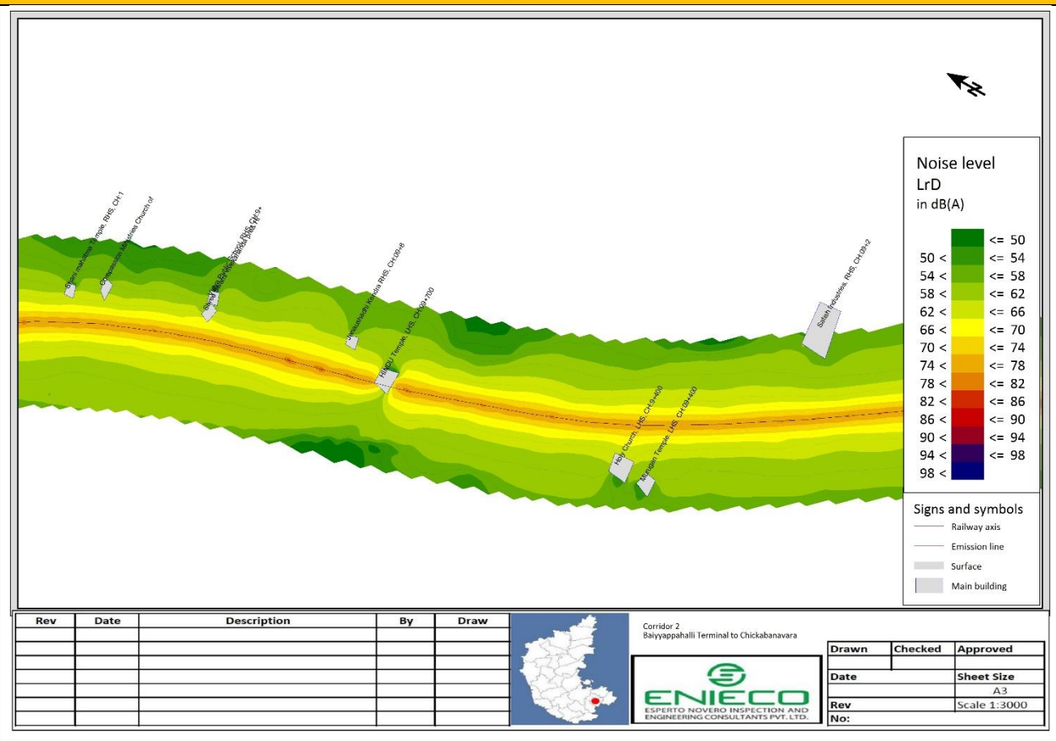
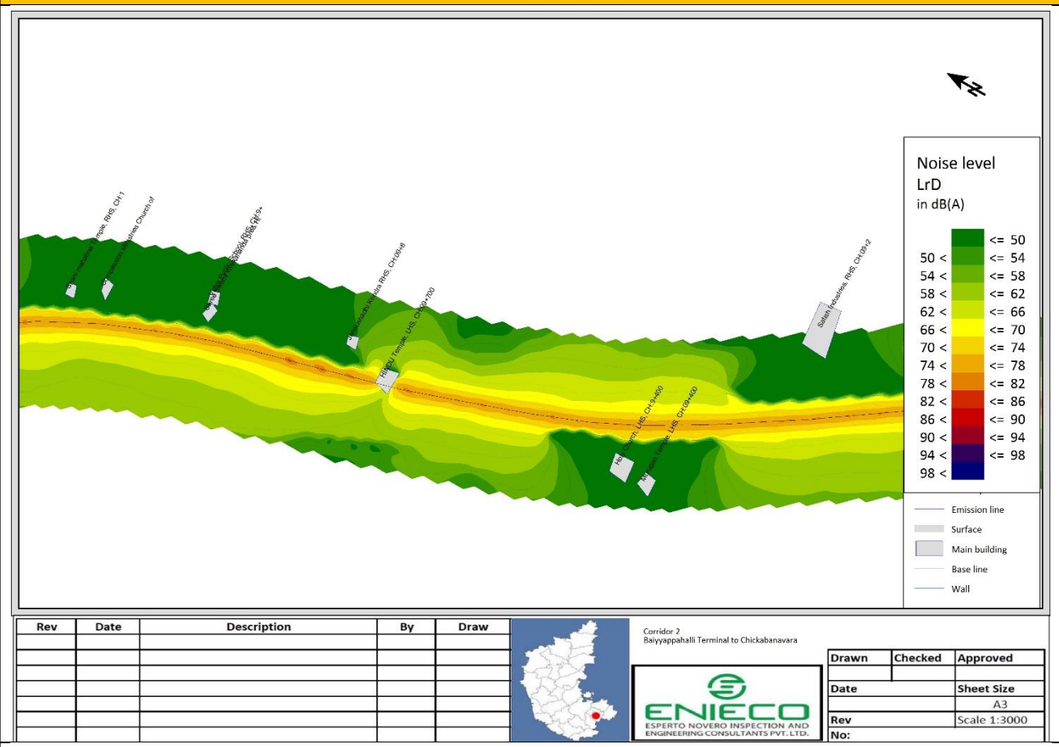
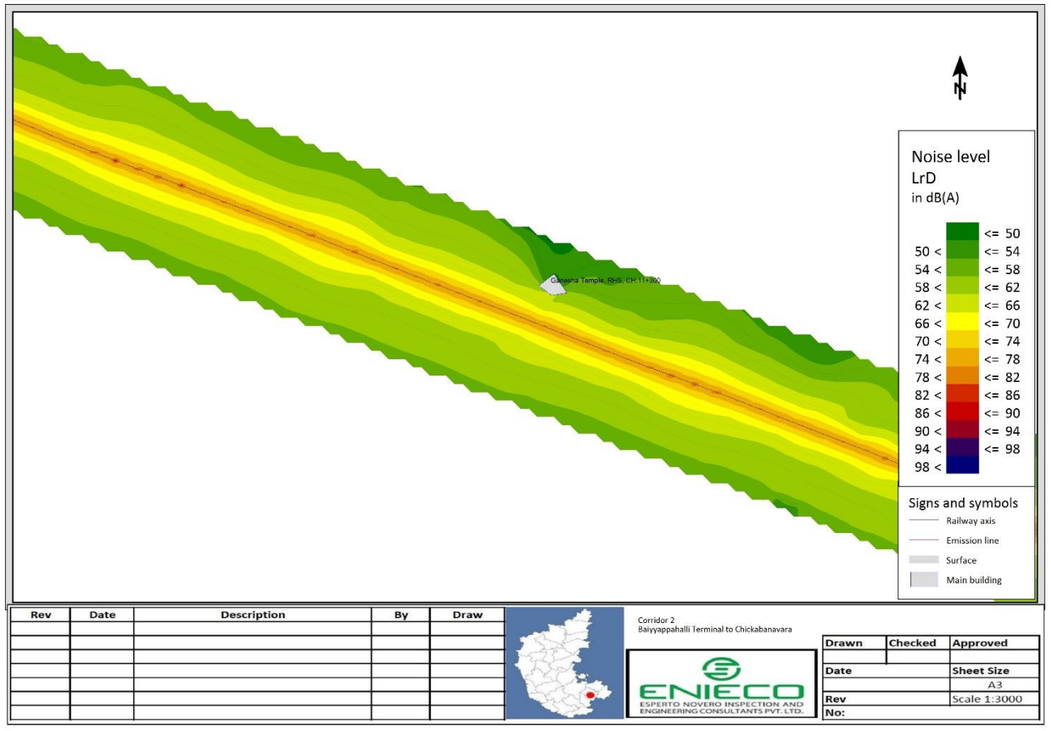
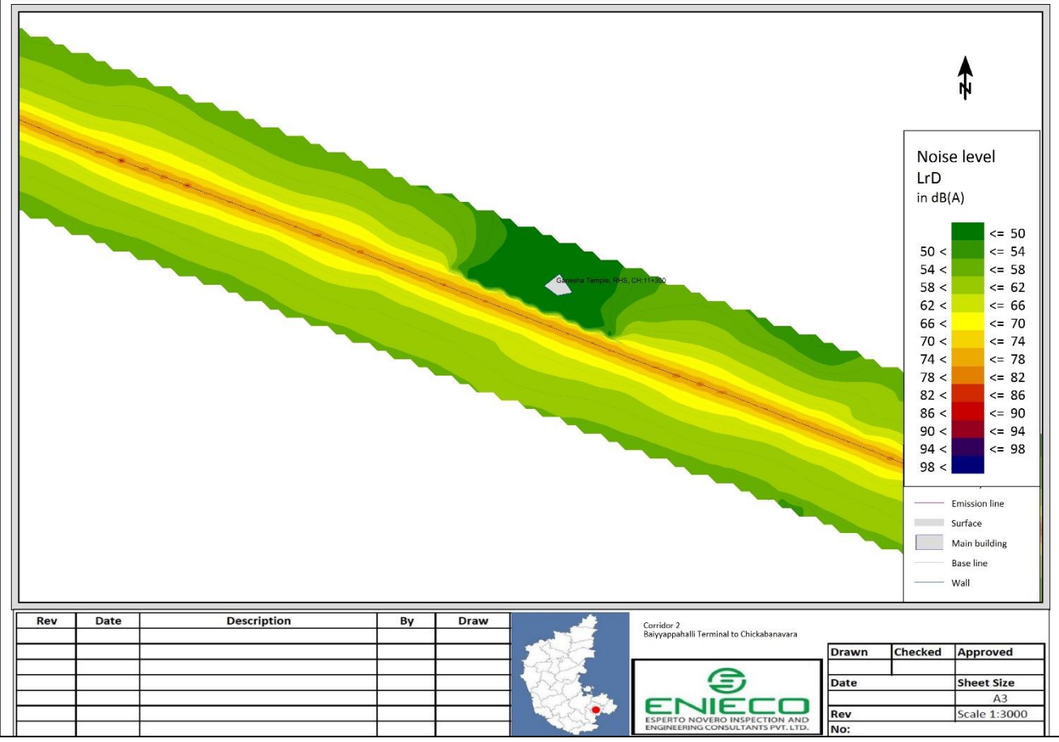
S.No	Without Barrier	With Barrier
6.		
7.		

A. Noise contours for Corridor 2 for the Year 2031

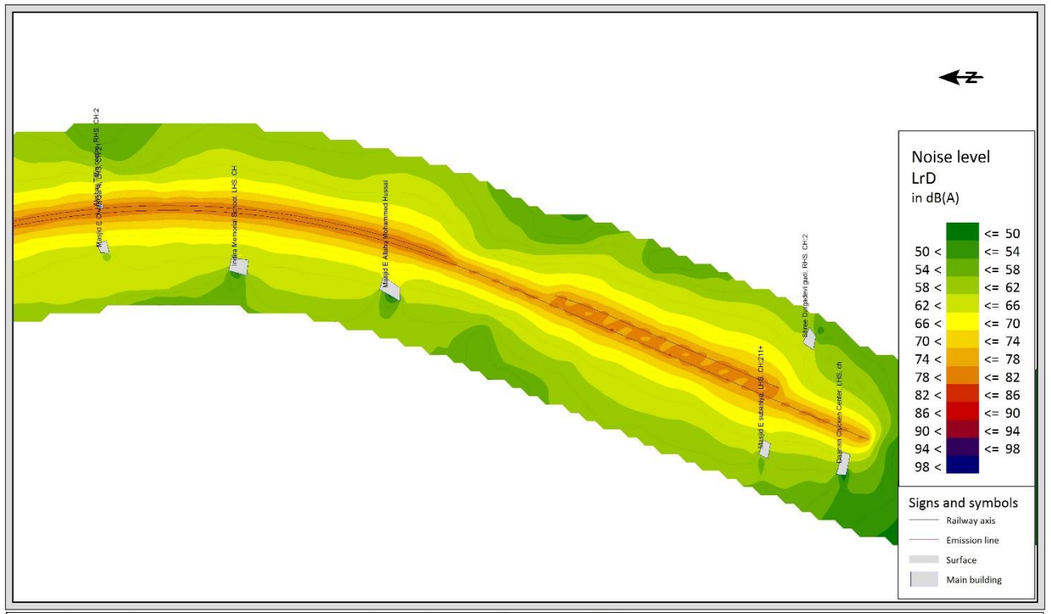
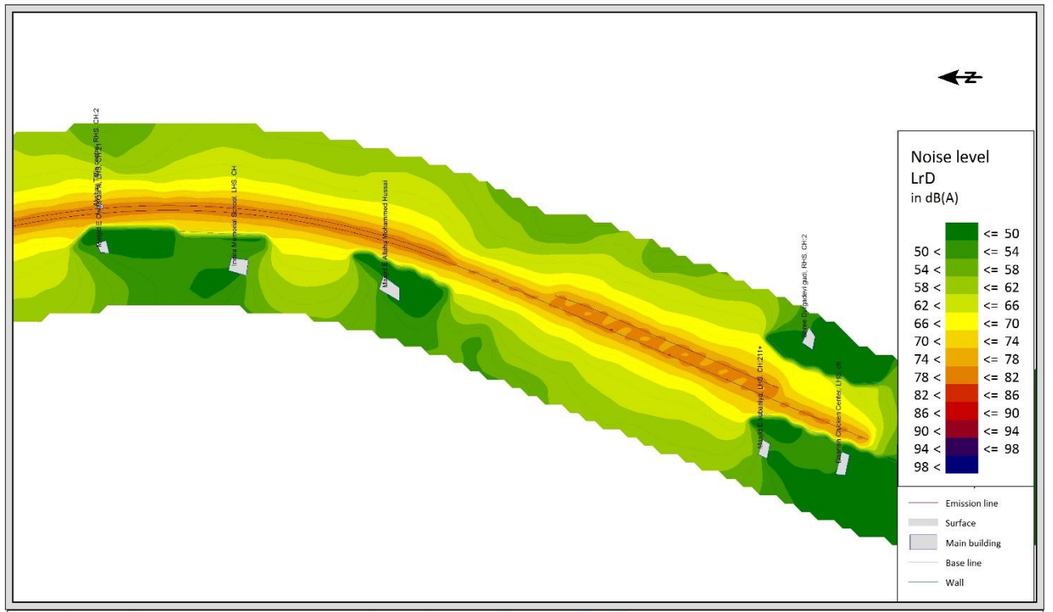
S.No	Without Barrier	With Barrier
1.		

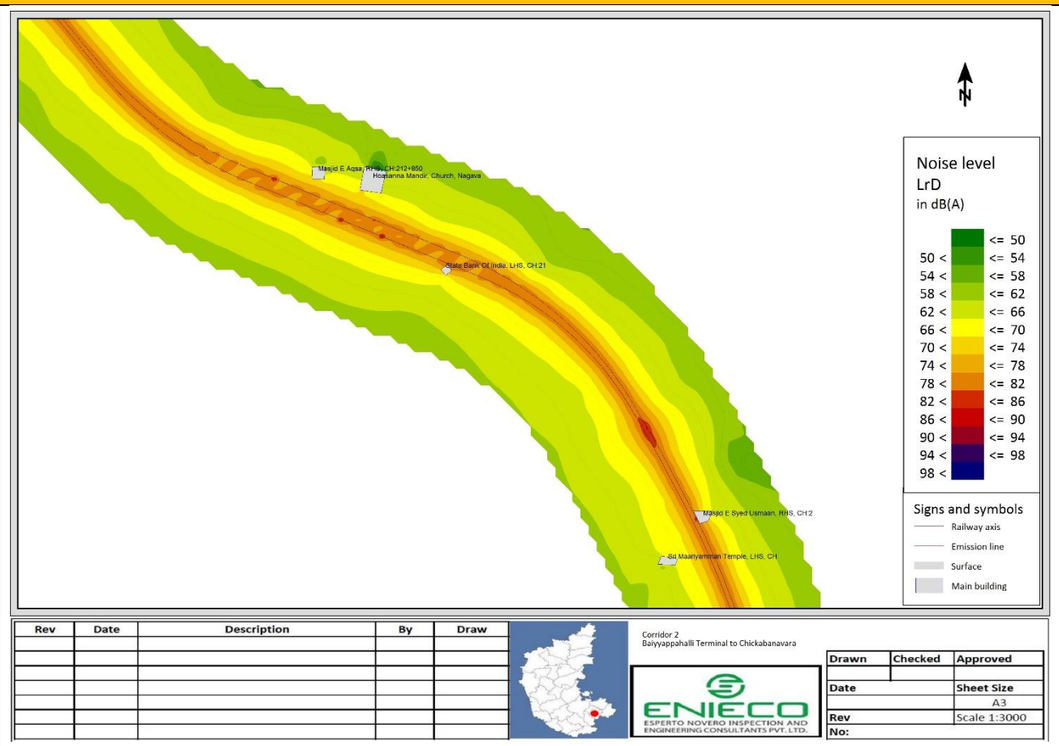
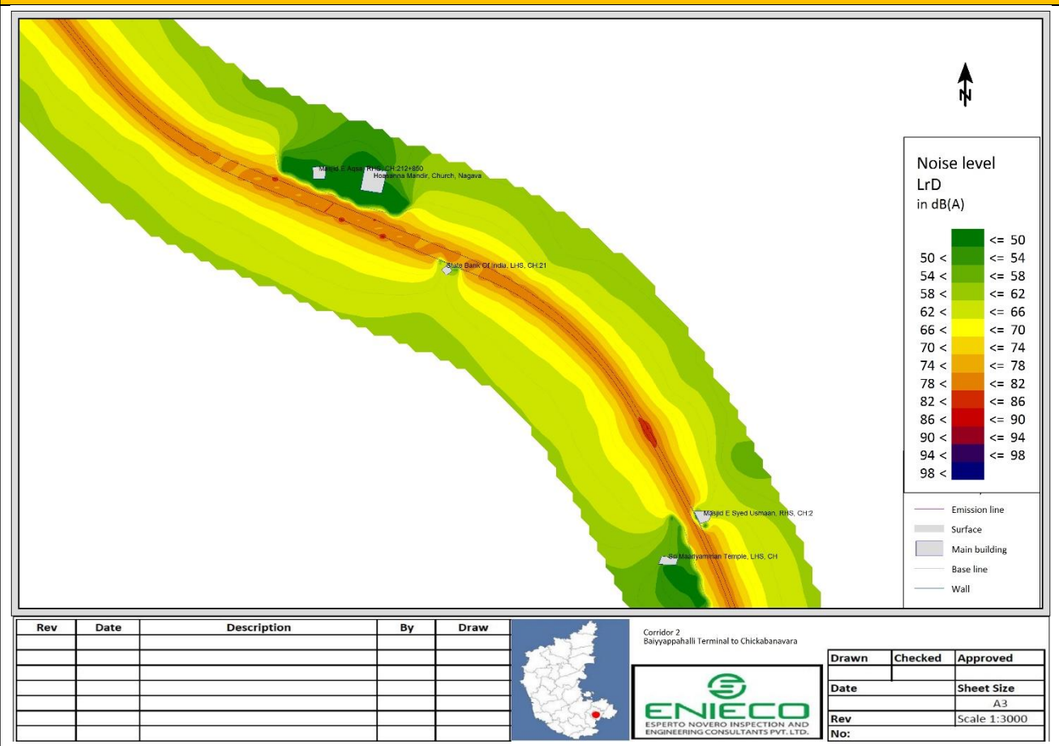
S.No	Without Barrier	With Barrier
2.		
3.		

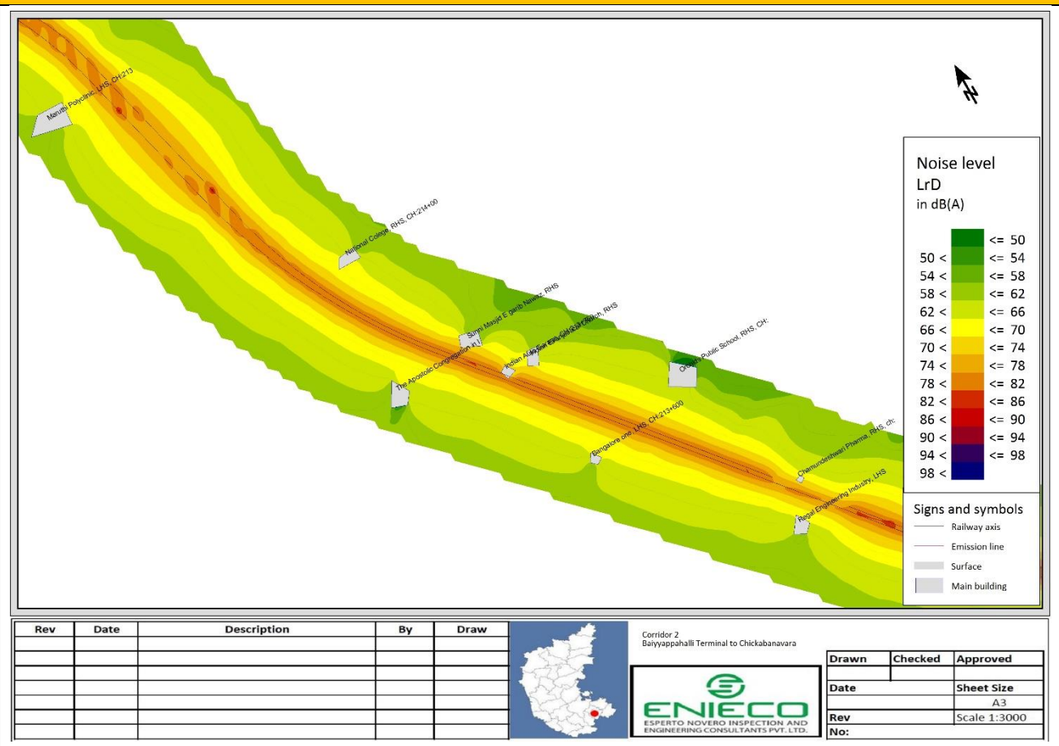
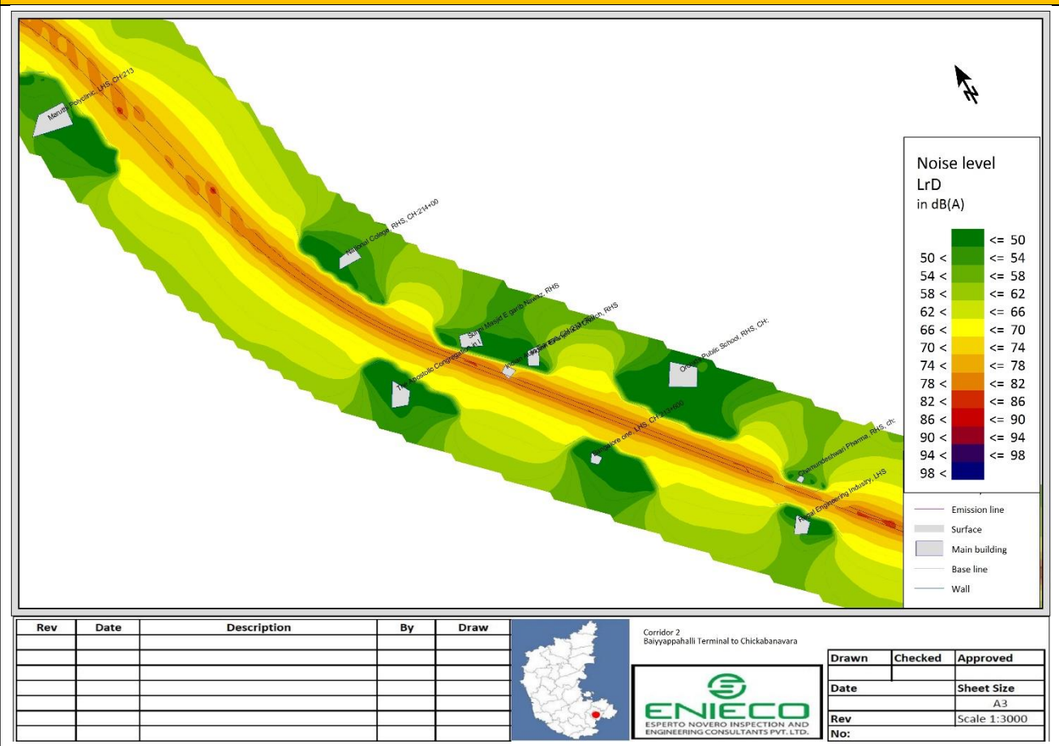
S.No	Without Barrier	With Barrier
4.		
5.		

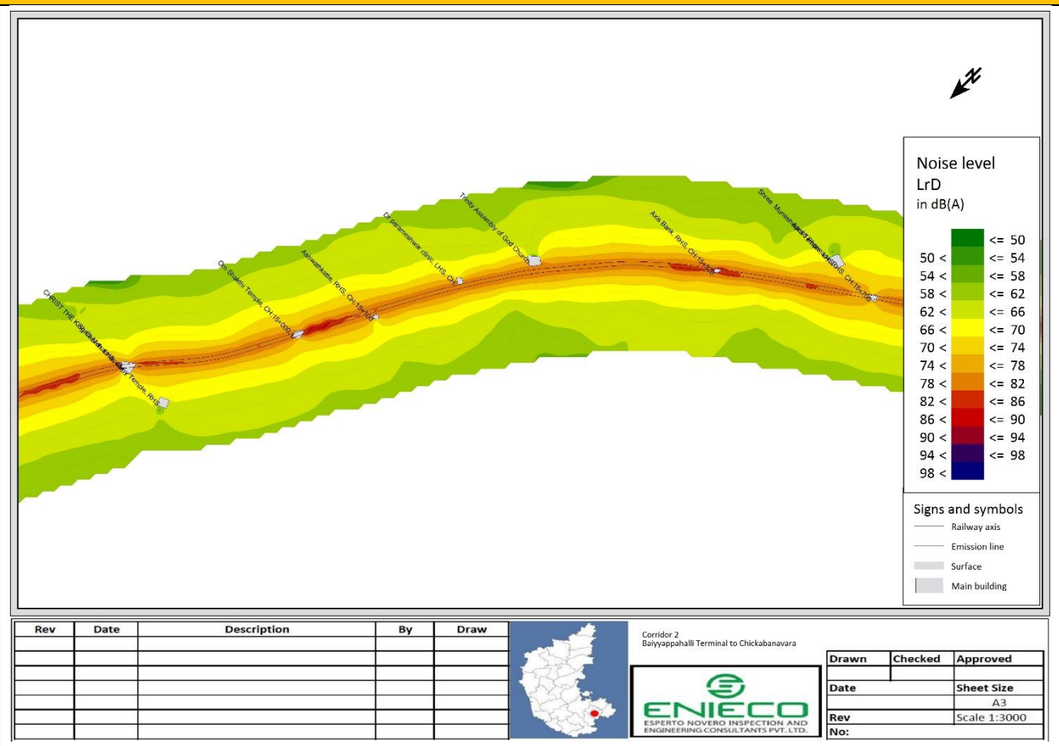
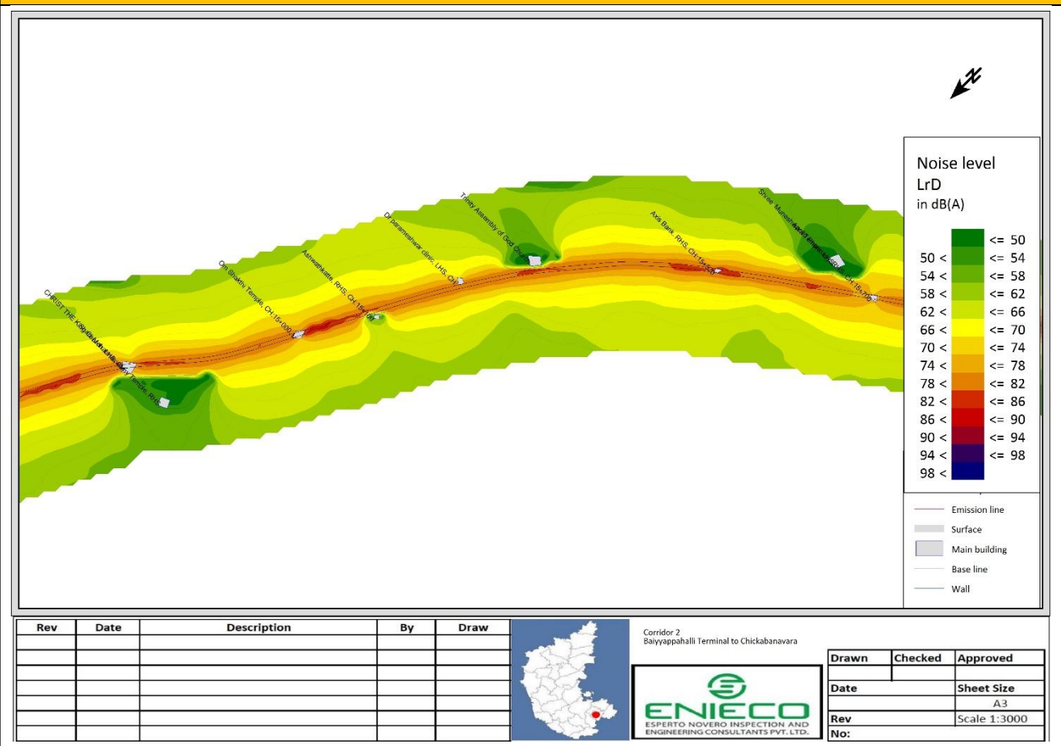
S.No	Without Barrier	With Barrier
6.		
7.		

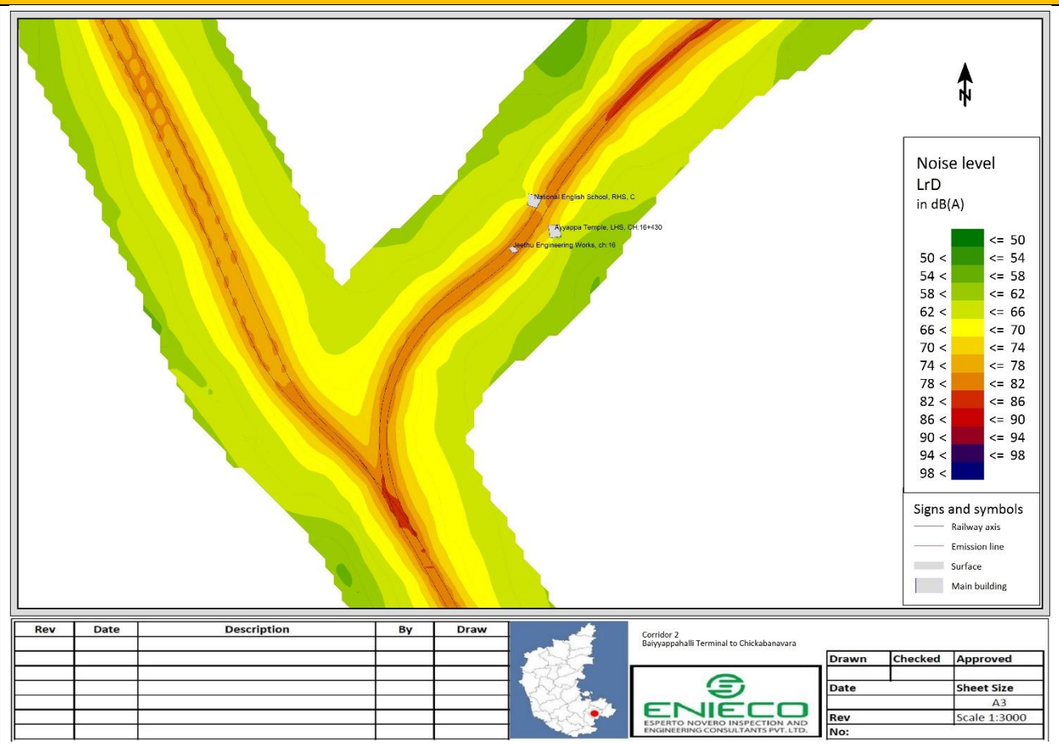
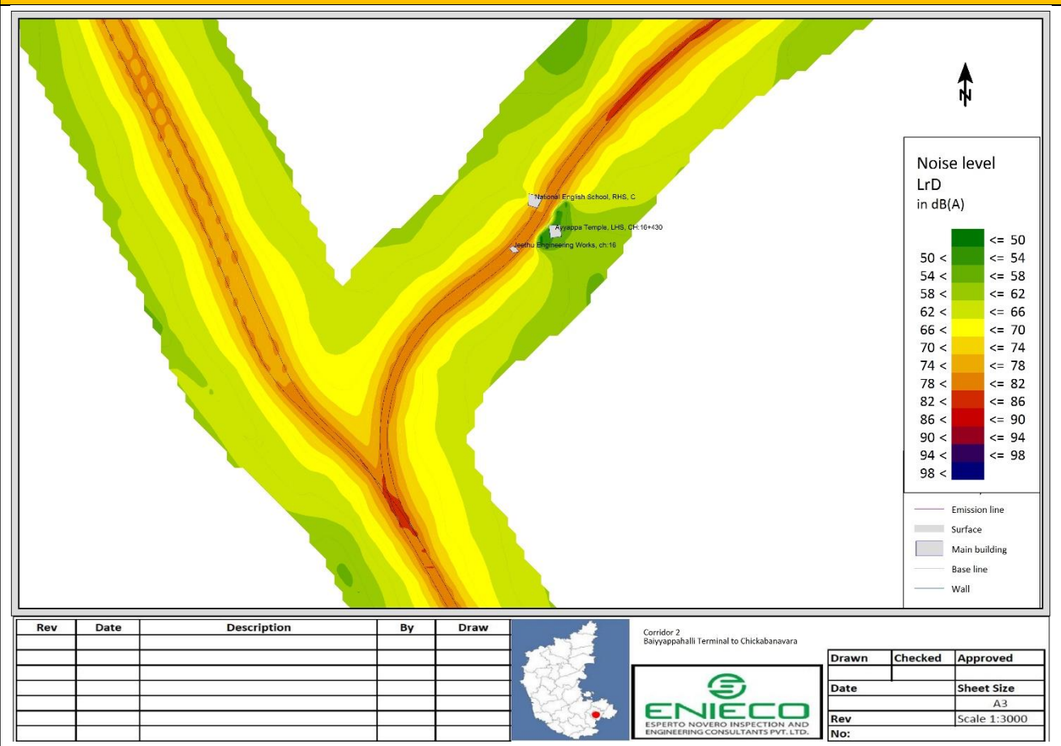
A. Noise contours for Corridor 2 for the Year 2041

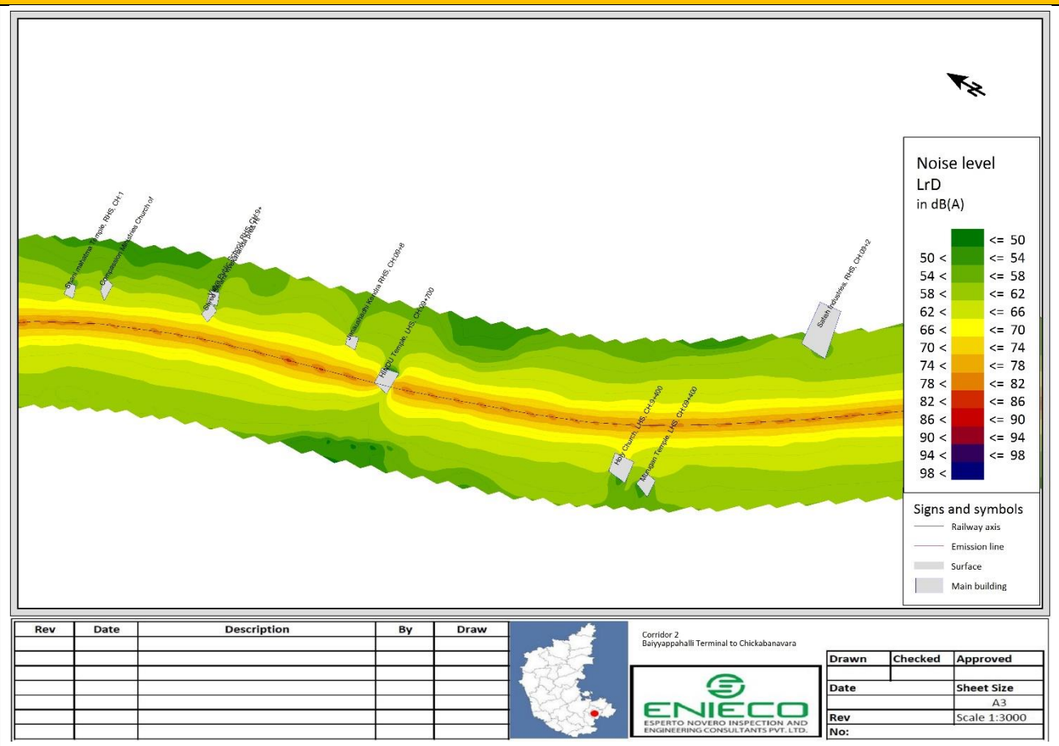
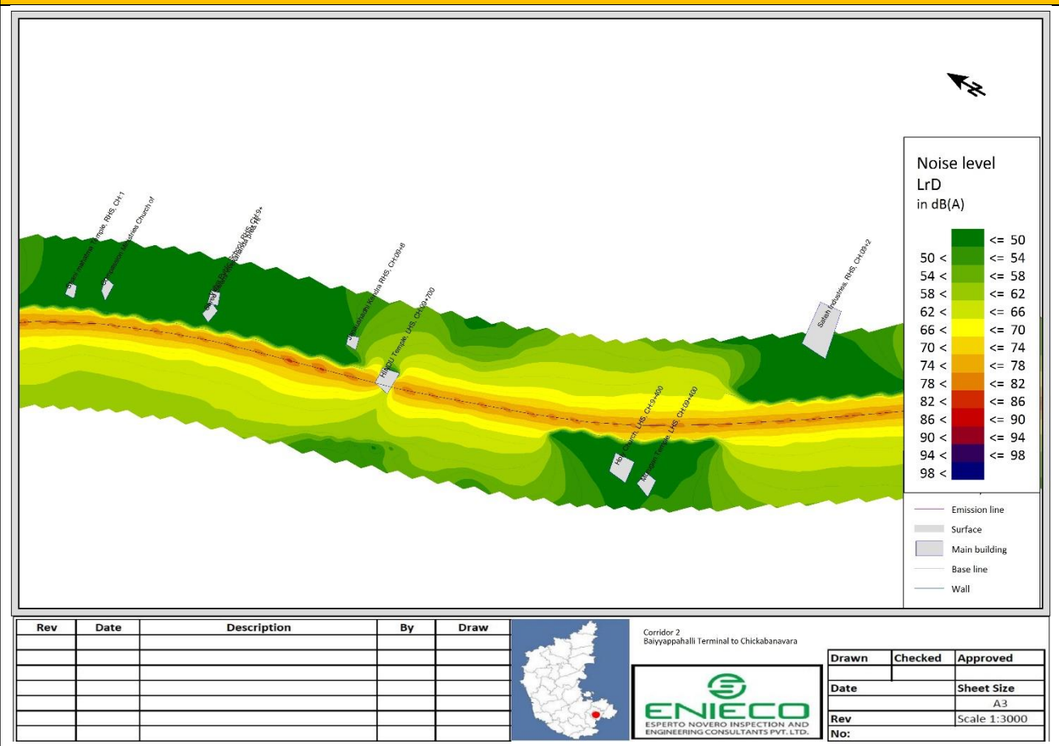
S.No	Without Barrier	With Barrier
1.		

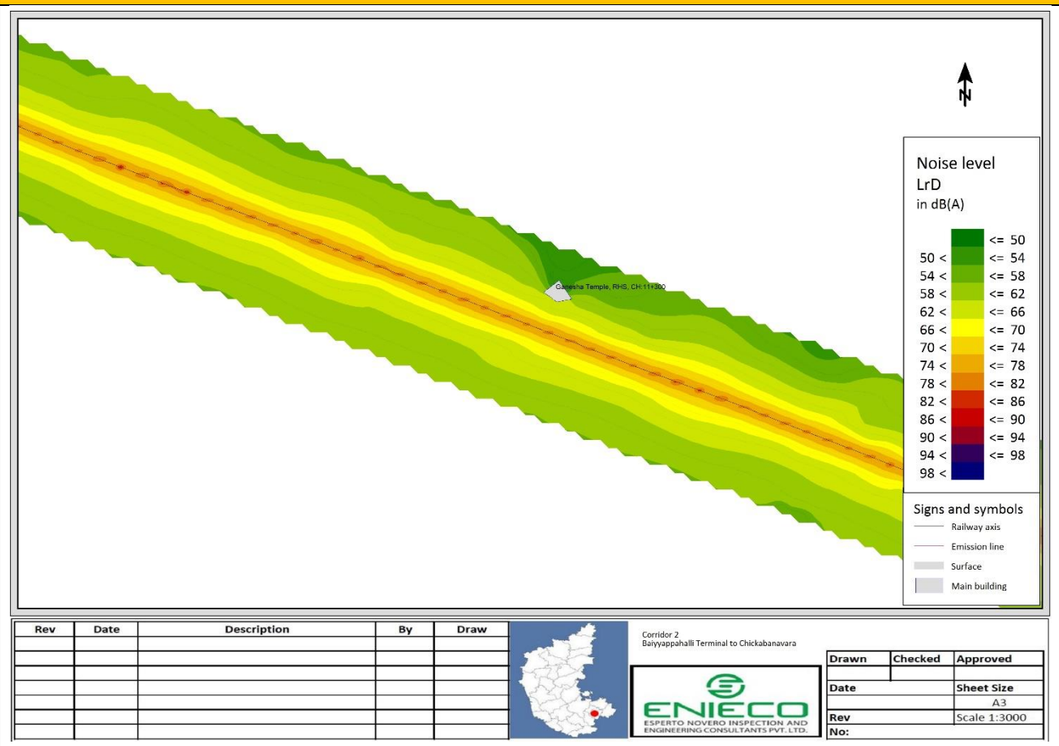
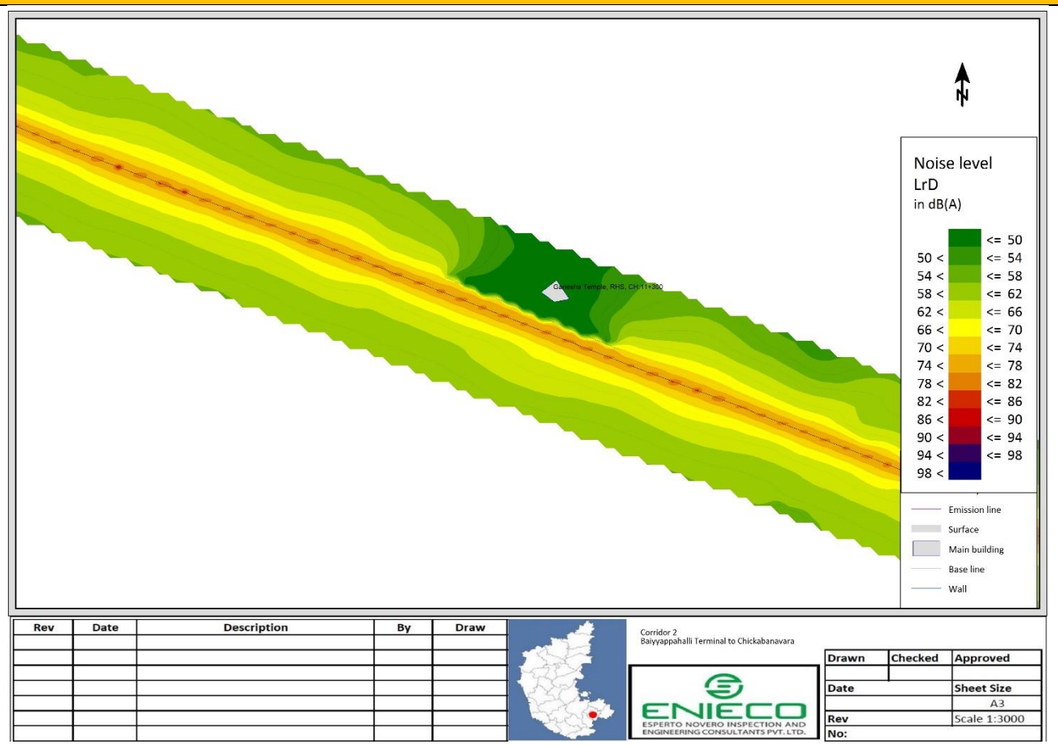
S.No	Without Barrier	With Barrier
2.		

S.No	Without Barrier	With Barrier
3.		

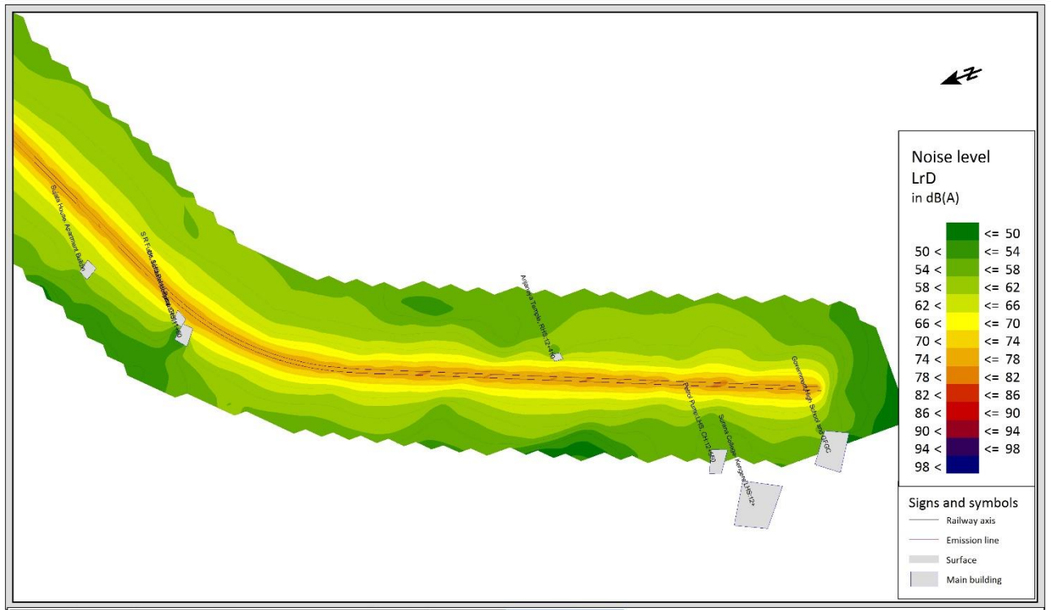
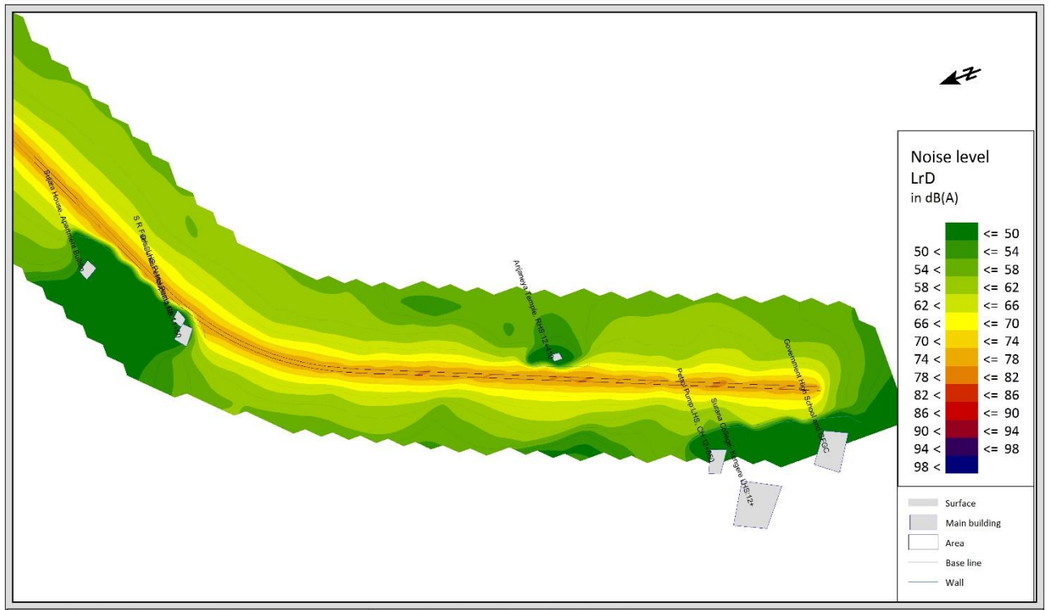
S.No	Without Barrier	With Barrier
4.		

S.No	Without Barrier	With Barrier
5.		

S.No	Without Barrier	With Barrier
6.		

S.No	Without Barrier	With Barrier
7.		

A. Noise contours for Corridor 3 for the Year 2025

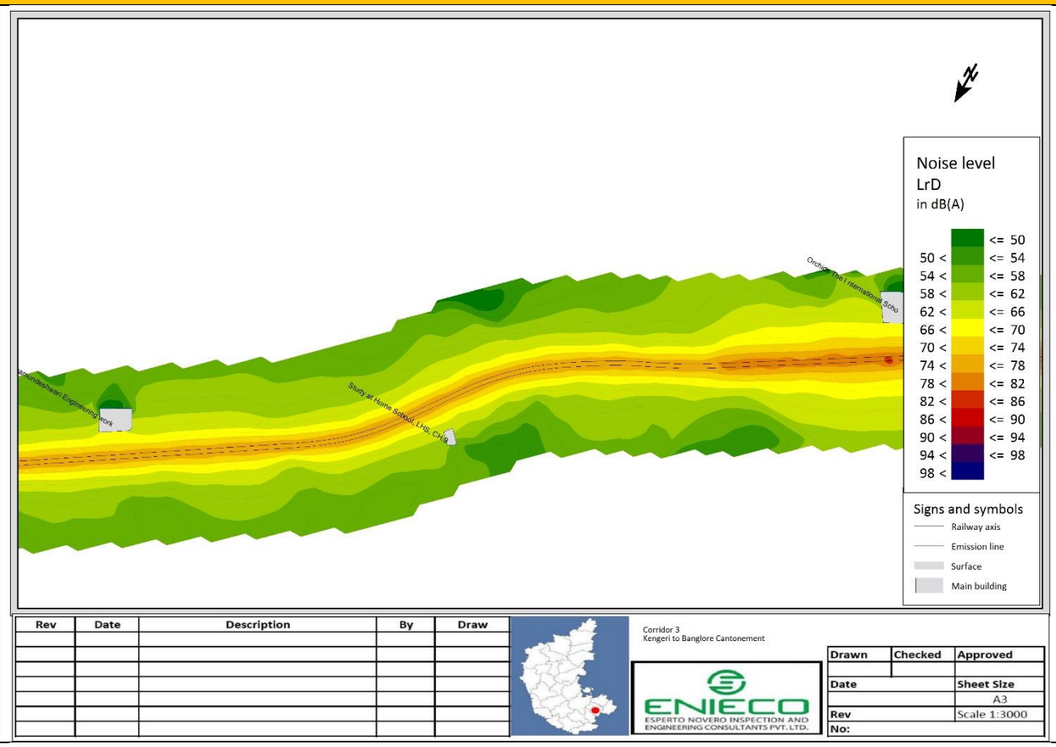
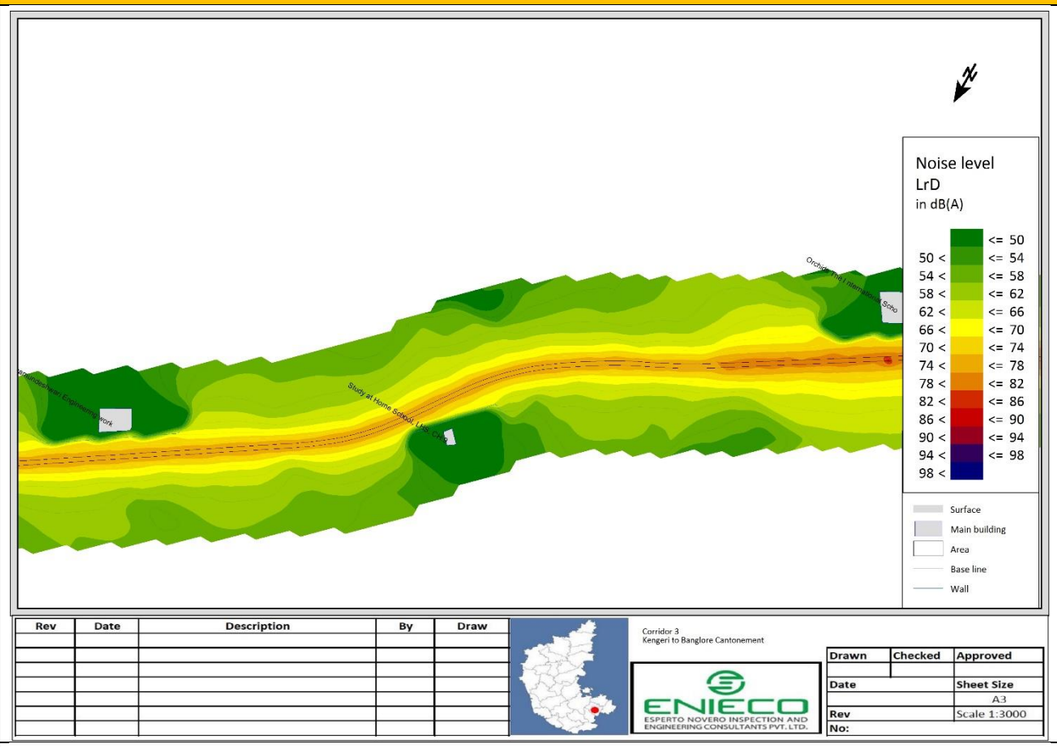
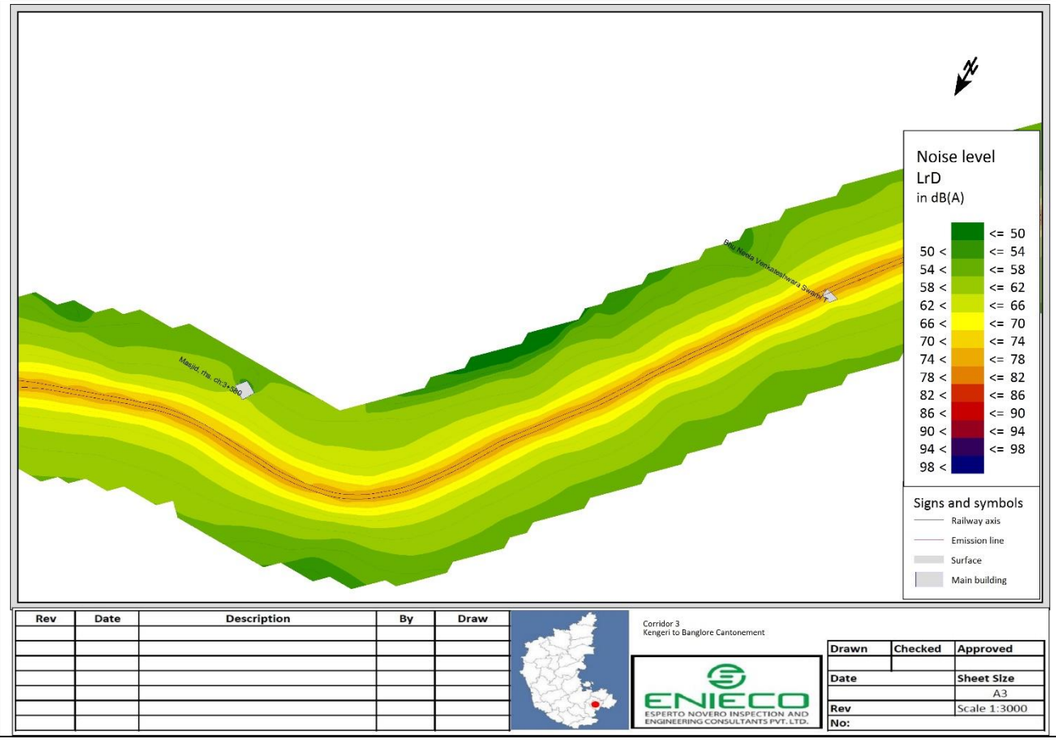
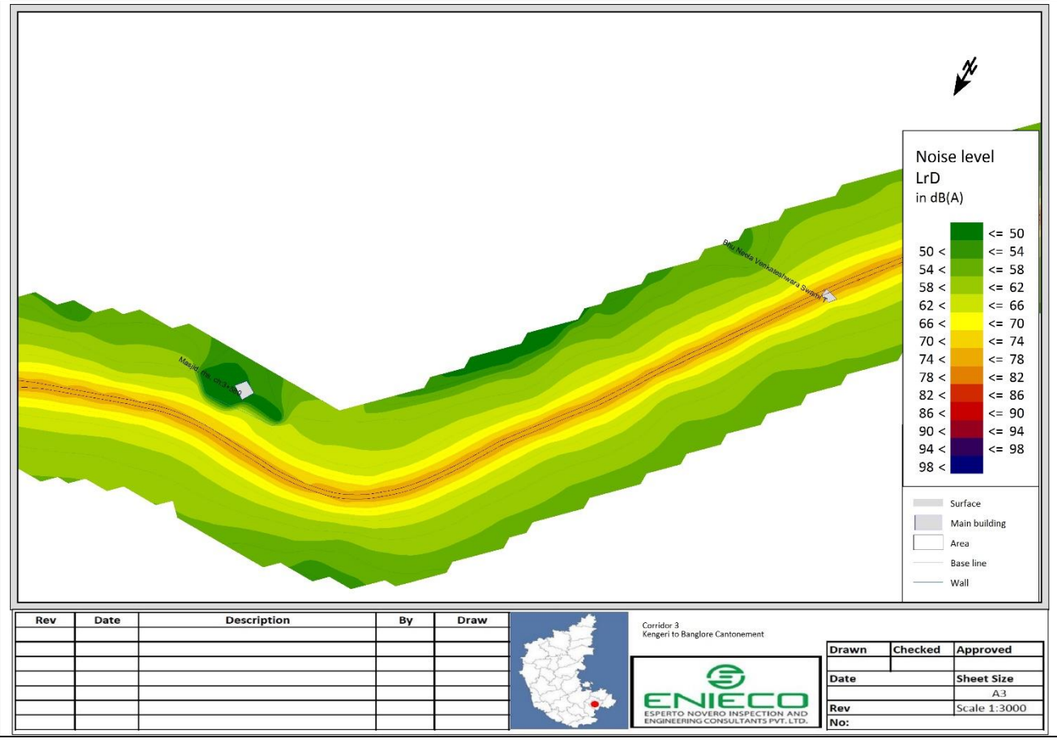
S.No	Without Barrier	With Barrier
1.		

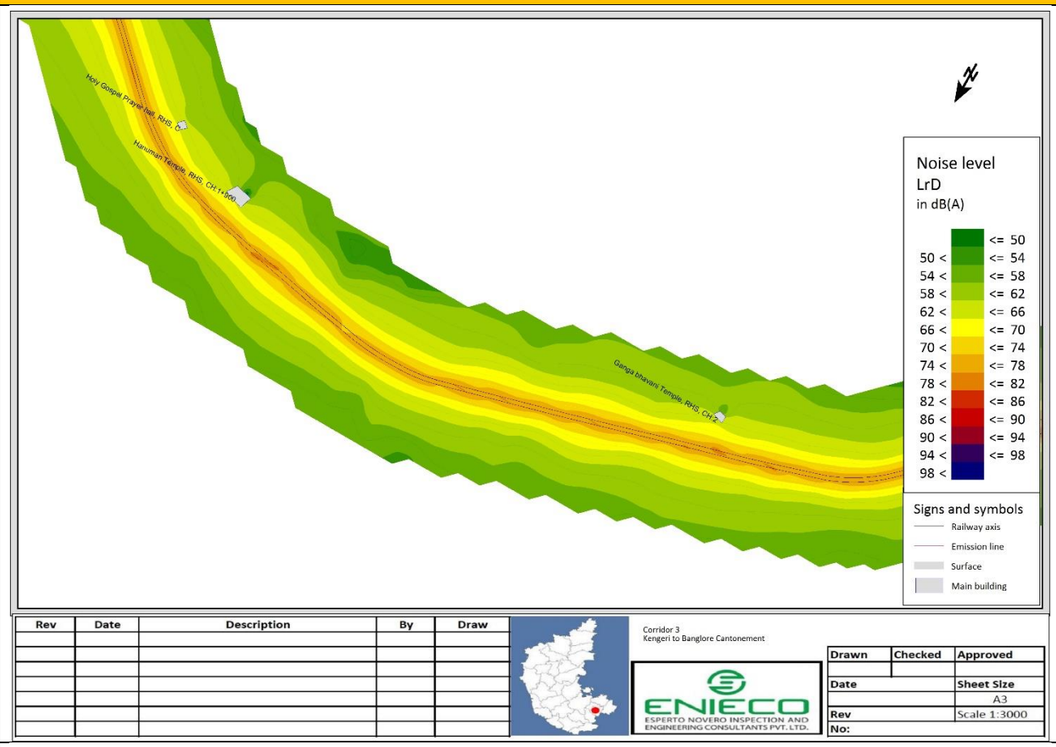
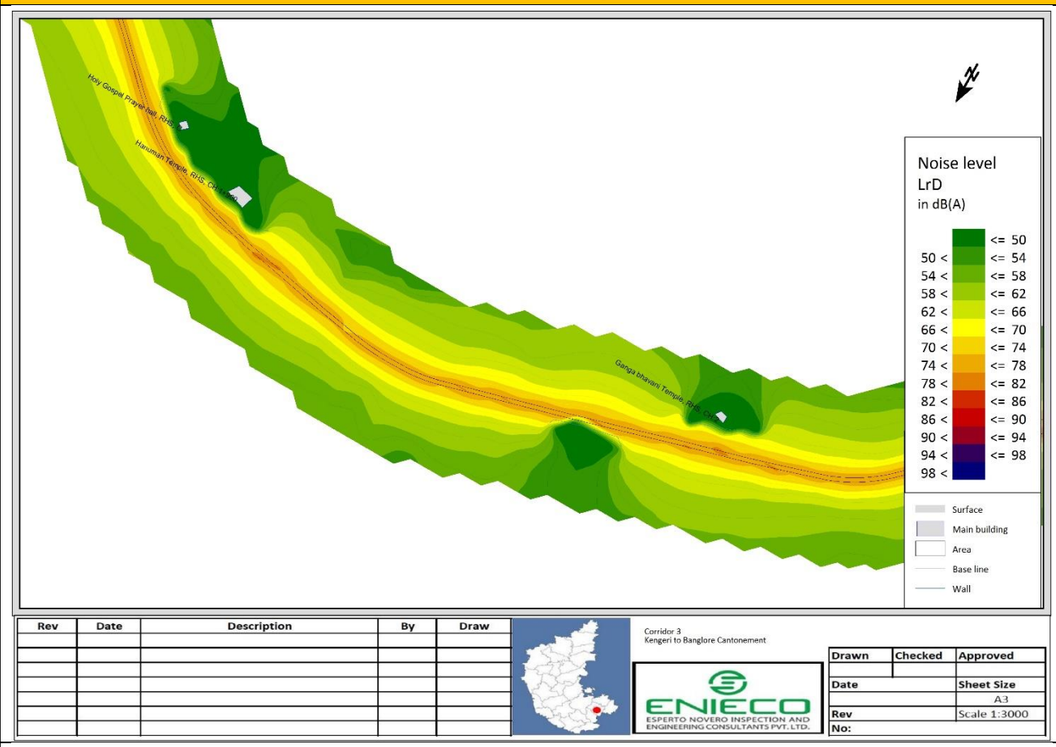
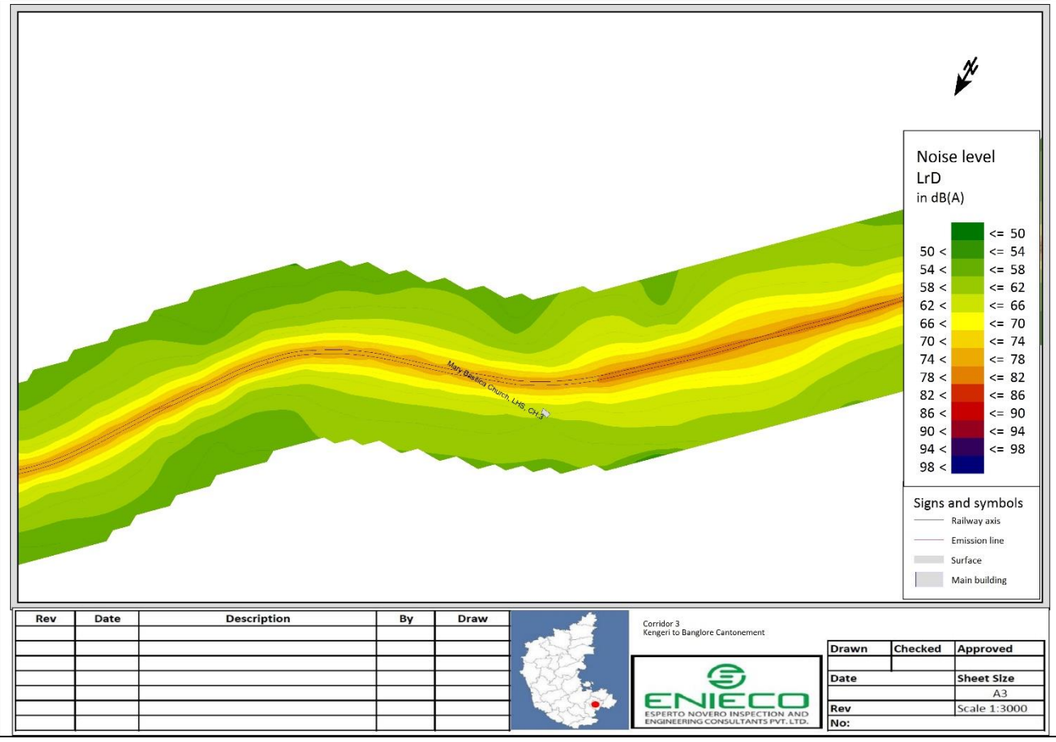
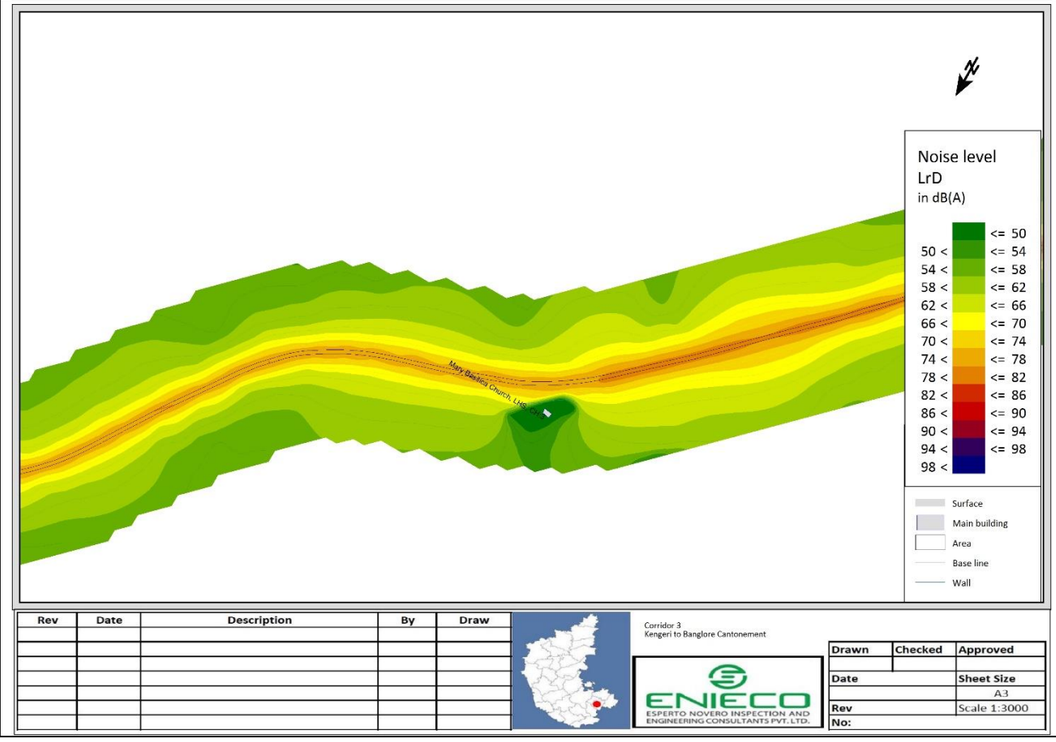
Rev	Date	Description	By	Draw

Corridor 3
Kengeri to Banglore Cantonement

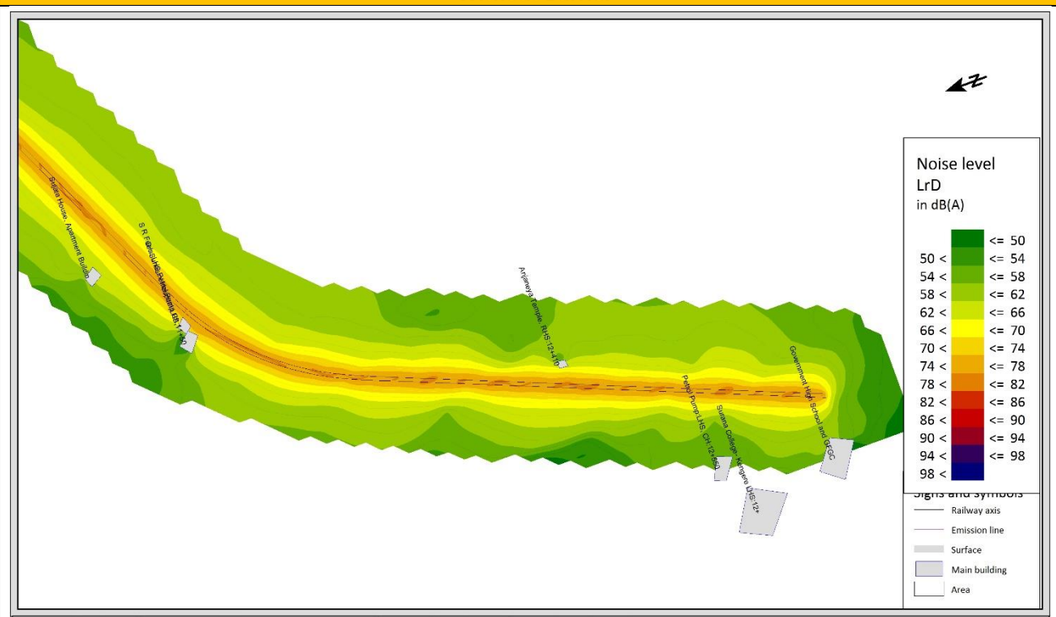
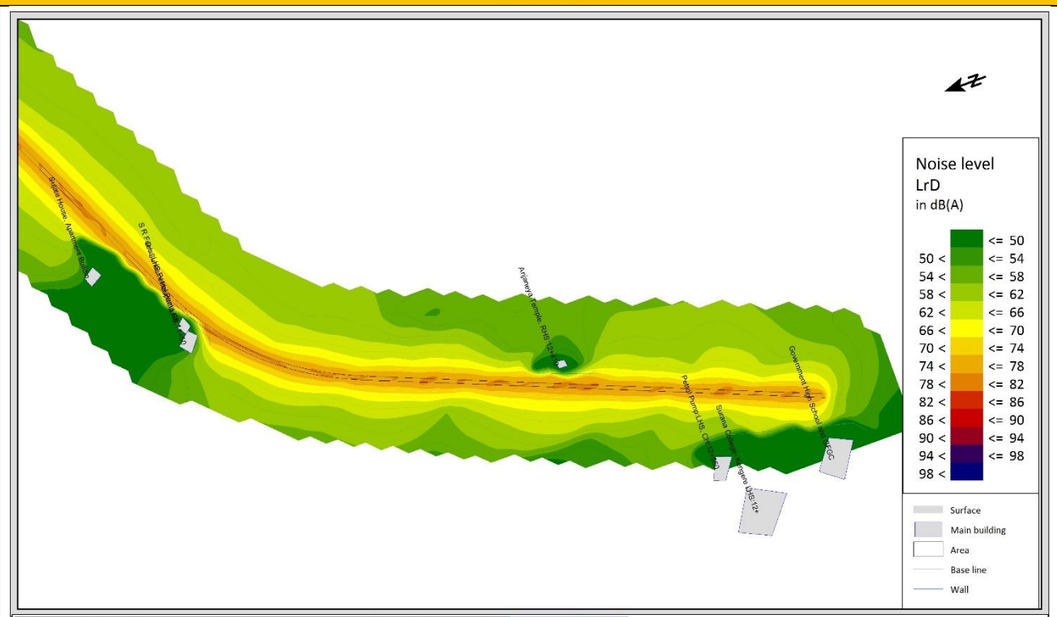
ENIECO
ESPERTO NOVERO INSPECTION AND ENGINEERING CONSULTANTS PVT. LTD.

Drawn	Checked	Approved
Date		Sheet Size
		A3
Rev		Scale 1:3000
No:		

S.No	Without Barrier	With Barrier
2.		
3.		

S.No	Without Barrier	With Barrier
4.		
5.		

B. Noise contours for Corridor 3 for the Year 2031

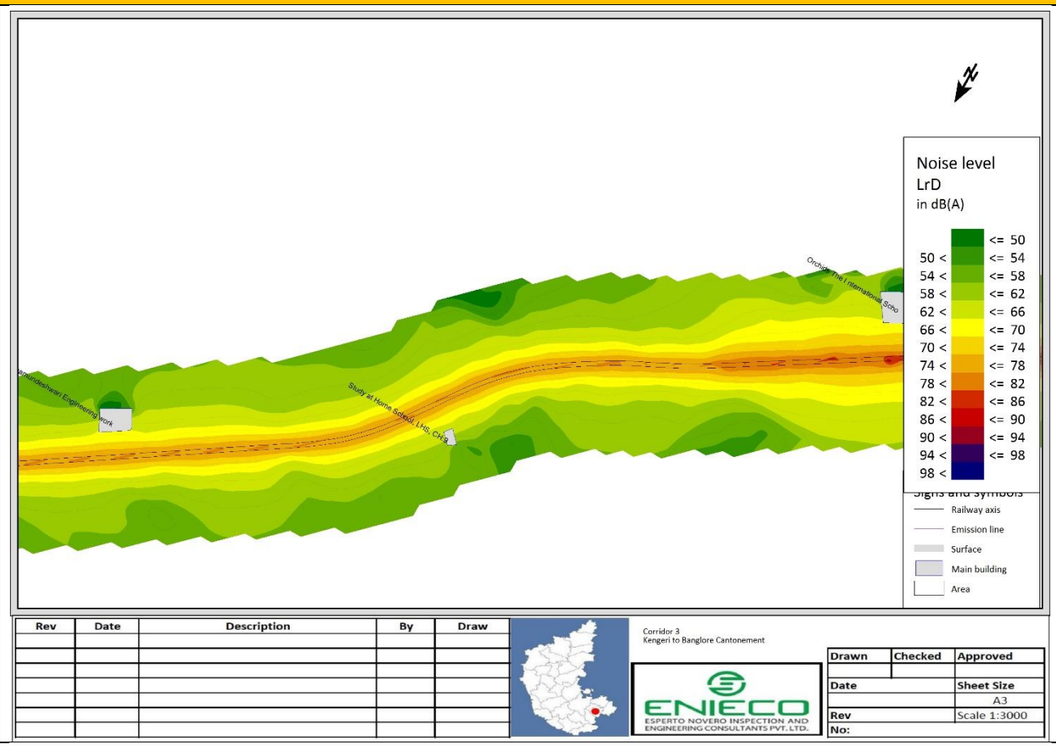
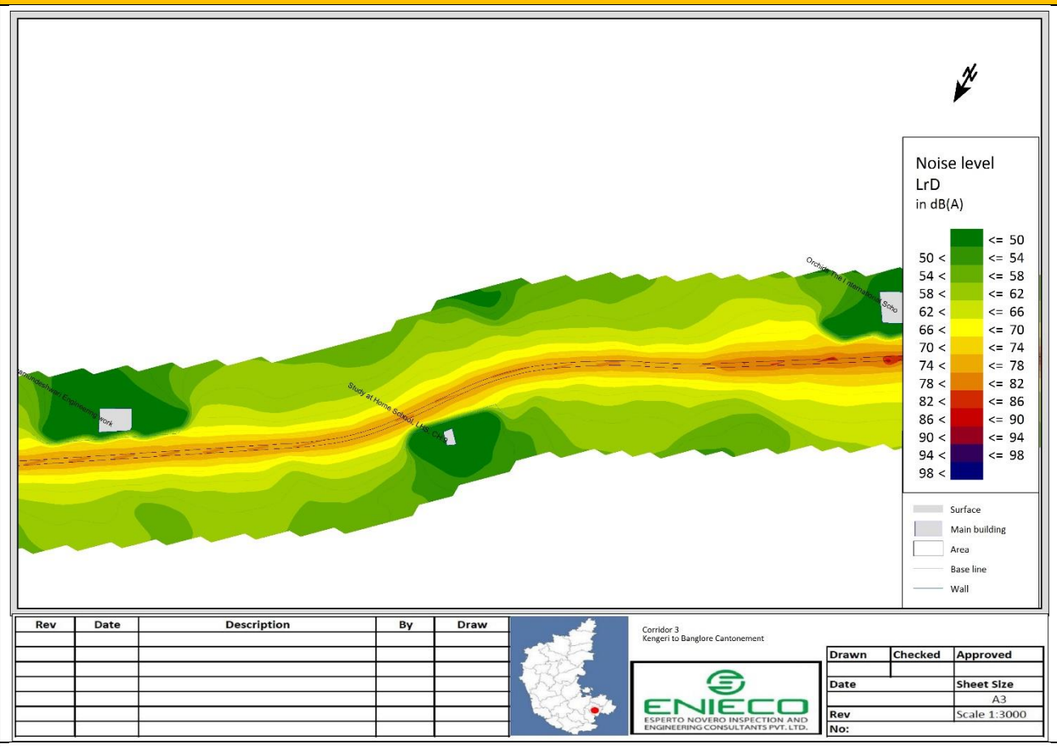
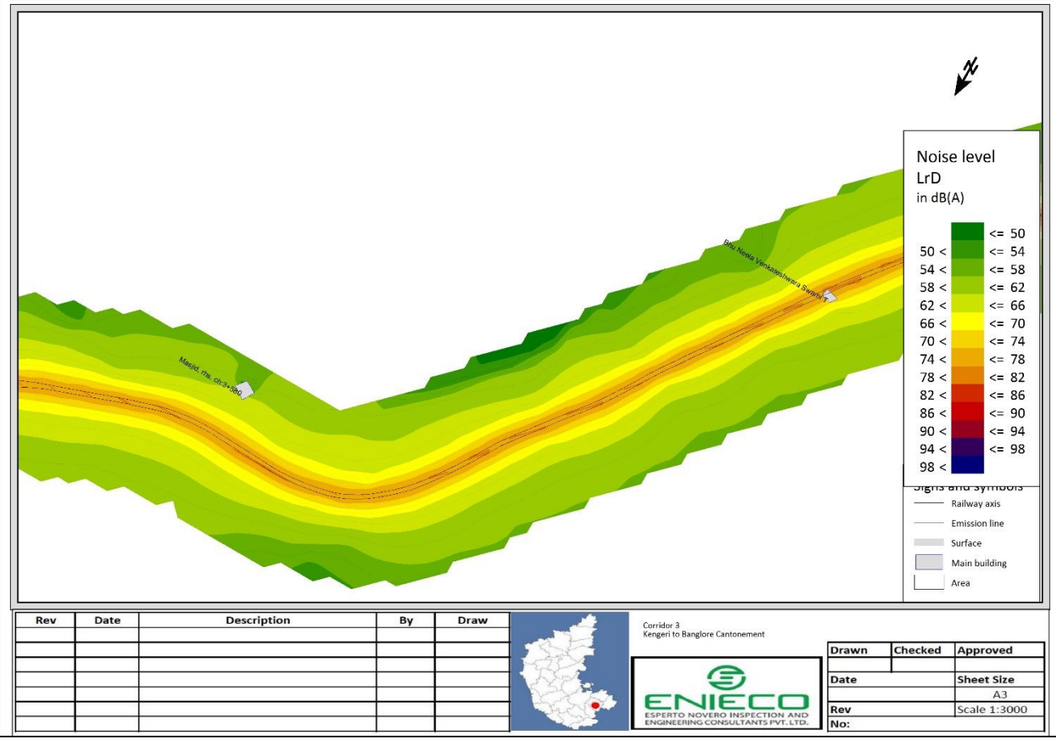
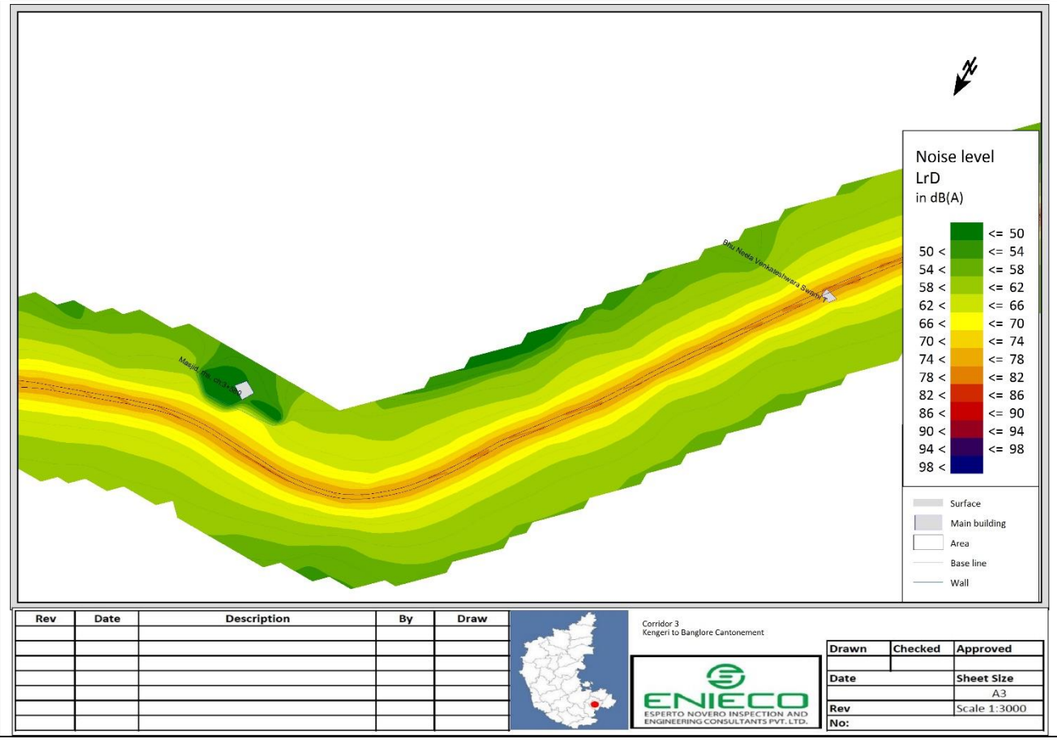
S.No	Without Barrier	With Barrier
1.		

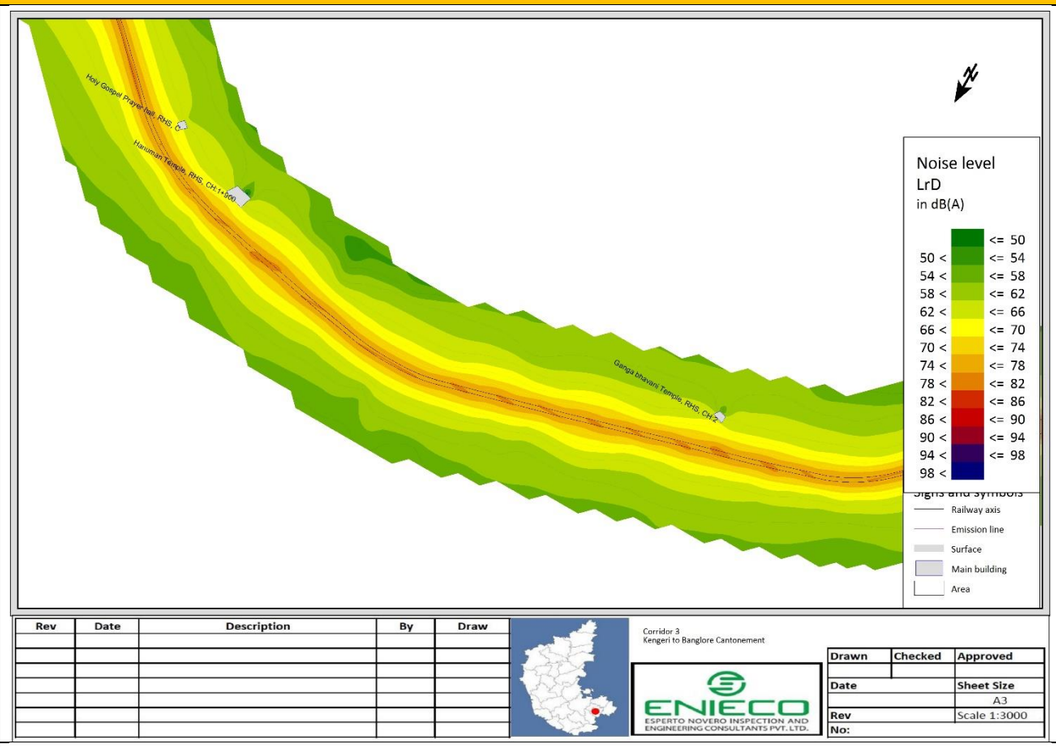
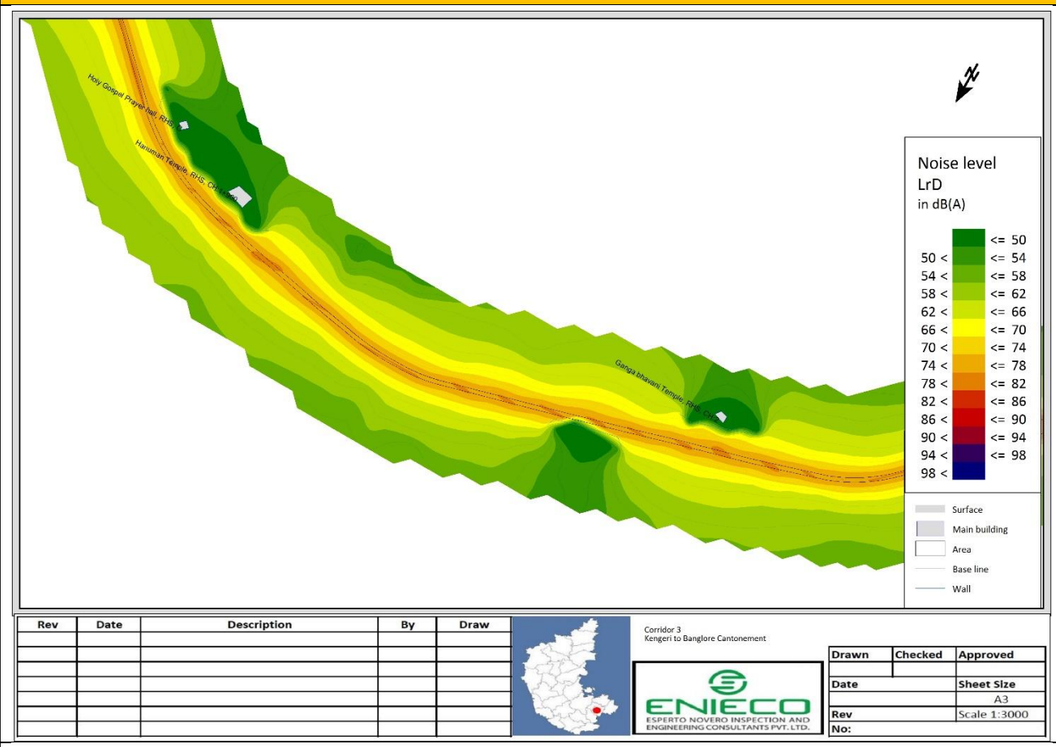
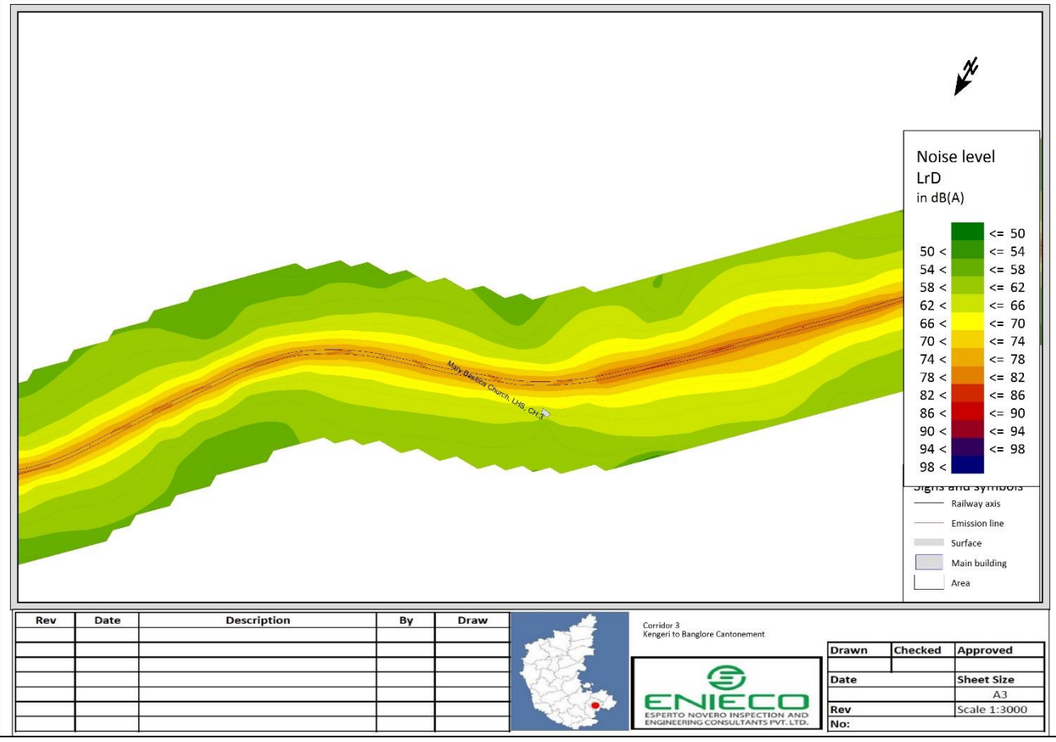
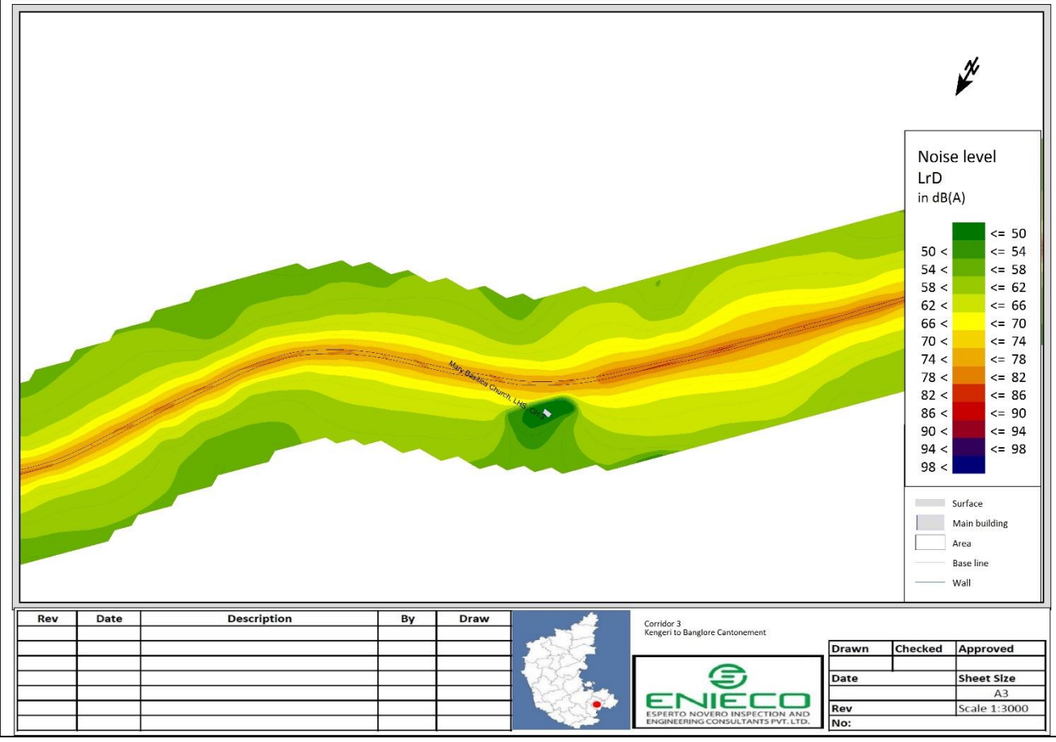
Rev	Date	Description	By	Draw

Corridor 3
Kengeri to Banglore Cantonement

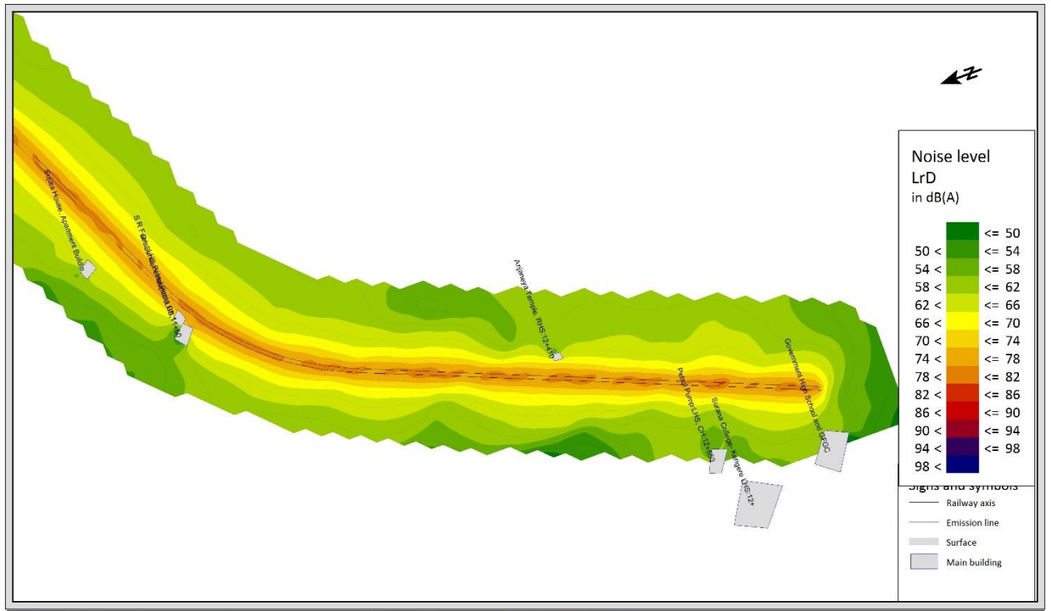
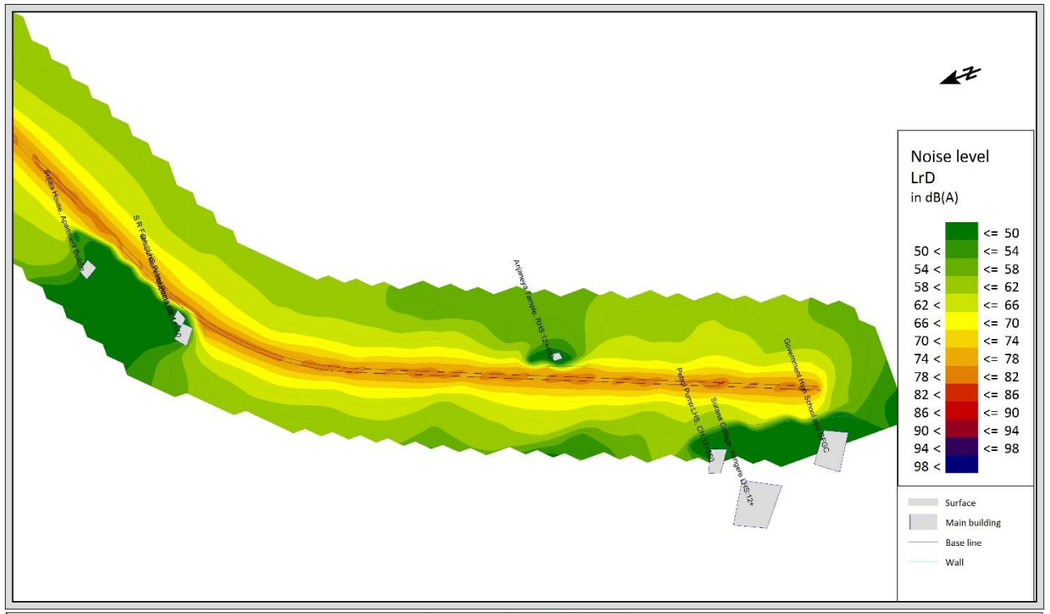
ENICO
ESPERTO NOVERO INSPECTION AND ENGINEERING CONSULTANTS PVT. LTD.

Drawn	Checked	Approved
Date		Sheet Size
		A3
Rev		Scale 1:3000
No:		

S.No	Without Barrier	With Barrier
2.		
3.		

S.No	Without Barrier	With Barrier
4.		
5.		

C. Noise contours for Corridor 3 for the Year 2041

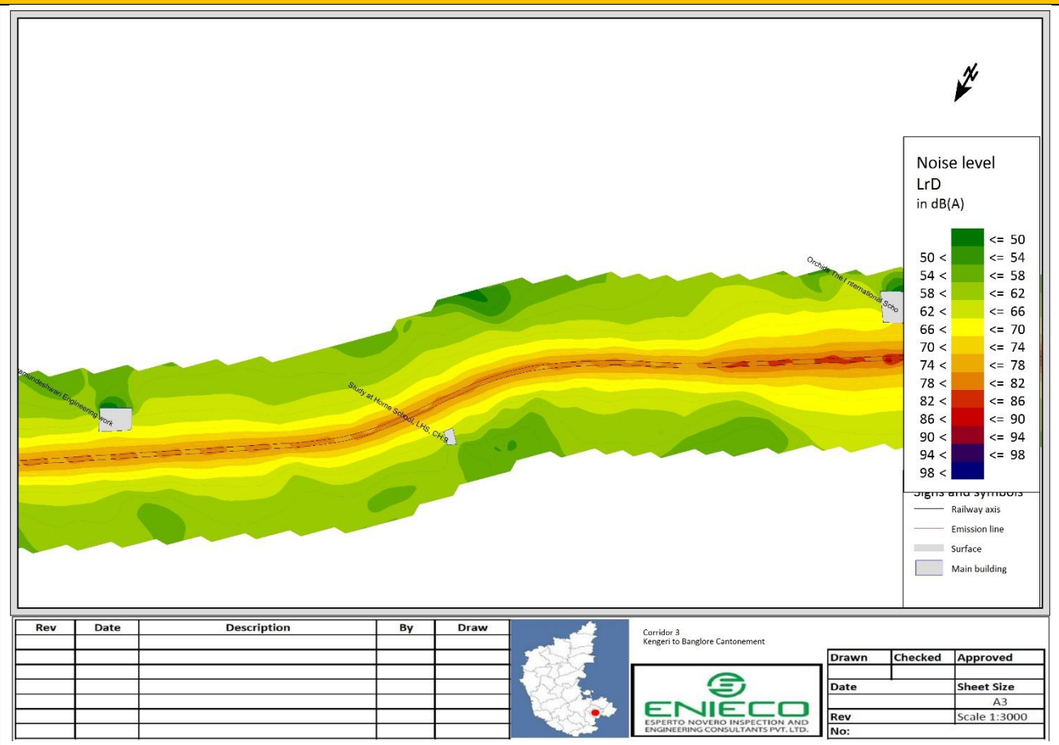
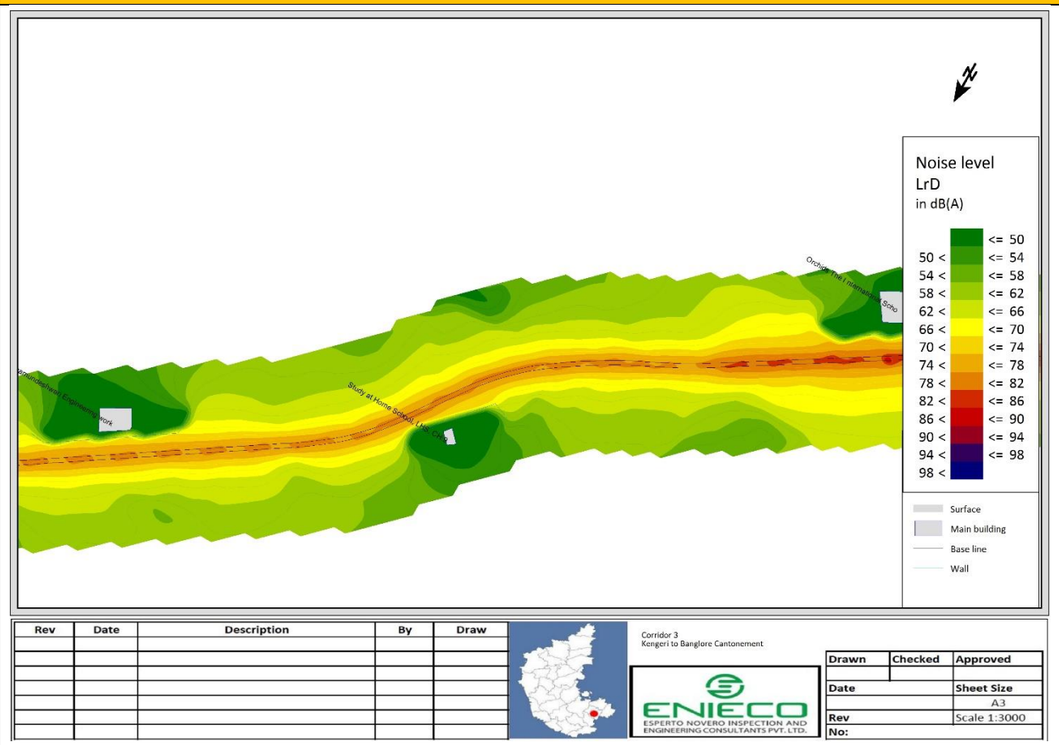
S.No	Without Barrier	With Barrier
1.		

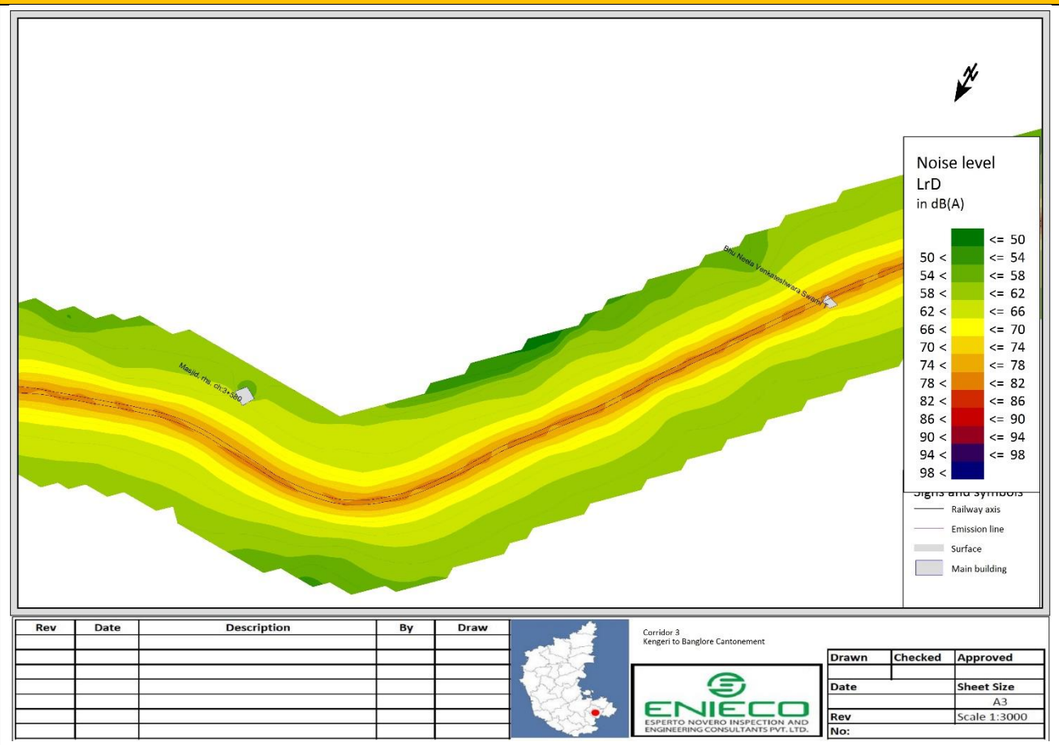
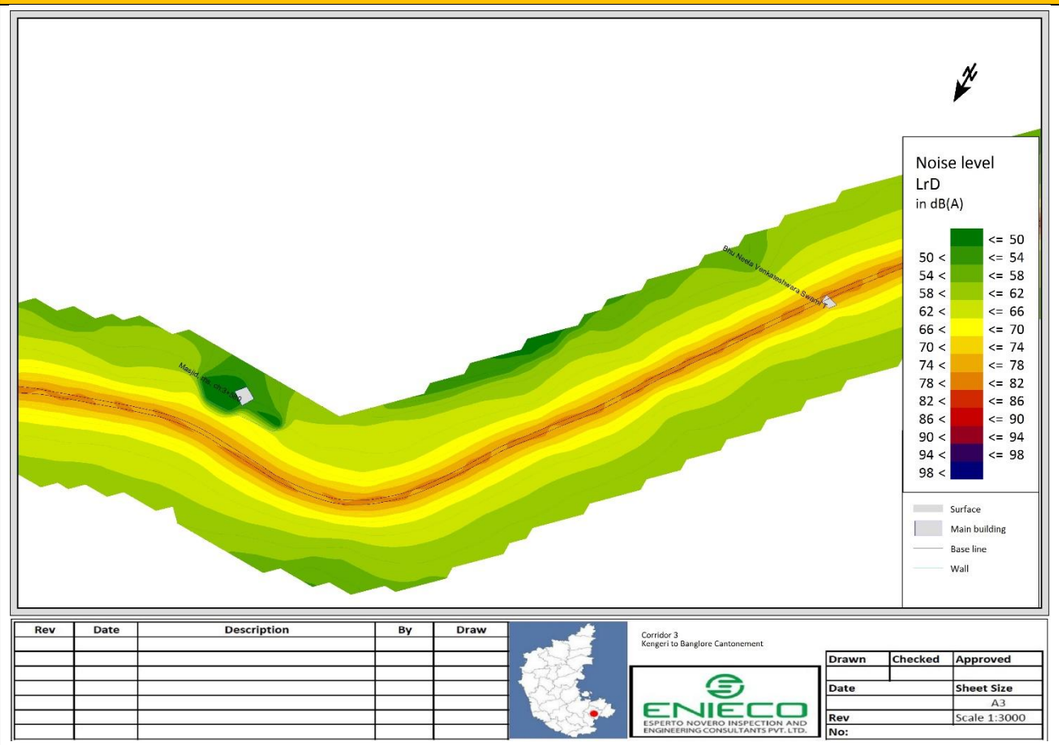
Rev	Date	Description	By	Draw

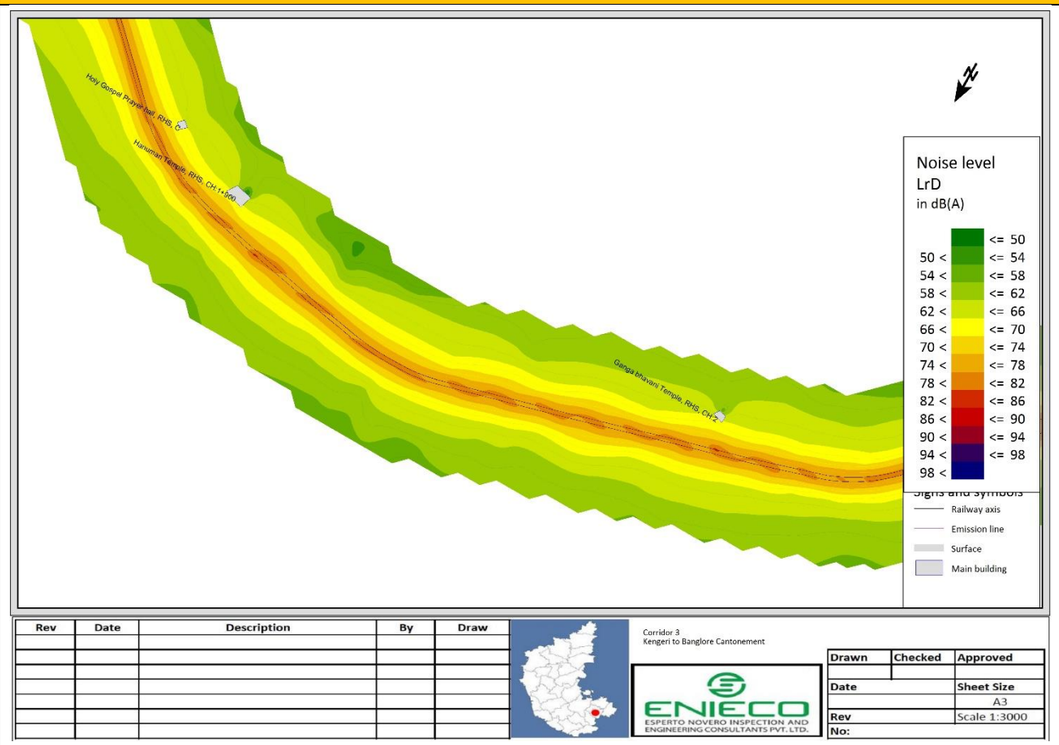
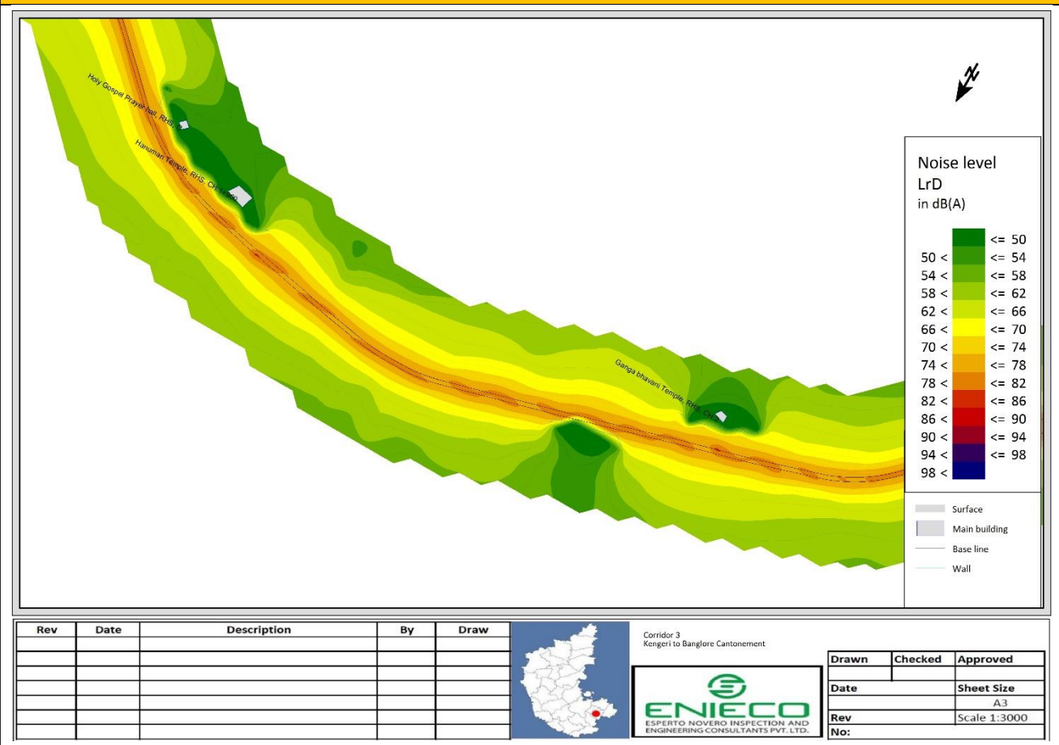
Corridor 3
Kengeri to Banglore Cantonement

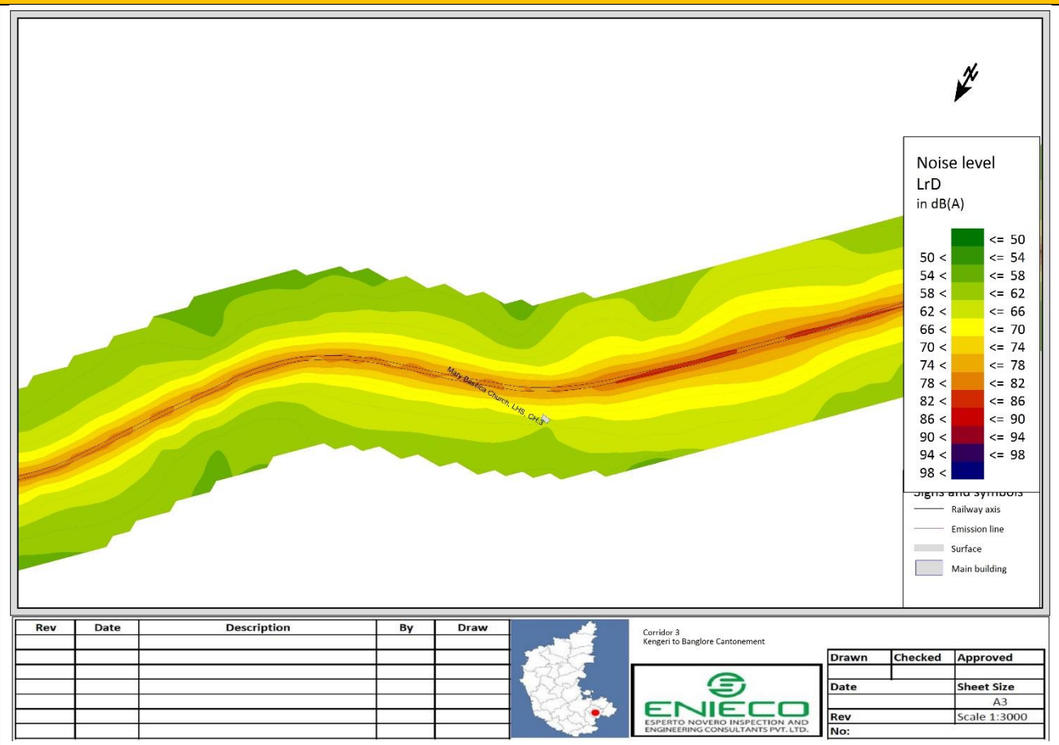
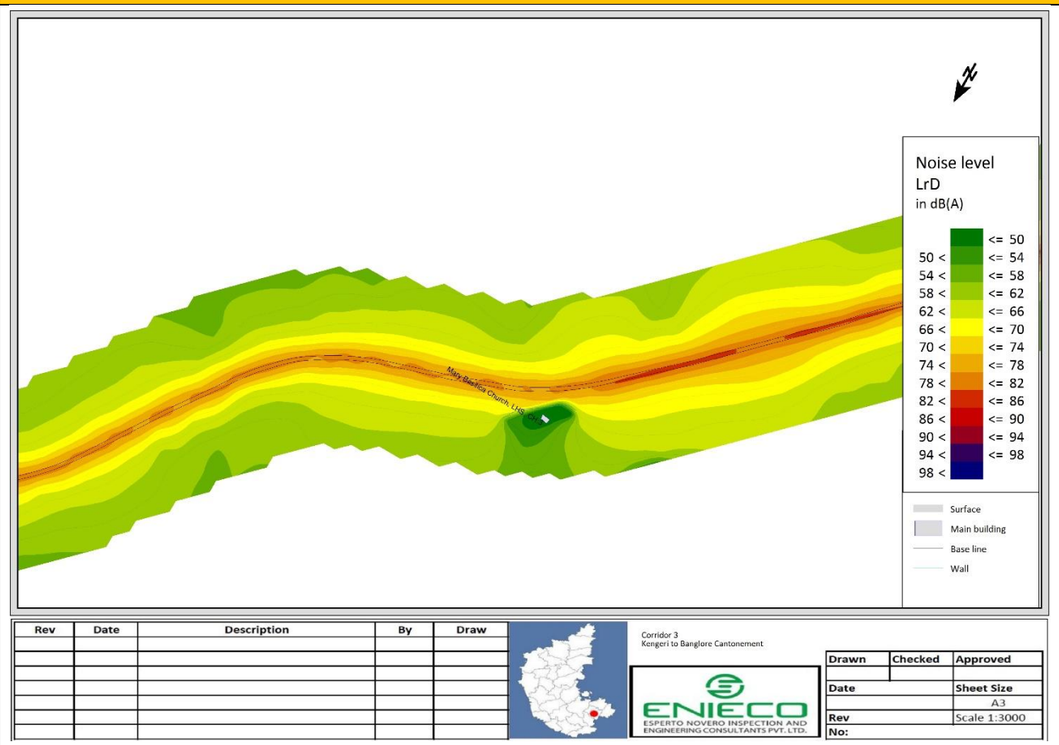
ENIECO
ESPERTO NOVERO INSPECTION AND ENGINEERING CONSULTANTS PVT. LTD.

Drawn	Checked	Approved
Date		Sheet Size
		A3
Rev		Scale 1:3000
No:		

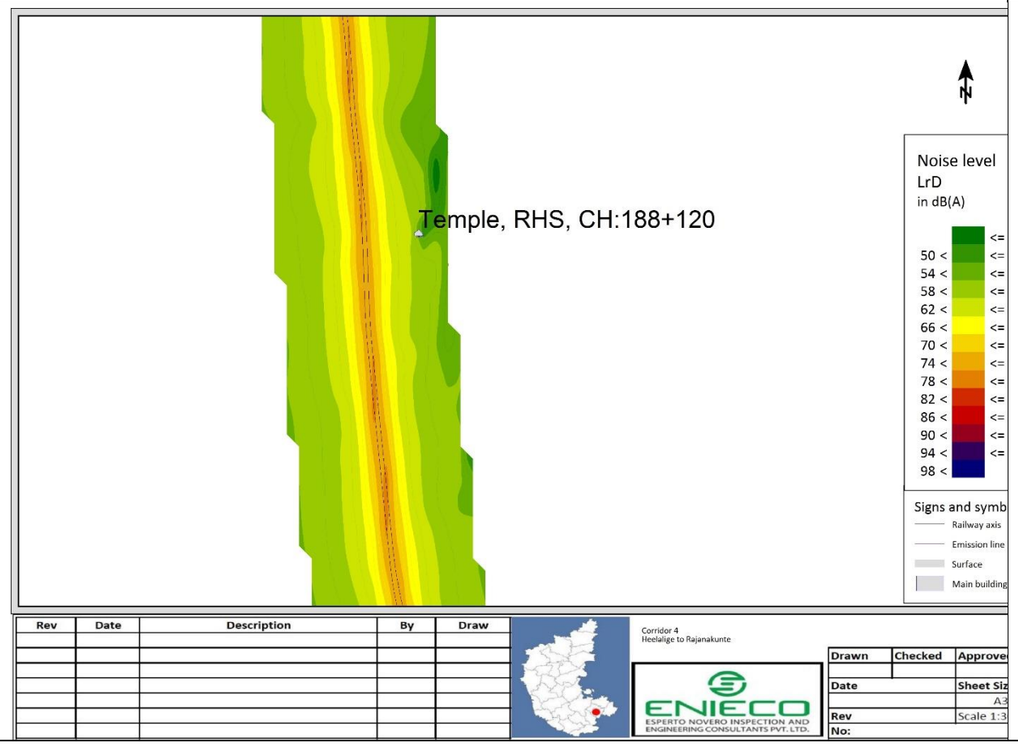
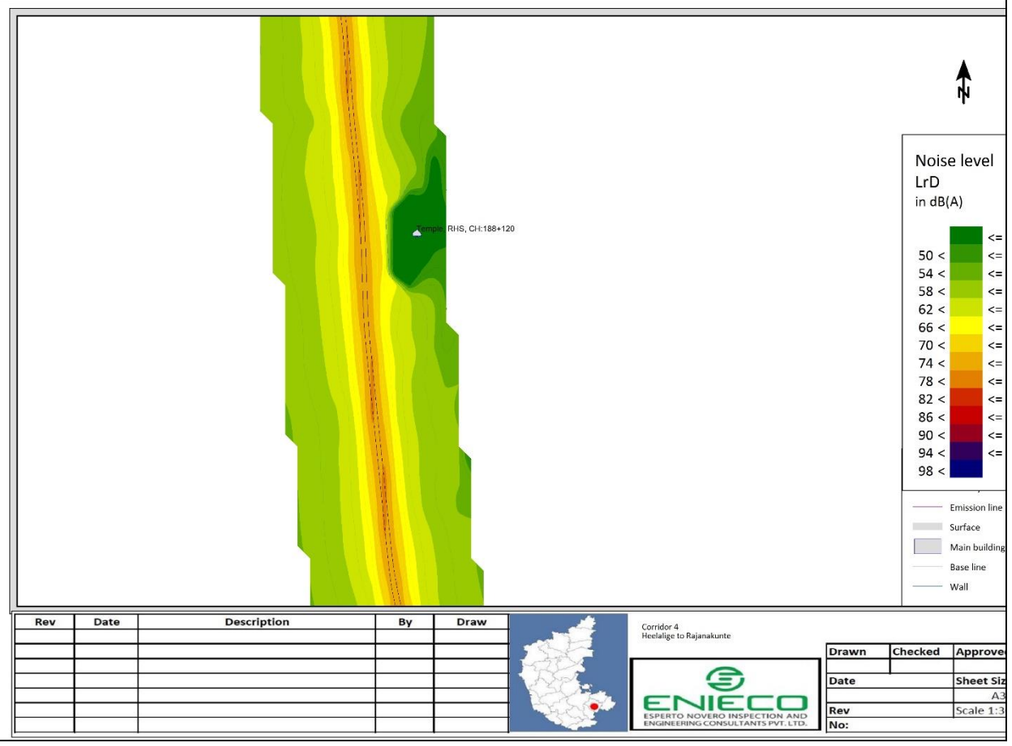
S.No	Without Barrier	With Barrier
2.		

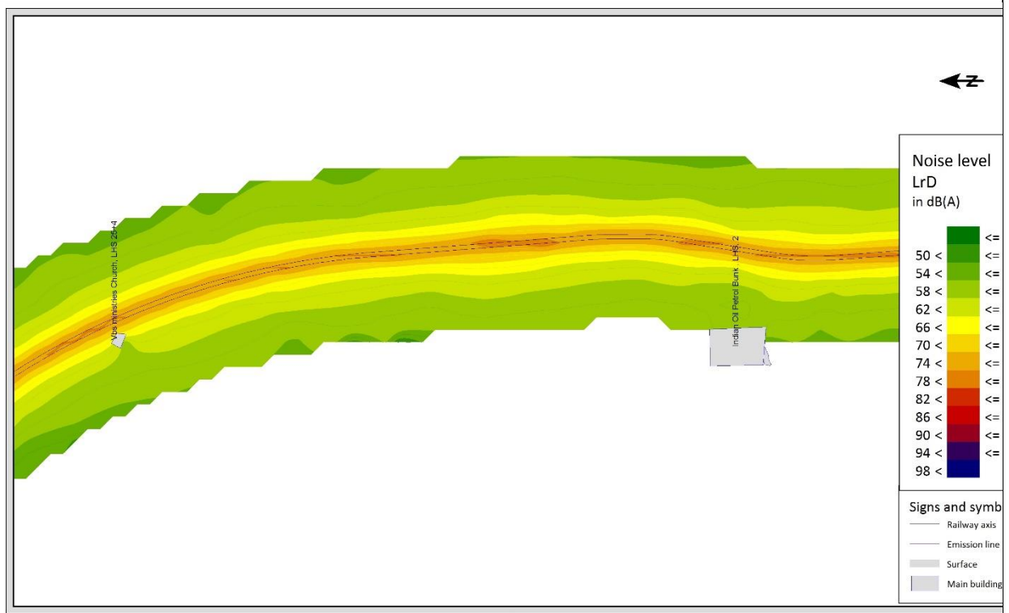
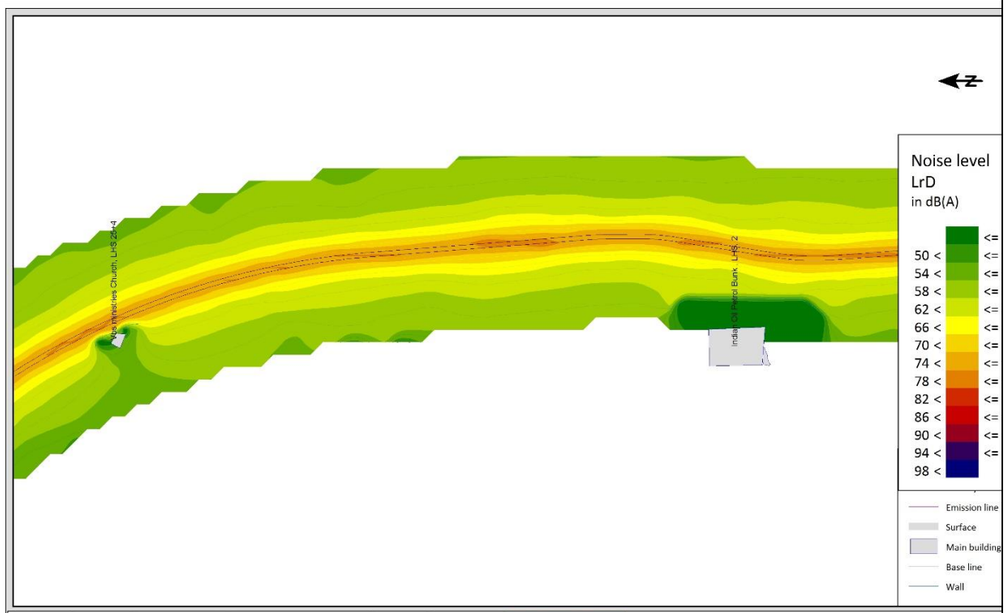
S.No	Without Barrier	With Barrier
3.		

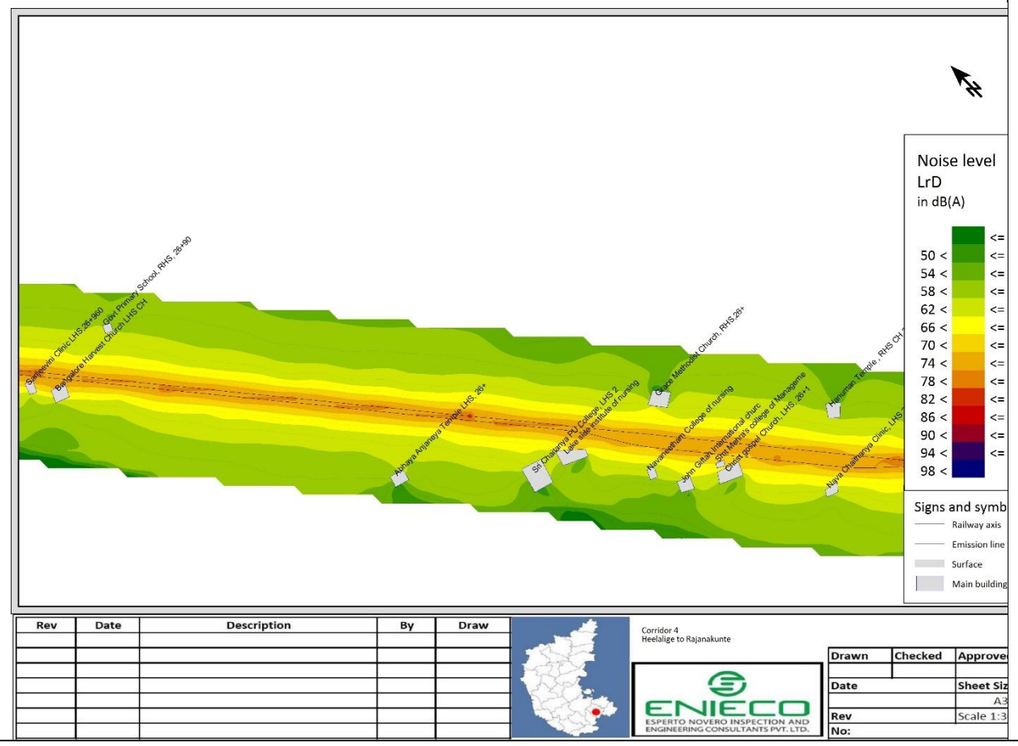
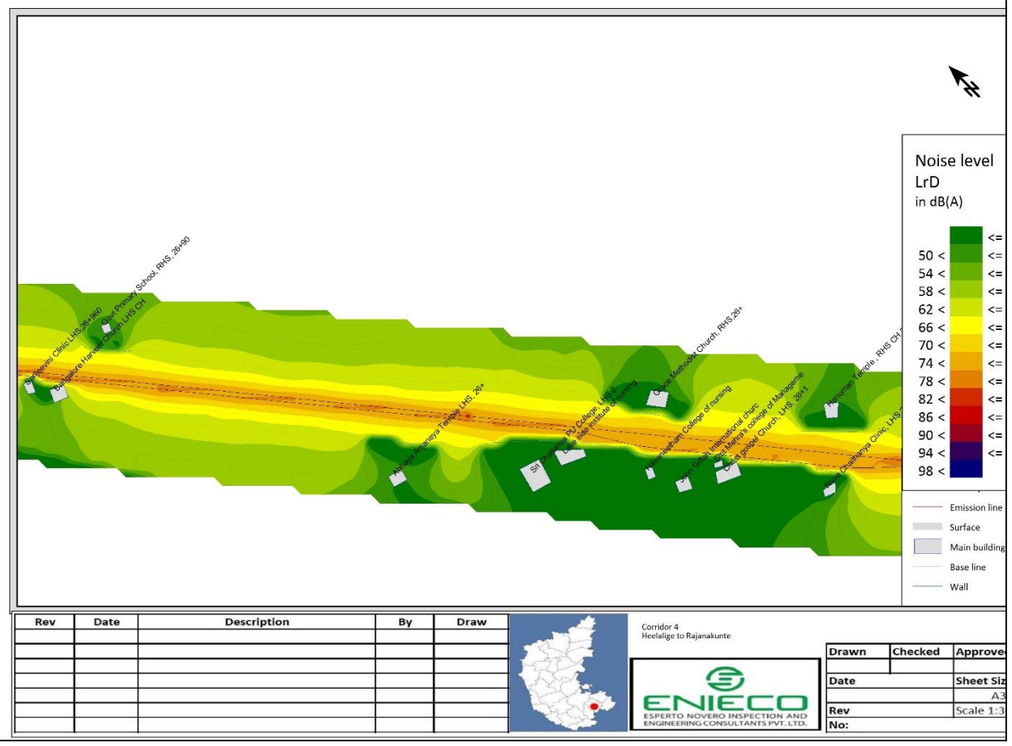
S.No	Without Barrier	With Barrier
4.		

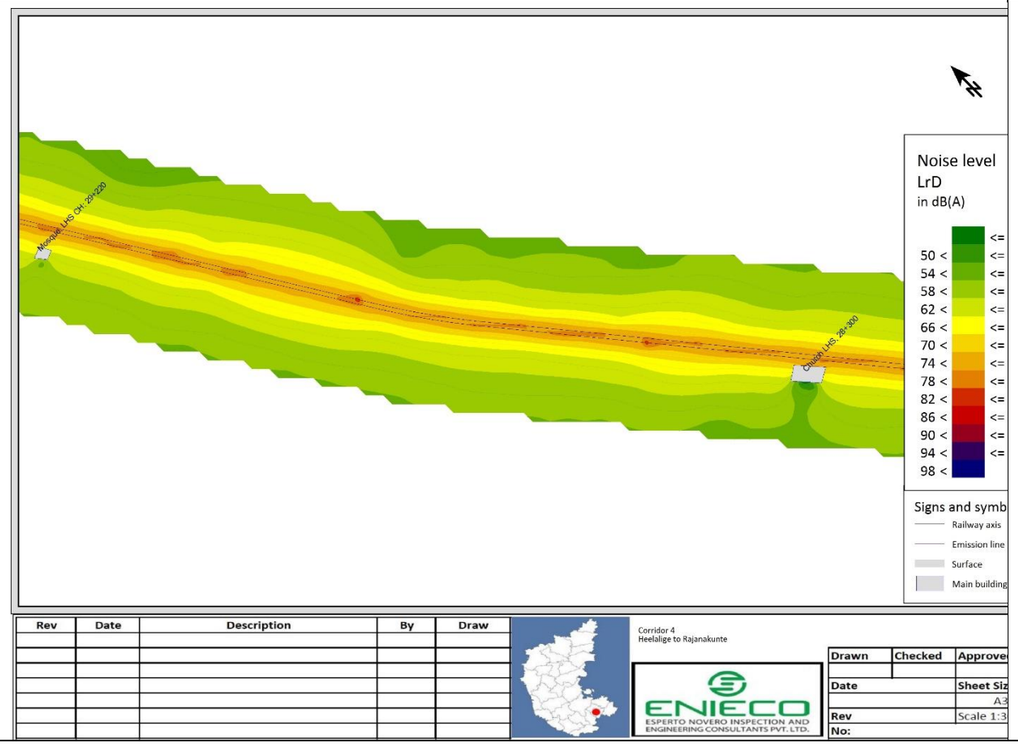
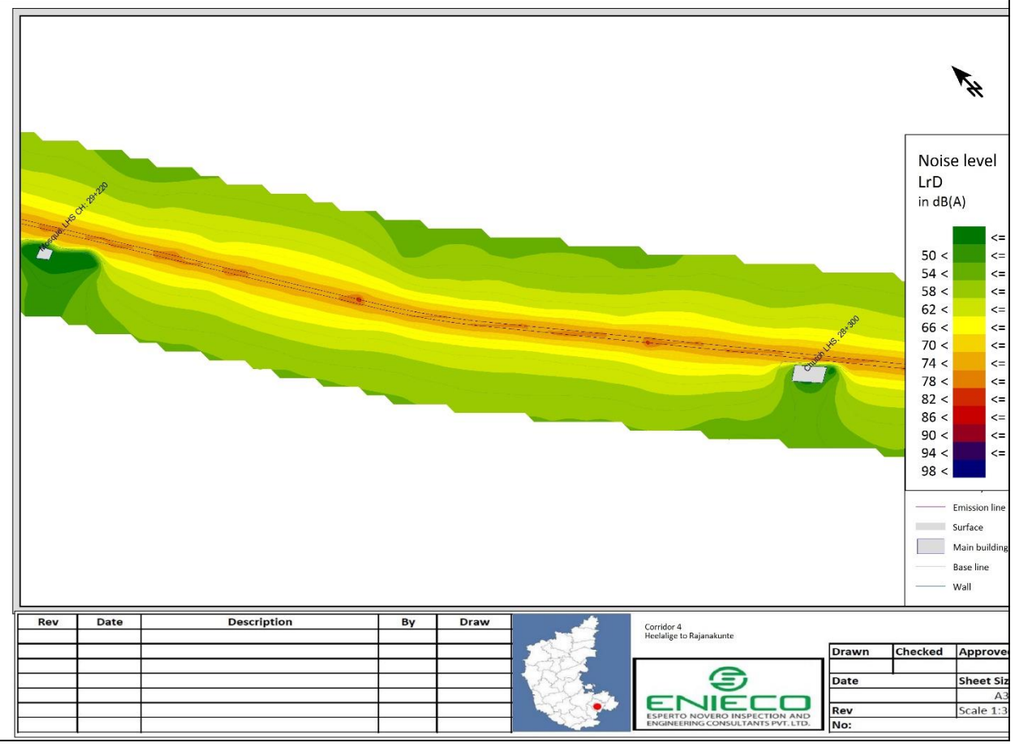
S.No	Without Barrier	With Barrier
5.		

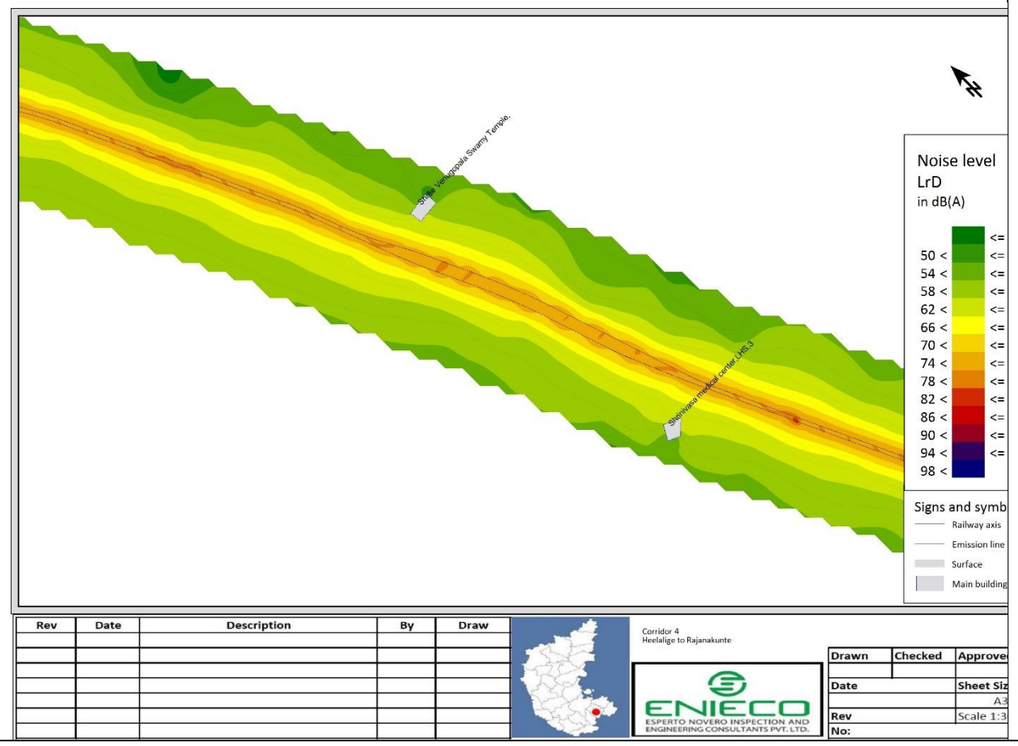
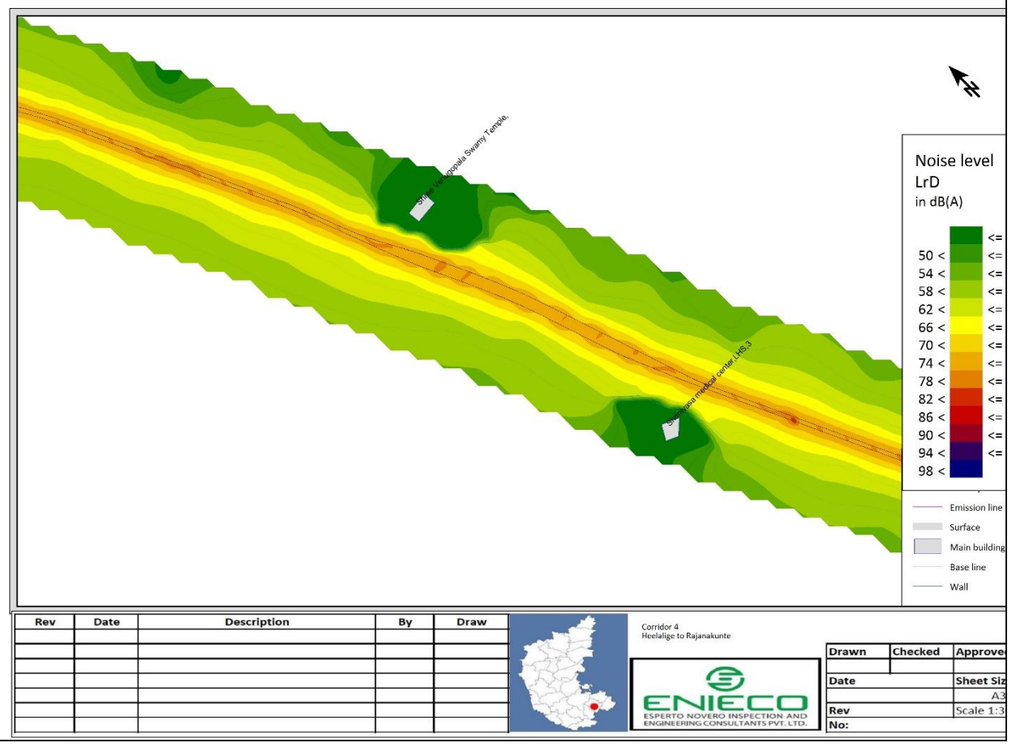
A. Noise contours for Corridor 4 for the Year 2025

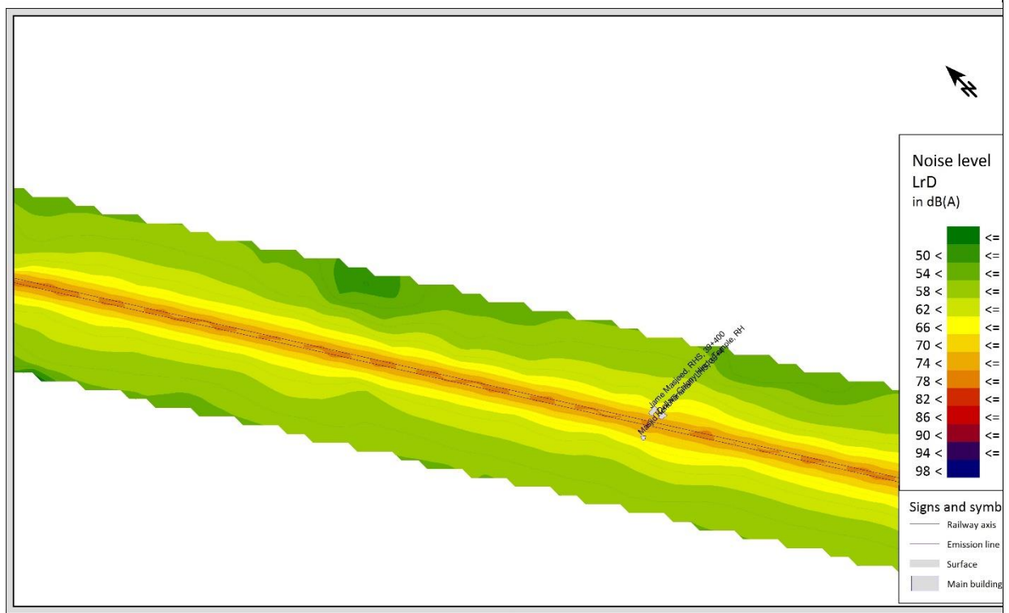
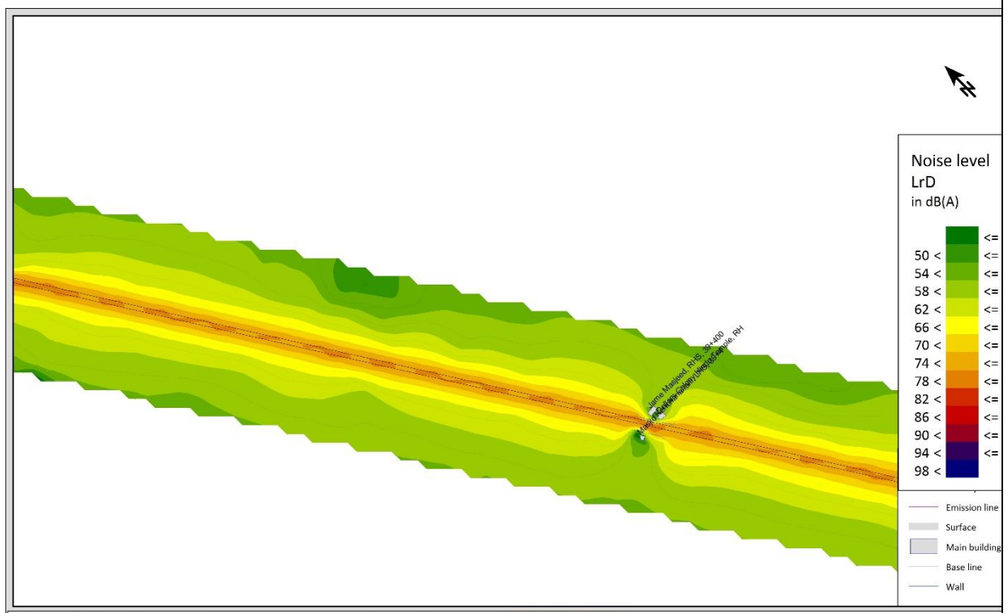
1. S.No	2. Without Barrier	3. With Barrier
1.		
4.		5.

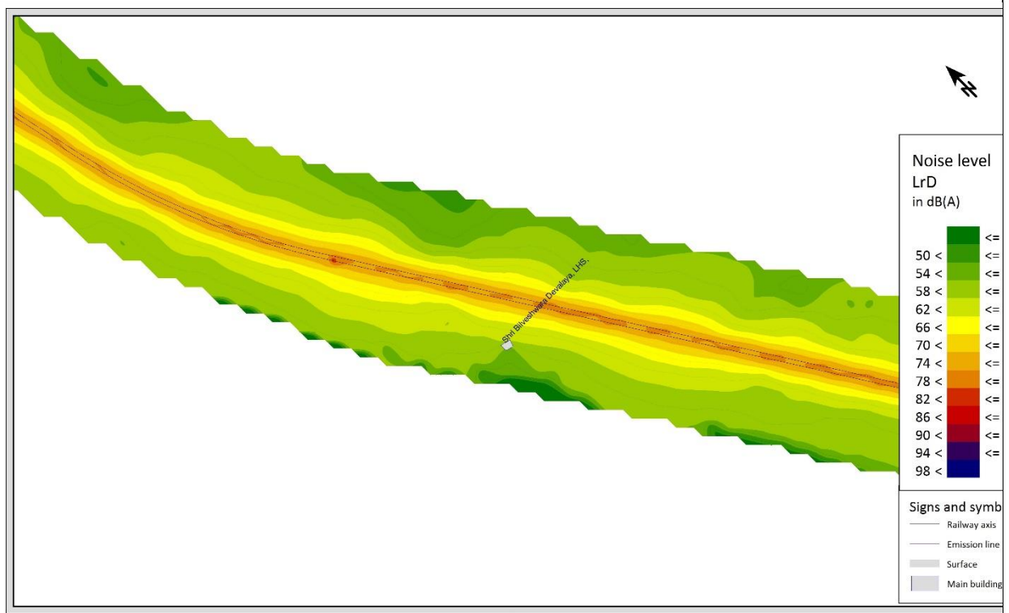
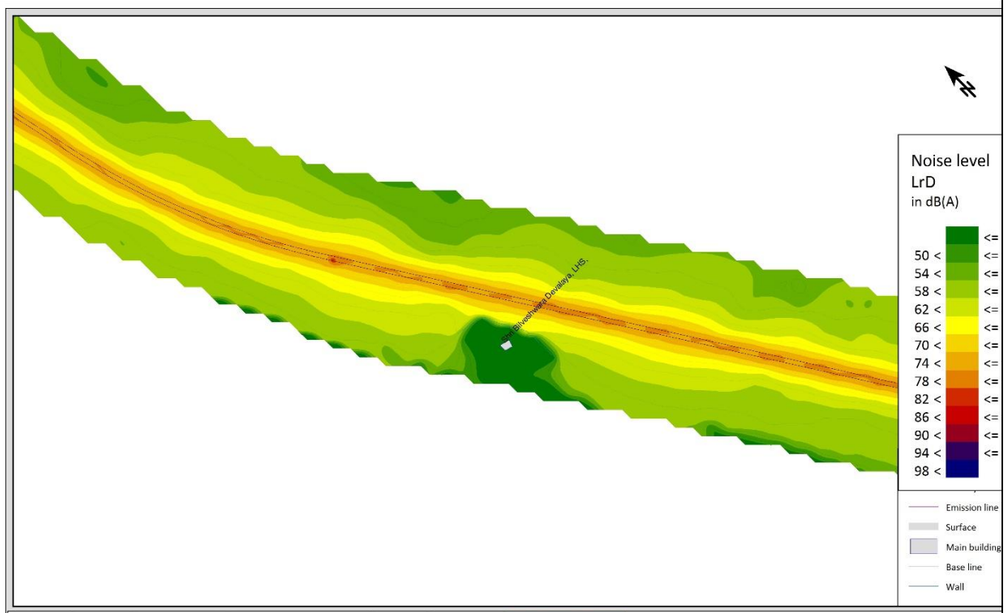
1. S.No	2. Without Barrier	3. With Barrier
2.		
6.		7.

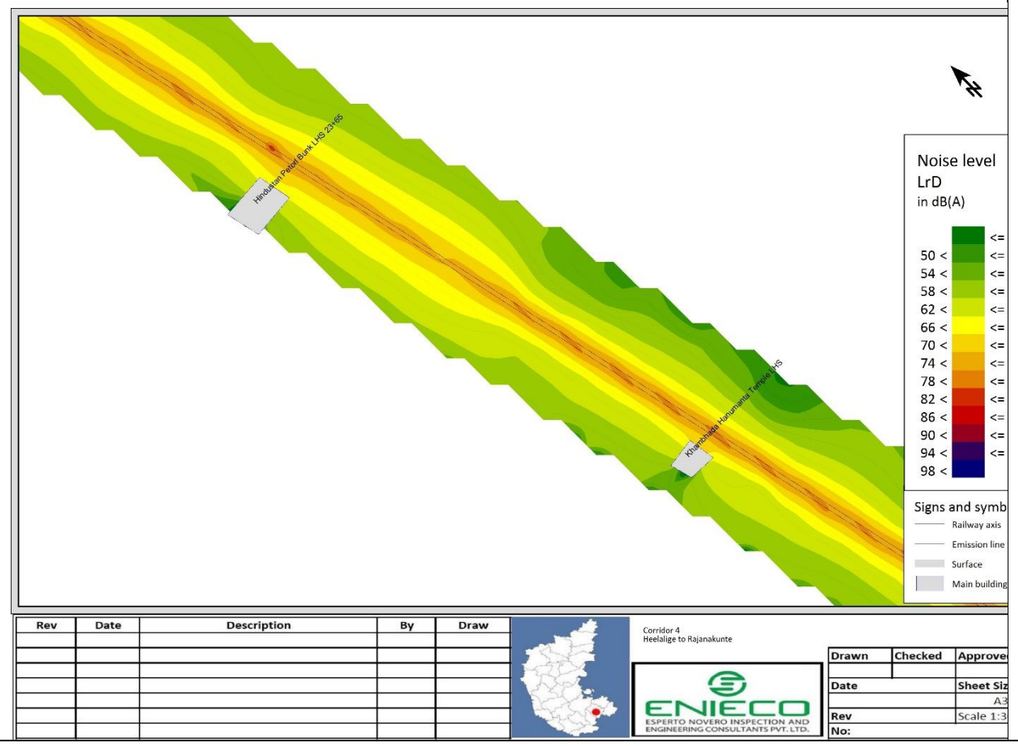
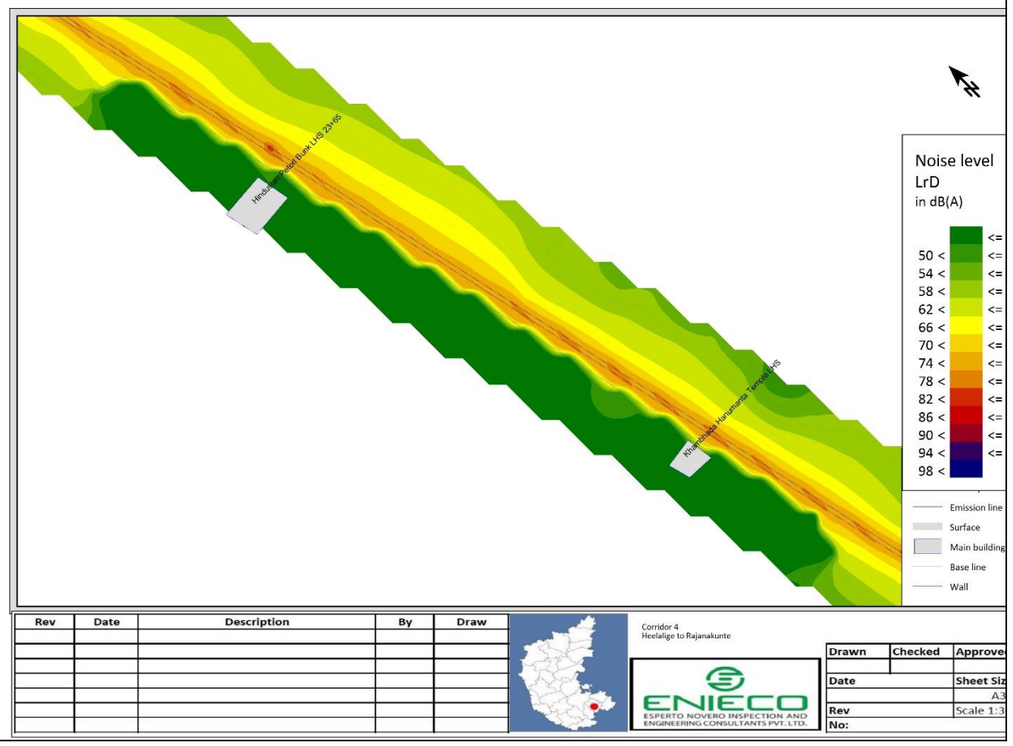
1. S.No	2. Without Barrier	3. With Barrier
3.		
8.		9.

1. S.No	2. Without Barrier	3. With Barrier
4.		
10.		11.

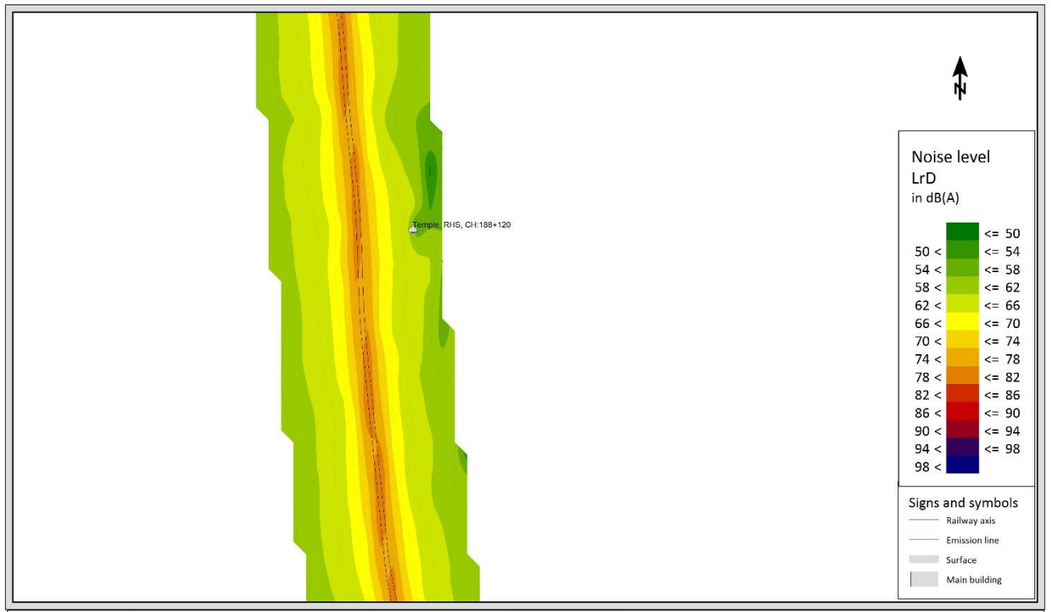
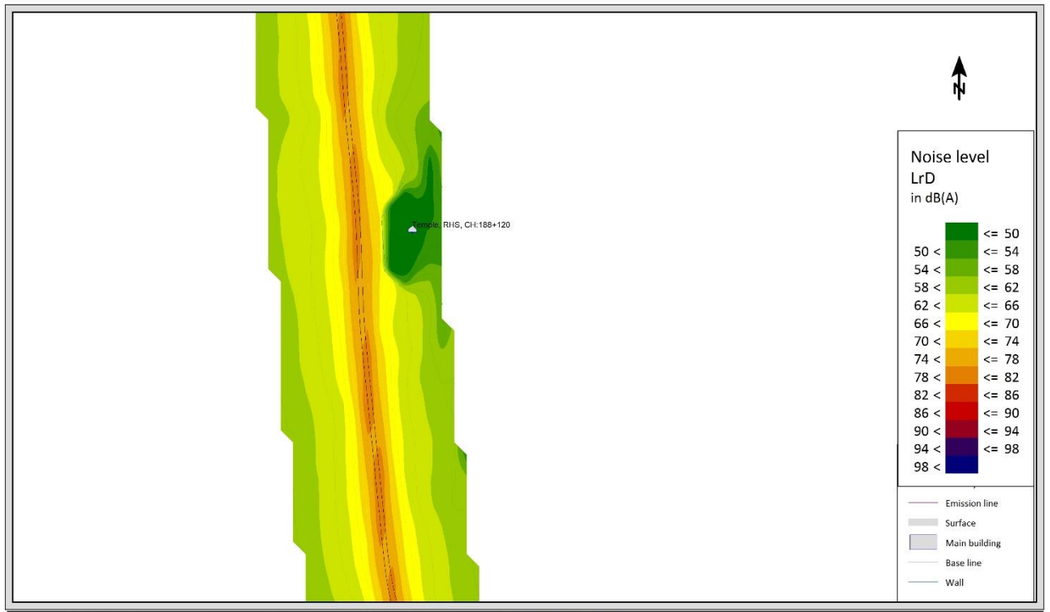
1. S.No	2. Without Barrier	3. With Barrier
5.		
12.		13.

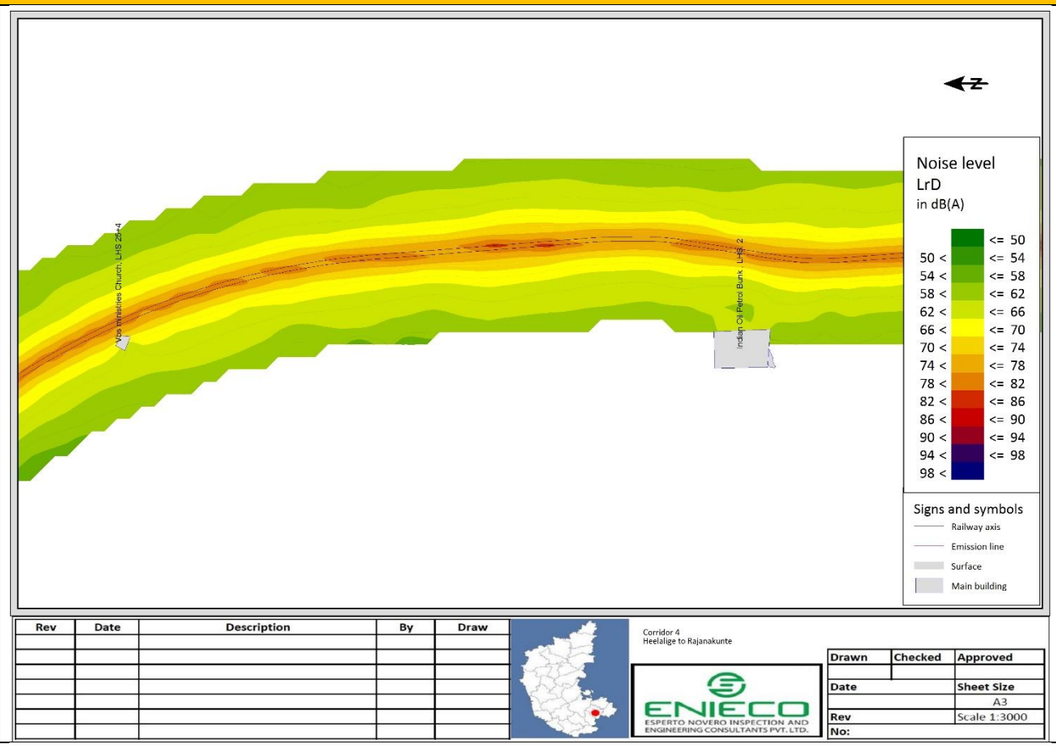
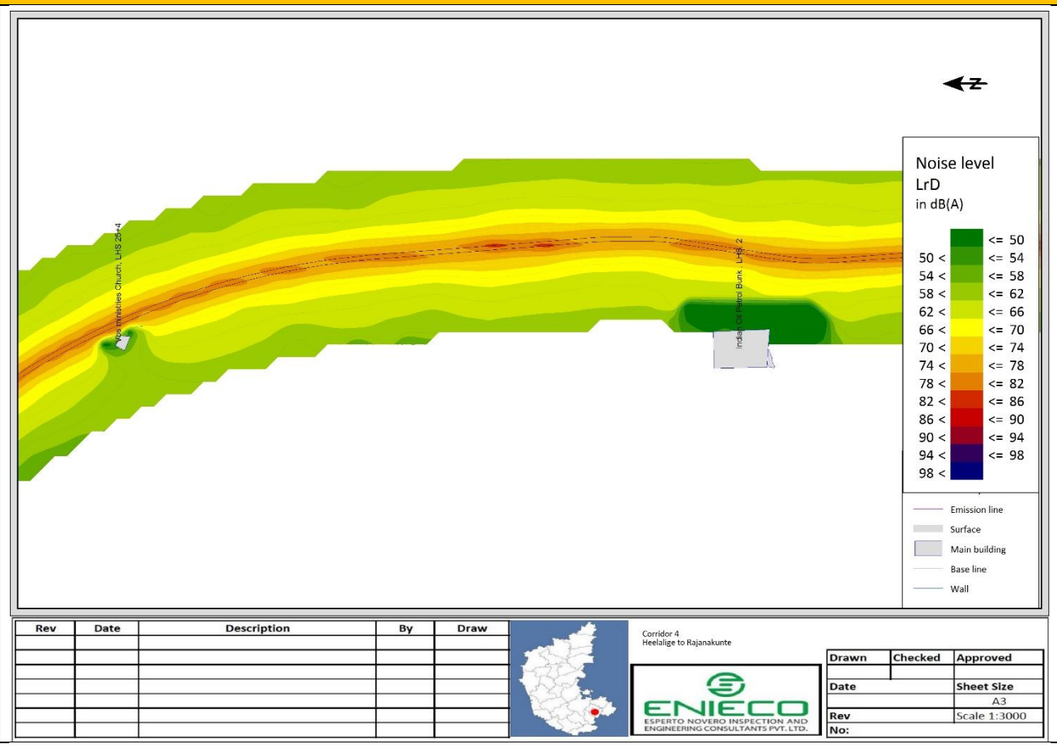
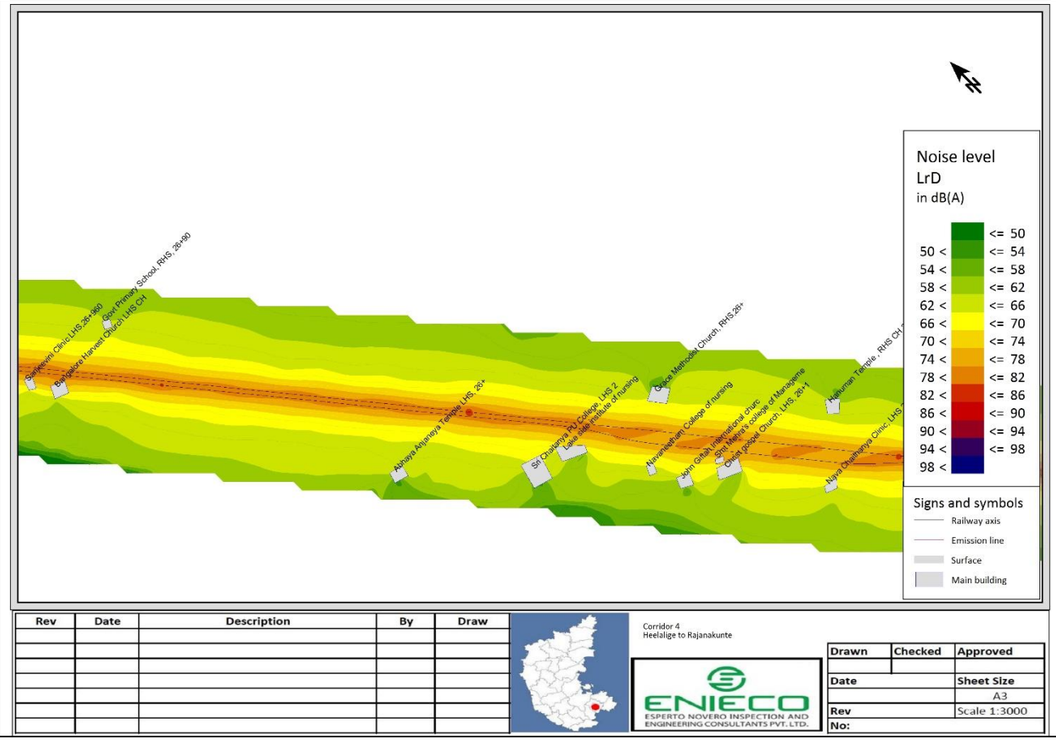
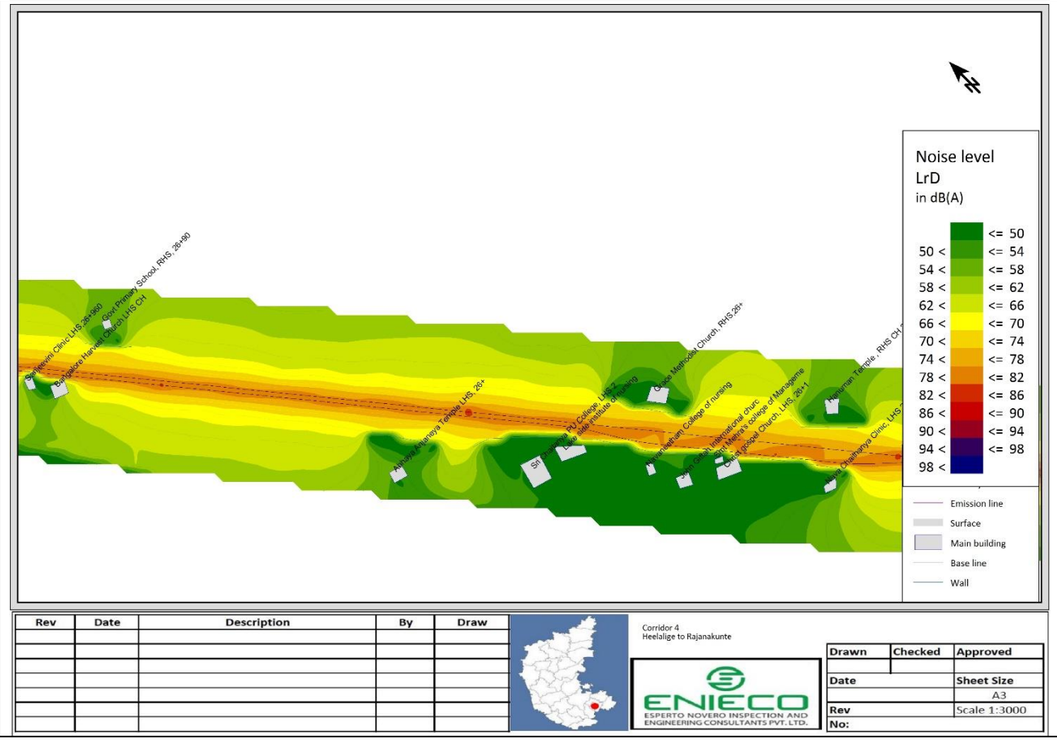
1. S.No	2. Without Barrier	3. With Barrier
6.		
14.		15.

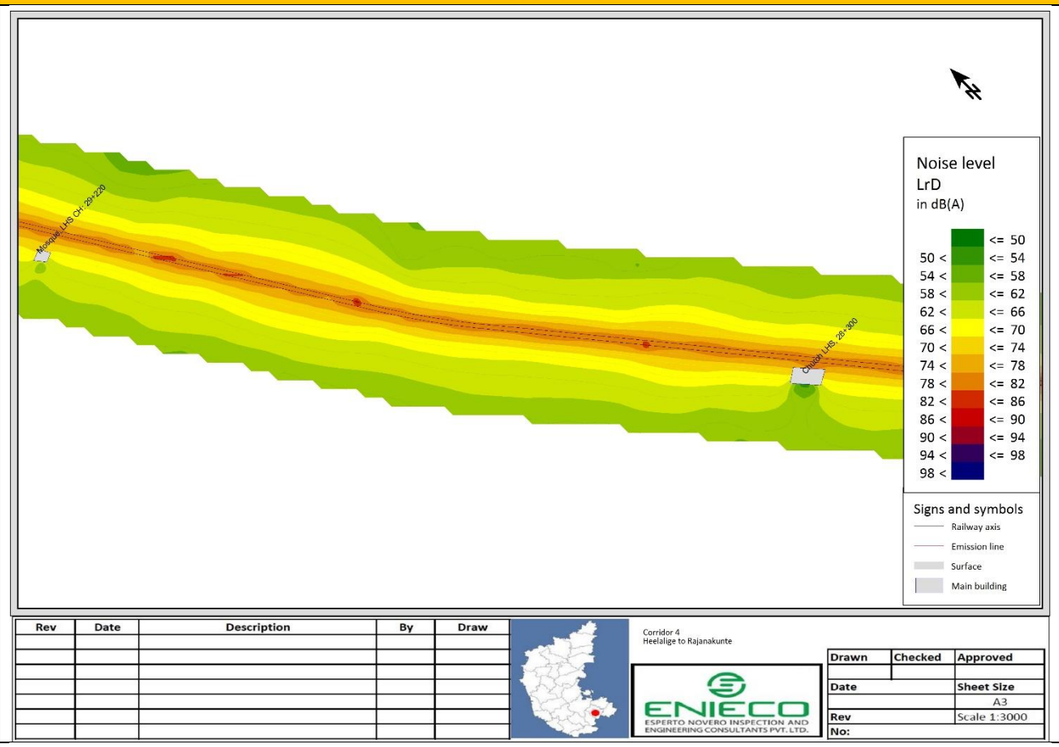
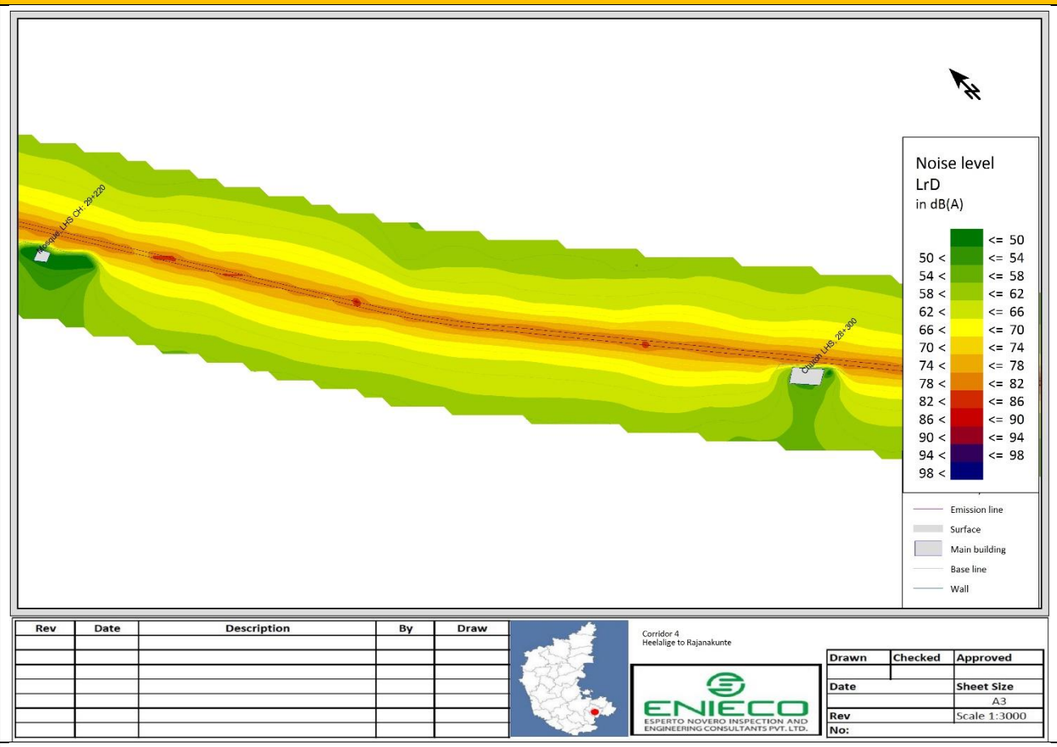
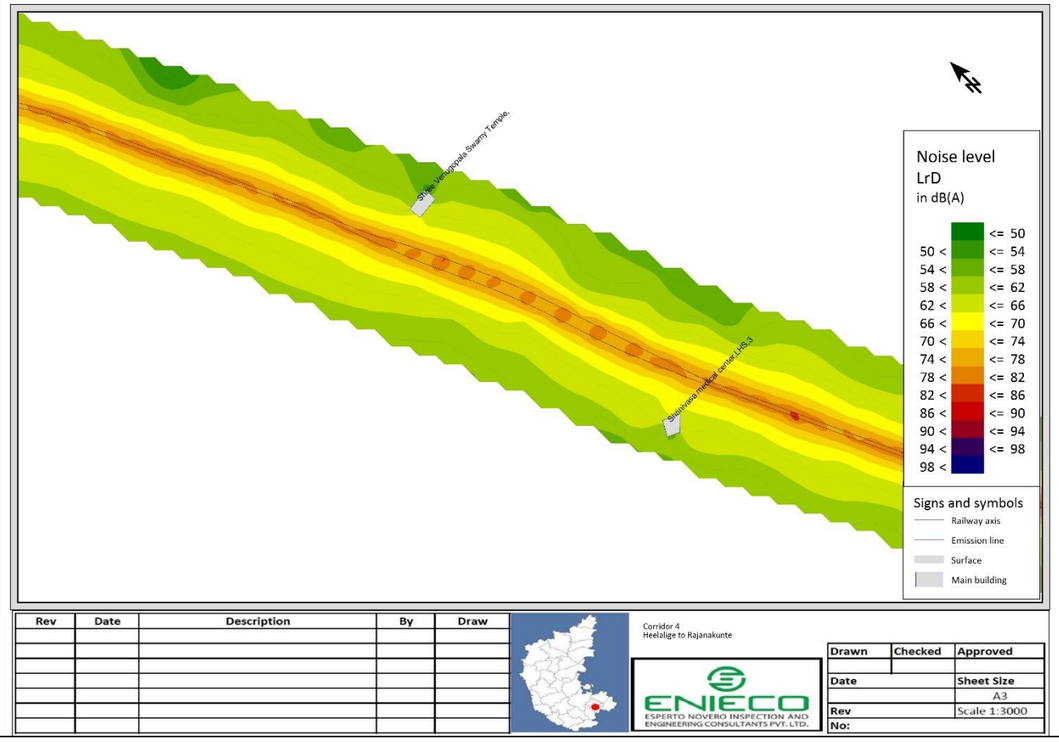
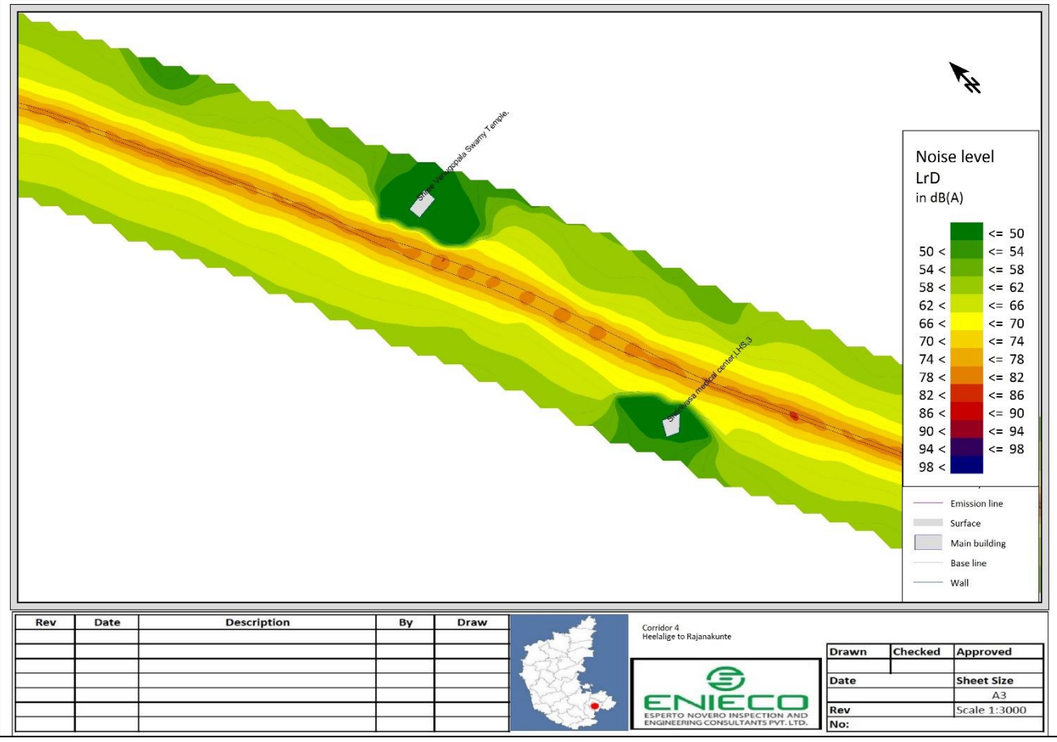
1. S.No	2. Without Barrier	3. With Barrier
7.		
16.		17.

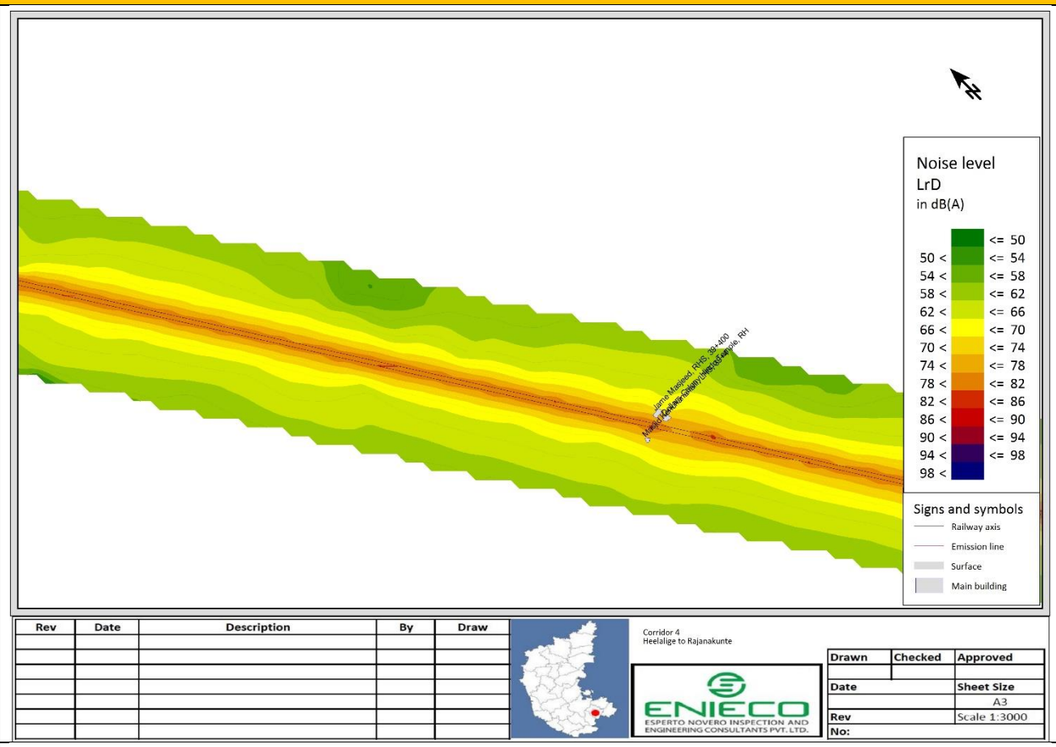
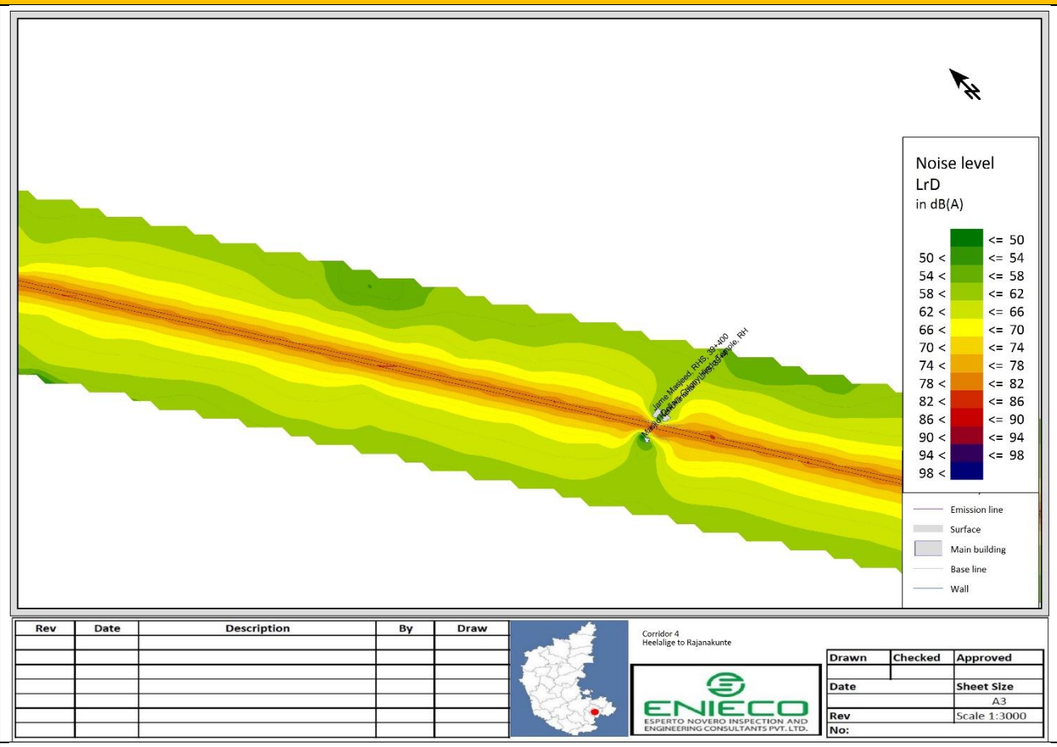
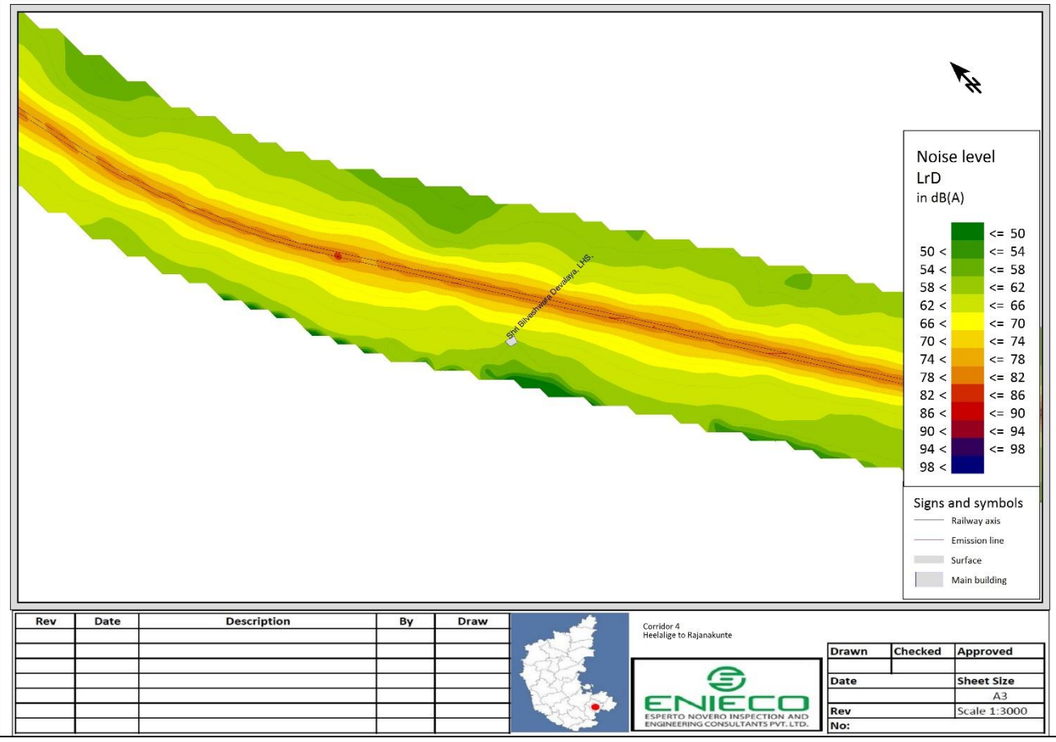
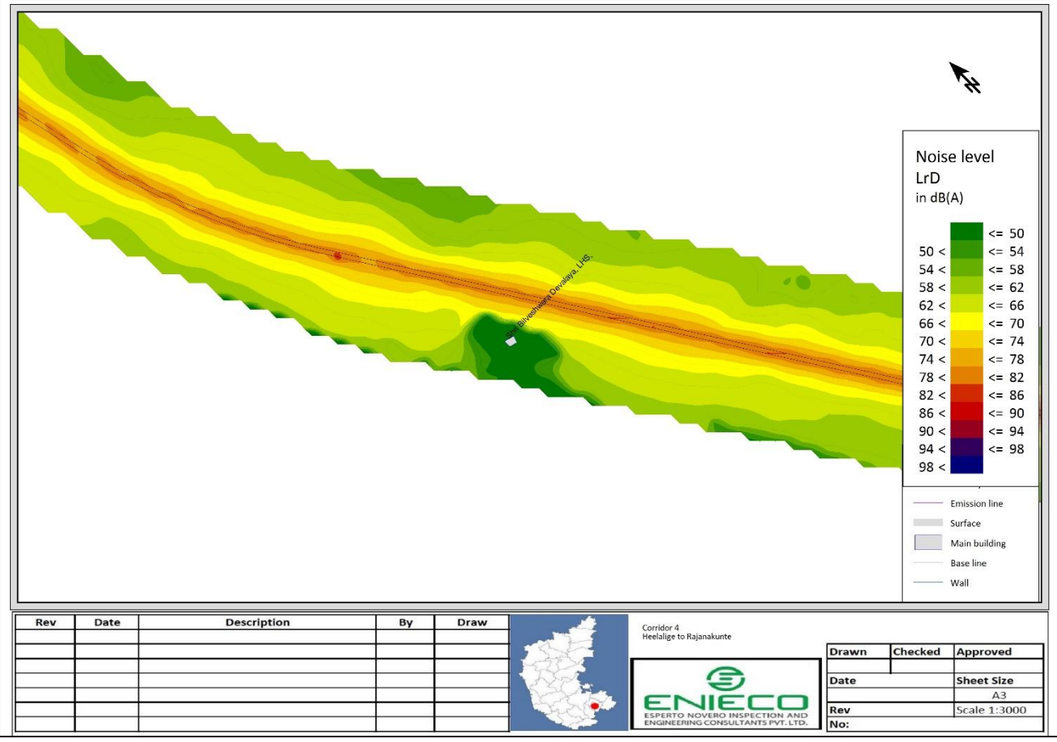
1. S.No	2. Without Barrier	3. With Barrier
8.		

B. Noise contours for Corridor 4 for the Year 2031

S.No	Without Barrier	With Barrier
1.		

S.No	Without Barrier	With Barrier
2.		
3.		

S.No	Without Barrier	With Barrier
4.		
5.		

S.No	Without Barrier	With Barrier
6.		
7.		

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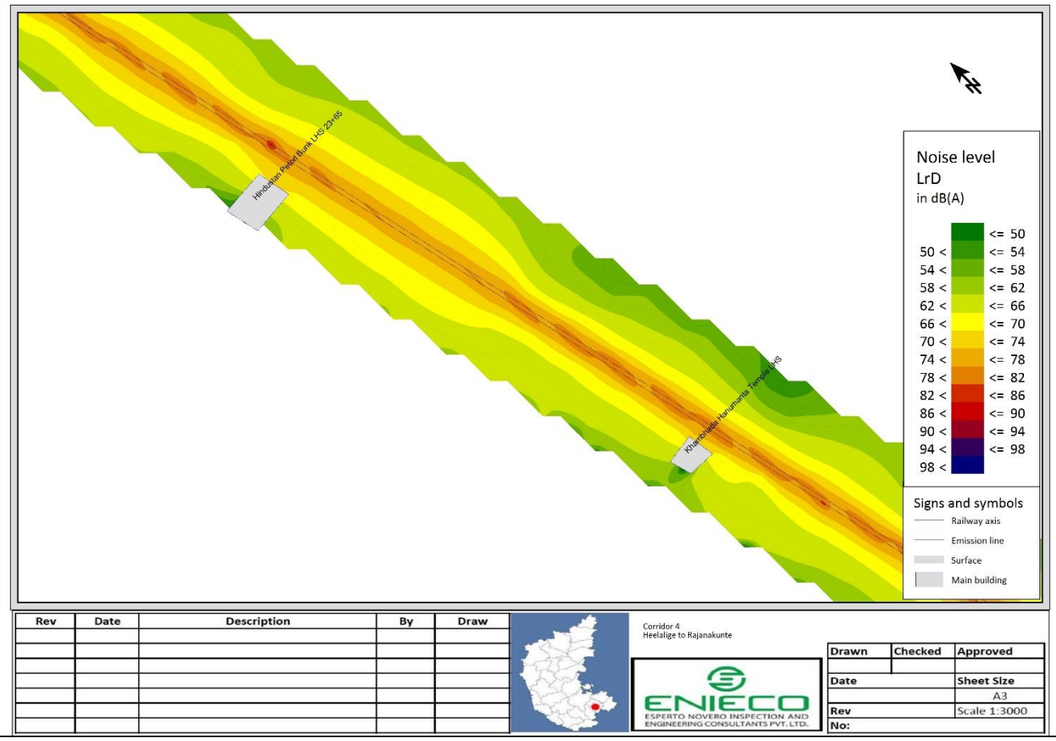
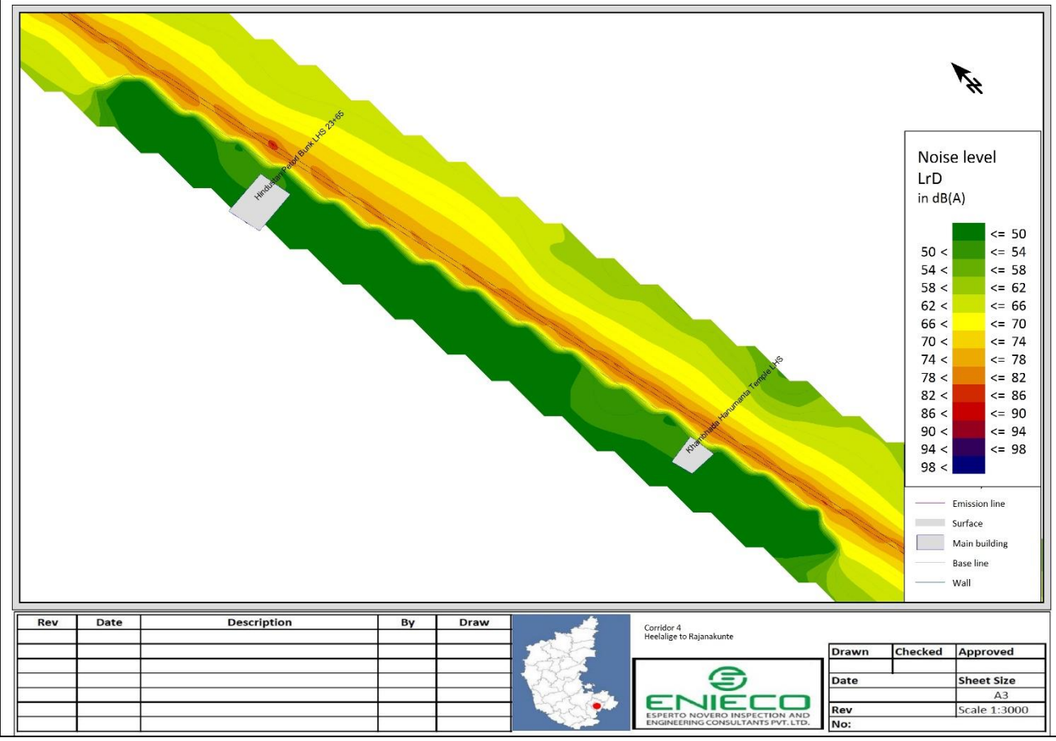
8.		

C. Noise contours for Corridor 4 for the Year 2041

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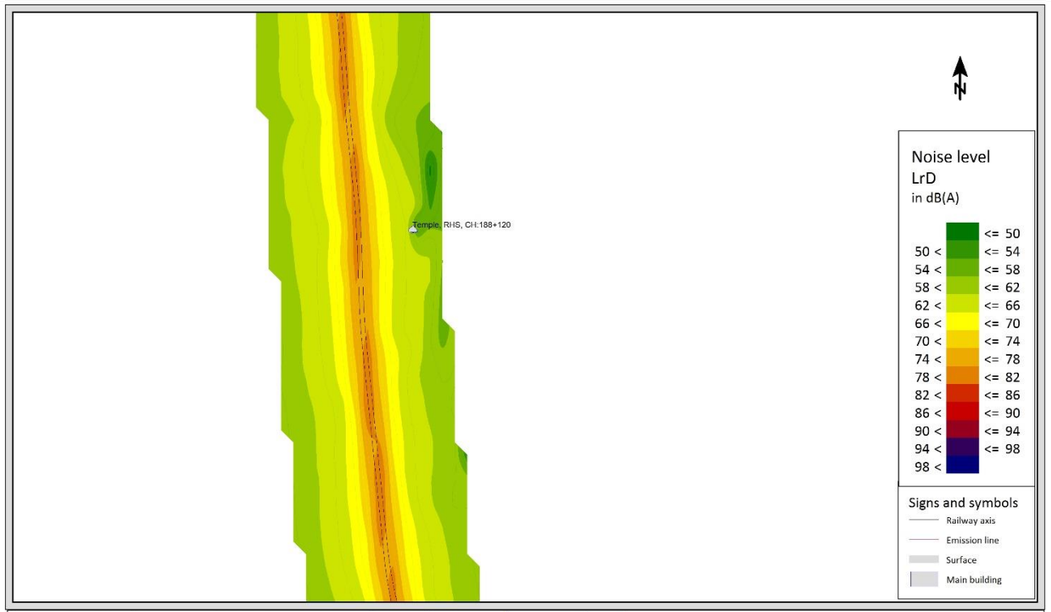
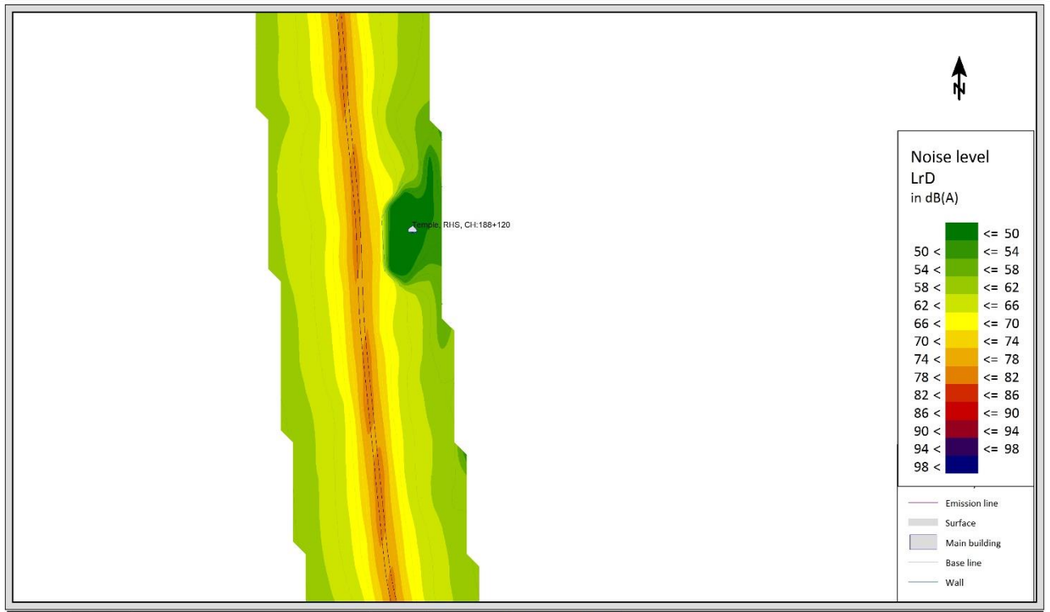
1.		

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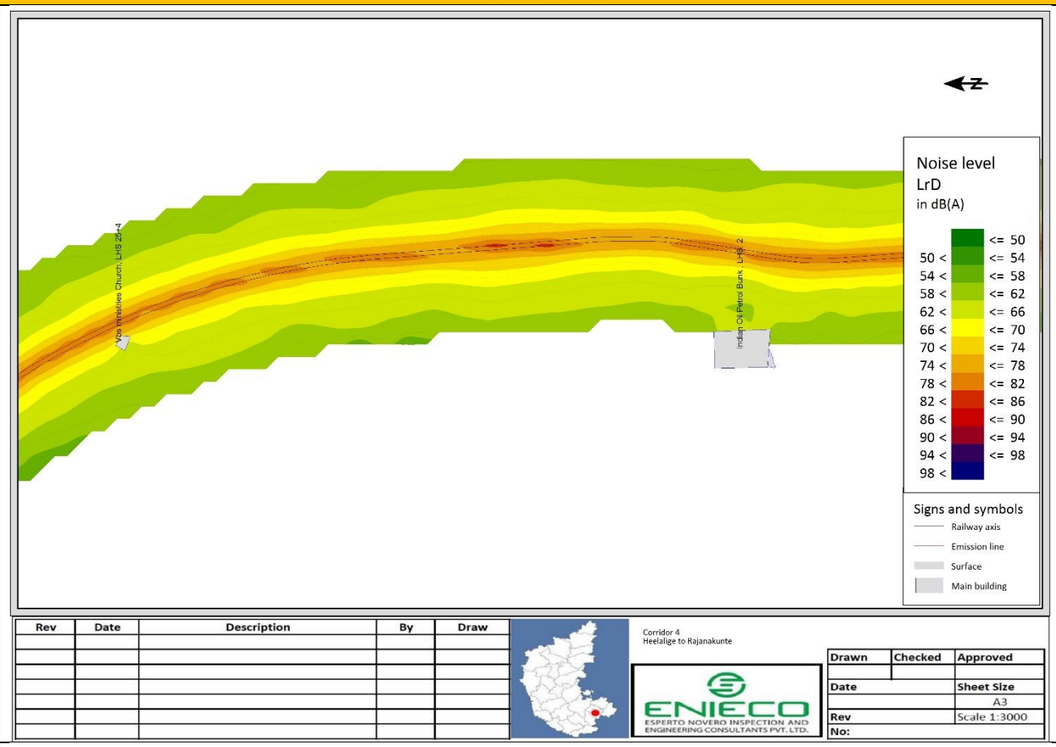
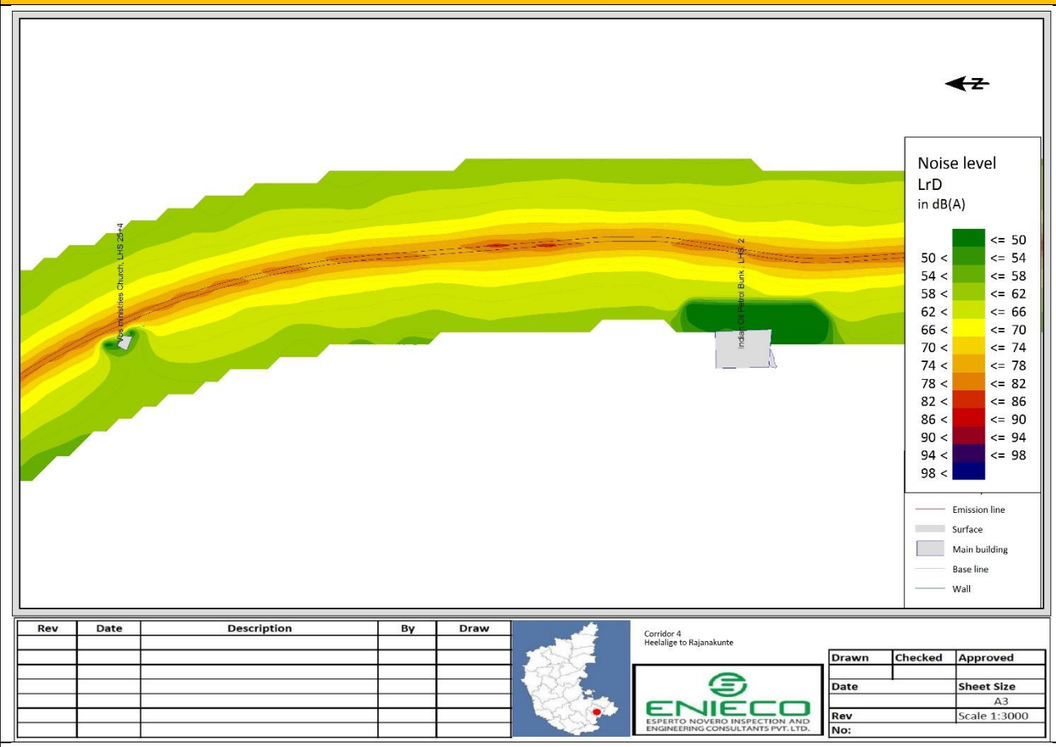
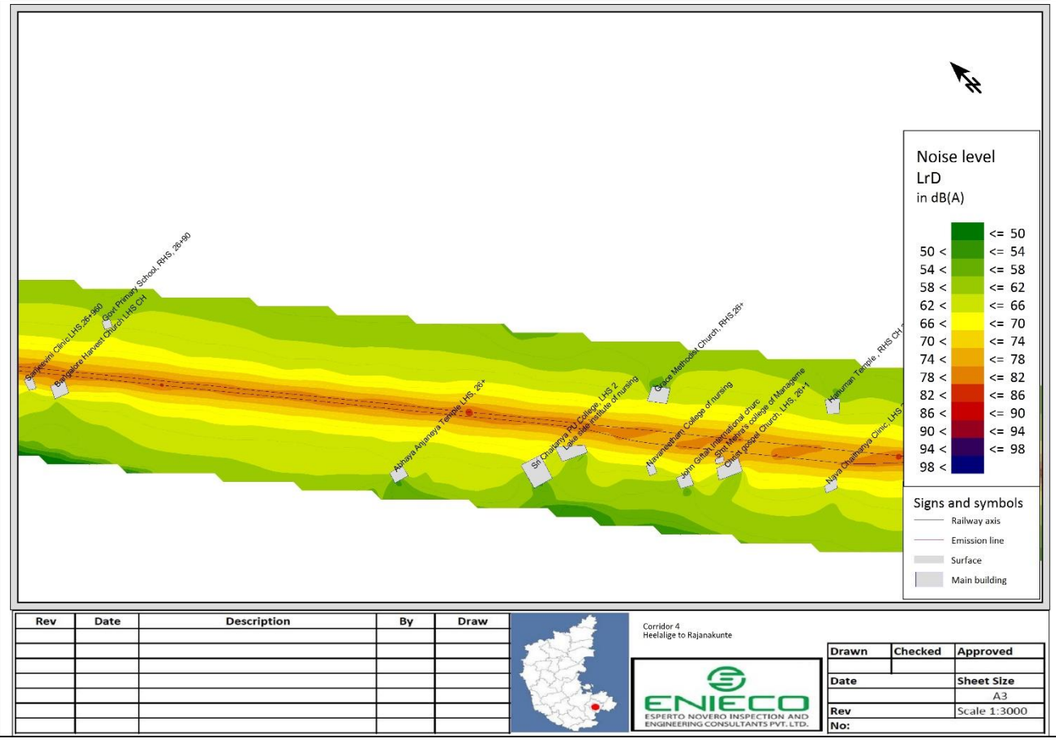
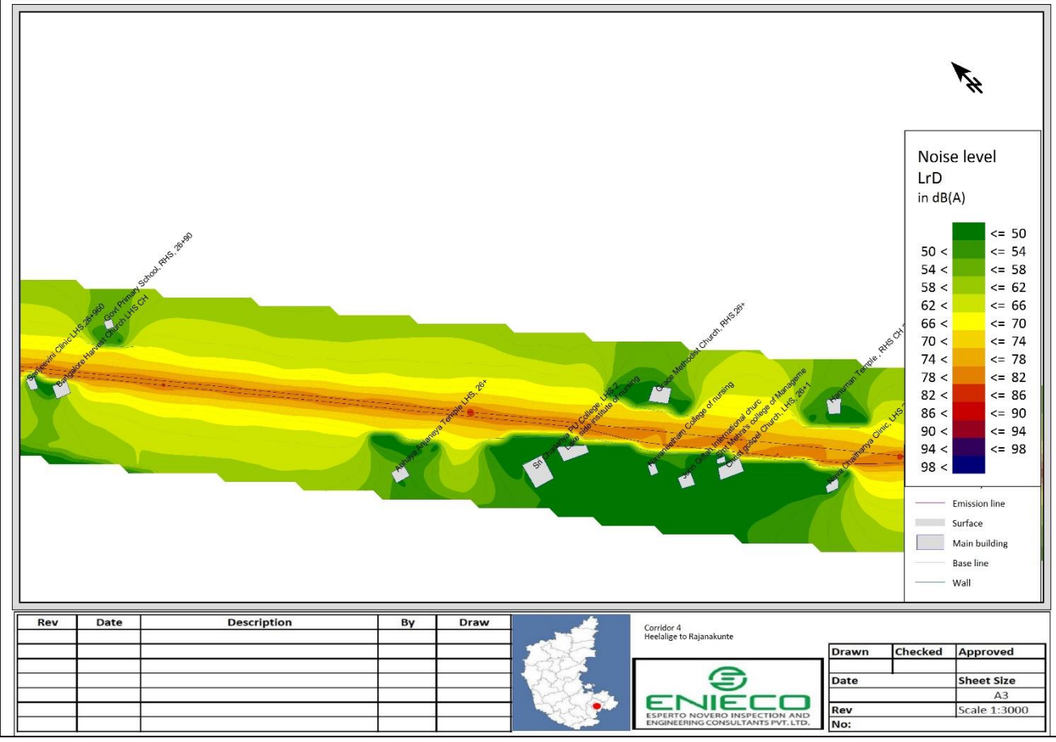
2.		
3.		

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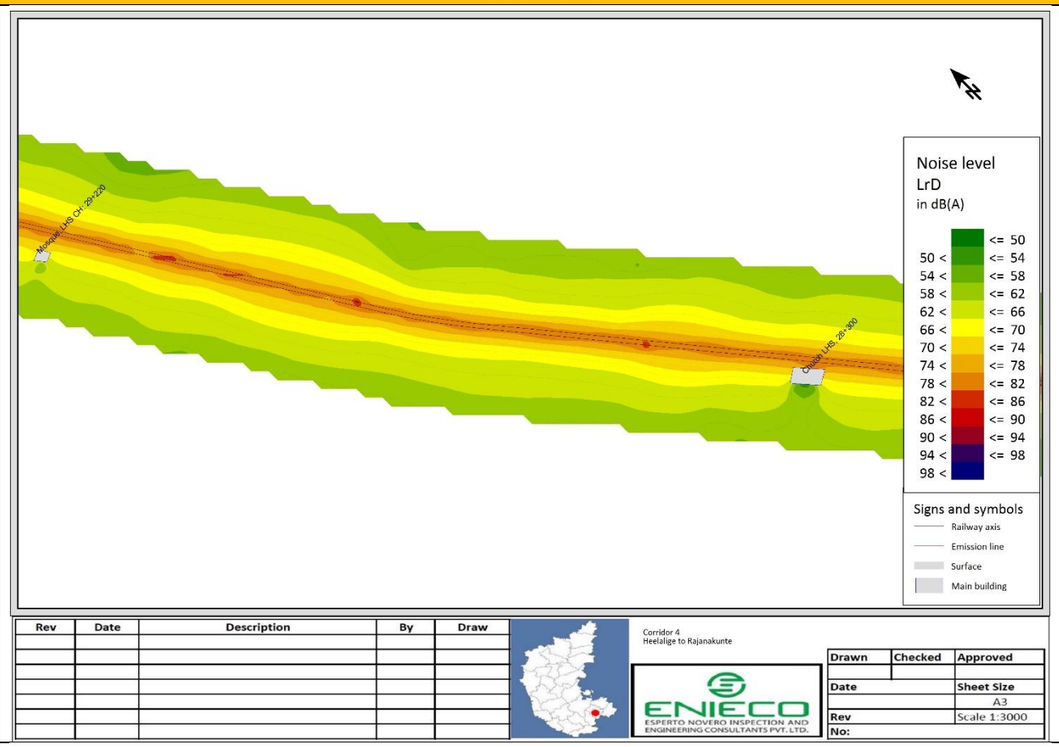
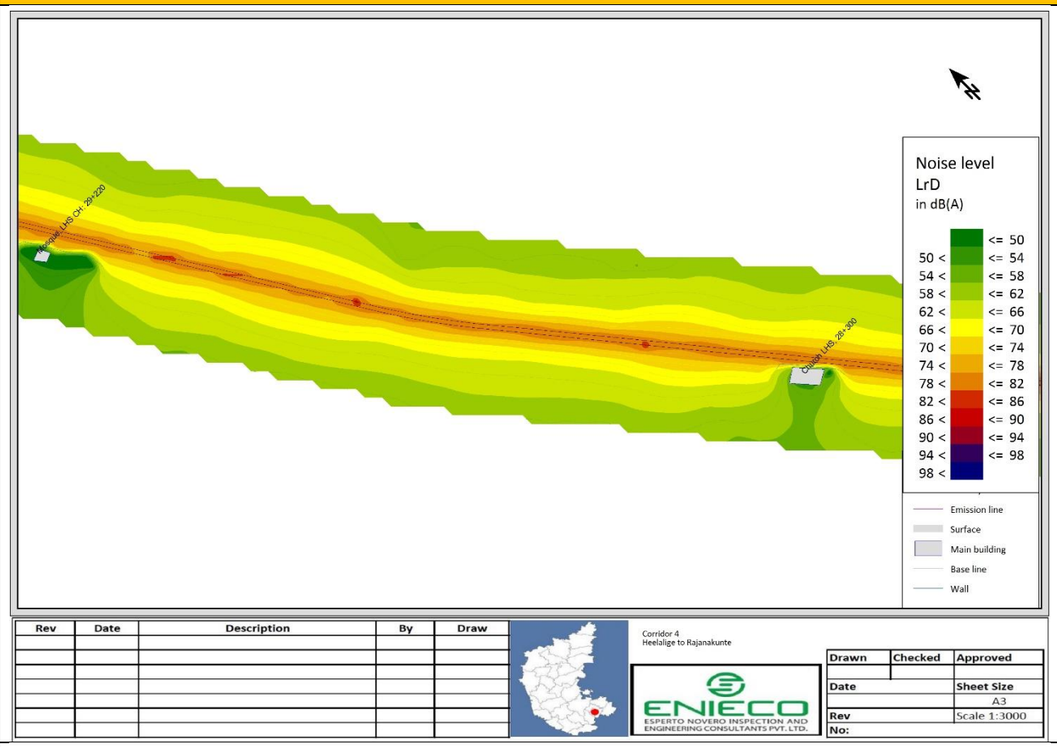
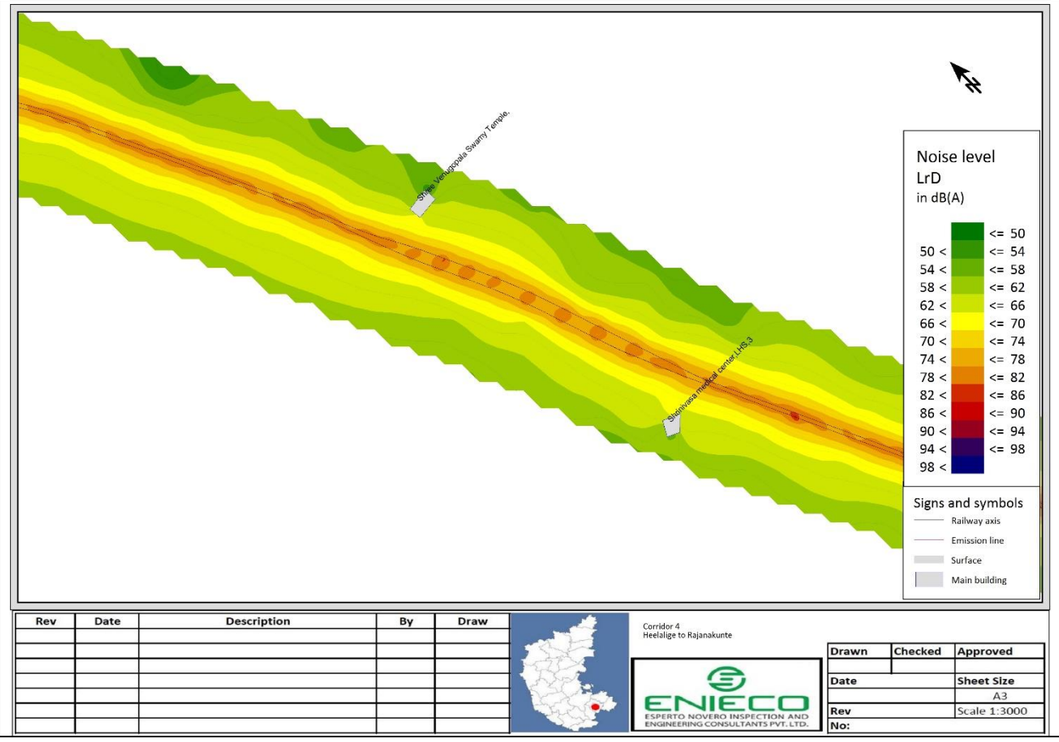
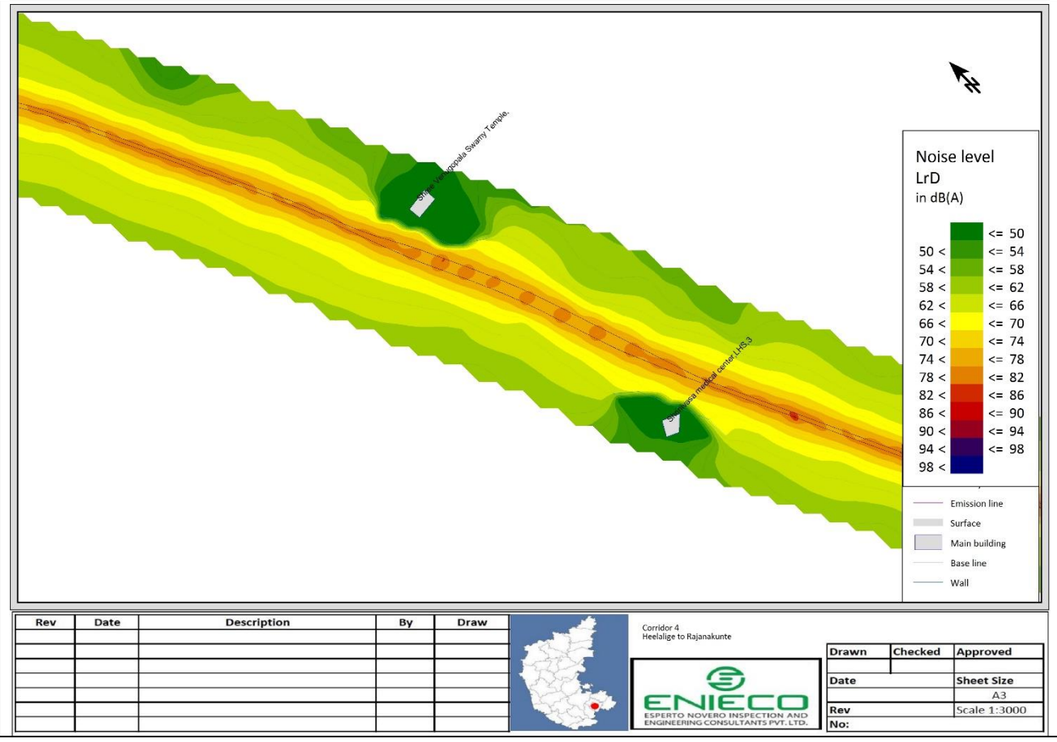
4.		
5.		

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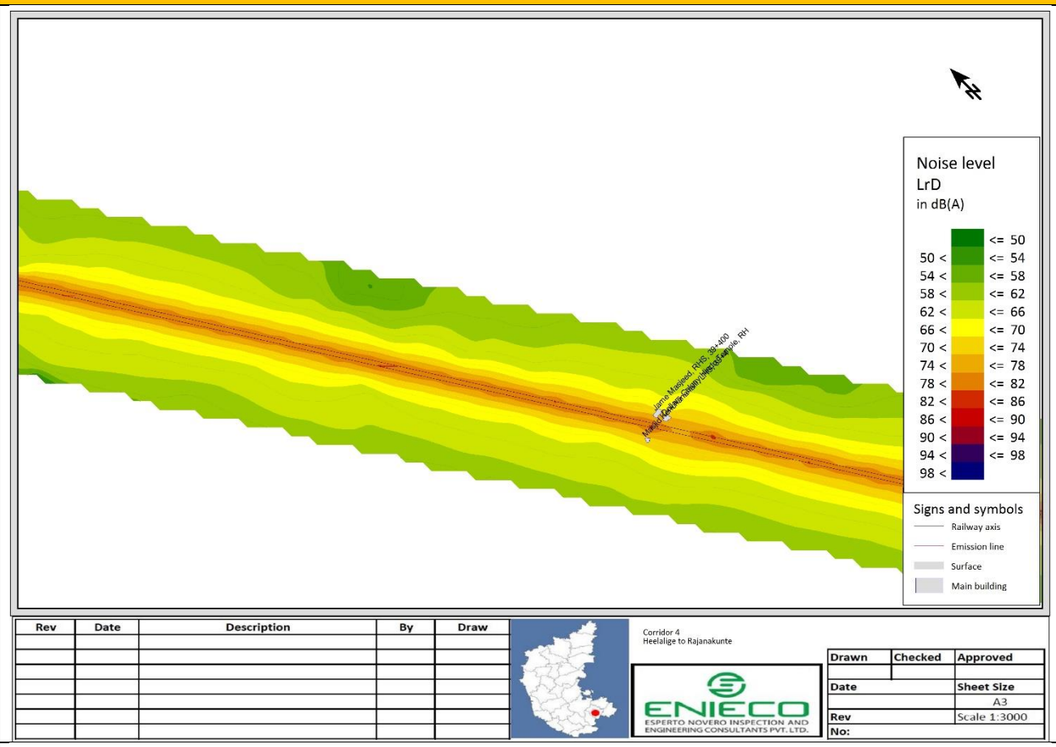
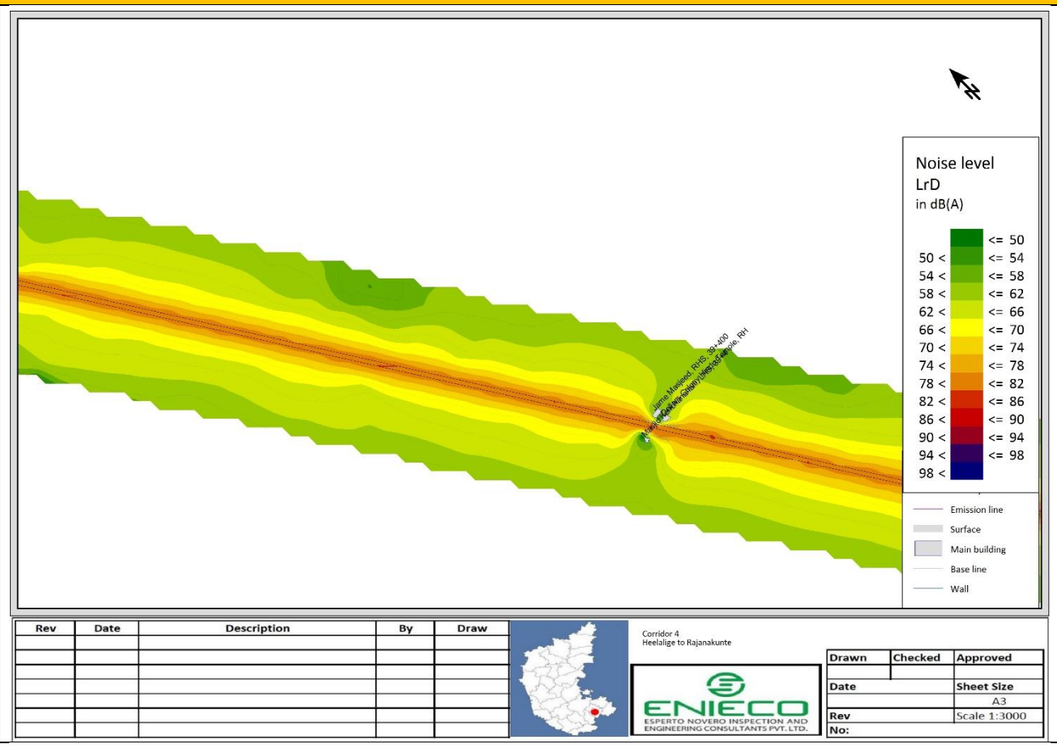
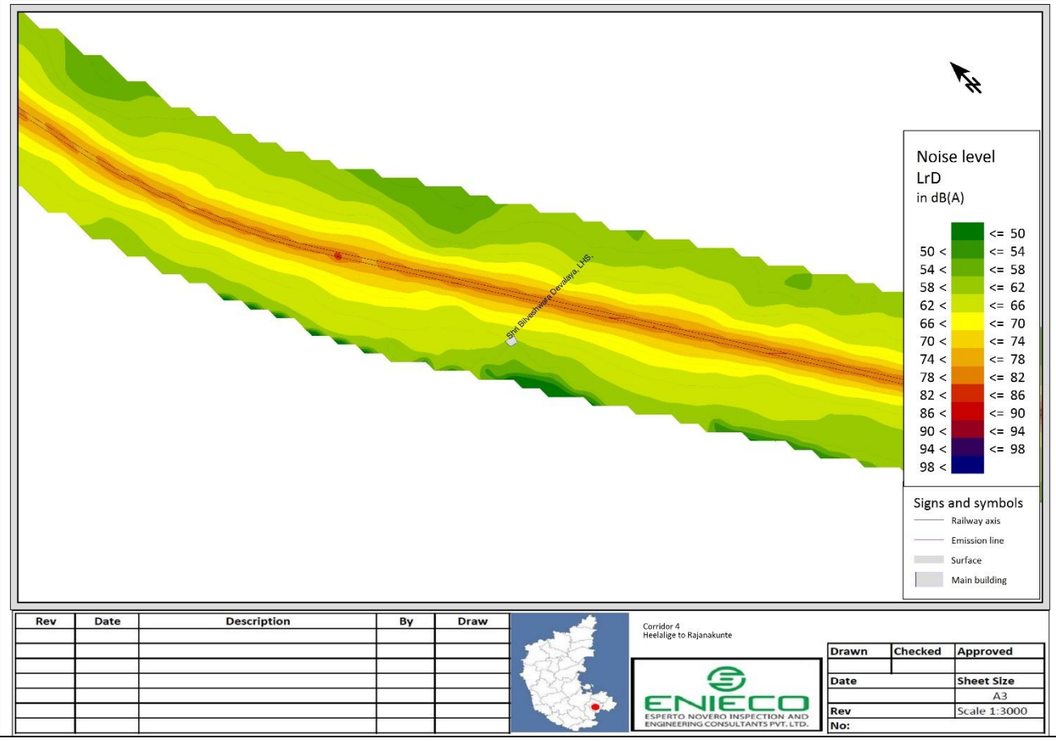
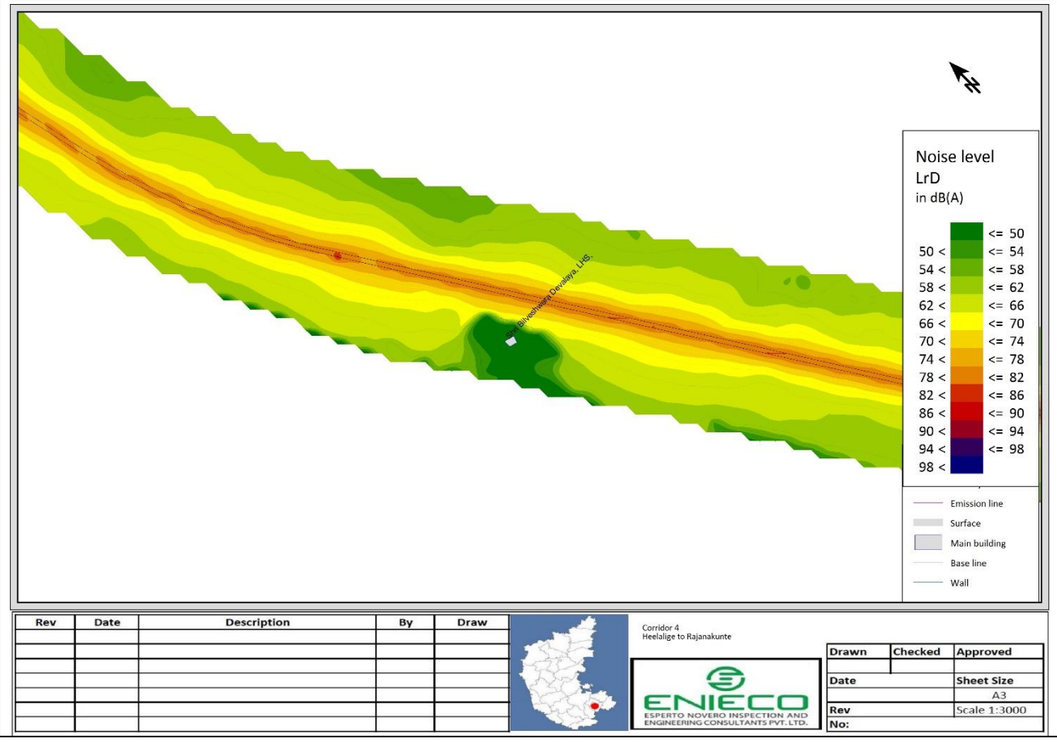
6.		
7.		

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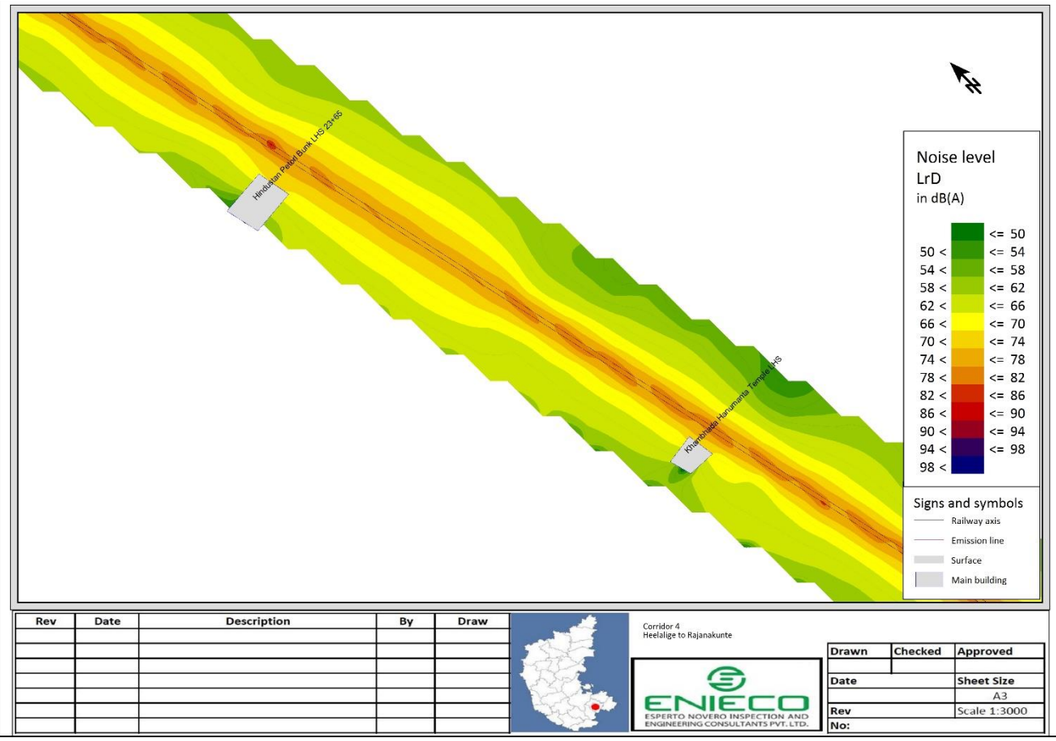
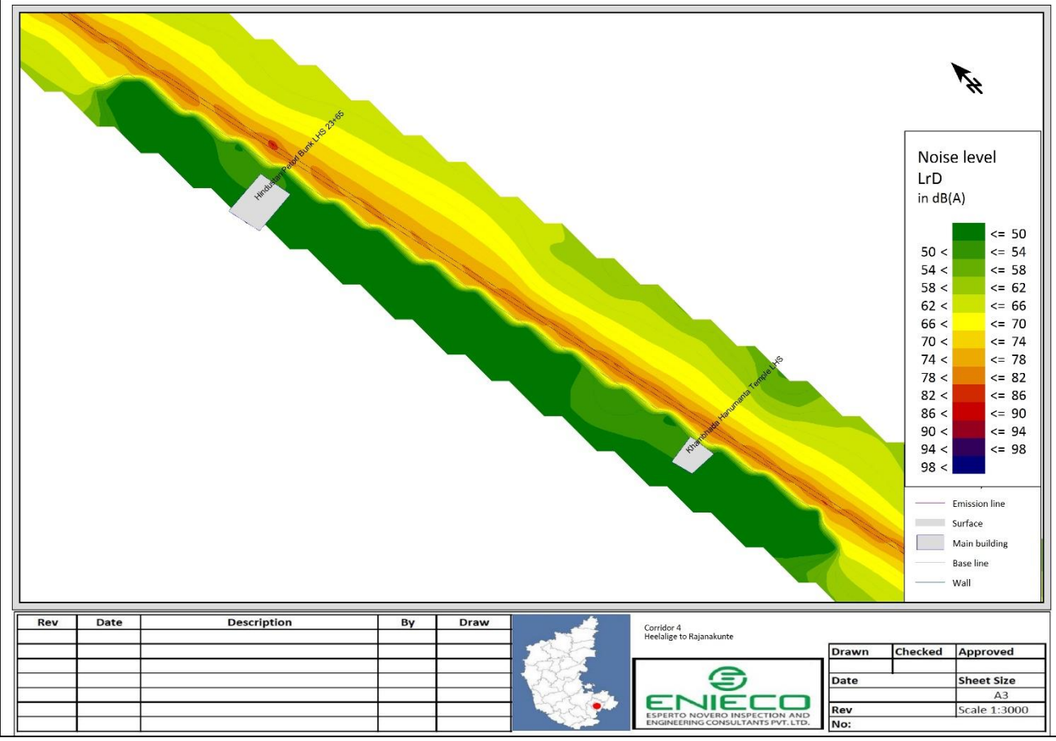
8.		

Annexure 10.1. Guidelines for Top Soil Conservation and Reuse

The top soil from all sites including all working area, cutting areas, quarry sites, borrow areas, construction camps, haul roads in agricultural fields (if any) and areas to be permanently covered shall be stripped to a specified depth of 15 cm and stored in stock piles for reuse.

At least 10% of the temporary acquired area for construction purposes shall be earmarked for stockpiling of fertile top soil

The locations for stacking will be pre-identified in consultation and with approval of Environmental Specialist of the Independent Engineer.

The following precautionary measures will be taken by the contractor to preserve the stock piles till they are re-used:

- Slop of the stockpiles should not exceed 1:2 (vertical to horizontal), and height is restricted to 2m to retain soil and allow percolation of H_2O.
- The edges of pile should be protected by silt fencing and allow percolation of water, which will help to retain soil
- Multiple handling kept to a minimum to ensure that no compaction occurs.
- Stockpiles shall be covered with empty gunny bags or will be planted with grasses to prevent the loss during rains.

Such stockpiled topsoil will be utilized for:

- Covering reclamation sites or other disturbed areas including borrow areas (not those in barren areas).
- Top dressing and raising turfs in embankment slopes
- Filling up of tree pits
- For developing median plantation
- In the agricultural fields of farmers, acquired temporarily that needs to be restored.

Residual top soil, if there is any, shall be utilized for the plantations works along the corridor. The utilization as far as possible shall be in the same area from where top soil was removed. The stripping, preservation and reuse shall be carefully inspected, closely supervised and properly recorded by the Environmental Specialist of the Independent Engineer.

Annexure 10.2. Guidelines for Siting and Layout of Construction Camp

A. Siting

The following guidelines shall be followed while siting the construction camps:

- The construction camps shall be located at least 500 m away from habitation. The living accommodation and ancillary facilities for labour shall be erected and maintained to approved standards and scales.
- Non-agricultural land should be used, as for as possible
- Not within 1,000 m of either side of locations of Forest areas.
- All sites used for camps must be adequately drained. They must not be subject to periodic flooding, nor located within 300 feet of pools, sink holes or other surface collections of water unless such water surface can be subjected to mosquito control measures.
- The camps must be located such that the drainage from and through the camps shall not endanger any domestic or public water supply.
- All sites must be graded, ditched and rendered free from depressions such that water may get stagnant and become a nuisance.

B. Layout

Contractor shall follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for development and maintenance of construction camp. A conceptual layout of a typical construction site has been presented in **Figure-A.** The contractor during the progress of work shall provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labor to standards and scales approved by the Engineer of IE. The site must be graded and rendered free from depressions such that water does not get stagnant anywhere. The entire boundary of the site should be fenced all around with barbed wire so as to prevent the trespassing of humans and animals. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. Safe drinking water should be provided to the dwellers of the construction camps. Adequate washing and bathing places shall be provided and kept in clean and drained condition. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force. Vehicle parking area is to be made impervious using 75 mm thick P.C.C. bed over 150 mm thick rammed brick bats. The ground will be uniformly slopped towards to adjacent edges towards the corridor. A drain will take all the spilled material to the oil interceptor.

C. Drinking Water

The contractor should provide potable water within the precincts of every workplace in a cool and shaded area, which is easily accessible. All potable water storage facilities must be on a safely raised platform that is at least 1m above the surrounding ground level. Such facilities shall be regularly maintained from health and hygiene point of view. If necessary, water purifier units shall be installed for providing potable water. As far as possible, shallow wells

should not be used as potable source of water. However, if water is drawn from any existing well, irrespective of its location from any polluting sources, regular disinfection of the water source (which may include application of lime, bleaching power and potassium permanganate solution) has to be ensured at weekly/fort nightly interval. All open wells will be entirely covered and will be provided with a trap door to prevent accidental fall and contamination from dust, litter etc. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once in a month. A reliable pump will be fitted to each covered well. A drain shall be constructed around the well to prevent flow of contaminated water into the well from railways, camp or other sources.

Contractor's vehicles shall not be allowed to wash in the river / stream / pond. This is to avoid potential pollution from oil residues.

D. Sanitation Facilities

Construction camps shall be provided sanitary latrines and urinals. Adequate number of toilets shall be provided separately for men and women depending on their strength. Sewerage drains should be provided for the flow of used water outside the camp. Drains and ditches should be treated with bleaching powder on a regular basis. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and be regularly emptied at designated disposal place in a hygienic manner.

Portable toilets may be brought to use and the night soil from such units has to be disposed through designated septic tanks so as to prevent pollution of the surrounding areas. All these facilities shall be inspected on a weekly basis to check the hygiene standards.

E. Shelter at Workplace

At every workplace, there shall be provided free of cost, four suitable shelter, two for meals and two others for rest, separately for use of men and women laborers. The height of shelter shall not be less than 3 m from floor level to lowest part of the roof. Sheds shall be kept clean and space provided shall be the basis of at least 0.5 m2 per head.

F. Canteen Facilities

A cooked food canteen on a reasonable scale shall be provided for the benefit of workers wherever it is considered necessary and should generally conform to sanitary requirements of local medical, health and municipal authorities including such precautionary measures as necessary to prevent soil pollution of the site.

G. First Aid Facilities

At every workplace, a readily available first-aid unit including an adequate supply of sterilized dressing materials and appliances shall be provided as per the Factory Rules. Workplaces in remote location and far away from regular hospital shall have indoor health units with one bed

for every 250 workers. Suitable transport shall be provided to facilitate taking injured and ill persons to the nearest hospital. At every work place an ambulance room containing the prescribed equipment and nursing staff shall be provided.

H. Health Care Facilities

Health problems of the workers should be taken care of by providing basic health care facilities through health centres temporarily set up for the construction camp. The health centre should have at least a doctor, nurses, duty staffs, medicines and minimum medical facilities to tackle first aid requirements or minor accidental cases, linkage with nearest higher order hospital to refer patients of major illnesses or critical cases.

The health centre should have MCW (Mother & Child Welfare) units for treating mothers and children in the camp. Apart from this, the health centre should provide with regular vaccinations required for children.

I. Day Care Facilities

At every construction site, provision of a day care shall be worked out so as to enable women to leave behind their children. At construction sites where 20 or more women are ordinarily employed, there shall be provided at least a hut for use of children under the age of 6 years belonging to such women. Huts shall not be constructed to a standard lower than that of thatched roof, mud walls and floor with wooden planks spread over mud floor and covered with matting. Hut shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provisions of sweepers to keep the places clean. There shall be two maid servants (or aayas) in the satisfaction of local medical, health, municipal or cantonment authorities. Where the number of women workers is more than 25 but less than 50, at least one hut and one maid servant should be provided to look after the children of women workers. Size of cares shall vary according to the number of women workers employed.

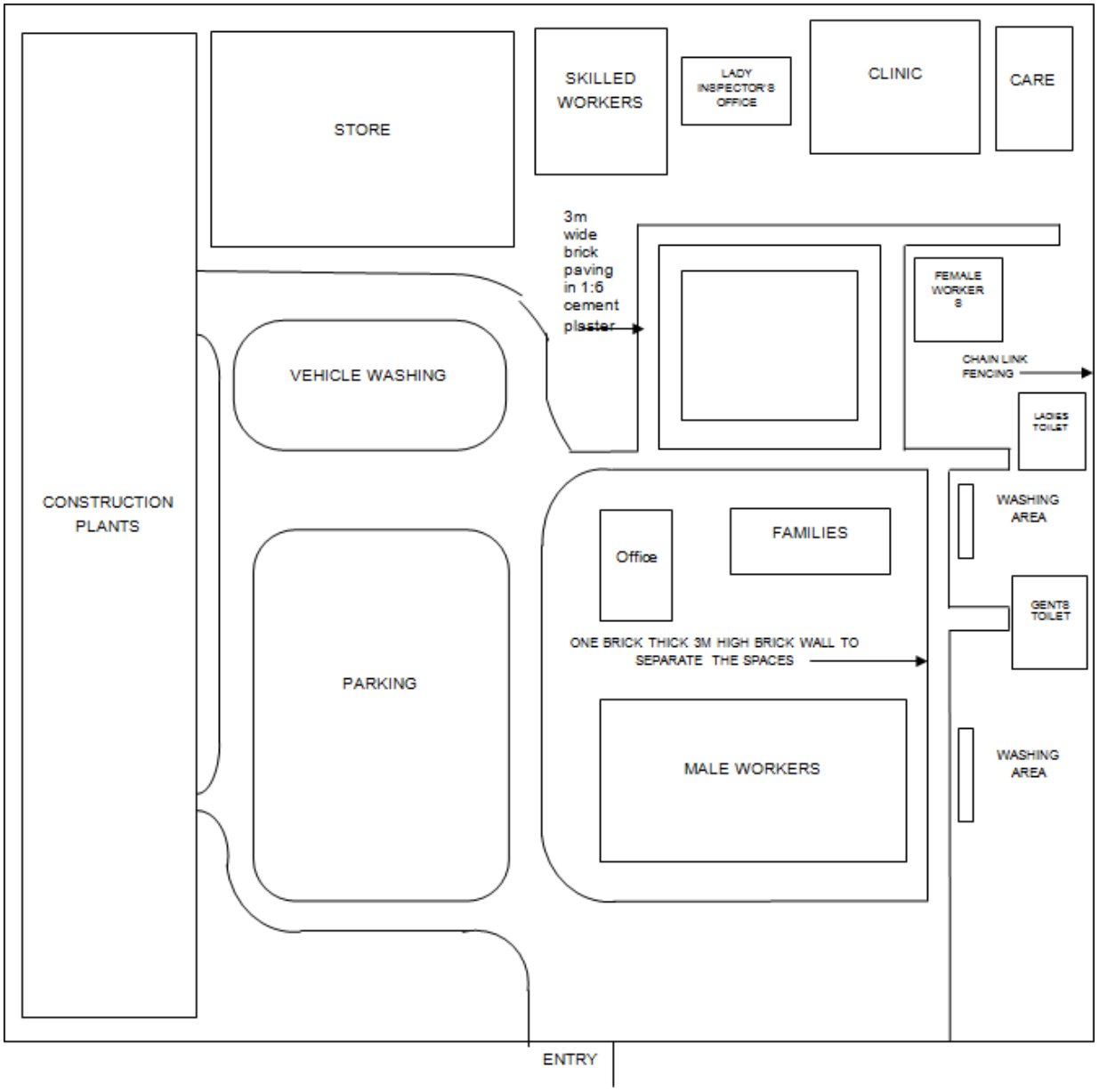


Figure-A Typical Layout of Construction Camp

Annexure 10.3. Guidelines on Slope Stabilization

Erosion Control measures are basically required for the protection of quality of water and the soil. The adoption of Soil erosion control and stabilization practices is being well received these days to avoid the soil exposure.

Bare ground should be covered, typically with grass seed and some form of matting or mulch. This will help prevent erosion and subsequent movement of sediment into river, streams, lakes and ponds. This movement of sediment can occur during and after suburban rail corridor construction. Erosion control measures need to be implemented immediately following construction and every time an area is disturbed.

A. Soil Erosion Control

When the intensity of rainfall increases surface run-off velocity accelerates and facilitates carriage of subsequent particles and ultimately results in disorders in the form of rill to gully and finally to erosion ditches. These disorders will impair slope stability worst if not controlled with proper protective measures.

Erosion control systems for the treatment of exposed slopes could be classified into three broad categories:

- Agronomic or biological
- Non –agronomic or conventional
- Engineered innovative

Agronomic or biological methods make use of vegetative or other forms of protective cover to check erosion. Protection of bare soil is effected by live plant cover afforded by maturing crops or by mulching derived from crop residue such as straw, wood shavings, sawdust, etc.

Ground cover is considered as the most suitable solution for erosion protection. Tress, grass and other plant species are natural soil-binders and provide the best natural solution against erosion.

Non-agronomic treatments include asphalting, aprons, pitching, soil cement stabilisation, etc. Large scale adoption of these techniques is often restricted on economic considerations, even though some of them may offer long lasting solutions.

In bio-engineering, plants have mainly two functions viz. hydrological and mechanical. Hydrological effects of plants are many such as interception (rain drops strike the leaves first before striking the ground soil), storage (leaves and stems hold water for some time before it eventually reaches the ground), infiltration (stems and shoots roughen and loosen the ground, enabling water to infiltrate more easily) etc. Mechanical function of plant is to reinforce the

soil by binding the loose soil particles with its fibrous root system.

Engineered systems of erosion control, largely bio-technical systems include geo-synthetics, geojute, etc. In case, long term soil protection is afforded by vegetative cover alone, biodegradable nets and meshes, usually derived from natural fibre, are used to provide short term protection. In situations, where vegetative cover alone is inadequate or cannot be ensured for long periods of time and high velocity overland flow is anticipated, synthetic roots reinforcing mats are advocated.

Bio-engineering is the technique of utilizing vegetation in addressing geotechnical problems. Environmental uncertainties are prompting engineers to favour bioengineering measures. Vegetation as an aid to artificial methods in controlling surficial soil erosion is gaining larger acceptability among engineers all over the world. Growth of appropriate vegetation on exposed soil surface is facilitated by use of natural geotextiles such as Coir Geotextiles. Properly designed Coir Geotextiles laid on slopes or any other exposed soil surface provides a cover over exposed soil lessening the probability of soil detachment and at the same time reduces the velocity of surface runoff, the main agent of soil dissociation. Natural geotextiles bios-degrade quicker than man-made counterpart, but facilitate growth of vegetation quicker and better due to its inherent characteristics. Bridge slope stabilization can range from allowing **native grass (Vetiver grass)** to re-establish on a disturbed slope to building an engineered wall.

B. Role of Coir Geotextile in Slope Stabilization

Coir is a biodegradable organic fibre material which is coarse, rigid and strong. The constituents of coir have been found to be mostly cellulose and lignin. Coir fibre is weather resistant and resistant to fungal and bacterial decomposition. The rate of decomposition of coir is much less than any other natural fibre. These characteristics are attributed due to the high lignin content in the fibre. Coir in the form of woven mesh mattings or non-woven stitch bonded blankets are used in engineering applications in the geotechnical field. Due to growing awareness to preserve environment, use of biodegradable natural material has gained popularity. The natural fibre, coir, which has been used in geotextiles for the past 20 years, has already proved its worth.

Coir geotextiles are made from coconut fibre extracted from the husk of coconut. Like other polymeric counterparts, coir geotextiles are developed for specific application in civil engineering like erosion control, ground improvement, filtration, drainage, river bank protection, road pavements, slope stability, etc. This biodegradable and environment friendly material is virtually irreplaceable by any of the modern synthetic substitutes.

Environment friendly Coir Geotextile can be laid on the shoulder and slope surface helped retain the soil particles and prevented detachment of soil particles from the prepared slope. Establishment of vegetation ensured stabilization of the soil on the slope surface. It is a bio-degradable natural geotextile, can conveniently be used for controlling surface soil erosion and help growth of vegetation as a bio-engineering measure. After biodegradation coalesces with the soil and adds nutrient to the soil and fosters growth of vegetation.

C. Role of Vetiver Grass in Slope Stabilization

Vetiver grass (Chrysopogon zizanioides) is native to India. It has been has been shown to be a simple and economical method to conserve soil by slowing the velocity of water and trapping sediment, filtering out nutrients, and stabilizing steep slopes. In western and northern India, it is popularly known as khus. Vetiver is an excellent erosion control plant in even warmer climates.

As typical tropical grass, Vetiver is intolerant to shading. Shading will reduce its growth and in extreme cases, may even eliminate Vetiver in the long term. Therefore, Vetiver grows best in the open and weed free environment, weed control may be needed during establishment phase. On erodible or unstable ground Vetiver first reduces erosion, stabilizes the erodible ground (particularly steep slopes), then because of nutrient and moisture conservation, improves its microenvironment so other volunteered or sown plants can establish later. Because of these characteristics Vetiver can be considered as a nurse plant on disturbed lands.

Vetiver is useful to treat pollution due to its capacity to quickly absorb nutrients and heavy metals, and its tolerance to elevated levels of these elements. Although the concentrations of these elements in Vetiver plants is often not as high as those of hyper-accumulators, it's very fast growth and high yield allows Vetiver to remove a much higher volume of nutrients and heavy metals from contaminated lands than most hyper-accumulators.

When planted closely together, Vetiver plants form dense hedges that reduce flow velocity, spread and divert runoff water and create a very effective filter that controls erosion. The hedges slow down the flow and spreads it out, allowing more time for water to soak into the ground.

Acting as a very effective filter, Vetiver hedges help to reduce the turbidity of surface run-off.

Since new roots develop from nodes when buried by trapped sediment, Vetiver continues to rise with the new ground level. Terraces form at the face of the hedges, this sediment should never be removed. The fertile sediment typically contains seeds of local plants, which facilitates their re- establishment.

D. Cost Analysis

Cost of slope stabilization using Coir Geo-textile and Vetiver Grass is approximately **Rs. 450/- per square meter**, which includes coir geo-textiles (erosion control blanket) 600 to 700 GSM woven or non-woven type (inclusive of transportation to site), GI hooks of 4 mm diameter U-Shaped point sharp edges of 300 mm length, installation charges, coir mat spreading, cutting, seeds mix broadcasting, over lapping, watering for 7-9 days twice per day and after complete installation of work get the quality certification from the authorized technical agency.

E. Where to Approach

Karnataka State Coir Co-Operative Federation an Enterprise of Government of Karnataka can be approached, the address of which is given below. Karnataka State Coir Co-Operative Federation was established in the year 1961 with the main objective of developing coir industry through co-operative movement in Karnataka state.

Address :
The Karnataka State Coir Co-operative Federation Ltd. (Govt. of Karnataka Enterprise) #953/A, 2nd Main, 4th Block, Rajajinagar, Bangalore - 560 010
Phone No: 080 – 23154220; Fax No. 080 - 23154231

Annexure 10.4. Guidelines for Siting, Operation and Re-Development of Borrow Areas

Potential sources of earth (borrow areas) for the construction of embankment and subgrade shall be identified by the Contractor in consultation with Sr. Environmental Specialist of CSC or IE in accordance with the specifications. However, borrow areas for the project will be finalized by the Contractor. All provisions stipulated in this guideline shall be strictly adhered to. The finalization of all such locations will depend on the approval given by the Sr. Environmental Specialist of the Independent Engineer (IE) on technical and environmental grounds. This includes on-site verification by the IE to cross-check the correctness of details provided by the Contractor in the prescribed format. Only after receipt of the written approval from the IE, the Contractor shall enter into a formal agreement with landowner.

The details of proposed borrow areas investigated with their respective locations; corresponding chainages and lead from nearest point to project corridor shall be reported as given in the Format below:

Location of Proposed Borrow Areas

S. No.	Chainage of Nearest Point on Project Corridor (km)	Side	Location / Village Name	Lead From Nearest Point on Project Corridor (km)	Type of Land	Approx. Quantity (m^3)
1.						
2.						
3.						
4.						
5.						
6.						
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A. Siting

The selection of borrow areas shall be based on environmental considerations apart from civil engineering considerations. Environmental considerations dictate that:

- Borrow areas should be located away from human habitation (1 km away) to avoid breeding of mosquitos and other organisms during monsoon when the borrow areas are flooded.
- Borrow areas should be at a distance of about 1.5 km from ecologically sensitive area i.e. Reserve Forest, Protected Forest, Sanctuary, National Park and any archaeological sites
- Borrow areas should be generally on degraded land unsuitable for any productive purpose. Government or community land should be preferred to private land. Productive agricultural land should not as far as possible, be used for borrowing earth and where it is used, the productive top soil must be stored and reuse.
- Borrow areas should not, as far as possible, obstruct the natural drainage of the ground and bunds and/or boundary drains should be created on their periphery to restore the flow of natural run off.
- Borrow areas should not be selected near sensitive locations such as banks or beds of rivers or channels, which can adversely affect the river hydrology and hydraulics, or along the road or rail embankment, which, apart from threatening the embankment may enhance the severity of accidents if these happen, or close to public structures such as transmission towers whose foundation can be endangered.
- Borrow area sites must be authorized sites. If located on private land, there should be written consent of the owner in the form of lease agreement permitting the use of the land for borrowing earth. If located on government or community land, the permission should be of the appropriate authority.

Avoid locating borrow area close to any road (maintain at least 30m distance from ROW and 10 m from toe of embankment, whichever is higher);

B. Borrow Area Operations

- Excavation in the areas should be planned keeping in view the end use of the borrow area land the shape and dimensions of the area to be excavated from (length, breadth and depth) should be accordingly decided. Generally the depth of excavation should not be deeper than 2 m from the consideration of safely of the humans or animals against accidental fell into the ditch.
- The eventual slope of the excavation should be 2 (H):1(V) from the consideration of safety of the slopes as well as humans.
- There should be safe access to the earth moving equipment and transport vehicles into the borrow areas
- The approach to the borrow areas from the public or private haul roads should have a reasonable design to withstand the movement of transport vehicles.Dust palliation measures should be taken to minimise dust pollution on the approach roads (e.g. watering, spraying of lime or cement slurry or bitumen emulsion, etc.)
- Spillage of materials under transit on to the haul roads or main roads through

gaps in the transport vehicles should be guarded against buy plugging such gaps. Similarly, Wind blowing of the materials in transit should be checked by suitable covers.

- Where productive agricultural land is used for borrow areas, the top soil in 150 mm thickness should be scrapped, stock piled and re-used for rehabilitation of borrow areas. At least 10% of the temporary land should be earmarked for stockpiling. The top soil should be seeded and mulched to cover the slopes, or any degraded area in thickness between 75 -150 mm.

C. Borrow Area Rehabilitation Plan

The borrow area must be rehabilitated after completion of the work and rehabilitation plan should be prepared in advance in consultation with the community. The area shall be restored to a safe and secure area usable to the public enabling safe access and entry to the restored site by filling the borrow pit floor to approximately the access road level. Some indicative rehabilitation measures could be community water storage facility, pisciculture ponds, recreational spots, landscape enhancement, or rehabilitation by re-vegetation of the borrow area. Where re-vegetation is done, it should be ensured that:

- Vegetative cover is established on all affected land
- Topsoil is placed, seeded and mulched within 30 days of final grading if it is within a current growing season or within 30 days of the start of the next growing season.
- Vegetative materials to be used are grasses, legumes, herbaceous or woody plants or a mixture thereof
- Plant material must be planted during the first growing season following the reclamation phase
- Selection and use of vegetative cover should take into account soil and site characteristics such as drainage, pH, nutrient availability and climate to ensure permanent growth. Choice of plant species for the planting program shall be made in consultation with ecological consultant and local forest department.
- The planning of trees and shrubs results in a permanent stand or regeneration and succession rate, sufficient to assure a 75% survival rate
- The planning results in 90% ground coverage
- The site should be inspected when the planting is completed and again at one year to ensure compliance whit the reclamation plan

D. Borrow Area Documentation

1) Location reference and potential yield: The information as per the table below should be contained in the documentation:

Sample No.	Name of Village	Material Type	Site identification		
			Nearest Chainage (Km)	Left / Right Hand Side	Offset from nearest Chainage (m)

1	2	3	4	5	6

Approximate Quantity (Cum)				Available land / Terrain	Surrounding Land / Terrain	Remarks
Length (m)	Breadth (m)	Depth (m)	Total (cum)			
7	8	9	10	11	12	13

2) Land use and vegetative cover (exiting)

- Existing land use (agricultural/barren/scrub/grazing/any other type)
- Vegetation /trees to be removed
- Erosion /degradation potential
- Distance and name of the nearest settlement
- Distance from the nearest surface water body
- Drainage pattern of the area
- Distance of the nearest reserve forest / eco-sensitive area (if any)
- Distance of the nearest sacred tree (if any)
- Distance from the nearest school/hospital/primary health center
- Daily / occasional or avenues for generation of income for adjoining community

3) Borrow area and community features

- Area (in Sq. m)
- Type of Access / width / kutcha / pucca etc. from carriageway
- Soil type
- Slope / drainage characteristics
- Water Table of the area or identify from nearest well etc. /ask people
- Land-use type such as barren / agricultural / gazing land
- Social features of settlement / community and its proximity to
- Present use of the borrow area by the community
- Identification of any other community facility in the vicinity of the borrow pit

4) Plans and photographs

- Borrow area site plans showing the land use, habitation, drainage pattern and structures and other physical features such as access roads, haul roads, existing community facilities (roads, schools, play grounds, community facilities, religious places etc.)
- Before and after photographs of the borrow areas.

Annexure 10.5. Chance Find Procedure

Purpose of the chance find procedure

The chance find procedure is a project-specific procedure that outlines actions required if previously unknown heritage resources, particularly archaeological resources, are encountered during project construction or operation.

A Chance Find Procedure, as described in IFC Performance Standard 8 and EBRD Performance Requirement 8 and law on Cultural Heritage of Georgia, is a process that prevents chance finds from being disturbed until an assessment by a competent specialist is made and actions consistent with the requirements are implemented.

Scope of the chance find procedure

This procedure is applicable to all activities conducted by the personnel, including contractors that have the potential to uncover a heritage item/site. The procedure details the actions to be taken when a previously unidentified and potential heritage item/site is found during construction activities. Procedure outlines the roles and responsibilities and the response times required from both project staff, and any relevant heritage authority.

Induction/Training

All personnel, especially those working on earth movements and excavations, are to be inducted on the identification of potential heritage items/sites and the relevant actions for them with regards to this procedure during the Project induction and regular toolbox talks.

Chance find procedure

If any person discovers a physical cultural resource, such as (but not limited to) archaeological sites, historical sites, remains and objects, or a cemetery and/or individual graves during excavation or construction, the following steps shall be taken:

1) Stop all works in the vicinity of the find, until a solution is found for the preservation of these artefacts, or advice from the relevant authorities is obtained;
2) Immediately notify a foreman. The foreman will then notify the Construction Manager and the Environment Officer (EO)/Environmental Manager (EM);
3) Record details in Incident Report and take photos of the find;
4) Delineate the discovered site or area; secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities take over;
5) Preliminary evaluation of the findings by archaeologists. The archaeologist must make a rapid assessment of the site or find to determine its importance. Based on this assessment the appropriate strategy can be implemented. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage such as aesthetic, historic, scientific or research, social and economic values of the find;
6) Sites of minor significance (such as isolated or unclear features, and isolated finds) should be recorded immediately by the archaeologist, thus causing a minimum

disruption to the work schedule of the Contractor. The results of all archaeological work must be reported to the Ministry/Agency, once completed.

7) In case of significant find the Agency/Ministry (Agency for Protection of National Heritage or Archaeological Research Centre, should be informed immediately and in writing within 7 days from the find (ref. law on heritage protection).
8) The onsite archaeologist provides the Heritage team with photos, other information as relevant for identification and assessment of the significance of heritage items.
9) The Ministry must investigate the fact within 2 weeks from the date of notification and provide response in writing.
10) Decisions on how to handle the finding shall be taken by the responsible authorities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archaeological importance) conservation, preservation, restoration and salvage;
11) Construction works could resume only after permission is granted from the responsible authorities.
12) In case no response received within the 2 weeks period mentioned above, this is considered as authorisation to proceed with suspended construction works. One of the main requirements of the procedure is record keeping. All finds must be registered. Photolog, copies of communication with decision making authorities, conclusions and recommendations/guidance, implementation reports ± kept. Additional information Management options for archaeological site x Site avoidance. If the boundaries of the site have been delineated attempt must be made to redesign the proposed development to avoid the site. (The fastest and most cost-effective management option)

Mitigation - If it is not feasible to avoid the site through redesign, it will be necessary to sample it using data collection program prior to its loss. This could include surface collection and/or excavation. (The most expensive and time-consuming management option)

- Site Protection - It may be possible to protect the site through the installation of barriers during the time of the development and/or possibly for a longer term. This could include the erection of high visibility fencing around the site or covering the site area with a geotextile and then capping it with fill. The exact prescription would be site- specific.

Management of replicable and non-replicable heritage: Different approaches for the finds apply to replicable and non-replicable heritage. Replicable heritage Where tangible cultural heritage that is replicable and not critical is encountered, mitigation measures will be applied. The mitigation hierarchy is as follows:

- Avoidance;
- Minimization of adverse impacts and implementation of restoration measures, in situ;
- Restoration of the functionality of the cultural heritage, in a different location;

Replicable cultural heritage is defined as tangible forms of cultural heritage that can themselves be moved to another location or that can be replaced by a similar structure or natural features to which

the cultural values can be transferred by appropriate measures. Archaeological or historical sites may be considered replicable where the particular eras and cultural values they represent are well represented by other sites and/or structures.

- Permanent removal of historical and archaeological artefacts and structures ;
- Compensation of loss - where minimization of adverse impacts and restoration not feasible.

Non-replicable heritage - Most cultural heritage is best protected by in situ preservation, since removal is likely to result in irreparable damage or even destruction of the cultural heritage. Nonreplicable cultural heritage must not be removed unless all of the following conditions are met:

- There are no technically or financially feasible alternatives to removal;
- The overall benefits of the project conclusively outweigh the anticipated cultural heritage loss from removal; and Any removal of cultural heritage must be conducted using the best available technique advised by relevant authority and supervised by archaeologist.

Annexure 10.6. Guidelines for Sediment Control

Right at the initial stage of the work, the operations such as clearing and grubbing, corridors, roadway and drainage excavation, embankment / sub-grade construction, bridges and other structures across, pavement courses and shoulders are undertaken. These activities generate huge wastes and debris, which should not find their way into drainage channels and water courses nor should remain exposed to wind at the site and allowed to erode and contaminate productive soils or generate windblown dust particles in the atmosphere.

Erosion and sediment control measures shall, therefore, be planned to prevent soil erosion and sedimentation. These measures may involve temporary measures at construction stage, such as of temporary berms, dikes, sediment basins, slope drains, use of temporary mulches, fabrics, mats, seeding or other control devices .Permanent erosion control measures aim at preventing erosion during the project life cycle and should be planned as a part of the project design. These may involve turfing or pitching the embankment Slopes, turfing / mulching / vegetating the exposed areas, vegetating or reinforcing the cut slopes by appropriate methods such as shot-creting, rock bolting, soil-nailing, gabions etc.

Sediment control, whether temporary or permanent, would be mostly project and site specific. However, some of the generic measures shall be as follows.

- Debris generated at construction site must be removed immediately and dumped at the designated dump sites after useful recyclable materials are sorted out, and properly stocked or stacked.
- The site cleared after removal of debris would usually be prone to erosion. These areas should be treated by mulching and other dust palliation measures.
- There could be many mulching options such as seeding top soil and spreading the mulch (organic) to permit growth of grass, or other methods like mulches of tiles, brick bats, stone chips, or any other non-erodible wastes, which cover the exposed soil, allow moisture to be retained within soil and prevent erosion.
- Dust palliation measures by any suitable commercially available dust palliatives, application of water, cement and lime emulsion in thin application to bind the dust particles together.
- All slush at construction sites, which after drying up become erodible must be either dredged and removed or treated appropriately in-situ (say by mulching).
- Temporary drains combined with sedimentation tanks should be created at the periphery or edge of the work sites to arrest the sediments brought by rains or construction activities requiring water and discharge only sediment free water into the water courses.

Annexure 10.7. Guidelines for Muck Disposal and Site Management

The following points shall be considered and followed as guidelines for finalization of the areas to be used as dumping sites:

- The dumping sites shall be selected as close as possible to the project area to avoid long distance transport of muck.
- The site shall be free from any landslides or creep and care shall be taken that the sites do not have a possibility of toe erosion and slope instability.
- There shall be no active channel or stream flowing through the dumping sites. The site should be away from human settlement areas and it is to ensure that no residential areas are located downwind side of these locations.
- Dumping sites shall be located at least 1000 m away from sensitive locations like Settlements, Water body, notified forest areas, Sanctuaries or any other sensitive locations.
- Public perception about the location of debris disposal site has to be obtained before finalizing the location.
- Permission from the Villager/local community shall be obtained for the Disposal site selected.
- The Plan must be approved by IE/CSC/PMC and/or KRIDE.

A. PRECAUTIONS TO BE ADOPTED DURING DISPOSAL OF MUCK

The contractor shall take the following precautions while disposing off the muck/debris:

- Contractor will look into wind direction during disposal and ensure that no dust issues arise
- During the site clearance and disposal of muck, the contractor will take full care to ensure that public or private properties are not damaged/ affected.
- Contractor will dispose-off muck/debris at the identified places or at other places only with prior permission of Engineer-in-Charge of works.
- In the event of any muck or debris from the sites being deposited on any adjacent land, the contractor will immediately remove all such spoil debris and restore the affected area to its original state to the satisfaction of the Engineer-in-Charge of works.
- At all times, the contractor will ensure that the canals and drains within or adjacent to the site are kept safe and free from any debris.
- Contractor will utilize effective water sprays during the delivery and handling of materials when dust is likely to be created and to dampen stored materials during dry and windy weather.
- Materials having the potential to produce dust will not the loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
- Any diversion required for traffic during disposal of debris shall be provided with traffic control signals and barriers after the discussion with local people

and with the permission of Engineer-in-Charge of works.

- ❖ During the debris disposal, contractor will take care of surrounding features and avoid any damage to it.
- ❖ Some of the dumpsites could be used either for plantation or for growing agricultural produce
- ❖ Care should always be taken to maintain the hydrological flow in the area.
- ❖ Display Boards: The capacity of the disposal locations, name of the location, etc. shall be written in an Information board at each identified disposal locations.

B. PROPOSED DESIGN

Contractors need to get approvals for specific design for each identified disposal area.Contractor needs to plan the disposal in the following way.

- Identify the disposal area
- Need to record the present land use and condition of the area
- Consult with all stake holders
- Get written agreements from all concerned
- Prepare a suitable design for the safe disposal
- Construct all required structures (e.g. retaining wall)
- Planting of fast growing poplar trees on the outer portion of the retaining wall in theform of a linear wall parallel to the retaining wall
- Estimate the quantities
- Compact of the materials after disposal
- Prepare a Contractors muck debris disposal plan with design drawings for each identified area

Annexure 10.8. Guidelines for Debris Disposal and Site Management

SELECTION OF DISPOSAL SITES:

The locations of Disposal sites have to be selected such that:

- No residential area are located downwind side of these locations,
- Disposal sites are located at least 1000 m away from sensitive locations like Settlements, Water body notified forest areas, Sanctuaries or any other sensitive locations.
- Disposal sites do not contaminate any water sources - rivers, lakes, etc. for this site should be locatedaway from water body and disposal site should be lined properly to prevent infiltration of water.
- Public perception about the location of debris disposal site has to be obtained before finalizing thelocation.
- Permission from the Village/local community is to be obtained for the Disposal site selected.
- Environment Engineer of CSC and Executive Engineer of Contract Management Unit mustapprove the Plan.

PRECAUTIONS TO BE ADOPTED DURING DISPOSAL OF DEBRIS / WASTE MATERIAL

The Contractor shall take the following precautions while disposing off the waste material

- During the site clearance and disposal of debris, the Contractor will take full care to ensure that public or private properties are not affected, there is no dwellings below the dumpsite and that the traffic is not interrupted.
- The Contractor will dispose-off debris only to the identified places or at other places only with prior permission of Engineer-in-Charge of works.
- In the event of any spoil or debris from the sites being deposited on any adjacent land, the Contractor will immediately remove all such spoil debris and restore the affected area to its original state to the satisfaction of the Engineer-in-Charge of works.
- The Contractor will at all times ensure that the entire existing canal and drains within and adjacent to the site are kept safe and free from any debris.
- Contractor will utilize effective water sprays during the delivery and handling of materials when dust is likely to be created and to dampen stored materials during dry and windy weather.
- Materials having the potential to produce dust will not the loaded to a level higher than the side and tail boards and will be covered with a tarpaulin in good condition.
- Any diversion required for traffic during disposal of debris shall be provided with traffic control signals and barriers after the discussion with local people and with the permission of Engineer-in- Charge of works.
- During the debris disposal, Contractor will take care of surrounding features and avoid any damage to it.

While disposing debris / waste material, the Contractor will take into account the wind direction and location of settlements to ensure against any dust problems.

GUIDELINES FOR REHABILITATION OF DISPOSAL SITES

The dumpsites filled only up to the ground level could be rehabilitated as per guidelines below and to be decided by the Engineer and the supervision consultant

- The dumpsites have to be suitably rehabilitated by planting local species of shrubs and other plants. Local species of trees has also to be planted so that the landscape is coherent and is in harmony with its various components.
- In cases where a dumpsite is near to the local village community settlements, it could be converted into a play field by spreading the dump material evenly on the ground. Such playground could be made coherent with the landscape by planting trees all along the periphery ofthe playground.
- Some of the dumpsites could be used either for plantation or for growing agricultural producesuch as ginger, turmeric or oranges etc.
- Care should always be taken to maintain the hydrological flow in the area.

Possible impacts due to the excavated debris materials:

If not disposed-off properly what would be the expected scenario? This is described in the following sections.

1 Obstruction to natural watercourses

The materials if not disposed off properly would be taken by the running water to the lowest portionof the valleys/streams creating huge obstruction to free flow of natural stream water. If people were residing nearby that would affect their life by way of flooding or by spoiling the premises.

2 Siltation in surface water reservoir

Most of the materials would be ultimately taken down stream through rivers and ultimately depositingin to reservoirs leading to heavy siltation. This in turn would reduce the reservoir capacity substantially within a very short span. This could incur huge losses to the exchequer. Desiltation isalso expensive and normally carried out after many years of operation of reservoirs in the natural circumstances.

3 Soil Erosion

Massive soil erosion is the most direct impact of the debris excavation. The precipitation and the consequent run off would erode the loose materials by way of suspension and solution. Once reached up to the mainstream courses even the big boulders would be transported down due to the steep gradients available along the stream courses.

4 Spoiling of Agricultural land

As a usual practice mainly due to poor planning and limited resources, the Contractor usually throw the materials to the nearby valley areas. This would be taken down to the private agricultural areas. The farmer will incur huge losses and may even sue the Contractor. As a result the project could be stopped indefinitely leading to losses for the people of the State.

5 Destruction of Agricultural crops

Destruction of agricultural crops immediately down the hill will require crop compensation

there by reducing the profit margin of the Contractor.

Identification of Disposal Areas:

The Contractor should also try to make use of all disposal areas identified during the project preparation stage. If the corridor execution is approaching hilly area, rolling terrain, mountainous area or rocky area then importance should be given to screening i.e., to screen the debris into useful materials.Useful stones can be utilized as construction material and non-useful can be used as development of the public, social and cultural properties as already written above such as parking places, school playground, bus bays, ground near any temple and Mosque so that people participation can be assuredin the implementation of the project. So it would be good if NGOs are introduced to perform this task more efficiently.

In order to maximize the profits or at least to reduce the expenditure, the contractor usually resorts tohis own methods. In that process Contractor could find a more number of feasible areas.

Disposal methods and its limitations:

There are several constraints in the disposal of materials in the identified locations. Required measures to be followed include the following :

- Most of the disposal areas would require construction of retaining walls, as per site requirement.
- Disposal areas would require compaction
- Disposal areas would require plantation
- No overloading and should be in small trucks or dumpers
- Need to transport safely with covered trucks using tarpaulin
- Consultation with all concerned
- Written permission form all concerned
- To transport through difficult haul roads- may require maintenance

Local community Groups

At each identified debris disposal locations, it is necessary to form local community groups. Entrust the duty of the supervision and all other assistance to dumping process. Ultimately the disposed area should be compacted using road rollers.

Information display boards

The capacity of the disposal locations, name of the location, etc. shall be written in an informationboard at each identified disposal locations.

Proposed design:

Contractor needs to plan the disposal in the following way

- Identify the disposal area
- Need to photograph the present land use and condition of the area
- Consult with all stakeholders
- Get written agreement from all concerned
- Prepare a suitable design for the safe disposal
- Construct all required structures (e.g. retaining wall)

- Planting of fast growing popular trees on the outer potion of the retaining wall in the form ofa linear wall parallel to the retaining wall
- Compact of the materials after disposal
- Prepare a Contractors debris disposal plan with design drawings for each identified area
- With regards to plan, there would be only one disposal plan with small changes for each location. Contractors need to get approvals for specific design for each identified disposal area.

Penalties:

Stringent action & penalties for dumping of materials in locations other than the pre-identified locations is to be worked out to avoid clandestine disposal in the midnight hours. There are several cases of dumping of material randomly in many locations.

Annexure 10.9. Guidelines for Preparing Comprehensive Waste Management Plan

A. Overview

A comprehensive waste management plan shall be prepared by the contractor prior to initiation of any works. The purpose of the plan is to provide standardized procedures for the clearance, removal and disposal of waste generated during the construction work as well as to establish the most efficient and cost effective methods to resolve waste disposal issues.

B. Preparation of Comprehensive Waste Management Plan

The Contractor should prepare a Comprehensive Waste Management Plan to be submitted to Sr. Environmental Specialist of the Independent Engineer for approval prior to setting up of construction and labour camp and it should comprise the following details:

- Categorization of waste into degradable, biodegradable and hazardous categories and list out different types of waste that falls in each of these categories
- Estimates about the quantity of waste generated in each category and type of storage units required.
- Detail the provisions for storage and handling of waste until disposed. A plan of the respective camps / areas like construction camp, labour camp etc. to be attached indicating the space allocated for storage and handling of wastes.
- Detail the precautions to be taken while storing, handling and disposing each type of waste, trainings to be imparted to workers to create awareness about waste management.
- Details of each debris disposal site
- Copy of approved site identification report along with location plan on a village map showing the waste disposal sites, its survey no., access road, project stretch, distance from the project stretch, surrounding features and land use (like residences, agricultural land, water bodies etc.), photograph of the site showing the topography and other existing features.
- All staff and workers involved in the highway construction should be imparted training about comprehensive waste management plan including the need for such a plan, its components and measures adopted by the contractor for implementing it. In addition, all personnel involved should be made aware about various steps and measures each of them has to follow so as to ensure the compliance to the comprehensive waste management plan.
- Precautions to be adopted during disposal of waste material

The contractor shall take the following precautions during transportation and disposal of

waste material:

- A register should be kept for recording the details of the waste generated and their disposal.
- The pre-designated disposal sites should be a part of Comprehensive Solid Waste Management Plan and should be identified prior to initiation of any work on a particular section of the corridor.
- The contractor will take full care to ensure that public or private properties are not damaged/ affected during the site clearance for disposal of debris and the traffic is not interrupted.
- In the event of any accidental spill or spread of wastes onto adjacent parcels of land, the contractor will immediately remove all such waste material/s and restore the affected area to its original state to the satisfaction of Sr. Environmental Specialist of the Independent Engineer.
- Contractor should ensure that any spoils / materials unsuitable for embankment fill shall not be disposed off near any water course; water body; agricultural land; flood plains, forests etc. pasture; eroded slopes; and in ditches, which may pollute the surrounding.
- Contractor should ensure effective water sprinkling during the handling and transportation of materials where dust is likely to be created.
- Materials having the potential to produce dust will not be loaded beyond the side and tail board level and will be covered with a tarpaulin in good condition.

C. Waste Disposal in Construction Camp

- Concrete flooring and oil interceptors should be provided for hot mix plant area, workshops, vehicle washing and fuel handling area.
- POL (petroleum, oil and lubricants) waste shall be stored safely in separate containers and should be disposed-off by transfer only to recycler / re-refiners possessing valid authorization from the State Pollution Control Board.
- Used lead batteries, if any, should be disposed as per the Batteries (Management and Handling) Rules 2001.
- Water separated and collected from oil interceptor should be reused for dust suppression.
- There should be a register to record the details of the oil wastes generated at the workshops and oil storage areas.
- The Contractor will provide separate garbage bins in the camps and ensure that these are regularly emptied and disposed-off in safe and scientific manner as per the Comprehensive Solid Waste Management Plans approved by the IE.
- No incineration or burning of wastes shall be carried out.

- Discarded plastic bags, paper and paper products, bottles, packaging material, gunny bags, hessian, metal containers, strips and scraps of metal, PVC pipes, rubber and poly urethane foam, auto mobile spares, tubes, tires, belts, filters, waste oil, drums and other such materials shall be either reused or will be sold / given out for recycling.
- Septic tank must be provided for toilets and the sludge should be cleared by municipal exhausters.

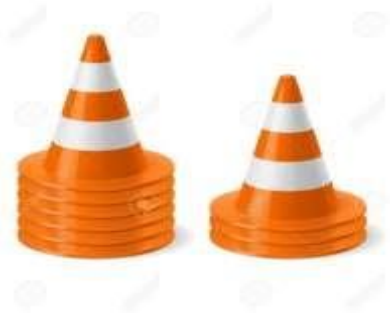
D. Waste Disposal in Labour Camp

- The Contractor should provide separate garbage bins in the camps for bio- degradable, non-biodegradable and domestic hazardous waste and ensure that these are regularly emptied and disposed-off in safe and scientific manner.
- The disposal of kitchen waste and other biodegradable matter shall be carried out in pits covered with a layer of earth within the camp site to avoid smell and pests. The contractor may use the compost from such wastes as manure in the plantation sites.
- Noon-biodegradable waste like discarded plastic bags, paper and paper products, bottles, packaging material, gunny bags, metal containers, strips and scraps of metal etc. and other such materials shall be either reused or should be sold /given out for recycling.
- No incineration or burning of wastes should be carried out.
- Effluent treatment system like septic tank with soak pits provided for toilets should be sited, designed, built and operated in such a way that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place.
- Soak pits must be provided to collect waste water from bathrooms and kitchen.

Annexure 10.10. Guidelines for Preparation of Traffic Management Plan

The Contractor shall at all times carry out work on the corridor in manner creating least interference to the flow of traffic with the satisfactory execution. For all works involving improvements to the existing state highway, the Contractor shall, in accordance with the directives of the Sr. Environmental Specialist of the Independent Engineer (IE), provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement, or along a temporary diversion constructed close to the state highway. The Contractor shall take prior approval of the IE regarding traffic arrangements during construction.

Traffic Safety and Corridor Works



- Delineate advance warning zones, transition zones and construction zones at both ends of a work front. Use devices such as regulatory signs, delineators, barricades, cones, pavement markings, lanterns and traffic control lights, reflectors and signal men in appropriate manner round the clock.
- No work front should be 'touched' without putting appropriate safety measures in place. Sr.
- Environmental Specialist of the Independent Engineer will be responsible to ensure that the permission for any activity is not given without the required safety plan and practices in place.

- Put signage at appropriate locations as per the Corridor construction activity plan to warn the road users, construction vehicles / equipment operators, pedestrians and local residents about the work in progress, speed controls, hindrances / blockages, diversions, depressions etc. in lines with contract requirements and IRC guidelines.

- Signage has to be: (i) simple, easy-to-understand and should convey only one message at a time; (ii) has florescent and reflective properties of the paints; (iii) broad, prominent and with appropriate size of letters and figures;
(iv) placed at the appropriate 'point/s' as specified in the IRC guidelines to allow proper stoppage / reaction time to approaching vehicles.

- Express a regret signage for the inconvenience caused and alert about the dangers ahead on account of construction

activity.

- Different sign boards shall have a mix of pictorial signs and messages in local language, Hindi and English.
- While using barricades, ensure that traffic is kept away from work areas and the road user is guided to the safe, alternative movement track.
- Ensure that excavation sites are provided with effective barriers and reflecting signage to prevent any accidental approach by vehicles during the day or night.
- Provide proper uniform (light reflecting garments) to flagmen engaged in traffic control at diversions so that they can be singled out from the moving traffic.
- Prevent entry of cattle and wildlife through proper fencing / barricading around the excavation sites.
- Provide wide red and green flags or red and green lights to flagmen for controlling traffic. In high traffic zones and congested areas, use of wireless communication devices with protective headgear and shoes by flagmen has to be ensured to prevent confusion and minimize the risk of accidents.

Ensuring Traffic Control

- Where the execution of the works requires temporary closure of road traffic use, the Contractor should provide and maintain temporary traffic diversions. The diversions should generally consist of 200 mm thickness of gravel laid directly upon natural ground and earthworks.
- Where the execution of the works requires single-lane operation on public road, the Contractor should provide and maintain all necessary barriers, warning signs and traffic control signals.
- At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the Carriageway) the lane width path for traffic should be clearly marked with the aid of pavement markings and painted drums or a similar device. At night, the passage should be delineated with lanterns or other suitable light source.
- One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This should be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen should be equipped with red and green flags and lanterns / lights.
- On both sides, suitable regulatory / warnings signs as approved by the IE shall

be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs should be of design and of reflector type.

- Upon completion of the works for which the temporary traffic arrangements or diversions have been made, the Contractor should remove all temporary installations and signs and reinstate all affected roads and other structures or installations to the conditions that existed before the work started.

Annexure 10.11. Guidelines to Ensure Worker's Safety During Construction

Construction site safety is a very significant facet of construction-related activities with great concern towards protection of construction site workers and others from death, injury, disease or other health-related risks. Construction is land-based activity where site workers may be exposed to various risks and hazards. Site risks can include working at height, moving machinery (vehicles, cranes, etc.) and materials, power tools and electrical equipment, hazardous substances, plus the effects of excessive noise, dust and vibration. The leading causes of construction site fatalities are falls, electrocutions, crush injuries, and caught-between injuries. Following are the good and mandatory Worker's Safety practices to be adopted at work sites by all workers and the Contractor should ensure the adoption of all safety practices at site and aim for zero accident project activities.

A. Tree Felling

- Use hard hats during tree felling
- Ensure safe use and storage of tools such as axes, power chain saw, hand saw of different types, HDPE ropes of approved thickness to drag felled trees and logs.
- Keep the saw blades in proper lubrication and sharpened state for efficient workability.
- Determine proper foot and body position when using the implements for felling, cutting and dragging.
- Wear appropriate foot protection
- Avoid cutting overhead branches
- Keep first aid kits ready at the site.
- Determine possible hazards in the area, e.g. electrical or telephone or other utility lines, buildings, vehicles and domestic cattle that may create unsafe work situations.
- Prior to felling, determine the safest direction of fall and orient fixing of ropes and cutting positions accordingly.
- Determine the proper hinge size before directing the fall.
- Keep machineries and workers ready for speedy removal of the tree from the main traffic movement area.
- Keep flag men and warning signal signage at either end of felling area to control movement of traffic and warn passers-by

B. Plant Sites, Construction Camp and Quarry Areas

- Install perimeter fencing
- Ensure good visibility and safe access at site entrances
- Provide adequate warning signs at the entrance and exit, as necessary
- Provide adequate space / area for loading and unloading, storage of materials, plant and machinery
- Display emergency procedure and statutory notices at conspicuous locations
- Provide areas for collecting garbage and other waste material, and also arrange for their regular / periodic disposal.
- Arrange appropriate storage, transportation and use of fuel, other flammable materials and explosives in line with the license requirements obtained from concerned authorities
- Provide defined access roads and movement areas within the site
- Ensure availability of first aid facilities and display notices at various work

places showing the location of first aid facilities and emergency contact numbers
- Provide and enforce use of PPE at plant and quarry sites

C. House Keeping Practices

- Provide proper slope in kitchen, canteens, washrooms, toilets and bathrooms for easy and immediate draining of water
- Keep all walkways and circulation areas clear and unobstructed at all times
- Ensure that spillages of oil and grease are avoided and in case of accidental spills, these should be collected immediately
- Use metal bins for collection of oily and greasy rags
- Stack raw materials and finished products out of walkways
- Do not leave tools on the floor or in any location where they can be easily dislodged
- Keep windows and light fittings clean
- Maintain the workplace floors dry and in a non-slippery condition
- Provide and maintain proper drainage system to prevent water logging and unhygienic conditions
- Ensure that protruding nails in boards or walls are moved or bent over or removed so that they do not constitute a hazard to people
- Store all flammable materials in appropriate bins, racks or cabinets with proper cover and labels as required for various products
- Make sure that hazardous / dangerous chemicals are kept in the goods stores with the appropriate labeling, display of the material-safety-data-sheet (MSDS) and other precautionary measures.
- Display 'no smoking' signs in areas with high risks of fire, (e.g. near fuelling areas, diesel /oils / lubricant /paint storage area, hessians, rubber, wood and plastic etc.) in and around working area

D. Safety during Excavation

- The risk of accidents involving people and vehicles remains high in excavated sites. All pits or excavations shall to be barricaded to warn the road users and residents and to avoid any unauthorized entry of persons, children, domestic cattle or wildlife. For deep excavations and culvert construction sites, painted GI sheets, delineators, lamps (as required) and retro-reflective signage shall be used.
- Excavation more than 1.5 m is to be done in steps of minimum 500 mm offsets with plank and stuttering support, as required under contract clauses.
- For excavation in slippery or water logged area, try to dewater the area and spread minimum 150 mm thick sand layer to avoid slipping.
- For excavation for drain, the area should be properly barricaded with sign boards and illumination / lamps for night time safety. In congested stretches, watchmen / guards can also be placed for vigil.
- Snake bites or Scorpion stings during excavation - in areas with vegetation, tall grasses and forest cover, the contractor shall provide the labour with gum boots and gloves. He shall also make snake antidotes available on site. Emergency vehicles should also be kept ready to rush the patient to the nearest hospital.

E. Safety during Some Typical Construction Work

Centering and Scaffolding

- Many a times ballies joined together give away due to weak joints. Use of metal scaffolding and centering plates with metal fasteners are the safest and highly recommended materials for use in all project construction works for ensuring safety, stability and casting of structures. All such scaffolding should be placed on a firm and a level base on the ground for ensuring stability. No wooden scaffolding or bamboo scaffolding is to be used for any casting of heavy (RCC) structural construction as the risk to safety of workers is higher.
- Railings are to be provided along working platforms and ladders for better safety. Nets shall be hung below the scaffolding or structures where work is on-going to prevent fall of debris, stones, bricks, equipment and other heavy to retain soil objects and even workmen, which could be fatal.

Form-work for small/light beams and slabs

- The collapse of bottom of the beam that may bring down the slab as well is a risk in such operations, which may injure the labour or supervision staff. Slender ballies without bracing are not be allowed for such works. No concreting should be allowed without bracing at 300 mm above ground and at midway for normal beams and slabs. The bracings should be for the support of beams as well as the slabs.
- Direct ballies support from the ground and the practice of tying planks with binding wire to the steel reinforcement shall not be allowed. A temporary railing and properly based working platforms along the periphery of slab reduces risk to the life of labour and supervision staff.

Dismantling of Scaffoldings

- Dismantled materials may fall on passer-by and workers. Workers could also get injured during the removal of such materials. Prior to dismantling of scaffoldings / working platforms, the area of operation should be closed for all outsiders. No one should be allowed within 50 m. from the place of demolition.
- Helmets, safety belts and other PPE must be worn by all the workers engaged in such a work. This work requires careful handling by an experienced supervisor / work force and should be executed with utmost caution. Gradual dislodging and use of PPE is required.

Column Reinforcements

- The tendency of bar-benders is to tie the vertical steel with coir rope or 8 mm steel rods as ties on all four sides of the column reinforcements. Reinforcement to columns shall be by welding MS rods with metal scaffolding to keep it in position till the final casting of RCC is done.

Falling of Objects or Debris from a Height

- At bridges construction sites (or in work areas at a height above ground level) thick nylon net or hessian barriers shall be used to prevent any splinter, debris, mortar or concrete from falling onto the passersby or workmen around.

Site Cleaning

- Throwing of waste materials, broken concrete pieces, brick bats, sand etc. straight from the top of a structure onto the ground can injure a worker or a passerby. Such materials should be brought to the ground with the help of lift or the use of rope over pully with a bucket.

Operation of Excavators

- Ensure that excavators are operated by authorized persons who have been adequately trained.
- Prevent any unauthorized use of the excavators.
- Ensure that only experienced and competent persons are engaged in supervising all excavations and leveling activity.
- Check and maintain as per the manufacturer's manual.
- Issue relevant information, including that related to instructions, training, supervision and safe system of work in writing and provides expert supervision for guidance.
- Ensure that the operation and maintenance manuals, manufacturer's specifications, inspection and maintenance log books are provided for the use of the mechanics, service engineers or other safety personnel during periodic maintenance, inspection and examination.
- During tipping or running alongside the trenches, excavators must be provided with stop blocks.
- Excavators must be rested on firm ground after field operation away from the road
- Locate and identify underground services including telephone cables, OFC cables, sewerage and drainage lines, water supply, electrical cables etc. by checking with all concerned underground utility providers.
- When reversing or in cases where the operator's view is restricted, adequate supervision and signaling arrangements shall be provided.
- Ensure that the type and capacity of the excavator are properly chosen for the intended purposes and site conditions. Never use a machine for any purposes other than it is designed for.
- Check and report for excessive wear and any breakage of the bucket, blade, edge, tooth and other working tools of the excavator and ensure replacement / repair to avoid mishap and break down.
- Check that all linkages / hinges are properly lubricated and linkage pins are secured. Never use improper linkage pins.

Operation of Trucks and Dumpers

- Ensure that only trained, authorized and licensed drivers operate the vehicles.
- Switch-off the engine when not in use to save fuel, prevent accidents and unnecessary noise and air pollution.

- Lower the tipping bodies when the machine is unattended, but if it is necessary to leave them in the raised position they should be blocked to prevent their fall by fixing a sturdy support below.
- Carryout periodic servicing as per the manufacturer's requirements
- All records of maintenance and repairs should be in writing and available for verification.
- Keep the vehicle tidy and the cabin free from clumsy utilities, which might obstruct the controls and create hazards.
- Follow safe driving principles including speed limits as per traffic signage.
- Avoid carrying additional passengers in the cabin or on the body of the dumper, while in field operation other than the connected workers.
- Provide stop blocks when the vehicle is tipping into or running alongside excavations or when it is parked.
- Do not overload the vehicle.
- Carry only well secured loads and use proper covers and fasteners.

Manual Handling and Lifting

- Avoid manual handling of heavy and hazardous objects and chemicals.
- Pre-assess the actual requirement of manpower in case of emergency situations.
- The hazardous and poisonous materials should not be manually handled without proper equipment /gears and prior declaration of the risks needs to be made to the involved workers.
- All concerned persons shall be trained in proper methods of lifting and carrying.
- In all manual operations where groups of workers are involved, a team leader with necessary training to handle the entire work force in unison has to be provided for.
- Watch and ward to control / supervise / guide movement of equipment and machineries, loading and unloading operations, stability of the stockpiled materials and irregularly shaped objects have to be provided for safety and security of workers.
- Carriageway used by the workers must be free from objects, which are dangerous.
- Loading and unloading from vehicles shall be under strict supervision.

Gas Welding

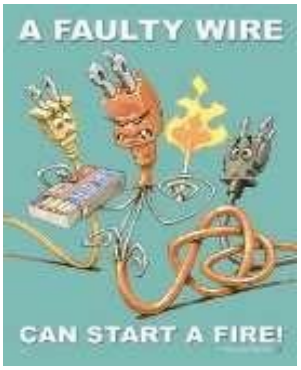
- The welders and welding units should follow all the basic principles of welding for safety and security
- Use face shield to protect the eyes
- Use goggles, particularly when chipping slag and cutting strips.
- Use gloves long enough to protect wrists and forearms against heat, sparks, molten metal and radiation hazards.
- Use high-top boots / gum

boots to prevent sparks, splinters, sharp edges of metal and hot welded strips, welding rods, electric cables etc. from injuring the legs.

- Avoid inhaling the noxious fumes and gasses from burning electrodes by using gas masks and screen of the work area to prevent the glare moving outside it.
- Keep the key hung from the regulator control for split seconds operations to stop the valve in case of any accidental damage or leakage to supply pipeline that may catch fire and cause accidents in case acetylene or LPG cylinder.
- The welding area should have sufficient openings with fixed exhaust ventilators or adequate air flow openings to remove poisonous fumes and gases.
- Take precautions of wearing hard hats or fiber helmets to prevent injury due to fall of any object and accidental injury from projections while welding.
- Welders operating above ground should have adequate safety belt secured to stable platform to prevent accidental fall or injury from the scaffold. All electrical and gas connection lines up to the welder should be sufficiently insulated and protected from sharp edges and sharp objects. These shall not come into contact with hot metal.
- Do not use gas cylinders for supporting work or as rollers. While using LPG or CNG cylinders for welding, follow all safety precautions as has been prescribed by the supplier company.
- Avoid fire hazards and accidents by posting safety supervisors to oversee the activities of workers.
- Do not store explosives, high inflammable materials, loose hanging overhead objects, hot welded strips etc. near gas cylinders.
- Close all valves, switches and circuits while leaving the work place under proper lock and key. In case of mobile units, proper carriage procedure has to be followed for safety and security of men and materials.

F. Electrical Hazards in Construction Areas

- Statutory warning leaflets / posters are to be distributed / displayed by the Contractor in the vicinity of work sites for the benefit of all workers, officers and supervisors as well as the public, indicating the do's and don'ts and warning related to electrical hazards associated with operations to be executed / in progress.
- All wires shall be treated as live wires
- Report about dangling wires to the site-in-charge and do not touch them.
- Only a qualified electrician should attempt electrical repairs.
- Train all workers about electrical safety.
- Shut down the equipment that is sparking or getting over heated or emitting smoke at the time of operation, if it is not the normal way of working of such machines.
- Inform technical person/s for required maintenance.
- Never used damaged wires for electrical connection
- Demolition, tree felling and removal of overhead transmission lines shall be undertaken with strong, efficient and closely monitored arrangements to avoid accidents.



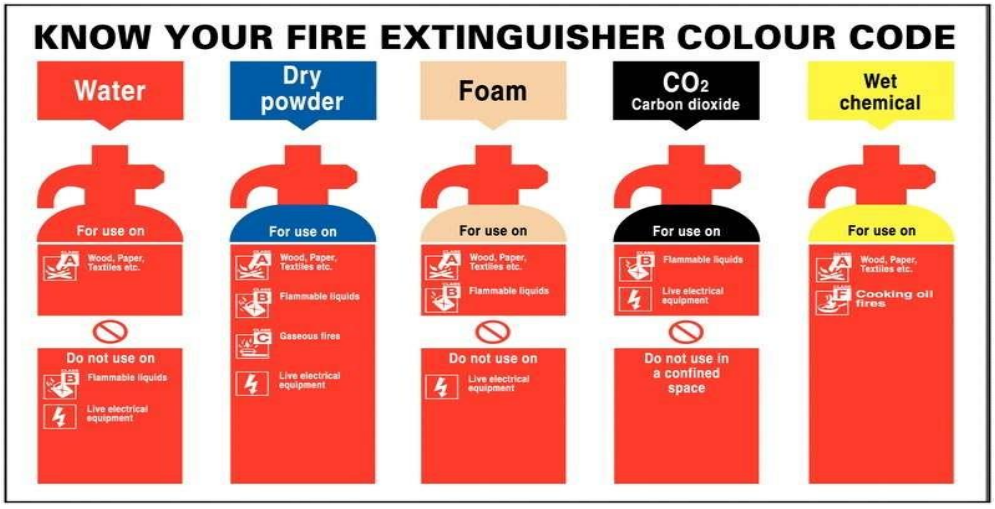
G. Use and Storage of Gas (LPG)

- Store filled LPG cylinder in a secure area – mark this as a no smoking area.
- Transport, store, use and secure cylinders in upright position
- Ensure proper ventilation at the ground level in locations where LPG is in use.
- Avoid physical damage to the cylinders
- Never weld near the cylinder
- Store empty cylinders secured and upright
- Make sure that the cylinder is closed immediately after use
- Investigate immediately if there is the smell of LPG or gas
- Make sure that there is no other unrelated fire in the vicinity of the cylinder.

H. Fire Safety Practices

- Store flammable material in proper areas having adequate fire protection systems
- Display sufficient warning signs
- Install fire alarm wherever required and test regularly.
- Inspect fire extinguishers regularly and replace as necessary.
- Train selected personal on use of fire extinguishers
- Fire escape route should be kept clear at all times and clearly indicated
- Train workers about the escape route and assembly point/s.
- Carryout fire drill periodically When fire breaks out alert all persons through fire alarms or other methods.
- Put off the fire with appropriate fire extinguishers only when you are sure that you are safe to do so.
- Escape if you are in danger through the fire escape route to assembly point.

- Call-up Fire Service
- Fire officers to carryout head count at the assembly point.



I. Noise Hazards and its Control

- Plan camp lay-out in a manner that ensures barriers /buffers between residential / office units and high noise generating zones.
- Use sound meters to measure the level of noise and if it exceeds 75 dB (A), then ensure preventive measures.
- Make personnel aware of noisy areas by using suitable warning signs and insist on use of ear protectors / ear plugs to prevent excess noise affecting the workmen.
- Reduce noise at source by: use of improved equipment; regular and proper maintenance of the machinery as per the manufacturer's manual; by replacing rickety and noisy equipment and machineries.
- Screening locations with noise absorbing material; making changes in the process / equipment; controlling machine speeds; ensuring that two noise-generating machines are not running at the same time close to each other at same location; using cutting oils and hydraulic noise breakers; providing vibration and noise absorbing platform and firm embedding of equipment with fasteners.
- Appoint a competent person to carry out a detailed noise assessment of the site; designate ear protection zone/s; give training / instructions on the necessary precautionary measures to be observed by site personnel including using suitable type of ear protection equipment.

J. Personal Protective Equipment (General)

- Ensure that sufficient personal protective equipment are provided and that they are readily available for every person who may need to use them.
- Provision of personal protective equipment has to be made over and above all measures taken for removing or controlling safety hazards on a work site.
- The Contractor's Project Manager shall ensure that all persons make full and proper use of the personal protective equipment provided.
- Provide instruction/s and training for the proper use and care of personal protective equipment.
- Ensure that the personal protective equipment is in good condition.

- Do not willfully misuse, interfere with or mis-handle any protective clothing and equipment provided.
- Ensure that the personal protective equipment is in good condition. Report immediately any damage to the management for replacement. Always keep the personal protective equipment as clean as possible.
- Train workers to report unintentional damages for replacement and to always keep the personal protective equipment clean. PPE includes the following, but may not be limited to the same.

List of personal protective equipment (PPE)

Sl. No.	Part of the body	Personal protective Equipment
1	Eye	Safety glasses, Goggles
2	Face	Face shields
3	Nose	Nose masks
4	Head	Helmets
5	Feet	Safety shoes
6	Hands and Arms	Gloves
7	Body	Vests
8	Hearing	Earplugs, Earmuffs

IMAGES FOR PERSONAL PROTECTIVE EQUIPMENT (PPE)

Eye Protection

- Project construction work sites, quarries and crushers are full of dust particles, sand, splinter, harmful gases, bright light and welding arc lights, which are injurious for the eyes. Therefore, eye protection and adequate lighting in work areas is required. All workers, supervisors and inspection officers and dignitaries coming over for study of works should be compelled to wear eye protecting glasses /goggles properly fitting the eye sockets to prevent damage due to dust, gases and other particles.

Head Protection

- Hard hats are compulsory for all workers, supervisors and managers /officials while working and / or inspecting a work sites. Hard hat areas shall be

demarcated clearly.

Hearing Protection

- Provide ear plugs or ear muffs to the workers and to those who need to get in and out of a high noise area frequently.
- Use re-usable earplugs when the reduction required (15-25 dBA) is not excessive.
- Use earmuffs where a large attenuation of up to 40 dBA is demanded.
- Do not use dry cotton wool for hearing protection because it doesn't provide any such protection.
- Provide disposable ear plugs for infrequent visitors and ensure that these are never re-used.
- Replenish ear plugs from time to time for those who need to work continuously for a long period in a high noise area/s.
- Use ear muffs with replaceable ear cushions because they deteriorate with age or may be damaged in use.
- Avoid wearing spectacles with ear muffs. Use soap and water or the recommended solvent for cleaning ear muffs.

Respiratory (Protective) Equipment

- Wear suitable masks for protection when there is a potential for small particles entering the lungs, e.g. emptying of cement bags, working at crusher sites etc.
- Provide training to all persons using the masks / respirators for their correct fitting, use, limitations and symptoms of exposure.
- Clean and inspect all respirators before and after use
- Store respirators properly when

not in use Safety Footwear

- Wear suitable footwear for work
- Wear suitable safety shoes or ankle boots when working anywhere where there is high risk of foot injuries from slippery or uneven ground, sharp objects, falling objects etc.
- All safety footwear, including safety shoes, ankle boots and rubber boots, should be fitted with steel toecaps.
- Avoid wearing flip flops, high heeled shoes, slippers, light sport shoes in situations where there is a risk of foot injury and keep shoelace knots tight.

Hand Protection

- Wear suitable gloves for selected activities such as welding, cutting and manual handling of materials and equipment.
- Do not wear gloves where there is a risk of them becoming entangled in moving parts of machinery.
- Wash hands properly with disinfectant soap and clean water before drinking or eating.
- Wash hands immediately after each operation on site when the situation warrants.

K. First Aid

- Provide first aid boxes at every work site in a cool and shaded place.
- Ensure that training on the use of the first aid box is provided to at least every supervisor on the site.
- Display the list of persons along with their contact numbers who are trained on providing first aid.
- Ensure that every first aid box is marked "First Aid" in English and in local language.
- Check for expiry dates and replace the contents, as necessary.
- Maintain a register on health records including injuries / accidents.

L. Accident Investigations

- Carryout the investigation/s as quickly as possible
- Investigation should be carried out both internally as well as through third party.
- Conduct interviews with as many witnesses as necessary including the affected persons and supervising officials.
- Do not rely on any one / limited source of evidence.
- Check all the log books, stock registers, issue registers and movement registers on site
- Safety regulations, traffic signals and signal men activities, signage, as well as other field positions and keep a record of all investigations through audio-visual and electronic medium for presenting an evaluation of the incident/s.
- After completion of the investigation / enquiry, a summary of the facts recorded, sequence of happenings, persons-in-charge, persons examined, equipment and machineries tested, follow-up of action as per legal requirements, copy of station diary entry, hospital entry, safety regulations etc. to be prepared with a comparative analysis for proper assessment.

Annexure 10.12. Guidelines for Storage, Handling, Use and Emergency Response for Hazardous Substances

A. Handling Hazardous Substances (including Chemicals)

- As far as practicable the hazardous materials will be stockpiled under proper mechanical loading, unloading and stacking aided by manual labour where necessary.
- Exercise great care in the storage and use of chemicals because they may be explosive, poisonous, corrosive or combustible.
- Separate different chemicals physically and store accordingly after proper labeling.
- Stock taking of all hazardous will be mandatory together with enforcement of manufacturer's or supplier's safety standard/s and drill exercises.
- New and less known chemicals and building materials, for which toxicological studies are wanted, need to be properly evaluated prior to their inclusion in the materials list.
- All containers should be clearly labeled to indicate contents.
- Maintain the Material Safety Data Sheet of all chemicals for reference on safety precautions to be taken and the use of suitable PPE.
- Ensure use of correct personal protective equipment before allowing workers to handle chemicals.
- When opening containers, ensure holding of a rag over the cap / lid or use of safety gloves, as some volatile liquids tend to spurt up when released.
- Eye fountain, emergency shower and breathing apparatus should be available near the workplace.
- Ensure immediate medical attention in case of spill / splash of a chemical.
- Safety instructions for handling emergency situations shall be displayed prominently at both the storage and use locations.

B. Refueling / Maintenance procedure

- Truck or suitable containers will bring in all fuel and fluids. There will be no storage of fuel, oil or fluids within 200m of a water line.
- Prior to re-fueling or maintenance, drip pans and containment pans will be placed under the equipment. Absorbent blankets may also be required to be placed under the equipment and hoses where there is a possibility of spillage to occur.
- All used oils or fluids will be properly contained and transported to appropriately licensed (authorized) disposal facilities;
- Following re-fueling and maintenance, the absorbent blankets (if any) and spill pans will be picked up and the fuel truck or container moved outside of the 200m wide area.

C. Emergency Spill Procedure

The applicable emergency spill procedure as outlined below and / or as directed by the manufacturer / supplier shall be followed:

Spill Procedure (inside the stream)

In the case of a spill, overflow or release of fluid into the stream waterway (whether water is flowing during the spill or not), do what is practical and safely possible to control the situation, then get help.

1) Stop the flow

- Stop the release into the stream waterway
- Shutdown equipment
- Close valves and pumps
- Plug hoses

2) Remove Ignition sources

- Shut off vehicles and other engines
- Do not allow tiger torches, vehicles, smoking or other sources of ignition near the area. Keep a fire extinguisher on hand but keep it a safe distance away from the potential ignition source (if a fire starts, the extinguisher must be easily accessible)

3) Contact the Environmental Officer and initiate emergency response

- Notify the site supervisor and the Contractor's Environmental Officer as soon as possible
- The Environmental Officer will review the situation and decide if emergency services like fire brigade are required
- Appropriate parties to be notified of the spill are:
  - The contractor's Project Manager
  - The Engineer through his designated Environmental Officer
  - The Client
  - Regulatory Agencies like Pollution Control Board, Municipal Authorities, as applicable.
  - Site safety Officer

4) Cleanup and Disposal

- Emergency Services will be engaged for the containment, cleanup and disposal of contamination release into the environment.

5) Reporting

- The Contractor's Environmental Officer will document the event and submit repots to the Engineer, the client and appropriate regulatory agencies like the Pollution Control Board.

6) Procedure Review

- The Engineer will review the report, determine if changes are required to be incorporated in the plan of activity under the revised guidelines and recommendation/s that have been suggested by the technicians / manufacturer / supplier / fire brigade / SPCB / Environment Expert of the PIU, as the case may be.

Spill Procedure (on Land)

In the case of a spill, overflow or release fluid onto land, do what is practical and safety possible to control the situation and then get help.

1) Avoid the flow

- Avoid the release into the water body
- Shutdown equipment
- Close valves and pumps
- Plug hoses

2) Remove Ignition sources

- Shut off vehicles and other engines
- Do not allow tiger torches, vehicles, smoking or other sources of ignition near the area. Keep a fire extinguisher on hand but keep it a safe distance away from the potential ignition source (if a fire starts, the extinguisher must be easily accessible)

3) Contain the Spill

- Dike around the spill to contain the material
- Spread absorbent or place a spill blanket on the spill
- Enlist the help of personnel on site
- Notify your supervisor as soon as possible

4) Notification

Appropriate parties to be notified of the spill are

- The Contractor's Project Manager
- The Engineer through his designated Environmental officer
- The Client
- Regulatory Agencies like Pollution control Board, Municipal Authorities, as applicable
- Site Safety coordinator

5) Cleanup and Disposal

- The Engineer's Environmental officer will ensure that a proper cleanup and disposal method is determined. Absorbent pads will soak up the spilled material. The pads will be contained and removed from site for disposal at a licensed (authorized) facility.

6) Reporting

- The Contractor's Environmental Officer will document the event and submit reports to the Engineer, the Client and appropriate regulatory agencies like the Pollution control Board(s)

7) Procedure Review

- The Engineer will review the report, determine if changes are required to procedures and recommend implementation of all required changes.

Annexure 10.13. Environmental Non-conformity, Corrective & Preventive Action

1.0 Purpose

The purposes of this procedure is to define a system for,

a) To establish compliance with regulations and requirements of EMS policies,

b) Handling and investigation of incidents; mitigation of consequences of incidents,

c) To maintain records for analyzing the data related to nonconformities, incidents and toinitiate appropriate corrective and preventive actions.

d) To take appropriate corrective and preventive action

2.0 Scope

Applicable to all areas, activities and operations carried out by K RIDE, includingactivities carried out by suppliers' contract personnel.

3.0 Associated and reference documents

a) ISO 14001:2004 clause 4.5.3

b) ISO 14001:2014 EMS

4.0 Definitions

c) **Nonconformity** (ISO 14001:2004): Non-fulfillment of a requirement.

d) **Correction:** Action taken to eliminate a detected nonconformity (mitigating an identifiednonconformity)

e) **Corrective action:** Action to eliminate the cause of a detected nonconformity or other undesirable situation (i.e., action taken to prevent recurrence)

f) **Preventive action:** Action taken to eliminate the cause of a potential nonconformity orother undesirable situation (i.e., action taken to prevent occurrence)

5.0 Responsibility

Responsibility is described in the procedural part.

6.0 Procedures

6.1 Operational Nonconformities

Nonconformities with regard to EMS system implementation are

a) Deviation from operational control / system procedures, and

b) Deviation from EMS Management Programs

The above nonconformities may get identified through

a) Monitoring and measurement of key characteristics of EMS elements,

b) Internal audits,

c) Review of emergency preparedness and response,

d) Complaints received from interested parties, and

e) Management review

6.1.1 Nonconformities identified through monitoring and measurement

Whenever nonconformities are identified through monitoring and measurement, the personnel responsible for the monitoring and measurement of a key characteristic should immediately inform it to the concerned Head of dept.

Examples:

1) If smoke emissions from DG set found to be abnormal, it should be informed to the Head of Administration / Site in charge who in turn will take up the issue with concerned contractor forits repair/maintenance.
2) It may be observed during inspection of fire safety control that a particular fire extinguisher found to be damaged / unfit for use; it should be reported to location /area head as well as EMR.

6.1.2. Nonconformities identified through internal audits

Nonconformities identified through internal audits are reported through either NC Report or Audit Observation sheet. In either case, it is the responsibility of the respective auditee /respective HOD to take immediate action to mitigate the nonconformity. Further, corrective and preventive action may be initiated in accordance with procedure EMSP 14 - Corrective and preventive action.

6.1.3. Nonconformities identified through review of emergency preparedness and response

Mock drills are conducted for the identified emergencies as per defined response plan (see EMSP 06); response to an actual emergency is also done as per defined response plan. In both the cases, there is a possibility of some nonconformities gets identified. It can be ineffectiveness of the response plan or deficiency in the plan to mitigate the effects in a timely manner. Whenever such nonconformities are identified, the emergency response team shall report it to EMR who in turn review the causes of nonconformity and initiate appropriate action (Revising the emergency response plan, re-training the team members, improving the techniques / methods used).

6.1.4. Nonconformities identified through complaints received from interested parties

Whenever complaints are received from interested parties, the same should be reported to EMR. Most of the time, such complaints may be traceable to a legal requirement or a significant environmental aspect. EMR shall review the complaints and initiate appropriate actions to mitigate the problem as well as taking action to prevent their recurrences. In certain circumstances, it may have to be discussed in MRM.

6.1.5. Nonconformities identified through management review

Whenever nonconformities are identified though management review, the review committee shall ensure that such nonconformities are appropriately resolved, and necessary directionsare

provided for the executive management members on how similar issues in other operational areas have to be dealt with. EMR shall ensure that required communication takes place in this regard. Following are the typical nonconformities that may get identified inthe management review:

a) Supplier's / Contractor's EMS performance not up to the expectations of

b) EMS management program has observed some lapses;

c) Internal audit were not effective [to prevent the types of nonconformities reportedduring third party (certification body) audits];

d) Induction training given to new employees not effective

6.2. Incident management

6.2.1. Environmental incident

Where the result of an incident / accident has an impact on the Environment (e.g. chemical spills enters storm drain that has the potential to cause water pollution). In such cases, prescribed operational control procedure should be followed. In the absence of such procedure, the operational personnel shall seek advice from EMR.

6.3. Analysis of data

Coordinator(s) shall compile the data related to EMS nonconformities, incidents and analyzeto determine those requiring action or those that can be prevented or if the severity of impactcould be reduced. This information shall be forwarded to the MR for taking up the issue in the Management review .

7.0. Corrective and preventive action

Nonconformity is non-fulfillment of a requirement. A requirement may be stated in relation tothe management system or in terms of environmental performance. Situation may occur where part of the system may not function as intended or environmental performance requirements are not met. System for corrective and preventive action is described in two stages. This procedure addresses all types of nonconformities including, but not limited to,

a) Results of audits.

b) Inputs obtained from measurement & monitoring.

c) Regulatory non-compliances and incidents and accidents

d) Non-conformances with internal objectives and targets

e) Insufficient documentation to evaluate conformance with EMS

f) Non-conformances with respect to existing policies and procedures.

7.1. Corrective action

7.1.1. Below mentioned table details the type of nonconformity, source for its identification, and the mitigation action recommended. Criterion for taking corrective action is described in the subsequent paragraphs.

Sl. No.	Type of nonconformity (NC)	Source for the identification and reporting of NC	Mitigation action
1	Documentation inadequacy toachieve policy and objectives,and to fulfill standards requirements	Audit – adequacy audit	Review and revision of identified document
2	Responsibilities not definedfor a system activity	Document review – part ofaudit	Review and revision of identified document
3	Pertinent operational document not available at thepoint of use	Audit	Ensure its availability
4	Non-compliance with EMS Legal requirement which wasnot identified	External Communication	Update legal register; establish compliance
5	Legal and other requirementsnot complied with	Evaluation of compliance	Establish compliance for the reported finding
6	Operational control not effective to achieve plannedresults	Management review inputs(related to process performance)	Review and ensure established operational controls are adequate; personnel are competent.
7	Objectives and targets notachieved	Management review inputs;Audit	As decided in the MRM
8	Emergency response noteffective	Emergency response report	Revise Emergency response procedures; trainpersonnel
9	Internal audits are noteffective	External audit	Review by top management and implement the actions proposed
10	Incident occurred is related toan unidentified aspect.	Internal communication	Implement operational controls; update aspect-impact.

7.1.2. Criterion for initiating corrective action

A corrective action is always preceded by cause analysis. Cause analysis may not feasible for all the identified / reported nonconformity. Following criterions shall be applied for variousstеps of corrective action.

Sl. No.	Corrective action steps	Criterion for initiating the corrective actionstep
1	Reviewing nonconformities (NC) forinitiating corrective action.	• If it is a major nonconformity; • It is a minor NC being recurred more than 3times • If it is related to achievement of objective and targets or a legal concern
2	Determining the causes of nonconformities	1) If it is a major nonconformity; 2) It is a minor NC being recurred more than 3times 3) If it is related to achievement of objective and targets or a legal concern
3	Evaluating the need for action to ensurethat nonconformities do not recur	○ If the NC is related to a critical legal requirement (subject for penalization) ○ If it is affecting the business performanceconsiderably
4	Determining and implementing actionneeded	▪ If the NC is related to a critical legal requirement (subject for penalization) ▪ If it is affecting the business performanceconsiderably ▪ Financial viability of the proposed action ascompared to consequences of taking no action
5	Maintaining records of the results ofaction taken	Mandatory for all CA taken
6	Reviewing corrective action taken	Mandatory for all CA taken; to be carried outduring subsequent internal audit

Once it is determined to complete the corrective action process, concerned process owner / functional head shall carryout the root-cause analysis, and further complete the corrective action process steps detailed above. Generally the root-cause of nonconformity will be one or more of the following:

a) Personnel – competence, awareness and training

b) Resources - deficient resources / constraints in resources provided

c) Policies and procedures – deficient / inadequate / inconsistent with organization'soverall policy

7.2. Preventive action

Elements for which a preventive action can be implemented are similar to those described under corrective action. One or more of the following means can be utilized to identify opportunity for preventive action:

a) Trend analysis of element (of EMS system) wise nonconformities;

b) Trends in “no loss incidents”

c) Periodic inspection / “walk-through”

d) Suggestion from employees

e) Audit recommendations

Root-cause analysis shall be carried out for the identified / reported potential nonconformity. Preventive actions proposed for an identified / reported potential nonconformity shall be reviewed in the management review meetings or by the EMR for techno-commercial viability.The respective functional heads shall implement those that are approved. Records of the results of action taken shall be maintained.

8.0 Records

Sl. No	Name of the Record	Custodian	Retention Period
1	Summary of incidents / accidents.	Coordinator	3 Years
2	Corrective/Preventive action report	Concerned functional head; copy shall be given to MR	3 Years

Annexure 10.14. Guidelines for Provision of Noise Barriers

A. Typical Design for Noise Barriers

Mitigation at the sensitive receptor locations may include posting of signs prohibiting the use of horns and, to the extent possible planting of trees serve as green noise barriers. Effect of noise can be reduced considerably by the combined effect of sound insulating walls and green barriers. Nevertheless the green barriers require at least 2-5m additional space between the solid barrier and thereceptor. Proposed project mitigation actions should be cost effective and implementable when compared to the generally recommended expensive double glazed windows.

B. Sound insulating walls for silence zones

The design of these barriers is proposed with a brick wall to act as sound barrier. The Hospitals, Medical centre, Schools and other Educational institutions are affected by the traffic noise. A number of schools and a few hospitals are generally observed adjacent to the project corridor.

C. Green barriers for Silence zones

These are simply a thick layer of green plantation with small leaves acting as noise attenuates. These trees may be planted just inside and adjacent to the wall. Contractors will be responsible for the implementation of the civil works. Tree plantation will be carried out by the Forest department under the tree-planting scheme of the project. The implementation aspects are provided in the EMP. In addition to the noise mitigation, the thick green belt will act as an air quality filter for vehicular emissions. A typical green barrier of 100m lengths will have 200 trees in 4 rows.

Noise mitigation techniques will be employed as may be warranted at each of the sensitive receptor sites tabulated in the above table. Definitive noise levels will be empirically determined at each site and selection of the mitigation technique shall be made on a site- specific basis in consultation with property owners. Co-ordination and implementation will be the responsibility of the Environmental officer of the construction supervision consultants (CSC) or Independent Engineer (IE). Mitigation cost has been estimated as a part of the environmental costs of the project.

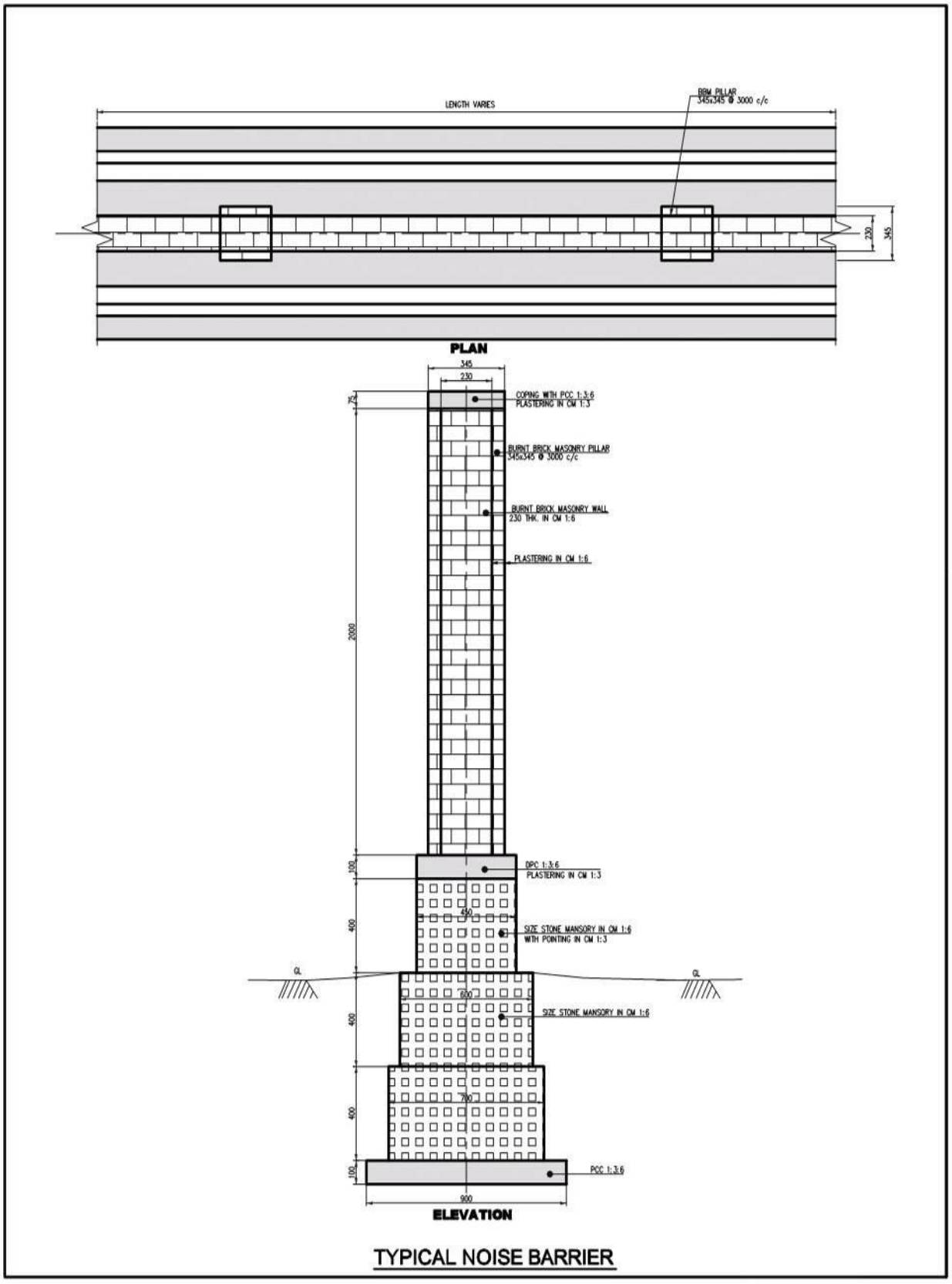


DIAGRAM SHOWING TYPICAL SOLID NOISE BARRIER

Annexure 10.15. Format for Report Details of Batching Plant

(To be filled by the Contractor)

Name of Location _____

Reporting Month……..

Date of Submission……..

1. Environment Features of the surrounding area

1.1	Name and location of Batching Plant	
1.2	Coordinates	
1.3	Wind direction	
1.4	Name (s), distance population and type of Settlement/s in a 1.5 km radius of site.	

2. Details of Batching Plant and Mitigation Measures taken

2.1	Installed Capacity	
2.2	Average Utilization	
2.5	Last maintenance date	

3. Brief Air Pollution Control Measures taken at the Batching Plant site

4. Brief Noise Pollution Control Measures taken at the Batching Plant site

Remarks :

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of IE/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.16. Reporting Format for Identification of Construction Camp Site

(To be filled by the Contractor)

Name of Project Corridor : _____

Construction Stage Report:

Date_____

Month: _____

Year: _____

Sl. No.	Project Details	Particulars		
1.	Name and address of the Contractor			
2.	Contact details of the Contractor			
3.	Name of Project Corridor			
4.	Stage of the Project			
5.	Site Details	Information (Coordinates)		
6.	Name of the Village		Panchayat	
7.	Name of the Taluk		District	
8.	Chainage (km)		Side	LHS/RHS
9.	Area of site		Current land use	
10.	Ownership of the land	Owned/Leased	Survey No.	
11.	If leased, name, address and contact details of			
12.	Distance from nearest settlement			
13.	Distance from surface water course or body			
14.	Distance from Ecologically Sensitive Areas			
15.	Width of access road			
16.	No of trees with girth > 0.3m			
17.	No. of trees to be cut			
18.	Is top soil conservation required (Yes/ No)			
List of Enclosure		Location Map		

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of IE/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.17. Reporting Format for Setting-Up of Construction Camp

(To be filled by the Contractor)

Name of Project Corridor : _____

Construction Stage Report:

Date_____

Month: _____

Year: _____

(Site Layout of Construction camp and working drawings of dwelling units with allied facilities to be attached with format)

FORMAT TO BE SUBMITTED FOR ESTABLISHING CAMPS

Sl. No	Item	Unit	Details	Remarks by CSC/IE/PMC
1	Detail of item camp			
	Coordinates of the Camp			
	Size of camp	m x m		
	Area of camp	Sq. m		
	Distance from nearest settlement			
	Distance from nearest water source	Type / Size / Capacity / Present Use / Ownership		
	Date of camp being operational dd / mm / yy			
	Present land use			
	No of trees with girth > 0.3m			
	Details of Storage area (Availability of impervious surface)	m x m		
	Availability of separate waste disposal	Cum		
2	Details of topsoil stacking			
	Quantity of top soil removed	Sq. m		
	Detail of storage of topsoil	Describe stacking arrangement		
3	Details of workforce	Nos.		
	Total no. of Laborers	Nos.		
	Total no. of Male Workers	Nos.		
	No. of Male Workers below 18 years of age	Nos.		
	Total No. of Female Workers	Nos.		
	No. of Female Workers below 18 years of age	Nos.		

Sl. No	Item	Unit	Details	Remarks by CSC/IE/PMC
	No. of children	Nos.		
4	Details of dwelling units			
	No of dwellings/huts			
	Minimum Size of Swelling	m x m		
	No. of openings per dwelling	Nos.		
	Minimum size of opening	m x m		
	Walls	Specifications		
	Roofing	Specifications		
	Flooring	Specifications		
	Drinking Water Tank	Specifications		
	Capacity of Drinking Water Tank	Cum		
	Size of Drinking Water Tank	m x m		
	Total no of WC	Nos.		
	No of WCs for female workers	Nos.		
	Minimum Size of WC	m x m		
	Total No of Bathrooms for female workers	Nos.		
	Size of septic tank for WC / Baths	m x m		
	Capacity of Water Tank for WCs / Bathrooms and general purpose			
	Fencing around camp	Yes / No		
5	Details of facilities			
	Availability of security guard 24 hrs. a day	Yes / No		
	Details of First Aid Facility	Yes / No		
	Availability of Day Care Centre	Yes / No		
	Availability of dust bins (capacity 60ltr)	Nos.		

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of IE/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.18. IFC's Environmental, Health, and Safety Guidelines for Railways

Environmental, Health, and Safety Guidelines for Railways

Introduction

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)[1]. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These industry sector EHS guidelines are designed to be used together with the **General EHS Guidelines** document, which provides guidance to users on common EHS issues potentially applicable to all industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. A complete list of industry-sector guidelines can be found at: www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons.

When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

Applicability

The EHS Guidelines for Railways are applicable to activities typically conducted by rail infrastructure operators dedicated to passenger and freight transport. The document is organized into two main areas, namely rail operations, covering construction and maintenance of rail infrastructure as well as operation of rolling stock, such as locomotives and rail cars; and, locomotive maintenance activities, including engine services, and other mechanical repair and maintenance of locomotives and railcars. This document is organized according to the following sections:

Section 1.0 — Industry-Specific Impacts and Management
Section 2.0 — Performance Indicators and Monitoring
Section 3.0 — References
Annex A — General Description of Industry Activities

[1] Defined as the exercise of professional skill, diligence, prudence and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of pollution prevention and control techniques available to a project may include, but are not limited to, varying levels of environmental degradation and environmental assimilative capacity as well as varying levels of financial and technical feasibility.

1.0 Industry-Specific Impacts and Management

The following section provides a summary of EHS issues associated with railways that may occur during the construction and operation phases of a project, along with recommendations for their management. Additional recommendations for the management of EHS issues during the decommissioning phase of railways are provided in the **General EHS Guidelines.**

1.1 Environment

1.1.1 Rail Operations

Environmental issues associated with construction and maintenance of rail infrastructure, as well as operation of rolling stock (e.g. locomotives and rail cars), may include the following:

- Habitat alteration and fragmentation
- Emissions to air
- Fuel management
- Wastewater
- Waste
- Noise

Habitat Alteration and Fragmentation

The construction and maintenance of railroad rights-of-way may result in alteration and disruption to terrestrial and aquatic habitats.

Construction of Rail Rights-of-Way[2]

Right-of-way construction activities along a railway alignment may adversely affect wildlife habitats depending on the characteristics of existing vegetation, topographic features, and waterways. Habitat alteration may include fragmentation of forested habitat; loss of nesting sites and other wildlife habitat through bush clearing; disruption of watercourses; establishment of non-native invasive plant species; creation of barriers to wildlife movement; and visual and auditory disturbance due to the presence of machinery, construction workers, and associated equipment. In addition, sediment and erosion from construction and stormwater runoff may increase turbidity of surface waters.

Recommended measures to prevent and control impacts to wildlife habitats during construction of rights-of-way include:

- Avoid fragmentation or destruction of critical terrestrial and aquatic habitats[3] by siting railways, rail yards, support facilities, and maintenance roads to avoid such locations or by utilizing existing transport corridors whenever possible. Where fragmentation of critical habitats cannot be avoided, maximize the availability of animal crossings (e.g. bridges, culverts, and over-crossings) and provide jointing chambers to allow small animals a means of escape from the railway;
- When rail crossings of watercourses are unavoidable, maintain water flow and fish access by utilizing clear-span bridges, open-bottom culverts, or other appropriate methods. Where sensitive habitats cannot be avoided by rail alignment, construction of bridges should be considered to span at-risk areas (e.g. wetlands);
- Minimize the clearing of riparian vegetation during construction;
- Avoid construction activities during the breeding season and other sensitive seasons or times of day, especially

[2] Also known as a 'wayleave' or 'easement' in some countries, but referred to in these guidelines as 'right-of-way".

[3] The term "critical habitats" is defined in IFC Performance Standard 6: Biodiversity Conservation and Natural Resource Management, along with other terminology related to the preservation of biodiversity. Available at: www.ifc.org/envsocstandards

where critically endangered or endangered species are concerned;

- Avoid the introduction of invasive species during reinstatement activities, preferably through the use of native plant species and, when feasible, clear invasive species during routine vegetation maintenance (see 'Right-of-way maintenance' section below);
- When procuring crossties for rail line construction, consider their source to ensure that it has not originated from unsustainable harvesting of forest products in a critical habitat.
- Additional recommendations on managing construction site activities are described in the **General EHS Guidelines.**

Right-of-Way Maintenance

Regular maintenance of vegetation within railroad rights-of-way is necessary to avoid interference with train operations and track maintenance. Unchecked growth of trees and plants can cover signals, fall onto the tracks and overhead power lines, and prevent workers from getting to places of safety when trains are passing. Regular maintenance of rights-of-way to control vegetation may involve the use of mechanical methods (e.g. mowing), manual methods (e.g. hand pruning), and use of herbicides. Vegetation maintenance beyond that which is necessary for safety may remove unnecessary amounts of vegetation, resulting in the continual replacement of successional species and an increased likelihood of the establishment of invasive species.

Recommended measures to prevent and control impacts from right-of-way vegetation maintenance include:

- Implementation of integrated vegetation management (IVM). The track area should be kept completely clear of vegetation. From the edge of the track area to the boundary of the right-of-way, vegetation should be structured with smaller plants near the line and larger trees further away from the line to provide habitats for a wide variety of plants and animals;[4]
- Native species should be planted and invasive plant species removed;[5]
- Railways should be designed and maintained to discourage plant growth in the track area (e.g. providing lateral barriers to plant migration and ensuring rapid drainage of the track area);
- Biological, mechanical, and thermal vegetation control measures should be used where practical, and use of chemical herbicides on the bank beyond the transition area should be avoided (approx. 5 meters from the track);
- Maintenance clearing in riparian areas should be avoided or minimized.

An integrated approach to vegetation management may indicate use of herbicides as a preferred approach to control fast-growing vegetation within railway rights-of-way. In this case, the recommended precautions include:

- Personnel should be trained in herbicide application, including applicable certification or equivalent training where such certifications are not required;[6]

[4] Mowing can be used to control growth of ground covers, minimize propagation of plants in the track area, and prevent the establishment of trees and shrubs in the right-of-way. Herbicides, in combination with mowing, can control fast-growing weedy species that have a potential to mature to heights over those permitted within the right-of-way. Trimming and pruning can be utilized at the boundaries of rights-of-way to maintain corridor breadth and prevent the encroachment of tree branches. Hand removal or removal of vegetation, while labor intensive, can be used in the vicinity of structures, streams, fences, and other obstructions making the use of machinery difficult or dangerous.

[5] Dense, thorny native shrubs can be used to help deter trespassers. Native plants can also help to stabilize clay soils, reducing the need for ballast maintenance. Leaves of some tree species with invasive root systems can cause traction problems for train wheels. Therefore, such trees are often removed, even if native to the area. Waste from removal of invasive species should be disposed of (e.g. by incineration or at a landfill) to avoid accidental spreading of the weeds to new sites.

[6] Examples of certification schemes are provided by the United States Environmental Protection Agency (US EPA) (2006), which categorizes pesticides as either "unclassified" or "restricted" and requires workers that apply unclassified pesticides to be trained according to the Worker Protection

- Avoid the use of herbicides that fall under or are listed under:
  - The World Health Organization Recommended Classification of Pesticides by Hazard Classes 1a and 1b
  - Avoid the use of pesticides that fall under the World Health Organization Recommended Classification of Pesticides by Hazard Class II if the project host country lacks restrictions on distribution and use of these chemicals, or if they are likely to be accessible to personnel without proper training, equipment, and facilities to handle, store, apply, and dispose of these products properly;
  - Annexes A and B of the Stockholm Convention, except under the conditions noted in the convention[7]
- Herbicides used should be manufactured under license, registered and approved by an appropriate authority, and in accordance with the Food and Agriculture Organization's (FAO) International Code of Conduct on the Distribution and Use of Pesticides;[8]
- Only herbicides that are labeled in accordance with international standards and norms should be used, such as the FAO Revised Guidelines for Good Labeling Practice for Pesticides;[9]
- Users should review manufacturers' directions on maximum recommended dosage or treatment, as well as published reports on reduced rates of herbicide application without loss of effect,[10] and apply the minimum effective dose;
- Herbicide application should be based on criteria (e.g. field observations, weather data, time of treatment, and dosage) with use of a pesticide logbook to record data;
- Application practices should be designed to reduce unintentional drift or runoff;
- Herbicide application equipment should be maintained and calibrated in accordance with manufacturers' recommendations;
- Untreated buffer zones or strips should be established along water sources, rivers, streams, ponds, lakes, and ditches to help protect water resources;
- Contamination of soils, groundwater, or surface water resources due to accidental spills during transfer, mixing, and storage of herbicides should be prevented by following the hazardous materials storage and handling recommendations presented in the **General EHS Guidelines**.

Forest Fires

If vegetation growth is left unchecked or slash from routine maintenance is left to accumulate within the right-of-way, sufficient fuel can accumulate that may promote forest fires. Recommended measures to prevent and control risk of forest fire include:

- Monitoring of right-of-way vegetation according to fire risk;
- Removal of blowdown and other high-hazard fuel accumulations;
- Timing of thinning, slashing, and other maintenance activities to avoid seasons when the risk of forest fires is high;
- Removal of maintenance slash or management by controlled burning.[11] Controlled burning should adhere to

Standard (40 CFR Part 170) for Agricultural Pesticides. It further requires restricted pesticides to be applied by or in the presence of a certified pesticide applicator.

[7] Stockholm Convention on Persistent Organic Pollutants (2001).

[8] Food and Agriculture Organization of the United Nations (FAO) (2002)

[9] FAO (2002)

[10] Danish Agricultural Advisory Service (DAAS), 2000.

[11] Controlled burning should only be performed after considering potential impacts to air quality and according to the local air quality management requirements.

applicable burning regulations, fire suppression equipment requirements, and typically should be monitored by a fire watcher;

- Planting and management of fire-resistant species (e.g. hardwoods) within, and adjacent to, rights-of-way.

Emissions to Air

Locomotive engines may be significant contributors to air pollution in urban areas, especially in the vicinity of rail yards. Worldwide, approximately 60 percent of passenger trains and 80 percent of freight trains are powered by diesel locomotives which emit combustion products, including nitrogen oxides (NO_X) and particulate matter (PM), both of which contribute to public health problems, and carbon dioxide (CO_2), a greenhouse gas.[12] Transportation and transfer of dry granular materials (e.g. minerals and grain) may result in dust emissions, while the storage and transfer of fuels or volatile chemicals may result in fugitive emissions. Recommended measures to prevent, minimize, and control air emissions include:

- Reduction of fuel consumption / increase of energy efficiency through:
  - Use of modern, fuel-efficient, low-emission locomotives or scheduled substitution or re-powering of existing fleets
  - Maximizing cargo and passenger space utilization within safety standards to minimize specific fuel consumption
  - Decreasing wind resistance (e.g. by grouping inter-modal loads with rail cars of height similar to the containers and filling empty slots with empty containers, covering of empty freight cars,[13] installing fairings on bogies (also known as trucks) of high-speed trains, and acquisition of new rolling stock with low wind resistance
  - Optimizing efficiency of passenger comfort functions during service and while parked (e.g. by installing demand-oriented ventilation controls and automatic control of comfort functions in parked trains);
  - Improving driving economy through staff training, incentive programs, driving advice systems, and improved traffic flow to minimize unnecessary acceleration and deceleration
  - In electrically powered locomotives, use of regenerative braking systems to recycle energy for use by other locomotives
- Depending on the potential impact of the operation in already degraded airsheds, consider the reduction and control of combustion source emissions through:
  - Use of, or conversion to, alternative fuels (e.g. low-sulfur diesel, bio-diesel)
  - Locomotive re-powering programs
  - Installation of high-efficiency catalytic exhaust emission control systems[14]
  - Use of alternative power sources for idling locomotives[15]
  - Improvements in ground service and field operations vehicle fleets as described in the **General EHS Guidelines**
- Depending on the potential impact of the operation in already degraded airsheds, considering the reduction and control of fugitive emissions through:

[12] Generation of electricity also results in emissions of NOx, PM, and other air pollutants, and, therefore, electric-powered trains result in indirect air emissions.
[13] Even at the relatively low speeds of freight trains, a locomotive pulling open, empty cars on level terrain consumes more energy than one pulling a heavy load.
[14] The US EPA is considering requiring such emission controls on new diesel locomotives. See 69 FR 39276 – 39289.
[15] Guidance for Quantifying and Using Long Duration Switch Yard Locomotive Idling Emission Reductions in State Implementation Plans. EPA 20-B-04-002. Office of Transportation and Air Quality, US EPA (2004)

- Use of enclosed cars or covering of open cars used to carry minerals and grains to reduce fugitive dust emissions
- Implementing measures presented in the **General EHS Guidelines** to minimize fugitive air emissions from diesel and other fuel storage and handling activities

Fuel Management

Rail operations with diesel locomotive engines depend on fueling stations strategically situated along the rail network. Fueling stations typically include aboveground storage tanks, piping, and filling equipment with the potential for soil and water resource contamination due to leaks and spills. Storm water falling on fueling areas and secondary containment systems may contain oil residues from incidental releases.

In addition to the recommendations for hazardous materials and oil management in the **General EHS Guidelines**, measures to manage these types of hazards include:

- Storage tanks and components should meet international standards for structural design integrity and operational performance to avoid catastrophic failures during normal operation and during exposure to natural hazards and to prevent fires and explosions;[16]
- Storage tanks should have appropriate secondary containment as discussed in the **General EHS Guidelines**, including procedures for the management of containment systems;
- Secondary containment in rail fueling areas should be appropriate for the size of the railcar, level, curbed, sealed, and draining to a sump connected to a spill retention area. The spill retention area should also be equipped with an oil / water separator to allow the routine discharge of collected rainwater;[17]
- Fueling facilities should develop a formal spill prevention and control plan that addresses significant scenarios and magnitude of releases. The plan should be supported by the necessary resources and training. Spill response equipment should be conveniently available to address all types of spills, including small spills.

Wastewater

Rail operations may generate sanitary wastewater primarily from passenger terminals and from passenger rail service. Wastewater from all sources should be managed according to the recommendations provided in the **General EHS Guidelines**.

Waste

Depending on the number of passengers handled and the services provided, trains and passenger train terminals may generate solid, non-hazardous, food waste from food establishments, in addition to packaging materials from retail facilities, and paper, newspaper, and a variety of disposable food containers from trains and common passenger areas. The maintenance and upgrade of rail infrastructure may also result in the generation of non-hazardous and hazardous waste including lubricants from field maintenance equipment and steel and wood from rails and rail ties. Recommended waste management strategies include:

Waste from Passenger Trains and Terminals

- Instituting a solid waste recycling program, depending on the existence of local facilities, involving the placement of

[16] Examples include American Petroleum Institute (API) Standard 620: Design and Construction of Large, Welded, Low-pressure Storage Tanks, 2002; and API Standard 650: Welded Steel Tanks for Oil Storage, 1998; in addition to European Standard (EN) 12285-2 Workshop fabricated steel tanks for the aboveground storage of flammable and non-flammable water polluting liquids, 2005.

labeled waste containers in passenger terminals for metals, glass, paper, and plastics. Food establishments should segregate compostable and other food waste for recycling as agricultural fertilizer and animal feed;

- Passenger train operators and cleaning contractors should be encouraged to segregate waste in the trains by separating the collection of newspapers / papers, plastic, and metallic containers.

Waste from Field Operations

- On-site generation and storage of hazardous wastes and their subsequent treatment and disposal should be managed according to the recommendations provided in the **General EHS Guidelines**;
- Where feasible, avoid use of crossties treated with chromated copper arsenate and consider use of copper azote for wood treatment as a substitute, or using concrete crossties;
- Recycling of crossties may involve crushing for recovery of the steel rebar and use of the crushed material in road construction. Wood crossties may be chipped for reuse, burnt, or disposed of in landfills. Landfill facilities should be capable of handling wastes that may have chemical leaching properties. Disposal of wood crossties by incineration or recycling should take into account associated air emissions and secondary product residues of preservative chemicals.

Noise and Vibrations

Railway noise is generated from a variety of sources, each contributing to the total noise output. Sources include rolling noise generated by the contact between wheel and rail during normal movement and braking; aerodynamic noise generated by the train pushing air (particularly for high speed trains); and traction noise generated by the engine and cooling fans.[18] Recommended noise management strategies include:[19]

- Implementation of noise reduction or prevention measures at the source including, including:
  - Use of modern non-metallic disc brakes, which can reduce rolling noise by 8-10 decibels (dB) compared to cast-iron block tread brakes utilized on older vehicles (non-metallic disc brakes also reduce wearing of wheels and rails)
  - Reducing the roughness of running surfaces through regular maintenance of wheels and tracks, and consideration for replacing traditional jointed track with continuously welded rail
- Installation of noise controls at the source for improved sound-proofing, and other noise reducing features (e.g. engine enclosures and exhaust muffling for diesel engines, and shielding of wheels with vehicle-mounted shrouds);
- Depending on the location of noise-sensitive areas, noise and vibrations should be considered in the design, construction, and operation of railways (e.g. through alignment choice, relocation of nearby buildings, and soundproofing, such as noise barriers, along railways or next to buildings).

1.1.2 Maintenance of Rolling Stock

The main environmental issues typically encountered in locomotive and railcar maintenance activities may include:

[17] API Standard 2610: Design, Construction, Operation, Maintenance, and Inspection of Terminal & Tank Facilities (2005).

[18] The most significant source of noise is rolling noise from contact between wheel and rail (lateral and longitudinal wheel and track friction from sideways wheel slide and from braking, respectively, including noise from contact between the brake pad and wheel), followed by engine noise and aerodynamic noise.

[19] For additional information, see Dittrich, Michael. 2003. Basic Targets and Conditions for European Railway Noise Abatement Strategies: Analysis of the Current Situation. Working Group (WG) on Railway Noise. European Commission (EC). Also, additional documents published by the WG on Railway Noise. Available at: http://ec.europa.eu/transport/rail/environment/noise_en.htm

- Hazardous materials
- Wastewater
- Waste management

Hazardous Materials

Hazardous materials, including solvents, coolants, acids, and alkalis, may be used in locomotives and rolling stock maintenance operations. Polychlorinated biphenyls (PCB) may be found in older electrical equipment (e.g. transformers and capacitors), and asbestos may be present in older parts such as wheel bearings and seals for steam engines. In addition to the applicable guidance provided in the **General EHS Guidelines**, recommended hazardous materials management strategies include:

- Use of aqueous detergent cleaning solutions or steam cleaning, or use and recycling of aliphatic cleaning solvents (e.g. 140 solvent), for example when removing axle protective coatings or for cleaning of large equipment;
- Use of water-based paints;
- Use of track mats to retain wayside grease and other contaminants;
- Avoiding use of new or replacement parts with asbestos-containing materials.

Wastewater

Rail car maintenance and refurbishment typically involves a high-pressure water wash which may contain residues from transported materials, paint, oil and grease, and other contaminants. Caustic solutions are often used to remove grease and dirt from axles and other metal parts. Acids and caustics may also be used for rust removal. Locomotive coolants are usually water-based with corrosion inhibitor additives. Passenger trains also generate domestic wastewater, which is sometimes discharged directly to the land surface.

Recommended measures to prevent, minimize, or control wastewater effluents include:

- Use of ultrafiltration to extend the life of washing solutions for aqueous parts or use of alternatives to water cleaning (e.g. dry cleaning by wire brush or bake oven);
- Plumbing connection of floor drains, if any, in maintenance areas to the wastewater collection and treatment system;
- Prevention of discharge of industrial wastes to septic systems, drain fields, dry wells, cesspools, pits, or separate storm drains or sewers. Keep wastewater from service bays out of storm drains by constructing berms or other barriers;
- Depending on the volume of contaminants present in the wastewater, and whether the rail facility is discharging into a municipal system or directly to surface waters, pretreatment of effluents may be necessary to reduce contaminant concentrations. Pretreatment systems typically consist of oil / water separators, biological and chemical treatment, and activated carbon systems.

Waste Management

Most wastes from railway operations are generated as a result of maintenance and refurbishment of locomotives and rolling stock and, to a lesser extent, from track maintenance. These wastes typically include solids from mechanical cleaning of rail cars; paint chips and sandblast grit; waste paint; spent solvent and solvent sludges (from painting and cleaning); sludge from cleaning and wastewater treatment; waste oil, hydraulic fluid, and other petroleum-based fluids; petroleum-contaminated solids (e.g. oil filters and saturated spill absorbent material); spent coolant; metal filings and scrap; spent locomotive and signal batteries; and spent brake shoes. These materials should be managed based on their characteristics (e.g. hazardous or non-hazardous) as described in the **General EHS Guidelines**.

1.2 Occupational Health and Safety

1.2.1 Rail Operations

Occupational health and safety hazards during the construction of railway systems are common to those of most large industrial facilities and their prevention and control is discussed in the **General EHS Guidelines**. Additional health and safety issues specific to railway operations include the following:

- Train / worker accidents
- Noise and vibration
- Diesel exhaust
- Fatigue
- Electrical hazards
- Electric and magnetic fields

Train / Worker Accidents

Railway workers in the vicinity of rail lines are exposed to moving trains. Recommended management strategies include:

- Training workers in personal track safety procedures;
- Blocking train traffic on lines where maintenance is occurring ("green zone working") or, if blocking the line is not feasible, use of an automatic warning system or, as a last resort, human lookouts;
- Design and construction of rail lines with adequate clearance for workers;
- Segregation of stabling, marshalling, and maintenance areas from the running lines.

Noise and Vibration

Crew members may be exposed to noise from locomotives, rolling stock, and machinery, as well as to significant repetitive mechanical shocks and / or vibrations.[20] Recommended management strategies include:

- Use of air conditioning systems to maintain cabin temperature and provide fresh air so that windows can remain closed, limiting wind and outside noise;[21]
- Reduction of internal venting of air brakes to a level that minimizes noise without compromising the crew's ability to judge brake operation;
- Installation of active noise cancellation systems;
- Use of personal protective equipment (PPE) if engineering controls are not feasible or adequate to reduce noise levels;
- Use of dampers at the seat post to reduce the vibration experienced by the operator;[22]
- Installation of active vibration control systems for locomotive suspension, cabs, or seat posts, as needed to comply with applicable international and national standards and guidelines.[23]

Diesel Exhaust

Railway workers, including locomotive crews and workers in stations, rail yards, and locomotive and car shops, may be exposed to exhaust from diesel locomotives and other diesel engines. Crew members riding immediately behind the lead engines of trains (e.g. trailing locomotives) and workers in indoor turnaround areas where locomotives are usually left operating, sometimes for prolonged periods, may be exposed to particularly high levels of diesel exhaust.

[20] Guidance for the evaluation of mechanical shock and vibration can be found in the International Organization for Standardization (ISO) 2631-1:1997, Mechanical vibration and shock: Evaluation of human exposure to whole-body vibration—Part 1: General requirements.

[21] Insulation from exterior sound may hinder hearing of exterior noises that provide important cues (e.g. horn loudness, torpedoes). Use of exterior sensors and interior annunciators may be required to compensate.

Measures to control air emissions from locomotives are discussed in Section 1.1 above. In addition, the following measures are recommended to prevent, minimize, and control workers' exposure to diesel exhaust:

- Limiting time locomotives are allowed to run indoors and use of pusher cars to move locomotives in and out of maintenance shops;
- Ventilation of locomotive shops or other enclosed areas where diesel exhaust may accumulate;
- Filtration of air in the train crew cabin;
- Use of PPE where engineering controls are not sufficient to reduce contaminant exposure to acceptable levels (see Section 2.2).

Fatigue

Locomotive engineers and other railway workers are often required to work irregular work hours which may result in fatigue. Fatigue may be affected by the length and time of the shift (e.g. long night shifts, shift start times); the nature of the changes between shifts (shift rotation); the balance in concentration and stimulation in the work activities being undertaken; insufficient rest breaks; and the time of day. Fatigue, particularly of drivers, signalers, maintenance workers, and others whose work is critical to safe operation, can pose a serious safety risk for railway workers and the general public.[24]

Railway operators should schedule rest periods at regular intervals and during night hours, to the extent feasible, to maximize the effectiveness of rest breaks, and in accordance with international standards and good practices for work time.[25]

Electrical Hazards

Electrified railways use either overhead wires or a conductor rail (e.g. third rail) to transmit electrical power to the train locomotive or multiple units. Overhead power lines may also be present near non-electrified rail lines. General electrical safety measures are addressed in the General EHS Guidelines. In addition, workers exposed to electrical hazards from electrified railways should be trained in personal track safety. Only workers who are specifically trained and competent in working with overhead lines and conductor rails should be allowed to approach these systems.

Electric and Magnetic Fields

Railway workers on electric railway systems may have a higher exposure to electric and magnetic fields (EMF) than the general public due to working in proximity to electric power lines.[26] Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program including the following components:

- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, and limiting access to properly trained workers;

[22] Vibration dampening of the seats can create a difference in relative vibration of the operator and the controls and displays. Operation and legibility problems can result if the difference is large enough.

[23] See International Organization for Standardization (ISO) 2631-1:1997.

[24] Office of Rail Regulation.

[25] For example, see The Council of the European Union, Council Directive 93/104/EC, of 23 November 1993, concerning certain aspects of the organization of working time, amended by Directive 2000/34/EC of 22 June 2000 of the European Parliament and of the Council; and Transport Canada, Work / Rest Rules for Railway Operating Employees (2005).

[26] Detailed studies of workplace exposure to EMF in the United States, Canada, France, England, and several Northern European countries have found no conclusive link or correlation between typical occupational EMF exposure and adverse health effects. However, some studies have identified a possible association between occupational exposure to EMF and cancer, such as brain cancer (U.S. National Institute of Environmental Health Sciences 2002) indicating that there is evidence to warrant limited concern.

- Implementation of an action plan to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the Institute of Electrical and Electronics Engineers (IEEE)[27].

1.2.2 Maintenance of Rolling Stock

Occupational hazards typcially associated with locomotive and railcar maintenance activities may include physical, chemical, and biological hazards as well as confined space entry hazards. Physical hazards may be associated with work in proximity to moving equipment (e.g. locomotives and other vehicles) and machine safety, including work-portable tools, and electrical safety issues. Chemical hazards may include potential exposures to a variety of hazardous materials (e.g. asbestos, PCB, toxic paint, heavy metals, and VOCs, including those resulting from the use of solvent-based paints and cleaning solvents in enclosed spaces). Other chemical hazards may include the potential for fire and explosion during the conduct of hot work in storage tank systems. Biological hazards may include potential exposures to pathogens present in sewage storage compartments. Confined spaces may include access to railroad tank and grain cars during repair and maintenance. All of these occupational health and safety hazards should be managed based on the recommendations provided in the **General EHS Guidelines.**

1.3 Community Health and Safety

Community health and safety impacts during the construction, rehabilitation, and maintenance of railways are common to those of most infrastructure or large industrial facility construction projects, and are discussed in the **General EHS Guidelines**. These impacts include, among others, dust, noise, and vibration from construction vehicle transit, and communicable diseases associated with the influx of temporary construction labor.

Health and safety issues specific to railway operations include:

- General rail operational safety
- Transport of dangerous goods
- Level crossings safety
- Pedestrian safety

General Rail Operational Safety

The most significant safety issue potentially affecting both crew and passengers is the threat of serious injury or the potential loss of life due to train collisions with other trains or with road vehicles, as well as the possibility of derailment due to these or other operational causes. Recommended management actions include:

- Implementation of rail operational safety procedures aimed at reducing the likelihood of train collisions such as a positive train control (PTC) system. If a full PTC system is not practical, automatic rail switches should be installed or, where manual switches remain, documenting when a manually operated switch in non-signaled territory is changed from the main track to a siding, and returned back to the normal position for main track movements. This information should be communicated to all crew members and the train dispatcher;[28]

[27] The International Commission on Non-Ionizing Radiation Protection (ICNIRP) exposure guidelines for Occupational Exposure are listed in Section 2.2 of this Guideline.

[28] PTC allows for the coordination of information to ensure proper train movements.

- Regular inspection and maintenance of the rail lines and facilities to ensure track stability and integrity in accordance with national and international track safety standards;[29]
- Implementation of an overall safety management program that is equivalent to internationally recognized railway safety programs.[30]

Transport of Dangerous Goods

Dangerous goods are frequently transported in bulk or packaged form by rail, representing a potential risk of release to the environment in the event of accidents on a number of other causes.[31] Examples include valve leakage or safety valve releases in pressurized and general-service tank cars or other hazardous material containers (e.g. covered hoppers, intermodal trailers and containers, or portable tanks). In intermodal containers, spills and leaks may result from improper packing and resultant load shifting during transport. Additionally, there is a potential for the release of diesel during fueling operations.[32]

In addition to guidance on hazardous materials management provided in the **General EHS Guidelines**, recommended measures to prevent, minimize, and control releases of hazardous materials during rail transportation and use include the following:

- Implementation of a system for the proper screening, acceptance, and transport of dangerous goods. Since these materials may be provided by third parties, the screening and acceptance process should confirm accordance with international standards applicable to packaging, marking, and labeling of containers (or placarding), as well the necessary certificates and manifests from the shipper.[33]
- Use of tank cars and other rolling stock that meet national and international standards (e.g. thermal protection and puncture resistance) appropriate for the cargo being carried,[34] and implementing a preventive maintenance program;
- Preparation of spill prevention and control, and emergency preparedness and response plans, based on an analysis of hazards, including the nature, consequence, and probability of accidents. Based on result of the hazard analysis, implementation of prevention and control measures which may include:
  - Routing and timing of hazardous materials transport to minimize risk to the community (e.g. restricting transport of hazardous materials on some routes)
  - Limiting train speed in developed areas
  - Construction of protective barriers and other technical measures (e.g. drainage / receptacle provisions) at sensitive locations (e.g. water resources and settlements)
- Dissemination of emergency preparedness and response information to the potentially affected communities (e.g. emergency notification systems and evacuation procedures);

[29] See U.S. Department of Transportation. Federal Railroad Administration. Track Safety Standards, Final Rule, 49 CFR Part 213 (1998)

[30] Examples include the elements of a safety management system specifically applicable to rail such as provided in the European Union Railway Safety Directive (Directive 2004/49/EC) or the Guidelines for the Safety Management System published by the Safety Management in Railways (SAMRAIL) group of the International Union of Railways (UIC).

[31] Although hazardous materials are shipped in various kinds of rail cars (e.g. tank cars, covered hoppers, boxcars, intermodal equipment) tank cars carry the major portion of the traffic.

[32] Gasoline use is typically limited in railroad operations.

[33] Examples of international standards include the Convention Concerning International Carriage by Rail (COTIF). Transport of dangerous goods is addressed in the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID). The most recent version of the Regulations concerning the International Carriage of Dangerous Goods by Rail (RID, 2006) came into effect on January 1, 2007. United Kingdom Department for Transport. Statutory Instrument No. 568. The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (2004).

[34] See, for example, US Department of Transportation, Regulations on Use of Tank Cars, 49 CFR 173.31.

- Implementation of a hazardous material security plan and security awareness training, including provisions for personnel security, prevention of unauthorized access, and measures to reduce risks during storage and transport of hazardous materials;[35]
- Use of standardized fuel spill prevention system for locomotive fueling, including automatic shut-off systems.[36]

Level Crossings Safety

Level crossings (at-grade road / rail intersections) represent high-risk accident locations for railways. On railways with sparse traffic, a flagman may be used to stop all traffic at the crossing and clear the tracks before the approach of a train. Automatic warning lights and bells, and / or closable gates which barricade the roadway are more commonly used. The gates are intended to be complete barriers against intrusion of any road traffic onto the railway. Ungated crossings present the greatest potential risk. Recommendations to prevent, minimize, and control risks associated with level crossings include:

- Use of bridges or tunnels in place of level crossings. The removal of crossings may also improve train performance since most crossings have low speed limits to minimize risks to road traffic;
- Installation of automatic gates at all level crossings, and regular inspection/maintenance to ensure proper operation.

Pedestrian Safety

Trespassers on rail lines and facilities may incur risks from moving trains, electrical lines and equipment, and hazardous substances, among other issues. Measures to minimize, prevent, or control trespassing include:

- Posting of clear and prominent warning signage at potential points of entry to track areas (e.g. stations and level crossings);
- Installation of fencing or other barriers at station ends and other locations to prevent access to tracks by unauthorized persons;
- Local education, especially to young people, regarding the dangers of trespassing;
- Designing stations to ensure the authorized route is safe, clearly indicated, and easy to use;
- Use of closed-circuit television to monitor rail stations and other areas where trespassing occurs frequently, with a voice alarm system to deter trespassers.

[35] See U.S. Department of Transportation, Security Plans, 49 CFR Part 172, Subpart I.

[36] See Association of American Railroads, 2002. Manual of Standards and Recommended Practices Section M—Locomotives and Locomotive Interchange Equipment: RP-5503—Locomotive Fueling Interface.

2.0 Performance Indicators and Monitoring

2.1 Environment

Emissions and Effluent Guidelines

Emissions from new engines used for the propulsion of locomotives and railcars should be consistent with internationally recognized emissions limit values for nitrogen oxides (NOx), particulate matter (PM), carbon monoxide (CO), and Total Hydrocarbons (THC).[37] Railways operations should also target improvements in the efficient use of energy which may contribute to the overall reduction of polluting emissions.[38]

Effluents from maintenance facilities should be treated to a level consistent to the requirements of local sewer network operation or, if discharged into surface waters, according to the guideline values provided in the **EHS Guidelines for Metals, Plastics, and Rubber Products Manufacturing,** which provide treated effluent guideline values applicable to metals machining, cleaning, and plating and finishing processes, including painting. Site-specific discharge levels may be established for sewer and process effluents from maintenance facilities and terminals based on the availability of publicly operated sewage collection and treatment systems or, if discharged directly to surface waters, on the receiving water use classification as described in the **General EHS Guidelines**.[39]

Combustion source emissions guidelines associated with steam- and power-generation activities from sources with a capacity equal to or lower than 50 Megawatt thermal (MWth) are addressed in the **General EHS Guidelines** with larger power source emissions addressed in the **EHS Guidelines for Thermal Power**. Guidance on ambient considerations based on the total load of emissions is provided in the **General EHS Guidelines**.

Environmental Monitoring

Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the **General EHS Guidelines**.

2.2 Occupational Health and Safety

Occupational Health and Safety Guidelines

Occupational health and safety performance should be evaluated against internationally published exposure guidelines, of which examples include the Threshold Limit Value (TLV®) occupational exposure guidelines and Biological Exposure Indices (BEIs®) published by American Conference of

[37] Internationally recognized emissions values include the EU Stage III/IV emissions standards for non-road engines (Directive 2004/26/EC) and US Tier 3 / 4 standards (U.S. EPA 40 CFR Part 92). Achieving the most stringent values for NOx and PM may require the use of secondary controls.

[38] As a point of comparison, average energy use by large freight railroads in the United States in 2004 (the most recent year for which data is available) was 245 kilojoules / revenue freight ton-kilometer (US Department of Transportation, Bureau of Transportation Statistics. 2006. National Transportation Statistics, Table 4-25M).

[39] Effluent guidelines specifically applicable to rail tank car cleaning activities can be found at US EPA 40 CFR Part 442 Subpart B.

Governmental Industrial Hygienists (ACGIH),[40] the Pocket Guide to Chemical Hazards published by the United States National Institute for Occupational Health and Safety (NIOSH),[41] Permissible Exposure Limits (PELs) published by the Occupational Safety and Health Administration of the United States (OSHA),[42] Indicative Occupational Exposure Limit Values published by European Union member states,[43] or other similar sources.

Accident and Fatality Rates

Projects should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities. Facility rates may be benchmarked against the performance of facilities in this sector in developed countries through consultation with published sources (e.g. US Bureau of Labor Statistics and UK Health and Safety Executive)[44].

Occupational Health and Safety Monitoring

The working environment should be occupational hazards relevant to the specific project. Monitoring should be designed and implemented by accredited professionals[45] as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the **General EHS Guidelines**.

[40] Available at: http://www.acgih.org/TLV/ and http://www.acgih.org/store/
[41] Available at: http://www.cdc.gov/niosh/npg/
[42] Available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992
[43] Available at: http://europe.osha.eu.int/good_practice/risks/ds/oel/
[44] http://www.bls.gov/iif/ and http://www.hse.gov.uk/statistics/index.htm
[45] Accredited professionals may include Certified Industrial Hygienists, Registered Occupational Hygienists, or Certified Safety Professionals or their equivalent.

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Annex A: General Description of Industry Activities

Typical railway components include locomotives and railroad cars, known as rolling stock, in addition to fixed infrastructure, including tracks, stations, fueling facilities, and maintenance and repair facilities.

Establishment of railway tracks and infrastructure include the siting of the railway right-of-way. The basic land requirement for a railway right-of-way is approximately 2.5 – 3.0 hectares of land per kilometer of track. Passenger rail systems may require three times this amount of land when including indirect land uses such as stations and parking areas. The land requirement per transport unit (e.g. passenger-km and tonne-km) is about 3.5 times lower for rail than for automobiles.[46]

Project development and construction activities typically include access road construction or upgrade, site preparation and development (e.g. construction of bridges and tunnels), removal of select vegetation, if any, and the grading and excavation of soils for the installation of structural foundations for tracks and site utilities, such as stations, workshop and railway maintenance yards / depots, signaling systems, electricity supplies, and fueling facilities.

Rolling Stock

Locomotives

Passenger and freight railcars are typically pulled or pushed by diesel-powered locomotives. Electric locomotives may be used on rail lines that have electric power supplied by means of overhead lines or a conducting third rail. Modern electrified railway systems typically operate on an alternating current, but many existing direct current (DC) systems are still in use worldwide. The operating voltage for DC systems is in the range of 750 to 3000 volts (V), while for AC systems 15 to 25 kilovolts (kV) is typical. Locomotives are often subdivided by their usage, namely passenger locomotives, freight locomotives, and switcher (or shunting) locomotives. These categories mainly depend on maneuverability, traction power, and speed. Electrically powered locomotives may be equipped with a regenerative brake system to recapture part of the kinetic energy that would otherwise be lost as heat when braking, transmitting it into the overhead wire for use by other locomotives. The locomotives provide the power to move a number of connected passenger or freight (cargo) railroad cars, and this unit is collectively known as a "train".

Passenger Cars

Most passenger cars are made of steel, and may consist of double decks to accommodate passengers. Passenger cars may serve multiple functions including dining and baggage storage. Toilet facilities for passenger cars may deposit waste directly onto the tracks or employ retention tanks that are emptied at stations.

Freight / Cargo Cars

There are a number of types of freight cars designed for specific functions. Common types include:

- *Lorries:* Open top railway cars with tipping troughs, often used for transport of ore or minerals
- *Boxcars:* Enclosed railway cars with side doors used for most kinds of cargo
- *Refrigerator cars:* Refrigerated boxcars for the transport of foodstuffs

[46] European Environment Agency, Spatial and Ecological Assessment of the TEN – demonstration of indicators and GIS methods, 1998.

- *Gondolas:* Railway cars with an open top, enclosed sides and ends, used for bulk commodities and other goods
- *Flatcars:* Open cars for transportation of standard shipping containers and semi-trailers
- *Tank cars:* Tanks for the transport of liquids

Railway Track

The rail track is constructed of two parallel steel rails attached to perpendicular crossties (sleepers) made of timber, concrete or steel. The crossties are mounted in a bed of ballast, with underlying sub-ballast and a fine-grained subgrade foundation. Traditionally, bolted rail joints have been used for all railways. However, continuous-welded rails are now commonly installed when constructing new tracks or replacing rails during track maintenance. Wooden crossties are resilient and tend to give a smooth ride, but require initial chemical treatment to prevent rot and are not structurally suitable for modern high-speed tracks. Ballast generally consists of a 150-225 millimeter (mm) deep layer of stone crushed to a size of 40-65 mm, and provides support for the crossties and promotes drainage.

Railway Operations

The operational activities of rolling stock include all aspects of the movement of locomotives and railcars over a section of track, including passenger and freight transport, loading and unloading of freight at stations, and locomotive fueling. Most modern railways use automatic systems to monitor the location of trains and to operate signal / rail switching infrastructure.[47] Operational and maintenance activities associated with rail infrastructure include the maintenance and clearance of tracks, signaling and switching systems, as well as associated roads, tunnels, bridges, and buildings.

Maintenance Activities

In addition to the track and track right-of-way maintenance activities, maintenance activities may consist of routine servicing or heavy mechanical maintenance activities. Routine maintenance activities may include lubricating oil changes and mechanical safety inspections, exterior washing of locomotives and wagons, and interior washing of rail tankers.

Heavy mechanical maintenance may include replacement of rolling and engine components, engine overhauls, mechanical tests and adjustments, among others. Heavy mechanical maintenance may also include parts machining, welding, cleaning (including degreasing), and other types of activities typically conducted in metal mechanics shops. Passenger and cargo wagons may also be cleaned and painted, including touch up painting, during heavy maintenance.

[47] The flow of train traffic is governed through a system of location and movement signal controls, which are mechanical or electronic and involve the use of time schedules, signs, colored lights, and rail track switching equipment. This system informs train operators regarding the status of the railway line and serves to prevent collisions.

Annexure 10.19. Reporting Format for Borrow Areas Management

(To be filled and submitted by the Contractor for taking permission from GC)

Name of Project Corridor: _____

Name of Contractor : _____

Date :_____

Sl. No.	Approved Borrow Area (BA) No.	Village/ Locality	Ch. in Km & Side (LHS /RHS)	Type of material	Quantity of available material (cum)	Quantity of available material required (cum)	Quantity of available material utilized (cum)	Balance Quantity left out in B.A.	Top Soil conservation	Dust suppression of B.A. & haul Roads – (method & frequency)	Redevelopment (in to Leveled/Pond, etc. for Agriculture purpose)	Land Use		Remarks, if any
												Before	After	

List of Enclosure	Location Map
	Land Owner's Agreement/Consent/Approval
	Redevelopment Plan
	Photographs of Site before use, during operation and after Redevelopment

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.20. IFC's Workers' Accommodation: Processes and Standards

Workers' accommodation: processes and standards

A guidance note by IFC and the EBRD

European Bank
for Reconstruction and Development

The EBRD is an international financial institution that supports projects from central Europe to central Asia. Investing primarily in private sector clients whose needs cannot be fully met by the market, we foster transition towards open and democratic market economies. In all our operations we follow the highest standards of corporate governance and sustainable development.

IFC, a member of the World Bank Group, creates opportunity for people to escape poverty and improve their lives. We foster sustainable economic growth in developing countries by supporting private sector development, mobilising private capital, and providing advisory and risk mitigation services to businesses and governments. Our new investments totalled US$ 15 billion in fiscal 2009, helping play a prominent role in addressing the financial crisis. For more information, visit www.ifc.org.

About this guidance note

This Guidance Note is aimed at providing practical guidance to IFC and EBRD specialists, consultants and clients on the processes and standards that should be applied to the provision of workers' accommodation in relation to projects funded by IFC or the EBRD. Applying appropriate standards to the construction and operation of worker housing falls within the performance requirements on labour and working conditions expected of clients by both institutions. The Guidance Note also provides examples of good practice approaches that businesses have successfully applied in their operations. IFC and the EBRD have not financed all the projects or companies mentioned in the Note. Some of the information in the Note originates from publicly available sources such as company web sites. IFC and the EBRD have not verified the accuracy of such information nor the companies' practices. This Guidance Note is not intended to establish policy itself; and any issues arising in an IFC- or EBRD-financed project will be assessed and addressed in the context of the particular circumstances of that project. The EBRD and IFC recognise that there are no comprehensive international regulations relating to workers' accommodation, and that good and best practices are constantly evolving. The EBRD and IFC intend to update this Guidance Note to reflect such developments, and would welcome feedback and comments from users to contribute to this process. Comments should be sent to environmentalandsocial@ebrd.com and asksustainability@ifc.org

Contents

Workers' accommodation: processes and standards

Public guidance note by IFC and the EBRD

EXECUTIVE SUMMARY

This guidance note addresses the processes and standards that should be applied to the provision of workers' accommodation in relation to projects funded by the EBRD or IFC. Applying appropriate standards to the construction and operation of worker housing falls within the performance requirements on labour issues expected of clients by both organisations.

There is a range of different types of workers' accommodation that may be required by various projects and at different stages within projects, including temporary exploration camps, construction camps and permanent dormitories. Specific issues arise in relation to each of these. This note reviews various international, national, private sector and public sector standards and guidance that are more generally applicable. In some cases clear standards or good practice have been identified. In others, we present a range of standards that provide some flexibility and adaptability within the local context. In these cases, compliance with at least the minimum standard is expected.

Issues for consideration are organised in terms of a staged process to be undertaken in planning, constructing and then operating worker housing facilities. These issues may be relevant to the direct client or to (sub)contractors undertaking particular elements of a project, such as construction or management of facilities. In cases where contractors are used, it is important to set up appropriate mechanisms and processes (reporting/monitoring) to ensure that performance requirements are complied with.

At the initial stage of any project, there is a need to assess whether accommodation for workers is required, and if so, whether this can be provided within existing local communities or whether new facilities should be constructed. The likely impact on local communities and the housing market of either option should be assessed.

Before constructing any facilities, other potential impacts should be evaluated. These may include the impact of construction, and the effect of a new housed labour force on community services, such as health, and on community cohesion and safety. These assessments should form part of a project's Environmental and Social Impact Assessment.

The next step is to consider the standards to be applied for the location, arrangement and construction of any facilities. Issues here include consideration of a safe and healthy location, application of appropriate construction standards, provision of adequate and sanitary living conditions and provision of appropriate leisure and health facilities.

There are no universally applicable international regulations relating to workers' accommodation standards in general. However, there are some international standards/guidance on food safety, water sanitation and waste management that should be applied, and national or local building regulations that must be complied with.

Lastly, when the accommodation has been completed, there are issues around its operation and management. These include the type of staff who will manage it, development of appropriate management policies, such as security and grievance procedures, and ongoing liaison with local communities. All such policies should be subject to regular review.

INTRODUCTION

This guidance note looks at the provision of housing or accommodation for workers by employers and the issues that arise from the planning, construction and management of such facilities.

Generally, workers are housed by their employers in cases where, either the number or the type of workers required cannot be sourced from or accommodated within local communities. Thus provision of workers' accommodation is often associated with the importation of an external workforce into an area. This can occur because the local labour supply or skills base is inadequate, because the workers are simply not available due to the remote location of the worksite or the particular skills required or because labour requirements can only be satisfied by migrant workers due to the nature of the work or the working conditions.

Provision of worker housing may relate to a temporary phase of a project (for example an exploration or construction camp) or may be more permanent (for example a factory dormitory or plantation camp). Depending on the type of accommodation, there are a range of considerations relating to both the living conditions of the workers themselves, and to the impact that workers' housing facilities may have on surrounding communities. The provision of workers' accommodation is a frequent component of large-scale projects funded by institutions such as the EBRD or IFC.

This note is aimed at providing practical guidance to IFC and EBRD specialists, consultants and clients on appropriate policies and standards relating to workers' accommodation. Both the EBRD and IFC apply environmental and social performance standards in relation to their investments that include provisions on labour and working conditions. The EBRD has included a specific provision in its *Environmental and Social Policy* addressing workers' accommodation; paragraph 16 of *Performance Requirement 2* (PR2) stipulates:

> *Where a client provides accommodation for workers, the accommodation shall be appropriate for its location and be clean, safe and, at a minimum, meet the basic needs of workers. In particular, the provision of accommodation shall meet national legislation and international good practice in relation, but not restricted, to the following: the practice for charging for accommodation; the provision of minimum amounts of space for each worker; provision of sanitary, laundry and cooking facilities and potable water; the location of accommodation in relation to the workplace; any health, fire safety or other hazards or disturbances and local facilities; the provision of first aid and medical facilities; and heating and ventilation. Workers' freedom of movement to and from the employer-provided accommodation shall not be unduly restricted.*

IFC *Performance Standard 2* (PS2) aims to promote "safe and healthy working conditions, and to protect and promote the health of workers." Arguably this covers living conditions as well when these are the responsibility of employers. *IFC Guidance Note 2 on Labour and Working Conditions* specifically mentions the potential danger of forced labour when housing is provided to workers in lieu of payment or where inappropriate charges for housing are levied.

In some instances, for example during construction phases of projects, workers will not be directly engaged by the EBRD's or IFC's clients, but by (sub)contractors. However, both the EBRD and IFC require their clients to ensure that non-employee

Box 1 - Construction camp built and operated by a Chinese contractor

This example illustrates the different mechanisms and processes which can be set up in order to ensure that workers' accommodation standards are being implemented by contractors.

Antea, a Greek client of the EBRD and IFC, and a subsidiary of Titan Cement Co, has contracted out the construction of a cement factory in Albania to a Chinese contractor. The construction involves bringing in 700 migrant workers and housing them in workers' accommodation. As part of the contract with the construction company, Antea has included a Code of Conduct and specific language referring to compliance with national labour law, ILO conventions and IFC PS2 and has developed a supervision and monitoring plan (including safety and labour audits) to ensure the construction company is in compliance with all requirements stated in PS2, that living conditions in particular comply with the guidance provided by the EBRD/IFC and that all conditions enhance a safe and good working and living environment. Safety training courses and integration of best practices in accident prevention have been instigated, while solid waste and wastewater generated in the camp is managed in accordance with Albanian regulations and IFC/EBRD guidelines.

workers, engaged by contractors or other intermediaries to work on a project site to perform work related to the core function of the project, are covered by most of the provisions within PS2 and PR2, including (in the EBRD's case) paragraph 16 on workers' accommodation. To this end, clients should set up mechanisms and processes to ensure that contractors and other intermediaries comply with the EBRD's/IFC's standards. This should involve including contractual covenants related to workers' accommodation standards, reviewing contractor agreements, implementing reporting mechanisms and monitoring the implementation of workers' accommodation standards.

A process approach

There are several stages to the process of addressing issues raised by workers' accommodation. These are:

- assessing whether housing is needed for the project and if so, what sort
- assessing impacts on local communities and planning mitigation of potential negative impacts
- awareness of the national and local regulatory framework
- determining the standards to apply to the location of facilities, the construction of housing and provision of facilities
- managing accommodation.

There are no comprehensive international regulations relating to workers' accommodation. However, there are legal and regulatory instruments and guidance that relate to particular aspects of the provision of worker housing.[1] This guidance note is based on a review of these instruments and legislation, as well as guidelines and best practices produced by a range of different private and public sector actions at national and international level. As such, the processes and standards cited often represent a range of acceptable practice. Those correspond to the Benchmark paragraphs under each section. The particular standard to be applied will depend on criteria such as the type of project, location, climate and length of project. In all cases at least the minimum standard included in a given range should be applied. However, depending on the particular circumstances the minimum standard may not always be acceptable, in which case the EBRD/IFC will agree an appropriate higher standard with the client, based on the environmental and social due diligence.

Figure 1: Workers' accommodation, assessment and management process

Need assessment	Is there a need for workers' accommodation?	▸ Assess the availability of the local workforce ▸ Assess the availability of existing housing
Impact assessment	What are the expected impacts (positive and negative) on the communities?	▸ Determine specific impacts of the workers' accommodation construction phase (including security and involuntary resettlement) ▸ Assess existing community infrastructures, services and facilities ▸ Understand the local business and employment context ▸ Give special attention to community health and safety issues and social cohesion ▸ Think about the consequences of dismantling and reinstatement
Construction	Which accommodation standards are needed?	▸ Identify and review the international, national, regional and sectoral regulations which address workers' accommodation ▸ Apply mandatory provisions and use non-binding provisions as guidance ▸ Apply at least the minimum requirements set out in this guidance note
Management	What management systems are required?	▸ Design management plans covering health and safety, security, workers' and communities' rights ▸ Appoint the right staff or contract the right companies ▸ Implement management plans ▸ Set up complaint/grievance and conflict resolution mechanisms (for both workers and communities) ▸ Review policies

1. See footnotes under Part I, introductory remark

PART I: PLANNING AND ASSESSING REQUIREMENTS FOR WORKERS' ACCOMMODATION

In considering worker housing, it is important to first be aware of the international, national and local regulatory framework. At a general level, several international instruments recognise a right to an adequate standard of housing for everyone or for specific categories of the population as part of respecting human rights.[2] To ensure the full realisation of this right, binding instruments generally require the State to take appropriate steps and measures. For workers, the recognition of such a right has been included in ILO Conventions and Recommendations for both Plantations and for Safety and Health in Agriculture, and in the ILO Recommendation 115 on Workers' Housing (1961) in particular. Although the latter is a non-binding recommendation providing guidance on policy, legislation and practice to the State and to the national authorities in charge of housing in particular, it offers useful guidance on what is expected from employers who provide housing to their employees, and it specifies a number of housing standards (See Box 2).

Box 2 - ILO Workers' Housing Recommendation 115

- It is generally not desirable for employers to provide housing for their workers directly and employers should use alternatives where possible. If there are no alternatives, specific attention should be paid to renting arrangements, workers' rights and housing standards. In addition, the possibility of worker-occupants acquiring, for a fair price, ownership of housing provided by the employer should also be examined.
- Renting arrangements should be fair. Adequate and decent housing should not cost the worker more than a reasonable proportion of their income and should never include a speculative profit.
- The employer should be entitled to repossess the accommodation within a reasonable time in the event of termination of the worker's contract of employment and the worker should be entitled to a reasonable period of continued occupancy and/or fair compensation when he ceases to exercise his employment.
- During the time workers spend in the workers' accommodation they should enjoy their fundamental human rights and freedom of association in particular. Workers' accommodation arrangements should not restrict workers' rights and freedoms.
- Housing standards should include special attention to the following:
  - minimum space allocated per person or per family (floor area; cubic volume; or size and number of rooms)
  - supply of safe water in the workers' dwelling in such quantities as to provide for all personal and household uses
  - adequate sewage and garbage disposal systems
  - appropriate protection against heat, cold, damp, noise, fire, and disease-carrying animals, and, in particular, insects
  - adequate sanitary and washing facilities, ventilation, cooking and storage facilities and natural and artificial lighting
  - a minimum degree of privacy both between individual persons within the household and for the members of the household against undue disturbance by external factors
  - the suitable separation of rooms devoted to living purposes from quarters for animals.
- Where accommodations are provided for single workers or workers separated from their families, additional housing standards should be considered:
  - a separate bed for each worker
  - separate gender accommodation
  - adequate sanitary conveniences
  - common dining rooms, canteens, rest and recreation rooms and health facilities, where not otherwise available in the community.

2. See for example
1948 Universal Declaration of Human Rights (Article 25)
1965 Convention on the elimination of all forms of racial discrimination (Article 5)
1966 International Covenant on Economic, Social and Cultural Rights (Article 11.1)
1979 Convention on the elimination of all forms of discrimination against women (Article 14.2)

At a national or regional level, regulations tend to contain only general provisions requiring employers to provide a decent standard of accommodation to workers. However, in some jurisdictions there are detailed regulations or standards setting out a comprehensive framework to be applied.[3] There may also be building regulations relating to issues such as sanitation, safety or building materials that must be adhered to. Therefore, national regulations and standards are the first place to look when determining the necessary standards for living facilities. However, responsibility for planning and building standards may well lie with regional or local levels of government, so it is important that these local authorities are consulted. Provisions on workers' accommodation can also be found in policy, guidelines or codes of practice adopted by a wide variety of actors such as international bodies, industry associations, national, regional or local authorities.[4] Compliance with national and local law is the basic and essential requirement.

Benchmarks

1. The international/national/local regulatory frameworks on workers' accommodation have been reviewed.

2. Identified mandatory provisions on workers' accommodation are implemented thoroughly.

I. Assessing the need for workers' accommodation

Before building and running workers' accommodation, it is important to understand the local housing and labour markets and the potential effects the building of new facilities may have on the surrounding communities.

A. Availability of workforce

At the initial scoping phase of a project, it is important to consider whether workers' accommodation is needed at all. In this respect, it is worth analysing the project's workforce requirements including skills and likely numbers over the project cycle and to assess the capacity of the local population to meet those workforce requirements either from its current base or as a result of training. It is preferable to source labour from the local communities as this has many advantages; not only in terms of reducing the need for workers' accommodation, but also as it will increase the direct and indirect benefits to the community arising from the project. This approach is strongly supported by the EBRD and IFC. Any national/local requirements to promote local employment opportunities must also be taken into account. It should be noted that even in the absence of such requirements, new recruitment on EBRD/IFC-financed projects must not be discriminatory.

Benchmarks

1. There has been an assessment of workers' availability in the neighbouring communities.

2. There has been an assessment of the skills and competencies of the local workforce and how those skills and competencies fit the project needs.

3. There has been an assessment of opportunities to train the local workforce to fulfil the project's needs.

B. Availability of existing housing

If local workers are unavailable or not sufficiently skilled, the question arises of whether external workers can be accommodated within the existing local housing capacity or whether new facilities are needed. In general, the decision to utilise host-community accommodation or to develop on-site accommodation will be based on factors such as whether project development is occurring near to larger, established population centres and on the capacity of any nearby communities, quality of housing stock and the capacity of the environment to assimilate a new workforce.

If existing capacity is available, in the form, for example, of lodging with local families, hotels, hostels or rented housing, the impact on the local communities and housing market should be assessed. Such off-site housing may create a wide range of economic opportunities such as rental income for local people or development of local businesses (shops and restaurants for instance), which are positive project impacts, and may also result in improvements to existing housing stock. However, off-site housing may also be associated with a range of adverse social impacts including increased demands on infrastructure, services and utilities, development of illicit trade activities (drugs, prostitution, selling of stolen goods) and inflation in local rent and other subsistence items with detrimental

3. See for example:
United States - Occupational Health and Safety Act (Standards 29, paragraph 1910.142)
Brazil - Health and safety regulation in the agricultural, livestock farming, forestry and aquaculture sectors, 2005
Malaysia - Workers' minimum standards of housing and amenities Act, 1990
South Africa - Basic condition of employment Act, 1997
New South Wales, Australia - Rural Workers Accommodation Act, 1969
Western Australia - Construction camp regulations, 1970
Dubai Municipality - Labour camp specifications (last updated in 2007)

4. See for example:
New South Wales, Australia - Accommodation for rural agricultural work, code of practice, 2006
Singapore - Code of practice on environmental health, 2005
Israel - Guide for Migrant Workers, Housing
ILO - Code of Practice, safety and health in forestry work, 1998
City of Geraldton-Greenough, Western Australia, Local planning policy - Temporary accommodation camps, 2006
Sustainable Agriculture Network Standards, 5.14, 2009.

consequences for the local population. If a project anticipates that the workforce is to be resident within the local communities it is good practice to provide financing options for local residents to develop and/or improve hostels for instance.

Conversely, to provide on-site housing opportunities minimises workforce-host community interactions and reduces the pressure on existing infrastructures and can also pre-empt the development of various external activities such as prostitution.

In some cases, it may be feasible and beneficial to offer workers or certain categories of workers an option between self-accommodation and company-provided accommodation with varying compensation accordingly.

To avoid or mitigate the most negative impacts, it is important to conduct a comprehensive assessment of the housing market and the likely impact of the various options for workers' accommodation. For larger projects, this assessment will best be done at the stage of the Environmental and Social Impact Assessment (ESIA). Measures resulting from this assessment will need to be incorporated in tendering and contracting documentation. Furthermore, in cases where local facilities are utilised, potential mitigation measures for adverse impacts such as increased inflationary rates on local costs must be assessed in the ESIA, and procedures that will be implemented to monitor this must also be presented.

Benchmarks

1. Prior to building any workers' accommodation, a comprehensive assessment of the local housing market has been conducted and the different types of housing available in the surrounding communities have been identified. For larger projects this assessment has been conducted at the stage of the project's Environmental and Social Impact Assessment.

2. There has been an assessment on communities of the impact of using existing housing opportunities.

3. Measures to mitigate adverse impacts on the local housing market have been identified and included in the Environmental and Social Action Plan (ESAP) or other relevant action plan.

II. Assessing impacts of workers' accommodation on communities

Where the need to provide new workers' accommodation is identified, it is important to consider how this will impact on the surrounding communities. This may be relevant both to the construction phase of the camp (or other accommodation) and during its operation. Risk identification and assessments specific to the workers' accommodation should be undertaken as part of the Environmental and Social Impact Assessment and any related development of an Environmental and Social Action Plan. This assessment can also be used to determine whether contact between non-local workforce and local communities should be encouraged or minimised.

Box 3 - Singapore National Environment Agency - Code of Practice on Environmental Health, 2005

The following guidelines shall be used for stand-alone dormitories.

- If the dormitory does not provide a separate space for cupboards/locker rooms, the minimum room space shall be 4 square metres per person (assuming a height of 2.4m).
- If the dormitory provides a separate space for cupboards/locker rooms, the minimum room space shall be 3 square metres per person (assuming a height of 2.4m).
- The room shall be adequately ventilated and lit.
- Adequate number of toilets and sanitary fittings shall be provided (1 toilet, 1 hand wash basin, 1 urinal and 1 bathroom with bench per 15 male workers).
- Where cooking area is to be provided in the dormitories, such provisions shall be in accordance with the requirements stipulated under Section 2.4 of the latest edition of Singapore Standard CP 102.

The above Singapore guidelines are mentioned as an example of "soft" regulations only. The standards described above may be inappropriate in different environments. Other standards apply in other countries.

A. Specific impacts during the construction phase

The construction of workers' accommodation and its potential impacts on communities should be managed in the same way as for construction of the project itself. Impacts need to be identified and may include health and safety, disturbance issues arising from construction, including traffic (dust, noise and vibration), and involuntary resettlement issues (including physical and economical displacement) when the erecting of workers' accommodation entails land acquisition.

B. Community infrastructure

Workers' influx in the vicinity of a community may strain existing infrastructure, in particular the water and sanitation, electricity and transport systems. Impacts of the worker facility should be avoided or mitigated, and included within the assessment of the overall project.

In general, where facilities are developed close to local communities it is important to provide adequate transport systems to preserve the right of workers' freedom of movement if they are not to become effectively "trapped". This should be balanced against the need to prevent any unecessary disruption of and/or to the local communities. Therefore it may be appropriate to limit worker movements, but any restriction should be clearly justified by the need to avoid the disruption of local communities, in particular local communities' transport infrastructures – and to provide maximum security and safety to both workers and communities (see PART II, Section E "Workers' rights, rules and regulations on workers' accommodation", below at page 21).

C. Community services and facilities

Depending on the size of the workers' accommodation, conditions of engagement (accompanied or unaccompanied) and the level of services offered to those workers, it may be necessary to assess the impact of workers on local medical, social, educational and recreational services and facilities, potentially to the detriment of nearby communities. It must be ensured that such services and facilities can meet increased demand. If not, services must be available to the workers on site.

D. Local businesses and local employment

Local businesses such as shops, restaurants or bars are likely to benefit from their proximity to workers' living facilities. However, there may also be negative issues that need to be managed such as increases in local prices, crime, prostitution or alcohol consumption (see below Part II, section E).

E. Community health and safety

The presence of a large number of workers, principally males, can give rise to an increased spread of communicable diseases such as HIV/AIDS in particular and other sexually transmitted diseases. In addition, special attention should be paid to risks such as road accidents, and other detrimental consequences of increased traffic generated by the project (dust, noise, and pollution). If the proposed project has major-accident hazards associated with it, emergency response and evacuation plans in accordance to PS4/PR4 will also need to be in place.

F. Community cohesion

The impact of the presence of workers with different lifestyles or cultural backgrounds on the host community needs to be assessed and managed, in particular issues such as religious or other cultural proscriptions, local traditions and community structure and the relationship between men and women.

G. Land acquisition and resettlement

Impacts and mitigation plans relating to land used for workers' accommodation facilities should be managed in the same way as for the project as a whole. As far as possible, land acquisition should be avoided or minimised.

H. Dismantling and reinstatement

Dismantling and reinstatement of workers' accommodation should be taken into account at the outset of the project in order to avoid any unnecessary lasting impacts of the accommodations on the communities (land use for instance). Where possible and appropriate, the facilities can be handed over to the communities.

Benchmarks

1. A community impact assessment has been carried out as part of the Environmental and Social Assessment of the overall project with a view to mitigate the negative impacts of the workers' accommodation on the surrounding communities and to enhance the positive ones.

2. The assessment includes potential health and safety impacts on the communities - including disturbances and safety issues caused by traffic (dust, noise, vibration, road accidents, disease) and consequences of land acquisition and involuntary resettlement occurring during the construction phase of the workers' accommodation.

3. Positive and negative impacts of workers' accommodation on community infrastructures, services and facilities have been included in the assessment, including specific attention to emergency responses and evacuation plans.

4. Impacts of workers' accommodation on community local businesses and local employment have been included in the assessment.

5. General impacts of workers' accommodation on the health of communities (notably the increased risk of road accidents and the increase of communicable diseases) and community social cohesion have been included in the assessment.

6. The assessment includes appropriate mitigation measures to address any adverse impacts identified.

Table 1: A typology of workers' accommodation

Category	Subcategory/examples	Common characteristics	Sectors covered	Key issues
Rural workers' accommodation	Logging camp Off-farm accommodation	Permanent or seasonal Remote	Forestry Agriculture	Worker access Monitoring difficulties
Plantation housing	Worker village Off-farm accommodation	Permanent and long term Families	Agriculture	Need to provide sustainable livelihoods Social infrastructures Living conditions
Construction camp	Worker camp Worker village Mobile worker camp	Temporary Migrant workers Gender separation	Extractives Utilities Infrastructure Manufacturing	Enforcement of standards and monitoring difficulties Relations with the communities Living standards Cost
Mine camp	Company towns Dormitories Integrated within existing communities Commuter (fly-in, fly-out)	Long term Remote location Gender separation	Extractives	Relations with communities Remoteness Living standards Worker access Long shifts No rest periods
Factory dormitory		Permanent Urban Internal migrants	Garments/textiles Manufacturing – toys, electronics	Space Privacy Living standards Deduction of excessive rent from wages

III. Types of workers' accommodation

There is a large variety of workers' living facilities. These may be classified in a number of ways. Table 1 provides one typology. Key criteria may include whether the facilities are temporary or permanent, their location (remote or non-remote), size, or economic sector (agriculture, mining, oil and gas, construction, manufacturing).

The typology above is given as an example only; other classifications are possible. For instance, housing may be categorised in terms of project phases for example, exploration (fly-in, fly-out camps), construction (temporary construction camp often with large proportion of migrant workers) and operational (permanent, dormitory, possible family accommodation).

Depending on the type of project, specific attention should be given to either providing single workers' accommodation or family accommodation. As a general rule, the more permanent the housing, the greater considerations should be given to enabling workers to live with their families. Such consideration is important where the workforce is

Box 4 - Best practice on home-ownership

When access to property schemes is proposed it is important to guarantee the sustainability of workers' investments. To this end, the location of the project and of the workers' accommodation and their integration in existing communities are factors to take into consideration. Caution should be exercised when offering such schemes in remote locations as it might be impossible to create a sustainable community and to develop non-project-related sources of livelihood.

Affordable housing in a sustainable town: A provider of affordable housing in South Africa and a provider of housing development for the mining sector worked together on a project to move away from mining hostels and rental villages to providing home-ownership opportunities to workers. To this end they developed a 400-plus unit in a village 20 km from the mine with the idea to create an economically and socially viable community close to the mine. A concern was to integrate people within existing communities with the necessary social amenities and infrastructures and to put the emphasis on better housing conditions, home ownership and affordable housing for mining workers. The success of the project relied on the ability for the service provider to take into account the often difficult financial situation of workers. To overcome over-indebtedness of workers, specific access to property schemes and programmes have been designed including employer support, economies of scale, low interest rate and stepped payment options.

Affordable housing in a self-sustaining community: An FMO (Netherlands Development Finance Company) client operating a mine in a remote location intends to manage and develop a well-planned, secure and independent village for approximately 1,000 employees. The FMO client is expected to provide residents with basic services, including water, electricity and sewerage as well as education, health services, sports facilities, shops, green areas and places of worship. In addition, provision has been made for a light industrial and small business area to support local business development. The long-term vision is for the Village to grow into a self-sustaining community of over 4,000 houses, which is capable of supporting a variety of small businesses and local enterprises. To support the long-term vision of a self-sustaining village and to provide mine employees with an opportunity to build up cash equity (in the form of a house), the FMO client will promote home ownership. In this context, an employee housing scheme has been designed that allows mine employees in all income categories to acquire title to property through mortgage debt all associated rights and obligations. Participation in the scheme is not a prerequisite for employment. The scheme includes several provisions to ensure affordability of home ownership to all mine employees and to protect employees against downside risks.

not sourced locally and in particular where migrant workers are used.[5] Provision for families will affect the other facilities necessary and the management of the accommodation. Best practice includes:

- To provide workers and their families individual family accommodation comprising bedrooms, sanitary and cooking facilities with an adequate level of privacy allowing families to have a normal family life.

- To provide nurseries, schools, clinics and recreational facilities for children, or to make sure that those services are readily available in the surrounding communities and of good quality.

Benchmarks

1. Consideration has been given to provision of family accommodation.

2. When arrangements for family accommodations are in place:
   - families are provided with individual accommodation comprising bedroom, sanitary and cooking facilities
   - adequate nursery/school facilities are provided
   - special attention is paid to providing adequate safety for children.

Additional issue

In projects located in rural and remote locations, issues around the question of how workers can travel to their communities/countries of origin might arise. Alternatively, the possibility to create a sustainable community and to bring in the workers' families might be considered.

Box 5 - Best practice on migrant workers' accommodation: Business in the Community - Voluntary Code of Practice on Employing Migrant Workers/Overseas Staff in Great Britain[6]

The Code, which is designed to guide and reinforce best practice in relation to the employment of migrant workers, points out that migrant workers will often have to travel long distances and be in need of accommodation when they take up a job. Consequently, the Code suggests the following.

- Employers should assist with travel costs incurred by migrant workers during the recruitment stage and the repayment of these costs should follow a clear process and the money paid back at an agreed affordable rate over a specified time period. The total amount repayable should be no more than that lent so that workers are not financially disadvantaged.

- Employers, where possible, should support migrant workers in finding suitable accommodation. Workers should not be required to stay in accommodation provided by the employer but should be free to choose their own if they wish to do so. Where employers do provide accommodation, they should ensure that they do not breach the rules relating to the apportionment of wages for payment for accommodation (the accommodation offset rules).

- Employers should help to ensure that, where workers obtain their own accommodation, they are not being exploited, and offer advice and help if requested.

- Employers should ensure that accommodation which is provided is not overcrowded and does not pose a risk to the health and safety of those living there, and that any agreed notice periods are observed.

5. On the increase in the recognition of workers' rights to family life, the ILO Migrant Workers Convention No 143 calls Member States to take all necessary measures which fall within its competence and collaborate with other Members to facilitate the reunion of the families of all migrant workers legally residing in its territory. In the same way, Art 44-2 of the International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families requires States Parties to take measures that they deem appropriate and that fall within their competence to facilitate the reunion of migrant workers with their spouses [...]as well as with their minor dependent unmarried children.

6. www.bitc.org.uk/resources/publications/migrant_workers_1.html

PART II: STANDARDS FOR AND MANAGEMENT OF WORKERS' ACCOMMODATION

I. Standards for workers' accommodation

This section looks at the principles and standards applicable to the location and construction of workers' accommodation, including the transport systems provided, the general living facilities, rooms/dormitories facilities, sanitary facilities, canteen and cooking facilities, food safety, medical facilities and leisure/social facilities.

A. National/local standards

The key standards that need to be taken into consideration, as a baseline, are those contained in national/local regulations. Although it is quite unusual to find regulations specifically covering workers' accommodation, there may well be general construction standards which will be relevant. These may include the following standards:

- Building construction: for example, quality of material, construction methods, resistance to earthquakes.
- Housing and public housing: in some countries regulations for housing and public housing contain requirements on issues such as the basic amenities, and standards of repair.
- General health, safety and security: requirements on health and safety are often an important part of building standards and might include provisions on occupation density, minimal air volumes, ventilation, the quality of the flooring (slip-resistant) or security against intrusion.
- Fire safety: requirements on fire safety are common and are likely to apply to housing facilities of any type. This can include provision on fire extinguishers, fire alarms, number and size of staircases and emergency exits, restrictions on the use of certain building materials.
- Electricity, plumbing, water and sanitation: national design and construction standards often include very detailed provisions on electricity or plumbing fixtures/fittings, water and sanitation connection/ equipment.

Benchmark

1. The relevant national and local regulations have been identified and implemented.

B. General living facilities

Ensuring good standards in living facilities is important in order to avoid safety hazards and to protect workers from diseases and/or illness resulting from humidity, bad/stagnant water (or lack of water), cold, spread of fungus, proliferation of insects or rodents, as well as to maintain a good level of morale. The location of the facilities is important to prevent exposure to wind, fire, flood and other natural hazards. It is also important that workers' accommodation is unaffected by the environmental or operational impacts of the worksite (for example noise, emissions or dust) but is sufficiently close that workers do not have to spend undue amounts of time travelling from their accommodation to the worksite. Living facilities should be built using adequate materials and should always be kept in good repair, clean and free from rubbish and other refuse.

Benchmarks

1. Living facilities are located to avoid flooding and other natural hazards.

2. Where possible, living facilities are located within a reasonable distance from the worksite.

3. Transport from the living facilities to worksite is safe and free.

4. The living facilities are built with adequate materials, kept in good repair and kept clean and free from rubbish and other refuse.

Drainage

The presence of stagnant water is a factor of proliferation of potential disease vectors such as mosquitoes, flies and others, and must be avoided.

Benchmarks

1. The building site is adequately drained to avoid the accumulation of stagnant water.

Heating, air conditioning, ventilation and light
Heating, air-conditioning and ventilation should be appropriate for the climatic conditions and provide workers with a comfortable and healthy environment to rest and spend their spare time.

Benchmarks

1. For facilities located in cold weather zones, the temperature is kept at a level of around 20 degrees Celsius notwithstanding the need for adequate ventilation.

2. For facilities located in hot weather zones, adequate ventilation and/or air conditioning systems are provided.

3. Both natural and artificial lighting are provided and maintained in living facilities. It is best practice that the window area represents not less than 5% to 10% of the floor area. Emergency lighting is provided.

Water
Special attention to water quality and quantity is absolutely essential. To prevent dehydration, water poisoning and diseases resulting from lack of hygiene, workers should always have easy access to a source of clean water. An adequate supply of potable water must be available in the same buildings where bedrooms or dormitories are provided. Drinking water must meet local or WHO drinking water standards[7] and water quality must be monitored regularly. Depending on the local context, it could either be produced by dedicated catchment and treatment facilities or tapped from existing municipal facilities if their capacity and quality are adequate.

Benchmarks

1. Access to an adequate and convenient supply of free potable water is always available to workers. Depending on climate, weather conditions and accommodation standards, 80 to 180 litres per person per day are available.

2. Drinking water meets national/local or WHO drinking water standards.[8]

3. All tanks used for the storage of drinking water are constructed and covered as to prevent water stored therein from becoming polluted or contaminated.

4. Drinking water quality is regularly monitored.

Wastewater and solid waste
Wastewater treatment and effluent discharge as well as solid waste treatment and disposal must comply with local or World Bank effluent discharge standards[9] and be adequately designed to prevent contamination of any water body, to ensure hygiene and to avoid the spread of infections and diseases, the proliferation of mosquitoes, flies, rodents, and other pest vectors. Depending on the local context, treatment and disposal services can be either provided by dedicated or existing municipal facilities.

Benchmarks

1. Wastewater, sewage, food and any other waste materials are adequately discharged, in compliance with local or World Bank standards – whichever is more stringent – and without causing any significant impacts on camp residents, the biophysical environment or surrounding communities.

2. Specific containers for rubbish collection are provided and emptied on a regular basis. Standards range from providing an adequate number of rubbish containers to providing leak proof, non-absorbent, rust and corrosion-resistant containers protected from insects and rodents. In addition it is best practice to locate rubbish containers 30 metres from each shelter on a wooden, metal, or concrete stand. Such containers must be emptied at regular intervals (to be determined based on temperatures and volumes generated) to avoid unpleasant odours associated with decaying organic materials.

3. Pest extermination, vector control and disinfection are carried out throughout the living facilities in compliance with local requirements and/or good practice. Where warranted, pest and vector monitoring should be performed on a regular basis.

7. www.who.int/water_sanitation_health/dwq/en/
8. ibid

9. As per the "Pollution Prevention and Abatement Handbook", World Bank Group, July 1998, available from www.worldbank.org

C. Room/dormitory facilities

The standards of the rooms or dormitory facilities are important to allow workers to rest properly and to maintain good standards of hygiene. Overcrowding should be avoided particularly. This also has an impact on workers' productivity and reduces work-related accidents. It is generally acknowledged that rooms/dormitories should be kept clean and in a good condition. Exposure to noise and odour should be minimised. In addition, room/dormitory design and equipment should strive to offer workers a maximum of privacy. Resorting to dormitories should be minimised and single or double rooms are preferred. Dormitories and rooms must be single-sex.

Benchmarks

1. Rooms/dormitories are kept in good condition.

2. Rooms/dormitories are aired and cleaned at regular intervals.

3. Rooms/dormitories are built with easily cleanable flooring material.

4. Sanitary facilities are located within the same buildings and provided separately for men and women.

5. Density standards are expressed either in terms of minimal volume per resident or of minimal floor space. Usual standards range from 10 to 12.5 cubic metres (volume) or 4 to 5.5 square metres (surface).

6. A minimum ceiling height of 2.10 metres is provided.

7. In collective rooms, which are minimised, in order to provide workers with some privacy, only a reasonable number of workers are allowed to share the same room. Standards range from 2 to 8 workers.

8. All doors and windows should be lockable, and provided with mosquito screens where conditions warrant.

9. There should be mobile partitions or curtains to ensure privacy.

10. Every resident is provided with adequate furniture such as a table, a chair, a mirror and a bedside light.

11. Separate sleeping areas are provided for men and women, except in family accommodation.

Additional issue

Irrespective of whether workers are supposed to keep their facilities clean, it is the responsibility of the accommodation manager to ensure that rooms/dormitories and sanitary facilities are in good condition.

Bed arrangements and storage facilities

The provision of an adequate numbers of beds of an appropriate size is essential to provide workers with decent, safe and hygienic conditions to rest and sleep. Here again, particular attention should be paid to privacy. Consideration should be given to local customs so beds could be replaced by hammocks or sleeping mats for instance.

Benchmarks

1. A separate bed for each worker is provided. The practice of "hot-bedding" should be avoided.

2. There is a minimum space between beds of 1 metre.

3. Double deck bunks are not advisable for fire safety and hygiene reasons, and their use is minimised. Where they are used, there must be enough clear space between the lower and upper bunk of the bed. Standards range from to 0.7 to 1.10 metres.

4. Triple deck bunks are prohibited.

5. Each worker is provided with a comfortable mattress, pillow, cover and clean bedding.

6. Bed linen is washed frequently and applied with repellents and disinfectants where conditions warrant (malaria).

7. Facilities for the storage of personal belongings for workers are provided. Standards vary from providing an individual cupboard for each worker to providing 475-litre big lockers and 1 metre of shelf unit.

8. Separate storage for work boots and other personal protection equipment, as well as drying/airing areas may need to be provided depending on conditions.

D. Sanitary and toilet facilities

It is essential to allow workers to maintain a good standard of personal hygiene but also to prevent contamination and the spread of diseases which result from inadequate sanitary facilities. Sanitary and toilet facilities will always include all of the following: toilets, urinals, washbasins and showers. Sanitary and toilet facilities should be kept in a clean and fully working condition. Facilities should also be constructed of materials that are easily cleanable and ensure privacy. Sanitary and toilet facilities are never shared between male and female residents, except in family accommodation. Where necessary, specific additional sanitary facilities are provided for women.

Benchmarks

1. Sanitary and toilet facilities are constructed of materials that are easily cleanable.

2. Sanitary and toilet facilities are cleaned frequently and kept in working condition.

3. Sanitary and toilet facilities are designed to provide workers with adequate privacy, including ceiling to floor partitions and lockable doors.

4. Sanitary and toilet facilities are not shared between men and women, except in family accommodation.

Toilet facilities

Toilet arrangements are essential to avoid any contamination and prevent the spread of infectious disease.

Benchmarks

1. An adequate number of toilets is provided to workers. Standards range from 1 unit to 15 persons to 1 unit per 6 persons. For urinals, usual standards are 1 unit to 15 persons.

2. Toilet facilities are conveniently located and easily accessible. Standards range from 30 to 60 metres from rooms/dormitories. Toilet rooms shall be located so as to be accessible without any individual passing through any sleeping room. In addition, all toilet rooms should be well-lit, have good ventilation or external windows, have sufficient hand wash basins and be conveniently located. Toilets and other sanitary facilities should be ("must be" in cold climates) in the same building as rooms and dormitories.

Showers/bathrooms and other sanitary facilities

Hand wash basins and showers should be provided in conjunction with rooms/dormitories. These facilities must be kept in good working condition and cleaned frequently. The flooring for shower facilities should be of hard washable materials, damp-proof and properly drained. Adequate space must be provided for hanging, drying and airing clothes. Suitable light, ventilation and soap should be provided. Lastly, hand washing, shower and other sanitary facilities should be located within a reasonable distance from other facilities and from sleeping facilities in particular.

Benchmarks

1. Shower/bathroom flooring is made of anti-slip hard washable materials.

2. An adequate number of handwash facilities is provided to workers. Standards range from 1 unit to each 15 persons to 1 unit per 6 workers. Handwash facilities should consist of a tap and a basin, soap and hygienic means of drying hands.

3. An adequate number of shower/bathroom facilities is provided to workers. Standards range from 1 unit to 15 persons to 1 unit per 6 persons.

4. Showers/bathrooms are conveniently located.

5. Shower/bathroom facilities are provided with an adequate supply of cold and hot running water.

E. Canteen, cooking and laundry facilities

Good standards of hygiene in canteen/dining halls and cooking facilities are crucial. Adequate canteen, cooking and laundry facilities and equipments should also be provided. When caterers are contracted to manage kitchens and canteens, special attention should be paid to ensure that contractors take into account and implement the benchmarks below, and that adequate reporting and monitoring mechanisms are in place. When workers can individually cook their meals, they should be provided with a space separate from the sleeping areas. Facilities must be kept in a clean and sanitary condition. In addition, canteen, kitchen, cooking and laundry floors, ceilings and walls should be made of easily cleanable materials.

Benchmarks

1. Canteen, cooking and laundry facilities are built in adequate and easy to clean materials.

2. Canteen, cooking and laundry facilities are kept in a clean and sanitary condition.

3. If workers can cook their own meals, kitchen space is provided separate from sleeping areas.

Laundry facilities

Providing facilities for workers to wash both work and non-work related clothes is essential for personal hygiene. The alternative is for the employer to provide a free laundry service.

Benchmarks

1. Adequate facilities for washing and drying clothes are provided. Standards range from providing sinks or tubs with hot and cold water, cleaning soap and drying lines to providing washing machines and dryers.

2. When work clothes are used in contact with dangerous substance (for example, application of pesticide), special laundry facilities (washing machines) should be provided.

Additional issue

When workers are provided with facilities allowing them to individually do their laundry or cooking, it should be the responsibility of each worker to keep the facilities in a clean and sanitary condition. Nonetheless, it is the responsibility of the accomodation manager to make sure the standards are respected and to provide an adequate cleaning, disinfection and pest/vector control service when necessary.

Additional issue

When the employer provides family accommodation, it is best practice to provide each family with a private kitchen or the necessary cooking equipment to allow the family to cook on their own.

Canteen and cooking facilities

Canteen and cooking facilities should provide sufficient space for preparing food and eating, as well as conform to hygiene and safety requirements.

Benchmarks

1. Canteens have a reasonable amount of space per worker. Standards range from 1 square metre to 1.5 square metres.

2. Canteens are adequately furnished. Standards range from providing tables, benches, individual drinking cups and plates to providing special drinking fountains.

3. Places for food preparation are designed to permit good food hygiene practices, including protection against contamination between and during food preparation.

4. Kitchens are provided with facilities to maintain adequate personal hygiene including a sufficient number of washbasins designated for cleaning hands with clean, running water and materials for hygienic drying.

5. Wall surfaces adjacent to cooking areas are made of fire-resistant materials. Food preparation tables are also equipped with a smooth durable washable surface. Lastly, in order to enable easy cleaning, it is good practice that stoves are not sealed against a wall, benches and fixtures are not built into the floor, and all cupboards and other fixtures and all walls and ceilings have a smooth durable washable surface.

6. All kitchen floors, ceiling and wall surfaces adjacent to or above food preparation and cooking areas are built using durable, non-absorbent, easily cleanable, non-toxic materials.

7. Wall surfaces adjacent to cooking areas are made of fire-resistant materials. Food preparation tables are equipped with a smooth, durable, easily cleanable, non-corrosive surface made of non-toxic materials. Lastly, in order to enable easy cleaning, it is good practice that stoves are not sealed against a wall, benches and fixtures are not built into the floor, and all cupboards and other fixtures have a smooth, durable and washable surface.

8. Adequate facilities for cleaning, disinfecting and storage of cooking utensils and equipment are provided.

9. Food waste and other refuse are to be adequately deposited in sealable containers and removed from the kitchen frequently to avoid accumulation.

F. Standards for nutrition and food safety

When cooking for a number of workers, hygiene and food safety are absolutely critical. In addition to providing safe food, providing nutritious food is important as it has a very direct impact on workers' productivity and well-being. An ILO study demonstrates that good nutrition at work leads to gains in productivity and worker morale, prevention of accidents and premature deaths and reductions in health care costs.[10]

Benchmarks

1. The WHO 5 keys to safer food or an equivalent process is implemented (see Box 6 below).

2. Food provided to workers contains an appropriate level of nutritional value and takes into account religious/cultural backgrounds; different choices of food are served if workers have different cultural/ religious backgrounds.

3. Food is prepared by cooks. It is also best practice that meals are planned by a trained nutritionist.

Box 6 - Five keys to safer food

Keep clean	
Wash your hands before handling food and often during food preparation. Wash your hands after going to the toilet. Wash and sanitise all surfaces and equipment used for food preparation. Protect kitchen areas and food from insects, pests and other animals.	While most micro organisms do not cause disease, dangerous micro organisms are widely found in soil, water, animals and people. These micro organisms are carried on hands, wiping cloths and utensils, especially cutting boards and the slightest contact can transfer them to food and cause food borne diseases.
Separate raw and cooked	
Separate raw meat, poultry and seafood from other foods. Use separate equipment and utensils such as knives and cutting boards for handling raw foods. Store food in containers to avoid contact between raw and prepared foods.	Raw food, especially meat, poultry and seafood, and their juices, can contain dangerous micro organisms which may be transferred onto other foods during food preparation and storage.
Cook thoroughly	
Cook food thoroughly, especially meat, poultry, eggs and seafood. Bring foods like soups and stews to boiling to make sure that they have reached 70°C. For meat and poultry, make sure that juices are clear, not pink. Ideally, use a thermometer. Reheat cooked food thoroughly.	Proper cooking kills almost all dangerous micro organisms. Studies have shown that cooking food to a temperature of 70°C can help ensure it is safe for consumption. Foods that require special attention include minced meats, rolled roasts, large joints of meat and whole poultry.
Keep food at safe temperatures	
Do not leave cooked food at room temperature for more than 2 hours. Refrigerate promptly all cooked and perishable food (preferably below 5°C). Keep cooked food piping hot (more than 60°C) prior to serving. Do not store food too long even in the refrigerator. Do not thaw frozen food at room temperature.	Micro organisms can multiply very quickly if food is stored at room temperature. By holding at temperatures below 5°C or above 60°C, the growth of micro organisms is slowed down or stopped. Some dangerous micro organisms still grow below 5°C.
Use safe water and raw materials	
Use safe water or treat it to make it safe. Select fresh and wholesome foods. Choose foods processed for safety, such as pasteurised milk. Wash fruits and vegetables, especially if eaten raw. Do not use food beyond its expiry date.	Raw materials, including water and ice, may be contaminated with dangerous micro organisms and chemicals. Toxic chemicals may be formed in damaged and mouldy foods. Take care in selection of raw materials and implement simple measures such as washing.

Source: World Health Organization, Food Safety
www.who.int/foodsafety/publications/consumer/en/5keys_en.pdf

10. C. Wanjek (2005), "Food at Work – Workplace solutions for malnutrition, obesity and chronic disease", International Labour Organization, Geneva.

G. Medical facilities

Access to adequate medical facilities is important to maintain workers' health and to provide adequate responses in case of health emergency situations. The availability or level of medical facilities provided in workers' accommodation is likely to depend on the number of workers living on site, the medical facilities already existing in the neighbouring communities and the availability of transport. However, first aid must always be available on site.

First aid facilities
Providing adequate first aid training and facilities can save lives and prevent minor injuries becoming major ones.

Other medical facilities
Depending on the number of workers living on site and the medical services offered in the surrounding communities, it is important to provide workers with additional medical facilities. Special facilities for sick workers and medical services such as dental care, surgery, a dedicated emergency room can, for instance, be provided.

Benchmarks

1. A number of first aid kits adequate to the number of residents are available.

2. First aid kits are adequately stocked. Where possible a 24/7 first aid service/facility is available.

3. An adequate number of staff/workers is trained to provide first aid.

4. Where possible and depending on the medical infrastructures existing in the community, other medical facilities are provided (nurse rooms, dental care, minor surgery).

Box 7 - UK/HSE First Aid facilities

What should be in a first aid kit?

There is no standard list and it very much depends on the assessment of the needs in a particular workplace:

- a leaflet giving general guidance on first aid, for example HSE leaflet *Basic advice on first aid at work*
- individually wrapped sterile adhesive dressings (assorted sizes)
- two sterile eye pads
- four individually wrapped triangular bandages (preferably sterile)
- six safety pins
- six medium-sized (approximately 12 cm x 12 cm) individually wrapped sterile unmedicated wound dressings
- two large (approximately 18 cm x 18 cm) sterile individually wrapped unmedicated wound dressings
- one pair of disposable gloves.

What should be kept in the first aid room?

The room should contain essential first aid facilities and equipment. Typical examples of these are:

- a sink with hot and cold running water
- drinking water and disposable cups
- soap and paper towels
- a store for first aid materials
- foot-operated refuse containers, lined with disposable yellow clinical waste bags or a container for the safe disposal of clinical waste
- a couch with waterproof protection, clean pillows and blankets
- a chair
- a telephone or other communication equipment
- a record book for recording incidents where first aid has been given.

Source: UK Health and Safety Executive

H. Leisure, social and telecommunication facilities

Basic leisure and social facilities are important for workers to rest and also to socialise during their free time. This is particularly true where workers' accommodation is located in remote areas far from any communities. Where workers' accommodation is located in the vicinity of a village or a town, existing leisure or social facilities can be used so long as this does not cause disruption to the access and enjoyment of local community members. But in any case, social spaces should also be provided on site. Exercise and recreational facilities will increase workers' welfare and reduce the impact of the presence of workers in the surrounding communities. In addition it is also important to provide workers with adequate means to communicate with the outside world, especially when workers' accommodation is located in a remote location or where workers live on site without their family or are migrants. Consideration of cultural attitudes is important. Provision of space for religious observance needs to be considered, taking account of the local context and potential conflicts in certain situations.

Benchmarks

1. Basic collective social/rest spaces are provided to workers. Standards range from providing workers multi-purpose halls to providing designated areas for radio, TV, cinema.

2. Recreational facilities are provided. Standards range from providing exercise equipment to providing a library, swimming pool, tennis courts, table tennis, educational facilities.

3. Workers are provided with dedicated places for religious observance if the context warrants.

4. Workers have access to public phones at affordable/public prices (that is, not inflated).

5. Internet facilities can also be provided, particularly where large numbers of expatriates/Third Country Nationals (TCNs) are accommodated.

Box 8 - Examples of social/leisure facilities

In Qatar there is a newly built 170-hectare complex which accommodates contractors and more than 35,000 workers for a project run by a major oil company. At the heart of this complex, the recreation area includes extensive sport facilities, a safety-training centre, an outdoor cinema and a park. The purpose of those facilities goes beyond providing adequate accommodation to the large numbers of contractors and workers on this project but is designed to provide the same level of services as a small town. The accommodation complex has a mayor, as well as a dedicated welfare team which is responsible for the workers' welfare, cultural festivals and also acts as the community's advocates.

II. Managing workers' accommodation

Once the living facilities have been constructed and are operational, effective ongoing management of living facilities is essential. This encompasses issues such as the physical maintenance of buildings, security and consultation with residents and neighbouring communities in order to ensure the implementation of the housing standards in the long term.

A. Management and staff

Worker camps and housing facilities should have a written management plan, including management policies or plans on health and safety, security, living conditions, workers' rights and representation, relationships with the communities and grievance processes. Part of those policies and plans can take the form of codes of conduct. The quality of the staff managing and maintaining the accommodation facilities will have a decisive impact on the level of standards which are implemented and the well-being of workers (for instance on the food safety or overall hygiene standards). It is therefore important to ensure that managers are competent and other workers are adequately skilled. The manager will be responsible for overseeing staff, for ensuring the implementation of the accommodation standards and for the implementation of the management plans. It is important the accommodation manager has the corresponding authority to do so.

If the facility is being managed by a contractor, as is often the case, the expected housing and management standards should be specified in the relevant contract, and mechanisms to ensure that those standards are implemented should be set up. As part of this process, the accommodation manager (or contractor) should have a duty to monitor the application of the accommodation standards and to report frequently on their implementation to the client.

Benchmarks

1. There are management plans and policies especially in the field of health and safety (with emergency responses), security, workers' rights, relationships with the communities.

2. An appointed person with the adequate background and experience is in charge of managing the workers' accommodation.

3. If contractors are being used, there are clear contractual management responsibilities and monitoring and reporting requirements.

4. Depending on the size of the accommodation, there is a sufficient number of staff in charge of cleaning, cooking and of general maintenance.

5. Such staff are recruited from the local communities.

6. Staff have received basic health and safety training.

7. Persons in charge of the kitchen are trained in nutrition and food-handling and adequately supervised.

B. Charging fees for accommodation and services

Charging fees for the accommodation or the services provided to workers such as food or transport should be avoided where workers do not have the choice to live or eat anywhere else, or if deemed unavoidable, should take into account the specific nature of workers' accommodation. Any charges should be transparent, discussed during recruitment and specified in workers' contracts. Any such charges should still leave workers with sufficient income and should never lead to a worker becoming indebted to an employer.

Benchmarks

1. When fees are charged, workers are provided with clear information and a detailed description of all payments made such as rent, deposit and other fees.

2. When company housing is considered to be part of workers' wages, it is best practice that workers are provided with an employment contract clearly specifying housing arrangements and regulations, in particular rules concerning payments and fees, facilities and services offered and rules of notice.

3. When fees are charged, the renting arrangements are fair and do not cost the worker more than a small proportion of income and never include a speculative profit.

4. Food and other services are free or are reasonably priced, never above the local market price.

5. The provision of accommodation or other services by employers as a payment for work is prohibited.

Additional issue

To avoid that fair renting arrangements turn into unfair ones, any deposit of advance should be set at a reasonable level and it is best practice that renting prices include a fixed fee covering the water needed and the use of the energy required to the functioning of the heating/cooling/ventilation/ cooking systems. However, in such cases it might be necessary to raise workers' awareness to ensure that workers will use the facilities responsibly, particularly in areas where water is scarce.

C. Health and safety on site

The company or body in charge of managing the workers' accommodation should have the prime responsibility for ensuring workers' physical well-being and integrity. This involves making sure that the facilities are kept in good condition (ensuring that sanitary standards or fire regulations are respected for instance) and that adequate health and safety plans and standards are designed and implemented.

Benchmarks

1. Health and safety management plans including electrical, mechanical, structural and food safety have been carefully designed and are implemented.

2. The person in charge of managing the accommodation has a specific duty to report to the health authorities the outbreak of any contagious diseases, food poisoning and other important casualties.

3. An adequate number of staff/workers is trained to provide first aid.

4. A specific fire safety plan is prepared, including training of fire wardens, periodic testing and monitoring of fire safety equipment and periodic drills.

5. Guidance on the detrimental effects of the abuse of alcohol and drugs and other potentially harmful substances and the risk and concerns relating to HIV/AIDS and of other health risk-related activities is provided to workers. It is best practice to develop a clear policy on this issue.

6. Workers have access to adequate preventive measures such as contraception (condoms in particular) and mosquito nets.

7. Workers have easy access to medical facilities and medical staff. Where possible, female doctors/nurses should be available for female workers.

8. Emergency plans on health and fire safety are prepared. Depending on the local context, additional emergency plans are prepared as needed to handle specific occurrences (earthquakes, floods, tornadoes).

D. Security of workers' accommodation

Ensuring the security of workers and their property on the accommodation site is of key importance. To this end, a security plan must be carefully designed including appropriate measures to protect workers against theft and attacks. Policies regarding the use of force (force can only be used for preventive and defensive purposes in proportion to the nature and the extent of the threat) should also be carefully designed. To implement those plans, it may be necessary to contract security services or to recruit one or several staff whose main responsibility is to provide security to safeguard workers and property. Before making any security arrangements, it is necessary to assess the risks of such arrangements to those within and outside the workers' accommodation and to respect best international practices, including IFC PS4 and EBRD PR4 and applicable law.[11] Particular attention should be paid to the safety and security of women workers.

Benchmarks

1. A security plan including clear measures to protect workers against theft and attack is implemented.

2. A security plan including clear policies on the use of force has been carefully designed and is implemented.

3. Security staff have been checked to ensure that they have not been implicated in any previous crimes or abuses. Where appropriate, security staff from both genders are recruited.

4. Security staff have a clear mandate and have received clear instruction about their duties and responsibilities, in particular their duties not to harass, intimidate, discipline or discriminate against workers.

5. Security staff have received adequate training in dealing with domestic violence and the use of force.

6. Security staff have a good understanding about the importance of respecting workers' rights and the rights of the communities.

7. Body searches are only allowed in specific circumstances and are performed by specially trained security staff using the least-intrusive means possible. Pat down searches on female workers can only be performed by female security staff.

8. Security staff adopt an appropriate conduct towards workers and communities.

9. Workers and members of the surrounding communities have specific means to raise concerns about security arrangement and staff.

11. See for instance the Voluntary Principles on Security and Human Rights. www.voluntaryprinciples.org/principles

E. Workers' rights, rules and regulations on workers' accommodation

Freedoms and human rights of workers should be recognised and respected within their living quarters just as within the working environment. House rules and regulations should be reasonable and non discriminatory. It is best practice that workers' representatives are consulted about those rules. House rules and regulations should not prevent workers from exercising their basic rights. In particular, workers' freedom of movement needs to be preserved if they are not to become effectively "trapped". To this end it is good practice to provide workers with 24/7 access to the accommodation and free transport services to and from the surrounding communities. Any restriction to this freedom of movement should be limited and duly justified. Penalties for breaking the rules should be proportional and implemented through a proper procedure allowing workers to defend themselves and to challenge the decision taken. The relationship between continuing employment and compliance with the rules of the workers' accommodation should be clear and particular attention should be paid to ensure that housing rules do not create indirect limitation of the right to freedom of association. Best practice might include a code of conduct relating to the accommodation to be signed together with the contract of employment.

Box 9 - Dole housing plantation regulation in Costa Rica

In every plantation there is an internal accommodation regulation that every worker is required to sign together with his/her employment contract. That document describes the behaviour which is expected from workers at all times and basic rules such as the prohibition of alcohol and the interdiction to make noise after a certain time at night. In case there is any problem concerning the application of those internal rules, a set of disciplinary procedures which have been designed with the workers' representatives can be enforced. Workers are absolutely free to enter or leave the site and do not have any restrictions in relation to accessing their living quarters. Families are not allowed in the living quarters unless they have been registered for a visit.

Benchmarks

1. Restriction of workers' freedom of movement to and from the site is limited and duly justified. It is good practice to provide workers 24/7 access to the accommodation site. Any restrictions based on security reasons should be balanced by the necessity to respect workers' freedom of movement.

2. Where possible, an adequate transport system to surrounding communities is provided. It is good practice to provide workers with free transportation to and from local communities.

3. Withholding workers' ID papers is prohibited.

4. Freedom of association is expressly respected. Provisions restricting workers' rights on site should take into account the direct and indirect effect on workers' freedom of association. It is best practice to provide trade union representatives access to workers in the accommodation site.

5. Workers' gender and religious, cultural and social backgrounds are respected. In particular, workers should be provided with the possibility of celebrating religious holidays and observances.

6. Workers are made aware of their rights and obligations and are provided with a copy of the internal workers' accommodation rules, procedures and sanction mechanisms in a language or through a media which they understand.

7. Housing regulations, including those relating to allocation of housing, should be non-discriminatory. Any justifiable discriminatory rules – for example all-male dormitories – should be strictly limited to the rules which are necessary to ensure the smooth running of the worker camp and to maintain a good relationship with the surrounding communities.

8. Where possible, visitor access should be allowed.

9. Decisions should be made on whether to prohibit alcohol, tobacco and third party access or not from the camp and the relevant rules should be clearly communicated to all residents and workers.

10. A fair and non-discriminatory procedure exists to implement disciplinary procedures including the right of workers to defend themselves (see also next section).

F. Consultation and grievance mechanisms

All residents should be made aware of any rules governing the accommodation and the consequences of breaking such rules. Processes that allow for consultation between site management and the resident workers will assist in the smooth running of an accommodation site. These may include a dormitory or camp committee as well as formal processes that allow workers to lodge any grievances about their accommodation.

Benchmarks

1. Mechanisms for workers' consultation have been designed and implemented. It is best practice to set up a review committee which includes representatives elected by workers.

2. Processes and mechanisms for workers to articulate their grievances are provided to workers. Such mechanisms are in accordance with PS2/PR2.

3. Workers subjected to disciplinary proceedings arising from behaviour in the accommodation should have access to a fair and transparent hearing with the possibility to contest decisions and refer the dispute to independent arbitration or relevant public authorities.

4. In case conflicts between workers themselves or between workers and staff break out, workers have the possibility of easily accessing a fair conflict resolution mechanism.

5. In cases where more serious offences occur, including serious physical or mental abuse, there are mechanisms to ensure full cooperation with the police authority (where adequate).

Additional issue

Alcohol is a complex issue and requires a very clear policy from the workers' accommodation management. If a non-alcohol policy is taken, special attention should be paid to clearly communicate the interdiction, how it applies and the consequences for breaching this rule. Special attention should also be paid to enforce it adequately.

G. Management of community relations

Workers' living facilities have various ongoing impacts on adjacent communities. In order to manage these, it is good practice to design a thorough community relations management plan. This plan will contain the processes to implement the findings of the preliminary community impact assessment and to identify, manage, mitigate or enhance ongoing impacts of the workers' accommodation on the surrounding communities. Issues to be taken into consideration include:

- community development – impact of workers' camp on local employment, possibility of enhancing local employment and income generation through local sourcing of goods and services
- community needs – ways to identify and address community needs related to the arrival of specific infrastructures such as telecommunications, water sanitation, roads, health care, education, housing
- community health and safety – addressing and reducing the risk in the increase in communicable diseases, corruption, trade in illegal substances such as drugs, alcohol (in the Muslim context), petty crimes and other sorts of violence, road accidents
- community social and cultural cohesion – ways to mitigate the impact of the presence of large numbers of foreign workers, often males, with different cultural and religious background, ways to mitigate the possible shift in social, economic and political structures due to changes in access to income generation opportunities.

Benchmarks

1. Community relations plans addressing issues around community development, community needs, community health and safety and community social and cultural cohesion have been designed and implemented.

2. Community relations plans include the setting up of a liaison mechanism allowing a constant exchange of information and consultation with the local communities in order to identify and respond quickly to any problems and maintain good working relationships.

3. A senior manager is in charge of implementing the community relations management plan and liaising with the community.

4. The impacts of workers' accommodation on local communities are periodically reviewed, mitigated or enhanced.

5. Community representatives are provided with an easy means to voice their opinions and to lodge complaints.

6. There is a transparent and efficient process for dealing with community grievances, in accordance with PS1/PR10.

Box 10 - Examples of community relations management

Community consultation in the Baku-Tbilisi-Ceyhan (BTC) pipeline

The BTC pipeline's Environment and Social Management Plans incorporated a Worker Camp Management Plan to be implemented by the construction contractor. As part of ongoing community liaison over the project as a whole, community liaison officers were appointed for worker camps who were responsible for meeting regularly with communities, identifying issues and addressing community concerns. A particular responsibility was to review HR records and disciplinary logs at worker camps to assess that rules were being implemented effectively and that any community liaison after any incidents was effective.

ANNEX I: CHECKLIST ON WORKERS' ACCOMMODATION

	Y	N	N/A	Comments
General regulatory framework				
Have the international/national/local regulatory frameworks been reviewed?				
Are mandatory provisions on workers' accommodation identified?				
Assessing the need for workers' accommodation				
Availability of the workforce				
Has there been an assessment of workers' availability in the neighbouring communities?				
Has there been an assessment of the skills and competencies of the local workforce and how do those skills and competencies fit the project's need?				
Has there been an assessment of the possibility of training a local workforce in order to fulfil the project's needs?				
Availability of housing				
Has there been a comprehensive assessment of the different type of housing available in the surrounding communities prior to building any workers' accommodation?				
For a larger project: is that assessment included in the Environmental and Social Impact Assessment?				
Has there been an assessment of the impact on the communities of using existing housing opportunities?				
Have measures to mitigate adverse impacts on the local housing market been identified and included in the Environmental and Social Action Plan (ESAP) or other relevant action plan?				

	Y	N	N/A	Comments
Assessing impacts of workers' accommodation on communities				
Has a community impact assessment been carried out as part of the Environmental and Social Assessment of the overall project with a view to mitigate the negative impacts of the workers' accommodation on the surrounding communities and to enhance the positive ones?				
Have the potential health and safety impacts and consequences of land acquisition and involuntary resettlement occurring during the construction phase of the workers' accommodation been included in the assessment?				
Have the impacts of workers' accommodation on community infrastructures, services and facilities been included in the assessment?				
Have the impacts on local community's businesses and local employment been included in the assessment?				
Have general impacts of workers' accommodation on communities' health, (notably the increased risk of road accidents and of communicable diseases), and community social cohesion been included in the assessment?				
Does the assessment include appropriate mitigation measures to address any adverse impacts identified?				
Types of workers' accommodation				
Has consideration been given to provision of family accommodation?				
Are individual accommodations comprising bedrooms, sanitary and cooking facilities provided as part of the family accommodation?				
Are adequate nursery/school facilities provided?				
Is special attention paid to providing adequate safety for children?				

Standards for workers' accommodation

	Y	N	N/A	Comments
National/local standards				
Have the relevant national/local regulations been identified and implemented?				
General living facilities				
Is the location of the facilities designed to avoid flooding or other natural hazards?				
Are the living facilities located within a reasonable distance from the worksite?				
Is transport provided to worksite safe and free?				
Are the living facilities built using adequate materials, kept in good repair and kept clean and free from rubbish and other refuse?				
Drainage				
Is the site adequately drained?				
Heating, air conditioning, ventilation and light				
Depending on climate are living facilities provided with adequate heating, ventilation, air conditioning and light systems including emergency lighting?				
Water				
Do workers have easy access to a supply of clean/ potable water in adequate quantities?				
Does the quality of the water comply with national/local requirements or WHO standards?				
Are tanks used for the storage of drinking water constructed and covered to prevent water stored therein from becoming polluted or contaminated?				
Is the quality of the drinking water regularly monitored?				

	Y	N	N/A	Comments
Wastewater and solid waste				
Are wastewater, sewage, food and any other waste materials adequately discharged in compliance with local or World Bank standards and without causing any significant impacts on camp residents, the environment or surrounding communities?				
Are specific containers for rubbish collection provided and emptied on a regular basis?				
Are pest extermination, vector control and disinfection undertaken throughout the living facilities?				
Rooms/dormitories facilities				
Are the rooms/dormitories kept in good condition?				
Are the rooms/dormitories aired and cleaned at regular intervals?				
Are the rooms/dormitories built with easily cleanable flooring material?				
Are the rooms/dormitories and sanitary facilities located in the same buildings?				
Are residents provided with enough space?				
Is the ceiling height high enough?				
Is the number of workers sharing the same room/dormitory minimised?				
Are the doors and windows lockable and provided with mosquito screens when necessary?				
Are mobile partitions or curtains provided?				
Is suitable furniture such as table, chair, mirror, bedside light provided for every worker?				
Are separate sleeping areas provided for men and women?				

	Y	N	N/A	Comments
Bed arrangements and storage facilities				
Is there a separate bed provided for every worker?				
Is the practice of "hot-bedding" prohibited?				
Is there a minimum space of 1 metre between beds?				
Is the use of double deck bunks minimised?				
When double deck bunks are in use, is there enough clear space between the lower and upper bunk of the bed?				
Are triple deck bunks prohibited?				
Are workers provided with comfortable mattresses, pillows and clean bed linens?				
Are the bed linen washed frequently and applied with adequate repellents and disinfectants (where conditions warrant)?				
Are adequate facilities for the storage of personal belongings provided?				
Are there separate storages for work clothes and PPE and depending on condition, drying/airing areas?				
Sanitary and toilet facilities				
Are sanitary and toilet facilities constructed from materials that are easily cleanable?				
Are sanitary and toilet facilities cleaned frequently and kept in working condition?				
Are toilets, showers/bathrooms and other sanitary facilities designed to provide workers with adequate privacy including ceiling to floor partitions and lockable doors?				
Are separate sanitary and toilet facilities provided for men and women?				

	Y	N	N/A	Comments
Toilet facilities				
Is there an adequate number of toilets and urinals?				
Are toilet facilities conveniently located and easily accessible?				
Showers/bathrooms and other sanitary facilities				
Is the shower flooring made of anti-slip hard washable materials?				
Is there an adequate number of hand wash basins and showers/bathrooms facilities provided?				
Are the sanitary facilities conveniently located?				
Are shower facilities provided with an adequate supply of cold and hot running water?				
Canteen, cooking and laundry facilities				
Are canteen, cooking and laundry facilities built with adequate and easy to clean materials?				
Are the canteen, cooking and laundry facilities kept in clean and sanitary condition?				
If workers cook their own meals, is kitchen space provided separately from the sleeping areas?				
Laundry facilities				
Are adequate facilities for washing and drying clothes provided?				
Canteen and cooking facilities				
Are workers provided with enough space in the canteen?				
Are canteens adequately furnished?				
Are kitchens provided with the facilities to maintain adequate personal hygiene?				

	Y	N	N/A	Comments
Are places for food preparation adequately ventilated and equipped?				
Are kitchen floor, ceiling and wall surfaces adjacent to or above food preparation and cooking areas built in non-absorbent, durable, non-toxic, easily cleanable materials?				
Are wall surfaces adjacent to cooking areas made of fire-resistant materials and food preparation tables equipped with a smooth, durable, non-corrosive, non-toxic, washable surface?				
Are adequate facilities for cleaning, disinfecting and storage of cooking utensils and equipment provided?				
Are there adequate sealable containers to deposit food waste and other refuse? Is refuse frequently removed from the kitchen to avoid accumulation?				
Standards for nutrition and food safety				
Is there a special sanitary process such as the WHO "5 keys to safer food" implemented in relation to food safety?				
Does the food provided contain appropriate nutritional value?				
Does the food provided take into account workers' religious/cultural backgrounds?				
Medical facilities				
Are first aid kits provided in adequate numbers?				
Are first-aid kits adequately stocked?				
Is there an adequate number of staff/workers trained to provide first aid?				
Are there any other medical facilities/services provided on site? If not, why?				
Leisure, social and telecommunications facilities				
Are basic social collective spaces and adequate recreational areas provided to workers?				
Are workers provided with dedicated places for religious observance?				
Can workers access a telephone at an affordable/public price?				
Are workers provided with access to internet facilities?				

Managing workers' accommodation

Management and staff

	Y	N	N/A	Comments
Are there carefully designed worker camp management plans and policies especially in the field of health and safety (including emergency responses), security, workers' rights and relationships with the communities?				
Where contractors are used, have they clear contractual management responsibilities and duty to report?				
Does the person appointed to manage the accommodation have the required background, competency and experience to conduct his mission and is he/she provided with the adequate responsibility and authority to do so?				
Is there enough staff to ensure the adequate implementation of housing standards (cleaning, cooking and security in particular)?				
Are staff members recruited from surrounding communities?				
Have the staff received basic health and safety training?				
Are the persons in charge of the kitchen particularly trained in nutrition and food handling and adequately supervised?				

Charging fees for accommodation and services

Are the renting arrangements fair and transparent?				
Are workers provided with adequate information about payment made?				
Where appropriate, are renting arrangements and regulations clearly included in workers' employment contracts?				
Are food and other services provided for free or reasonably priced, that is, not above the local market price?				
Is the payment in kind for accommodation and services prohibited?				

	Y	N	N/A	Comments
Health and safety on site				
Have health and safety management plans including electrical, mechanical, structural and food safety been designed and implemented?				
Has the accommodation manager a duty to report to the health authority specific diseases, food poisoning or casualties?				
Is there an adequate number of staff/workers trained in providing first aid?				
Has a specific and adequate fire safety management plan been designed and implemented?				
Is guidance on alcohol, drug and HIV/AIDS and other health risk-related activities provided to workers?				
Are contraception measures (condoms in particular) and mosquito nets (where relevant) provided to workers?				
Do workers have an easy access to medical facilities and medical staff, including female doctors/nurses where appropriate?				
Have emergency plans on health and fire safety been prepared?				
Depending on circumstances, have specific emergency plans (earthquakes, floods, tornadoes) been prepared?				
Security on workers' accommodation				
Has a security plan including clear measures to protect workers against theft and attack been designed and implemented?				
Has a security plan including clear provisions on the use of force been designed and implemented?				
Have the backgrounds of security staff been checked for previous crimes or abuses?				
Has the recruitment of security staff from both genders been considered? Have security staff received clear instruction about their duty and responsibility?				
Have security staff been adequately trained in dealing with domestic violence and the use of force?				

	Y	N	N/A	Comments
Are body searches only performed in exceptional circumstances by specifically trained security staff of both genders?				
Do security staff have a good understanding about the importance of respecting workers' rights and the rights of the surrounding communities and adopt appropriate conduct?				
Do workers and communities have specific means to raise concerns about security arrangements and staff?				
Workers' rights, rules and regulations on workers' accommodation				
Are limitations on workers' freedom of movement limited and justified?				
Is an adequate transport system to the surrounding communities provided?				
Is the practice of withholding workers' ID papers prohibited?				
Is freedom of association expressly respected?				
Are workers' religious, cultural and social backgrounds respected?				
Are workers made aware of their rights and obligations and provided with a copy of the accommodations' internal rules, procedures and sanction mechanisms in a language or through a media they understand?				
Are house regulations non discriminatory, fair and reasonable?				
Are regulations on alcohol, tobacco and third parties' access to the camp clear and communicated to workers?				
Is a fair and non-discriminatory procedure to implement disciplinary procedures, including the right for workers to defend themselves, set up?				

	Y	N	N/A	Comments
Consultation and grievance mechanisms				
Have mechanisms for workers' consultation been designed and implemented?				
Are workers provided with processes and mechanisms to articulate their grievances in accordance with PS2/PR2?				
Have workers subjected to disciplinary proceedings arising from conduct in the accommodation had access to a fair and transparent hearing with the possibility to appeal the decision?				
Are there fair conflict resolution mechanisms in place?				
In cases where serious offences occur, are there mechanisms to ensure full cooperation with police authorities?				
Management of community relations				
Have community relation management plans addressing issues around community development, community needs, community health and safety and community social and cultural cohesion been designed and implemented?				
Do community relation management plans include the setting up of liaison mechanisms to allow a constant exchange of information and consultation of the surrounding communities?				
Is there a senior manager in charge of implementing the community relation management plan?				
Is there a senior manager in charge of liaising with the surrounding communities?				
Are the impacts generated by workers' accommodation periodically reviewed, mitigated or enhanced?				
Are community representatives provided with easy means to voice their opinions and lodge complaints?				
Is there a transparent and efficient process for dealing with community grievances, in accordance with PS1/PR10?				

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Annexure 10.21. Reporting Format for Identification of Debris Disposal Site

(To be prepared by the Contractor)

Sl. No.	Project Details			
1.	Name and address of the Contractor			
2.	Contact details of the Contractor			
3.	Name of Project Corridor			
4.	Stage of the project			
5.	Site Details	Information (Coordinates)		
6.	Name of the Village		Panchayat	
7.	Name of the Taluk		District	
8.	Chainage (km)		Side	LHS/RHS
9.	Area of site		Current land use	
10.	Ownership of the land	Owned/Leased	Survey No.	
11.	If leased, name, address and contact details of owner			
12.	Distance from settlement			
13.	Distance from surface water course or body			
14.	Distance from Ecologically Sensitive Areas			
15.	Width of access road			
16.	No of trees with girth > 0.3m			
17.	No of trees to be cut			
18.	Is top soil conservation required (Yes/ No)			
List of Enclosure		Location Map		

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.22. Reporting Format for Debris Disposal Site Selection and Management

(To be prepared by the Contractor)

Dumping site location …….
Reporting Month……..
Date of Submission …….

1. Environment Features of the surrounding area

1.1	Location of Dumping site	
1.2	Coordinates of Dumping site	
1.3	Capacity of Dumping site	
1.4	Safety measure taken at Dumping site (s)	
1. 2. 3. 4. 5.		

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.23. Reporting Format for Muck Disposal Site Selection and Management

(To be prepared by the Contractor)

Muck disposal site location …….
Reporting Month……..
Date of Submission …….

2. Environment Features of the surrounding area

1.1	Location of Muck disposal site	
1.2	Coordinates of Muck disposal site	
1.3	Capacity of Muck disposal site	
1.4	Safety measure taken at Muck disposal site (s)	
1. 2. 3. 4. 5.		

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.24. Details of Machinery during Construction

(To be filled Monthly by the Contractor)

Location Name ……
Reporting Month……..
Date of Submission ……..

1. Details of Machinery Operation

1.1	Total machinery in operation (Nos.)	
1.2	Number of pavers	
1.3	Number of rollers	
1.4	Number of excavators	
1.5	Number of graders	
1.6	Number of dumpers	
1.7	Number of Cranes	
1.8	No. of workshops with repairs facility (furnish location and type of facility provided)	Workshop on Facility Location Provided
1.9	Number of vehicles in repair at each location	
1.10	Details of waste disposal	
1.11	Others	

Remarks :

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.25. Embankment/Slope Protection Measures

(To be filled Monthly by the Contractor)

Location Name .....
Reporting Month.....
Date of Submission .....

Sl. No.	Chainage (Km)	Location	Length (in m)	Height (in m)	Type of Slope Protection measures				Status	Remarks
					Seeding	Turfing	Mulching	Vegetation		

REMARKS :

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.26. Reporting Format for Safety Checklist

(To be prepared by the Contractor)

1. Name of the Project Corridor
2. Contract No.
3. Name of the Contractor
4. Name of Safety Officer
5. Date of Inspection
6. Location description: Location-1_____; Location-2_____

Particulars	Location-1			Location-2			Remarks
	A	B	C	A	B	C	
General							
House Keeping							
▪ Stacking of Material							
▪ Passageway							
▪ Lighting							
▪ Ventilation							
▪ Others							
Electrical							
▪ Switches							
▪ Wirings							
▪ Fixed Installation							
▪ Portable Lighting							
▪ Portable Tool							
▪ Welding Machine							
▪ Others							
Fire Prevention							
▪ Fire Fighting Appliance							
▪ Dangerous Goods Store							
▪ Gas Welding Cylinders							
Others							
▪ Dust Control							
▪ Noise Control							
▪ First Aid Equipment							
▪ Washing Facility							
▪ Latrine							

Particulars	Location-1			Location-2			Remarks
	A	B	C	A	B	C	
▪ Canteen							
Provision of Personal Protective							
▪ Helmet							
▪ Eye Protector							
▪ Ear Protector							
▪ Respirator							
▪ Safety Shoes							
▪ Safety Belts							
▪ Others							

A = Adequate at the time of Inspection

B = Needs Improvement

C = Needs Immediate Attention

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.27. Reporting Format for Project Safety Measures during Construction

(To be prepared by the Contractor)

One time reporting before commencement of construction (zone wise)

1. Name of the Project Corridor
2. Contract No.
3. Name of the Contractor
4. Name of Safety Officer
5. Date of Inspection
6. Location description: Location-1_____; Location-2

Sl. No.	Item	Unit	Compliance	Remarks
Details of Construction Zone				
1.	Length of Construction Zone			
2.	Distance between this and next construction zone			
3.	Length of work sub zone in urban stretch (should be <2 km)			
4.	Distance between two work sub zones			
Signage's in Construction Zones				
1.	Sign saying 'Men at Work' 1 km ahead of transition sub zone			
2.	Supplementary sign saying diversion 1 km provided			
3.	Sign saying 'Road Closed ahead' provided			
4.	Compulsory Right Turn /Left sign provided			
5.	Detour sign placed			
6.	Sharp deviation sign placed at end of advance warning sub zone			
Signage in Transition Sub Work Zone				
1.	Signage saying 'Keep Right / Left' provided			
2.	Delineators placed along length of transition			
Signage in work sub zone				
1.	Hazard Marker placed where railing for CD structure on diversion starts			
2.	Barricade on either side of work sub zone			
Signage in Termination sub zone				
1.	Sign for indication of end of work zone 120 m from			

	end of termination sub zone			

Road Delineator				
1.	Roadway indicators provided			
2.	Hazard Makers provided			
3.	Object Makers Provided			

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.28. Format for Accident Report

(To be completed on Occurrence of Injury by the Safety Officer)

1. Name of the Project Corridor
2. Contract No.
3. Name of the Contractor
4. Name of Safety Officer
5. Date of Inspection
6. Location description:

Type of Accident

	Fall of person from a height		Explosion
	Slip, trip or fall on same level		Fire
	Struck against fixed objects		Contact with hot or corrosive substances
	Struck by flying or falling objects		Contact with poisonous gas or toxic substances
	Struck by moving objects		Contact with electric current
	Struck / caught by cable		Hand tool accident
	Stepping on hail etc.		Vehicle / Mobile plant accident
	Handling without machinery		Machinery operation accident
	Crushing / burying		Other (please specify)
	Drowning or asphyxiation		

Agent Involved in Accident

	Machinery		Excavation / underground working
	Portable power appliance		Floor, ground, stairs or any working, surface
	Vehicle or associated equipment / machinery		Ladder
	Material being handled, used or stored		Scaffolding/gondola
	Gas, vpour, dust, fume or oxygen		Construction formwork, shuttering and falsework
	Hand tools		Electricity supply cable, wiring switchboard and associated equipment
	Floor edge		Nail, sllnter or chipping
	Floor opening		Other (Please specify)
	Left shaft		
	Stair edge		

Unsafe Action Relevant to the Accident

	Operating without authority		Failure to use proper footwear
	Failure to secure objects		Failure to use eye protector

	Making safety devices inoperative		Failure to use respirator
	Working on moving or dangerous equipment		Failure to use proper clothing
	Using un-safety equipment		Failure to use warn others or given proper signals
	Adopting unsafe position or posture		Horseplay
	Operating or working at unsafe speed		No unsafe action
	Unsafe loading, Placing, mixing etc.		Others (please specify)
	Failure to use helmet		
	No Protective gear		Unsafe layout of job, traffic etc.
	Defective protective gear		Unsafe process of job methods
	Improper dress / footwear		Poor housekeeping
	Improper guarding		Lack of warming system
	Improper ventilation		Defective tool, machinery or materials
	Improper illumination		No unsafe condition
	Improper procedure		Others (please specify)

Personal Factor Relevant to the Accident

	Incorrect attitude / motive		Unsafe act by another person
	Lack of knowledge or skill		No unsafe personal factor
	Physical defects		Other (please specify)

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.29. Reporting Format for Worker's Health Check-Up

(To be prepared by the Contractor)

(Once in 3 or 6 Months during Construction)

1. Name of the Project Corridor
2. Name of the Contractor
3. Name of Environmental Officer
4. Date of Health Check-up
5. Location:

***Name of the Worker :** **Designation :** **Age :** **Date :**

Sl. No.	Details of Check-up	Inference	Prescription	Remarks
General Check-up				
1.	Height / weight check			
2.	Blood pressure check			
3.	Respiratory Rate			
4.	Lung Capacity Test			
5.	Oxygen Level			
6.	Heart Rate (Pulse)			
7.	Cholesterol level check			
8.	Blood sugar test			
9.	Blood Test for Haemoglobin level			
10.	Throat check			
11.	Ear check			
12.	Eye check			
13.	Electrocardiogram (for those at a higher risk of heart disease)			

List to be enclosed for all workers

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.30. Reporting Format for Workshop / Awareness Programme on Health /Aids/COVID

(To be prepared by the Contractor)

(Once in 3 or 6 Months during Construction)

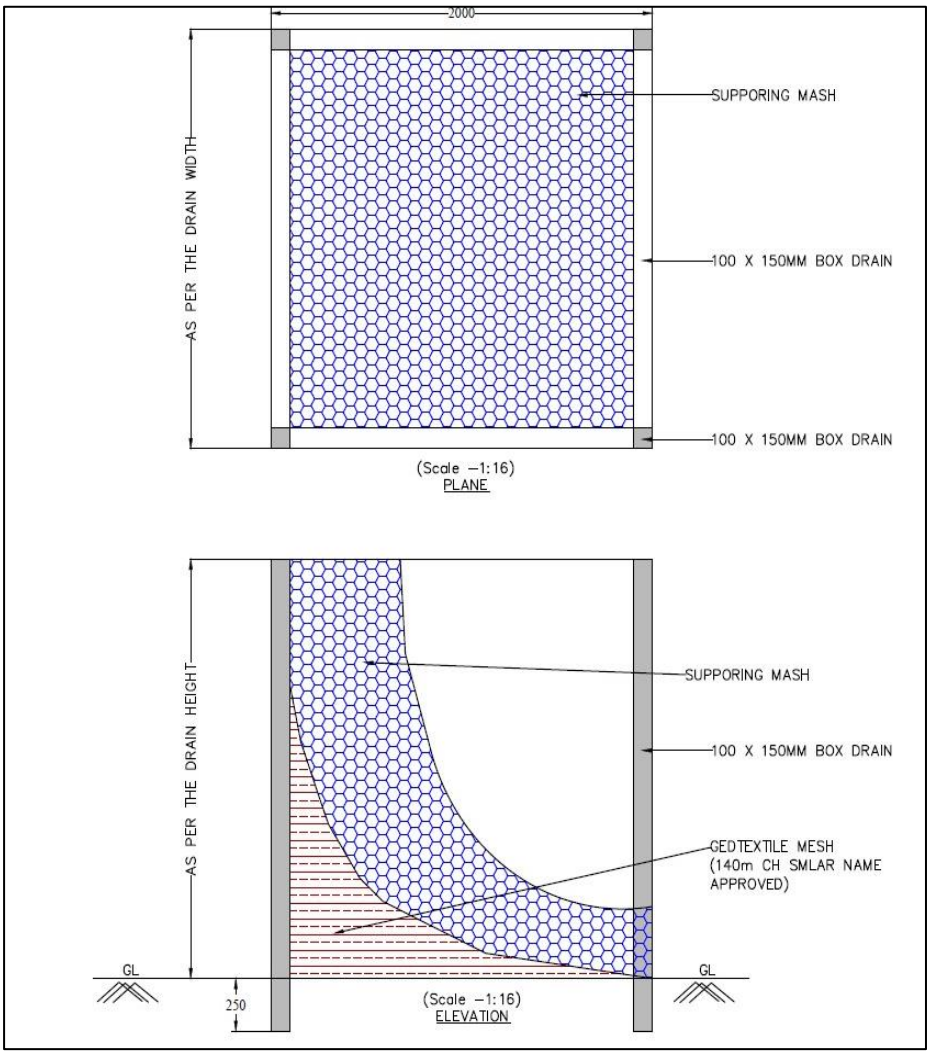
1. Name of the Project Corridor
2. Name of the Contractor
3. Name of Environmental Officer
4. Date of Health Check-up
5. Location:
6. Conducted By :
7. Organized By :
8. Abstract Of The Program / Workshop :----------

LIST OF PARTICIPANTS

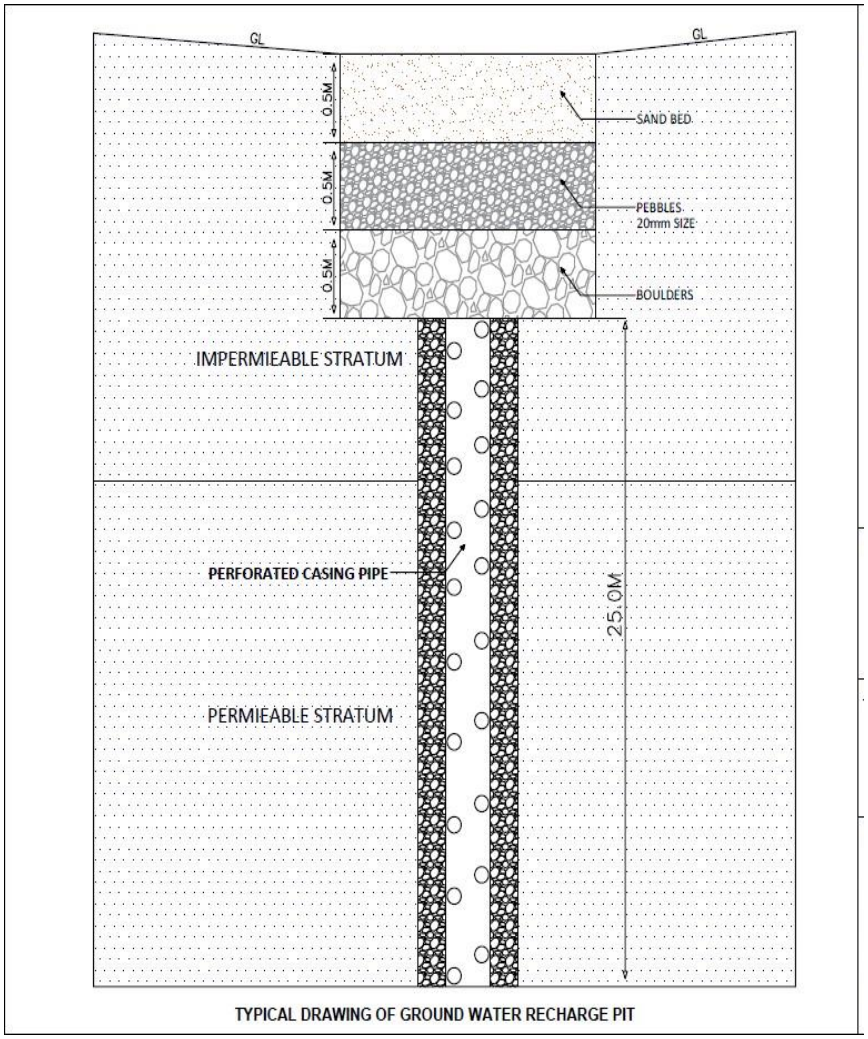
Sl. No.	Name	Designation	Age	Feed Back / Remarks	Signature

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.31. Typical Cross Section of Silt Trap

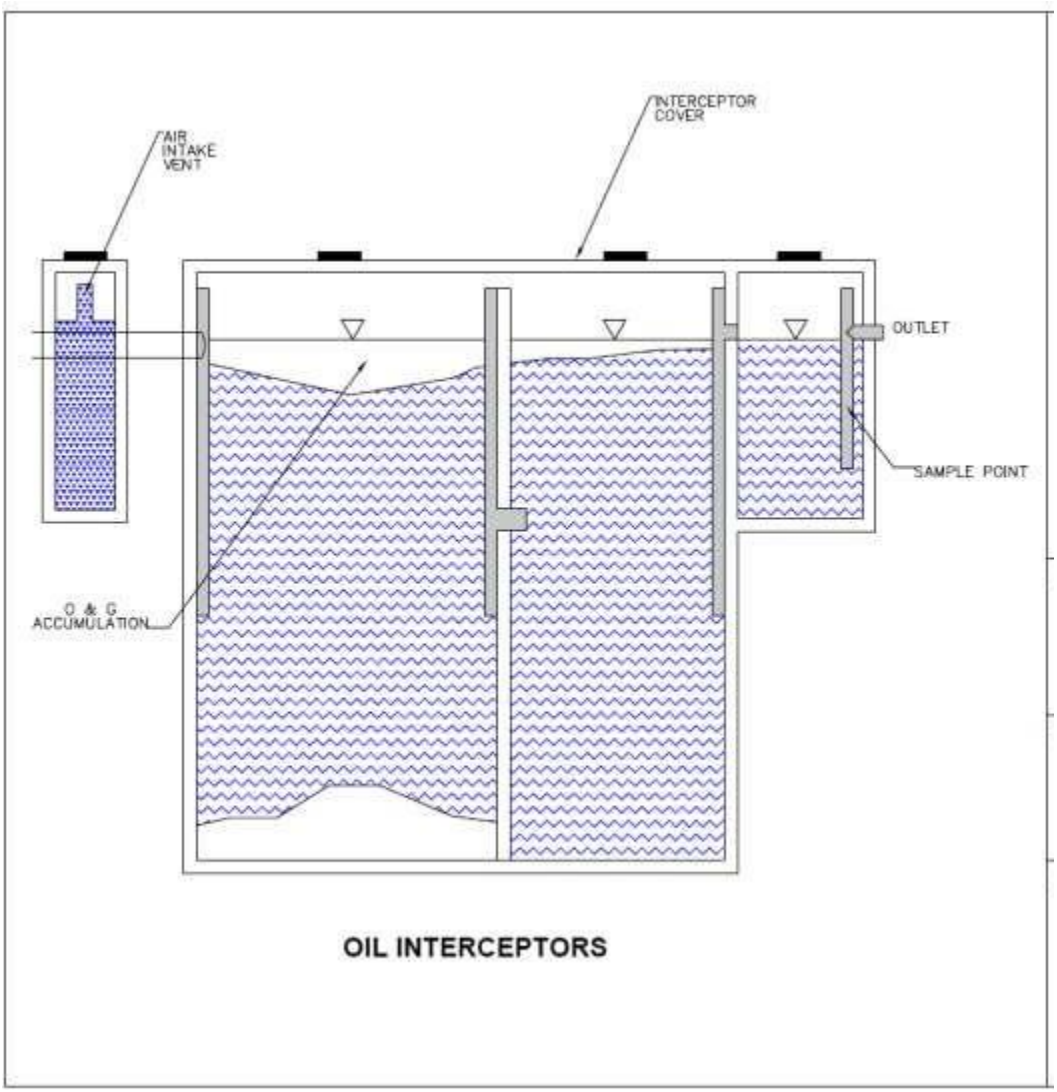


Annexure 10.32. Typical Cross Section of Ground Water Recharge Pit



TYPICAL DRAWING OF GROUND WATER RECHARGE PIT

Annexure 10.33. Typical Cross Section of Oil Interceptor



Annexure 10.34. Reporting Format for Pollution Monitoring

(To be filled by the Contractor)

Construction site location _____
Construction Stage: Report – Date:__Month_Year___
Mitigation measures suggested in last report complied or Not……
If not reasons thereof……
(Location at which monitoring to be conducted as per EMP)

Sl. No.	Chainage (km)	Details of locations	Duration of monitoring	Instruments used	Completion	Monitoring Parameters	Standards	Results	Reasons for exceeding standards	Mitigation Measures suggested	Type of area (Residential / Industrial / Commercial)	Remarks
1. Air Monitoring (As per National Ambient Air Quality Standards, CPCB (2009)												
		As per decision of Engineer inCharge	As per Section 8.1			PM2.5	60 µg/m3					
						PM10	100 µg/m3					
						SO_2	80 µg/m3					
						CO	02 mg/m3					
						NOx	80 µg/m3					
2. Water Monitoring (As per Drinking Water Quality Standards, IS 10500, 2012)												
		As per decision of Engineer in Charge	As per Section 8.1			pH	6.5-8.5					
						BOD	Nil					
						COD	Nil					
						TDS	500 mg/l					
						Chlorides	250 mg/l					
						Nitrates	45 mg/l					
						Sulphates	200 mg/l					
						Iron	0.3 mg/l					
						Calcium	75 mg/l					
						Lead	0.01 mg/l					
3. Soil Monitoring												

Sl. No.	Chainage (km)	Details of locations	Duration of monitoring	Instruments used	Completion	Monitoring Parameters	Standards	Results	Reasons for exceeding standards	Mitigation Measures suggested	Type of area (Residential / Industrial / Commercial)	Remarks
		As per decision of Engineer inCharge	As per Section 8.1			pH	<7.0 Acid 6.5–7.5 Neutral >7.5 Alkaline					
						Organic Matter	0.5 -0.75 %					
						Sodium	0-1 %					
						Potassium	2-6 %					
						Chloride	0-1 %					
						Available Nitrogen	280-560 kg/hac					
						Phosphorous	11.5 – 24.5 kg/hac					
						Arsenic	< 20 mg/kg					
						Cadmium	< 1 mg/kg					
						Mercury	< 1 mg/kg					
						Lead	< 35 mg/kg					
						Electric Conductivity	0.0-2.0 Non Saline 4.1-8.0 Saline 16.0 Strongly Saline					
4. Noise Monitoring (As per National Ambient Noise Standards, CPCB												
		As per decision of Engineer	As per Section 8.1			Lday	Residential-55 dB(A) Commercial-					

Sl. No.	Chainage (km)	Details of locations	Duration of monitoring	Instruments used	Completion	Monitoring Parameters	Standards	Results	Reasons for exceeding standards	Mitigation Measures suggested	Type of area (Residential / Industrial / Commercial)	Remarks
		inCharge					65 dB(A)					
						Lnight	Residential-45 dB(A) Commercial-55 dB(A)					
Remarks												

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of IE/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.35. Reporting Format for Vibration Monitoring

(To be filled by the Contractor)

Construction site location _____ Construction Stage: Report – Date:___Month_Year___

Mitigation measures suggested in last report complied or Not……

If not reasons thereof……

(Location at which monitoring to be conducted as per EMP)

	Format for Vibration monitoring								
Sampling code	**Location**	**Date**	**Start Time**	**Stop Time**	**Vibration level (PPV in mm/s)**	**Latitude**	**Standard**	**Longitude**	**Remarks**
1							DGMS (Directorate General of Mines and Safety)		
2									
3									

Remarks :

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of IE/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.36. Restoration of Construction Sites

(To be filled by the Contractor)

Construction site location _____ (Reporting by Contractor to PIU)

Construction stage: Monthly Report – Date ……Month ……Year.

Sl. No.	Contract Package	Labor Camp		Construction Camp		Plant Site		Disposal Locations		Top Soil	
		O	R	O	R	O	R	O	R	Preserved	Restored

O : Operation R : Restoration

Remarks :

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of GC/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.37. Reporting Format for Records of Consents Obtained by Contractor

Construction site location _____

Construction Stage: Report – Date:_____Month_____Year_____

Sl. No.	Contractor's Name	Clearance	Applicable Acts	Agencies	Obtained on	Valid up to	Remarks
	Construction site location						

Remark

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of IE/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.38. Public Consultation at Work Sites

(To be filled monthly by supervisory staff)

1. Name of the Project Corridor
2. Name of the Contractor
3. Name of Environmental Officer
4. Date of Public Consultation :
5. Location:

Sl. No.	Name	Age	Designation & Address	Issue Of Concern	Remarks	Signature

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of IE/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.39. Environmental Checklist

(To be filled monthly by supervisory staff)

Construction site location ___

Date of Inspection___

Sl. No.	ESMP Measures	Action Taken	Remarks
1	Provision of a personnel accountable for implementation of ESMP / Safety Measures with Contractor		
2	Consent of PCB to Establish Batching Plant		
3	Consent of PCB to operate Batching Plant		
4	Compliance of PCB Conditions for Batching Plant installation and operation		
5	Whether compliance reported through monthly Progress report to In-Charge (PIU)		
6	PUC taken for all Construction vehicles		
7	Concrete platform with trap under bitumen boiler, Fuel Tank for Batching Plant and generator set provided or not		
8	Precautions to prevent contamination of soil by emulsion, oil and lubricant taken while storing		
9	Providing cover to fine construction material & bituminous mix during transportation		
10	Muck /debris disposal:		
	a) Present status of land		
	b) Closure and completion plan		
11	Site specific traffic Safety management Plan:		
	a) Contractor installed the warning / regulatory Traffic signs at the construction site		
	b) The arrangement adequate		
12	Safety equipment i.e helmet, gloves, gumboot, mask, earplugs etc. provided to workers		
13	Health Facility at camp and work site i.e. First Aid kit & suitable vehicle for conveyance in case of emergency / accident		
14	Permit for Procuring River sand		
15	License from Department of mines for quarrying		
16	Consent to establish / operation of crusher		
17	Provision of labour camp with sanitation & potable water		
18	Fire precautions at Plant and site Office		
19	Air and noise monitoring done in camp site		
20	Whether any cultural property is being impacted		
21	Status of drainage provision in camp area		
22	General House Keeping		

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of IE/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE

Signature			
Name			
Designation			

Annexure 10.40. Summary Sheet

(To be filled monthly by supervisory staff)

Construction site location _____

Month_____Date_____

Sl. No.	Description	Remarks
1	***No Objection Certificate***	
A	Cement Batching Plant	
	Location 1	
	Location 2	
	Location 3	
2	***Pollution Under Certificate***	
	Vehicles	
	Machineries	
3	**No Objection Certificate for Diesel Gen set**	
	Location 1	
	Location 2	
4	**Labour Camps**	
	No. of sites Identified	
	Approved	
	Opened	
	Conforms to conditions imposed at the time of opening of sites	
	Closed	
5	***Workers***	
	No of workers employed	
	No of male workers	
	No of female workers	
	No of day workers	
6	**Borrow Area**	
	No. of sites identified	
	Approved	
	Opened	
	Quantity of available material	
	Quantity of material Utilized	
	Quantity of Topsoil preserved	
	Quantity of top soil used	
	No of sites closed	
	No. of sites Rehabilitated	
7	**Quarry**	
	No. of sites identified	
	Approved	
	Opened	
	Material available	
	Material obtained	

	No. of sites Rehabilitated	
8	**Disposal Locations**	
	No. of sites identified	
	Approved	
	Opened	
	Amount of Waste disposed	
	Type of waste disposed	
	No. of sites Rehabilitated	
9	**Road Safety**	
	Road Safety norms and approved Traffic plan	
10	**Cleaning of Culvert/ drains**	
	No. of culverts/ drains	
	Nos Cleaned	
11	**Trees**	
	No of trees marked for cutting in field	
	No of trees cut	
	No of trees to be Planted	
	Trees Planted	
12	**Haul Roads**	
	Adequacy of maintenance of Haul Road Network	

Remarks

Submission Details	Submitted by : Contractor	Checked by: Sr. Env. Specialist of IE/CSC/PMC	Approved by: In-charge Officer, EMU, KRIDE
Signature			
Name			
Designation			

Annexure 10.41. Climate Change and Risk Assessment Report by K RIDE

Table of Content

List of Tables

List of Figures

ABBREVIATIONS

ADB	–	Asian Development Bank
asl	–	Above sea level
amsl	-	Above mean sea level
BCCI-K	–	Bengaluru Climate Change Initiative-Karnataka
BMRCL	–	Bengaluru Metro Rail Corporation Limited
CCKP	–	Climate Change Knowledge Portal
CRVA	–	Climate risk and vulnerability assessment
DPR	–	Detailed project report
INR	–	Indian rupee
IPCC	–	Intergovernmental Panel on Climate Change
km	–	Kilometer
km2		Square kilometer
m	–	Meter
mm	–	Millimeter
RCP	–	Representative Concentration Pathway
SRES	–	Special Report on Emissions Scenarios

Climate Change and Adaptation Measures for Bengaluru Suburban Railway Project (BSRP)

1.1. Overview

Railway infrastructure is the pillar for the growth and development of nation, economy and society. Due to an exponential increase in population and demand for transport network infrastructure, the current infrastructure is experiencing loads higher than that of the designed capacity limits. Transport infrastructure is always exposed to extreme weather events and climate change evolution, creating more excessive deterioration. Considering practical constraints related to capital investment, government policies, and sustainability issues of building new railway infrastructure, utilizing climate adaptation options on the operation and maintenance of existing railway infrastructure is inevitable. Adaptation options are measures and actions that can be implemented to improve adaptation to climate change. Climate adaptation for Bengaluru Suburban Railway networks refers to the process by which traffic administration, including infrastructure and rolling stock, should mitigate and control risks due to extreme weather events and gradual degradation of infrastructure. The overall objective of the Bengaluru Suburban Railway project is to achieve long-term serviceability and economic benefits.

An overview of the project and its objectives, as well as the climate change plan and policy of Karnataka for Bengaluru Suburban Railway Project (BSRP) are provided in this report. It describes the project background, including the need for the suburban rail project in Bengaluru, and provides details about the project area, such as its geographic, edaphic, and seismic status, topography, and climate. Overall, the report provides a comprehensive overview of the Bengaluru Suburban Railway Project. It addresses the importance of climate change adaptation measures in railway infrastructure and emphasizes the need to mitigate risks due to extreme weather events and infrastructure degradation. The report also highlights the government's climate change plan and policy, showcasing the efforts to incorporate climate change considerations into development planning.

1.2. Climate Change Plan and Policy of Karnataka

The Karnataka State Action Plan for Climate Change (KSAPCC) version 2 Draft Report, 2021, was the first policy document to tackle climate change on state level in Karnataka and this policy document was prepared by the Environmental Management and Policy Research Institute (EMPRI), an autonomous body under the Department of Forest, Ecology and Environment, Government of Karnataka. It laid the ground for crucial mitigation and adaptation action.

The Karnataka State Climate Action Plan process resulted from the central government directive in 2008 that all Indian states initiate a state action plan on climate change. With the aim of mainstreaming climate change in the Karnataka state’s development planning, three independent but parallel documents, each following their own distinct procedures, were produced for Karnataka.

It is reported that EMPRI did not have the requisite capacity to draft the plan and could bring only nominal expertise to bear on the topic, an opinion consistent with the research conducted in their study. The other two bodies that independently produced a state action plan were the Bengaluru Climate Change Initiative-Karnataka (BCCI-K) and another non-governmental body, the Centre for Sustainable Development.

The Karnataka Climate Change Action Plan (KCCAP) adopted the BCCI-K climate change projections for Karnataka state. BCCI-K action plan (May 2011) comprises Greenhouse gas inventory for the state, the impacts of climate change in vital sectors such as forests, agriculture, and water resources along with an analysis of socioeconomic vulnerability and adaptive capacity assessments. The BCCI-K focused on a scientific assessment of the likely implications of climate change and the projections used simulation data from the global climate model, HadCM3, from the Hadley Centre in the United Kingdom. Climate change projections for daily values of temperature (mean, maximum, and minimum) and daily values of precipitation were derived at grid-spacing of 0.44250 latitude by 0.44250 longitude and for Special Report on Emissions Scenarios (SRES) A1B midterm (2021–2050) emissions scenario relative to the baseline period 1961–1990.

1.3. Project Background in Brief

The Bengaluru Suburban Railway Project is proposed by GoK and Ministry of Railways in order to overcome issues of traffic control i.e. to decongest road traffic, to provide better public transport system, connect to airport and enhance the connectivity to the outskirts of the city. To increase the share of public transport in Bengaluru, GoK and Railways had commissioned many studies though RITES Ltd., for introduction of Commuter Rail Services (CRS) in Bengaluru. The studies analyzed the existing rail network and suggested improvements / augmentation by way of doubling / quadrupling etc. Railway has decided to explore the possibility of introducing / enhancing the Commuter Rail Services in Bengaluru, with minimum land acquisition. Towards this end, Railways entrusted the work of carrying out the Feasibility of running Suburban Rail services along the existing rail network of Bengaluru to RITES Ltd.

1.4. Project Area Description

1.4.1. General Features of the Project Area

1.4.1.1. Geographic, Edaphic and Seismic status

Bengaluru Urban has an aerial coverage of about 2,174 km^2 and is situated within the north latitude of 12°39'32'' and 13°14'13'' and east longitude of 77°19'44'' and 77°50'13''. The area falls in southern Karnataka plateau that has a general elevation of 600 m–900 m amsl. Bengaluru lies on one of the world's oldest exposed rocks called peninsular gneiss, a type of metamorphic rock, while the soils in the city consist of red laterite and fine red loamy to clayey soils. In terms of seismicity, Bengaluru falls within seismic zones II and III of the Indian subcontinent, which has experienced quakes of magnitude as high as 6.4.

1.4.1.2. Topography

Bengaluru has two unique topographic terrains—North Bengaluru taluk which is a flat plateau, and the South Bengaluru taluk, which is characterized by undulating terrain. The middleof the taluk is a prominent ridge running north–northeast to south–southwest with gentle slopes and valleys on either side of this ridge. Although the Cauvery River basin encompasses a significant part of the southern Karnataka plateau, there are no major rivers flowing through Bengaluru Urban area except for a minor river, Vrishabhavathi, a tributary of the Arkavathi, whichalso flows through the city. Both rivers, Arkavathi and Vrishabhavathi, carry much of Bengaluru's sewage. Bengaluru has a good number of shallow water bodies varying in size from small pondsto lakes of considerable extents.

1.4.1.3. Climate

Bengaluru has a tropical wet and dry or savanna climate (Köppen climate classification Aw) with distinct wet and dry seasons. Situated in the Deccan plateau at an average altitude of around 900 m amsl, Bengaluru generally enjoys a moderate climate throughout the year with occasional heat wave conditions. April is the hottest month with temperature rising up to 35°C during the day and 21°C at night. December to January is the winter season with a maximum average temperature of 26°C and a minimum average temperature of 15°C. Although January isthe coldest month, the temperature rarely drops below 10°C.

Over the past decade, the climate of Bengaluru is observed to have changed as a result of rapid urbanization and heat island effect, increasing pollution, and obliteration of vegetation and water bodies. The maximum temperature in Bengaluru Urban has risen to as high as 38°C to 39°C during April–May while in earlier decades it hardly exceeded 35°C.

The summer season extends from March to May and the winter extends from January to February. The mean annual rainfall is around 875 millimeters (mm) spread over about 50 days in a year. Over half of the rainfall comes during the late monsoon months of August to October. Cyclonic rains occur during November and December while there is virtually no rainfall during January–March. Bengaluru receives both southwest as well as northeast monsoons.

1.4.2. Project Design Methodology

The drone based aerial survey has been conducted to ascertain the existing infrastructure and constraints all along the existing railway boundary of the study area. The main output of the project will be the construction of 4 new suburban rail lines/corridors of a total length of 149.184 kilometers.

The Ground Control Point (GCP) of known coordinates have been established with traditional surveying methods or have been obtained from other sources (LiDAR, older maps of the area, Web Map Service) as they significantly increase the absolute accuracy of the data collected. The minimum number of GCPs required for this project has been considered and accordingly the GCP's have been marked on ground at appropriate locations. The total GCPs marked on ground are of 644 numbers which is approximately 4 GCPs per km length.

Drone was flown over the corridors length according to the flight path and acquired the images through photo chromatic camera with Pix4Dcapture software using grid option.

Image Processing and Ortho-rectification has been done. Pre-Processing and ortho-rectification of imagery and pre-processing of acquired Images by way of digital surface models, digital terrain model generation and Ortho-Rectification of satellite Images has been undertaken.

1.4.3. Salient Features of Project in Brief

The complete length of four independent new corridors have been surveyed and studied as part of this assignment. The corridors studied are as given below :

Corridor – 1: KSR Bengaluru City to Devanahalli

Corridor – 2: Baiyyappanahalli Terminal to Chikkabanavara

Corridor – 3: Kengeri to Whitefield (via KSR and Cantonment)

Corridor – 4: Heelalige to Rajanukunte

With the proposed lines, network coverage and density of Bengaluru Suburban Railway will be increased substantially, and the BSRP will offer more convenient services to users. Multimodal facilities will be developed at Suburban Railway stations including car and motor pool, bus bay, and taxi pool, as well as pedestrian bridges, which will enable smooth inter-modal connectivity and provide better last mile connectivity. The details are provided in the **Chapter 3 :** Description of the Project of the EIA Report. The summary is provided below in **Tables 1.1**, **Table 1.2** and **Table 1.3**.

Table 1.1. Salient Features and Design Norms

Sl. No.	Item Description	Salient Features
1	Tracks	BG Tracks (1676mm)
2	Centre to Centre Spacing of existing IR tracks at-Grade	5.30m
3	Centre to Centre Spacing of Proposed tracks in elevated structure	4.725m
4	Width of Proposed Viaduct	10.9m for two tracks
5	Distance of Proposed At-grade nearest Sub urban track from Centre line of nearest IR track	7.8m
6	Distance of Proposed Centre line of viaduct from Centre line of nearest IR track	8.5m
7	Design Speed	90 Kmph
8	Types of track proposed	(a) Ballast-less track for elevated structure. (b) Ballast cushion of 350mm for At-Grade track
9	Horizontal Curves	Minimum radius of 200mm for at grade/ elevated
10	Radius of curves	1000m at stations
11	Cant Deficiency	Not to exceed 100mm
12	Actual Cant	Not to exceed 125mm
13	Vertical Curves	(a) Radius of vertical curve is 3000m (normal circumstances) & 2500m in exceptional circumstances (b) Minimum length shall be 20m
14	Gradient	(a) Elevated station -Level (or) 1 in 1000, At-Grade – Existing grade (b) At mid sections - Not Steeper than 2 % (May be 3% for elevated section in exceptional situation) (c) At par with existing IR tracks in mid locations at grade
15	Turnouts/Crossovers	(a) Main lines/ other running lines 1 in 12 (b) Depot/Yard lines 1 in 8.5
16	Depot Yards	(a) Lines are normally flat/level in yards ,

Sl. No.	Item Description	Salient Features
		may not be steeper than 1 in 1200
		(b) Curves in yards shall have radii not
		less than 175mm
		(c) Stabling lines shall have clear standing
		length of 350m for one rake length

Source: Feasibility Report prepared by RITES Consultant for BSRP Project in 2019 & Design update as on 22.11.2022.

Proposed Project Alignments/Corridors

Corridor – 1: KSR Bengaluru City to Devanahalli:

Total length is 41.222 kms out of which elevated section is 16.175 km and at-grade is 25.047 kms. Stations on Corridor-1 are fifteen (15) out of which seven (7) stations are elevated including one future station at Srirampura and Eight (8) Stations (including one future station) are at-grade.

Corridor – 2: Baiyyappanahalli Terminal to Chikkabanavara:

Total length is 26.507 km out of which elevated section is 7.723 km and at-grade is 18.784 km. stations on Corridor-2 are fourteen (14), out of which eleven (11) stations are at-grade including two future stations and three (03) stations are elevated.

Corridor – 3: Kengeri to Whitefield:

Total length is 35.52 km out of which the suburban corridor considered for the present study is only between Kengeri and KSR Bengaluru – Bengaluru Cantonment. The length of this section between Kengeri and Bengaluru Cantonment is 18.47 km. A stretch of 17.05 km between Bengaluru Cantonment and Whitefield is being taken up by the SWR for quadrupling. Once this is completed and becomes operational, two lines of the same shall be utilized for the Suburban services. Stations on C-3 are fourteen (14) out of which nine (09) stations are elevated and five (05) stations are at-grade including one future station at RV College and five (05) stations are in quadrupling section.

Corridor – 4: Heelalige to Rajanukunte:

Total length is 46.154 km out of which elevated section is 8.850 km, at-grade is 37.304 km. Stations on C-4 are twenty (20) out of which three (3) stations are elevated and nineteen (17) stations are at-grade including one future station. Yelahanka is an inter-change station.

The private open land of about 28.63 hectares and private built-up land of about 12.52 hectares will have to be acquired for implementation of the project. The total railway land required is about 132.33 hectares.

Table 1.2. Salient Features of Alignment

Sl No	Item Description	Salient Features
1	Alignment	(a) Proposed along parallel to existing IR Tracks.
		(b) Proposed within Railway ROW to Minimize the private land acquisition.
2	Crossings	Bare minimum crossing proposed to reduce cost & avoid disturbances to train Operations of IR.
3	Height of Deck	15.0m to be maintained above existing rail level.

Sl No	Item Description	Salient Features
4	Thickness of Elevated Deck Girder	Varies from 2.45m to 2.75m (based on span design)

Source: Feasibility Report prepared by RITES Consultant for BSRP Project in 2019 & Design update as on 22.11.2022.

Table 1.3. Salient Features of Corridors

Sl. No.	Item Description	Corridor 1	Corridor 2	Corridor 3		Corridor 4
		KSR Bengaluru City to Devanahalli	Baiyyappanahalli Terminal to Chikkabanavara	Kengeri to Cantonment	Cantonment to Whitefield	Heelalige to Rajanukunte
1.	Length of corridor (Km)	41.222	26.507	18.47	17.05	46.00
2.	Length of elevated section (Km)	16.175	7.723	10.40	-	9.045
3.	Length of At-Grade section (Km)	25.047	18.84	8.07	17.05	36.955
4.	Number of stations	15	14	9	5	20
5.	No. of Elevated stations	8 (including one future station)	3	4	-	3
6.	No. of At-Grade stations	7	11 (including two future stations)	5 (including one future station)	5	17 (including one future station)
7.	No. of stations repeated	1 (with corridor 3)	2 (with corridor 1)	0	-	1 (with corridor 1)
8.	No. of Interchange stations	3	2	1	-	1
9.	No. of Existing ROB on the corridor	10	6	3	-	10
10.	No. of Existing FOB on the corridor	6	2	5	5	4
11.	No. of Existing LCs on the corridor	10	11	3	3	14
12.	No. of LCs' under sanction for RUB/ROB	1	2	1	Quadrupling section	2
13.	No. of Existing LCs to be eliminated in At-Grade locations	6	5	1		11

Sl. No.	Item Description	Corridor 1	Corridor 2	Corridor 3		Corridor 4
		KSR Bengaluru City to Devanahalli	Baiyyappanahalli Terminal to Chikkabanavara	Kengeri to Cantonment	Cantonment to Whitefield	Heelalige to Rajanukunte
14.	No. of LCs where Suburban track is elevated	3	4	1		1
15.	Land to be acquired (Vacant / Built-up) (Acres)	12.10	28.59	20.71	-	40.28

Source: Feasibility Report prepared by RITES Consultant for BSRP Project in 2019 & Design update as on 22.11.2022.
Note: On Corridor – 3, the stretch of Bengaluru Cantonment to Whitefield of 17.05 km is not taken for the study since Quadrupling is in progress and on completion the same will be merged with Suburban system. However, 5 stations are identified on this stretch and all the 5 are existing stations.

Source : Website of K-RIDE

Figure 1.1. Screen shot of Bengaluru Suburban Rail Projects (BSRP) Corridors

Screen shot of BSRP corridors is presented in **Figure 1.1** and System map is presented as **Figure 1.2.**

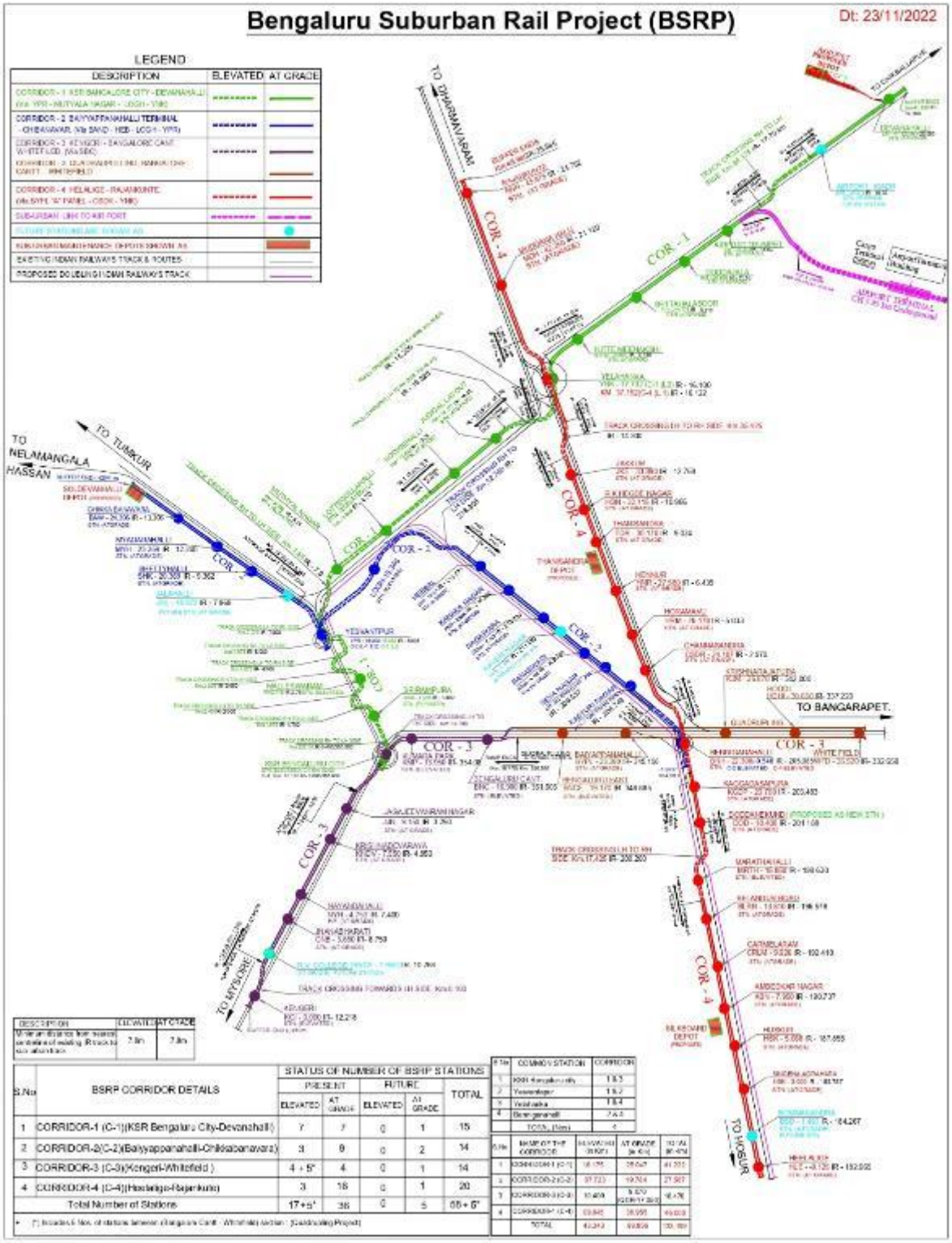


Figure 1.2. System Map of the Bengaluru Suburban Railway Project Corridors

1.5. Scope and Objectives of Climate Change Risk Assessment Study

The Climate Change Study is very important to be considered for this proposed Suburban Rail project in Bengaluru as there are possibilities of risks and hazards due to change in climate in future and if the project is implemented without proper understanding, care and concern towards Climate Change and implementation of required adaptation measures for the same. The scope of Climate Change Study is to understand and address the impacts of the climate crisis, empowering them with the knowledge, skills, values and attitudes needed to act as agents of change.

The broad objectives of this CRVA are as follows :

- to assess the exposure, sensitivity, and adaptive capacity of the investment project to climate risks; and
- to examine climate-risk adaptive interventions to build resilience. The scope of this report thus lies in the assessment of climate- related natural hazards and associated risks and adaptive measures of the Bengaluru suburban rail system.

The main objectives of this climate change study includes :

- To qualitatively identify and assess the impact of climate change on Bengaluru Suburban railway infrastructure with associated risks and consequences.
- To provide Adaptation Measures for identified climate change risks and impacts on railway assets; and their associated incremental costs.
- To achieve long-term serviceability and economic benefits.

1.6. Methodology

Methodology employed for the Climate Risks and Vulnerability Assessment (CRVA) for BSRP included the following:

- A review of relevant regulatory framework, guidelines and standards;
- An analysis of the emissions from surrounding activities, such as industry (if any), farming, transportation vehicles, etc.;
- Collection of data and estimation of potential emissions from key Project (Rail) activities during the construction and operation phases of BSRP and
- Compilation of Data and Assessment of risks and feasible adaptation for Climate Change and mitigation measures to save CO2 emission (CO2 reduction) during the construction and operation phases of BSRP

Desk Study & Reviews : Primarily desk reviews have been carried out for the Climate change studies of BSRP. The desk resources include the related research papers, books, reviews, reports and other documents such as science Articles, paper news, etc. online and offline. Analysis and assessment of the previous studies for different projects in similar line were understood and relevant aspects were applied for the proposed BSRP. Many of the issues related to climate change and adaptation measures related to transport infrastructure were emanated during Desk reviews. With due care and concern regarding climate change risks and adaptation measures study has been carried out for the investment project in the railsector, such BSRP.

Consultations with stakeholders, Engineers and Experts : Representative consultation in a broad spectrum was carried out with prime or key Stake holder i.e. K-RIDE in this project and others such as experienced experts and engineers. This has helped to ensure a wide range of perceptions on climate change and required action towards adaptation measures. The key stakeholder i.e. the K-RIDE has provided first-hand information about the extent to which climate stressors affect or can affect the project. Experts have provided substantialinformation on the identification and analysis of risks while engineers were able to provide facts and figures or analysis related to sensitivity, including design and construction standards relevant to climate impacts and adaptive capacity.

1.7. Limitations

Climate change related adaptation is needed in complementarity with mitigation since mitigation alone is not enough to stave off the adverse effects of climate change.

- Climate factors manifest their effects in a multitude of ways that make climate proofing a challenging activity given the complexities and uncertainties of the factors that define climate risks and vulnerability, particularly at the project level.
- Although the impacts of climate change are widely recognized, there exist gaps in guidance materials and information resources necessary to facilitate the climate proofing of investment projects within the region. Furthermore, there is no clear and universally adopted methodology to model the adverse effects of climate change and its integration in infrastructure design procedures.
- As such, there will certainly be a large number of important quality and limitation issues in relation to the presentation of this vulnerability assessment and the application of adaptation strategies.

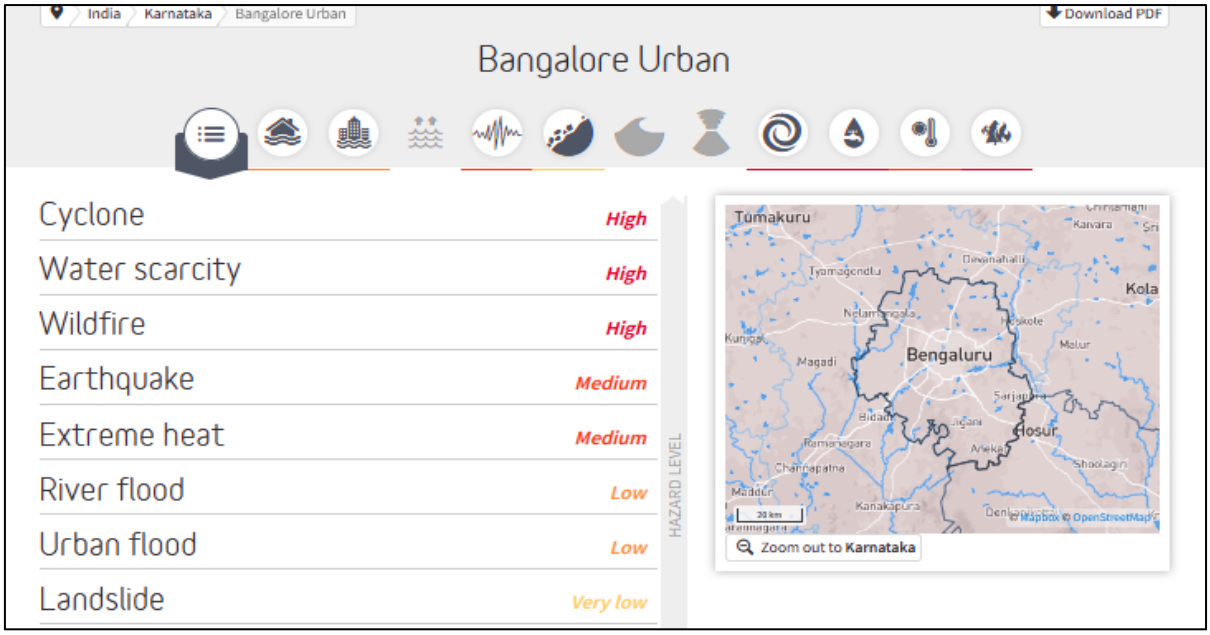
K-RIDE has a good awareness of climate change impacts and will adopt mitigation measures in advance and in due course of time to minimize the climate change risks in this current project.

1.8. Baseline Natural Hazards and Risks in Bengaluru

1.8.1. Likelihood of Natural Hazards

ThinkHazard, a web- based tool has been accessed to understand the general perspective of natural hazards and risks in Bengaluru and to reduce their impact. ThinkHazard is a simple and quick yet robust analytical tool that provides a general view of the hazards, for a given location, that should be considered in project design and implementation to promote disaster and climate resilience. The tool highlights the likelihood of different 11 natural hazards affecting project areas (very low, low, medium and high), provides guidance on how to reduce the impact of these hazards, and where to find more information. The tool analyzes hazard under current climate conditions and also provides guidance from IPCC on how climate change may alter hazard frequency and intensity into the future.

By using the tool and applying it specifically to Bengaluru, the likelihood of natural hazards such as cyclones, water scarcity, earthquake, extreme heat, river flood, and urban flood is identified with risk levels categorized as very low, low, medium, and high. The screenshot shown in **Figure 1.3** is reproduced from the ThinkHazard webpage for Bengaluru Urban. The hazard levels provided in this tool are reportedly based on published hazard data, provided by a range of private, academic, and public organizations.



Source: ThinkHazard.

Figure 1.3. Likelihood of Natural Hazards in Bengaluru

ThinkHazard web-tool outputs are not project-specific. Thus, further detailed information is recommended to be obtained to adequately account for the level of hazard in the project area. Nevertheless, based on information currently available, ThinkHazard provides the following hazard accounts and recommendations that could be followed in different phases of the project to help reduce the risks to the project:

1) **Cyclone** : Cyclone (also known as hurricane or typhoon) hazard is classified high and this means that there is more than a 20% chance of potentially damaging wind speeds in the project area in the next 10 years. Based on this information, the impact of cyclones must be considered in all phases of the project, particularly during design and construction.
2) **Water scarcity** : Water scarcity is classified high and this means that droughts are expected to occur on average every 5 years. Based on this information, the impact of drought must be considered in all phases of the project, particularly its effect on personnel and stakeholders, and during the design of buildings and infrastructure. Further detailed information should be obtained to adequately account for the level of hazard.
3) **Earthquake** : Earthquake hazard is classified medium and this means that there is a 10% chance of potentially damaging earthquake shaking the project area in the next 50 years. Based on this information, the impact of earthquake should be considered in all phases of the project, particularly during design and construction. Project planning decisions, project design, and construction methods should take into account the level of earthquake hazard.
4) **Extreme heat** : Extreme heat hazard is classified medium based on modelled heat information and this means that there is more than a 25% chance that at least one period of prolonged exposure to extreme heat, resulting in heat stress, will occur in the

next 5 years. Project planning decisions, project design, and construction methods should take into account the level of extreme hazard.

5) **River flood** : River flood hazard is classified low based on modelled flood information currently available and this means that there is a more than 10% chance that potentially damaging and life-threatening river floods will occur in the coming 10 years. Project planning decisions, project design, and construction methods should take into account the level of river flood hazard. Surface flood hazard in urban and rural areas is not included in this hazard classification and may also be possible in the project location.
6) **Urban flood** : Urban flood hazard is classified low based on modelled flood information currently available and this means that there is a more than 10% chance that potentially damaging and life-threatening urban floods will occur in the coming 10 years. Project planning decisions, project design, and construction methods should take into account the level of urban flood hazard.

Inference

Global average tropical cyclone wind speed and rainfall are likely to increase in the future, and the global average frequency of tropical cyclones is likely to decrease or remain unchanged. It is possible that the frequency of the most intense tropical cyclones will increase substantially in some ocean regions. The present hazard level in areas currently affected by tropical cyclones may increase in the long term. Projects located in such areas should be robust to futureincreases in cyclone hazard (IGPC, 2010).

It is to be remarkably noted that Model projections for river and urban floods are inconsistent in their estimates of changes in rainfall. The present hazard level depicted in **Figure 1.7** may increase in the future due to the effects of climate change. It would be prudent to design projects in this area to be robust to riverflood hazard in the long term.

It is to be remarkably noted that cyclone wind risks cannot be totally mitigated, and damages are not limited to wind but also include cyclone-induced heavy rainfall and subsequent flooding.

1.8.2. Urban Flooding in Bengaluru

A vulnerability assessment of flood-affected areas of Bengaluru (R. Prasad and Narayanan, P. 2016) states that the first recorded incident of urban flooding in the city occurred a little more than a century ago, when on 18 September 1912, the central business district around Fort Area of the city was affected by flood resulting from a bout of intense rainfall. Flood waters entered into buildings, leaving peoplestranded in knee-deep water. The overflowing drains inundated roads and low-lying areas of thecity, which took 6 days to recede. The municipality then deemed the entire storm water drain infrastructure inadequate.

Now a century later, monsoon rains continue to plague Bengaluru city almost annually inthe absence of an integrated approach in mitigating urban floods by the city's administrative body, the Bruhat Bengaluru Mahanagara Palike. In the name of development and demand for land, low-lying flood plains as well as the city's numerous lakes are transformed for urban infrastructure with previous lessons unaccounted. The conversion of natural land to impervious surfaces has resulted in faster rainfall–runoff processes and reduced recharge. Negative impacts of rapid urbanization and

unplanned infrastructure development such as dumping of solid waste, laying of cables in the channels, and under-capacity storm water drains and culverts have all added to urban flooding woes.

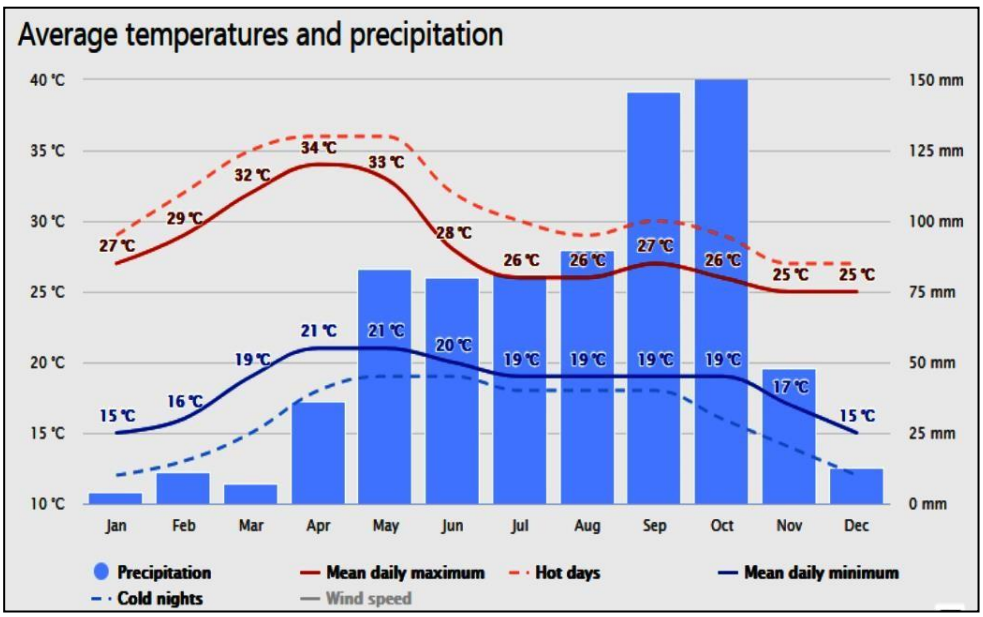
According to the National Disaster Management Authority's Guidelines on Management of Urban Flooding (GoI, DMA 2010), problems associated with urban floods vary from rural areas and range from relatively localized incidents to major incidents, resulting in cities being inundated from a few hours to several days.

1.9. Climate Change Trends in Bengaluru

1.9.1. Baseline Climate of Bengaluru

The Data on base line climate is sourced from Meteoblue.Data.Org., a web based tool that provides Climate Predictions showing the past and most likely future development of more than 20 variables, including air temperature, precipitation amount and wind speed based on simulation data from the IPCC report. Below are given Meteoblue climatediagrams based on 30+ years (from 1985 onwards) of weather data followed by weather model simulations. Typical climate patterns and expected conditions in terms of temperature, precipitation, sunshine, and wind are indicated by the Meteoblue climatediagrams. The simulated weather data have a spatial resolution of approximately 30 km and do not reproduce all local weather effects, such as thunderstorms, local winds, or cyclones.

Average monthly baseline information in terms of two important climatic variables, temperature and precipitation for Bengaluru (12.97°N 77.59°E, 920 m asl) are presented in **Figure 1.4**. Themean daily maximum (solid red line) shows the maximum temperature of an average day for every month in Bengaluru. Likewise, the mean daily minimum (solid blue line) shows the average minimum temperature. Hot days and cold nights (dashed red and blue lines) show the average ofthe hottest day and coldest night of each month during the last few decades.



Source: Meteoblue.Data.org.

Figure 1.4. Modeled Average Monthly Temperature and Precipitation for Bengaluru

1.9.2. Climate Trends in Bengaluru

A nationwide network of meteorological stations is maintained by the Indian Meteorological Department (IMD) and provides climatic observations and products to national as well as international agencies such as the United Nations Framework Convention on Climate Change and the IPCC. The source of information provided below on observed climate trends in Karnataka state is from an IMD publication entitled State Level Climate Change Trends in India and is derived from long-term, observed datasets (1951–2010) from 282 stations for temperature and 1,451 stations for rainfall series across the nation (GoI, 2013). The insight into climate change occurring over smaller regions are specified in the publication along with the information on assistance to the states in formulating their adaptation and mitigation strategies in light of rapidly changing climate trends.

1.9.2.1. Temperature Trends

State-level annual and seasonal mean maximum temperature, mean minimum temperature, and mean trends based upon 242 surface meteorological observations (20 for temperature and 222 for rainfall) in Karnataka for the observed period 1951–2010 are extracted in **Table 1.4** below.

Table 1.4. Observed Temperature Trends in Karnataka State, 1951–2010

	Annual	Winter	Summer	Monsoon	Post-Monsoon
Mean maximum temperature trend in°C per year	+0.02*	+0.02*	+0.02*	+0.02*	+0.02*
Mean minimum temperature trend in°C per year	No trend	-0.01	-0.01*	No trend	No trend
Mean temperature trend in °C per year	+0.01*	+0.01	No trend	+0.01*	+0.01*
Mean diurnal temperature range trend in °C per year	+0.02*	+0.03*	+0.02*	+0.02*	+0.02*

Rainfall Trends Note: Increasing trend is indicated by a (+) and decreasing trend by a (-) sign. The asterisk (*) indicates significant trend at 95% confidence level.
Source: Indian Meteorological Department.

1.9.2.2.

Average Annual rainfall in Karnataka is 1,151 mm. About 80% of rainfall is received during the southwest monsoon, 12% in the post-monsoon period, 7% during summer, and 1% in winter. Considerable variations are noticed within the state. Rainfall is noticed to be much higher in coastal locations on the windward side of the Western Ghats (3,350 mm) which drops sharply on the leeward side (600 mm–700 mm) during the southwest monsoon. Northern interior regions by contrast have markedly semi-arid climates with low annual precipitation (500 mm–600 mm). In **Table 1.5** the state-level annual and seasonal rainfall trends based upon 220 rainfall stations in Karnataka for an observed period 1951–2010, is presented.

Table 1.5. Rainfall Trends in Karnataka State, 1951–2010 (mm/year)

	Annual	Winter	Summer	Monsoon	Post-Monsoon
Annual and Seasonal Rainfall Trends	- 0.05	+0.10	-0.41	+0.61	+0.14

mm = millimeter.

Note: Increasing trend is indicated by a (+) and decreasing trend by a (-) sign. The asterisk (*) indicates significant trend at 95% confidence level.

Source: Indian Meteorological Department.

Trends based on daily weather data from the Indian Meteorology Department, Pune for the period 1901 to 2008 is assessed by the report submitted by the BCCI-K in 2011 (World Bank, 2011). A decline in total annual rainfall for the state was observed from 1,204 mm during 1901–1950 to 1,140 during 1951–2008. However, both annual rainfall as well as seasonal rainfall increased for Bengaluru Urban as indicated in **Table 1.6**.

Table 1.6. Normal Rainfall and Trends in Bengaluru Urban, 1901–2008

District	Pre-Monsoon (Jan–May)			Southwest Monsoon (Jun–Sep)			Northeast Monsoon (Oct–Dec)			Annual	
Bengaluru Urban	Trend	mm	%	Trend	mm	%	Trend	mm	%	Trend	mm
	↑	168	19	↑	466	53	↑	241	28	↑	875

mm = millimeter.

Source: Bengaluru Climate Change Initiative-Karnataka.

1.9.2.3. Extremes of Temperature and Precipitation

From a historical stand point of view, the ever-recorded maximum temperature, minimum temperature, and 24-hour heaviest rainfall up to year 2010 for two meteorological stations in Bengaluru are shown in **Table 1.7** below (IMD, Pune, 2010) along with Dates of occurrence of extremes.

Table 1.7. Ever-Recorded Maximum and Minimum Temperatures and 24-hour Heaviest Rainfall until 2010

Station Nameand Number	Highest Maximum Temperature ºC (mm)	Lowest Minimum Temperature ºC (mm)	24-hour Heaviest Rainfall (mm)
Bengaluru Station No: 43295	38.9 (22 May 1931)	7.8 (13 January 1884)	178.9 (01 October 1997)
Bengaluru Station No: 43296	38.3 (14 April 1960)	8.8 (03 January 1993)	169.2 (07 October 1953)

mm = millimeter.

Source: Indian Meteorological Department.

1.9.3. Future Climate Projections

1.9.3.1. Temperature

A set of worldwide climate models are cradled in the World Bank's Climate Change Knowledge Portal (CCKP) (World Bank Group) to help decision makers understand the projections of future climate change and related impacts. The analysis of climate impacts using multi-model groups is supported by the CCKP, as they represent the range and distribution of the most plausible projected outcomes

when representing expected changes. Future climate information in the CCKP is derived from 35 available global circulation models used by the IPCC Fifth Assessment Report (AR5). The CCKP takes advantage of the most widely used Coupled Model Inter-comparison Project, Phase 5 (CMIP5) model with data presented at 1°x1° global grid spacing and provides options to visualize climate variables and indices for different time frames, statistics, emission scenarios, and climate models.

The significant variables in the design of various civil elements of land transport infrastructure include mainly temperature extremes with their diurnal ranges rather than average temperatures. The projected changes (anomalies) in daily maximum temperature (*Tmax*) and daily minimum temperature (*Tmin*) over the period of interest and relative to the reference period (1986–2005) for Bengaluru located at around 77.59°E, 12.97°N, are illustrated in **Figure 1.5**. The contrast in temperature anomalies estimated under lower and upper representative concentration pathways (IPCC, 2014) RCP2.6 and RCP8.5, respectively, are presented in the charts below.

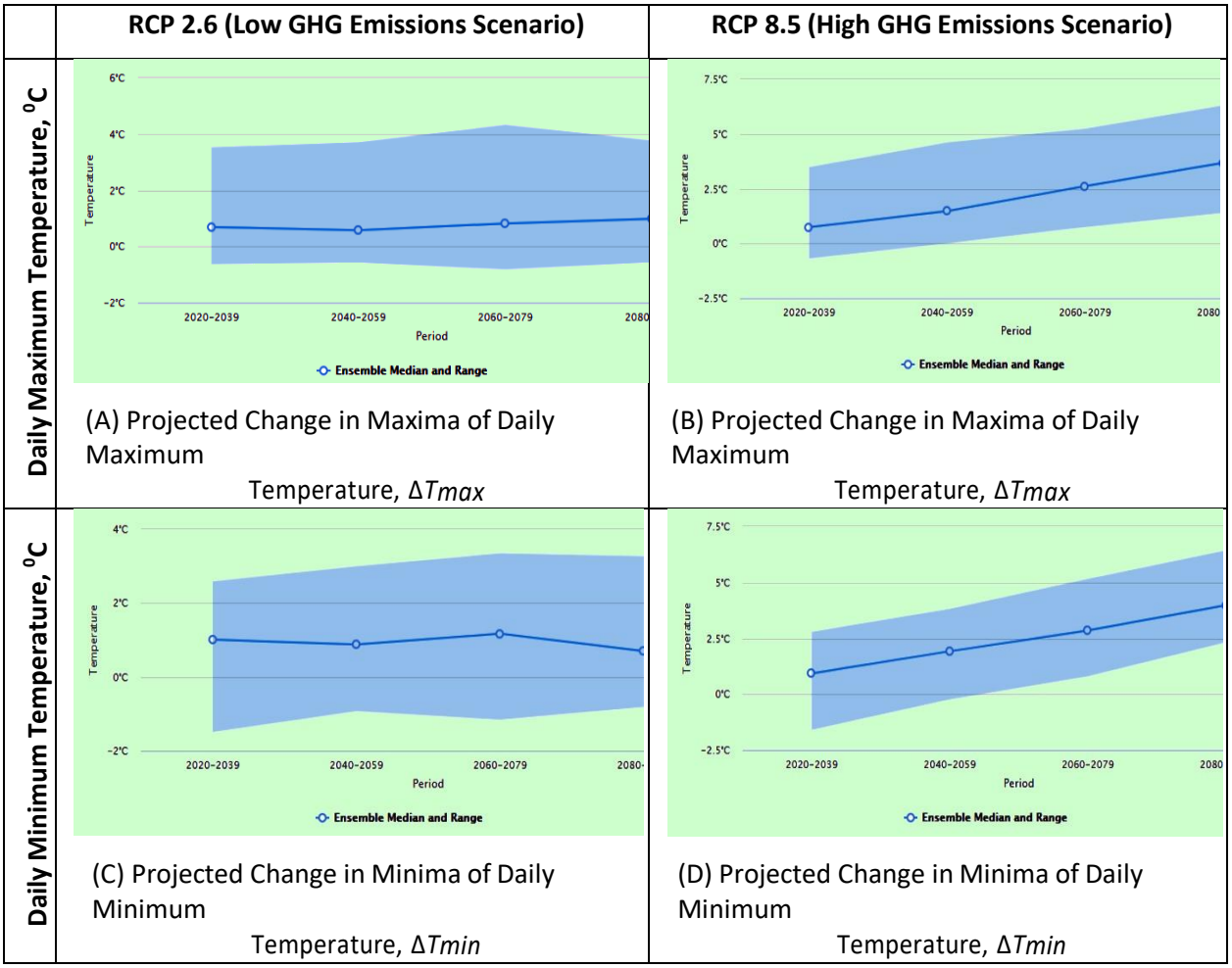


Figure 1.5. Projected Changes in Temperature for Various Timeframes (Location: 77.59°E, 12.97°N)

GHG = greenhouse gas, RCP = representative concentration pathway, Tmax = daily maximum temperature, Tmin = daily minimum temperature.
Source: World Bank's Climate Change Knowledge Portal.

The climate change projections for Karnataka state are provided in the Karnataka Climate Change Action Plan. These projections are sourced from the BCCI-K report which presents the undertaken study results regarding Karnataka's climate trends and made projections based on a coupled

atmosphere–ocean general circulation model, HadCM3. Climate change projections for daily values of temperature (mean, maximum, and minimum) and daily values of precipitation were derived at grid-spacing of 0.44250 latitude by 0.44250 longitude and for SRES A1B midterm (2021–2050) emissions scenario relative to thebaseline period 1961–1990. The SRES A1 greenhouse gas scenario formulated by IPCC's Special Report on Emission Scenarios (2000) stands for rapid economic growth in a globalizing world with balanced emphasis on all energy sources. The following **Table 1.8** presents the midterm (2021–2050) projections of temperature and precipitation for the districts of Bengaluru Urban and Bengaluru Rural.

Table 1.8. Projected Increase in Mean, Maximum, and Minimum Temperatures, 2021– 2050

Districts	Projected Increase in Mean Temperature, Tav,˚C	Projected Increase in Mean Maximum Temperature, Tmax,˚C	Projected Increase in Mean Minimum Temperature, Tmin, ˚C
Bengaluru Urban	1.96	2.06	1.88
Bengaluru Rural	1.97	2.06	1.91

Tmax = mean maximum temperature, Tmin = mean minimum temperature, Tav = mean temperature.
Source: Karnataka Climate Change Action Plan.

1.9.3.2. Heat Waves

It is predicted that extreme heat waves will become more and more common worldwide because of raise in average global temperature. In **Table 1.6**, the mean maximum temperature in Bengaluru is projected to increase by around 2.06°C in the 2030s, which means the extreme upper temperature is also progressively pushed up. There is an increasing trend of heat waves in India over the past several years due to whish several cities in India have been severely affected (NDMA, 2016). Abnormal high temperatures have been observed during April–June (pre-monsoon) 2010 to 2015 across the country. (*Additional Information - In 2015, daily maximum temperature exceeded the average maximum temperature by more than 6°C to 8°C in many parts of India, and in Karnataka state, a highest maximum temperature of 44.1°C was recorded on 30 May 2015 at Kalburgi where the* mean *daily maximumtemperature hovers usually at around 32.4*°C).

1.9.3.3. Rainfall

Usually changes in extreme precipitation are analyzed based on the evolution of the percentiles of the daily precipitation. However, in engineering design application, the magnitude of daily maximum rainfall or return level and the associated frequency of extreme rainfall event or return period, are imperative.

CMIP5 projections of changes in maximum daily rainfall for return periods of 10 and 25 years have been provided by the World Bank's CCKP. The projected rainfall changes for 25-year return periods under lower RCP 2.6 and upper RCP 8.5 scenarios are illustrated in **Figure 1.6**. A 25-year return level of daily precipitation is the maximum daily rainfall that can be expected once in an average 25-year (i.e., 4% chance) period with the possibility that two or moreevents of that magnitude can occur in much shorter intervals.

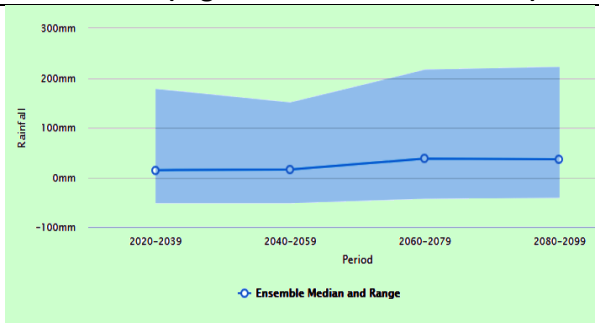
RCP 2.6 (Low GHG Emissions Scenario)	RCP 8.5 (High GHG Emissions Scenario)
	
(A) Projected Change in Annual Maximum DailyPrecipitation, (25 yr Return Level)	**(B) Projected Change in Annual Maximum DailyPrecipitation, (25 yr Return Level)**

Figure 1.6. Projected Change in 25-year Return Level of Maximum Daily Precipitation (mm) (Location: 77.59°E, 12.97°N)

GHG = greenhouse gas, RCP = representative concentration pathway.
Source: World Bank's Climate Change Knowledge Portal.

As per Karnataka Climate Change Action Plan, the climate change projections are given for mean change in annual and seasonal precipitation and are compared with the reference period (1961–1990) for Bengaluru Urban and Bengaluru Rural. The same is illustrated in **Table 1.9**. In general, the valueof seasonal precipitation change varies between -15% and +36%.

Table 1.9. Projected Change in Annual and Seasonal Rainfalls, 2021–2050 (SRES A1B Emissions Scenario)

No.	Districts	Projected Change for JF Months (%)	Projected Change for MAM Months (%)	Projected Change for JJAS Months (%)	Projected Change for OND Months (%)	Projected Change in Annual Mean (%)
1	Bengaluru Urban	-15.11	29.92	-2.89	10.14	3.66
2	Bengaluru Rural	3.05	36.30	-2.31	9.61	3.56

JF = January/February, JJAS = June/July/August/September, MAM = March/April/May, OND = October/November/ December.
Source: Karnataka Climate Change Action Plan

1.10. Climate Change Risks and Vulnerability Assessment (CRVA)

1.10.1. General

Railway embodies an energy efficient transport mode with comparatively minimum environmental impact, which favours Railway transport in the implementation of the long-term neutral-carbon transport strategy. This is also related to the potential of Rail transport to mitigate climate change, since the growth of Rail transport would result in reduction in greenhouse gas emissions. However, this potential can only be realized if Railways are adapted to withstand impacts associated with climate change.

As per the conventional method of understanding of the Climate Change Risks, there exists an inter-relationship between exposure, sensitivity and adaptive capacity. The following various factors are known to influence Climate Change Vulnerability :

- geographic location,
- the actions taken by the local environment, and
- the capability of local authorities to respond to events and adapt measures in advance to manage infrastructure assets

Land Transport infrastructure, particularly rail infrastructure and their operations are directly exposed to natural forces and hence, are vulnerable to Climate Change risks. Conditions may become worsened if proper adaptation measures are not implemented in time. One of the most critical vulnerabilities in the Railway transport system is the low flexibility of both infrastructure and operations in the event of disturbances. The Rail transport system also depends on other types of infrastructure. For example disturbances in the power supply due to extreme weather events directly influence the functionality of the Railway transport system. Due to the long lifetime of Rail infrastructure, which is expected to operate at full capacity for more than 100 - 120 years (and even longer, for some installations), it is appropriate to integrate climate change aspects into the long-term Railway planning, design and management process.

The main objective of this climate change study is to qualitatively identify and assess the impact of climate change on Bengaluru Suburban railway infrastructure with associated risks and consequences and adoptive measures. World Bank (WB ESS 3 – 'A' Management of air Pollution under Resource Efficiency and Pollution Prevention and Management) and EIB Guidelines (EIB ESS 5 – Climate Change) for Climate Change Risks Vulnerability Assessment have been followed during this study.

1.10.2. Climate Change Risk Screening

1.10.2.1. A. Sensitivity of Project Components to Climate/Weather Conditions and Geological Hazards

(a) BSRP Components

The project – BSRP components include the Construction of 149.184 kilometers of new suburban rail lines, mostly at-grade (corridors and stations) and elevated (viaduct structures and short segments).

(b) Sensitivity of BSRP components

Climate change raises very concrete challenges for the project. With majority of the lines being elevated, structures are exposed to excessive heat, causing damage and disruption of rail operations. High temperatures may cause rail tracks to expand and buckle. More frequent and severe heat waves may cause derailments and require track repairs or speed restrictions. Heavy precipitation could also lead to delays and disruption, and tropical storms and cyclones can also flood or leave debris on railways, disrupting rail travel. Damages from flooding may require rail lines to be rebuilt, particularly along at grade portions, or raised in future expansion projects. Impacts on passenger comfort also raise additional problems. **Table 1.10** provides basic screening of Climate Change Risks for Risk categorisa tion of Proposed project.

Table 1.10. Initial Climate Risk Screening

Sl. No.	Projected Climate Change/Risks	Description	Risk Severity Level
1	Increase in Temperature	Annual and Monthly - average, minimum and maximum temperatures to increase	Moderate
2	Variation in Average Precipitation	Monthly precipitation is highly variable	Low
3	Extreme Events	-	
	(i) Heat Waves	Relatively increasing number of hot days (greater than 40^{o}C) is expected in March to June.	Moderate
	(ii) High or low Rainfall leading to floods or droughts	Increased intensity in Rainfall during the monsoon season. Water scarcity, which is an identified risk for the area, may also be exacerbated.	Moderate
4	High Winds/Cyclones	Frequency of the tropical cyclones possible to increase in the risky area.	Medium
5	Lightning and Electrical Storms	Frequency based on severity of rains.	Low

Based on the above table of overall Climate Change Risk Assessment Result the Climate Change Risks are categorised as Medium Risks.

1.10.3. Indicators of Risk Assessment

To assess the impact of climatic changes on the operation and maintenance of the railway network, an attempt has been made during the Desk study to identify the impact of climate changes on key indicators of railway operation and maintenance services. The identified key indicators are as given below :

- Railway infrastructure robustness;
- Railway operation;
- Railway safety;
- The economic impact for various stakeholders; and
- Other vulnerability impacts.

1.10.4. Climate Change Risk and Vulnerability Assessment (CRVA)

Climate change risk assessment is a prerequisite process for planning a corridor-map to mitigate climatic impacts and identify critical infrastructure assets and vulnerable geographical locations.

Climate Risk and Vulnerability Assessment (CRVA) shall (i) assess how climate change may affect the project and the system in which the project takes place, including the natural environment and the people potentially affected, and (ii) identify commensurate adaptation measures to reduce the risks posed by climate change to the project and the system in which it takes place.

1.10.5. Project (BSRP) Specific Climate Change Risks and Vulnerability Assessment (CRVA)

1.10.5.1. Casual Factors

The increased concentrated urbanization with developmental activities and industrialization has resulted in the increase in population and consequent pressure on infrastructure and natural resources, and ultimately raising serious challenges such as climate change impacts, enhanced greenhouse gas emissions, lack of appropriate infrastructure, traffic congestion, and lack of basic amenities (electricity, water, drainage and sanitation facilities) inmany localities of the city (IISC, 2017). Increased population growth of 1,028% in urban areas of Greater Bengaluru across 45 years (1973 to 2017), Urban heat island phenomenon with higher local temperatures climate (an increase of around 2ºC to 2.5ºC duringthe last decade), floods, impact on natural resources (88% decline in vegetation cover and 79% decline in water bodies) necessitates appropriate strategies for sustainable management and adaptaton to climate change.

1.10.5.2. Potential Risks of Climate Change on BSR Assets

Increased intensity and frequency of extreme weather conditions caused by climate change can have a negative impact on rail service performance and also increased total ownership costs. Research has shown that adverse weather conditions are responsible for 5 to 10 % of total failures and 60 % of delays on the railway infrastructure. The impact of short-term and long-term effects of climate change and extreme weather events depends on the design characteristics of the railway assets, geographical location, operational profile, maturity of the climate adaptation, etc. These extreme events will have major consequences such as traffic disruption, accidents, and higher maintenance costs during the operation and maintenance (O&M) phase. Therefore, a detailed assessment of the effects of climate change on the O&M phase requires a more comprehensive review of the previous studies reported from different parts of the world.

The potential impacts of climate change on BSR infrastructures/assets are compiled and briefly outlined here. These impacts call for careful consideration of rail design, construction, and maintenance to achieve lasting benefits.

Weather-related hazards are already among the factors most frequently causing disturbances for railways. Flooding and storm are considered major threats to the system. Climate change might in the long run produce new kinds of hazards and threats to the railway system, but the climate change will principally involve a strengthening of the already known threats, in terms of increased frequency as well as increased intensity. Based on examples of natural hazards' impact on railways (floods), possible approaches of vulnerability assessment are described which could also address potential consequences of climate change. In order to reduce the effects of weather hazards technical countermeasures are necessary, but also an appropriate risk management required, for e.g. flooding in the Bengaluru Suburban railway networks.

Weather phenomena can result in severe impacts on Railway infrastructure. Management of risks and adaptation to climate change is needed, if Railways are to continue running safe, reliable, and efficient services in longer duration. Temperature, rainfall and humidity are the major climate parameters that could impact the suburban railway infrastructure in Bengaluru, whereas snow, permafrost, storms and sea-level rise factors are not applicable to BSRP as the city is far away from Sea and snow falling regions.

The Bengaluru Suburban Rail Project (BSRP) comprises many different interacting infrastructures including earthworks and civil structures, rapid rail track structure, signaling, and many interconnected installations. After understanding the climate change vulnerability of location of BSRP as discussed in previous sections, it is known that BSRP assets are sensitive and vulnerable to critical climate risks. The project specific risks by identified significant long term impacts and its management through proper care, concern and pro-actions are briefed in the following sections.

The various possible effects on vulnerable railway infratructures/ assets are presented in Impact Matrix in **Table 1.11.**

Table 1.11. Impact Matrix of Climate Change on Vulnerable Assets

Vulnerable Infrastructure/Assets	Climate Variation/Change				
	Temperature	Rainfall	Flood	Wind	Storm/ Cyclone impact
Bridges	√	√	-	√	√
Drainage Systems	-	√	√	-	√
Railway Tracks	√	√	√	-	√
Culverts	-	√	√	-	√
Slip Slopes	-	√	√	-	√
Signalling, telecommunication and solar panels	√			√	√

Significant risks to the project are posed by both ambient and periodic extremes in temperature, extreme heat (heat waves), extreme precipitation and flooding along with medium and indirect impacts from Lightning. The same are briefly explained in the following sections.

Risks due to Extreme Temperature

The main climate parameter that is responsible for climate change is temperature. There is moderate impact of temperature on “Railway infrastructure robustness and service life” and medium impacts of temperature on “Railway operation”, “Railway safety”, and “Economy impacts to various stakeholders”. It is reported that global temperature will rise by 1.2 °C and the current mitigation actions are not satisfactory for all nations to achieve net-zero emissions by 2050–2060. The feasible approach is to utilize the climate adaptation strategies to control climate change impacts.

It is understood from **Table 1.4** on climate change projections for 2021–2050 that the annual average temperature, and the minimum, maximum, and monthly mean temperatures for Bengaluru Urban are on the increasing side. Increase in average temperature leads to increase extreme hot weather conditions.

The proposed BSRP corridors are is designed as elevated rail stretches at certain locations with track supporting structures with a vertical clearance of 5.50 m above road level. The vulnerability of rail infrastructures and operations to extreme temperature conditions with thermal impacts, is highly likely to be exacerbated under climate change due to the direct exposure of rail assets/infrastructures to sunlight.

Increase in temperature impacting rails is not the key issue of concern here. Due to continuous and direct exposure to sunlight the temperature of steel rails can reach up to 20+ degrees higher than the air around them. If ambient temperatures approach 38+oC, which Bengaluru experiences usually during pre-monsoon period (**Table 1.4**), there is possibility of shooting up of rail track temperatures

to as high as or over 60°C. That causes the metal to expand, putting it at risk of misalignment and deformations that are introduced in rail when the weight of train cars put stress in areas that are weakened by exposure to excessive heat.

Climate change impacts significantly the rail assets/infrastructure by increasing the frequency and magnitude of extreme heat conditions, due to which risk of track failures due to track expansion. The conventional practice measure to overcome this issue is to reduce the traffic on the affected areas by reducing the speed of the trains, or in extreme events, stopping traffic completely for a period of time.

The railway assets such as the elevated viaducts (or bridges) of reinforced cement concrete, signaling system, telecommunication and solar panel infrasturures are exposed to direct heat. These structures will be continuously subjected to daily, seasonal, and yearly repeated cycles of heating and cooling induced by solar radiation and surrounding air. Influencing factors such as change in temperatures i.e. increased rate of temperature along with type of aggregates used and the stability, the concrete structures get highly impacted leading to structural movements. Movements of concrete structures due to expansion and contraction under temperature changes are accommodated by bearings and expansions joints but with pervasive changes induced by extreme heat may eventually lead to deformations and failure. Additionally, sudden change in temperature can result in due to thermal shock leading to cracking and spalling of concrete. Also, distress within the concrete may result due to aggregate expansion.

Risks due to heavy precipitation /extreme rainfall

Causal factors of flooding include (i) combinations of loss of pervious area in urbanizing landscapes; (ii) inadequate drainage systems; (iii) blockade due to indiscriminate disposal of solid waste and building debris; (iv) encroachment of storm water drains; (v) loss of interconnectivity among lakes, housing in floodplains, and natural drainage; and (vi) loss of natural flood-storage sites.

Flooding has a significant high impact (aggregation of moderate, high, and very high levels) on “Railway operation”. The underlying fact is flooding can cause soil erosion underneath the rail track or submerge in the track superstructure due to an inadequate water drainage system. The additional impact of flooding of railway infrastructure is overhead contact lines that can cause short circuits of the signalling system. In some cases, if water levels rise above the rails, the train operator needs to reduce speed to prevent damage to the train and infrastructure, which in turn can cause delays. The impacts of flooding on “Railway infrastructure robustness and service life”, “Railway safety”, and “Economy impacts to various stakeholders” are moderate whereas the impact on the “Other vulnerabilities” is not properly known.

As presented in **Table 1.6** normal rainfall and observed trends during the years 1901 to 2008 that the annual precipitation variability has increased in the urban area of Bengaluru. Previously during 1901–2008, rainfall during the monsoon months (June–September) was observed to be raised up by 53% against a normal of 466 mm. In terms of future rainfall projections for the urban area of Bengaluru, this section, **Table 1.9** on June–September total precipitation shows a minor downward trend by 2.89% for 2021–2050. Although the projection shows to be insignificant, under climate change, intense rainfall incidents are expected to be more frequent and more intense, leading to an increased risk of flooding.

Since 2000 frequent flooding in Bengaluru is a consequence of the increase in impervious area with the high-density urban development in the catchment and loss of wetlands and vegetation (IISC

Technical Report, 2017). In addition, it was also noticed that there was narrowing and concretizing storm water drains, lack of appropriate drainage maintenance works with the changes in enhanced run-offs, the encroachment and filling in the floodplain on the waterways, obstruction of sewer pipes and manholes and relevant structures, deposits of building materials and solid wastes, and flow restrictions from under-capacity road crossings (bridge and culverts).

The proposed BSRP is designed as mostly elevated and at grade line systems. There are no tunnels proposed in BSRP projects and hence there will be no chance of significant potential risk of flooding by ingress of flood waters from various sources such as river (fluvial) flooding, surface water (pluvial) flooding, and burst city water pipes. Hence, these are not considered in this study.

Overloading of existing drainage systems may be resulted due to increased volume, frequency, and intensity of precipitation under climate change, thus causing backups and flooding. Elevated concrete structures for BSRP Corridors envisaged to be constructed along the existing railway lines or road medians create expanses of impervious surfaces, thus promoting faster (efficient) transformation of rainfall to runoff, which adds on to already flooded roads below.

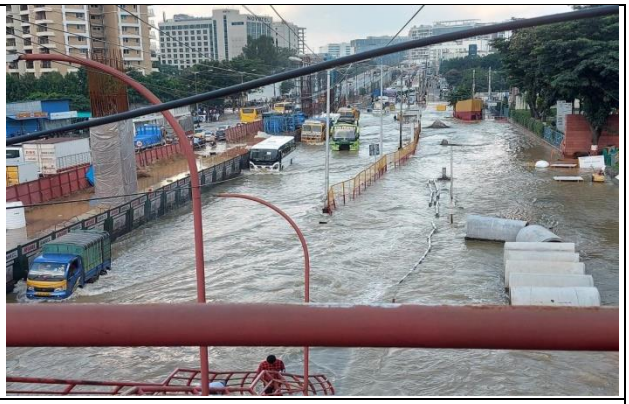
Understanding the dynamics of flooding in various areas of Bengaluru is difficult. However, it is emphasized that heavy rainfall is the primary cause of flooding in the city. Storms and floods may be increased because of an increase in storms and floods in the city. The immediate impact of floods in Bengaluru's transport system can be envisioned by the boxed scenes given in **Figure 1.7**.

Risks of Fluvial flooding in the city by the rivers Arkavathi and Vrishabhavathi that flow through Bengaluru are complex in nature and have become one of the major problems in Bengaluru. These days Arkavathi and Vrishabhavathi Rivers are considered as urban drains (Mori in Kannada) receiving pollutants from industries and sewage. All the sewer lines have been connected to the river by the Bangalore Water Supply and Sewerage Board (BWSSB). These primeval untouched pure rivers (up to 1970) in these days have become sewage carriers in Bengaluru.

1. Source: rainmanspeaks.blogspot.com. (2012)

2. Source: drivespark.com. (2012)

3. Source : techcrunch.com (2022)



4. Source : downtoearth.org.in (2022)

5. Source : DHNS, 2022

6. Source : REUTERS, 2022

Figure 1.7. Exhibits of Flood impacts on Bengaluru's Transport System

*Note :
Box 1: rainmanspeaks.blogspot.com (Rainmanspeaks from Bangalore: From trickle to flood, 2012).
Box 2: drivespark.com (Incessant monsoon rains flood Bangalore streets, 2012)
Box 3 : technocrunch.com (https://techcrunch.com/2022/09/07/bangalore-india-floods-startups/ - Climate - Torrential rains, floods and power cuts disrupt lives, business operations in India's Silicon Valley, 2022)
Box 4 : downtoearth.org.in (https://www.downtoearth.org.in/news/climate-change/multiple-troughs-la-nina-why-bengaluru-is-flooding-repeatedly-this-monsoon-84742-06 Sep. 2022)
Box 5 : DHNS, Bengaluru, Sep 11 2022 (https://www.deccanherald.com/city/top-bengaluru-stories/bengaluru-may-need-new-canals-to-handle-heavy-rains-1144054.html - Heavy rains and tank breaches earlier this week exposed the frailty of drainage system and insensitivity and lackadaisical attitude of civic bodies in addressing the perennial problem of flooding in Bengaluru. Credit: DH file photo)
Box 6 : Members of a rescue team row their boat past submerged vehicles following torrential rains in Bengaluru, India, September 5, 2022 (REUTERS/Samuel Rajkumar)

Storms/Extreme Wind Impact

Storms and extreme winds with their impacts on Rail Infrastructure are not recorded in Bengaluru. However, it is known that if there are events of Storms or extreme Winds, they are known to have medium or minor impacts on "Railway infrastructure robustness and service life". However, this impact is lower when compared to the rated impact of temperature and flooding. The significant impacts of storms and extreme winds on "Railway operation", "Railway safety", and "Economy impacts to various stakeholders" are very minimal or negligible. Storms and extreme winds have a very minimal or negligible impact on railway operation and services in BSRP.

Lightning Impact

Signal systems, including on board and trackside devices, are especially vulnerable to lightning and electromagnetic interference due to the sensitivities to radiation, electric and magnetic fields. The

impact of lightning on “Railway operation” is considered as moderate. The impacts of lightning on “Railway infrastructure robustness and service life”, “Railway safety”, and “Economy impacts to various stakeholders” are minimal.

1.10.5.3. Climate Change Risks due to Carbon Footprint (GHG Emissions)

Currently, data and tools to support CO_2 impact analysis in the transport sector are inadequate to address assessment. Only web based tools are applied in this study along with required consultation with Stake holders, concerned personnel or directly or indirectly related organizations, and public.

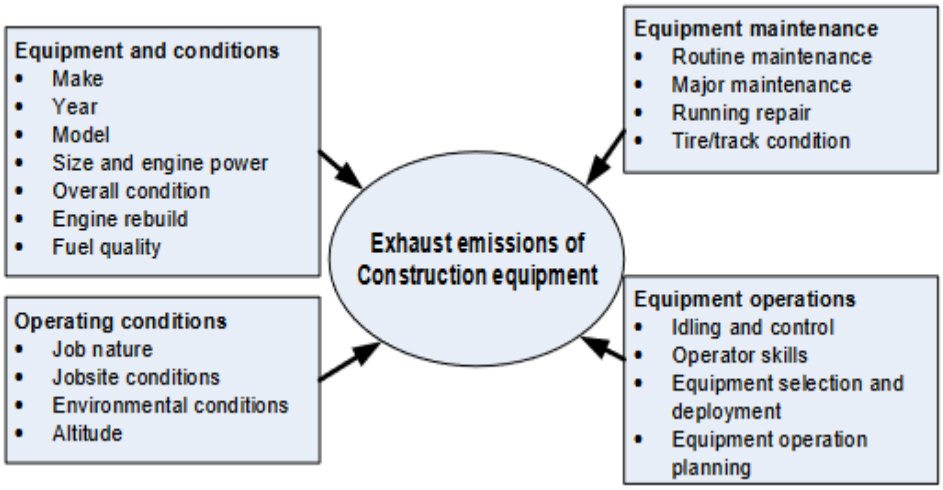
Climate change includes both the global warming driven by human emissions of greenhouse gases and the resulting large-scale shifts in weather patterns. The development and operation of the Project (Rail) has the potential to contribute to the greenhouse effect through emissions produced by various activities throughout the construction and operation of the Rail Project - BSRP. The 3 main GHGs include carbon dioxide (CO_2), Hydrocarbons (HC) and nitrous oxide (N_2O).

Carbon Footprint (GHG Emission) during Construction Phase

- The GHG emissions generated during the construction of the Project (Rail) will result from emissions generated during vegetation removal, wastewater treatment, transport, manufacturing and construction of building materials and energy usage. These GHG emissions will be relatively low, produced over a short time period and are therefore unlikely to contribute significantly to overall GHG emissions from BSRP.
- Due to tree felling and vegetation clearance (along alignment and for depots), increase in Carbon Emission during pre- construction and construction phase is 710 tonnes of CO2e for one year of activities. This contributes to 31% of the GHG emissions.
- Compensatory afforestation will be done for the tree felling, resulting in about 7,100 tonnes of CO2e per year reduced for the year 2025 (compensation of new trees for trees felled in the ratio of 10:1) (Ref. Section 9.1.9 of EIA Report)
- Construction equipment and vehicular emissions account for major contribution of about 69% towards GHG emissions, particularly 1566.81 tonnes of CO2e for a total period of 3 years of construction.

Factors affecting the construction equipment emissions

There are a large number of factors affecting the exhaust emissions of construction equipment, many are difficult to measure and quantify their degree of impact on the rate of emissions. Overall the factors can be categorized into four groups as shown in **Figure 1.8**.



Source : H. Fan, 2017 - A Critical Review and Analysis of Construction equipment emission factors

Figure 1.8. Factors of Impact on Construction Equipment Exhaust Emissions

Table 1.12 depicts net GHG Emission from BSRP construction equipment, Machinery and vehicles during project Construction phase.

Table 1.12. Carbon Footprint (GHG Emissions) during Construction Phase (for a period of 3 Years)

Sl. No.	Description of the Machinery	Nos. Per Corridor	Fuel type	g/Km					Tonnes/Km				
				CO	HC	Nox	CO2	PM	CO	HC	Nox	CO2	PM
1	Crushers	2	Electric	0	0	0	0	0	0	0	0	0	0
2	Batching Plants	2	Electric	0	0	0	0	0	0	0	0	0	0
3	Gantry Cranes	6	Electric	0	0	0	0	0	0	0	0	0	0
4	Rail Threading Machines	6	Diesel	2,30,040.00	14,185.80	3,56,562.00	2,92,30,032.60	47,541.60	0.23	0.01	0.36	29.23	0.05
5	Grinding rail machines	2	Electric / Diesel	76,680.00	4,728.60	1,18,854.00	97,43,344.20	15,847.20	0.08	0.00	0.12	9.74	0.02
6	Power Generators	10	Diesel	13,79,700.00	85,081.50	21,38,535.00	17,53,11,580.50	2,85,138.00	1.38	0.09	2.14	175.31	0.29
7	Backhoe	5	Diesel	4,59,900.00	28,360.50	7,12,845.00	5,84,37,193.50	95,046.00	0.46	0.03	0.71	58.44	0.10
8	Cranes	8	Diesel	7,35,840.00	45,376.80	11,40,552.00	9,34,99,509.60	1,52,073.60	0.74	0.05	1.14	93.50	0.15
9	Compressors	2	Diesel	1,05,120.00	6,482.40	1,62,936.00	1,33,57,072.80	21,724.80	0.11	0.01	0.16	13.36	0.02
10	Welding Equipment	15	Electric	0	0	0	0	0	0	0	0	0	0
11	Grinders	2	Electric	0	0	0	0	0	0	0	0	0	0
12	Excavators	4	Diesel	3,67,920.00	22,688.40	5,70,276.00	4,67,49,754.80	76,036.80	0.37	0.02	0.57	46.75	0.08
13	Dump Tracks	20	Diesel	18,39,600.00	1,13,442.00	28,51,380.00	23,37,48,774.00	3,80,184.00	1.84	0.11	2.85	233.75	0.38
14	Girder Launching Equipment Vehicles	4	Electric	0	0	0	0	0	0	0	0	0	0
15	Dozers	10	Diesel	9,19,800.00	56,721.00	14,25,690.00	11,68,74,387.00	1,90,092.00	0.92	0.06	1.43	116.87	0.19
16	Rollers	10	Diesel	9,19,800.00	56,721.00	14,25,690.00	11,68,74,387.00	1,90,092.00	0.92	0.06	1.43	116.87	0.19
17	Pile hydraulic rig	4	Diesel	3,67,920.00	22,688.40	5,70,276.00	4,67,49,754.80	76,036.80	0.37	0.02	0.57	46.75	0.08

Sl. No.	Description of the Machinery	Nos. Per Corridor	Fuel type	g/Km					Tonnes/Km				
				CO	HC	Nox	CO2	PM	CO	HC	Nox	CO2	PM
18	Personnel Vehicles (Car/Taxi)	10	Diesel	1,52,205.00	16,425.00	13,140.00	1,52,77,440.00	2,190.00	0.15	0.02	0.01	15.28	0.00
Total GHG Emission Per Corridor=				**75,54,525.00**	**4,72,901.40**	**1,14,86,736.00**	**95,58,53,230.80**	**15,32,002.80**	**7.55**	**0.47**	**11.49**	**955.85**	**1.53**
Total GHG Emission for all 4 Corridors =				**4,51,46,74,794.30**	**28,26,11,551.46**	**6,86,46,11,274.43**	**5,71,22,93,60,964.85**	**91,55,43,257.31**	**4,514.67**	**282.61**	**6,864.61**	**5,71,229.36**	**915.54**

Source : Carbon Emission factors from CPCB/MoEF, 2008 (for HCV Construction Vehicles) and BSRP Feasibility Report (for Personal Vehicles)

Table 1.13. Net Carbon Foot Print as GHG Emissions during Construction Phase (for a period of 3 Years)

GHGs	Emission in g/Km	Emission in g/Km for total Project	Emission in Tonnes/Km	Emission in Tonnes/Km for total Project
CO	**75,54,525.00**	**4,51,46,74,794.30**	**7.55**	**4,514.67**
HC	**4,72,901.40**	**28,26,11,551.46**	**0.47**	**282.61**
NOx	**1,14,86,736.00**	**6,86,46,11,274.43**	**11.49**	**6,864.61**
CO_2	**95,58,53,230.80**	**5,71,22,93,60,964.85**	**955.85**	**5,71,229.36**
PM	**15,32,002.80**	**91,55,43,257.31**	**1.53**	**915.54**

Source: Estimate prepared for the CRVA Report based on "Carbon Emission factors from CPCB/MoEF, 2008 (for HCV Construction Vehicles) and BSRP Feasibility Report (for Personal Vehicles)"

Carbon Footprint (GHG Emissions) during Operation Phase

According to a 2007 estimate, electricity generation in India contributes 37.8% of CO2 eq. emissions – CO2, SO2, NO2 (MOEF, 2010) and is mainly by coal-based thermal power plants.. Since the coal in India has a higher fly ash content (30–40%), electricity generation leads to the formation of particulate matter (PM10 /PM2.5) – a source of air pollution in the form of fly ash (Senapati, 2011). Therefore, the BSRP has no direct emissions from its operation, but contributes to carbon emissions at power plants during the generation of electricity used for its operation.

BSRP operations will avoid or reduce the need for other forms of travel (for eg. diesel buses, cars, motorbikes), thus avoiding CO_2 emissions. The emissions savings include approximately 32 tonnes of CO_2e per day (about 12,000 tonnes/year) for the year 2025, increasing up to about 56 tonnes of CO2e per day (20,000 tonnes/year) by 2041. **Table 1.14** depicts Vehicular GHG Emission and Reduction in GHG Emission from BSRP during project Construction, whereas **Table 1.15** presents Vehicular Emission and Reduction in GHG Emission from BSRP Operation phases along with annual projected estimate.

Table 1.14. Vehicular Emissions and Reduction in GHG Emissions of BSRP during Operation Phase

Vehicular GHG Emissions with BSRP (in Tonnes/year)					Vehicular GHG Emission without BSRP (in Tonnes/year)					Reduction in GHG (in Tonnes/year)					Reduction in GHG in %				
Year	2025	2031	2041	2051	Year	2025	2031	2041	2051	Year	2025	2031	2041	2051	Year	2025	2031	2041	2051
Total Vehicles	984375	1341165	1760519	2310995	Total Vehicles	13836053	16384800	19570733	23376154	Total Vehicles	12851678	15043635	17810214	21065159	Total Vehicles	93	92	91	90
CO	1305.360	1778.492	2334.589	3064.564	CO	18347.713	21727.556	25952.358	30998.650	CO	17042	19949	23618	27934	CO	93	92	91	90
HC	256.410	349.347	458.580	601.968	HC	3604.015	4267.913	5097.785	6089.021	HC	3348	3919	4639	5487	HC	93	92	91	90
NO_X	1030.011	1403.341	1842.137	2418.133	NO_X	14477.492	17144.399	20478.032	24459.872	NO_X	13447	15741	18636	22042	NO_X	93	92	91	90
PM	56.818	77.412	101.617	133.391	PM	798.617	945.731	1129.623	1349.272	PM	742	868	1028	1216	PM	93	92	91	90
CO_2	150598.626	205183.599	269340.182	353556.999	CO_2	2116765.019	2506695.478	2994108.437	3576296.294	CO_2	1966166	2301512	2724768	3222739	CO_2	93	92	91	90

Source : Feasibility Report, 2019 and EIA Report of DPR for BSRP, 2022

Table 1.15. Annual GHG Emission due to power consumption by BSRP during Operation Phase

Prediction Years	Energy Consumption (in Crore KWh)	GHG Emission					
		CO_2		SO_2		NO_2	
		kg	Tonnes	g	Tonnes	g	Tonnes
2025	25.5	242250000	242250.0	1836000000	1836.000	1116900000	1116.900
2026	26.08	247760000	247760.0	1877760000	1877.760	1142304000	1142.304
2027	26.65	253175000	253175.0	1918800000	1918.800	1167270000	1167.270
2028	27.23	258685000	258685.0	1960560000	1960.560	1192674000	1192.674
2029	27.81	264195000	264195.0	2002320000	2002.320	1218078000	1218.078
2030	28.39	269705000	269705.0	2044080000	2044.080	1243482000	1243.482
2031	28.97	275215000	275215.0	2085840000	2085.840	1268886000	1268.886
2032	29.35	278825000	278825.0	2113200000	2113.200	1285530000	1285.530
2033	29.75	282625000	282625.0	2142000000	2142.000	1303050000	1303.050
2034	30.14	286330000	286330.0	2170080000	2170.080	1320132000	1320.132
2035	30.54	290130000	290130.0	2198880000	2198.880	1337652000	1337.652
2036	30.92	293740000	293740.0	2226240000	2226.240	1354296000	1354.296
2037	31.3	297350000	297350.0	2253600000	2253.600	1370940000	1370.940
2038	31.68	300960000	300960.0	2280960000	2280.960	1387584000	1387.584
2039	32.06	304570000	304570.0	2308320000	2308.320	1404228000	1404.228
2040	32.46	308370000	308370.0	2337120000	2337.120	1421748000	1421.748

Prediction Years	Energy Consumption (in Crore KWh)	GHG Emission					
		CO_2		SO_2		NO_2	
		kg	Tonnes	g	Tonnes	g	Tonnes
2041	32.84	311980000	311980.0	2364480000	2364.480	1438392000	1438.392
2042	33.24	315780000	315780.0	2393280000	2393.280	1455912000	1455.912
2043	33.63	319485000	319485.0	2421360000	2421.360	1472994000	1472.994
2044	34.03	323285000	323285.0	2450160000	2450.160	1490514000	1490.514
2045	34.41	326895000	326895.0	2477520000	2477.520	1507158000	1507.158
2046	34.79	330505000	330505.0	2504880000	2504.880	1523802000	1523.802
2047	35.18	334210000	334210.0	2532960000	2532.960	1540884000	1540.884
2048	35.57	337915000	337915.0	2561040000	2561.040	1557966000	1557.966
2049	35.96	341620000	341620.0	2589120000	2589.120	1575048000	1575.048
2050	36.35	345325000	345325.0	2617200000	2617.200	1592130000	1592.130

Note : CO2 =0.95 kg/kWh, SO2 = 7.2 g/kWh; NO2 = 4.38 g/kWh: Traction Energy Consumption is 66 %.

Source : Estimated for the Climate Change Study of BSRP, 2022-23

Table 1.16. Net Savings in plying Vehicular CO_2 Emission (in Tonnes/Year) due to Project Implementation

	2025	2031	2041	2051
Reduction in CO_2 Emission with BSRP	1,50,598.58	2,05,183.65	2,69,340.17	3,53,557.05
CO_2 Emission without BSRP	21,16,764.97	25,06,695.54	29,94,108.38	35,76,296.27
Overall Reduction in CO_2 Emission	19,66,166.38	23,01,511.89	27,24,768.21	32,22,739.22
Reduction in CO_2 Emission in %	92.89	91.81	91.00	90.11

Source : Feasibility Report, 2019 and EIA Report of DPR for BSRP, 2022

Table 1.17. Net Savings of overall CO_2 Emission after 5 years of Operation of BSRP (in Tons)

Savings of CO2 Emission during BSRP Implementation	2031	2041	2051
Savings of CO2 Emission =	7,10,49,63,677.88	7,10,53,86,934.26	7,10,58,84,905.30
Total CO2 Emission with BSRP Implementation (in Tons)	4,47,433.60	5,11,590.18	5,95,807.00
Net Savings in CO2 Emission (in Tons)	7,10,45,16,244.28	7,10,48,75,344.08	7,10,52,89,098.30
Net Savings in CO2 Emission (in Million Tons)	7,104.52	7,104.88	7,105.90
Net Savings in CO2 Emission (in Crore Tons)	**710.45**	**710.49**	**710.53**

Source : Estimated for the Climate Change Study of BSRP, 2022-23

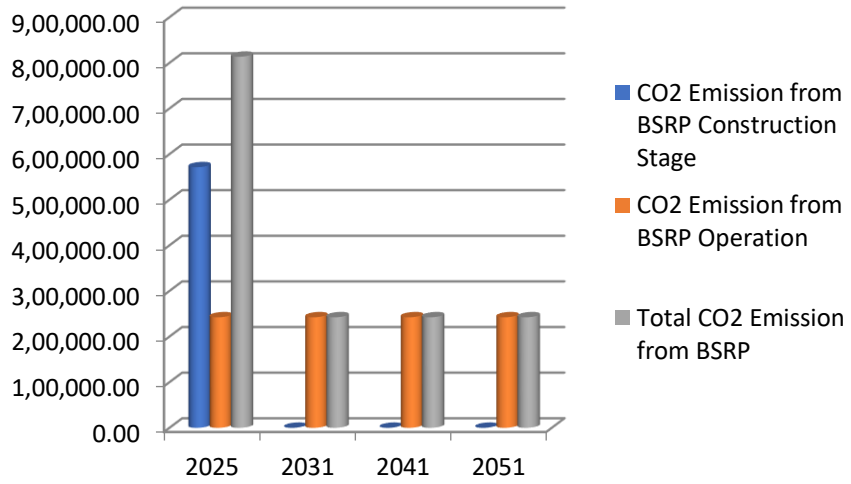


Figure 1.9. CO2 Emission during BSRP Execution

Figure 1.9 depicts the CO2 emission during the Construction and Operation Stages of BSRP. Emissions from power generation necessary for Suburban Rail operation have been deducted from the CO2 emission savings. Electricity consumption of the train operation depends on the Specific Electricity Consumption of the train (0.045 kilowatt hour per gross ton kilometer), the total line length, the number of trips per day, the composition of the train, the number of persons transported, and the amount of electricity regenerated by the train itself (30% regeneration as per DPR). Electricity consumption of stations and depots is calculated with a 50% increase over the lifetime of the project, corrected for the expected amount for electricity generated by solar power at stations and depots.

Gross CO2 emissions from the operations of KfW-EIB funded proposed rail transport project were estimated as 4,47,433.6 tons, or an decadal average of 5,18,276.93 Tons. CO2 emission and Savings in CO2 Emission for decadal predictions is presented in **Table 1.16** and **Table 1.17** and depicted in **Figure 1.10** and **Figure 1.11**.

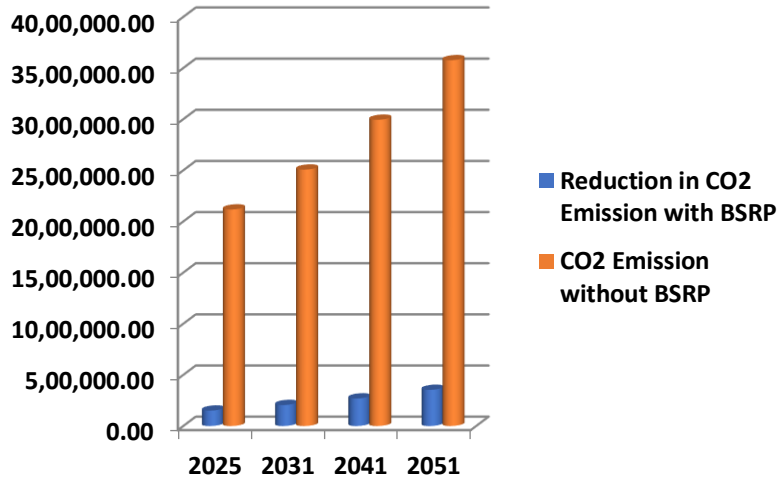


Figure 1.10. CO2 Emission with and without BSRP Implementation

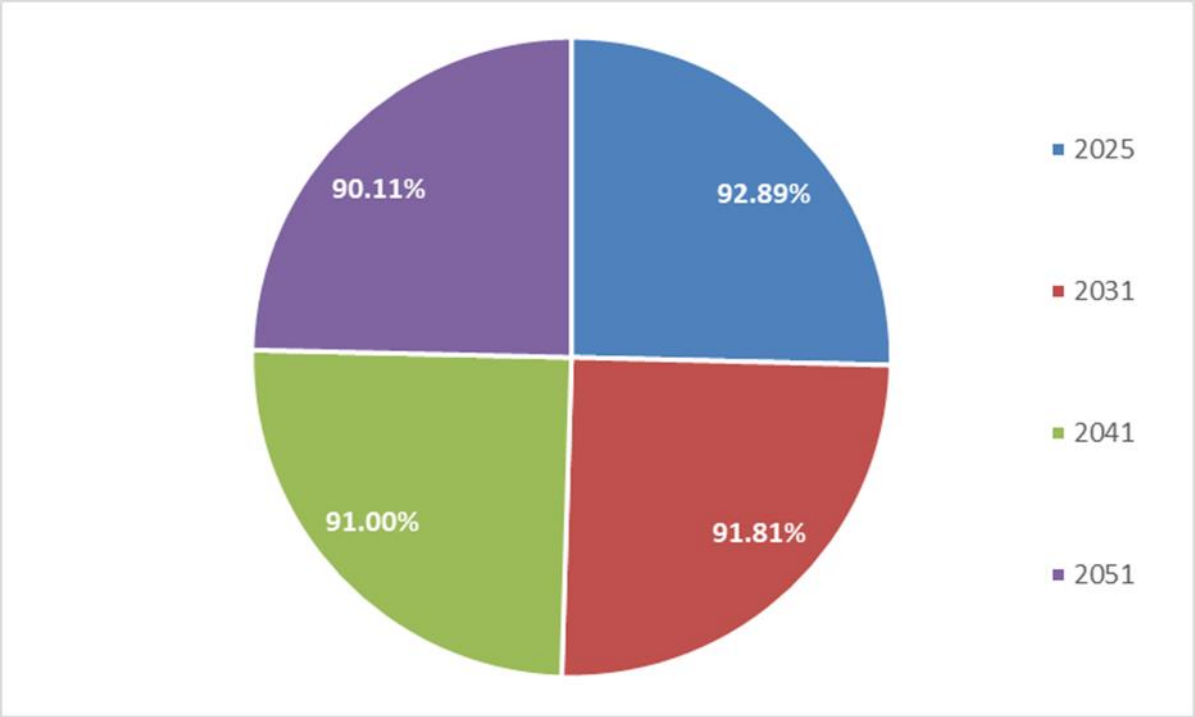


Figure 1.11. Decadal Savings of CO2 Emission during BSRP Implementation

The key points noted are as given below :

1) Output indicator – The output indicator - CO_2 intensity per km per year of proposed rail transport infrastructure i.e. BSRP funded by KfW-EIB, is 1,50,598.58 tons per km (2025).
2) Mobility indicator – Railways are more efficient than roads by this criterion. The Mobility indicator - CO_2 intensity per unit of passenger-km and freight-km of BSRP was estimated to be 13,284.91 tonnes per km (2025) travelled. Due to lack of adequate data passenger and freight mobility analysis could not be done in detail.
3) Investment indicator – Reduction in CO_2 intensity per dollar of investment provides values for each transport mode that are consistent with the other indicators. The reduced aggregate CO_2 intensity per dollar of investment was found to be 101.09 tons per $1 million invested (2025) over the current projects' life time. However, within a specific context, this indicator should not be used on a standalone basis but needs to be used in conjunction with the output and mobility indicators to ensure consistency.

1.10.5.4. Risks on Biodiversity

The main driver of biodiversity loss remains humans' use of land – primarily for food production. Human activity has already altered over 70 per cent of all ice-free land. When land is converted for agriculture, some animal and plant species may lose their habitat and face extinction.

But climate change is playing an increasingly important role in the decline of biodiversity. Climate change has altered marine, terrestrial, and freshwater ecosystems around the world. It has caused the loss of local species, increased diseases, and driven mass mortality of plants and animals, resulting in the first climate-driven extinctions. The environmental changes being driven by climate change are disturbing natural habitats and species in ways that are still only becoming clear. There

are signs that rising temperatures are affecting biodiversity, while changing rainfall patterns and extreme weather events are putting pressure on species already threatened by other human activities. There no oceans nearby, and hence there is no issue of ocean acidification impacting biodiversity.

On land, higher temperatures have forced animals and plants to move to higher elevations or higher latitudes, many moving towards the Earth's poles, with far-reaching consequences for ecosystems. The risk of species extinction increases with every degree of warming.

If current rates of warming continue, by 2030 global temperatures could increase by more than 1.5°C (2.7°F) compared to before the industrial revolution. Risks of Forest fires may be rare as there are no dense forests near the project area. Another major impact of climate change on biodiversity is the increase in the intensity and frequency of storms. However, in Bengaluru storms are rare of occurrence impacting the biodiversity. Intensity and frequency of fires or periods of drought are uncommon in Bengaluru city and hence, no impacts on biodiversity predicted. The threat posed by climate change to biodiversity is expected to increase, yet thriving ecosystems also have the capacity to help reduce the impacts of climate change.

1.10.5.5. Health Risks due to Climate Change

Climate change and associated increases in climate variability will likely further exacerbate global health disparities. More research is needed, particularly in developing countries, to accurately predict the anticipated impacts and inform effective interventions.

In particular, tropical regions will experience significant changes in human–pathogen relationships because of climate change (Sattenspiel 2000). Changing temperatures and precipitation patterns linked to climate change will further affect health by changing the ecology of various vector-borne diseases, such as malaria, dengue, chikungunya, encephalitis, kala-azar, and filariasis (Bhattacharya et al. 2006; Dhiman et al. 2008). Vulnerable populations include the elderly, children, urban populations, and the poor (Ebi and Paulson 2010; O'Neill and Ebi 2009).

Climate change affects people's health in two main ways:

- By changing the seriousness or frequency of health problems that people already face.
- By creating new or unanticipated health problems in people or places where they have not been before.

A person's **vulnerability** to climate change impacts depends on three key factors:

1) **Exposure -** People will encounter climate hazards differently. Exposure will depend on where and how long people spend time and what they do. For example, people who spend a lot of time outdoors may be more exposed to extreme heat.
2) **Sensitivity -** Some people are more sensitive than others to climate hazards due to factors like age and health condition. For example, children and adults with asthma are particularly sensitive to air pollutants and wildfire smoke.
3) **Adaptive capacity -** People can adjust to, take advantage of, or respond to climate change hazards. A person's ability to adapt may depend upon their income, age, living situation, access to health care, and many other factors

Overall, climate change affects the health of ecosystems, influencing shifts in the distribution of plants, viruses, animals, and even human settlements. This can create increased opportunities for animals to spread diseases and for viruses to spill over to humans. Human health can also be affected by reduced ecosystem services, such as the loss of food, medicine and livelihoods provided by nature.

Climate variability and human health are interrelated along with Poverty and base line vulnerability. There requires the greater understanding of the relationship between climate variability and emerging and re-emerging infectious diseases such as dengue, yellow fever, cholera, and the chikungunya virus as well as chronic diseases related to cardiovascular and respiratory illness, asthma, and diabetes. The health effects of climate change include respiratory and heart diseases, pest-related diseases like Lyme disease and West Nile Virus, water- and food-related illnesses, and injuries and deaths. Climate change has also been linked to increases in violent crime and overall poor mental health.

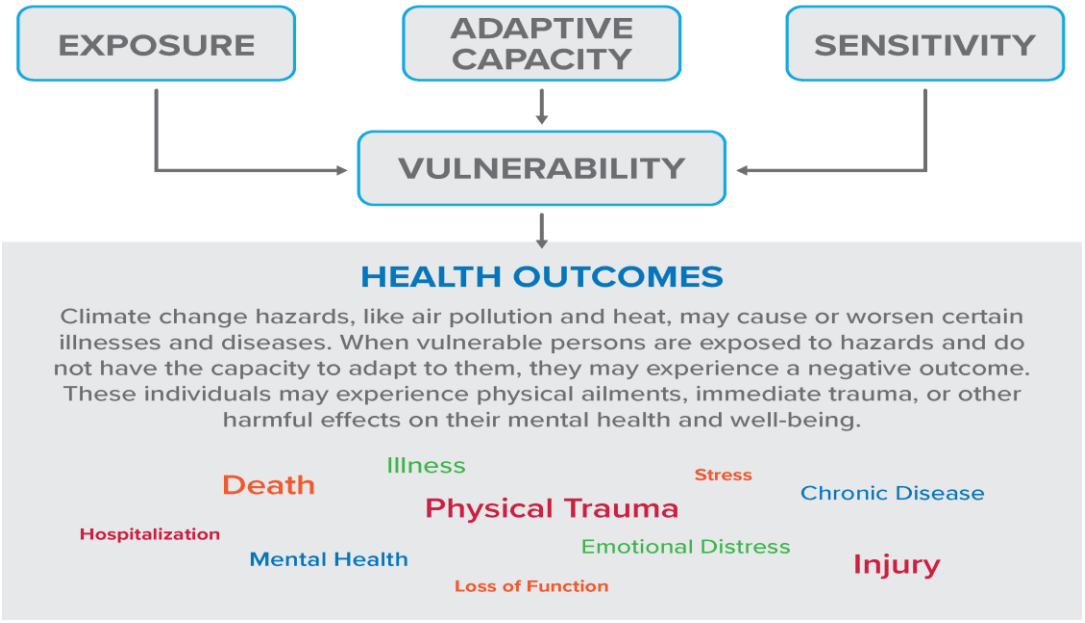


Figure 1.12. A person's vulnerability to climate change impacts

Source : US EPA - How Climate Change Affects Human Health (https://www.epa.gov/climateimpacts/climate-change-and-human-health)

Climate change impacts and health risks are dealt in brief in the following sections :

Potential health impacts fall into three categories: (i) heat stress and air pollution, (ii) waterborne diseases, and (iii) vector-borne diseases focusing on malaria.

Heat stress and air pollution

The summer of 2010 was the hottest summer on record in India, with temperatures approaching 50°C (122°F); the effects were far-reaching, including hospitalization because of heatstroke, suffering of livestock, and severe drought in some regions that affected health as well as agriculture (Burke 2010). It is estimated that individuals in the 0- to 14-year-old age group had greater vulnerability to temperature increases than those in the 15- to 64-year-old age group or in the ≥ 65-year-old age group. Limited work has been conducted on the combined effects of weather, climate variability, and increased air pollution in India (Agarwal et al. 2006; Karar et al. 2006).

Waterborne infectious disease

Increased death rate is predicted due to drinking contaminated water, living in or around unhygienic situations and breathing polluted air due to climate change (WHO and UNICEF 2000). Diseases such as cholera and hepatitis play major roles attacking vulnerable groups such as Children in the 0- to 14-year-old age group and old people in the ≥ 65-year-old age group. As prediction models evolve, region-specific action plans and adaptation strategies need to be developed in future.

Vector-borne disease

Like most infectious diseases, malaria may occur during heavy monsoon period in areas which lack proper sanitation and potable drinking water facilities, and hygienic conditions. The malaria mortality in India is difficult because correctly diagnosed episodes are successfully treated and do not result in death; in fatal cases it is due to lack of medical intervention. Malaria is easily mistaken for some other life-threatening fever; and particularly, in most rural areas death from malaria is common where proper medical attention at the time of death is uncommon. In urban areas, malaria mortality is negligible.

High risk and vulnerability are not observed due to climate change in Bengaluru as it is the urban area where basic facilities are provided to the population including proper sanitation and potable drinking water.

Impact on Food Safety and Nutrition

Climate change and the direct impacts of higher concentrations of carbon dioxide in the atmosphere are expected to affect food safety and nutrition. In general, extreme weather events can also disrupt or slow the distribution of food leading to Malnutrition cases.

1.10.6. Consequences of Climate Change Risks

These above events have extreme consequences for the dependability of railway infrastructure and the acceptable level of services by the executing agency - K-RIDE and other stakeholders. It is quite complex and difficult to quantify the consequences of climate change on railway infrastructure because of the inherent nature of the railway itself. As such, Meteorological phenomena *viz…* temperature and precipitation are not necessarily hazardous themselves: hazards arise only when a weather phenomenon manifests itself in a way that could cause harm with linear impacts.

Figure 1.13 shows that weather hazards can have multiple impacts and consequences, including on Railway elements other than infrastructure (and indeed, more widely than that). While the direct effects of extreme weather are often short-lived, the longer-term impacts on Railway infrastructure can be safety- and performance-critical, and thus form part of holistic asset management. Consequences of infrastructure failure are mainly governed by the type of failure—whether requiring routine repair, or major replacement—and the impact that failure has on the people and services depending on it. The consequences can be direct, including loss of asset value and lives; and indirect, including consequential revenue losses. Some weather events result in very widespread impacts. Synoptic-scale or unexpected storms can cause network-wide impacts, causing failure of multiple elements of infrastructure and sometimes cascading or cumulative effects. Local weather impacts on Railway infrastructure should be considered in the decision-making process for maintenance and renewal programs, as part of asset management strategies, to help minimize the risk or severity of impacts. Result of Climate Change Risk screening Assessment is summarised in **Table 1.18**.

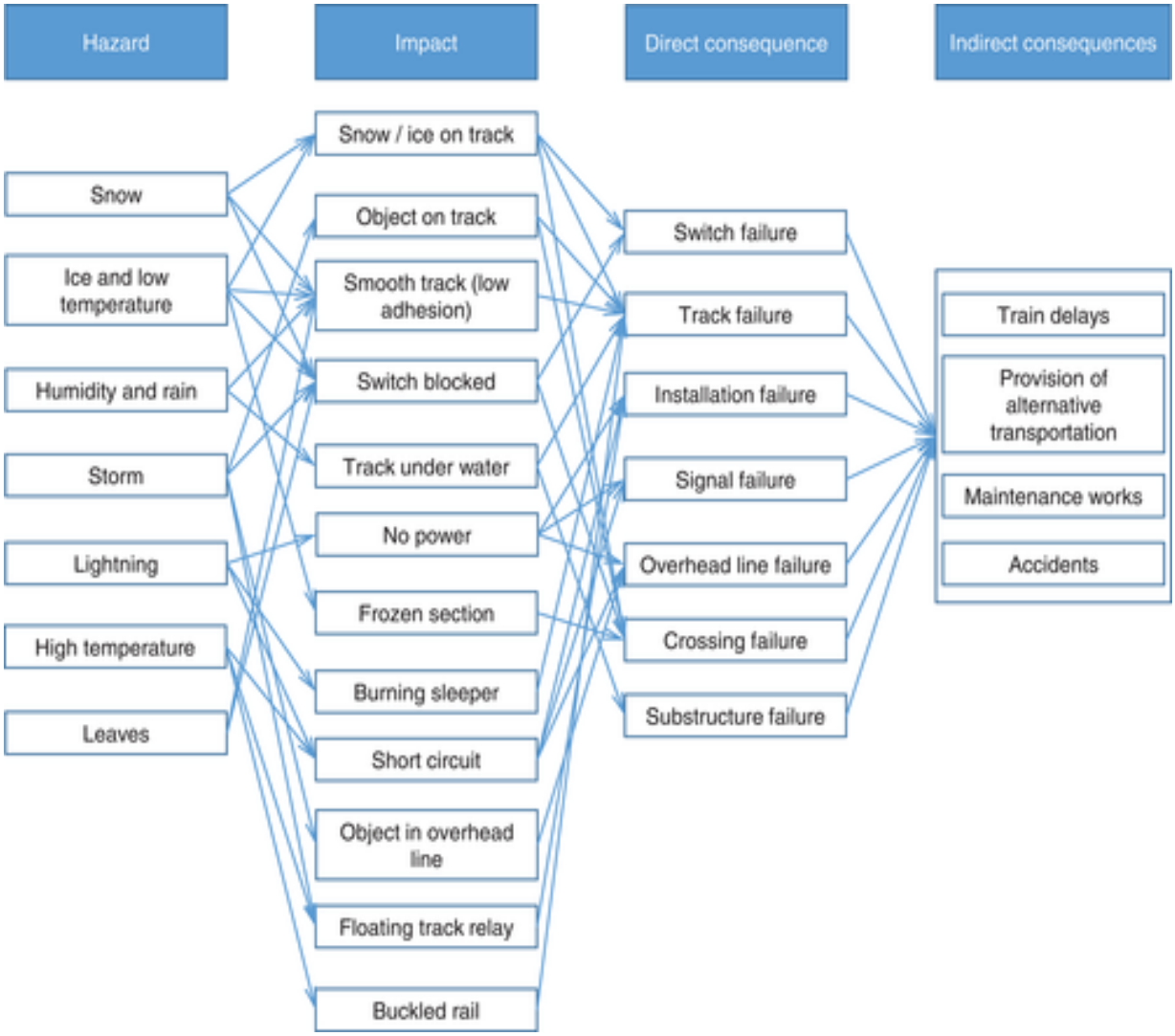


Figure 1.13. Direct or Indirect Consequences of weather hazards on Railway Elements

The impact of these climate change parameters on vulnerable railway assets leads to several consequences as listed below :

- track movement,
- track buckling,
- track washout,
- erosion of track bed,
- over-flooding,
- falling of trees,
- higher winds,
- visibility,
- drainage system clogging,
- landslips,
- disruption of bridge foundations,
- settlement of edifices,
- arcing of conductive components,

- wayside fires,
- vegetation, etc.

Severity of risks may lead to the following :

- Stoppage and / or cancellation of Rail services
- Inefficient acceleration and braking, slower speeds and delays
- Accidents
- Material damage to Rail fleet, equipment and infrastructures

The impacts of extreme weather events can be particularly severe on Rail infrastructure because of the highly integrated nature of the Rail system and the need to maintain safe operations. Failure of a single asset can result in potential fatalities, large replacement costs, loss of service (sometimes may extend in terms of days or week), and reputational damage. Replacement costs for Civil Engineering infrastructure items such as bridges, *etc*. are sometimes prohibitive, leading to long-term closure of the suburban Rail services. Since climate change is a major concern for government, it is imperative to plan and implement policies and regulations so that the stakeholders can accordingly build their strategy to handle climate change impacts.

Many of the major public health concerns are associated with climate change. Climate change poses an overwhelming stressor that will magnify existing health threats.

Risk Assessment Matrix

Figure 1.14 also shows a possible application to climate change risk. The output of such risk assessment is an input to the decision-making processes of the entity undertaking the assessment. **Figure 1.15** shows that Risk assessment Matrix with different colours based on likelihood and severity. Where the likelihood of occurrence of a hazard of certain intensity can be quantified, we refer to the term probability of occurrence (P). When the extent of the impacts, namely consequences (C) are independent of the probability of occurrence of the hazard, which is often the case for purely natural hazards, risk can be expressed algebraically as follows (**Figure 1.14):**

Risk = P X C …… (eq 1.0)

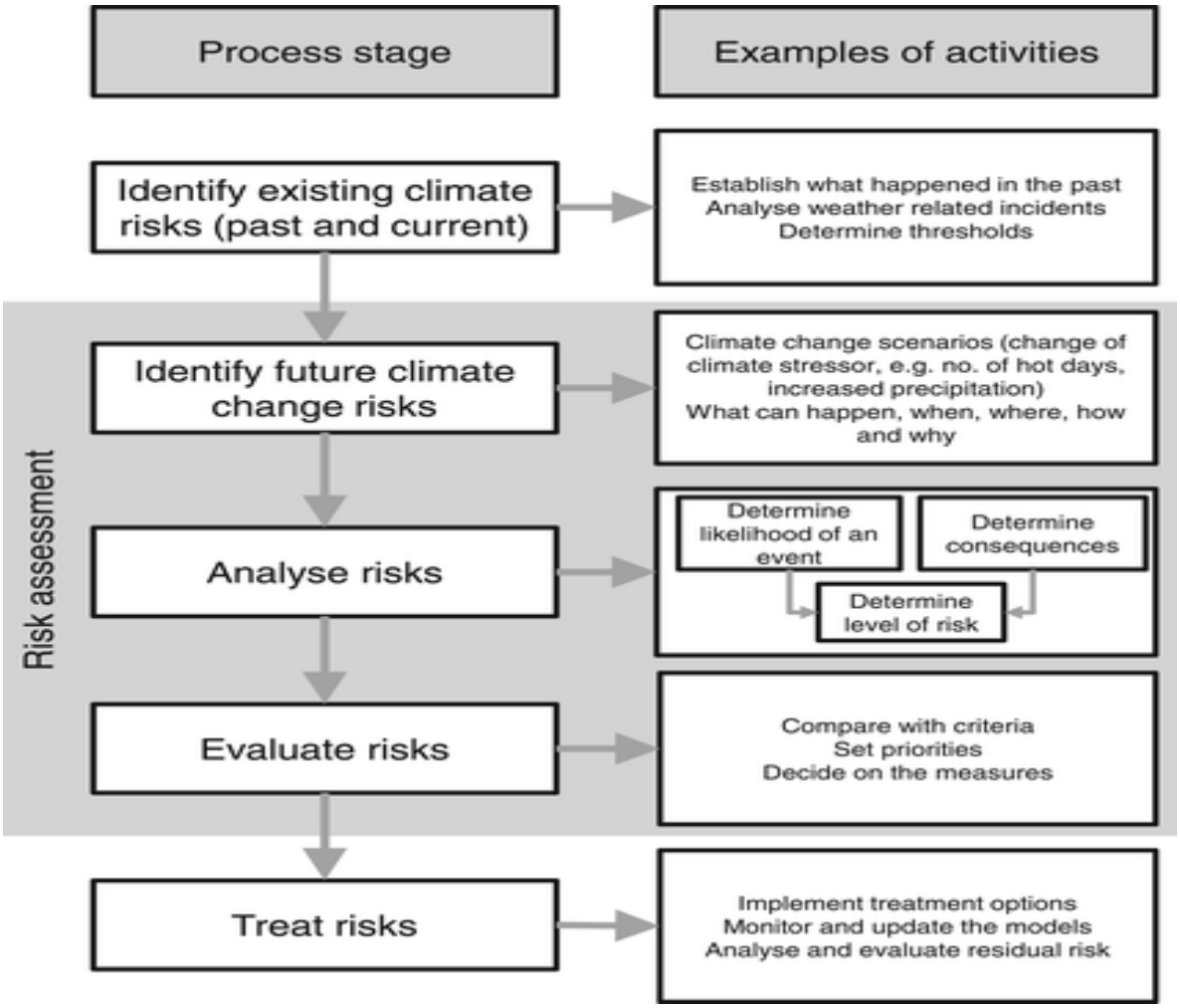


Figure 1.14. Risk Management Process

Figure 1.15. Risk Assessment Matrix (5 X 5)

Color-coding for a 5×5 risk assessment matrix is to represent the combination level of probability and impact of the identified risks. **Figure 1.15** shows high risks must be in red, moderate risks in yellow (amber), and low risks in green. Adaptation measures will reduce the high risks to moderate and low risks.

The performance of adaptation measures depends on their robustness against various possible futures, with varying climate change impacts. Residual impact is associated for each adaptation measures due to the heavy rains, temperature & Wind speed etc. **Figure 1.16** shows that Residual Risk assessment Matrix with different colours based on likelihood and severity.

	Severity →			
Likelihood ↑	**Residual impacts**	**Minor**	**Moderate**	**Major**
	Likely	**3**	**6**	**9**
	Possible	**2**	**4**	**6**
	Unlikely	**1**	**2**	**3**

Figure 1.16. Residual Risk Assessment Matrix (3 X 3)

1.11. Adaptation Measures to Climate Change and Bengaluru Suburban Railway Asset Management

1.11.1. General

Climate adaptation is a complex and complicated approach that necessitates the understanding of various interdependencies between climate parameters and infrastructure assets using models for the prediction of the health of the asset.

The control on Climate change can be achieved through a holistic perspective considering local/regional climate conditions, climate change impacts, stakeholders' participation, policy changes, and infrastructure health during the operation and maintenance phase of the project. Based on risk priorities, adaptation strategies can be developed, supporting decision- making about future maintenance, rehabilitation and repair planning. One of the means to make decisions is to evaluate the economic effectiveness of proposed adaptation measures. In order to perform that decision makers need access to figures that represent the net costs of climate change, which is usually very difficult to collect and separate from other costs and effects.

Furthermore gaps in knowledge and capacity to understand potential effects of climate change may act as barriers to implement effective adaptation, for example :

- uncertainty in regional climate change projections, combined effects of different weather phenomena

- a lack of strategic direction from legislation and policy to drive adaptation
- a lack of sector-specific information sources and methodologies to assess how effective adaptation responses could be.

Adaptation responses to reduce the vulnerability of proposed Railway infrastructure from climate change is assessed based on the following considerations:

- The magnitude and rate of climate change: adaptation is more feasible when climate change is moderate and gradual than when change is abrupt.
- Clear identification or establishment of where responsibility for adaptation options may lie, plus any influence on these options.
- Where existing risk management responses can accommodate climate change considerations; and
- Where adaptation actions can be effective in achieving specific (and other) goals, acknowledging that adaptation responses can have unintended consequences.

The proposed project is categorized as medium risk project. Rolling Stock procured under this project will be used on Railway network areas which may be exposed to climate change related hazards. The project may also upgrade existing depots located away from climatic and geophysical hazards. The core of adaptation to negative impacts of both climatic and non-climatic risks lies in the fact that all infrastructure components should at the outset be well constructed and founded on robust groundwork so that deterioration does not result from inadequacies in construction, and/or deficiencies in the structural properties, and/or quality of materials. This adaptation approach rests with the K-RIDE and comprises setting and enforcing adequate engineering and performance standards during the construction phase.

In the Rail Transport Sector, adaptation options are generally grouped into engineering (structural) options and non-engineering options as shown in **Figure 1.17**. Adaptation options from the structural standpoint view at design standards of vital project components that may be compromised by climate change, which include (i) subsurface materials, composition, stability, and strengths; (ii) material specifications in terms of physical properties and behaviour under environmental severity; (iii) cross-sections and dimensions of project elements; (iv) drainage and erosion considerations responsive to changes in future rainfall and runoffs or floods; and (v) other protective engineering structures.

Non-engineering options of climate change adaptation for the BSRP at various processes of adjusting to changing climate and its cascading impacts include the following aspects such as (i) maintenance planning and early warning, (ii) master planning including land use planning, and (iii) local environmental management. Environmental management aspects are examined in the environmental safeguard assessments and documented in Chapter 10 on Environment and Social Impact Assessment (ESIA) of the DPR for BSRP, as well as the environmental impact assessment prepared in compliance with KfW and EIB requirements. The ESIA reports effects of project activities on the immediate environment and environmental quality issues and recommends risk mitigation or adaptation measures to be considered during the project design, construction and operation phases.

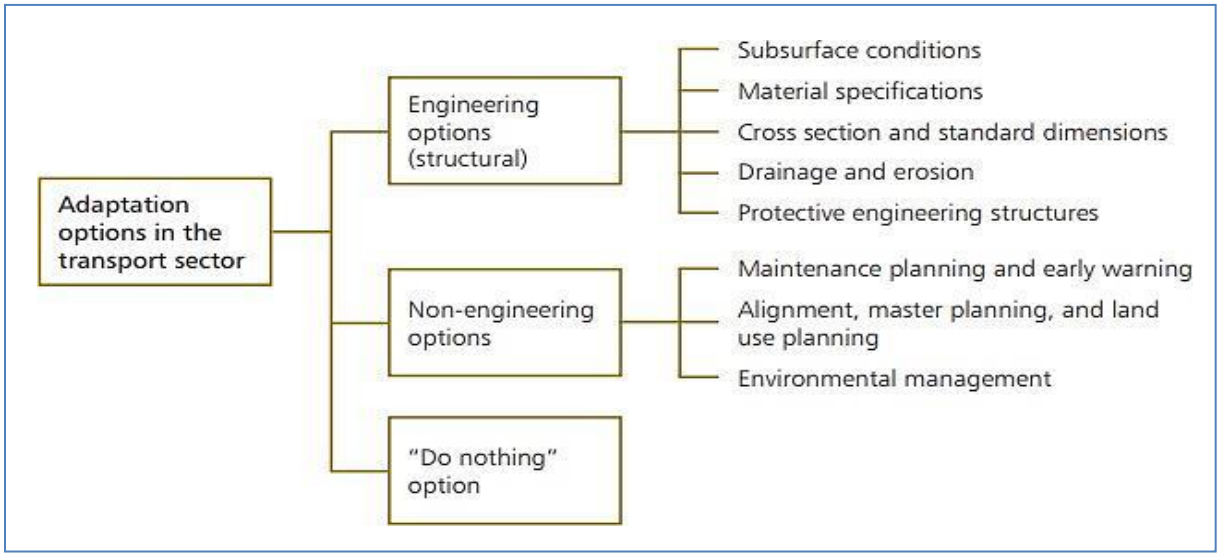


Figure 1.17. Nature of Adaptation Options in the Transport Sector

Source: Asian Development Bank, Guidelines for Climate Proofing Investment in the Transport Sector, 2014.

The decision-making in climate change adaptation measures can be difficult primarily due to relatively new area of the subject – Climate Change adaptation measures, information gaps/lack of adequate information, or inconclusive studies on the vulnerability, sensitivity, and impact assessments. In this case "Do nothing" option is also provided as indicated in **Figure 1.17**.

In this project case, adaptive maintenance or incremental adaptation actions can be decided and implemented in successive short timescales. This can provide advantage in managing climate change uncertainty iteratively, based on gradual, increasingly reliable climate change knowledge. This reduces the risks of committing to highly expensive initial investment. It is to be noted here that not all adverse consequences of climate change on a project can be avoided through adaptation alone.

1.11.2. Project specific Climate Change Adaptation Measures

A primary cost incurred by railways lies in the maintenance and renewal of track and its related infrastructure caused by temperature-induced defects such as buckling and kinks (areas of rail weakened by exposure to excessive heat) and rolling contact fatigue defects (RCF) as a result of intensive usage. **Table 1.4** show the annual average temperature, and the minimum, maximum, and monthly mean temperatures for Bengaluru city to be on the increasing side. Risks to rail tracks due to extreme temperature are well-known as elevated Suburban Rail tracks will be constantly exposed to elements of nature, including extreme high temperatures resulting from direct exposure to sunlight and variability in diurnal temperatures.

The K-RIDE has proposed the use of head-hardened 1080 steel rails (UIC60) for rail tracks. Head-hardened 1080 steel rails (UIC60), a product of recent advances in special heat treatment of steel achieves an increase in hardness by nearly 50% in comparison with standard steel grades. Technology improvements in track components can assure better track performance under severe climatic conditions and longer service lifetime, achieve high level of safety and efficiency, and are subjected to intensive usage with very little time for day-to-day maintenance.

1.11.2.1. Temperature

Temperature impacts on rails include buckling or alignment deformation due to thermal stresses that build up in rails. The new tracks are proposed to be continuous welded rail, mechanically or thermally altered to achieve a measured length equivalent to a stress-free temperature before it is clipped down. This action ensures that at a known temperature (dependent on location), there would be no thermal forces, either compressive or contractive, in the rail. This stressing of rail installs a stress-free temperature so that there will be a greatly reduced risk of fracturing or buckling at temperature extremes. The design temperature for rails in the Bengaluru Suburban Rail project is designed to take up a temperature range from -10^{o}C to 70^{o}C.

1.11.2.2. Precipitation/Rainfall

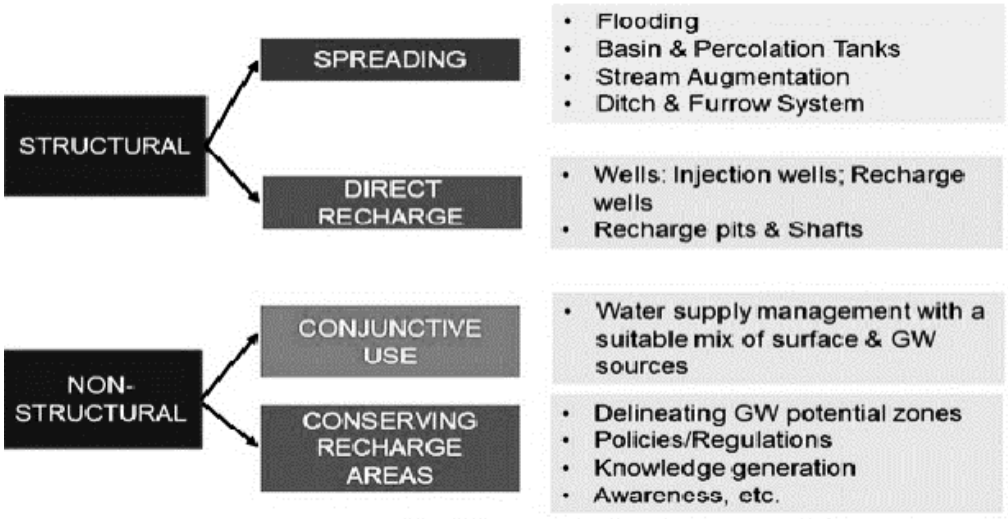
Rainfall incidents are expected to be more frequent and more intense, leading to an increasing risk of flooding. Rainfall is reported to be the primary cause of flooding in the city and the observed increase by 53% of June–September monsoon rains during 1901–2008 in Bengaluru (**Table 1.6**) is a significant trend indicating that Bengaluru will need to become more resilient to flooding when it does occur through prevention, preparation, and planning. The risk of flooding is recognized as one among many other disaster-causing factors and is addressed in the DPRs. Chapter 10 of the DPRs is dedicated to disaster management and security measures that include early warning systems, limiting exposure to flooding and the damage it causes, and through organization of more effective recovery.

The elevated viaducts (or bridges) of reinforced cement concrete that run through the median of the city's busy roads are exposed impermeable structures that transform rainfall to runoff in much shorter duration and that add to water logging of the already flooded roads below. To alleviate this distress to some extent, means of water harvesting from elevated structures have been proposed in the design of viaduct structures. The cross-slope or camber provided in the viaduct superstructure design permits runoffs to be channelled through drain piping to water harvest ponds, which are proposed to be constructed between each pier span where the accumulated water is settled to allow percolation into natural ground.

Where water accumulates for days due to an ineffective road drainage system, there are the risks of reduced bearing capacities of water-logged soils on which the pier foundations are set as elevated structures applying considerable load on the foundation system.

1.11.2.3. Ground water systems

Ground water systems are critical to climate-change adaptation and require appropriate structural and non-structural management if they need to sustain a growing population. Some of the potential adaptation options currently available are illustrated in **Figure 1.18**. They should include both demand and supply side management to ensure that groundwater withdrawals are revised in alignment with realistic assessments to minimise dependence on groundwater. The supply-side management entails appropriate measures for recharge enhancement, taking into consideration the potential feedback loops associated with climate- change induced changes in precipitation patterns and the need to ensure adequate water quality for aquifer recharge.



(Source: Shrestha et al., 2018)

Figure 1.18. Potential adaptation options for groundwater management

Hard rock strata are faced along the proposed BSRP corridor within 4.5 m to 5 m depth below existing ground level, permitting the foundations to be positioned on hard strata. The possibility of occurrence of upward force by hydrostatic pressure on the foundation will also be eliminated. In areas where hard rock stratum is encountered at considerable depths, the foundation supporting the elevated rail track and elevated stations are proposed to be supported on pile foundations based on geotechnical investigations. The end bearing piles shall be socketed into the hard strata, which could be soft weathered rock or hard rock.

In addition to the above mentioned adaptation measures, the following are the recommended Climate Change Adaptation Measures to be implemented for BSRP:

To incorporate climate change projections into the design and capacity of drainage to cope with projected future flooding frequency and magnitude. The drainage standards should include allowances for impact from future climate in the design of railway assets.

To improve wind resilience of catenary masts and keep areas close to tracks and catenaries free from hazardous objects. Even though many operational failures are caused by trees fallen to track or catenaries, vegetation is often used as a buffer zone for noise and pollution along railway tracks and also to protect the track from direct insulation. Ecosystem based measures increasing resilience to wind (e.g. trees able to withstand high wind speeds) should therefore be preferred.

To install spare and emergency capacity for the safety and operational systems (pass-by trucks, switches, operation on opposite lane) to back up the capacity affected by extreme weather.

To develop strategies minimizing the impact of operational failures caused by extreme weather conditions (special timetables, rerouting models), and provide replacement of services if needed (e.g. bus transport)

To provide real-time information to passenger and maintain communication with important institutions.

- Essential measures considered to protect railway infrastructure against specific weather events include the following :

- switch protection,
- pile construction for buildings with technical equipment,
- cooling of signals and installation of fans to keep electronic equipment functional during periods of extreme heat,
- increased (preventive) maintenance activities (infrastructure and existing protection systems),
- vegetation and land use regulations along rail tracks,
- installation of (automatic) monitoring systems such as anemometer, water and rain gauge, rail temperature gauge, landslide detectors.
- Boost energy-efficiency programmes - Ensure efficient provision for natural lighting and Solar lighting (at least one-third of all lightings)
- Adopt efficient lighting such as usage of LED based lighting

More efforts are needed in other asset infrastructures, such as drainage systems, catenary systems, and vegetation management, to reduce their impact due to climate change. The project specific potential Risks of Climate change with associated mitigation measures in BSRP have been briefly stated in the **Table 1.18**. Further, K – RIDE will follow the guidelines and Preventive measures as per Indian Railway Manual to handle Monsoon Preparedness, Flood events, regular checking of Retaining walls, Rail affecting Tanks, drain cleaning and slopes stability in BSRP.

Table 1.18. Climate Change Risk Assessment and Measures provided for Construction and Operation Phase including Maintenance of BSRP Assets

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
1	**Precipitation / Rain fall**												
A	Low / Medium Rainfall	Medium to Moderate	-	Increased risk of earthwork failures due to desiccation.	4	3	12	De-vegetation programme, Re-ballasting and tamping interventions	1 to 2	Section-8B: Technical Specifications. Chapter-2 Suitability of Subsoil & Ground Improvement Techniques	570 – 578	The cost of work is included in the respective construction activity.	Implemented during the construction stage/ Implemented by the Contractor/ Monitored by GC to BSRP & K RIDE
										Section-8B: Technical Specifications. Clause 3.4 Cross Slope of Formation	580		

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
										Section-8B: Technical Specifications. Clause 4.3.1 Geotextile Clause 4.3.2 Geogrid	595 - 597		
B	High Rainfall	Major	Flooding (surface water, fluvial, groundwater); infiltration and Landslides	• Increased risk of earthwork failure and groundwater content in low-lyingareas; landslides in wet weather landslide. • Infrastructure slope failure; bridge scour; flooding of	4	4	16	**Construction Phase :** • **Usage of Protection boxes** to shield equipment that can't be moved or require protection and ventilation. • **Adopting Equipment protection systems** safeguard essential equipment and items that cannot be relocated from flood-prone areas. • **Flood panels** serve as door barriers during hurricanes, offering excellent defense	3 to 4	Section-8A Employer's Requirement Clause 14 Turfing/ Planting Clause 15 Provision of Jute Geo Textile	277 277	The cost of work is included in the respective construction activity.	Implemented during the construction stage/ Implemented by the Contractor/ Monitored by GC to BSRP & KRIDE

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
				track, depots, buildings; water damage to electronic equipment. • Track buckling/washout line closure • Reduced operating speeds				against flooding and water damage and for protection of construction materials. • **Usage of Compression panels** for glass during emergency, to create a sealed flood protection barrier around openings, preventing water entry. • **Flood barriers** offer a strong, long-term solution to protect buildings. • **Conducting Awareness programs** for working staff and local Community. • **Flood Preventive and Control Measures** shall be in compliance with IRBM : 1998 and Handbook on Railway					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								Construction, Second Edition, June 2020. **Operation Phase :** • Planting of 'protection Trees' Slope stabilisation programmes including installation of retaining walls, soil nails and sheet piles Counterfort retaining drains in slopes and crest drain refurbishment.. • Regular monitoring during rainy season. • Review and update • Asset Risk Assessment and Action Plan in line with implementation timetable with identification of standards to be updated to take account of climate change.					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								• Conducting Awareness programs for working staff and local Community. • Flood Preventive and Control Measures shall be in compliance with IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020.					
		Moderate	Inland erosion	• Over flow from Culverts and Cross Drainages • Disruptions from blockages affecting track stability	3	4	12	Applicable Measures for High Flood Control as provided above shall be followed during construction and operation phases. Periodic cleaning of drainages with the cooperation of BBMP and Local Authorities.	1 to 2	Section-8B: Technical Specifications. Chapter 8: Erosion Control of Slopes	641 - 649	The cost of work is included in the respective construction activity.	Implemented during the construction stage/ Implemented by the Contractor/ Monitored by GC to BSRP & K RIDE
		Moderate		Increased risk of bridge scour	4	3	12	Bridge scour protection programmes	3 to 4	Drainage Arrangement Drawing	-	The cost of work is	Implemented during the

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
				arising from flood events.								included in the respective construction activity.	construction stage/ Implemented by the Contractor/ Monitored by GC to BSRP & K RIDE
		Minor	Flooding	• Infrastructure slope failure; track misalignment; misalignment of poles supporting overhead lines • Reduced operating speeds	2	5	10	• Increase capacity of spillways and culverts. Embankment protection through tree plantings, Vegetation. Improvement of longitudinal ditches and drains • Green planning. • Increasing height of Station Entrances. • Increase road embankment level to at least 0.5 m over	1 to 2	Section-8B: Technical Specifications. Chapter 1: Soil Exploration & Survey	564	The cost of work is included in the respective construction activity.	Implemented during the construction stage/ Implemented by the Contractor/ Monitored by GC to BSRP & K RIDE
										Section-8B: Technical Specifications. Clause 3.11 Height of	592		

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								the maximum flood level		Embankment and Formation Layer Thickness			
										Section-8B: Technical Specifications. Chapter 8: Erosion Control of Slopes	642		
		Moderate		• Failure of other structure supports due to increased risk of scour Standing water fouling	3	4	12	• Expanding drainage capacity , Discharge Capacity for infrastructure including culvert size, design for new flood event thresholds, • Increasing maintenance including clearing debris from culverts	1 to 2	Section-8B: Technical Specifications. Clause 6.2.5 Drainage Arrangements in Embankmen	628 - 631		

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
				track ballast. • Reduced operating speeds				to reduce flooding Installation of emergency culvert etc., Installation of pumped drainage solutions. • Double twisted hexagonal woven steel wire mesh		ts and Cuttings			
										Section-8A Employer's Requirement Clause 44: RoB Drainage	277		
		Minor		• Voluminous Mud flow causing structural	2	5	10	Installation of containment channels and dikes, Revetments using riprap, gabion	1 to 2	Section-8B: Technical Specifications.	642	The cost of work is include	Implemented during the construction stage/

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
				damage to infrastructure. • Reduced operating speeds				mattresses and concrete facings Anchors, geo-grids and micro-piles		Chapter 8: Erosion Control of Slopes		d in the respective construction activity.	Implemented by the Contractor/ Monitored by GC to BSRP & K RIDE
2	**Temperature**												
A	High Temperature	Medium	Heat waves; wildfire (very rare)	• Track buckling line closure; thermal expansion in structures and/or associated misalignment problems. • Track stability may be affected. Dis-position of high-risk track	3	4	12	**Construction Measures** : • Change Rail installation procedure to increase temperature threshold for thermal expansion. • During extreme winter and summer, ambient temperature should be monitored and necessary steps shall be taken to cold/hot weather concreting as applicable. • Using measures such as preventive grinding and milling to minimize the	1 to 2	Measure considered under good engineering practice (Ref. : IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020)			

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
				segments may lead to incidences of high temperatures. • Reduced operating Speeds.				effects of temperature variation. • Measures during Concreting in Hot Weather: **DOs:** • ● Depute competent inspection personnel at site to anticipate the need for requirements during hot weather concreting and ensure them. • When temperature conditions are critical, carry out concreting during evening or night. • If ambient temperature is likely to exceed 40 degree Celsius during period of concreting, start concreting only if arrangements for hot					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								weather concreting are in place. • Plan the locations of construction joints ahead of time with hot weather contingencies in mind. • Do not add water to pre-mixed concrete at the job site unless it is part of the amount required initially for the specified maximum water-cement ratio and the specified slump. • Use all available means to maintain the materials at as low temperatures as practicable. • Provide shades on stockpiles to protect them from direct rays of the sun.					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								• Sprinkle water on the coarse aggregate piles & apply moisture correction accordingly. • Use cold water in concrete and keep it cold by protecting pipes, water storage tanks, etc. • Mix ice directly into the concrete as part of the mixing water. • Design the mix with minimum cement content consistent with other functional requirements. • Use lower heat of hydration cements instead of that with greater fineness and high heat of hydration. • Check concrete temperature frequently using a metal clad					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								thermometer by embedding it in concrete. • Keep the mixing time to the minimum as required to ensure adequate quality and uniformity. • Paint the exposed mixer surface yellow or white, cover it with hessian cloth and spray cool water. • Keep the period between mixing and delivery to an absolute minimum. • Coordinate the delivery of concrete with the rate of placement to avoid delays in delivery. • Sprinkle forms, reinforcement, and subgrade with cool water just prior to placement of concrete.					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								• Wet the area around the work to cool the Surrounding air and increase its humidity. • Deploy ample personnel to place concrete immediately on delivery to minimise the delay losses. • Place concrete in thin layers and small areas to reduce time interval between consecutive placements. • Moist fresh the concrete by means of fog sprays, wet hessian cloth, cotton mats, or other means if cold joints or cracks tend to form, especially shortly after placement and before finishing. • Protect the concrete from evaporation of moisture, preventing					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								ingress of external water, by means of wet (not dripping) gunny bags, hessian cloth, etc., immediately after consolidation and surface finish. • Commence the moist curing once the concrete has attained some degree of hardening sufficient to withstand surface damage (approximately 12 hour after mixing). • Sprinkle water on formed surface while forms are still in place. Keep the vertical and steeply sloping formed surfaces moist by applying water to the top surfaces prior to and during form removal.					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								• Keep the exposed surfaces moist by wet curing & Provide wind breaker wherever possible. • Spray the covering material with water to keep them soaked. • Heavily reinforced area should be given special attention. **DONTs:** • Use such large chunks of ice that do not melt down completely before mixing is completed. • Use concrete if its temperature is above 40 degree Celsius • Rely on the protection afforded by forms for curing in hot weather. • In initial stages of hardening, temp of curing water should be approximately					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								equal to that of concrete. • Remove wet covers until they are completely dry. • Delay in finishing air entrained concrete in hot weather. • Let the concrete surface dry during curing causing alternate drying and wetting conditions. • Prolong mixing. • Finish slabs prematurely, e.g. While bleed water is still on the surface. **Operation Measures :** • Change Rail installation procedure to increase temperature threshold for thermal expansion. Replacement of jointed track with					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								continuously welded Rail. • Painting Rails white in areas of known high risk to thermal expansion by direct sunlight. • Regular monitoring during summer season at extreme temperatures. • Review and update Asset Risk Assessment and Action Plan in line with implementation timetable with identification of standards to be updated to take account of climate change • To overcome the same, provision of thermal joint/ expansion joint is required to be provided.					

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
								• Eventually, sensors may be installed directly on the tracks to monitor rail stresses in real time and implement an early warning system.					
		Minor		Expansion of moveable assets such as swing bridges hindering operation. Reduced operating speeds	2	4	8	Sprinkler systems Replacement of bridges with heat resistant materials with lower thermal expansion coefficients	1 to 2	Measure considered under good engineering practice (Ref. : IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020)			
		Low		• General increase in failure rate of assets in high	3	2	6	Use of coolers, fans and air conditioning to improve tolerance of signaling equipment. Double-skinned	1 to 2	Measure considered under good engineering practice			

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				temperatures. • Reduced operating speeds				equipment casing to assist cooling		(Ref. : IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020)			
		Low		• Sagging of the overhead line equipment. • Reduced operating speeds	2	3	6	• Removal of fixed termination overhead line equipment Improved balance weight and head span technologies. • Provision of Counter weights	1 to 2	Measure considered under good engineering practice (Ref. : IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020)			
		Low		• Increased fire risk.	2	4	8	Vegetation management along tracks	1 to 2	Measure considered under good			

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
				• Reduced operating speeds						engineering practice (Ref. : IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020)			
B	Low Temperatures	Low	-	• Rail fracture, weld failure, cracks and/or associated misalignment problems. • Reduced operating speeds	1	2	2	• Proper Supervisions and Inspections • Only ornamental trees will be planted at embankments, slope etc.	1	Measure considered under good engineering practice (Ref. : IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020)			

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
3	**High Wind Speed – Wind Storms**	Moderate	Tree fall; wind-blown objects Severity of gusts at higher wind location	Increased risk of leaf fall leading to low track adhesion Rolling stock instability	3	4	12	• Leaf Removal and partly de - vegetation programmes. • During Operation & Maintenance Stage, periodic cleaning will be carried out.	3 to 4	Measure considered under good engineering practice (Ref. : IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020)			
		Moderate	Tree fall; wind-blown objects	• Damaged trees and debris falling onto track • Downed power lines; structural damage and/or track misalignm	3	4	12	De-vegetation programmes Establishment of tree-free zones in Rail corridor and control measures to avoid debris falling.	3 to 4	Measure considered under good engineering practice (Ref. : IRBM : 1998 and Handbook on Railway Construction, Second			

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
				ent by fallen trees/wind-blown objects. • Reduced operating speeds						Edition, June 2020)			
		Major	Tree fall; wind-blown objects	• Excessive wind loading on structures such as masts and towers. • Reduced operating speeds	3	5	15	• Strengthening of existing equipment, build in resilience to design of new equipment. • Improved overhead wire tensioning systems.	3 to 4	Measure considered under good engineering practice (Ref. : IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020)			
		Mode rate	Tree fall; wind-blown objects	• Increased risk of damage to bridges in	2	5	10	Install damping devices	1 to 2	Measure considered under good engineering			

Sl. No.	Climate Change Phenomenon	Scale	Predicted hazards	Predicted Risks/Impacts on Vulnerable Asset or Activity	Likelihood	Severity	Risk Level	Potential Adaptation Measures/ Activities	Residual Risk Level	Section/ Clause in Tender Document (Annexure enclosed)	Page No.	Budget Considered in INR	Implementation Stage/ Implementing agency/ monitoring Agency
				high winds. • Equipment destruction • Reduced operating speeds						practice (Ref. : IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020)			
4	**Lightning and electrical storms**	Minor	Risk to line workers Outages of power	Damage to buildings and structures from lightning strikes	2	4	8	• Install lightning conductors / arresters. • Fitment of surge protection.	1 to 2	Station tender: SECTION-8A-Part-2-Employers-Requirements Clause 12.1. (h)	396	The cost of work is included in the respective construction activity.	Implemented during the construction stage/ Implemented by the Contractor/ Monitored by GC to BSRP & K RIDE
*Management (or non-structural) adaptation measures: e.g., changing the timing of maintenance to account for changing patterns of energy demand and supply, investment in early warning systems or purchasing insurance to address financial consequences of climate variability. These measures can also include enhanced monitoring of existing assets to reduce the risk of failure as climate conditions change. Adaptive management approaches also include provisions to include flexibility from the outset to monitor and adjust to changing circumstances over the assets lifetime.													
Ref. : IRBM : 1998 and Handbook on Railway Construction, Second Edition, June 2020 and other relevant Indian Railway guidelines													

Adaptation of Early Warning System in Climate Change Risk Management

Early Warning System is an integrated adaptive system of climate change hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events. The significant purpose of early warning systems is mitigating the risk produced by disasters, but these risks are compounded by the socio-economic vulnerability of the population exposed to the hazards. In this context, early warning systems shall be inclusive and sensitive to the different sources of vulnerability.

The methods of early warning systems include detection, analysis, prediction, and then warning dissemination followed by response decision-making and implementation in phases of risk assessment, monitoring and predicting, disseminating and communicating warnings, and response.

The Early Warning Centre receives real-time Seismic data from the national seismic network and climate data from the Indian Meteorological Department (IMD) and other International seismic /Climatic networks. . Signaling a EWS form warns regarding changes in spatial patterns close to a tipping point, foreshadowing a collapse transition. The reading of early warning signals can highlight when corrective actions need to be taken in order to return the system to a more stable state. Early warning system by using integrated communication systems help communities prepare for hazardous climate-related events. Early Warning Systems for Climate Resilient Development and adaptation to climate change in the form of Emergency Broadcast/Alert System (EBS or EAS) is to ensure preparedness and rapid response to natural disasters. A successful EWS saves lives and jobs, land and infrastructures and supports long-term sustainability. Early warning systems will assist public officials and administrators in their planning, saving money in the long run and protecting economies (UN).

The four key Multi-Hazard Early Warning Systems (MHEWS) required to be managed in PIA, K RIDE during Disaster Management are as follows :

- Disaster risk knowledge and management : aims to collect data and undertake risk assessments to increase knowledge on hazards and vulnerabilities and trends.
- Detection, observations, monitoring, analysis and forecasting of hazards : Develop hazard monitoring and early warning services.
- Dissemination and communication : Communicate risk information so it reaches all those who need it, and is understandable and usable.
- Preparedness and response : Building regional and community response capabilities.

It helps reducing harm to people and damage to assets ahead of impending hazards, including storms, floods, tsunamis, droughts and heat waves, etc. Multi-hazard early warning systems address several hazards that may occur alone or simultaneously. Environmental and Social Management Unit of K RIDE will be responsible for implementation of EWS to manage risks. EWS is addressed in Disaster Management of Chapter 10 of EIA Report.

1.11.3. Mitigation Measures to Reduce GHG Emissions

1.11.3.1. Construction Phase Mitigation Measures

Mainly Construction Phase Mitigation Measures are required to save CO2 emission. Adverse impacts of GHG emissions arising from the construction of the proposed Rail Project (BSRP) have been

addressed according to the hierarchy of avoidance, mitigation and offsetting of adverse impacts, implemented where possible through the planning and design process and the development of on-going standard practices.

Reduction and Avoidance

Implementation of vehicle operating guidelines to encourage correct and efficient operation of vehicles includes as follows;

- The implementation of a traffic management plan, that:
- Reduces the number of vehicles and/or trips required for transport
- Uses buses for transportation of large numbers of personnel to minimise number of vehicles operating
- Implementation of a wider fuel management strategy which encourages use of more efficient plants and vehicles, planning, logistics, driver education and maintenance ≈ Efficient management of procurement and product supply
- Reduction on the amount of waste disposed to landfill and reuse of waste on site as much as possible, which will subsequently reduce the amount of vehicle movements and therefore fuel usage
- Use of teleconferencing and video conferencing to reduce travel to and from offices and associated gaseous emissions from fuel combustion
- GHG emissions and energy consumption will be measured in accordance with current legislative requirements
- Fuel consumption, energy use and GHG emissions will form part of reporting requirements to K-RIDE
- GHG emissions and energy consumption will be reported to relevant authorities in accordance with current legislative requirements
- A more comprehensive GHG emissions inventory will be addressed by the Contractor with approval by Environmental Specialist of General Consultant prior to construction that provides greater detail on construction emissions.
- The next step will be to set achievable and realistic reduction targets and identify and investigate potential reduction opportunities to realise these targets. A site specific marginal abatement cost curve for identified reduction opportunities will be developed to assist K-RIDE to prioritise these opportunities and be useful in determining what particular opportunities can be employed to reach a specific carbon reduction goal Activities such as vegetation clearing will be restricted to the required footprint only through the implementation of the EMP which will identify clearing limits. The concept design also re-uses excavated spoil material onsite as fill for the Suburban Rail line embankment, thereby reducing transport distances and heavy vehicle trips to an offsite disposal area. While fuel usage is a necessary requirement for construction of the BSR Project, so far as to reduce GHG emissions the following measures will be implemented as far as practicable:
- Adopting vehicle pooling for transport of construction personnel to minimise the number of vehicles operating

- Procurement of generators which use biodiesel or natural gas, where possible

Mitigation

On 10.08.2015, Government allowed direct sale of Biodiesel (B100) for blending with diesel to Bulk Consumers such as Railways, State Road Transport Corporations. On 29.06.2017 Government allowed sale of biodiesel to all consumers for blending with diesel. India's Ministry of Petroleum and Natural Gas published its “National Policy on Biofuels" in 2018, and further amended it in June 2022. The policy's objective is to reduce the import of petroleum products by fostering domestic biofuel production (MoPNG, GoI Guidelines, 2018).

Biodiesel blends (diesel that has a percentage of the fuel replaced with biodiesel) may reduce greenhouse gas emissions due to fuel consumption. However, this is dependent on a number of factors including the origin of the biodiesel feedstock. When sourced from appropriate feed-stocks, the reduction in emissions is approximately equivalent to the percentage of biodiesel in the blend (for example diesel with 20 per cent biodiesel will reduce greenhouse gas emissions by approximately 20 per cent). Opportunities for the use of biodiesel will be further examined and used where possible on the BSRP.

The application of technical efficiencies in construction plant and equipment will also provide more efficiency. These options will be further investigated, including any new technologies available, expected benefits, potential risks and costs.

Through the EMAP, appropriate management will be integrated into all construction activities and processes and GHG emissions will be monitored. Through assessment and review, the BSRP will seek continuous improvement in compliance and emissions reduction.

Energy Efficiency and Management

Given that energy is the largest source of GHG emissions, appropriate mitigation measures will be implemented to reduce energy use as far as practicable through the following:

- Identification of the significant energy consuming equipment and recognising opportunities where technical efficiencies in plant and equipment can be applied. To improve fuel efficiency, an understanding of energy uses and corresponding fuel consumption would help K-RIDE to identify further opportunities where reduction in sources is most feasible and effective
- Site offices and accommodation buildings will be designed and constructed so as to include energy and water efficient equipment
- Implementation of a Construction EMP which establishes the baseline water, materials and energy use objectives and targets with the aim of introducing resources and emissions reductions targets through the construction phase
- The EMP will set out appropriate management and encourage integration of key activities and processes so as to effectively monitor GHG emissions

Implementation of mitigation measures such as resource efficiency, adoption of less carbon-intensive or renewable energy sources to reduce fugitive emissions will be followed as per the EMP to save CO2 emission (EMAP Table 10.2, Section 10.9 of Chapter 10 – Environmental Management Plan of EIA Report).

Offset Measures

The feasibility of generating carbon offsets for the construction of the BSRP in accordance with the Carbon Farming Initiative is recommended to be investigated by K-RIDE. The feasibility study would need to consider legislative and development approval requirements in assessing whether the potential carbon offset projects comply with the additional requirements of the Carbon Farming Initiative. There is need to consider Offsetting additional GHG emissions through the purchase of carbon offsets generated in India or overseas, while assessing the BSRP liability under the carbon pricing mechanism.

1.11.3.2. Operation Phase Mitigation Measures

The project involves the running of electrical energy based suburban rail cars during operation. Hence, no CO2 emission while running of the BSRs. Emission as mentioned earlier, will be mainly during the production of electricity at base source. Savings in CO2 emission due to the project implementation is presented in the **Table 1.16**. GHG emissions during project operation are negligible. Energy efficient system, and solid waste and Waste water recycling systems will be adopted at stations and depots. Energy efficient lighting and ventilation will be implemented at Stations, depots and trans-modal cars.

In future, there is possibility of BSRP to switch on to total harnessing of natural sources of energy, such as solar power for lighting and ventilation, which will further contribute to savings in CO2 emission during maintenance facilities at stations and Depots. Additionally, the application of technical efficiencies in construction plant and equipment will also provide opportunities for greater efficiency; expected benefits, reduction in potential risks and costs.

1.11.3.3. Mitigation Measures to overcome Risks on Biodiversity

Climate change is happening due to natural factors and human activities. It expressively alters biodiversity, agricultural production, and food security. Mainly, narrowly adapted and endemic species will be under extinction. Accordingly, concerns over species extinction are warranted as it provides food for all life forms and primary health care for more than 60–80% of humans globally. Very little is known about the magnitude of the problem.

Climate change, biodiversity, and food security are interrelated. Data, climatic models, emission, migration, and extinction scenarios, and outputs from previous publications were reviewed in this regard.

Due to climate change, distributions of species have shifted to higher elevations at a median rate of 11.0 m and 16.9 km per decade to higher latitudes. Accordingly, to avoid extinction species will be with limited, unlimited and no migration scenarios.

When an environmental variation occurs on a timescale shorter than the life of the plant any response could be in terms of a plastic phenotype. However, phenotypic plasticity could buffer species against the long-term effects of climate change.

Furthermore, climate change affects food security particularly in communities and locations that depend on rain-fed agriculture. Crops and plants have thresholds beyond which growth and yield are compromised. The food shortage problem can be solved through bringing extra land into agriculture and exploiting new fish stocks is a costly solution, when protecting biodiversity is given priority. Therefore, mitigating food waste, compensating food-insecure people conserving biodiversity, effective use of genetic resources, and traditional ecological knowledge could decrease further

biodiversity loss, and meet food security under climate change scenarios. However, achieving food security under such scenario requires strong policies, releasing high-yielding stress resistant varieties, developing climate resilient irrigation structures, and agriculture. Therefore, degraded land restoration, land use changes, use of bio-energy, sustainable forest management, and community based biodiversity conservation are recommended to mitigate climate change impacts.

1.11.3.4. Awareness on Climate Change and Adaptation and Mitigation Measures

Awareness on Climate Change and Adaptation Measure is recognised as one of the major key factors in the climate adaptation process. Lack of Awareness among the personnel involved in BSRP during operation and maintenance and public is considered to be important. Therefore, dedicated training programs and workshops including awareness-raising and sharing best practices for BSRP Staff and Awareness Programs for public are essential aspects of global responses towards Adaptation measures for climate change. It helps society to recognize the effect of global warming and helps them to deal with climate change impacts and implement adaptation policies. To increase the level of awareness, the main target trainees considered include government, local authorities and public.

1.11.3.5. Assessment of CO_2 Increase and O_2 Deficit with Carbon Credits and Mitigation

Trees play a significant role in reduction of CO_2 by sequestering it from the atmosphere during photosynthesis to produce carbohydrates that are used in plant structure/function and return O_2 back into the atmosphere as a by-product. Roughly half of the greenhouse effect is caused by CO_2. Therefore, trees act as carbon sinks, alleviating the greenhouse effect. As per the project study, the process for CO2 conversion will get affected as a result of removal of trees for the project. The total loss due to tree removal is evaluated as given in the **Table 1.19**.

Table 1.19. Assessment of CO_2 increase and Oxygen Deficit due to Tree Loss

Si. No.	Description	Quantity
1.	Total no. of Trees to be cut	32572
2.	Increase in CO_2 in the atmosphere (or Decrease in CO_2 absorption by tree) @ 21.8 Kg/year/tree	710069 Kg/Year (710 Tons/Year)
3.	Decrease in Oxygen production @ 49 Kg/year/ tree	1596028 Kg/Year (1596 Tons/Year)

Source: EIA Survey & Study

Mitigation Measures:

According to Clean Development Mechanism (CDM), one ton of CO_2 increase will yield one Carbon credit and 80.72 Euros (1EUR = ₹ 80.52) as on 02nd August 2022, is earned by one carbon credit. Total loss of carbon credit is 710 tons per year due to cutting of 32,572 trees. About 1596 tons of Oxygen production will get reduced because of tree loss and loss of ₹ 957.62 lakh (1596028 (kg of O_2) X 60 (₹/Kg of O_2) is anticipated due to loss of trees.

The biosphere does have an impact on global CO_2 levels by tree removal or planting trees. Tree planting helps to tackle climate change. The combination of CO2 removal from the atmosphere, carbon storage in wood and the cooling effect makes trees extremely efficient tools in fighting the greenhouse effect. Planting trees remains one of the most cost-effective means of drawing excess CO2 from the atmosphere.

The tree removal for the project needs to be compensated with afforestation by tree planting in the ratio 1:10 by the Forest Department in consultation with K RIDE and in accordance with CAMPA.

One Carbon Credit is one tons of CO_2 prevented from entering the atmosphere. Therefore, as per the assessment, a loss of 710 Carbon Credits per year is accounted due to the loss of trees and loss in amount of Euros 57316.82 and Indian ₹ 4615150.2 per year is predicted. Survival of trees after afforestation in the ratio 1:10 is about 3,25,720 trees. The reduction of CO_2 from the atmosphere by the mature plants after 5 years (if 5 year old plants from Forest Nursery are planted during project Construction and nurtured well) would be 71,00,696 Kg/Year and Carbon Credits calculated may be 7100.70 and costs ₹ 461.52 lakhs. The O_2 production after 5 Years would be 1,59,60,280 Kg/Year and the cost would be ₹ 9576.17 lakhs. Thereby, the impact on Biological/Ecological aspects and Climate Change will be compensated and help to balance Carbon Credits.

Trees also remove other gaseous pollutants through the stomata in the leaf surface by absorbing them with normal air components. It is also observed from the study (Coder and Kim, 1996) that Tree cover removed 48 lb or 21.77 Kg (22 Kg) of particulates, 9 lb or 4.08 Kg of nitrogen dioxide, 6 lb or 2.72 Kg of sulfur dioxide, 0.5 lb or 0.226796 Kg or 227 g of carbon monoxide and 100 lb or 45.36 Kg of carbon – daily.

Residual Impacts & Measures: Reduction in O_2 production and absorption of GHG such as CO_2 by trees are anticipated during project operation due to loss of trees, though electric engines will be operated. However, the tree loss due to the project will be compensated with afforestation by tree planting in the ratio 1:10 by the Forest Department in consultation with K RIDE and in accordance with CAMPA. The residual impacts will be compensated in due course of time when plants grow into large trees and will be capable of managing O_2 deficits or CO_2 emission.

1.11.4. Adaptation measures to mitigate the Health impact on Vulnerable Community

Although adaptation to climate impacts has attracted substantial attention recently, the effectiveness of specific strategies in relation to greater resilience of public health systems remains under investigated. Adapting to climate change will be necessary and will occur at physiological, behavioural, social, institutional, and organizational scales. To take advantage of already on-going adaptations for creating more effective public health responses to climate change impacts—especially for poor rural communities whose access to health care is extremely limited even in the current policy environment—developing a baseline understanding of the region-specific demographic, social, and ecological determinants of health will be necessary. In designing public health responses, factors that must be considered include the population's age structure, socioeconomic profile, and baseline prevalence of climate-sensitive diseases, public awareness of risk, the built environment, existing infrastructure, available public health services, and autonomous responses to climate impacts on health that households and communities might undertake by themselves (McMichael 2004).

Adaptation measures that mitigate the health impact of climate change on vulnerable groups of community can be taken up in three different levels, namely, primary, secondary and tertiary.

- Primary level measures to stop spread of mosquitoes, prevent spread of disease
- Secondary level (surveillance, monitoring) looks at preventive measures taken in response to early evidence of impact and
- Tertiary level (effective medical treatment) focuses on actions taken to lessen the health effects.

Potential adaptation strategies in India could focus on controlling infectious diseases by removing vector breeding sites, reducing vector–human contact via improved housing, and coordinating monitoring of mosquitoes, pathogens, and disease burden. Another potential focus area for adaptation could be improving sanitation and drinking water by supporting inexpensive and effective water treatment and increasing rainwater harvesting, safe storage, and gray-water reuse. In some areas, the focus may shift to flood, heat wave, and emergency preparedness, including strategies to address the additional risks placed on displaced populations from these and other climate-sensitive hazards. One possible outcome could be the development of an integrated early warning system, emergency response plans, and refugee management plans, along with increased capacity to provide shelter, drinking water, sanitation, and sustainable agricultural products to the most vulnerable populations.

A greater understanding of the relationship between climate variability and human health could aid in the development of new prevention strategies and early warning systems, with implications throughout the developing world. Future studies must work to more explicitly define the relationship between climate variability and emerging and re-emerging infectious diseases such as dengue, yellow fever, cholera, and the chikungunya virus (Shope 1991), as well as chronic diseases related to cardiovascular and respiratory illness, asthma, and diabetes.

Potential physical and social impacts of climate change will likely be diverse with many important factors such as food yields, malnutrition, child growth, river flow, monsoon rain patterns, and freshwater availability. Additional necessary adaptation measures include Climate modelling and predictions for India, adaptation and vulnerability, surveillance and early warning systems, integration of spatial analysis, and bridging policy and science.

Furthermore, adaptation strategies in response to climate variability and change must be designed on specific temporal and spatial scales relevant to India. Taking steps now to adjust to current climate variability and modifying existing programs to address the anticipated impacts of climate change will make future adaptation strategies more effective (Ebi et al. 2006). The same changes may also aid in reaching additional environmental and social objectives, such as more equitable education, empowerment of women, and improved sanitation. These community-based initiatives should be complemented by government interventions. A variety of stakeholders, including those who will be affected most by climate change impacts, must be involved in the problem-solving process to enhance human and technical capacity across sectors at both local and national levels (Agrawal 2009; Ebi and Semenza 2008). Failure to invest now will likely increase the severity of consequences in the future (Haines et al. 2006).

1.11.4.1. Environmental monitoring and surveillance

There is a great need to improve environmental monitoring and surveillance systems in the country to control and adapt to climate changes. New initiatives should focus on collecting high-quality, long-term data on climate-related health outcomes with the dual purpose of understanding current climate–health associations and predicting future scenarios. Public health Monitoring is required through data collection regarding total morbidity and mortality and non-communicable diseases such as cardiovascular, respiratory, and circulatory diseases and asthma, as well as communicable and infectious diseases such as cholera, malaria, tuberculosis, typhoid, hepatitis, dysentery, tick-borne encephalitis, and other vector-borne and waterborne diseases. Such monitoring also requires the collection of appropriate climatic (e.g., temperature and precipitation) and non-climatic data (e.g., ozone). Surveillance of extreme weather conditions and risk indicators such as mosquito abundance or pathogen load is also necessary. The collection of such diverse data necessitates the creation of

linkable and documented repositories for meteorological, air pollution, and health data. This aids in to take proper pro and corrective action to control changes in climate and burden on the public health infrastructure.

1.11.4.2. Geospatial technology

Geographic information systems and spatial analysis must be further developed; they are very useful tools when conducting vulnerability assessments, assessing environmental exposures, prioritizing research, and disseminating findings to decision makers and the public alike (Jerrett et al. 2010). Remote sensing and environmental monitoring are particularly useful to catalog variables such as air pollution and heat exposure. Social data from census and surveys, which can be layered with the exposure data using geographic information systems, provide information on sensitivity and adaptive capacity, at both individual and community levels. Data on land use and land cover can provide additional information on relevant environmental factors that influence risk and vulnerability.

1.11.4.3. Human and technical capacity

For these new surveillance methods and analytical techniques to be effective, countries like India will need to enhance their human and technical capacity for risk communication. This could take the form of public education on climate change and associated health impacts to enhance awareness and to influence lifestyle, behaviour, and individual choices to protect and improve health. Such health promotion materials could manifest as low-tech flyers and advertisements as well as more high-tech materials including web-based and mobile-phone–based alerts. On the other end of the spectrum, developing capacity could take on a more holistic approach, such as region- and city-specific climate action plans and early warning system for heat stress events, droughts, hurricanes, and floods.

The innovative and multidisciplinary investigations using environmental epidemiologic methods to elucidate health risks posed by climate variability and subsequent climate change are possible. However, such work will require expanded partnerships among researchers, governments, and communities to develop a co-benefit strategy that addresses public health challenges and risks associated with climate change. Adoption and implementation of these research initiatives will provide the necessary tools and infrastructure to pose interesting scientific questions and design effective solutions to the complex issues imposed by climate change.

1.11.5. Barriers and Gaps in Implementation of Adaptation Actions

There have been policies and programmes being formulated and implemented over the years in the state. However, there are certain gaps in information and barriers to achievement of the full potential of` these policies and programmes in all sectors including land transport Sector such as Railways. A few such barriers are outlined in the following paragraphs.

- Increased frequency and intensity of floods and other natural events affecting project implementation
- Delays due to litigations, compensation payable to land, to farmers, administrative lapses, if any.
- Delays due to lack of capital, infrastructure, knowledge, awareness among stakeholders, farmers, Government, NGOs
- Delays due to lack of knowledge of existing laws, rules, regulations, institutional failures and

- Gaps in implementation due to technical factors – e.g. faulty location of bore well points leading to failure of bore wells.

1.12. Climate Change Adaptation and Mitigation Plan with Budget

Climate change risk assessment is dominated by uncertainty that can only be reduced with improved knowledge and information in the course of time. In this assessment and by the line of reasoning in the preceding sections on issues of climate change vulnerabilities, the Bengaluru Suburban Rail project is assessed to be of medium risk in terms of predicted impacts. K-RIDE has adopted Climate Change Adaptation and Mitigation Plan and planned budget for the implementation of BSRP. The design of the Bengaluru Suburban Rail project is said to adhere to latest standards and specifications that feature improvements in technology, improved standards in construction methods, and use of better quality materials. Also adapted to preventive measures to avoid impact on climate from project. Any upgrade in construction technology can enhance resilience to climate stresses and shocks.

The overall objective of the Bengaluru Suburban Railway project is to achieve long-term serviceability and economic benefits. Project Design includes overall adaptation measures towards Climate Change. The preceding section raised the issue of contribution of rainfall runoffs by the elevated viaducts to water logging of the already flooded city roads. As a mitigation measure, water harvesting from elevated structures and from rooftops of elevated stations along the corridors has been proposed in the design of Phase. Climate Adaptation Plan for BSRP is as given below (**Table 1.20**)

Tabel 1.20. Climate Adaptation Plan for BSRP

Adaptation Activity	Climate Risk	Estimated Adaptation Cost (₹ Lakhs)	Justification
1. Thermally treated Head-hardened 1080 grade steel rails, 60 UIC	Increased heat stresses and thermal expansion leading to increased incidences of buckling or twisting of tracks, sun kinks, and derailments	Cost is included under Civil Works Cost	The head-hardened rails will result in (i) better mechanical properties in terms of stiffness, higher lateral resistance, and better transmission of thermal stresses, and higher durability; and (ii) reduced maintenance resulting from practically unchanged track geometry over time and at almost any operating speed.
2. Elevated rails	Increased Rainfall	-	Elevated Rails avoid

Adaptation Activity	Climate Risk	Estimated Adaptation Cost (₹ Lakhs)	Justification
	leading to flood		the impact of Floods on assets.
3. Materials - Concrete Mix	Increased Rainfall leading to flood and soil erosion	-	Concrete mix materials are with increased durability with high strength and resistance to impacts.
4. Rainwater harvesting systems at all stations in the viaduct sections of Corridors	Built-up impervious area with resulting high rainfall–runoffs contributing to increased ground level road and other infrastructures flooding	₹ 312.9	The rainwater harvesting system will help prevent floods and also conserve water for use in the stations, and help address the problem of high water scarcity in Bengaluru during dry seasons.
5. Rainfall runoff harvesting from elevated viaducts to recharge pits (Construction of recharge pits along the median at each pier location to facilitate percolation of runoff into the ground) approved design by the Central Water Board	Increased precipitation resulting in flooding; exacerbated urban flooding due to increased impermeable surface		Inclusion of rainwater harvesting and recharge pits at all pier locations will entail additional civil works costs. These recharge pits will help recharge groundwater.
6. Standby diesel generator sets in case of emergencies, including flooding in metro stations and tunnels	Stranding of passengers and metro staff in the station or train and accidents during emergency situations triggered by climate change such as floods and cyclones	-	To cope with catastrophic power outages disrupting the operation of many critical metro infrastructures under major flood events, flood water pumping and relief operations can function with standby power

Adaptation Activity	Climate Risk	Estimated Adaptation Cost (₹ Lakhs)	Justification
			supply.
7. Emergency Early Warning System with Signaling and integrated tele-communication system and Support equipment and plant necessary for maintenance to carry out preventive, restorative, and adaptive maintenance	-	-	In recognition of the fact that a well-organized maintenance management support is the main backbone of all mitigation and adaptation to impacts of climate change
8. Support equipment and plant necessary for maintenance to carry out preventive, restorative, and adaptive maintenance	-	-	

Source: Table Outline sourced from ADB Report, 2021 and Estimate done for the study by KRIDE

The climate change mitigation activities to avoid any impact on Climate particularly during Construction Stage are to avoid and reduce risks of (i) air pollutants causing raise in Temperature and (ii) activities leading to Flooding; are provided in the Environmental Management Action Plan (EMAP) and Environmental Pollution Monitoring, Section 10.9 of Chapter 10 – Environmental Management Plan of EIA Report. The Cost of EMP includes the Climate Mitigation cost also.

Out of $ 19450.52 Million total cost of the project, the EIB in JV with KfW is financing 60% of the total civil works cost equivalent to $11,670.31 million. K-RIDE, a special purpose vehicle formed by the Union Ministry and Gov. of Karnataka is executing authority. Gov. of Karnataka and Union Ministry will bear 20% (i.e. $ 3,890.10 Million) each of the project cost. Climate Change Impact Mitigation Plan is provided in **Table 1.21**. The total cost to this mitigation measure as shown in **Table 1.22** is about INR ₹ 312.9 Lakhs.

Table 1.21. Climate Change Impact Mitigation Plan for BSRP

Mitigation Activity	Estimated Savings in GHG Emissions (tCO2e/year)	Estimated Mitigation Costs ($ millions)	Justification
Construction of at-grade and elevated medium capacity rail lines in BSRP	7,104.52 (Please refer Table 1.15 & Table 1.17 for details)	19,450.52	Efficient mode of rapid transport system will cause the public to shift from morepolluting road-based public and private transport to BSRP resulting in

Mitigation Activity	Estimated Savings in GHG Emissions (tCO2e/year)	Estimated Mitigation Costs ($ millions)	Justification
			reduced overall emissions.
Implementation of Specific Environmental Management Action Plan (EMAP) during Construction	Please refer EMAP Table 10.10 for details – Chapter 10 of EIA Report	EMAP Budget	To reduce/mitigate impact of pollutants – GHG Emissions on Climate and to reduce climate change risks.

GHG = greenhouse gas, tCO2e = tons of carbon dioxide equivalent.
Source: Table Outline sourced from ADB Report, 2021 and Estimate done for the study by KRIDE

Table 1.22. Cost of Climate Adaptation for Rain Water Harvesting

Sl. No.	Particulars	Amount in ₹. Lakhs					
		Quantity	Corridor 1	Corridor 2	Corridor 3	Corridor 4	Total
1	Rainwater Harvesting @ ₹ 0.917 lakh/Unit + ₹ 3000 Surcharges (LS)*	Quantity	100 x ₹ 94700	65 x ₹94700	51 x ₹ 94700	114x ₹ 94700	330
		Cost ₹ in Lakhs	₹ 94.7	₹ 61.56	₹ 48.30	₹ 108.4	₹ 312.9

Source : EIA Report of DPR

1.13. Transition Climate Risks and Adaptation

Transition climate risks are those associated with the pace and extent at which an organization manages and adapts to the internal and external pace of change to reduce greenhouse gas emissions and transition to renewable energy. Transitioning requires policy and legal, technology, and market changes to address mitigation and adaptation requirements related to climate change. Depending on the nature, speed, and focus of these changes, transition risks may pose varying levels of financial and reputational risk to organizations. Alternatively, a low-carbon emitting organization such as K-RIDE can experience market, technological and reputational opportunities in the renewable energy or climate transition market.

One of the most significant, risks that organizations face today relates to climate change. While it is widely recognized that continued emission of greenhouse gases will cause further warming of the planet and this warming could lead to damaging economic and social consequences, the exact timing and severity of physical effects are difficult to estimate. The large-scale and long-term nature of the problem makes it uniquely challenging, especially in the context of economic decision making. Climate related transition risks with opportunities and financial impacts are depicted in **Figure 1.19**. Climate related transition risks with corresponding financial impacts are briefed in **Table 1.23**.

Source: Recommendations of the Task Force on Climate-related Financial Disclosures, 2017

Figure 1.19. Climate-Related Risks, Opportunities, and Financial Impact

Table 1.23. Climate-Related Transition Risks and Financial Impacts

Climate-related Transition Risks	Potential Financial Impacts	Applicability to BSRP
Policy and Legal		
• Increased pricing of GHG emissions • Enhanced emissions reporting obligations • Mandates on and regulation of existing services • Exposure to litigation	• Increased operating costs (e.g., higher compliance costs, increased insurance premiums) • Write-offs, asset impairment, and early retirement of existing assets due to policy changes • Increased costs and/or reduced demand for services resulting from fines or judgement	Significantly
Technology		
• Substitution of existing services with lower emission options • Unsuccessful investment in new technologies • Costs to transition to lower emissions technology	• Write-offs and early retirement of existing assets • Reduced demand for services • Research and development expenditures in new and alternative technologies • Capital investments in technology development • Costs to adopt/deploy new practices and processes	• Significantly
Market		

Climate-related Transition Risks	Potential Financial Impacts	Applicability to BSRP
• Changing commuter behavior • Uncertainty in market signals • Increased cost of raw materials	• Reduced demand for goods and services due to shift in commuter preferences • Increased service costs due to changing input prices (e.g., energy, water) and output requirements (e.g., waste treatment) • Abrupt and unexpected shifts in energy costs • Change in revenue mix and sources, resulting in decreased revenues • Re-pricing of assets (e.g., energy reserves, land valuations, securities valuations)	Significantly
Reputation		
• Shifts in commuter preferences • Stigmatization of sector • Increased stakeholder concern or negative stakeholder feedback	• Reduced revenue from decreased demand for services • Reduced revenue from decreased production capacity (e.g., delayed planning approvals, supply chain interruptions) • Reduced revenue from negative impacts on workforce management and planning (e.g., employee attraction and retention) • Reduction in capital availability	• Significantly

Source: Recommendations of the Task Force on Climate-related Financial Disclosures, 2017

The following points related to transition climate risks are derived (Irina Stipanovic Oslakovic, *et al.,* 2013):

- the improvement of the data collection about the failures, if any, is necessary; data should be structured;
- only local effects are stored – there are often effects on other components (next level effects) and long-term effects;
- no consistent information about costs, delays and safety ;
- database should be in accordance with the final objective – development of maintenance and / or adaptation measures;
- infrastructure managers need quick answers which are very difficult to be given without clear image what has happened in the past
- better integration of climate change considerations into current asset management plans;
- adaptation strategies should involve users mind-set adaptation also.

It is aimed to support infrastructure Development Organizations to decide on the appropriate intervention strategies and measures, and to ensure climate robust infrastructure.

In fact, climate-related risks and the expected transition to a lower-carbon economy affect most economic sectors and industries. While transition changes to a lower-carbon economy will not affect BSRP and the executing agency K-RIDE as it is already a low carbon emitter, and hence no significant risks are posed to K-RIDE, however, significant opportunities are created for K-RIDE which has focused on climate change mitigation and adaptation solutions.

1.14. Economic Benefits of adopting Climate Change adaptation measures

The main benefit of adaptation measures is climate change resilient railway infrastructure and operation, ensuring connectivity of transport network with implications to economic prosperity and welfare. Besides, the auxiliary benefits of adaptation measures are contribution to sustainable development and climate change mitigation (transport mode shift towards rail leads to decrease in greenhouse gas emissions). Also other synergies and co-benefits of adaptation measures beyond the environmental field are desirable. For instance, structural protection measures may, apart from protecting railway track, also protect settlements or other infrastructure such as roads or energy supply.

Costs vary consistently according to the selected measures, their specific design, and scale of application, specific conditions of the locality where the measures are implemented, climate challenges addressed and many other factors. The costs are primarily covered by the railway company; co-financing may be provided from the public budget, European financial instruments and other sources.

Climate change is an unceasing process. As a result, the issue is not how to adapt to a “new” climate, but how and at what price to adapt our society to a constantly evolving climate. Adaptation must be therefore considered as a permanent transition policy on the very long-term.

1.15. Summary & Conclusions

There are certain policies and programmes being implemented in India across all sectors that directly or indirectly contribute towards climate change adaptation. There is a need to overcome the identified barriers in implementation of existing programmes and implement additional targeted adaptation strategies in the various sectors to buffer from shocks and losses that would incur because of changes in climate and its adverse impacts that exacerbates current vulnerabilities (KSAPCC Version 2 Draft, 2021).

Climate change will adversely affect the operation, safety and maintenance of railway infrastructure if no remedial action in terms of climate mitigation as well as climate adaptation is implemented. The overall study on Climate Change and Adaptation Measures is summarised as follows :

Regarding railway infrastructure risk incidences associated with climate change, rail buckling, bridge scouring, signalling system failure, and inadequate drainage capacity play a major role. The effective climate adaptation measures are required to reduce climate and maintenance debt, including awareness, risk mapping, vulnerability assessment, maintenance and emergency planning.

In vulnerability analysis results for the railway infrastructure the most critical asset impacts are in terms of signalling, monitoring, heating and traction systems, whereas when interdependent infrastructures are considered electricity and telecommunications networks have the biggest impact on railway operations.

The projected long-term rise in the mean air temperature will lead to an increase in frequency and intensity of extreme weather events which will, in turn, affect the susceptibility of railway infrastructure.

In the flood vulnerability analysis one can see that even though there are only a small number of assets exposed to flooding, their impacts on the network functionality are substantial. An extreme rainfall will lead to damage of infrastructure and flooding of urban areas if remedial actions such as enhanced drainage systems with a higher capacity to drain water, are not adopted.

Vulnerability also depends on the habituation of regions to specific events. The more often specific events occur, the better the infrastructure is equipped to handle these events. The vulnerability results highlight the importance of considering quantity and spatial extents of assets, which influence the spread of failures; and the specific locations of assets, which influence the disruptions of network flows. In addition, an appropriate warning system, an infrastructure that is able to withstand the impact also of future increasing weather conditions, a rapid recovery from the impacts of adverse and extreme situations, and an improved performance and safety during adverse and extreme weather conditions is important precondition.

It is recommended that state and local governments, as well as private infrastructure providers, incorporate climate change into long-term improvement plans, design, and operations and maintenance activities. It also discusses the potential benefits of using “smart” technologies for monitoring infrastructure, re-evaluating infrastructure design standards, updating maps used for flood insurance, and integrating climate change into transportation and land use planning EPA (EPA, 2017).

A railway that is safe and more resilient to the effects of weather is an important vision for the future. This could be achieved by identification of high risk sites with a particular focus on drainage, earthworks, structures and vegetation management. Increased spatial and temporal resolution for rainfall information would allow the development of better vulnerability mapping techniques and lead to more accurate rainfall risk assessment and prediction tools. Geographic Information Systems could be used to support the identification and mapping of sensitive hotspots.

Eventually, following conclusions are drawn from the current study :

The major issues of climate change include high or extreme temperatures and heavy precipitation in BSRP. Extreme temperatures may lead rail tracks to expand and buckle. In case of more frequent and severe heat waves, repair of tracks or restriction in speed may be required more often to avoid derailments. There may be chances of heavy precipitation leading to delays and disruption, and tropical storms and cyclones may result in flood or leave debris on railways, disrupting rail travel. Flood Damages may require rail lines to be rebuilt or raised in future expansion projects. Climate proofing of new infrastructure projects can be challenging and the scheme to delve into every seemingly promising adaptation measure without strong justifications supported by data and updated information may tend to result in an uneconomical project.

Technological advancements can help build resilience to climatic hazards even if not specifically targeting climate change, although climate change might produce new kinds of hazards and threats in the future. Certain required modifications to design standards have been made in DPR that keep in view technological innovation and specific needs of Bengaluru city.

The risk of flooding is addressed in DPR (Section 8.3.5.1). The risk of flooding of the Bengaluru city roads acts as a foremost disaster-causing concern due to enhanced contribution of rainfall runoffs by

the elevated viaducts to water logging of the already flooded city roads. As an alleviation measure, water harvesting from elevated structures and from rooftops of elevated stations have been proposed in the design of suburban rail lines. Flood-prevention measures were also considered along the cut-and-cover portions along the corridors of BSRP.

As an important point, it can be stated that not all vulnerabilities and adverse consequences of climate change can be avoided through adaptation alone, but the K-RIDE can significantly reduce the extent of damage through proactive actions to avoid, prepare for, and respond to climate change as future climate variation is bound to amplify existing climate-related risks creating new risks. Iterative adaptation responses can be achieved in later development and maintenance cycles based on experience and emerging information and technology. Given the many uncertainties and the costs involved, it is not advisable to make decisions at the outset nor is it possible or necessary to do every visualized adaptation measure at one-go.

Additionally, in future, the collection of detailed damage data due to natural hazards in case of happenings, significantly contribute to improving the understanding of damaging processes to railway infrastructure, the proportional share of different natural hazards to overall losses, and thus to the development of strategic risk management.

Finally, introducing effective guidelines and regulations for railway infrastructure design and construction considering climate change parameters and utilizing high level monitoring technologies and systems are essential actions required for climate adaptation and emergency response systems during operation stage of the project.

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Annexure 10.42. IFC's Managing Contractors' Environmental and Social Performance

GOOD PRACTICE NOTE

Managing Contractors' Environmental and Social Performance

IFC International Finance Corporation
WORLD BANK GROUP
Creating Markets, Creating Opportunities

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Table of Contents

List of Acronyms

CMP	Contractor Management Plan
E&S	Environmental and Social
EBRD	European Bank for Reconstruction and Development
EHS	World Bank Group Environmental, Health, and Safety Guidelines
EITI	Extractive Industries Transparency Initiative
EPC	Engineering-Procurement-Construction
EPCM	Engineering-Procurement-Construction-Management
ESAP	Environmental and Social Action Plan
ESHS	Environmental, Social, Health, and Safety
ESIA	Environmental and Social Impact Assessment
ESMS	Environmental and Social Management System
FIDIC	International Federation of Consulting Engineers
GBV	Gender-Based Violence
GIIP	Good International Industry Practice
GPN	Good Practice Note
GRI	Global Reporting Initiative
HR	Human Resources
ICMM	International Council of Mining and Metals
IFC	International Finance Corporation
KPI	Key Performance Indicator
MDGs	Millennium Development Goals
NEC	New Engineering Contract
O&M	Operations and Maintenance
OHS	Occupational Health and Safety
PSs	Performance Standards on Environmental and Social Sustainability (IFC)
RFI	Request for Information
RFP	Request for Proposal
SDGs	Sustainable Development Goals
SEA	Sexual Exploitation and Abuse
WBG	World Bank Group

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Executive Summary

International Finance Corporation (IFC) clients often rely on contractors for the implementation of their financed projects. Many clients, however, find it challenging to ensure their contractors implement the necessary environmental and social (E&S) requirements for their projects.

As established in Performance Standard (PS) 1: Assessment and Management of Environmental and Social Risks and Impacts, paragraphs 2 and 14, IFC clients are responsible for managing their contractors' E&S performance: *"Contractors retained by, or acting on behalf of the client(s), are considered to be under direct control of the client and not considered third parties. . ." and the E&S management ". . . programs may apply broadly across the client's organization, including contractors and primary suppliers over which the organization has control or influence . . ."*

It is the client's responsibility to comply with IFC Performance Standards on Environmental and Social Sustainability (PSs); relevant World Bank Group (WBG) Environmental, Health, and Safety (EHS) Guidelines requirements; loan agreement commitments; Environmental and Social Impact Assessment (ESIA) requirements; local laws and regulations; and permits and standards; and to ensure that all contractors providing any type of services to the client duly follow these requirements throughout the duration of the contract.

Clients are aware of this responsibility. However, it can be challenging for them to manage the E&S performance of contractors and subcontractors who are often perceived as "separate entities" or "third parties" not related to the client or to their organization.

This Good Practice Note (GPN) is aimed at helping clients implement sound, consistent, and effective approaches in compliance with IFC requirements, to manage the E&S performance of their contractors, subcontractors, and other third parties working for the project. This GPN provides practical guidance to clients and contractors on the process of prequalification, solicitation, evaluation, contracting, and procurement to ensure adequate E&S management during construction, operation, and demobilization activities. Finally, it provides recommendations

"IFC clients are responsible for managing their contractors' E&S performance: 'Contractors retained by, or acting on behalf of the client(s), are considered to be under direct control of the client and not considered third parties. . .'"

on how to manage project performance during the different phases of the services being provided by contractors (i.e., from mobilization to construction, operations, and maintenance) and how to monitor and report on contractor performance effectively.

A RISK-BASED APPROACH TO CONTRACTOR SELECTION

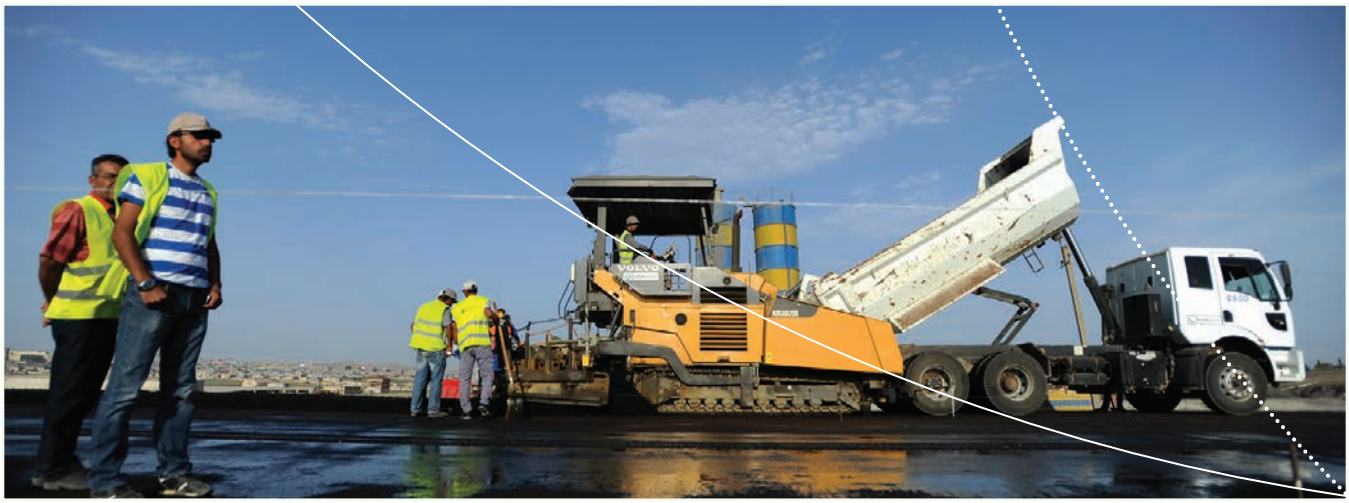
E&S risks in the contracting process are most effectively addressed by integrating the risk management requirements of the contractor into the contract. Following the construction risk assessment process, clients should identify the risk management measures that will be demanded of the contractor, formalize these as "Contractor Management Plans"or a "Contractor E&S Requirements document" and integrate these plans into the procurement process.

The Contractor Management Plans or Contractor E&S Requirements document should describe in a comprehensive and structured manner the various E&S considerations, controls, and commitments related to the main activities that the contractor will be required to implement as part of its scope of work. They should include all relevant E&S requirements, commitments, and provisions derived from the various source documents (e.g., E&S policies, regulatory requirements, E&S commitment registers, ESIA documentation, supplemental assessments, etc.) and should be an integral part of the contract.

These plans help improve the contractor's understanding of the E&S requirements for the project and provide an overall framework of the client's expectations on E&S matters. With a better understanding of these, the contractor can determine from the onset the resources and related associated costs that will be required for executing the work.

As a result, the bidding process, the selection of the contractor, the contract, and the execution of the work itself will include the client's (and project's) E&S considerations from the outset. By including all relevant provisions in these documents, and by making the Contractor Management Plans and/or the Contractor E&S Requirements document an integral part of the contract, the client will have better tools to manage the E&S performance of their contractors and will be in a better position to adequately control and mitigate the identified risks and impacts of the project or activity.

The contractor selection process should involve a multidisciplinary team, with one or more qualified E&S professionals responsible for the project's E&S-related aspects, including E&S performance; worker and community health,



safety, and security; and human resources. This will ensure that E&S matters and variables are considered early in the process of selecting a contractor.

MANAGING THE PROJECT PERFORMANCE THROUGH PROACTIVE MONITORING

The client is responsible for managing E&S risks in the project, and it must, therefore, proactively monitor the E&S performance of their contractors and subcontractors. On a day-to-day basis, contractors should monitor their own E&S performance and that of all its subcontractors throughout mobilization, the main construction phase, operation, and demobilization.

Clear responsibilities and reporting lines are essential to avoid duplication of effort and/or gaps in monitoring. Clients should agree on reporting metrics (which shall include relevant information and data from subcontractors, as applicable) and require contractors to report on E&S performance at an agreed frequency. Timely reporting of E&S performance and results enables the client to identify opportunities for improvement, prevent poor performance issues, and assist contractors if remedial action needs to be taken. Regular meetings between clients and contractors, and between contractors and their subcontractors, are essential to ensure contractor performance is satisfactory and that project specifications are being met. Throughout this process, clients should ensure that contractors employ qualified E&S personnel to oversee E&S performance, and that contractor staffing and resources are commensurate with the magnitude and timing of work and potential E&S risks.

A proactive monitoring of the contractors' E&S performance is key for the success of the work and service being provided, and for the overall E&S performance of the project. A successful contractor will foster good client E&S performance.

This GPN provides recommendations on how to monitor contractor performance from mobilization, to main construction, demobilization and site handover, including guidance on how to conduct site visits, how to perform E&S inductions and trainings, and how to assess E&S conditions and overall performance. This Good Practice Note further provides examples on monitoring and reporting requirements for contractors and suggestions on how the client can perform the E&S review of contractor invoices to ensure the fulfillment of contractual obligations.

1. Introduction

1. IFC clients[1] often rely on contractors for the implementation of the financed project. IFC clients are responsible for ensuring that their contractors are aware of and meet IFC's Performance Standards on Environmental and Social Sustainability (PSs) relevant to their activities, as well as the World Bank Group (WBG) Environmental, Health, and Safety (EHS) Guidelines (See Box 1). The contractors also must meet specific project environmental and social (E&S) requirements detailed in the project documentation and in the Environmental and Social Action Plan (ESAP).[2]

2. IFC clients often find it challenging to ensure that their contractors are implementing E&S requirements effectively. As a result, contractors' E&S performance may fail to meet project-specific commitments and fall short of good international industry practice (GIIP), as required by IFC PSs. These performance challenges can occur anywhere, but are particularly acute in countries where construction practices and operating procedures do not typically meet international standards for E&S performance and where local regulatory oversight and enforcement are limited.

3. E&S opportunities and issues of concern include all aspects of IFC PSs, which include, but are not limited to, occupational health and safety (OHS), community health and safety including sexual exploitation and abuse (SEA) and gender-based violence (GBV) prevention, labor conditions, safety and security, resettlement, biodiversity, cultural heritage, stakeholder engagement, procurement, and supply chain management. It should be noted that some of these, such as labor relations, OHS, and management of private or public security forces, may be the responsibility of departments other than E&S within the client's organization, but all aspects must be considered equally throughout the process of selecting, appointing, and managing contractors.

"IFC clients are responsible for ensuring that their contractors are aware of and meet IFC's Performance Standards relevant to their activities, as well as the WBG EHS Guidelines."

[1] IFC clients include direct investment clients as well as clients of the financial intermediaries IFC lends to.

[2] For purposes of this Good Practice Note, E&S requirements include the applicable requirements of IFC PSs and the WBG EHS Guidelines. These include the management of risks and their impacts, occupational and public health and safety, labor and working conditions, pollution prevention and control, emergency response, use of security forces, land acquisition and resettlement, biodiversity protection and natural resource conservation, cultural heritage protection, protection of indigenous peoples, stakeholder engagement, and grievance management. They also include the requirements of national and local laws and of the ESAP.

Box 1.

IFC Performance Standards on Environmental and Social Sustainability

- *The PSs provide guidance to clients on how to identify E&S risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts so as to conduct business in a sustainable way.*

WBG Environmental, Health, and Safety Guidelines

- *The EHS Guidelines are technical reference documents with general and industry-specific examples of GIIP.*

IFC Clients are Responsible for their Contractors Associated with the Project

- *"Contractors retained by or acting on behalf of the client(s) are considered to be under direct control of the client and not considered third parties for the purposes of this Performance Standard." (PS1, paragraph 2).*
- *"The [E&S management] programs may apply broadly across the client's organization, including contractors and primary suppliers over which the organization has control or influence" (PS1, paragraph 14).*

2. Purpose of this Good Practice Note

4. IFC developed this Good Practice Note (GPN) to help clients provide sound, consistent, and effective approaches for managing the E&S performance of contractors to ensure compliance with IFC requirements. The document will also assist contractors in managing their subcontractors.

5. IFC PSs require clients to identify E&S risks and impacts, typically through an Environmental and Social Impact Assessment (ESIA) process, which should ensure that the design and layout of the project are optimized and the mitigation hierarchy is applied to minimize negative impacts.[3] The process typically results in a number of documents, including an impact assessment, a commitment register (including project approval and permit conditions from the authorities), and/or an Environmental and Social Management Plan or similar document containing a series of project-specific management plans and procedures that can be implemented through an Environmental and Social Management System (ESMS).[4] Environmental design criteria and/or engineering design principles may also be developed, either as part of the ESIA process or separately.

6. The ESIA process specifies that construction, operation, and decommissioning activities are managed to avoid, minimize, and offset negative impacts or compensate for them, and that residual impacts are predicted. The management of impacts will be included in the various documents listed in paragraph 5, as well as in lender and equity agreements and conditions attached to project approval at the national level, depending on jurisdiction. The ESMS is comprised of a series of policies, procedures, plans, programs, and standards that enable the client to operate focusing on E&S protection and a safe working environment. It is the vehicle through which the mitigation hierarchy management measures are described and controls are developed to

"IFC developed this GPN to help clients provide sound, consistent, and effective approaches for managing the E&S performance of contractors to ensure compliance with IFC requirements."

[3] As per PS1, *mitigation hierarchy* means to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks and impacts to workers, affected communities, and the environment.

[4] The ESMS can be integrated with the OHS Management System, quality management systems, and a security management plan for the workforce to form an integrated management system.

eliminate or reduce risks and impacts to acceptable levels. While the implementation of an ESMS can provide a good indication that management is on the right track, the existence of an ESMS in itself is not sufficient to ensure compliance with IFC or other E&S requirements.[5]

7. IFC requires clients to adopt and implement an ESMS for "managing environmental and social risks and impacts in a structured way on an ongoing basis" (PS1, paragraph 1) and to ensure that contractors and subcontractors similarly adopt and implement an ESMS. This GPN is intended to support clients in ensuring contractor compliance with this requirement, support alignment of the client's and contractor's ESMSs, and ensure that contractors have an ESMS suitable for the business activities being carried out by each contractor.[6]

8. The GPN provides practical information for each step in the contractor management process, from preparing the request for proposal (RFP) to contract termination. For additional good practice materials on addressing and managing E&S risk related to security forces, stakeholder engagement and other themes or issues mentioned in this document, refer **to** Annex B**.**

[5] A fully functioning and accredited Environmental Management System (for example, under ISO 14001:2015) does not guarantee environmental performance in compliance with regulatory, IFC, or ESAP requirements, as the accreditation only covers the management system, which can be fully compliant in terms of the content and the procedures in place but does not guarantee that the various elements, programs, and mitigation measures and plans have been implemented effectively on the ground to address environmental performance.

[6] See IFC. 2014. Environmental and Social Management System Implementation Handbook: Construction, rev 2.2. Washington, DC. https://www.ifc.org/wps/wcm/connect/c03aa6804493c5bba71aafc66d9c728b/ESMS+Handbook+Construction.pdf?MOD=AJPERES.

3. Intended Audience

9. This GPN is intended primarily for companies that hire contractors that take part in construction, and operations and maintenance (O&M) activities in projects that are financed by IFC, and for financial institutions that receive IFC financing. Contractors are often hired for specific activities, such as design and construction as engineering-procurement-construction (EPC), engineering-procurement-construction-management (EPCM), or design-build contractors. Contractors may also be hired for operations, including as design-build-operate, O&M, or operator contractors. Separate contractors or subcontractors may also be hired for security, transport, or other specialty services.

10. The document is also intended for (i) personnel involved in and responsible for procurement, contracts, legalities, engineering and design, and management as well as contractor and subcontractor E&S staff; (ii) contractors themselves, including when they engage subcontractors; (iii) clients' engineers and other parties involved in supervising contractors and approving contractor invoices; and (iv) staff of IFC and other lenders involved in reviewing and monitoring the E&S performance of projects involving contractors.

"This GPN is intended primarily for companies that hire contractors that take part in construction, and O&M activities in projects that are financed by IFC, and for financial institutions that receive IFC financing."

4. Contractor Selection

11. The contractor selection process should involve a multidisciplinary team, with one or more qualified E&S professionals with primary responsibility for the project's E&S matters, including E&S performance, worker and community health, safety and security, and human resources (HR). The participation and engagement of the E&S professional in the contractor selection process is aimed at providing an early consideration of E&S matters and variables when selecting a contractor.

12. The first step in the contractor procurement process is the preparation of a RFP preparation. This RFP is typically prepared by procurement staff with input from the project manager, technical specialists (for example, engineers and E&S specialists), and lawyers.

13. A good international industry practice for EPC contracts is for the client to prepare Contractor Management Plans (CMPs) or similar documents, which describe in a comprehensive and structured manner the various E&S considerations, controls, and commitments related to the main activities that the EPC contractor will be required to implement as part of its scope of work. These management plans spell out E&S requirements to proactively manage risks and impacts in their activities including clear definitions of responsibilities, training needs, performance measurement tools, and reporting requirements. In sum, the CMPs describe the mitigation and performance improvement measures and actions that address the identified E&S risks and impacts of the project.[7]

14. Having a set of CMPs addressing all relevant E&S matters improves the understanding by the contractor of the E&S requirements, and provides an overall framework of the client's expectations on E&S matters. With a better understanding of these, the contractor can determine the resources required for executing the work with due consideration of the client's E&S requirements. As a result, the bidding process, the selection of the contractor, the contract, and the execution of the work itself includes the client's (and project's) E&S considerations from the outset.

15. For other types of contracts (i.e., contracts different in scope to EPC and EPCM contracts), clients may choose to develop a consolidated Contractor E&S Requirements document summarizing the general expectations in terms of occupational health and safety, and E&S for all of their contractors and subcontractors. This is a common industry practice that helps clarify the client's main Environmental, Social, Health, and Safety (ESHS) requirements, conditions, and provisions that every contractor or subcontractor must follow when entering into an agreement with the client. A high-level definition of ESHS expectations allows the contractor to better understand the minimum requirements that must be met. It also helps the client to set basic expectations of the ESHS framework that will govern the client–contractor relationship from the outset. A Contractor E&S Requirements document fosters a better

[7] Examples of Contractor Management Plans include those for footprint management, erosion control and reinstatement, restoration, transportation, community health and safety, environmental monitoring, pollution prevention, stakeholder engagement, and local hiring and purchasing, among others.

understanding of expectations and helps the contractor to know from the beginning what is required and deemed necessary to match the requirements and associated costs. This can be particularly helpful during the bidding and procurement process.

16. These documents (the CMPs and the Contractor E&S Requirements document) must include all relevant E&S requirements, commitments, and provisions derived from a number of source documents, including as applicable:

- IFC Performance Standards;
- WBG General and relevant industry-specific EHS Guidelines;
- Commitments included in the ESIAs, and E&S related permits;
- ESHS Commitment Registers;
- Legal obligations and applicable codes and standards; and
- Company policies and internal procedures.

17. By including all relevant provisions in these documents, and by making the CMPs and/or the Contractor E&S Requirements document an integral part of the contract, the client will have better tools to manage the E&S performance of their contractors, ensuring compliance with E&S requirements and will be in a better position to adequately control the identified risks and impacts of a project or activity.

18. Sometimes a request for information (RFI), "expression of interest," and/or a qualification questionnaire is issued prior to an RFP. RFIs are typically brief and include limited information. They are used to determine market interest and solicit preliminary information on potential vendors or contractors, and potentially to create a short list of contractors from whom to issue RFPs.

"...by making the CMPs and/or the Contractor E&S Requirements document an integral part of the contract, the client will have better tools to manage the E&S performance of their contractors, ensuring compliance with E&S requirements and will be in a better position to adequately control the identified risks and impacts of a project or activity."

4.1 PREQUALIFICATION

19. The contractors should be asked to provide details including (but not limited to) past EHS performance; status of ESMS; number and qualifications of ESHS personnel; occupational health and safety procedures and controls; HR policies, codes of conduct, and grievance mechanism controls, including means to address harassment and other forms of GBV plus prior reported incidents of SEA and GBV; and supply chain management as criteria for inclusion on such lists. The number of documents and level of information and detail that are requested to contractors shall be commensurate to the scope of work and other specific features that the contractor is being prequalified against.

20. Prequalification may be established by several means, including a simple questionnaire based on a selection of relevant PS criteria such as those presented in Annex A. This generic questionnaire can be adapted to a specific project and context. Responses to the questionnaire should include information not typically presented by contractors, which may be useful indicators of the contractors' understanding of ESHS management in general and their capacity to manage E&S matters, including existing and potential issues specific to a project. Contractors may also be encouraged to present details of their community engagement and grievance mechanism programs and to note their willingness to contribute to the client's E&S policies and programs at the construction site.

4.2 SOLICITATION

21. In the interest of sharing of project-specific E&S requirements, clients are encouraged to include the following in their RFPs or other solicitations to prospective contractors:

i. Documentation showing compliance with in-country ESHS legal requirements.

ii. The client's corporate E&S policy and other relevant policies, such as those for human resources, anticorruption and bribery, procurement, and stakeholder engagement.

iii. The client's Contractor E&S Requirements that define the main expectations in terms of occupational health, safety, E&S, and community aspects.

iv. Other governance frameworks or industry standards the client has publicly committed to comply with are also helpful information

"The number of documents and level of information and detail that are requested to contractors shall be commensurate to the scope of work and other specific features that the contractor is being prequalified against."

for contractors. These could include, for example, the Equator Principles, Global Reporting Initiative (GRI) standards, Millennium Development Goals (MDGs), Sustainable Development Goals (SDGs), Extractive Industries Transparency Initiative (EITI), International Council of Mining and Metals (ICMM) 10 Principles.[8]

v. Where there is not an ESIA prepared or permitting requirement in place for the project, the following documents may be used as sources of information about E&S concerns and sensitivities: (a) IFC's Environmental and Social Review Summary, available on IFC's website in the event that IFC is involved in the project and has concluded its appraisal process; (b) due diligence and independent engineer/E&S specialist reports; (c) gap analyses; (d) an assessment of security risks; (e) general E&S risk context of the project location(s); and (f) country legislation.

vi. Project-specific E&S requirements that are part of an ESIA or permits or approvals that will be included in the contract are also helpful to include in the RFP. These may include environmental design criteria (the environmental engineering parameters for aspects such as water quality, air quality, and noise) to which the project must adhere; specific social and labor issues that must be addressed (for example, protection for migrant workers); and relevant management plans. Where appropriate, the sustainability and/or certification of materials to be used should be included as a requirement.[9] A commitment register, or extracts from it, may also be useful. The project's ESAP, if available, should also be provided. The information in the RFP should be tailored to the contract activities as closely as possible.

vii. Relevant requirements of the client's ESMS, including any project-specific E&S management plans that have been prepared, are also helpful to potential contractors.

[8] For more on these initiatives, see the respective websites. Equator Principles, http://www.equator-principles.com/; GRI, https://www.globalreporting.org/Pages/default.aspx; MDGs, http://www.unmillenniumproject.org/goals/; SDGs, https://sustainabledevelopment.un.org/sdgs; EITI, https://eiti.org/; ICMM, https://www.icmm.com/en-gb/about-us/member-commitments/icmm-10-principles.

[9] For example, as in the GreenGuard, Forest Stewardship Council, and BRE GreenBook Live listings.

22. If a site visit is planned during the bidding phase (as should always be the case for significant construction contracts, or if the features, location, or specific characteristics of the service in the bidding process may require so), the solicitation should include a site visit. All information shared on the site visit should be made available to all the bidders. A client's E&S representative should always be present during the site visit(s) to present the E&S framework within which the project is operating, answer questions, and provide clarification to bidders. Whether a contractor's E&S representative attends the site inspection will depend on the significance and complexity of the E&S issues.

23. Gender should be addressed in the contracting process. Proactive promotion of gender equality and diversity can enhance the economic output, performance, development, and reputation of a project or business. Socially inclusive workplaces can increase productivity yields, flow and transparency of information, and quality of service; encourage adherence to rules and policies; and attract diverse points of view and opinions. It is important, therefore, that contractors' internally facing human resource policies and procedures actively seek to address all forms of deliberate or unintentional discrimination against women in the workplace.

24. It is often found in large-scale construction projects that contract and subcontract employees are predominantly male, well paid in the local context, and often from outside the host community and project area. These circumstances elevate the risk of SEA and GBV by contract workers. Such SEA and GBV can range in severity from sexual harassment to exploitation and abuse of women and children. Contractors should put in place measures, including codes of conduct, to address such risks. Such measures should clearly establish that contractors/workers should not engage in any sexual activities with children, defined as anyone under the age of 18 (regardless of national statues or standards). Different codes of conduct will be relevant for contracting companies, contracting company managers, and individual workers.

25. Contractors benefit from identifying areas and procedures where a more equal and diverse workplace can be developed. Contracts can include specific language, targets, and objectives around recruitment, hiring, training, management, and promotion of a diverse and competent workforce. Inclusiveness helps to ensure that all activities associated with a project respect and meet the needs of the workforce in a dignified manner, while ensuring equal pay for equal competencies and work. This includes ensuring all planning and implementation processes consider, for example, differences in training, communication, housing, personal hygiene and use of lavatories, personal protective equipment, and adherence to codes of conduct.

26. Contracts should explicitly integrate language, terms, and conditions for enabling equal opportunity and diversity in the workforce in each phase of the contracting and procurement process. Recruitment and hiring policies should strictly prohibit and discourage discrimination or exclusion based on gender or diversity. Finally, for the client to assess performance, contracts and contractors will need to include a means for reporting and measuring results and outcomes of having a socially inclusive workforce, considering both the formal and informal sectors, which are often important components of socially inclusive and diverse construction environments.

27. Concerning E&S Requirements, RFPs, and other solicitations when involving IFC finance prospective contractors should be required to do the following:

i. Submit information on their ESMSs, if any, including any certifications and recent modifications.

ii. Identify one or more E&S staff members, including personnel who will be responsible for E&S performance, HR, and/or safety, as key personnel, and define minimum qualifications and experience. (Qualifications and experience should be determined by the client's evaluation panel to be appropriate to the nature and scale of the work to be contracted.) In projects deemed at a high risk of SEA or GBV, the prospective contractor should demonstrate capacity to identify and manage these types of risk.

iii. Provide information on past E&S performance. Such information could include but not be limited to past violations of E&S regulations; worker accident and injury rates; reports of sexual harassment or discrimination and how those reports were addressed; lists of accidents and incidents involving workers; awards for safe working conditions or environmental performance; environmental incidents in previous projects or services; E&S training records, including training on anti-sexual harassment; labor inspection reports; summaries of material incidents involving worker-management relations (i.e., strikes, demonstrations, security incidents); any SEA or GBV-driven contract cancellations, suspensions, or calling of bid bonds; and material sanctions or fines from labor, health, safety, and/or environmental authorities.

iv. Provide information on existing E&S policies and capacities. This may include any policies related to sustainability, biodiversity, water management, stakeholder engagement, HR (including workplace antisexual harassment policies), codes of conduct which should include specific provisions against SEA and GBV for the contracting company and the contractor's managers and direct and subcontract employees,[10] grievance processes, and so forth.

v. Provide summary descriptions of past projects and/or references, highlighting E&S performance.

[10] Examples of such codes of conduct may be found in Annex 5 of the July 2017 report "Working Together to Prevent Sexual Exploitation and Abuse: Recommendations for World Bank Investment Projects" which may be accessed at http://documents.worldbank.org/curated/en/482251502095751999/Working-together-to-prevent-sexual-exploitation-and-abuse-recommendations-for-World-Bank-investment-projects.

vi. Provide client references, which should be checked to validate claims regarding E&S performance.

28. Many or most of the contract conditions listed in the preceding paragraphs and paragraph 50 may be defined in more detail in the solicitation, and/or the solicitation may require prospective contactors to provide more detailed information on how they intend to meet these E&S requirements. In those cases, this information would inform the development of specific contract conditions, including details of the elements listed in paragraph 50.

29. Solicitations should request an affirmative statement or other commitment by prospective contractors that they will be responsible for E&S performance of their subcontractors and suppliers.

30. Solicitations should ask for information in a consistent format, so that all contractors can be evaluated on the same basis.

31. The client's E&S representative should provide the materials listed in paragraph 21 to procurement personnel who are responsible for issuing the solicitation. In addition, if they have not participated in developing the solicitation, one or more of the client's E&S professionals should review the solicitation prior to issuance to prospective contractors and determine if requirements consistent with paragraphs 21 to 27 have been included. If changes are needed, the E&S professional(s) should work with the procurement department as necessary to ensure that appropriate E&S materials are solicited from prospective contractors. Prior to the solicitation package being issued to prospective contractors, it is recommended that the solicitation package also be cleared by the client's E&S representative.

32. If the solicitation defines line items to be used by the contractor in estimating costs and for payment, the costs and timelines must be adequate to allow the contractor to effectively implement the various E&S commitments related to E&S performance. Payment for the completion or partial completion of work milestones shall be based in part on satisfactory performance of related E&S requirements.[11]

[11] Other aspects might be meeting technical specifications, safety performance targets, and time schedules.

4.3 PROPOSAL EVALUATION AND CONTRACTOR SELECTION

33. It is recommended that the evaluation criteria be established alongside the bid packages and that these are included with the package so that prospective bidders can see early on the relative weightings of the environmental, social, and health and safety aspects of their proposal.

34. Evaluation methodology, criteria, key performance indicators (KPIs), and weightings need to be established in discussion with the rest of the project team. The following questions should be asked when developing the weightings: What answers are we looking for? And what KPI scores are acceptable? Significant E&S records and safety metrics are important, and poor records related to these matters should preclude the contractor from qualifying, regardless of technical aspects or price.

35. The contractor's existing systems, its capacity to implement E&S requirements, and the contractor-supplied information on past E&S performance should be among the key criteria used to evaluate contractors. Capacity may be judged by past performance, existing or projected management, technical ability, and resources. The latter can include solutions or options proposed by the contractor to implement the mitigations described in the E&S documentation, such as management plans that are contained in the bid package. A lack of capacity to establish an ESMS (if one does not exist), implement E&S requirements, and meet applicable standards should disqualify a contractor from further consideration. Referees should be asked to validate claims regarding E&S performance.

36. As the client evaluates proposals, past E&S performance and key personnel can be evaluated either on a pass-fail basis or on a numerical basis, which can then be included in overall comparisons (including technical and financial). If a numerical basis is selected, weightings should be carefully considered, with significant E&S sensitivities and safety being the highest priorities and the basis for passing or failing.

37. While the evaluation methodology will vary according to the project, scope of work of the activity, and any project-specific feature, it will need to be agreed on by the project team. It is recommended that the following be considered grounds for disqualification:[12]

i. Failure to provide information on past E&S performance, including health and safety records;

ii. Reports of past performance deemed unacceptable for the current project;

iii. Notices of material labor issues between workers and management;

iv. Fines and sanctions imposed by E&S and labor regulators and authorities;

v. Poor security management records from previous projects; and

vi. Material community grievances and high profile adverse press reports on E&S matters.

[12] Failure to respond to questions or requests for information usually is not a cause or condition for a bidder's disqualification, but increases the likelihood of a low score in its overall qualification (i.e., if the bidder does not provide information pertaining to a specific E&S requirement, then the score obtained for that selection criteria will be "zero").

38. It is strongly recommended that the team evaluating proposals includes at least one qualified and experienced E&S professional who has been involved in the development of solicitations and the establishment of the criteria that should be used to evaluate bidders' E&S qualifications.

39. Should interviews with key personnel be part of the evaluation of prospective contractors, clients are encouraged to require that prospective contractor E&S personnel be interviewed by client E&S personnel. As this will be a contractor expense, it should be made clear early on that this is a requirement.

40. Should a prospective contractor propose to substitute personnel for any proposed key E&S position(s) at any stage of the selection and or contract negotiation process, clients should require that the replacement(s) have at least equivalent qualifications and experience of the previous professional and that they be approved by the client, or the entire proposal may be reevaluated using the substitute personnel.

41. At the end of the evaluation and selection process, clients should issue a letter of intention to place a contract subject to certain conditions, including E&S requirements and conditions, which should be listed. These could be over and above those in the solicitation, but they must have been discussed with the contractor during the selection process.

4.4 CONTRACTING

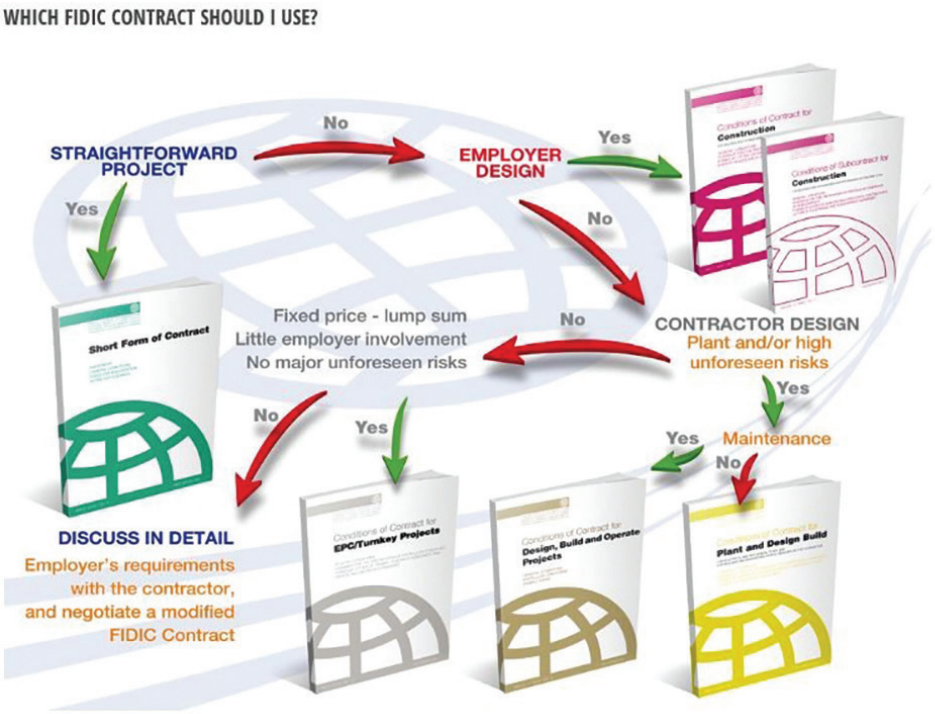
42. *Types of contract*. Clients may use any of a variety of contracts to procure various types of engineering and construction services. Widely used international contract templates and model contracts include those from the International Federation of Consulting Engineers (FIDIC), various forms of which are color coded (Table 1 and Figure 1); the New Engineering Contract (NEC) or NEC Engineering and Construction Contract (NEC3) contract suite; and the International Chamber of Commerce. Many companies, especially those with international experience, also have contract templates that are used on individual projects by their project companies and other subsidiaries.

TABLE 1. FIDIC CONTRACTS

Type of Contract Template	Description
FIDIC Red Book, 1999	Recommended for building or engineering/construction works (i.e., SMP, piping, E&I installation, civils, earthworks, etc.), design provided by the client or others (not the contractor).
FIDIC Yellow Book, 1999	Recommended for the provision of electrical/mechanical equipment and for design and execution of building/engineering works (i.e., mills, crusher, fuel farms, flotation cells, thickeners, etc.), design by the contractor. Generally, also used where the contractor is to provide process performance guarantees.
FIDIC Green Book, 1999	Recommended for building/engineering works of relatively small capital value and/or relatively simple/repetitive type of works. Generally, design provided by the client.
FIDIC White Book, 2006	Recommended for the appointment of consultants to provide services such as feasibility studies, design, contract administration, and project management.

Source: www.fidic.org

FIGURE 1. CHOOSING AN FIDIC CONTRACT



Source: www.fidic.org

43. *Standard E&S clauses*. Model international contracts and many companies' model contracts have conditions relevant to E&S performance, but these are general in nature and vary between the various types of contracts.[13] These contracts also allow for inclusion of project-specific special conditions, although in the past most special conditions have been related to engineering and payment for work completion. Requirements in the model contracts may require international good practice or a variant for some E&S requirements, such as on footprint management, erosion control, hazardous materials and hazardous waste management, site restoration, general pollution prevention, biodiversity management, and other general controls. They also may include requirements for worker safety and worker accommodation. Only rarely do these include requirements for stakeholder communication or community protection, and they do not include project-specific requirements needed to control site-specific impacts as described in the preceding paragraphs.

44. *Contract template review and revision*. Regardless of whether a contract is based on an international model, the client's E&S manager or other qualified person should review the contract to assess any general E&S requirements present and determine how such requirements need to be modified to fit the client's needs.

45. *E&S organization chart*. An organization chart illustrating reporting lines on E&S to the client and subcontractors is a key aspect of the contract negotiations and may be included with the contract documentation.

[13] There are a number of elements related to labor and working practices that are not covered by the FIDIC Red and Yellow Books. Elements not explicitly covered include: HR policy, child labor, forced labor, nondiscrimination and equal opportunity, migrant workers, workers' organizations, grievance mechanisms, and nonemployee workers.

46. *Inclusion of project-specific E&S requirements*. To require contractors to implement E&S commitments specified in project-specific ESIAs and E&S management plans, clients should include and directly reference these requirements (as annexes or appendixes), regardless of contract type.

47. *Identification of E&S plans to be developed by contractor*. Clients should list in the E&S conditions of the contract all E&S management plans and associated documentation that must be prepared or refined and implemented by the contractor, and require that these documents be submitted for client review and approval within an agreed timeline relative to the project schedule, contractor mobilization, and commencement of work. The level of required documentation and E&S plans may depend on the scope of work of the activities and services being provided. At all times, the E&S Plans to be developed by the contractor shall be proportionate to the E&S risks involved in the execution of the work. If it is an EPC or O&M contract, then certainly the contractor will have to develop a number of E&S "implementation" plans detailing the controls that will be applied to ensure compliance with E&S requirements. In the case of small contractors or tasks and services that do not pose significant E&S risks, a general E&S plan describing controls and monitoring mechanisms, or the adherence to a pertinent client's procedures, may be sufficient.

48. *Provision of E&S personnel and resources allocated to the contract or service*. Clients should include the requirement that appropriate resources and key E&S personnel be appointed as part of the contract, throughout project implementation, or during the period in which their services are needed to manage and implement E&S requirements. It is recommended that conditions for replacement of key personnel should be acceptable to the client's E&S representatives.

49. *Selection and alteration of E&S contract requirements*. Specific provisions should be included in the contract only after they are deemed to be acceptable by the evaluation panel, including the E&S representative(s), and approved by client management. If certain conditions are to be agreed on later, the contract should include requirements to reach such an agreement.

"At all times, the E&S Plans to be developed by the contractor shall be proportionate to the E&S risks involved in the execution of the work."

50. *General or specific requirements*. Clients should ensure their contracts include general and/or project-specific requirements for the following:

i. Development and adoption of an E&S management program or system or commitment to adhere to, adopt, and implement the client's ESMS framework, as necessary for the contractor involvement in the project. (See Footnote 6.)

ii. Number and qualifications of E&S personnel required to be on staff and on-site—including those responsible for HR; worker health and safety; worker grievances; environmental management; community health; safety and security; worker accommodation; site security; and emergency response.

iii. The nature, risks, and complexity of the project; the scope of work of the service being contracted; the development and implementation of specific client-approved E&S management plans; and associated documentation as required by the ESIA/Environmental and Social Management Plan, will include, at a minimum, implementation plans for occupational health and safety, emergency response, hazardous materials management, and site restoration, among others. The contract should list the plans the contractor is to develop for client approval and the plans that may have been prepared by the client for contractor implementation.

iv. Explicit commitment to compliance with the project commitments as captured in the commitment register; conditions of approval; environmental design criteria; management plans; ESAP and national law; and acquisition of all required permits, licenses, consents, and approvals prior to undertaking the activities being permitted or otherwise approved.

v. Specific reference to IFC PSs, EHS Guidelines (general and relevant sector specific), and other guidance as appropriate (for example, IFC and European Bank for Reconstruction and Development (EBRD) Guidance on Worker Accommodation).

vi. Adherence to the project code of conduct.

vii. Adherence to the project security forces management plan, if applicable.

viii. Induction and training programs for E&S and other personnel, including training on applicable HR policy provisions, grievance mechanisms, health and safety, code of conduct including training on the provisions intended to combat GBV and SEA, materials management, and environmental protection.

ix. Monitoring of E&S performance by contractor workers and subcontractors and client's role in this.

x. Any monitoring of environmental parameters (such as noise, air emissions and air quality, water flows and quality, waste generation and management) that contractors may be required to carry out.[14]

[14] Monitoring of environmental media often remains the responsibility of the client or owner's team to ensure consistency of methodology and analyses, for comparison with baselines and predictions. However, in some cases the contractors are required to monitor their own performance. Some specialist monitoring may be more appropriately carried out by the contractor, such as blast vibration monitoring or monitoring required only during the construction phase and related to particular activities. Client monitoring is preferred, and strict controls on sampling methods and equipment, labs, lab methods used, quality assurance/quality control, and chain of custody procedures should be in place.

xi. Implementation of a grievance mechanism for workers (including subcontract workers) either through a grievance mechanism implemented and managed by the contractors or through extending the grievance mechanism of the client to the workforce of the contractor. In both cases, clear reporting on grievances and how they are addressed between contractor and client is required. The grievance mechanism should ensure proper handling of GBV-related grievances, including but not limited to sexual harassment.

xii. Assurance that the client's grievance mechanism for external stakeholders[15] is either adopted by all contractors or there is clear communication to stakeholders on how to address grievances related to the activities of the contractors, including both works on the project site(s) and in any ancillary facilities and infrastructure. The community-level grievance mechanism should ensure proper handling of grievances arising from GBV or SEA.

xiii. Other requirements of the client's stakeholder engagement program that are to be supported by the contractor. This should be integrated with the client stakeholder engagement program to ensure consistency.

xiv. Creation and maintenance of records on E&S performance.

xv. The environmental conditions under which the contractor will be allowed to demobilize and leave the site, including conditions of site restoration and requirements for handling personnel retrenchment, particularly those involving local workers.

xvi. Penalties and/or incentives for E&S performance of contractors and subcontractors.

xvii. Reporting requirements, including reporting on E&S performance.

xviii. Clear contract statement that the contractor is responsible for the E&S performance of subcontractors and suppliers.

xix. Contract statement that on the contractor's failure to meet the E&S requirements in such a way as to prevent significant impacts to workers, local communities and/or individuals, and/or environmental resources, and on the contractor's failure to correct such deficiencies upon receiving proper notice, the client has the right to appoint and pay another party to repair damages or otherwise remedy the impacts and reduce payment to the contractor in the amount paid to the third party.

xx. As noted previously, mitigation measures to control E&S impacts during construction work to be considered as part of the works themselves, not measures that are needed in addition to the main works. The bill of quantities shall include adequate costs and timelines for expenditure to effectively implement the commitments related to E&S performance. The bill of quantities should define milestone and final payments for completion or partial completion of work, to include satisfactory performance of related E&S requirements. If a contract includes incentives for timely completion of work, it should also include corresponding penalties for failure to implement required mitigation measures.

51. *Implementing GIIP*. Because the full spectrum of E&S requirements may not be known at the time of the contract, IFC recommends that clients include general requirements in all contracts that GIIP must implement to mitigate E&S impacts.

[15] Stakeholder may need to be defined for the project as part of the discussions with the contractor(s).

52. *Review of bill of quantities*. The bill of quantities for payments should be reviewed and accepted by the client's contract administrator who has to ensure that the technical and overall quality of the service and work being conducted by the contractors follows the agreed terms and conditions. Depending on the sensitivity and complexity of the E&S matters of the contract, the client's contractor administrator may require that one or more senior client E&S professionals is involved in the review of invoices and bill of quantities since they will need to ascertain the implementation of E&S control and mitigation measures included in the contractor's work when requests for payment are received at milestones. If necessary, they may require the bill of quantities to be more explicit on specific mitigations that are required for specific works, or otherwise advise the contractor of such mitigations.

53. *Reviewing requirements*. IFC and/or its financial intermediaries or another party to which it delegates authority (for example, a technical advisor or independent engineer) may, at their discretion, review contracts to verify the inclusion of appropriate project-specific E&S requirements and E&S-related costs.

54. *Incentivizing good E&S performance*. Clients are encouraged to include incentive mechanisms in the bill of quantities for satisfactory E&S performance and control of potential impacts as part of their completion of major works. Such mechanisms may include: a better score in the contractors' overall qualification and clients' contractor performance database (which is helpful for any future bidding process or service); expedited processing of invoices or bill payments; recognition of good E&S practices; and an additional bonus for completion of the work package with overall good E&S performance.

4.5 SUBCONTRACTING AND PROCUREMENT

55. It is the client's responsibility to comply with IFC PSs, ESHS Guidelines, loan agreement commitments, ESIA, local laws and regulations, and permits and standards, ensuring that any contractor providing services of any kind to the client duly follows these requirements throughout the duration of the contract, including any activity or services performed by subcontractors or third parties undertaking a contract from the contractor.

56. Clients generally do not have direct control over subcontractor performance, although they may have some influence over selection and may (indirectly) supervise their E&S performance. Therefore, clients must use their direct control over their contractors to ensure that E&S requirements are being met by subcontractors. To achieve the commitment of paragraph 50 (xviii), clients should require contractors to include in subcontracts the requirement to comply with IFC PSs and all E&S requirements that are appropriate for the works being subcontracted and consistent with the client's and the contractor's E&S management programs. In general, clients should require that contractors apply the guidance described in sections 4.1 through 4.4 in prequalifying, soliciting, selecting, and entering into subcontracts.[16]

4.6 EXISTING CLIENT-MANAGED CONTRACTS

57. *Amending existing contracts*. For large development projects, there may be existing, smaller contracts managed by the client (for example for track maintenance and drill pad construction) that will continue into the construction phase alongside major contracts. For consistency, these contracts and the performance requirements associated with them should be reviewed and, if necessary, brought in line with the other contracts to properly incorporate all applicable E&S requirements. This is particularly the case where the ESIA process had not been completed when the contract was awarded. This might mean developing a contract amendment to ensure all the necessary E&S provisions are included and ensuring that contractor staff undergo the same training as other contractors new to the site.

"Clients generally do not have direct control over subcontractor performance, although they may have some influence over selection and may (indirectly) supervise their E&S performance. Therefore, clients must use their direct control over their contractors to ensure that E&S requirements are being met by subcontractors."

[16] An early "skill versus needs" assessment should be conducted when needed to identify challenges and opportunities to increase the local content in subcontractor hires and add needed measures (for example, capacity building and other training) to make sure local workers abide by project E&S standards.

5. Project Performance

58. *Understanding implementation responsibilities*. The roles of clients and contractors in meeting E&S requirements are usually intertwined and must be worked out at the project level. Some actions described below as being the responsibility of the client or the contractor may be reversed or shared on some projects. In some cases, such as stakeholder engagement, both clients and contractors will have certain obligations and limits and will need to coordinate their efforts. In others, such as monitoring, each party will monitor E&S performance, but at different frequencies and levels of detail. In all cases, the client remains ultimately responsible to lenders for ensuring E&S requirements are met, with the responsibilities of the contractor defined in the contract. For design-build (or design-build-operate) contractors, the design standards and requirements (and operation standards) will also be set out in the terms of reference to the contract. For public-private partnership (PPP) projects the administration may also have roles and responsibilities (to the Bank) which may be additional to their usual regulatory functions.

59. *Contractor oversight*. The client will monitor contractor and subcontractor E&S performance and ensure the contractor monitors its own and all subcontractors' E&S performance throughout construction, including mobilization, the main construction phase, and demobilization. Clear responsibilities and reporting lines are essential to avoid duplication of effort or, conversely, gaps in monitoring. If operations are carried out under contract, or some work is performed by contractors, the client and contractor will monitor E&S performance during operations as well.

60. Clients should require contractors to report on an agreed frequency their E&S performance and metrics (which shall include relevant information and data from subcontractors, as applicable). Timely reporting of E&S performance and results enables the client to identify opportunities for improvement, prevent poor performance issues, and assist contractors if remedial action is to be taken.

Box 2. Driving Performance through Competition

Experience has shown that some clients share performance-monitoring results at weekly meetings with all contractors to effectively drive improved performance by introducing a competitive element, sometimes with small incentives.

61. *E&S performance meetings*. Regular meetings are essential to ensure contractor performance is satisfactory and that project specifications are being met. (For an added benefit of meetings, see Box 2.) The authority of monitoring staff who control contractor performance also needs to be clarified and understood by contractors (for example, who gives instructions to stop work or proceed but with modifying the approach, scope, equipment, and so forth).

62. Clients should ensure that contractors employ qualified E&S personnel to oversee E&S performance, and that contractor staffing and resources are commensurate with the magnitude and timing of work and potential E&S risks. Clients should also approve documentation, including for training programs, to ensure all staff are aware of E&S commitments and their part in meeting them.

5.1 CONSTRUCTION

5.1.1 Mobilization

63. *Review and approval of contractor E&S plans*. As IFC clients are responsible for their contractors meeting all of the project's E&S requirements, it is essential for them to review and approve project E&S management plans and procedures at this stage. These might include such plans as working within boundaries (footprint management), protection of biodiversity, land clearing and erosion control, traffic management, labor sources and methods of recruitment of workers, worker accommodation, noise and dust control, and possibly others (See Box 3).

64. *Kickoff meeting*. Prior to early work activities, the client should hold a kickoff meeting with each of the contractors prior to arriving at the site. Timing of mobilization based on logistical issues, resources, customs delays, and so forth should be considered in the planning. Client and contractor project managers and major subcontractors should participate in these meetings. The purpose is to review planned activities and schedules, review E&S requirements (among others), review the roles of the various parties in implementing and monitoring mitigation measures, and agree on project-specific induction and training content. These meetings should include a discussion about control of access to the site, use of security forces if applicable, and how to best coordinate the client's security management system and E&S activities at both the base camp (accommodation site) and any remote construction sites. Both client and contractor E&S representatives should be present to reiterate all E&S commitments and establish initial compliance points and coordination requirements during site establishment.

65. *E&S induction and training*. A general E&S site induction should be mandatory for all workers, with specialized technical E&S training delivered to staff. The degree of training should be based on the project's E&S risks, on the tasks that will be performed, the code of conduct, including stakeholder engagement rules, and security management, and on the general E&S provisions that are applicable for all personnel, including contractors and subcontractors. All workers should be made aware of the worker and public grievance mechanisms and how to access them. In particular, security contractors should be given detailed training on community engagement and the grievance mechanism, as complaints may be brought to their attention in the first instance, and as contractors are not often included in employee training. In projects at high risk of SEA or GBV, contractors should develop and implement SEA and GBV awareness training for staff at all levels,

Box 3. Mobilization

The initial phase of construction usually begins with a mobilization or preconstruction phase during which the site is prepared for construction. This phase can include major works such as land clearing and excavation, building and office construction, access road construction or improvement, construction of worker accommodations (and use of temporary accommodations), arranging for adequate security systems and technical measures at the accommodation and construction sites, and other activities. Collectively these are usually known as "early works."

This is often the period of the greatest E&S impact. It is critical that the correct documents, training, procedures, and systems are in place to ensure the impacts are managed properly.

Clients are cautioned against authorizing contractors to begin work in advance of an effective ESMS, approved E&S management plans, and associated documentation being in place.

from contract management to day laborers. Additional training may be needed for staff that will be responsible for implementing, monitoring, and reporting E&S performance. Once the general E&S induction is defined, a series of specific trainings may be required in order to ensure that the requirements, controls, and mitigation measures are well communicated and understood.

66. *Client site visits and oversight*. At project sites where there could be significant and/or permanent impacts due to preconstruction activities, including sites where there is a substantial amount of land clearing, the client, representative engineer, or E&S lead should visit daily during the first weeks to help guide the contractor's E&S managers and staff in overseeing activities and ensuring that there are common expectations on E&S performance. This might continue for the duration of the activity with a periodicity properly assessed to ensure adequate supervision, proactive monitoring, and sound E&S performance.

67. Clients should monitor contractor E&S performance during this phase, as described in section 5.1.4. Clients should require contractors to monitor their own and their subcontractors' E&S performance and report to the client no less than weekly as described in section 5.1.5. In the case of certain environmental and safety incidents, the client should be informed immediately; these instances should be agreed and understood by all parties. Clients should consider E&S performance in the payment of invoices, as described in section 5.1.6.

5.1.2 Main Construction

68. *Client E&S capacity*. Clients and/or their representatives (for example, owner's engineers) must assign E&S personnel with appropriate qualifications and seniority to oversee and supervise the E&S performance of contractors, including their subcontractors. The number of personnel and their disciplines should be commensurate with the size of the project and the potential E&S risk.

69. Prior to construction activities that could cause E&S impacts, the client should hold a kickoff meeting with the contractors. Client and contractor project managers and E&S personnel should participate, as should E&S supervisors and personnel of major subcontractors. The purpose is to review planned activities and schedules, review E&S requirements and expectations, review the roles of the various parties in implementing and monitoring mitigation measures and E&S management plans, and agree on an induction and training program on project-specific E&S aspects, including site security arrangements. A general site induction to E&S, including OHS and code of conduct training, should be mandatory for all workers, with specialized training for key staff responsible for implementing, monitoring, and reporting E&S performance.

70. Clients will monitor contractor E&S performance during this phase as described in section 5.1.4. Clients will require contractors to monitor their own and their subcontractors' E&S performance and report to the client in a timely manner, as described in section 5.1.5. In the case of environmental, safety, or social incidents, the client should be informed immediately. The applicable instances should be agreed to and understood by all parties. Clients will consider E&S performance in the payment of invoices, as described in section 5.1.6.

5.1.3 Demobilization and Site Handover

71. Upon meeting the conditions established in the contract (see paragraphs 49 and 50) determining that construction is complete, the contractor can demobilize equipment and personnel and turn over the site or, if more than one, all work sites to the client. To ensure that all the necessary E&S provisions have been duly met and that the appropriate controls and requirements were implemented, the client could typically develop a checklist or punch list including all relevant E&S aspects that need to be verified upon completion of work. If there are pending topics or requirements, these shall be communicated to the contractor, who should address them on an agreed schedule.

72. Client E&S personnel should inspect all work sites and other areas affected by the contractor, when notified that construction is complete, to determine if the requirements established in the contract have been met. Clients will allow contractors to demobilize equipment and E&S personnel only after client E&S personnel determine that E&S requirements have been fully met. Handovers may be phased on complex sites and when work is completed early. Issues that have arisen during the contract should be reviewed carefully during the handover review and acceptance by the client, including the possibility of the issues arising in the future.

5.1.4 Client Monitoring of Activities

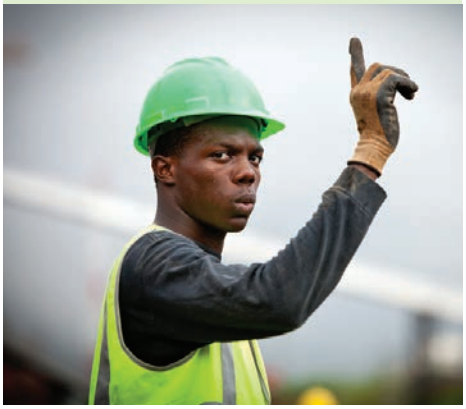
73. Client monitoring of contractor E&S performance must continue throughout construction, from mobilization through demobilization. This should involve both visits to work locations and reviews of records kept by the contractor and of reports submitted by the contractor. The frequency of site visits should be commensurate with the magnitude of the E&S risks of the activities being carried out and permanence of potential impacts that could result from ongoing activities. For highly sensitive projects (Category A[17]), consideration should be given to having the client or engineer's representative on-site on a permanent basis. Monitoring may be conducted by client E&S personnel and/or E&S personnel of an owner's team.

74. Client E&S personnel should review one or more recent inspection reports and the contractor's previous month's E&S progress report prior to visiting the site to monitor the contactor's E&S performance. They should do the same before participating in meetings where the contractor's E&S performance is to be discussed.

75. Client E&S personnel will review contractor reports and follow up as needed to ensure timely resolution of issues of noncompliance with E&S requirements. This may include additional visits to the contractor's site or offices, further communications with contractor E&S personnel, issuance of notices of deficiency or warnings to the contractor, and other actions as needed, including those in paragraphs 76 and 80.

76. At any stage of construction or other work, if the contractor has not taken appropriate action to achieve compliance with E&S requirements after repeated notices of violation and warnings of noncompliance, and significant E&S impacts are occurring or imminent, the client should order the contractor to stop work until E&S performance is brought under control and up to acceptable standards. See also Box 4 and paragraph 81.

"At any stage of construction or other work, if the contractor has not taken appropriate action to achieve compliance with E&S requirements after repeated notices of violation and warnings of noncompliance, and significant E&S impacts are occurring or imminent, the client should order the contractor to stop work until E&S performance is brought under control and up to acceptable standards."



[17] A Category A project is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. A Category B project has potential adverse environmental impacts on human populations or environmentally important areas—including wetlands, forests, grasslands, and other natural habitats—which are less adverse than those of Category A projects. A Category C project is likely to have minimal or no adverse environmental impacts.

"Clients should require contractors to report on E&S performance on at least a monthly basis throughout the construction phase, including mobilization, construction, and demobilization."

5.1.5 Contractor Monitoring and Reporting

77. Clients should require contractors to monitor and keep records on E&S performance in accordance with the ESMS and E&S management plans. This may include monitoring of E&S matters, scheduled and unscheduled inspections to work locations, observations made during routine activities, desk reviews, drills, and any other monitoring protocols implemented by the contractor to ensure E&S compliance. The client E&S personnel must be familiar with the contractor's monitoring and record keeping system so this aspect of the contractor's performance can itself be monitored.

78. Responsibilities for monitoring need to be clear between the client and contractor, and results (if client and contractor are both collecting data) must be comparable, for example, collected using the same methodologies, analyzed at the same labs, and using similar equipment, and so forth.[18]

79. Clients should require contractors to report on E&S performance on at least a monthly basis throughout the construction phase, including mobilization, construction, and demobilization. This could be more frequent for more sensitive E&S projects. It can be part of the overall engineering progress report or a stand-alone E&S report. Reported E&S information should include the following:

i. *Safety*: hours worked, recordable incidents and corresponding Root Cause Analysis (lost time incidents, medical treatment cases), first aid cases, high potential near misses, and remedial and preventive activities required (for example, revised job safety analysis, new or different equipment, skills training, and so forth).

ii. *Environmental incidents and near misses*: environmental incidents and high potential near misses and how they have been addressed, what is outstanding, and lessons learned.

iii. *Major works*: those undertaken and completed, progress against project schedule, and key work fronts (work areas).

iv. *E&S staffing*: new hires and departures, and listing of current staff and titles.

[18] To improve efficiency, responsibilities should be defined early regarding who collects what data. In relation to the data collected by the contractor, the owner should be comfortable with what is being collected and how it is being collected, analyzed, reported, and so forth. This is usually done through the sign-off by the owner on the proposed monitoring plan of the contractor.

v. *E&S requirements*: noncompliance incidents with permits and national law (legal noncompliance), project commitments, or other E&S requirements.

vi. *E&S inspections and audits*: by contractor, engineer, or others, including authorities—to include date, inspector or auditor name, sites visited and records reviewed, major findings, and actions taken.

vii. *Workers*: number of workers, indication of origin (expatriate, local, nonlocal nationals), gender, and skill level (unskilled, skilled, supervisory, professional, management).

viii. *Training on E&S issues*: including dates, number of trainees, and topics.

ix. *Footprint management*: details of any work outside boundaries or major off-site impacts caused by ongoing construction—to include date, location, impacts, and actions taken.

x. *External stakeholder engagement*: highlights, including formal and informal meetings, and information disclosure and dissemination—to include a breakdown of women and men consulted and themes coming from various stakeholder groups, including vulnerable groups (e.g., disabled, elderly, children, etc.).

xi. *Details of any security risks*: details of risks the contractor may be exposed to while performing its work—the threats may come from third parties external to the project or from inappropriate conduct from security forces employed either by the client or public security forces.

xii. *Worker grievances*: details including occurrence date, grievance, and date submitted; actions taken and dates; resolution (if any) and date; and follow-up yet to be taken—grievances listed should include those received since the preceding report and those that were unresolved at the time of that report.

xiii. *External stakeholder grievances*: grievance and date submitted, action(s) taken and date(s), resolution (if any) and date, and follow-up yet to be taken—grievances listed should include those received since the preceding report and those that were unresolved at the time of that report. Grievance data should be gender-disaggregated. Particular sensitivity may be needed around SEA or GBV issues raised.

xiv. *Major E&S changes*: to ESMS, E&S management, or E&S practices.[19]

xv. *Deficiency and performance management*: actions taken in response to previous notices of deficiency or observations regarding E&S performance and/or plans for actions to be taken—these should continue to be reported until the client determines the issue is resolved satisfactorily.[20]

[19] This is more often a requirement for the client. Of course, contractors should also report on changes, but they are usually limited in their ability to make significant E&S changes.

[20] As this could represent a significant undertaking for large projects, contractors usually will need a permanent staff member—usually a good clerk or junior or trainee engineer—who collects and helps organize the information.

5.1.6 Approving Invoices for Payment

80. *E&S review of contractor invoices*: The client's E&S manager or representative should be part of the process for signing off on all payments to contractors, even if the payment is not for work that is explicitly related to E&S mitigation and performance. E&S staff shall work closely with the project manager (client or engineer's project manager, depending on who employs the E&S personnel) to determine if there are any outstanding E&S items and whether including that full or partial payment under specific line items of the bill of quantities should be withheld, either temporarily or permanently, or that there should be some combination of temporary and permanent withholding (Box 4).

81. If the contractor does not take timely action to reach compliance with E&S requirements, client E&S personnel and the project manager should continue to take appropriate action to encourage compliance, which could include orders to stop work, withholding of further payments, and/or escalation of the issue to higher management. If significant impacts are occurring or imminent, the client may notify the contractor that another party will be brought in to deal with the issue and the payment to the contractor will be reduced by the amount paid to the other party, as would be specified in the contract. See paragraph 53.

Box 4. E&S Review of Contractor Invoices

- Temporary withholdings should be recommended in case of repeated minor violations of E&S requirements that are not leading to significant impacts on workers, external parties, or environmental resources; minor violations that are not corrected after repeated warnings; or first-time major violations that can be corrected easily and that have not led to permanent E&S impacts. The withheld amounts should be paid upon contractor correction of the deficiency to the client's satisfaction.
- Permanent withholdings should be recommended for minor violations that are not corrected after repeated warnings and that could result in significant impacts; or for any violations that have resulted in significant impacts, including permanent impacts. Some portion of such withholdings may be released upon satisfactory resolution of the issue, but some significant portion must be permanently withheld as a penalty to discourage repeated incidents.
- As noted in paragraphs 32 and 50 (xx), payments that are withheld either temporarily or permanently will be all or part of the payment specified for a line item in the bill of quantities, which in turn will be the payment due for a discrete portion of the total works. Client E&S personnel should work with the project manager and others as needed to arrive at the amount to be withheld. This amount should not be based directly on the cost of compliance but rather should be somewhat higher than this amount, and based on a specific percentage of the line item in question.
- The contractor should be notified of the specific actions that must be taken in order to receive further payments for the works in question, or to receive payment that has been temporarily withheld.

5.2 OPERATIONS AND MAINTENANCE

82. Clients who hire contractors to operate projects, or to undertake activities under contract during the operations period, should use the guidance in sections 4 and 5 to solicit, select, and supervise contractors, as is appropriate for this phase and the contractors' activities. Required policies, procedures, and guidelines for operations should include lessons learned from construction and any planning conditions, as well as ESIA commitments.

83. Prior to defining the full E&S requirements and approving the contractor's ESMS for the operations phase, the client should review the section of the ESIA relating to operations and its associated commitments, including mitigations and management plans and any conditions imposed by regulatory authorities. The client should make such modifications as are appropriately needed given changes to or knowledge of the site and its environment, including potentially affected people due to construction activities and the project itself.


KOMATSU

Annex A. Sample Questionnaire to Include in Requests for Expression of Interest or Prescreening of Contractors

Note that any questionnaire should be tailored to the sector and risk level of the project.

Relevant PS	Issue	Requested information
PS1	Assessment and management of environmental and social risks and impacts	
		Please provide a copy of the company's environmental, social, and health and safety policies.
		Please provide information on both: 1. The company's corporate ESMS 2. The project ESMS that the company would typically implement at the site
		Please provide details of any accreditations such as ISO 14001/OSHAS 18001, held by the company, and/or alignment with ISO 26000, GRI, United Nations Global Compact, World Business Council for Sustainable Development, and/or other social responsibility standards/guidelines/ formal initiatives.
		Please provide a typical organization chart that shows how safety and health, environmental, social (including stakeholder engagement and grievances), and labor issues are managed at the site level, including management and monitoring of subcontractors and their performance.
		Please provide appropriate E&S metrics for the past three calendar years, including spills, releases to the environment, number of environmental fines or regulatory administrative processes, number of registered stakeholder grievances (disaggregated by gender), and number of registered labor grievances (disaggregated by gender).
	Subcontractors	Please provide detailed information on how the company selects and manages its subcontractors (local or other), particularly in determining whether they have systems in place to follow the necessary environmental, social, and health and safety requirements of the project.
	Subcontractors	Please provide information on how the company monitors subcontractors' environmental, social, and health and safety compliance and performance.
		Please confirm that the company has read and understood the ESIA, with particular attention to the commitments register and the ESHS management plans for the project.

	Supply chain	The client requires that goods and services are procured locally, as far as possible, when available at equivalent quality and price. Please demonstrate how the company might achieve this, illustrating with examples from other projects if appropriate.
PS2	Labor and working conditions	
		Please provide a copy of the company's safety policy.
		Please provide a representative copy of a Health and Safety Site Management Plan.
		Please provide appropriate health and safety metrics for the past three calendar years, including (i) worked hours for the period, (ii) total recordable fatalities, (iii) total recordable injury frequency rate, and (iv) total recordable disease frequency rate (based, for example, on ICMM definitions).
		Please describe in detail how the company trains for and implements safe working practices among its workforce.
		Please describe how the company plans to safeguard the health and safety of its workers while on site. What are the anticipated OHS risks and how will they be addressed?
		Please provide a copy of the company's HR policies and grievance mechanism, and describe how these will be communicated to all workers on-site.
		Please provide details on how the company will comply with national labor and employment law.
		Please provide details how the company will manage equal opportunities and nondiscrimination, sexual harassment issues, migrant labor, and retrenchment among its workforce.
		Please describe how the above issues will be managed by the company at the subcontractor level, including monitoring and reporting systems.
		The client requires that as much local labor as possible be used during the construction phase. Please describe how the company would approach this to avoid importing third country nationals or expatriate labor, as far as possible, and to leave a useful legacy of skills in the area. (It is acknowledged that a proportion of skilled labor will have to be brought in to fulfill project needs.)
		The client requires that contractors have cognizance of the minimum standards for worker facilities at the site, including sanitation, access to drinking water, and accommodation set out in the IFC and EBRD Guidance Note, Workers Accommodation, Processes and Standards, and International Labour Organization requirements. Please describe how the company will incorporate these requirements into the project.

PS3	Resource efficiency and pollution prevention	
		Please describe how the company typically manages solid waste, both hazardous and nonhazardous, generated by its activities at a construction site, including reduce, reuse, and recycle initiatives.
		Please describe how the company typically manages wastewater (for example, in camps, process) generated by its activities at a construction site, including reduce, reuse, and recycle initiatives.
		Please describe how the company typically manages storm water flow generated by its activities at a construction site.
		Please describe how the company typically manages the transportation and storage of hazardous substances and materials at the company's sites.
		Please describe how the company typically manages soil removal and storage (for later reuse).
		Please describe how the company typically manages the control of erosion and sedimentation at the company's sites.
		Please describe how the company typically manages air quality at its sites.
		Please describe how the company typically manages nuisance noise at its sites.
		Please provide examples of environmental monitoring programs that the company has carried out on other jobs.
		Please describe how the company typically manages and uses fresh water at the company's sites.
		Please describe how energy efficiency is typically built into the company's activities.
		Please describe how greenhouse gas emissions will be accounted for and reported.
		Please describe other resource efficiency practices at the company's sites.
PS4	Community health, safety, and security	
		Please describe how the company prepares for emergencies at its sites, including those that may affect nearby communities, such as an explosion or accident or a spill or release into a local water course.
		Please describe how the company trains for and implements good driving practices among its workforce to avoid or minimize impacts to the communities.

		Please provide a code of conduct describing expectations for the behaviour of direct and subcontract employees when outside the work site and in the host community. The code of conduct should include specific provisions to prevent SEA and GBV.
		Please provide details of how the company typically manages community engagement and community relations to respect the client's existing relationship with communities and contributes to this.
		Please provide details of the company's physical and personnel security measures and how security is typically implemented at its sites.
		Please provide details of the company's policy for the adequate management of security measures and protection of human rights of local communities.
PS6	Biodiversity conservation and sustainable management of living natural resources	
		The client has several requirements relating to the conservation of biological diversity (biodiversity) including terrestrial and aquatic ecosystems. Please describe any previous projects that the company has undertaken where this was also a significant issue and how the company contributed to this effort.
		If the company has not been involved in projects where biodiversity has been a significant issue, please describe how the company would plan to address and support the client regarding the conservation of biodiversity for this project.
PS8	Cultural heritage	
		Please describe how the company typically addresses the finding of archaeological or cultural heritage items during execution of its work.
NA	Corporate social responsibility	
		The client has requirements relating to social responsibility for this project. Please provide examples of social responsibility initiatives that the company has contributed to at other sites or projects, and suggest ways that the company might contribute to this project, in discussion and coordination with the client.

Annex B. Further Resources

Below is a sampling of resources to help address risks mentioned throughout this document. For more good practice publications, visit http://ifc.org/sustainabilitypublications. Sign up for our mailing list at www.ifc.org/sustainabilitylist.

SECURITY FORCES

International Finance Corporation (IFC). February 2017. Good Practice Handbook: Use of Security Forces: Assessing and Managing Risks and Impacts.
www.ifc.org/securityforces.

INFLUX, IN-MIGRATION, INCLUDING GENDER AND RISK OF GENDER-BASED VIOLENCE

World Bank. December 2016. Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx. http://pubdocs.worldbank.org/en/497851495202591233/Managing-Risk-of-Adverse-impact-from-project-labor-influx.pdf.

IFC. September 2009. Good Practice Handbook Projects and People: A Handbook for Addressing Project-Induced In-Migration. http://www.ifc.org/HB-Inmigration.

Global Gender-Based Violence Task Force. July 2017. Working Together to Prevent Sexual Exploitation and Abuse: Recommendations for World Bank Investment Projects. http://documents.worldbank.org/curated/en/482251502095751999/pdf/117972-WP-PUBLIC-recommendations.pdf.

STAKEHOLDER ENGAGEMENT

IFC. May 2007. Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Market. http://www.ifc.org/HB-StakeholderEngagement.

GRIEVANCE MECHANISMS

IFC. September 2009. Addressing Grievances from Project-Affected Communities.
http://www.ifc.org/GPN-Grievance.

Compliance Advisor Ombudsman. Grievance Mechanism Toolkit.
https://www.cao-grm.org/.

WORKER ACCOMMODATION

IFC and EBRD. September 2009. Workers' Accommodation: Processes and Standards.
http://www.ifc.org/GPN-WorkersAccommodation.

ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEMS

IFC. October 2015. Environmental and Social Management System (ESMS) Implementation Handbook—GENERAL. http://www.ifc.org/esms.

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Creating Markets, Creating Opportunities

Annexure 10.43. Labour Management Procedures

LABOUR MANAGEMENT PROCEDURE (DRAFT)

1. Project Overview

The K RIDE's Project Bengaluru Suburban Railway Project (BSRP) is being prepared under the KfW's financial assistance and in line with World Bank's new Environment and Social Framework (ESF), replacing the Bank's Environmental and Social Safeguard Policies. Under the ESF, all World Bank Borrowers have agreed to comply with ten Environmental and Social Standards (ESSs) applied to investment project lending financed by the Bank. The Project recognizes the significance of and adopts the ESSs to identify and manage the environmental and social risks and impacts of this investment project.

2. The Labor Management Procedure (LMP)

The Labor Management Procedure (LMP) for K RIDE'S Project has been prepared to meet the objectives and requirements of ESS 2 and ESS 4, as well as the national Labor Law. This LMP assesses the potential risks and impacts of the assignment of labor for the implementation of Components 1 and 2 of the Bengaluru Suburban Rail Project (BSRP) and addresses them through mitigation measures in light of ESS and Labor policies and provisions.

Various types of workers (Direct, Contracted, and Primary Supply workers; and community workers), their estimated numbers, characteristics, etc., have been set out in this LMP. Critical potential environmental and social risks— such as unscrupulous labor practices, OHS, community risks, waste generation, and risks of GBV, child exploitation, and forced labor have been identified. Given the nature and size of the project, the potential Environmental and Social (ES) risks and impacts, the capacity of the implementing agency to manage and mitigate the ES risks, and the context under which the project is being implemented, the ES assessment has set the project risk classification as Moderate.

Provisions of ESS, The Contract Labor (Regulation and Abolition) Act, 1970, The Child Labor (Prohibition and Regulation) Amendment Act, 2016, etc. have been thoroughly studied and cited to meet their requirement and obligations. Major points of consideration that include Conditions of Employment, OHS, child/Forced Labor, etc., have also been referred to as guidelines.

The project, in general, will discourage the recruitment of children and practices of forced labor. It will primarily follow the national legislation. Furthermore, it will arrange for awareness-raising activities added with periodic monitoring to ensure that the standards set in this procedure are followed.

The LMP, with due importance, will incorporate the issue of Occupation Health and Safety ensuring appropriate implementation of the ESS4. The issues related to the safety of project communities exposed to the project activities and others pertain to the exposure and/or increased risks of diseases by the community due to the influx of people during construction and operation. The project includes a component on response to COVID-19 given the pandemic situation.

The project interventions will also address the challenges posed by the spread of COVID-19 and will ensure adequate measures to minimize the adverse effects of COVID- 19 on project workers – primary supply chain workers and contracted workers and working system; assuring continuity in the provision of education services; develop an improved and more resilient Suburban Rail corridor network. A Grievance Redress Mechanism (GRM) for labor has been worked out so that any potential dissatisfaction, concerns, or notice can be raised by anyone employed by the contractor.

The Labour Management Plan shall be prepared by the Contractor based on the type of labour employment and will be complied in line with World Bank's ESS 2 and ESS 4 and applicable labour/worker's laws and regulations such as The Contract Labor (Regulation and Abolition) Act, 1970, The Child Labor (Prohibition and Regulation) Amendment Act, 2016, etc. The LMP will be submitted to K RIDE for approval through General Consultant. The LMP will be approved by the PIA/TSG, K RIDE in consultation with the Bank before the start of any physical works.

The PIA/TSG, K RIDE will be supported by the Sr. Environmental Specialist and Social Specialist of General Consultant to monitor the performance of contractors concerning contracted workers focusing on compliance by contractors and their contractual agreements and this LMP.

The Labour Management Procedural Guidelines are given in the following Sections:

2.1 Characteristics of Project Workers

All hiring decisions in the project will be based on the principle of non-discrimination and equal opportunity. The Characteristics or Project Workers are grouped into the two applicable categories – Direct Workers and Contracted Workers (Construction workers, other consultants/consulting agencies).

Direct Workers: The Direct Workers will be the personnel of K RIDE. These would be in the level of Project Director / Chief Engineer and team of K RIDE and civil servants, who may provide support to the Project, will remain subject to the terms and conditions of their existing sector employment agreement or arrangement. Equal opportunities would be provided to both female and male candidates to be part of the project.

Contracted Workers: This category constitutes different sub-categories of Contract Workers as hereunder:

1. PIA/TSG, K RIDE: PIA/TSG, K RIDE assist direct workers in project implementation and construction supervision. The PIA/TSG, K RIDE is expected to deploy assigned workers, constituting multidisciplinary consultants/professionals over the project implementation phase. These workers will be technically qualified with a minimum age of 18 years and maximum 65 years. Some of these workers, in exceptional cases could have a maximum age of 70 years.

2. Contracted Consultants/Primary Supply Workers: K RIDE would require different consultancy services to achieve its objectives. The requirement of consultants is divided across the other project components/sub-components. Some of the consultancy services required include (but not limited to) preparing reports/carrying out external and internal audits, employer satisfaction surveys, digitization strategy, capacity building of faculty, monitoring construction activities of Contractors at every stage of Construction, communication strategies, etc. It is estimated that around 100 workers comprise multidisciplinary consultants/professionals over the project preparation and implementation phase. These contracted consultants (workers) will be technically qualified with a minimum age of 18 years and a maximum of 60 years. In exceptional cases, some of these workers could have a maximum age of 65 or 70 years.

3. Construction Workers: The project involves construction civil works for Suburban Rail networks with 4 corridors spread across Bengaluru. The construction/renovation works will require estimated 4000 contract workers, comprising professionally qualified civil engineers, skilled work supervisors, and technicians, skilled and unskilled construction workers (labor). These will be deployed by Contractors handling civil works construction/renovation. Among these, skilled and unskilled workers constitute nearly 60 percent, whereas experienced/skilled work supervisors and technicians constitute 35 percent, and the site supervisors would include about 5 percent. The skilled and unskilled construction workers will be from the same state or other neighboring states among the contract workers. However, deployment of personnel (unskilled) from the same state meeting the work requirements would be preferred. As a standard operating practice, the skilled and unskilled

workers will usually be sourced through registered labor contractors. The age of the technically qualified and or skilled contract workers can range between a minimum of 18 years and a maximum of 60 years, whereas the age of unskilled workers can range between 18 to 50 years, and in no case can it be expected to exceed 60 years. It is possible that some of the managerial or supervisory level contract workers deployed by contractors, in exceptional circumstances, could have a maximum age of 65 years. About 7-10 percent of the contract workers are expected to be women. There will be no child or forced labor assigned for the project. The LMF identifies the types of workers, i.e., direct, contracted, sub-contracted and primary supply workers to be engaged in the project. Further, it cites critical environmental and social risks related to the project. Some of the identified risks for the project are unscrupulous labor practices, Occupational Health and Safety, community risks, waste generation, risk of Gender-based Violence, exploitation of a child and forced labor, etc.

2.2 Timing of Labor Requirements

The timing and sequencing of Contracted Worker requirements in terms of numbers, locations, jobs, and skills will be decided with the design and approval of the construction work plan. The contracted Workers will be recruited as soon as the approval of the project, especially those forming part of PIA/TSG, K RIDE. Since the construction will primarily take place in the urban areas, it is expected that local labor will be available abundantly, and hence no or minimal migrant contracted workers are expected to be assigned.

2.3 Information on Contracted Workers

K RIDE will maintain information on engagement of contracted workers of all categories. The contractors will be contractually obligated to maintain updated information on all categories of contracted workers and periodically share the same with the PIA/TSG, K RIDE, which will in turn report to KfW. The information on all contract workers will be submitted in a prescribed format to be finalized during the engagement of contractors. The information database on contracted workers to be maintained by the contractor will include not limited to the following:

- Name and Age (to be supported by AADHAR /Voter Card)
- Parent's Names and Permanent Address
- Marital Status and Name of the Spouse (if married)
- Number of Children with Gender (as applicable)

• Place of Stay of Spouse and Children during work engagement under K RIDE

• Emergency contact number and address

• Key Skills and Years of Experience

• Work activities, Schedule, Duration of Engagement

• Duration of Contract and Rotation Arrangements

• Facilities Arranged by Contractor including health check-ups prior to engagement, accommodation (onsite workforce camps, with local community, transportation to work site and other facilities (to be specified by Contractor)

• Pre-Employment Check-ups, Fitness Tests and Health Awareness Campaign for workers

The contractor will be obligated to consider the following from COVID-19 considerations (provided that the dangers of COVID-19 are still prevalent, and the probability of the infection not being wholly gone by the start of civil works).

• Sensitization of all contracted workers about COVID-19, and precautions to be taken like social distance of a minimum of 1.5 meters during all work situations, use of face masks or cotton cloth, use of sanitizers and frequent washing of hands, avoid spitting in public, maintain hygiene, reporting of flu-like illness symptoms, avoid the use of chewing gum, tobacco in all forms, and creation of isolation/quarantine rooms, for any workers showing COVID signs, until shifted to COVID care centers or hospitals; Minimize movement in and out of site (consider extending the term of existing contracts to avoid workers returning home to affected areas or returning to the site from affected areas)

• Minimize contact with people near the site (including, in some instances, prohibit from leaving the site for the duration of their contract so that contact with local communities is avoided to the extent possible.

• Move workers to site accommodation (subject to availability) where they would be subject to the same restrictions.

• Minimize the contact with teachers and students: The construction work needs to be structured so that the labor is not in proximity of the teachers or students. This can be done by structuring the timing or the location of work. Further, proper care should be taken that the construction site is hygienic.

2.4. Assessment of Key Potential Labor Risks

Construction workers will be engaged in the extension of classrooms, workshops, and laboratories. They may also be required for incubation center facilitation. During operation and maintenance, services will also be sought especially from teaching staff (for supervision), technicians, and ground workers. Therefore, having the project being implemented on campuses, not only project workers may be exposed to risks but also students (though they will not be involved in providing labor). The safety and health risks to which the workers, students, and institute staff may be exposed from any project-related activities will be assessed. The ability to prevent or eliminate such risks or, if the risk cannot be controlled or eliminated, measures to protect workers, students, and institute staff from exposure will be explored. Though, given the small-scale construction works, no major risks are envisaged.

2.4.1 Key Labour Risks

Potential risks that may arise from the nature of activities to be undertaken include:

1) Employment practice that are not compliant with either labor law or ESS 2. For example, not providing written documents of assignments, wages not proportionate with tasks performed or industry standards, excess workload without provision of adequate rests and leisure, lack of hygiene facilities, discrimination towards women and labor with disability, unlawful termination and withholding of benefit, etc.

2) Lack of Occupational Health and Safety (OHS) practice and procedures during construction and operation resulting in unsafe work environment.

3) Short and long-term effects on health due to over exposure to dust, noise levels, and exposure to chemicals /hazardous wastes.

4) Absence or inadequate or non-responsive emergency response mechanism for rescue of workforce, during natural calamities like cloud bursts, landslides, disasters due to earthquake/floods/fire outbreak, etc. at operational sites.

5) Lack of adequate sanitation and health facilities at the work sites. Further, consideration is that the workers should not be using the sanitation facilities provided to the teachers and students in the school as it would increase the risk of transmission of covid-19 and other infectious disease.

6) Community health and safety issues, especially alteration of power dynamics, shifting the economic power balance, rise of communicable diseases, including Malaria and Cholera to the workforce, students, and staff.

7) The conduct of hazardous work, such as working at heights or in confined spaces, use of heavy machinery, or use of hazardous materials.

8) Generation of solid, liquid and fecal wastes, especially around labor camps and toilet area.

9) Rise of incidence of Gender-Based Violence GBV (Sexual Harassment, Sexual Exploitation, and Abuse, Rape and Discrimination) emanating from the labors.

10) Increased competition over resources due to influx of labor; labor conflicts and work conditions.

11) Other project related risk may include of child and forced labor and use of unscrupulous labor practice, and denial for workers' rights to form workers organizations, etc. (particularly for unskilled construction workers/labor), etc.

2.5 Legal and Regulatory Framework

Over the last decade or so, the Government of India has enacted several laws and policies relating to working conditions, promoting safety and health at work, fair treatment and non-discrimination, preventing forced labor and child labor, and protecting vulnerable workers. Key among these are:

1. Child Labor (Prohibition and Regulation) Amendment Rules, 2017 MINISTRY OF LAW AND JUSTICE (Legislative Department): This Act prohibits employment of children below 14 years of age in certain occupations and provides for the regulation of employment of children in all other occupations and processes. Employment of child labor is prohibited in Building and construction industry.

2. New Labor Codes

a) CODE ON WAGES, 2019: The Code on Wages, 2019 amalgamates and simplifies the provisions of four Central Labor Laws, namely:

- The Payment of Wages Act, 1936
- The Minimum Wages Act, 1948
- The Payment of Bonus Act, 1965

▪ The Equal Remuneration Act, 1976 Under the new Wages Code, allowances are capped at 50 percent. This means half of the gross pay of an employee would be basic wages.

b) INDUSTRIAL RELATION CODE, 2020: The Industrial Relations Code amalgamates and repeals three Labor Laws, namely: ▪ The Trade Unions Act, 1926 ▪ The Industrial Employment (Standing Order), 1946 ▪ The Industrial Disputes Act, 1947 : There will be no permanent workers and no Trade Union will be established. Hence, this rule may not be applicable to this K RIDE's BSRP.

c) OCCUPATIONAL SAFETY, HEALTH AND WORKING CONDITIONS CODE, 2020: This is a comprehensive code on Occupational Safety, Health, and Working Conditions, and amalgamates thirteen existing labor laws/acts relating to Safety and Health Standards, Health and Working Conditions into a single Code, namely:

▪ The Factories Act, 1948 ▪ The Contract Labor (Regulation and Abolition) Act, 1970

▪ The Mines Act, 1952

▪ The Dock Workers (Safety, Health, and Welfare) Act, 1986

▪ The Building & Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996

▪ The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979

▪ The Motor Transport Workers Act, 1961

d) CODE ON SOCIAL SECURITY, 2020: Code on Social Security (CoSS), 2020 also amalgamates and simplifies the provisions of nine Labor Laws with respect to social security, namely:

▪ The Employee's Compensation Act, 1923

▪ The Employees' State Insurance Act, 1948

▪ The Employees' Provident Funds and Miscellaneous Provisions Act, 1952

▪ The Employment Exchanges (Compulsory Notification of Vacancies) Act, 1959 ▪ The Maternity Benefit Act, 1961

▪ The Payment of Gratuity Act, 1972

▪ The Cine-Workers Welfare Fund Act, 1981

▪ The Building and Other Construction Workers' Welfare Cess Act, 1996

▪ The Unorganized Workers' Social Security Act, 2008.

3. The Trafficking in Persons (Prevention, Care and Rehabilitation) Act, 2021.

4. Sexual Harassment at the Workplace (Prevention, Prohibition and Redressal) Act, 2013 and amendments: The act provides for protection against sexual harassment of women in the workplace and for the prevention and redressal of complaints of sexual harassment and for matters connected therewith or incidental thereto.

5. Inter-state Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979: The inter-state migrant workers, in an establishment to which the Act becomes applicable, are required to be provided with certain facilities such as housing, medical aid, traveling expenses from home to the establishment and back, etc.

6. The Bonded Labor (Abolition) Act 1976: An Act to provide for the abolition of bonded labor system, with a view to prevent economic and physical exploitation of the weaker sections of the people and for all matters connected therewith or incidental thereto.

The World Bank's stipulations related to labor are outlined in its ESS2 (Labor and Working Conditions). The implementing agency promotes sound worker-management relationships and provides safe and healthy working conditions. The key objectives of the ESS2 are to:

• Promote safety and health at work;

• Promote the fair treatment, nondiscrimination, and equal opportunity of project workers;

• Secure protection of project workers, including vulnerable workers such as women, persons with disabilities, children (of working age, in accordance with this ESS) and migrant workers, contracted workers, community workers, and primary supply workers, as appropriate;

• Prevent the use of all forms of forced labor and child labor;

• Support the principles of freedom of association and collective bargaining of project workers in a manner consistent with national law; and

• Provide project workers with accessible means to raise workplace concerns.

ESS2 applies to project workers including full-time, part-time, temporary, seasonal, and migrant workers. Where government civil servants are working in connection with the project, whether fulltime or part-time, they will remain subject to the terms and conditions of their existing public sector employment agreement or arrangement, unless there has been an effective legal transfer of their employment or engagement to the project. ESS2 will not apply to government civil servants.

2.6 Working conditions and management of worker relationships:

The Implementing Agency will develop and implement internal labor management procedures applicable to the project. These procedures will set out the way in which project workers will be managed, in accordance with the requirements of national law and ESS. The procedures will address the way in which this ESS will apply to different categories of project workers including direct workers, and contract workers.

Project workers will be provided with information and documentation that is clear and understandable regarding their terms and conditions of employment. The information and documentation will set out their rights under national labor law and ESS requirements (which will include collective agreements), including their rights related to hours of work, wages, overtime, compensation, and benefits. This information will be provided at the beginning of the working relationship and when material changes occur.

2.7 Management of Workers/Labor in Work Contracts

2.7.1 Contractor's Selection Process

Selection of a Contractor for civil works or consultancy firms for studies, etc., will be undertaken through an open competitive online bidding process (e-procurement) having a two-stage (technical and financial) evaluation process. The national bids will be evaluated by a Bid Evaluation committee set up by KRIDE through the pre-set evaluation criteria; the K RIDE will set up bid-evaluation processes per the prevailing norms. Only the technically qualified bids will be considered for opening the financial offers. All the technical proposals will be evaluated for their past similar experience, financial standing, OHS performance in past projects, technical qualifications and experience criteria for Key persons, and available inventory of equipment and machinery, among others.

The final selection for civil contractors will be based on the lowest financial bid (post-qualification of the technical proposal). In case of other consulting engagements, appropriate weights would be provided for both technical and financial offers; typically, it would be 80 percent weightage for the

technical bid and 20 percent weightage for the financial proposal, and the final selection would be based on the summation of the technical and the financial scores.

2.7.2 Contractual Provisions for Labor Management and OHS

The environmental and social risks and impacts, including labor management and OHS issues identified in the KRIDE's BSR project, will be managed through the implementation of ESMP through the contractors and consulting organizations. The labor-management and OHS of workers and related issues arising during construction works will be under the direct control of contractors and will be managed by contractors. The construction contracts will include provisions related to labor and OHS as provided in the WB Standard Procurement Documents and the GoI and State laws and regulations. Contractual requirements for civil works will require that the contractors undertake the following actions:

Actions on Occupational Health and Safety:

• Comply with all central and state laws and regulations on the OHS of workers.

• Comply with the requirements of ESS2 on Labor and Working Conditions and WB Group's General EHS Guidelines.

• Provide workers with a safe working environment, including

(a) facilities such as drinking water, sanitation, first-aid kit, etc.

(b) modification, substitution, or elimination of hazardous conditions or materials from the work environment.

• Provide workers with all required PPE (Personal Protection Equipment) and safety gear.

• Make emergency prevention, preparedness, and response arrangements to emergencies.

• Institute remedies for adverse impacts such as occupational injuries, deaths, disability, and disease.
• Conduct, keep records and report monthly OHS training for workers.

• Monitor, keep records and report OHS incidents and accidents at the sub-project site.

ALL BID DOCUMENTS WILL INCORPORATE the ESHS requirements as special conditions and performance requirements for BSRP.

The ESHS performance requirements incorporated in the bid documents obligate the contractor, upon mobilization, to prepare a Contractor's ESMP (C-ESMP) that will include E&OHS plan along with Environmental Management Plan (EMP), labor management plan, labor Influx management plan, workers' campsite management plan, GRM for workers', COVID-19 considerations and among others in accordance with the GoI, & WB requirements. The C-ESMP will be reviewed and approved by the K RIDE, prior to commencement of construction works. The approved C-ESMP will be reviewed periodically and updated promptly to address changed requirements during project implementation.

2.7.3 Worker's Age of Employment

Direct Workers

The Direct workers will be technically qualified, with ages ranging between a minimum of 18 years and a maximum of 60 years. The direct workers will be K RIDE employees, whose credentials would have been duly verified by GoI at recruitment. Employees age is decide by the concerned authority.

Contract Workers:

The National Law permits engaging a technically qualified and or skilled contract worker between the age of 18 to a maximum of 60 years, whereas the age of unskilled workers can range between 18 to 50 years, and in no case can it be expected to exceed 60 years. It is possible that some of the personnel (especially consultants) deployed by PIU, in exceptional cases, could have a maximum age of 65 years.

K RIDE could verify the age of the personnel deployed by PIA/TSG through valid documents like an AADHAR Card /Voter Card/Passport/Valid Driving License. It is possible that some of the managerial or supervisory level contract workers deployed by the Contractor, in exceptional cases, could have a maximum age of 65 years. PIA/TSG, through the participating General Consultant, could verify the age of the skilled and unskilled personnel deployed by the Contractor through valid documents like an AADHAR Card/Voter Card/Passport/Valid Driving License. In exceptional cases, where the unskilled worker(s) cannot produce valid age proof documents for whatsoever reason, the age could be ascertained via medical examination by the competent medical authority at the Government hospital at the expense of the Contractor. Under no circumstance will children under 14 years of age be engaged in any prohibited work as per GoI and State Government norms. The same is as per the Child Labor Prohibition Act, 1986, and Child Labor (Prohibition and Regulation) Amendment Rules 2017. Suppose the institution/PIU/TSG/DHE officials detect it. In that case, the Contractor will be

immediately issued a show-cause notice for termination of the contract, and the matter will be duly reported to WB with immediate effect.

2.7.4 Payment of Wages

Specific wages of Direct Workers

The Direct workers engaged for the project are Government Officers whose salary and other emoluments will conform to the Rules and Regulations issued by the Department of Personnel and Training (DoPT), GoI.

Specific wages of Contracted Workers and Community Workers

The wages of consultants/personnel deployed through DHE/PIU/TSG or other consultancy firms for various studies are contracted services and determined through two-stage competitive bidding (technical and financial) procedures and prevailing market rates. The wages of technically qualified, skilled, unskilled workers to be engaged by the Contractor are determined by the Department of Labor and Employment, subject to the Minimum Wages Act, 1948. There will not be any discrimination in wages paid to male and female workers, and the same wages will be paid for equivalent work to all workers in conformity with the Provisions of Equal Remuneration Act, 1976.

2.7.5 Work Hours

The Direct workers at the DHE will work as per State Government Rules, which will follow the relevant notification by the Department of Personnel and Training, GoI. The work hours for contracted workers will not be more than 48 hours per week and 9 hours per day. Any contract or community workers made to work over the same will be entitled to overtime pay per building and other construction workers act, 1996.

2.7.6 Other Specific Terms and Conditions

• No contracted worker will be required or allowed to work continuously for more than five hours unless he/she had an interval of rest of not less than half an hour.

• The working day of the contracted workers will be so arranged that inclusive of the intervals of rest, it will not be more than twelve hours on any day

• Every worker will be allowed one day off as a rest day, ordinarily Sunday.

• No worker will be made to work on any day, which Central or State Government has notified in the Official Gazette as a Gazetted holiday, or any day declared as a National Holiday.

• All contract workers, particularly unskilled workers, can be directly engaged by the Contractor or sourced through labor contractors. In such cases, the labor contractor shall have valid registration with the competent authority in the participating state.

• All wages to contracted workers, especially for unskilled workers, are to be paid directly by the Contractor, even if the unskilled workers are engaged through labor contractors or any subcontractors.

Any denial and/or untimely payment of wages to workers will render the Contractor liable to action before the relevant Labor court/Industrial Tribunals under the Legislations.

• Conditions of employment for skilled and unskilled workers will conform to Building, and other construction workers act 1996.

• Under no circumstances child labor or forced labor (in any form) shall be engaged, as these are prohibited under National and State Government Norms.

• Contractor will also be liable to be prosecuted in his personal capacity under the Indian Penal Code 1860 and other Penal legislations before criminal courts in case of gross negligence and dereliction of duty or contraventions of any such statute resulting in death or injury of the workers.

• Regarding COVID-19, the safety protocols of the project would be guided by the Guidelines and SOPs as provided by the Central and State governments or the WB. The guidelines regarding staff attendance, arrival, departure of employees, lunch breaks, downloading and installation of the Aarogya Setu app, etc., would be strictly followed. Similar guidelines issued by Central Public Works Department would apply to workers at construction sites in terms of protocols to be observed at the site, including quarantine for 14 days for workers from outside. The Contractor will strictly adhere to these COVID-19 SOPs and Guidelines of State and Central governments, including WB (where applicable) at all construction sites, which will also be a part of the Contractor's labor management plan.

2.7.7 Monitoring of Performance of Contractors

The PIA/TSG supported by the General Consultant will monitor the performance of contractors concerning contracted workers focusing on compliance by contractors and their contractual agreements and this LMP. This will include the following:

• Review of Contractor's monthly reports

• Review of Contractor's incident/accident reports

• Periodic monitoring visits to sub-project sites involving spot checks and interaction with workers

• Inspection of on-site records maintained by Contractor

The performance requirements by the Contractor will be overseen and managed by the institution under the overall guidance and direction of the Chief Project Director (CPD). In the context of COVID, additionally, the Contractor will be required to include:

• Provision of medical insurance covering treatment for COVID-19, sick pay for workers who either contract the virus or are required to self-isolate due to close contact with infected workers, and compensation payment in the event of death

• Designating/appointing a COVID-19 focal point officer responsible for monitoring and reporting COVID-19 issues and liaising with competent authorities designated by district administration or the State Government.

Non-compliance by the Contractor will result in remedial actions as per the provisions of the contractual agreement.

2.7.8 Implementation Arrangement

PIA/TSG is a Central Sector Scheme; overall responsibility will lie with the K RIDE and MoR (Department/Ministry of Railways). The MoE will constitute a National Steering Committee (NSC) assisted by the National Project Directorate headed by the National Project Director (Additional Secretary in charge of higher/technical education). The MoE will delegate day-to-day implementation to a sufficiently staffed Project Implementation Unit (PIU)/ Technical Support Group (TSG), which will undertake all implementation-related activities following the Project Implementation Plan (PIP), prepared by the MoE and agreed with the World Bank.

2.7.8.1 Engagement and Management of Project Workers

Direct Workers

All Direct Workers engaged under MERITE at the DHE will be managed and overseen by the NPD. Other than the DHE staff, MERITE will have PIU/TSG staff project implementation at the center and SPIU in the participating states.

Contracted Workers

All the Contracted Workers will be engaged by the National Project Director. In the case of civil works, these workers would be managed by a Project-in-charge, representing the contractor. The Project-in-charge will also address the contracted workers of subcontractors (If any). In the case of consultancy services for conducting various testing, assessments or monitoring or reporting activities, the different consultancy teams would be managed by their respective Team leaders of the consultancy firm under the directions of the K RIDE and the Central Project Advisor (CPA) or Chief Project Director (CPD) or the other authorized official, whosoever concerned. .

2.7.8.2 Training of Workers

The OHS Plan will be submitted by the contractor to the General Consultant (GC) for review and approved by GC in consultation with the PIA/TSG before construction activities. The OHS Plan will be part of the C-ESMP and will have procedures and protocols for the training of workers at various stages as hereunder.

• Induction training of new workers on OHS

• Briefings by work supervisors daily, sensitization of workers about safety procedures at work for the day

• Briefing on safety at work procedures prior to commencement of any new activity/tasks

• Periodic review and refresh of site protocols on safety procedures at work

• Response and reporting in case of injuries and/or incidents related to safety at work • Periodic health check-ups and encourage to report occupational health issues

• Create Awareness and report unsafe incidents at work, injuries including minor ones

• Awareness and mock drills about emergency response plan at worksite and reporting protocols

• Awareness and Briefing on the Grievance Redressal Mechanism,

• Mandatory adoption of Covid-19 protocols as directed by Central and State governments and WB.

The contractors will be encouraged to deploy ESHS officers and work supervisors who have undergone professional training or certified courses in OHS at workplaces from accredited institutions. Specifically, in the context of COVID, DHE will require the Contractor's ESMP to cover aspects relating to the following:

• Details of key responsibilities and reporting arrangements vis-à-vis the project's Supervising Engineer and the main contractor

• Coordination and reporting arrangements between contractor and supervisor • Raising awareness and training of workers in mitigating the spread of COVID-19

• Assessment, quarantining, and treatment of patients and/or workers infected with COVID-19.

2.7.8.3 Grievance Mechanism (Centralized Grievance Redress and Monitoring System - CGRMS)

Centralized Grievance Redress and Monitoring System (CGRMS) is the platform established to resolve grievances of project workers, community workers and public workers regarding any issues raised during project implementation. The following steps will be taken by K RIDE :

• Information relating to the CGRMS functioning, including channels, tiers, timings, the procedure for registering complaints, handling of complaints, maximum time limits for redressal of complaints, escalation level for unresolved cases, and resolution thereof, will be disseminated to the workers upon joining.

Regular training/sensitization will be conducted. Likewise, Consulting agencies that K RIDE will contract for various activities/studies/works, etc., will ensure that they have established/functioning GRMs to address respective workers' concerns PIA/TSG.

• **Direct Workers:** The Project Director/ Head of TSG/PIA, K RIDE, will be responsible for providing guidance and advice on all worker-related grievances and their redressal, in line with the Central Government Rules and Regulations and CGRMS.

• **Contract Workers:** The contractor of the respective construction sites will be obligated to set up a GRM significantly to redress complaints relating to workers deployed for construction works under K RIDE. The GRM will have due representation of Project Management/ Construction Supervision or General Consultant, Contractor, Workers, and women (either from K RIDE/ Consultant/contractor/workers). The mandate for GRM, Institutional arrangements, the procedure

for receiving complaints, time limits for redressal of complaints, escalation level for unresolved cases, and resolution thereof will be finalized during the approval of C-ESMP by PIA/TSG. SPIAs (Social Cell) will have oversight of this labor GRM.

The GRM for the Workers will be set up during the mobilization phase of the contractor. The contractor will also be responsible for tracking and resolving workers' grievances and maintaining records about grievances/complaints received, minutes of discussions, recommendations and resolutions made thereof, and intimation of grievance resolution to the complainant.

• In the COVID context, the nature of complaints will be particularly time-sensitive and sensitive in terms of confidentiality. Hence, the Contractor should consider streamlined procedures to address specific worker grievances, allowing workers to quickly report labor issues, such as a lack of PPE, lack of proper procedures, or excessive overtime, and let the workers say freely, respond, take necessary action.

2.7.8.4 Other portals for filing grievances

2.7.8.4.1 CPGRAMS Centralized Public Grievance Redress and Monitoring System (CPGRAMS) is an online platform available to the citizens 24x7 to lodge their grievances to the public authorities on any subject related to service delivery. The status of the grievance filed in CPGRAMS can be tracked with the unique registration ID provided at the time of registration of the complainant.

CPGRAMS also provides appeal facility to the citizens if they are not satisfied with the resolution by the Grievance Officer. After the closure of the grievance if the complainant is not satisfied with the resolution, he/she can provide feedback. If the rating is 'Poor,' the option to file an appeal is enabled. The status of the Appeal can also be tracked by the petitioner with the grievance registration number.

Issues that are not taken up for redress by this system:

▪ Subjudice cases or any matter concerning judgment given by any court.

▪ Personal and family disputes.

▪ RTI matters.

▪ Anything that impacts upon territorial integrity of the country or friendly relations with other countries.

▪ Suggestions.

Occupational Health and Safety Guidelines shall be followed by the Contractor while preparing Labour Management Plan in accordance with applicable Indian and State Laws, IFC's EHS Guidelines for Railways and WB ESS 2 and 4.

Annexure 10.44. Tree Management Plan

TREE MANAGEMENT PLAN (TMP)

(TREE REMOVAL/FELLING AND TRANSLOCATION)

1. INTRODUCTION

K-RIDE is a Joint venture of Government of Karnataka and the Ministry of Railways. It has been created to boost "Rail Infrastructure Projects" in the state of Karnataka on the principle of cooperative federalism. Currently, the joint venture has been mandated with the critical responsibility of executing the flagship Bengaluru Suburban Rail Project (BSRP) and two large doubling projects. BSRP is an enhancer for comfort commutation for Bengaluru citizens to commute distant places of destination. Additionally, BSRP is an environment friendly project which significantly accomplishes to the reduction of CO_2 - Greenhouse Gas emissions. Mass Rapid Transport System (MRTS) is an elevated / at grade suburban railway system which facilitates large commuters to travel any part of the city within short duration. The large capacities of such systems make them potentially more efficient in terms of cost and comfort journey than any other automobile transportation. In addition, it helps to decongest the crowded road corridors and offers a more environment friendly, sustainable mass transportation alternatives.

During the planning stages of the project, suburban railway alignment is proposed along the existing Indian railway alignment in order to avoid the additional land acquisition and provide better connectivity considering other modes of public transport system (metro, BMTC, etc.,). Project corridors fall within the limits of Bengaluru urban district which mainly traverse busy major business districts of Bengaluru city.

Bengaluru is an important and a major junction on the South-Western railway network. There are three major railway stations in Bengaluru - City Railway Station, Cantonment Railway Station and Yeshwantpur Railway Station. Bengaluru is served by 5 radial rail corridors.

- B.G. line from Chennai on east
- B.G. line from Mumbai-Pune on north-west
- B.G. line from Guntakal on the north
- B.G. line from Salem / Thiruvananthapuram from east
- B.G. line from Mysuru from south-west

BSRP corridors passes through majority of these corridors and also intersect multiple major railway stations mentioned above. BSRP corridors details with its proposed length are presented below;

Corridor – 1: KSR Bengaluru City to Devanahalli (41.222Km),

Corridor – 2: Baiyyappanahalli Terminal to Chikkabanavara (26.507Km),

Corridor – 3: Kengeri to Whitefield (via KSR and Cantonment) (35.52Km) &

Corridor – 4: Heelalige to Rajanukunte (46.00Km).

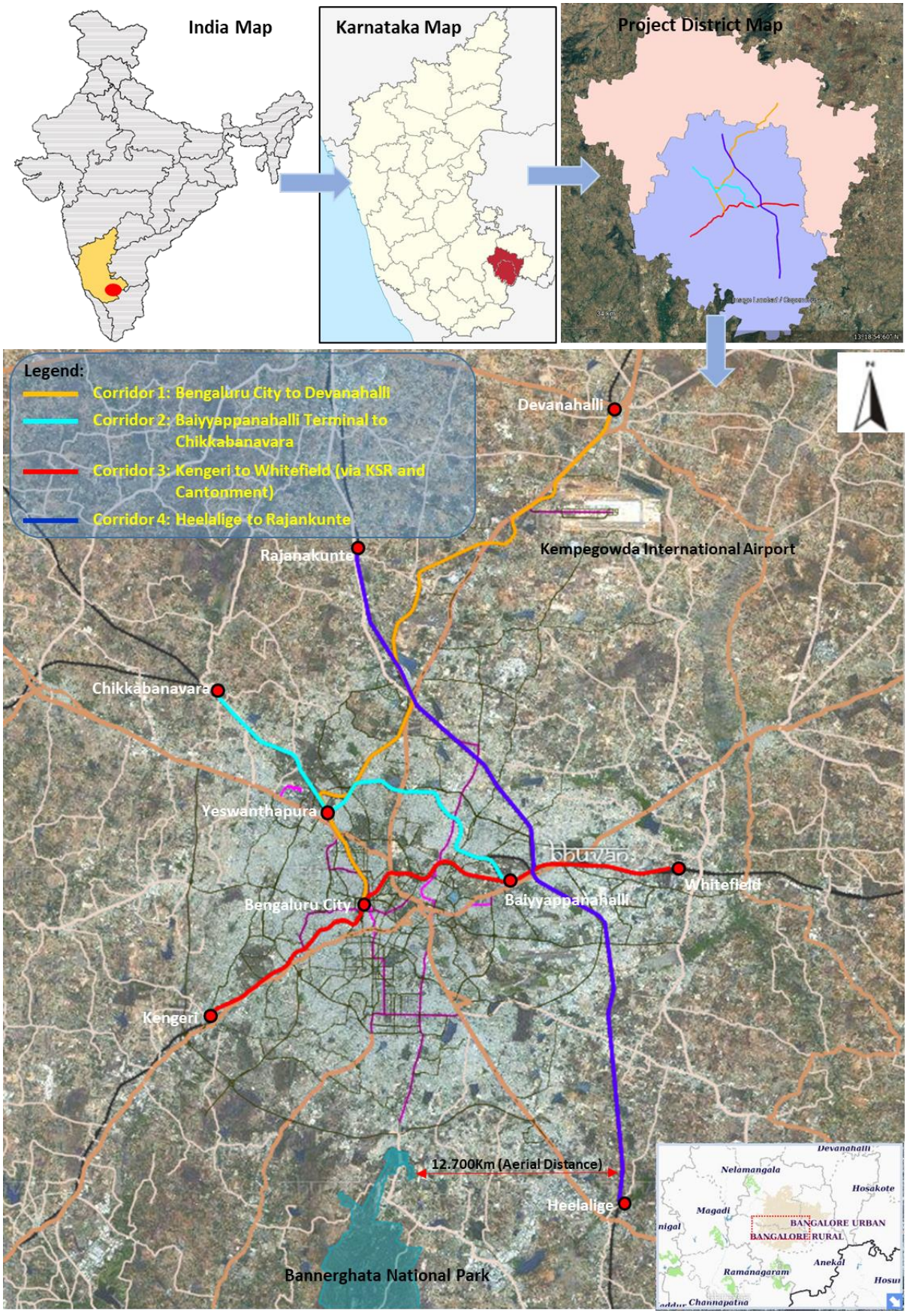


Figure 1: Maps of BSRP Corridors

Implementation of Mass Transport projects like Suburban Rail in the Urban area requires removal of some trees on along the existing Indian Railway tracks. However, in the places where the Suburban Stations are required to be located, as well as the ramps, where elevated alignment joins the at grade alignment, the trees have to be removed for the construction of stations. Table 1 shows the component wise details of the trees to be affected by the proposed Suburban Rail project.

Table-1: Tentative list of Trees Affected along the Alignment

Sl. No.	Alignment/Depot		Total No. of Trees
1.	Corridor 1 (KSR Bengaluru City - Devanahalli)		7198
2.	Corridor 2 (Baiyyappanahalli Terminal – Chikkabanavara)		3469
3.	Corridor 3 (Kengeri – B'lore Cantonment – Whitefield via SBC)		2072
4.	Corridor 4 (Heelalige – Rajanukunte)		2306
Sub-Total along the Alignment & Stations (A)			**15,045**
5.	Akkupete Depot	Forest land	17323
		Non – forest land	182
	Sub total		17505
6.	Soladevanahalli Depot		22
Sub-Total at Depots (B)			**17527**
Total Trees (A+B)			**32,572**

2. GOAL AND OBJECTIVES OF TREE MANAGEMENT PROGRAM

A comprehensive and proactive Tree Management Program should reflect and balance forest and ecosystem health, ecosystem services, aesthetics, social values, and risk management. The Tree Management Program will focus on the following areas:

- ✓ Tree Classification
- ✓ Maintenance & Monitoring
- ✓ Removals
- ✓ Renewal
- ✓ Protection & Conservation
- ✓ Communication

Adequate funding of a Tree Management Program is crucial to ensure that all aspects of this program are in place.

3. APPLICABLE REGULATORY FRAMEWORK:

Environment (Protection) Act (1986) & Rules (1986) empowers the Central Government to establish authorities [under section 3(3)] charged with the mandate of preventing environmental pollution in all

its forms and to tackle specific environmental problems that are peculiar to different parts of the country. EPA is enacted to provide for the protection and improvement of environment and for matters connected therewith. Whereas the decisions were taken at the United Nations Conference on the Human Environment held at Stockholm in June, 1972, in which India participated, to take appropriate steps for the protection and improvement of human environment; and whereas it is considered necessary further to implement the decisions aforesaid in so far as they relate to the protection and improvement of environment and the prevention of hazards to human beings, other living creatures, plants and property.

3.1 Karnataka Preservation of Tree Act, 1976.

Government of Karnataka (GoK) framed Karnataka Preservation of Tree Act, 1976, with the intention to mitigate the felling of large number of trees due to urbanisation, industrialisation and increase population and preserve trees by regulating felling of trees and plant adequate number of trees to restore ecological balance. Karnataka Preservation of Tree Act, 1976 is an act to make better provision for preservation of trees in the Karnataka state. As per the act, *"Tree Officer means a Forest Officer appointed as such by the Head of the Karnataka forest Department for the purposes of the act"*and its Tree Officer duty to inspect the trees and grant permission accordingly.

Karnataka Preservation of Tree Act, 1976 and Rules, 1977 is an Act to make better provision for preservation of trees in the State. Whereas with the growing pace of urbanisation, industrialisation and increasing population, there has been indiscriminate felling of a large number of trees in the rural and urban areas of the State of Karnataka leading to erratic rainfall, recurring famines and floods, soil erosion and consequent ecological disturbances; whereas iIt is expedient to provide for the preservation of trees in the State by regulating the felling of trees and for the planting of adequate number of trees to restore ecological balance and for matters connected therewith enacting mandates.

3.2 Tree Expert Committee (TEC)

Tree committee was formed on direction of the High Court. As per the orders of Hon'ble High Court of Karnataka dated:23.04.2019, Tree Expert Committee (TEC) is set up by Forest, Ecology and Environment, Department of Government of Karnataka to deal with the removal of trees infringing the infrastructure project works. The Terms of Reference for the working of TEC as expressed in the Government Order no. FEE-41, FAF 2019 dated 01/08/2019 states; "The Expert Committee shall examine whether trees proposed to be felled could be saved by adopting any alternative method. After

exhausting all methods, if it is found that it is impossible to save any tree, only then it shall be permissible to cut the trees".

Further, The Hon'ble High Court of Karnataka vide directions dated 4th November, 2020 in WP 17481/2018 ordered TEC to revise the Working procedure to make it further clear and bring transparency while dealing with applications under KPT Act, 1976. Accordingly, TEC has formulated Memorandum of Procedure (MoP) for consideration of applications.

4. PROCEDURE FOR REMOVAL OF TREES TO BE FOLLOWED AS PER TEC:

Applications are submitted to the Member Secretary of the TEC for removal of the trees, which are falling within the alignment of the Suburban Rail with copies marked to concerned Tree Officer, who is a Deputy Conservator of Forest-BBMP / Urban. Along with the application alignment drawing of the Suburban line indicating trees required to be removed is also submitted.

On receipt of the application, physical inspection is conducted by the concerned Tree Officer at the location where the trees exist and carryout enumeration and further submits the note to TEC.

Thereafter, TEC examines the application and physically inspects each tree vis-à-vis the alignment along with the briefing by Environment Officer, KRIDE regarding the project and note the type of the tree, the health of the tree; etc. to prepare their inspection report. Firstly, the TEC examines in detail as to whether the trees can be retained in the very place vis-à-vis the alignment of the Suburban line, station and Depots. If that is not feasible, TEC examines as to whether the tree is sufficiently healthy for translocation. Only if the above two are not possible, then as a last resort, the TEC concedes to felling of the tree. After the physical inspection as aforementioned, a meeting is held for finalizing the Field Inspection Report with tree species characteristics and justification for felling / translocation of trees and then, based on the physical inspection and inspection note, proceedings are recorded, indicating the trees in the category for felling, translocation or retention.

Subsequent to the proceedings of the TEC and based on directions of the TEC, Tree Officer issues order regarding retention of the trees, translocation of the trees or felling of the trees, which will be displayed in BBMP website 'https://bbmp.gov.in/departmentwebsites/Forest%20Department/downloads.html' for 15 days and public suggestions and objections shall be obtained. Public suggestions and objections will be received through mail of the officer concerned. The objections received shall be given appropriate responses and then execution of translocation of the trees or felling of trees shall be

undertaken by KRIDE through eligible contractor, by signing separate contract, who is specialized with respect to Tree Translocation.

5. Present status of Tree Felling/Translocation of BSRP

1. Corridor – 2:
    a. Submitted to DCF/BBMP for the permission of 2855 trees, out of which,
        1) Phase 1a: TEC inspected 661 trees and permitted to transplant 58 trees, fell 268 trees & to retain 315 trees;
        2) Phase 1b: TEC inspected 1430 trees and the reports are expected end of March 23;
        3) Phase 2: TEC inspection is scheduled from 1st week of April'23;

2. Corridor – 4:
    a. BBMP:
        1) Proposal of 3384 trees to transplant/fell was submitted to DCF/ BBMP.
        2) Expected month of inspection is Sep'23;
    b. Urban
        1) Proposal of 1071 trees to transplant/fell was submitted to DCF/ Urban which includes Anekal range (876 trees) and Yelahanka range (175 trees).
        2) Expected month of inspection is June'23;

3. Corridor – 1 & Corridor – 3:
    a. Finalization of Alignment and its approval are awaited to proceed for permission of tree felling/ translocation
    b. However, the enumeration of tree was completed

Status of Tree Felling and Translocation for Corridor 2

Subsequently, Environmental & Social Management Unit (ESMU)-KRIDE tries to locate suitable nearby land for translocation of the trees, by testing the soil and consulting in Indian Railway authority in Yeshwanthapur Railway Station. About 58 trees are recommended to translocated by TEC as of now for Corridor 2. Maps of sites identified for translocation of trees is presented as **Appendix 1**. Soil test results of translocation of site is presented as **Appendix 2.**

Sites identified for Translocation of Trees for Corridor 2;

- Yeshwantpur Railway Colony Water Circulating Plant for Translocation for Trees (Site No.3),
- Yeshwantpur Railway Station near Play Ground Closer to Boundary Wall (Site No.7),
- Yeshwantpur Railway Station opposite Play Ground near Fenced Area (Site No.90),
- Yeshwantpur Railway Station near Railway Quarters near Kendriya Vidyalaya (Site No.8),

Submission of application for remaining BSRP corridors is yet to be initiated. Hence, compensatory plantation/ translocation land for remaining corridors will be selected either owned by the Government, BBMP, BDA or Central Government Agencies. Only such lands which have sufficient tree growth and sufficient space for further planting of trees are identified for translocation. Thereafter, the ESMU, KRIDE Environment officials contact the Government Organizations who own the land where the trees have to be translocated and seek their permission to translocate the trees.

Respective Organizations such as Police Department, individual Land owner etc. shall be intimated regarding the Tree Clearance; and then Tree translocation / felling shall be carried out with very minimal hazard to the public. Once the trees are felled, the logs will be handed over to BBMP / Forest Division accordingly as per the instruction, for further process.

6. TRANSLOCATION AND MAINTENANCE OF TREES

Location for translocation of trees shall be identified jointly by Tree Officer- BBMP and KRIDE, care is taken to find the location near to the area where tree is removed, if suitable location nearby is not identified, then tree will be translocated to the suitable location by testing the soil of the place and consulting concerned land owners.

The translocation work is given to Expert Agencies. Quotations are called in this regard by KRIDE from various entities who have experience in translocating trees and the bidder is selected based on the criteria of past work experience, higher survival rate of translocated trees and methodology of translocation. Such agencies will be engaged by entering in to contract in translocation of the trees recommended by TEC in consultation with Tree Officer, BBMP. The Contractor is required to carry out the work scrupulously under the technical supervision of Deputy Conservator of Forest (DCF), Bruhat Bengaluru Mahanagara Palike (BBMP- Bengaluru Municipal Authority) and Urban Division. Translocation of trees will happen under the supervision of KRIDE and GC.

Meetings shall be conducted with the Expert Agencies that would carry out Translocation of the trees at the project site, regarding site preparation, translocation, supporting facilities required, various management plans to be adopted including watering, monitoring mechanism by the Forest Department/BBMP and for further reporting.

A proactive and sensitive approach would define exactly why a removal is being considered and weigh that against the advantages. Monitoring and Maintenance in general terms refers typically to proper

pruning. This involves the maintenance of appropriate road, sidewalk and pathway clearances, the removal of dead wood that may become hazardous, and other operations to maintain the health of the tree. Maintenance should also involve regular monitoring of health and pests, pest control, assessment of conflicts and hazards. Prevention and early detection is a cost effective way of avoiding serious problems.

Trees are maintained for three years after translocation. There will be recheck of survival of Translocated Trees periodically and 40% of total maintenance Cost is released after 60 days ascertaining the survival of trees, balance amount will be released in breakup of 30% (After 18 months from the date of translocation) and 30% (After 36 months from the date of translocation) only in case the tree survives.

Equipment's & Fertilisers used during Translocation are:

a. Excavator
b. Crane F-15
c. Trailer
d. Chain saw
e. Manure
f. Organic pesticides

7. COMPENSATORY PLANTATION BY KRIDE IN LIEU OF FELLING OF TREES

Sites for the compensatory plantation are selected in co-ordination with Bruhat Bengaluru Mahanagara Palike (BBMP, Bengaluru Municipal Authority) – Lakes, Bengaluru Development Authority etc. within Bengaluru city. Compensatory plantation in lieu of felling of trees is being undertaken by Forest Department/BBMP along with KRIDE at a ratio 1:10, i.e. for 01 tree felled / translocated, 10 saplings are planted, as per directions of Tree Expert Committee appointed by Government of Karnataka (GoK) under the orders of Hon'ble High Court and felling order by Tree Officer at suitable places. The compensatory plantation is maintained for three years after planting the sapling. Compensatory plantation is carried through Private agency recommended by Forest Department. Since the process of obtaining tree felling permission for few sections of Corridor 2 is under process, details of trees to be planted and translocated are proposed as follows;

Corridor - 2

- Vishweshwaraiah Layout near Kodigehalli (10,000 trees)
- Manganahalli Area (10,000 trees)
- Nada Prabhu Kempegowda Layout near BDA Sulikere Tank (10,000 trees)

Total number of trees to be felled for the Corridor 2 in 3469. About 34690 trees shall be planted/translocated for the project. Exact number of trees to be translocated and compensatory afforested (newly planted) shall be decided with TEC of BBMP forest wing. Maps of sites identified for new plantation for trees affected in Corridor 2 is presented as **Appendix 3**.

8. BENEFITS FROM COMPENSATORY AFFORESTATION

The following are merits or benefits from compensatory afforestation during implementation of BSRP:

Infrastructure Benefits

- Prolong the life of pavement by shading thus reducing summer surfacetemperatures
- Control dust, erosion, and sedimentation
- Reduce storm water costs by intercepting rainfall and absorbing slow water fromrainstorms
- Moderates the effects of wind and buffers damage from windstorms
- Provides buffer screens and arterial roadway enhancement
- Carbon Sequestering

Community Benefits

- Promotes community spirit and civic pride
- Encourages people to visit and creates a livable community
- Increases property values

Economic and Environmental Benefits

- Reduce energy bills from summer cooling and winter heating
- Supports sustainable transportation by encouraging people to walk or bike
- Reduces noise
- Absorb pollutants
- Supports biodiversity by providing food and shelter for wildlife
- Ecosystem services
- Trees are economic assets

Health Benefits

- Trees store and sequester carbon and produce oxygen therefore providing and improving air quality

- Improves water quality
- Provides stress relief by aesthetic appeal
- Offers educational and recreational opportunities

9. INSTITUTIONAL SET UP FOR TREE CLEARANCE AND MANAGEMENNT

KRIDE has set up Environmental & Social Management Unit (ESMU) which acts like a nodal department, coordinating between project site office, BBMP, TEC to look after the Tree Clearance part and Management. All the correspondence for obtaining tree felling/ translocation permission will be made by KRIDE. SEMU is collecting the request from all the reaches and project locations regarding Tree Clearance. Further, application is submitted for some sections of Corridor 2 for tree clearance to BBMP by following Tree Expert Committee guidelines also abiding to High Court orders as and when necessary.

10. ROLES AND RESPONSIBILITIES:

The roles and responsibilities of personnel involved in Compensatory Afforestation Programme are briefed below :

Sl.No	Organisation	Responsibility
1.	Environmental & Social Management Unit (ESMU), KRIDE	• Making necessary correspondence to Statuary body to obtain permission • Monitoring/Supervision of tree felling and translocation process • Compliance to the grievances received from stakeholders • Appointing expert agencies for tree felling/ translocation • Complying with Environmental rules and regulations.
2.	Forest Division/BBMP	• Obtain Tree Clearance. • Correspondence with BBMP, Forest Division & TEC. • Execute the Tree Clearance Order as per conditions mentioned by Hon'ble High Court of Karnataka • Translocation of trees. • Compensatory Plantation.
3.	Tree Authority – Tree Officer	• Inspect the Tree Clearance applications. • Provide comments and suggestions to TEC. • Issue Tree Clearance order.

		• Monitor Translocation of trees & Compensatory plantation.
4.	Tree Expert Committee (TEC)	• Review Tree Officer comments / suggestions. • Inspect the Tree Clearance applications. • Provide expert opinion to save trees / transplant etc.
5.	Contractor for Translocation & Compensatory Plantation	• To execute the work as per the terms and conditions within stipulated time, with high priority.

11. MONITORING & REPORTING MECHANISM

In order to monitor the Compensatory Plantation works, Environment Officers (EO), ESMU are appointed who are well experienced in Forest Services for 30 years are doing daily monitoring starting from 6.30 AM to monitor the plantation, maintenance works focusing to increase the survival rate of the trees by posting live photos in WhatsApp group.

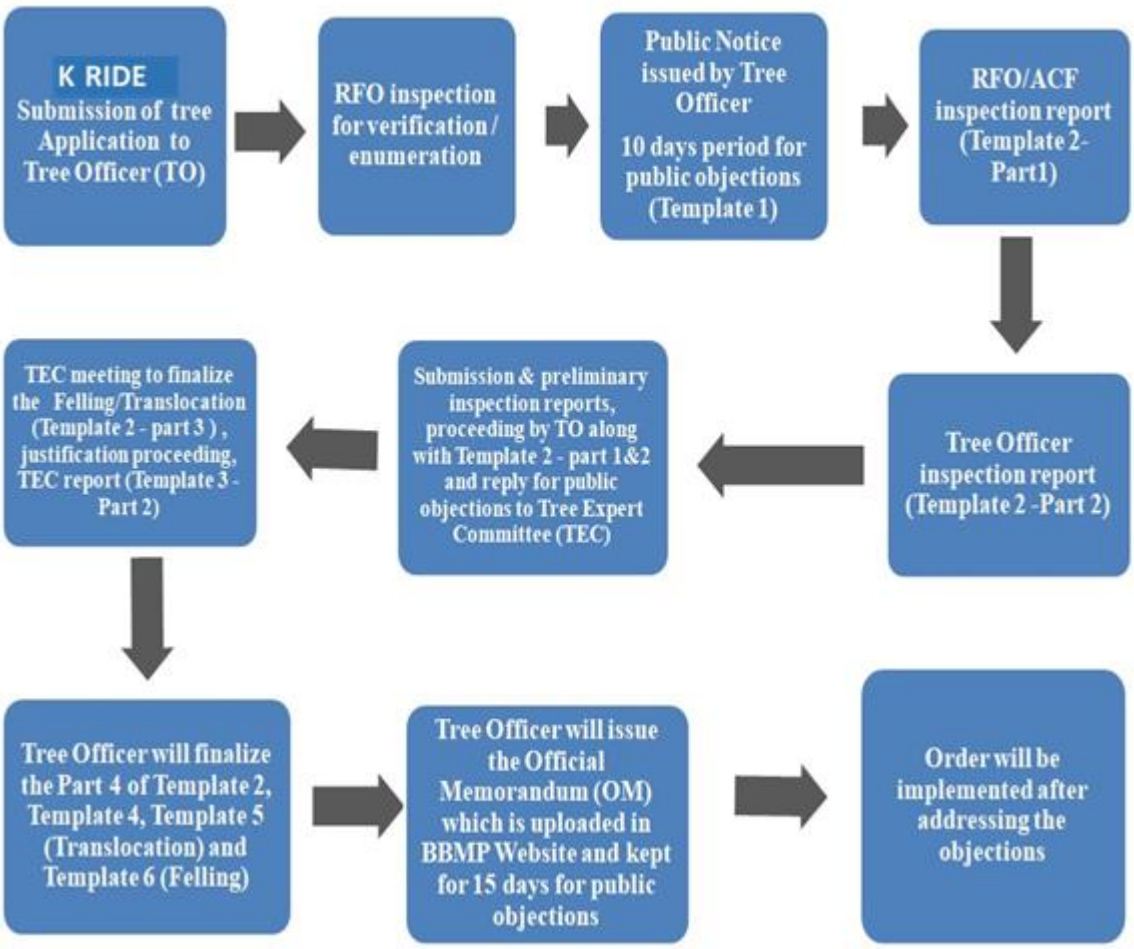
12. GRIEVANCE REDRESSAL MECHANISM

Notification regarding proposed tree removal / felling would be published in popular newspapers and objections are invited within stipulated time. The objections can be filed via e-mail / standard post, which would be duly addressed.

Apart from the above, any other grievances received through MD-KRIDE or any other channels are also addressed.

13. REFERENCE FLOW CHART FOR TREE CLEARANCE MANAGEMENT:

Tree Clearance Procedure as per Memorandum of Procedure (MOP) by TEC



Appendix 1. Maps of Sites Identified for Translocation of Trees for Corridor 2

YESHWANTPUR RAILWAY COLONY WATER CIRCULATING PLANT FOR TRANSLOCATION FOR TREES (SITE NO.3)

YESHWANTPUR RAILWAY STATION OPPOSITE PLAY GROUND NEAR FENCED AREA (SITE NO.9)

YESHWANTPUR RAILWAY STATION NEAR RAILWAY QUARTERS NEAR KENDRIYA VIDYALAYA (SITE NO.8)

YESHWANTPUR RAILWAY STATION NEAR PLAY GROUND
CLOSER TO BOUNDARY WALL (SITE NO.7)

BSRP CORRIDOR-2 BAIYAPANAHALLI TO CHIKKABANAVARA- BBMP TREE LIST									
S.No	**Tree Number**	**Species Name**	**Girth (m)**	**Clear bole Height (m)**	**Latitude and Longitude (Existing)**	**Latitude and Longitude (proposed)**	**Latitude and Longitude (proposed)**		**Site no**
1	161	MAHAGANI	0.72	4.0	N13.034326 E77.556780	N 13.028725 E 77.553736	13° 1'42.99"N	77°33'4.86"E	7
2	170	MAHAGANI	0.42	2.0	N13.034452 E77.556863	N13.028769 E 77.553734	13° 1'43.02"N	77°33'5.44"E	7
3	174	HONGE	0.28	1.5	13.034469 77.556890	N13.028806 E 77.553737	13° 1'42.95"N	77°33'8.85"E	7
4	180	MAHAGANI	0.51	6.0	13.034784 77.557189	N13.028854 E 77.553737	13° 1'42.96"N	77°33'9.91"E	7
5	187	Jungle tree	0.52	4.0	13.035414 77.558037	N13.028884 E 77.553646	13° 1'42.95"N	77°33'11.37"E	7
6	232	Honge	0.29	1.5	13.038091 77.559721	N13.028883 E 77.553614	13° 1'42.62"N	77°33'12.23"E	7
7	1	Honge	0.29	1.5	13.038091 77.559721	N13.028885 E 77.553597	13° 1'42.02"N	77°33'12.24"E	7
8	2	Honge	0.29	1.5	13.038091 77.559721	N13.028880 E 77.553568	13° 1'40.23"N	77°33'8.64"E	7
9	3	NERALE	0.29	1.5	13.038091 77.559721	N13.028860 E 77.553579	13° 1'40.22"N	77°33'9.15"E	7
10	264	MAHAGANI	0.36	3.0	13.034137 77.556374	N13.028889 E 77.553620	13° 1'40.25"N	77°33'9.66"E	7
11	265	Jungle tree	0.42	1.0	13.034146 77.556363	N13.028884 E 77.553585	13° 1'40.23"N	77°33'10.07"E	7
12	279	Honge	0.29	1.5	13.04206 77.562499	N13.028862 E 77.553579	13° 1'40.26"N	77°33'10.49"E	7
13	1	HONGE	0.29	1.5	13.04206 77.562499	N13.028837 E 77.553575	13° 1'40.90"N	77°33'11.78"E	7
14	291	Honge	0.47	1.0	13.034137 77.556374	N13.028843 E 77.553578	13° 1'40.89"N	77°33'12.30"E	7
15	1	Honge	0.47	1.0	13.034146 77.556363	N13.028824 E 77.553584	13° 1'39.69"N	77°33'6.64"E	7
16	2	Honge	0.47	1.0	13.034146 77.556363	N13.028329 E 77.553164	13° 1'39.61"N	77°33'7.08"E	
17	385	MAHAGANI	0.56	3.5	13.04206 77.562499	N13.028779 E 77.553579	13° 1'39.78"N	77°33'7.50"E	7
18	386	Jungle tree	0.65	1.8	13.042868 77.585754	N13.028787 E 77.553569	13° 1'39.82"N	77°33'8.19"E	7
19	398	Jungle tree	0.23	1.8	13.042691 77.585941	N13.027713 E 77.550917	13° 1'41.03"N	77°33'2.14"E	9
20	399	Jungle tree	0.49	2.8	13.042789 77.585964	N13.0278419 E 77.550728	13° 1'40.80"N	77°33'2.70"E	9
21	402	Jungle tree	0.70	1.4	13.042649 77.586353	N13.027840 E 77.550499	13° 1'40.53"N	77°33'3.26"E	9
22	403	MAHAGANI	0.57	1.8	13.042853 77.586227	N13.027946 E 77.550195	13° 1'41.11"N	77°33'3.92"E	9
23	407	MAHAGANI	0.54	3.0	13.042734 77.586222	N13.027913 E 77.549837	13° 1'41.91"N	77°33'3.93"E	9
24	408	Honge	0.53	0.6	13.042795 77.58619	N13.027664 E 77.550013	13° 1'42.60"N	77°33'3.96"E	9

25	409	MAHAGANI	0.54	3.2	13.042752 77.586201	N13.027482 E 77.550020	13° 1'43.29"N	77°33'3.85"E	9
26	412	MAHAGANI	0.63	3.0	13.04285 77.586399	N13.027301 E 77.550117	13° 1'40.57"N	77°33'2.25"E	9
27	414	MAHAGANI	0.50	3.0	13.042692 77.586318	N13.027025 E 77.550255	13° 1'40.32"N	77°33'2.91"E	9
28	416	MAHAGANI	0.58	3.0	13.042773 77.586471	N13.026846 E 77.550440	13° 1'40.10"N	77°33'3.45"E	9
29	417	MAHAGANI	0.63	3.0	13.042711 77.58658	N13.026191 E 77.551561	13° 1'35.98"N	77°33'5.09"E	8
30	418	MAHAGANI	0.60	3.2	13.042688 77.586628	N13.026131 E 77.552084	13° 1'36.04"N	77°33'6.08"E	8
31	423	TOREMATHI	0.52	1.2	13.033262 77.612764	N13.026222 E 77.552084	13° 1'36.09"N	77°33'6.97"E	8
32	424	TABEBUIA ROSEA	0.46	1.3	13.033242 77.612275	N13.026638 E 77.551633	13° 1'36.15"N	77°33'8.22"E	8
33	427	MAHAGANI	0.27	2.8	13.033251 77.612398	N13.026693 E 77.552173	13° 1'36.17"N	77°33'8.66"E	8
34	429	TABEBUIA ROSEA	0.42	1.7	13.03321 77.612372	N13.026886 E 77.552770	13° 1'36.23"N	77°33'9.09"E	8
35	430	MAHAGANI	0.27	5.5	13.033139 77.612464	N13.026815 E 77.553215	13° 1'36.26"N	77°33'9.51"E	8
36	432	MAHAGANI	0.23	3.5	13.033111 77.612464	N13.027240 E 77.553270	13° 1'35.08"N	77°33'10.53"E	8
37	433	JAMUN	0.37	1.2	13.033193 77.612508	N13.027633 E 77.553188	13° 1'35.04"N	77°33'10.01"E	8
38	434	JAMUN	0.33	2.0	13.033193 77.612489	N13.026784 E 77.553317	13° 1'34.98"N	77°33'8.51"E	8
39	497	KADUNALLI	0.63	2.5	13.004722 77.654566	N13.026917 E 77.553403	13° 1'34.89"N	77°33'6.29"E	8
40	514	TACOMA	0.50	2.5	13.004801 77.652992	N13.028655 E 77.550923	13° 1'40.40"N	77°33'2.17"E	9
41	517	TACOMA	0.41	1.3	13.00448 77.654364	N13.028491 E 77.550912	13° 1'39.84"N	77°33'2.32"E	9
42	519	JAKARANDA	0.63	2.2	13.004448 77.654593	N13.08305 E 77.550937	13° 1'39.27"N	77°33'2.41"E	9
43	523	DALICHAND	0.31	2.0	13.004336 77.654699	N13.028106 E 77.550978	13° 1'38.47"N	77°33'2.66"E	9
44	533	HONGE	0.54	1.9	13.004165 77.654699	N13.029089 E 77.550786	13° 1'38.46"N	77°33'3.04"E	9
45	539	KADUNALLI	0.35	1.7	13.004274 77.655458	N13.028451 E 77.550164	13° 1'38.41"N	77°33'3.62"E	9
46	540	MAHAGANI	1.05	3.0	13.004101 77.655853	N13.028332 E 77.550014	13° 1'42.21"N	77°33'1.85"E	9
47	542	TOCOMA	0.81	3.3	13.004233 77.656089	N13.021888 E 77.550073	13° 1'42.22"N	77°33'1.10"E	9
48	551	BAAGE	0.64	1.8	13.004182 77.65619	N13.0320726 E 77.544034	13° 1'54.25"N	77°32'44.14"E	3
49	554	HONGE	0.40	2.2	13.00288 77.658451	N13.032004 E 77.544077	13° 1'54.49"N	77°32'44.51"E	3
50	555	HONGE	0.35	1.2	13.002851 77.658605	N13.031959 E 77.544148	13° 1'55.12"N	77°32'45.76"E	3
51	555	TABUBIA AVALANDA	0.35	1.2	13.002564 77.659076	N13.031908 E 77.544246	13° 1'55.25"N	77°32'46.06"E	3

52	570	JAMUN	0.36	2.8	13.002393 77.659456	N13.031819 E 77.544403	13° 1'54.87"N	77°32'43.14"E	3
53	572	MAHAGANI	0.43	3.0	13.002335 77.659373	N13.031665 E 77.544506	13° 1'55.42"N	77°32'42.49"E	3
54	573	JAMUN	0.84	2.5	13.002372 77.659304	N13.031754 E 77.544612	13° 1'55.70"N	77°32'42.35"E	3
55	574	Jungle tree	0.35	1.3	13.002242 77.659218	N13.031505 E 77.544646	13° 1'54.78"N	77°32'42.83"E	3
56	587	MAHAGANI	1.03	3.3	13.001202 77.660425	N13.031424 E 77.544695	13° 1'56.96"N	77°32'45.53"E	3
57	592	MAHAGANI	0.82	2.4	13.001029 77.660713	N13.031358 E 77.544784	13° 1'56.57"N	77°32'45.73"E	3
58	593	MAHAGANI	1.03	3.5	13.000884 77.660653	N13.031196 E 77.544919	13° 1'55.98"N	77°32'46.46"E	3

Annexure - 3

Tree Transplantation

LARSEN & TOUBRO
K RIDE BSRP CORRIDOR 2, BANGALORE

Annexure-3

Tree Transplantation

Annexure-3

Tree Transplantation

Annexure - 3

Tree felling

Annexure-3

Tree felling.

Annexure -3

Tree felling.

Appendix 2. **Soil Test Results of Sites Identified for Translocation of Trees for Corridor 2**

UNIVERSITY OF AGRICULTURAL SCIENCES GKVK, BANGALORE
DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

SS&AC/ /2022-23 09-11-2022

To,
M/S LARASEN and TOURBO Limited
Transportation Infra, I.C No 12, 13, 14
Samvith Complex, 2nd Floor, Mayura Street,
Outer Ring Road, Near Gr Kalayanamantappa
Sahakarnagar(P), Nagashettyhalli,
Bangalore North-560 094
Ph no: 9666523908

Sir,

Sub: Analytical result of one soil sample ….. reg

Please find here with the analytical result of one soil sample provided by you for analysis to the Dept. of Soil Science and Agricultural Chemistry, College of Agriculture, GKVK, Bangalore-65

Soil sample

Parameters	**Yeshwanthpura railway station residence plot 13.026747N 77.550904E 3**
pH (1:2.5)	7.75
EC (1:2.5)(ds/m)	0.22
OC (%)	0.40
N (Kg / ha)	290.13
P_2O_5 (Kg / ha)	48.00
K_2O (Kg / ha)	365.40
Ca (meq/100 g)	7.20
Mg(meq/100 g)	2.00
S (ppm)	13.40
Fe (ppm)	11.16
Mn (ppm)	3.44
Zn (ppm)	2.84
Cu (ppm)	1.26

Inference: The soil provided for analysis is neutral in nature, low in salt content and organic carbon content. Hence organic manure should be applied. The soil has medium range of major nutrient NPK as per standards. Calcium and magnesium is in sufficient range. Whereas micronutrients Iron, Manganese, Zinc and copper is slightly high.

The result should not be utilized for legal / commercial purposes without prior consent of the Director of Research.

Yours faithfully,

Professor and Head
Department of Soil Science & Agricultural Chemistry
U.A.S., GKVK, Bengaluru-560065

Forwarded to
Director of Research

UNIVERSITY OF AGRICULTURAL SCIENCES GKVK, BANGALORE
DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

SS&AC/ /2022-23 09-11-2022

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Soil sample

Parameters	Railway quarters colony 13.031573N 77.545479E 2
pH (1:2.5)	8.05
EC (1:2.5)(ds/m)	0.27
OC (%)	0.44
N (Kg / ha)	300.62
P_2O_5 (Kg / ha)	57.16
K_2O (Kg / ha)	400.0
Ca (meq/100 g)	8.40
Mg(meq/100 g)	2.60
S (ppm)	15.63
Fe (ppm)	8.78
Mn (ppm)	4.10
Zn (ppm)	5.00
Cu (ppm)	3.44

Inference: The soil provided for analysis is alkaline in nature, low in salt content and organic carbon content. Hence organic manure should be applied. The soil has medium range of major nutrient Nitrogen and phosphorus and recorded high potassium as per standards. Calcium and magnesium is in sufficient range. Whereas micronutrients Iron, Manganese, Zinc and copper is slightly high.

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Yours faithfully,

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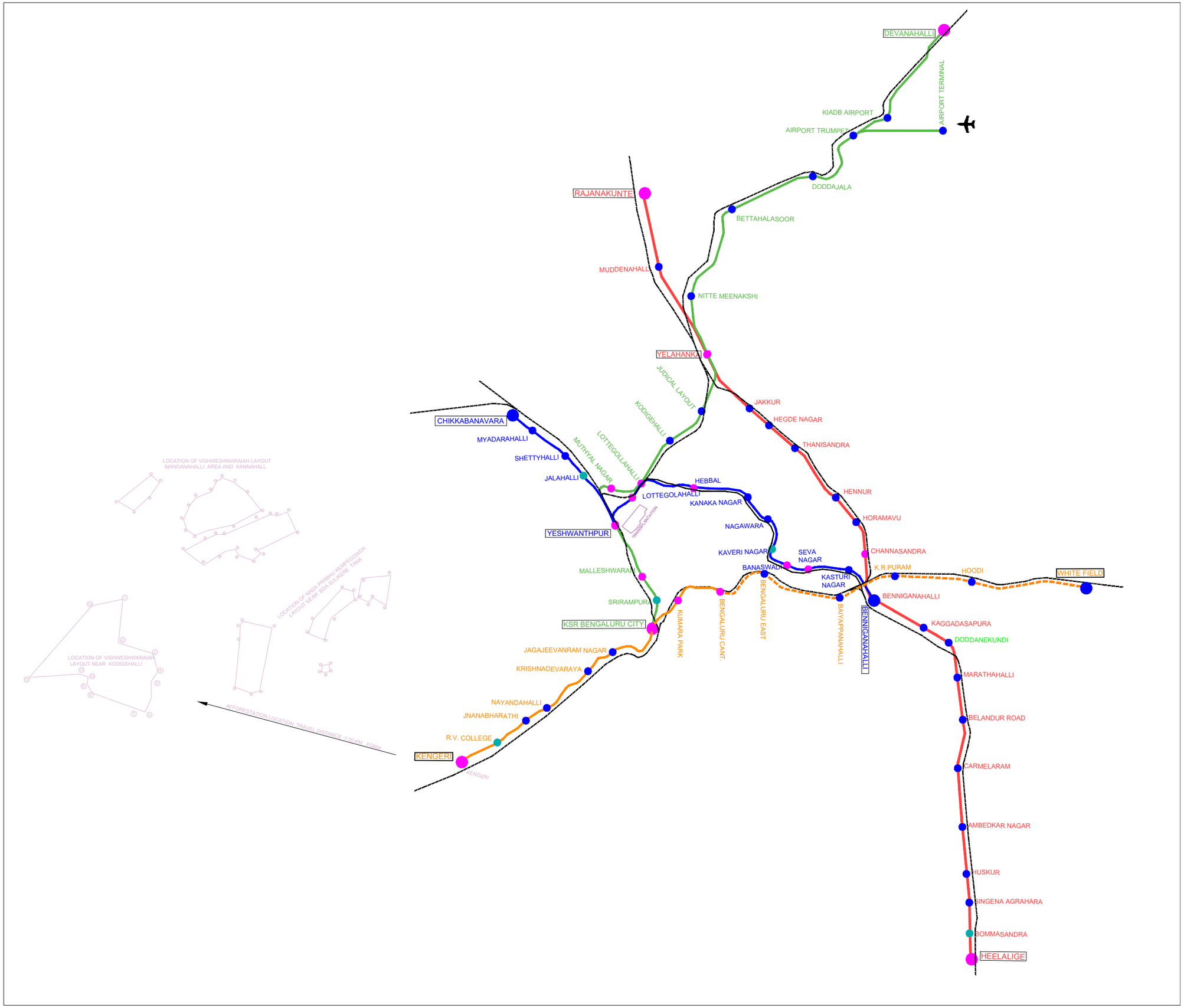
U.A.S., GKVK, Bengaluru-560065

Forwarded to
Director of Research

Appendix 3. **Sites Identified for New Plantation of Trees to be felled for Corridor 2**


DEVANAHALLI
AIRPORT TERMINAL
KIADB AIRPORT
AIRPORT TRUMPET
DODDAJALA
BETTAHALASOOR
RAJANAKUNTE
MUDDENAHALLI
NITTE MEENAKSHI
YELAHANKA
JUDICAL LAYOUT
KODIGEHALLI
LOTTEGOLLAHALLI
MUTHYAL NAGAR
CHIKKABANAVARA
MYADARAHALLI
SHETTYHALLI
JALAHALLI
YESHWANTHPUR
TRANSLOCATION
LOTTEGOLLAHALLI
HEBBAL
KANAKA NAGAR
NAGAWARA
KAVERI NAGAR
SEVA NAGAR
BANASWADI
KASTURI NAGAR
JAKKUR
HEGDE NAGAR
THANISANDRA
HENNUR
HORAMAVU
CHANNASANDRA
K.R.PURAM
HOODI
WHITE FIELD
BENNIGANAHALLI
BAIYAPPANAHALLI
BENGALURU EAST
BENGALURU CANT.
KUMARA PARK
MALLESHWARAM
SRIRAMPURA
KSR BENGALURU CITY
JAGAJEEVANRAM NAGAR
KRISHNADEVARAYA
NAYANDAHALLI
JNANABHARATHI
R.V. COLLEGE
KENGERI
KENGERI
KAGGADASAPURA
DODDANEKUNDI
MARATHAHALLI
BELANDUR ROAD
CARMELARAM
AMBEDKAR NAGAR
HUSKUR
SINGENA AGRAHARA
BOMMASANDRA
HEELALIGE
LOCATION OF VISHWESHWARAIAH LAYOUT MANGANAHALLI AREA AND KANNAHALLI
LOCATION OF VISHWESHWARAIAH LAYOUT NEAR KODIGEHALLI
LOCATION OF NADA PRABHU KEMPEGOWDA LAYOUT NEAR BDA SUJAKERE TANK
AFFORESTATION LOCATION, TRAVEL DISTANCE 7.00 KM. FORM KENGERI

LOCATION OF VISHWESHWARAIAH LAYOUT NEAR KODIGEHALLI
(10,000 Pbs)

LOCATION OF VISHWESHWARAIAH LAYOUT MANGANAHALLI. AREA
(10,000 Pbs)

LOCATION OF NADA PRABHU KEMPEGOWDA LAYOUT NEAR BDA SULIKERE TANK
(10,000 Pbs)

Appendix 1. Maps of Sites Identified for Translocation of Trees for Corridor 2

YESHWANTPUR RAILWAY COLONY WATER CIRCULATING PLANT FOR TRANSLOCATION FOR TREES (SITE NO.3)

YESHWANTPUR RAILWAY STATION NEAR PLAY GROUND
CLOSER TO BOUNDARY WALL (SITE NO.7)

YESHWANTPUR RAILWAY STATION OPPOSITE PLAY GROUND NEAR FENCED AREA (SITE NO.9)

YESHWANTPUR RAILWAY STATION NEAR RAILWAY QUARTERS NEAR KENDRIYA VIDYALAYA (SITE NO.8)

BSRP CORRIDOR-2 BAIYAPANAHALLI TO CHIKKABANAVARA- BBMP TREE LIST									
S.No	**Tree Number**	**Species Name**	**Girth (m)**	**Clear bole Height (m)**	**Latitude and Longitude (Existing)**	**Latitude and Longitude (proposed)**	**Latitude and Longitude (proposed)**		**Site no**
1	161	MAHAGANI	0.72	4.0	N13.034326 E77.556780	N 13.028725 E 77.553736	13° 1'42.99"N	77°33'4.86"E	7
2	170	MAHAGANI	0.42	2.0	N13.034452 E77.556863	N13.028769 E 77.553734	13° 1'43.02"N	77°33'5.44"E	7
3	174	HONGE	0.28	1.5	13.034469 77.556890	N13.028806 E 77.553737	13° 1'42.95"N	77°33'8.85"E	7
4	180	MAHAGANI	0.51	6.0	13.034784 77.557189	N13.028854 E 77.553737	13° 1'42.96"N	77°33'9.91"E	7
5	187	Jungle tree	0.52	4.0	13.035414 77.558037	N13.028884 E 77.553646	13° 1'42.95"N	77°33'11.37"E	7
6	232	Honge	0.29	1.5	13.038091 77.559721	N13.028883 E 77.553614	13° 1'42.62"N	77°33'12.23"E	7
7	1	Honge	0.29	1.5	13.038091 77.559721	N13.028885 E 77.553597	13° 1'42.02"N	77°33'12.24"E	7
8	2	Honge	0.29	1.5	13.038091 77.559721	N13.028880 E 77.553568	13° 1'40.23"N	77°33'8.64"E	7
9	3	NERALE	0.29	1.5	13.038091 77.559721	N13.028860 E 77.553579	13° 1'40.22"N	77°33'9.15"E	7
10	264	MAHAGANI	0.36	3.0	13.034137 77.556374	N13.028889 E 77.553620	13° 1'40.25"N	77°33'9.66"E	7
11	265	Jungle tree	0.42	1.0	13.034146 77.556363	N13.028884 E 77.553585	13° 1'40.23"N	77°33'10.07"E	7
12	279	Honge	0.29	1.5	13.04206 77.562499	N13.028862 E 77.553579	13° 1'40.26"N	77°33'10.49"E	7
13	1	HONGE	0.29	1.5	13.04206 77.562499	N13.028837 E 77.553575	13° 1'40.90"N	77°33'11.78"E	7
14	291	Honge	0.47	1.0	13.034137 77.556374	N13.028843 E 77.553578	13° 1'40.89"N	77°33'12.30"E	7
15	1	Honge	0.47	1.0	13.034146 77.556363	N13.028824 E 77.553584	13° 1'39.69"N	77°33'6.64"E	7
16	2	Honge	0.47	1.0	13.034146 77.556363	N13.028329 E 77.553164	13° 1'39.61"N	77°33'7.08"E	
17	385	MAHAGANI	0.56	3.5	13.04206 77.562499	N13.028779 E 77.553579	13° 1'39.78"N	77°33'7.50"E	7
18	386	Jungle tree	0.65	1.8	13.042868 77.585754	N13.028787 E 77.553569	13° 1'39.82"N	77°33'8.19"E	7
19	398	Jungle tree	0.23	1.8	13.042691 77.585941	N13.027713 E 77.550917	13° 1'41.03"N	77°33'2.14"E	9
20	399	Jungle tree	0.49	2.8	13.042789 77.585964	N13.0278419 E 77.550728	13° 1'40.80"N	77°33'2.70"E	9
21	402	Jungle tree	0.70	1.4	13.042649 77.586353	N13.027840 E 77.550499	13° 1'40.53"N	77°33'3.26"E	9
22	403	MAHAGANI	0.57	1.8	13.042853 77.586227	N13.027946 E 77.550195	13° 1'41.11"N	77°33'3.92"E	9
23	407	MAHAGANI	0.54	3.0	13.042734 77.586222	N13.027913 E 77.549837	13° 1'41.91"N	77°33'3.93"E	9
24	408	Honge	0.53	0.6	13.042795 77.58619	N13.027664 E 77.550013	13° 1'42.60"N	77°33'3.96"E	9

25	409	MAHAGANI	0.54	3.2	13.042752 77.586201	N13.027482 E 77.550020	13° 1'43.29"N	77°33'3.85"E	9
26	412	MAHAGANI	0.63	3.0	13.04285 77.586399	N13.027301 E 77.550117	13° 1'40.57"N	77°33'2.25"E	9
27	414	MAHAGANI	0.50	3.0	13.042692 77.586318	N13.027025 E 77.550255	13° 1'40.32"N	77°33'2.91"E	9
28	416	MAHAGANI	0.58	3.0	13.042773 77.586471	N13.026846 E 77.550440	13° 1'40.10"N	77°33'3.45"E	9
29	417	MAHAGANI	0.63	3.0	13.042711 77.58658	N13.026191 E 77.551561	13° 1'35.98"N	77°33'5.09"E	8
30	418	MAHAGANI	0.60	3.2	13.042688 77.586628	N13.026131 E 77.552084	13° 1'36.04"N	77°33'6.08"E	8
31	423	TOREMATHI	0.52	1.2	13.033262 77.612764	N13.026222 E 77.552084	13° 1'36.09"N	77°33'6.97"E	8
32	424	TABEBUIA ROSEA	0.46	1.3	13.033242 77.612275	N13.026638 E 77.551633	13° 1'36.15"N	77°33'8.22"E	8
33	427	MAHAGANI	0.27	2.8	13.033251 77.612398	N13.026693 E 77.552173	13° 1'36.17"N	77°33'8.66"E	8
34	429	TABEBUIA ROSEA	0.42	1.7	13.03321 77.612372	N13.026886 E 77.552770	13° 1'36.23"N	77°33'9.09"E	8
35	430	MAHAGANI	0.27	5.5	13.033139 77.612464	N13.026815 E 77.553215	13° 1'36.26"N	77°33'9.51"E	8
36	432	MAHAGANI	0.23	3.5	13.033111 77.612464	N13.027240 E 77.553270	13° 1'35.08"N	77°33'10.53"E	8
37	433	JAMUN	0.37	1.2	13.033193 77.612508	N13.027633 E 77.553188	13° 1'35.04"N	77°33'10.01"E	8
38	434	JAMUN	0.33	2.0	13.033193 77.612489	N13.026784 E 77.553317	13° 1'34.98"N	77°33'8.51"E	8
39	497	KADUNALLI	0.63	2.5	13.004722 77.654566	N13.026917 E 77.553403	13° 1'34.89"N	77°33'6.29"E	8
40	514	TACOMA	0.50	2.5	13.004801 77.652992	N13.028655 E 77.550923	13° 1'40.40"N	77°33'2.17"E	9
41	517	TACOMA	0.41	1.3	13.00448 77.654364	N13.028491 E 77.550912	13° 1'39.84"N	77°33'2.32"E	9
42	519	JAKARANDA	0.63	2.2	13.004448 77.654593	N13.08305 E 77.550937	13° 1'39.27"N	77°33'2.41"E	9
43	523	DALICHAND	0.31	2.0	13.004336 77.654699	N13.028106 E 77.550978	13° 1'38.47"N	77°33'2.66"E	9
44	533	HONGE	0.54	1.9	13.004165 77.654699	N13.029089 E 77.550786	13° 1'38.46"N	77°33'3.04"E	9
45	539	KADUNALLI	0.35	1.7	13.004274 77.655458	N13.028451 E 77.550164	13° 1'38.41"N	77°33'3.62"E	9
46	540	MAHAGANI	1.05	3.0	13.004101 77.655853	N13.028332 E 77.550014	13° 1'42.21"N	77°33'1.85"E	9
47	542	TOCOMA	0.81	3.3	13.004233 77.656089	N13.021888 E 77.550073	13° 1'42.22"N	77°33'1.10"E	9
48	551	BAAGE	0.64	1.8	13.004182 77.65619	N13.0320726 E 77.544034	13° 1'54.25"N	77°32'44.14"E	3
49	554	HONGE	0.40	2.2	13.00288 77.658451	N13.032004 E 77.544077	13° 1'54.49"N	77°32'44.51"E	3
50	555	HONGE	0.35	1.2	13.002851 77.658605	N13.031959 E 77.544148	13° 1'55.12"N	77°32'45.76"E	3
51	555	TABUBIA AVALANDA	0.35	1.2	13.002564 77.659076	N13.031908 E 77.544246	13° 1'55.25"N	77°32'46.06"E	3

52	570	JAMUN	0.36	2.8	13.002393 77.659456	N13.031819 E 77.544403	13° 1'54.87"N	77°32'43.14"E	3
53	572	MAHAGANI	0.43	3.0	13.002335 77.659373	N13.031665 E 77.544506	13° 1'55.42"N	77°32'42.49"E	3
54	573	JAMUN	0.84	2.5	13.002372 77.659304	N13.031754 E 77.544612	13° 1'55.70"N	77°32'42.35"E	3
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57	592	MAHAGANI	0.82	2.4	13.001029 77.660713	N13.031358 E 77.544784	13° 1'56.57"N	77°32'45.73"E	3
58	593	MAHAGANI	1.03	3.5	13.000884 77.660653	N13.031196 E 77.544919	13° 1'55.98"N	77°32'46.46"E	3

Appendix 2. **Soil Test Results of Sites Identified for Translocation of Trees for Corridor 2**

UNIVERSITY OF AGRICULTURAL SCIENCES GKVK, BANGALORE
DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

SS&AC/ /2022-23 09-11-2022

To,
M/S LARASEN and TOURBO Limited
Transportation Infra, I.C No 12, 13, 14
Samvith Complex, 2nd Floor, Mayura Street,
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Ph no: 9666523908

Sir,

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Parameters	Railway quarters colony 13.031573N 77.545479E 2
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S (ppm)	15.63
Fe (ppm)	8.78
Mn (ppm)	4.10
Zn (ppm)	5.00
Cu (ppm)	3.44

Inference: The soil provided for analysis is alkaline in nature, low in salt content and organic carbon content. Hence organic manure should be applied. The soil has medium range of major nutrient Nitrogen and phosphorus and recorded high potassium as per standards. Calcium and magnesium is in sufficient range. Whereas micronutrients Iron, Manganese, Zinc and copper is slightly high.

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Yours faithfully,

Professor and Head
Department of Soil Science & Agricultural Chemi
U.A.S., GKVK, Bengaluru-560065

Forwarded to
Director of Research

UNIVERSITY OF AGRICULTURAL SCIENCES GKVK, BANGALORE
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pH (1:2.5)	7.75
EC (1:2.5)(ds/m)	0.22
OC (%)	0.40
N (Kg / ha)	290.13
P_2O_5 (Kg / ha)	48.00
K_2O (Kg / ha)	365.40
Ca (meq/100 g)	7.20
Mg(meq/100 g)	2.00
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Inference: The soil provided for analysis is neutral in nature, low in salt content and organic carbon content. Hence organic manure should be applied. The soil has medium range of major nutrient NPK as per standards. Calcium and magnesium is in sufficient range. Whereas micronutrients Iron, Manganese, Zinc and copper is slightly high.

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Professor and Head
Department of Soil Science & Agricultural Chemistry
U.A.S., GKVK, Bengaluru-560065

Forwarded to
Director of Research

Appendix 3. **Sites Identified for New Plantation of Trees to be felled for Corridor 2**

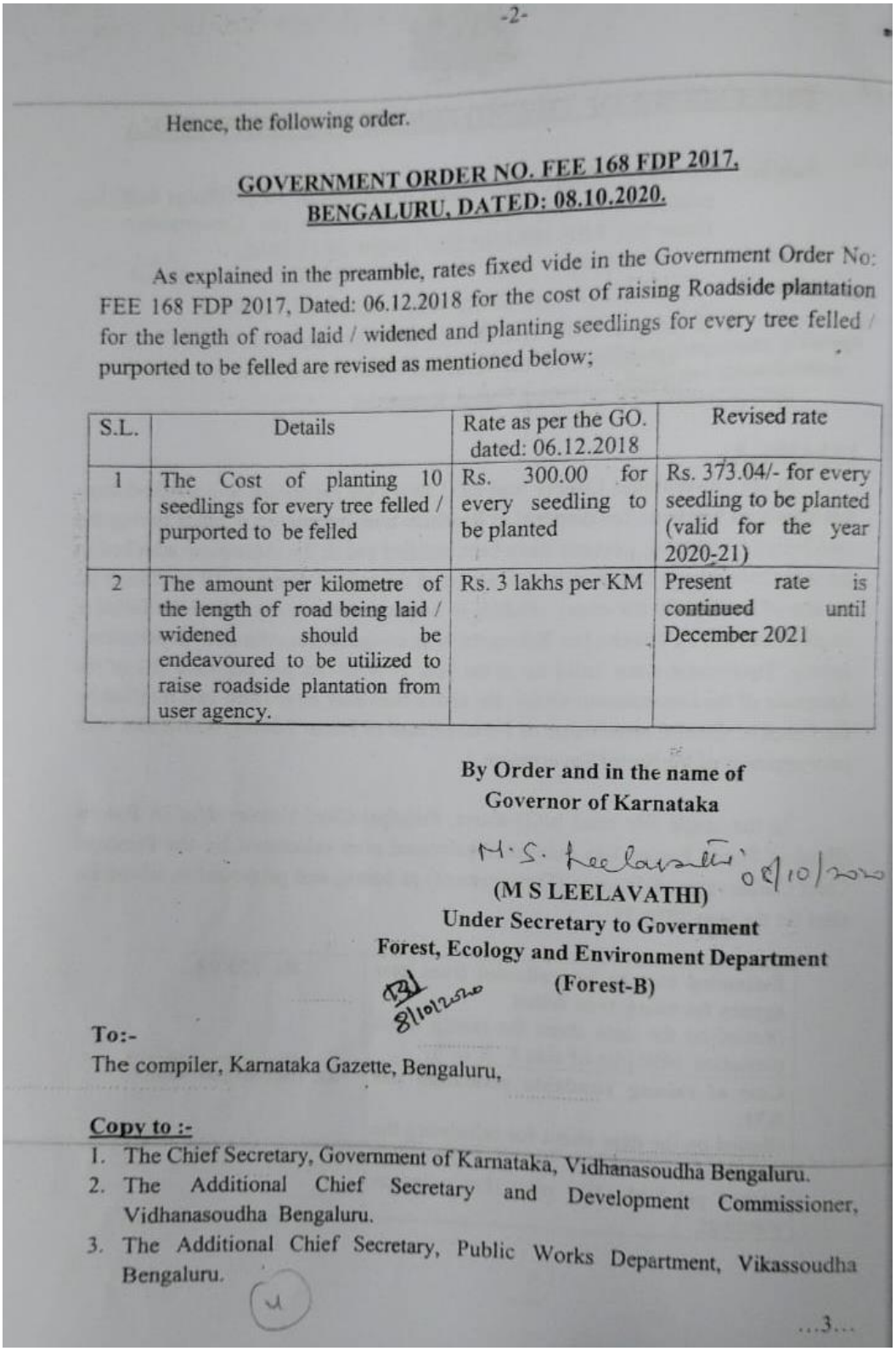
LOCATION OF VISHWESHWARAIAH LAYOUT NEAR KODIGEHALLI
(10,000 Pbs)

LOCATION OF VISHWESHWARAIAH LAYOUT MANGANAHALLI. AREA
(10,000 Pbs)

LOCATION OF NADA PRABHU KEMPEGOWDA LAYOUT NEAR BDA SULIKERE TANK
(10,000 Pbs)

Annexure 11.1. Source /Breakup for Unit Rate used in EMP Budget

A. Source of Unit Cost for Compensatory Afforestation



-2-

Hence, the following order.

GOVERNMENT ORDER NO. FEE 168 FDP 2017, BENGALURU, DATED: 08.10.2020.

As explained in the preamble, rates fixed vide in the Government Order No: FEE 168 FDP 2017, Dated: 06.12.2018 for the cost of raising Roadside plantation for the length of road laid / widened and planting seedlings for every tree felled / purported to be felled are revised as mentioned below;

S.L.	Details	Rate as per the GO. dated: 06.12.2018	Revised rate
1	The Cost of planting 10 seedlings for every tree felled / purported to be felled	Rs. 300.00 for every seedling to be planted	Rs. 373.04/- for every seedling to be planted (valid for the year 2020-21)
2	The amount per kilometre of the length of road being laid / widened should be endeavoured to be utilized to raise roadside plantation from user agency.	Rs. 3 lakhs per KM	Present rate is continued until December 2021

By Order and in the name of
Governor of Karnataka

M.S. Leelavathi 08/10/2020

(M S LEELAVATHI)
Under Secretary to Government
Forest, Ecology and Environment Department
(Forest-B)

8/10/2020

To:-
The compiler, Karnataka Gazette, Bengaluru,

Copy to :-
1. The Chief Secretary, Government of Karnataka, Vidhanasoudha Bengaluru.
2. The Additional Chief Secretary and Development Commissioner, Vidhanasoudha Bengaluru.
3. The Additional Chief Secretary, Public Works Department, Vikassoudha Bengaluru.

...3...

GOVERNMENT OF KARNATAKA
FOREST/HORTICULTURE/WATERSHED DEPARTMENT
Common Sanctioned Schedule of Rates for the year 2022-23

(b)	Fabrication of tree guards of 4 poles of 2.5 m. length and 12 batons of 40 cms length, treating with creosote oil completely from bottom to top, fixing side batons and chicken wire mesh of 28 gauge to a height of 2m. from the top of the poles (including the cost of chicken wire mesh and creosote oil) Transportation of the tree guards and fixing the tree guards firmly over the seedlings planted in towns/cities – complete. (Including the cost of purchase and delivery of poles and batons)	No.	1,256.30

B. Cost Source for Environmental Monitoring During Construction and Operation Phase

Envi. Monitoring Unit Cost						
	Air	Noise	S Water	G Water	Soil	Vibration
Base Cost	7,525	1,767	5,733	5,733	6,617	1,00,000
Construction Cost						
20% inflat	9030	2120	6880	6880	7940	120000
Round-off	**10000**	**2500**	**7000**	**7000**	**8000**	**120000**
Operation Cost						
Base Cost	11000	2750	7700	7700	8800	132000
Round-off	**12000**	**3000**	**8000**	**8000**	**9000**	**135000**

*Base Cost is Average of Cost Received from ABC, Senha & Envio Solu. laboratories Cost take in 2022.

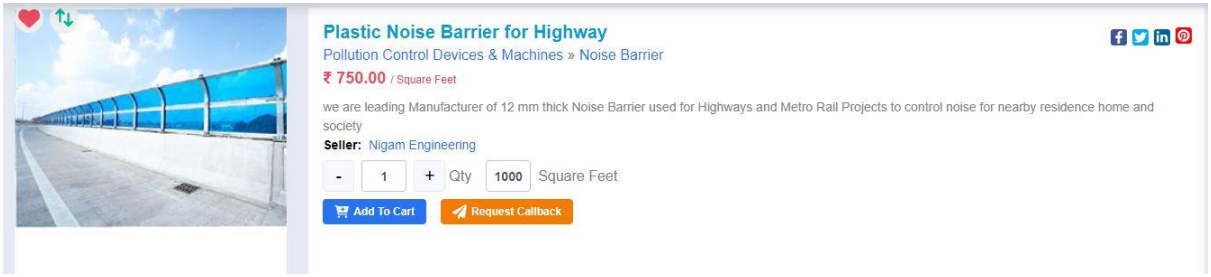
1. Quotation Received from ABC Techno Labs, Chennai

Project Corridors	Conducting Baseline Environmental Monitoring along the 4 corridors of Bengaluru Sub-urban Rail Project in Bengaluru City in the State of Karnataka										
	Air Quality	Unit Price/Sample/ Point	Noise Level	Unit Price/Sample/ Point	Surface Water	Unit Price/Sample/ Point	Ground Water	Unit Price/Sample/ Point	Soil Quality	Unit Price/Sample/ Point	Grand Total (Rs)
Corridor 1 - KSR Bengaluru City to Devanahalli (41.40Km)	12	4500	20	250	7	9500	5	9500	4	12500	Rs 2,23,000/-
Amount	Rs 54,000		Rs5,000		Rs 66,500		Rs 47,500		Rs 50,000		
Corridor 2 - Baiyyappanahalli Terminal to Chikkabanavara (25.01Km)	8	4500	12	250	8	9500	3	9500	3	12500	Rs 1,81,000/-
Amount	Rs 36,000		Rs 3000		Rs 76000		Rs 28500		Rs 37,500		
Corridor 3 - Kengeri to Whitefield (via KSR and Cantonment) (35.52Km)	12	4500	16	250	10	9500	6	9500	4	12500	Rs 2,60,000/-
Amount	Rs 54000		Rs 4000		Rs 95000		Rs 57000		Rs 50,000		
Corridor 4 - Heelalige to Rajankunte (46.24Km)	15	4500	24	250	12	9500	9	9500	5	12500	Rs 3,35,500/-
Amount	Rs 67500		Rs 6000		Rs 114000		Rs 85500		Rs 62,500		

2. Quotation Received from Enviro Solutions Labs, Coimbatore

S. No.	Description	Total Qnty	Price (INR)	Total Price (INR)
Corridor 1 - KSR Bengaluru City to Devanahalli (41.40Km)				
1.	**Ambient Air Quality Monitoring** – PM_{10} and $PM_{2.5}$ – Continuous sampling for 24 hrs & SO_2, NO_2, CO and Lead – Continuous sampling for 8 hrs, 3 samples in 24 hrs	12	8,965.00	1,07,580.00
2.	**Noise Levels (Once)** – Measurement of hourly L_{eq} in dB(A) for 24 hrs	20	1,250.00	25,000.00
3.	**Ground & Surface Water Quality (One Time Sampling)** – PH, Colour, Temperature, Electrical Conductivity, Turbidity, Total Solids, Suspended Solids, Total Dissolved Solids, Dissolved Oxyge, Biological Oxygen Demand, Chemical Oxygen Demand, Alkalinity as $CaCO_3$, Total Hardness as $CaCO_3$, Chlorides, Fluorides, Sodium, Potassium, Calcium, Magnesium, Sulphates, Nitrates, Nitrites, Total Nitrogen, N, Phosphates, Phenols, Iron as Fe, Mercury, Zinc, Copper, Nickel, Cadmium, Chromium Manganese, Lead, Oil and Grease, Total Coliforms, Faecal Coliforms	12	3,955.00	47,460.00
4.	**Soil Sample Analysis (One Time Sampling)** – Texture (Sand, Silt, Clay), Soil Type, Colour, Moisture Content, Electrical Conductivity (1:5 Soil Extract), pH, Organic Carbon, Nitrogen as N Phosphorus as P, Potassium as K, Chlorides, Sodium Sodium Absorption Ratio (SAR), Bulk Density, Water Holding Capacity, Infiltration, Cation Exchange Capacity, Cadmium as Cd, Chromium as Cr Copper as Cu, Iron as Fe, Manganese as Mn, Lead as Pb, Zinc as Zn Nickel as Ni	4	3,465.00	13,860.00
	Total			1,93,900.00

C. Cost Source for 12mm Polycarbonate Sheets noise barrier along Yelahanka lake



D. Operation Phase Oil Interceptor at Depot

View Similar Products

Neotech Industrial Effluent Oil Water Separator System /ows/tpi/cpi

₹ 3.45 Lakh Get Latest Price

Water Source	Industrial Effluent
Brand/Make	neotech
Installation Service	Yes
Function	oil removal
Angle Of Inclination	50

The Coalescing Plate Interceptor employs a series of plate packs inclined at opposite angles in close proximity; the most effective technique for increasing setting area per unit volume. As a result, CPI Separators requires far less space...

View Complete Details

Get Latest Price
Request a quote

NeoTech Water Solutions

Imran Nagar, Vapi, Valsad, Gujarat
4.5/5 ★★★★★ (34)
GST- 24ABHPD0245L1ZZ

View Mobile Number
86% Response Rate

Leading Supplier | TrustSEAL Verified
Verified Exporter | Manufacturer
Company Video

Contact Supplier

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E. Construction Phase Oil Interceptor at Base Camp/Workshop

View Similar Products

Delux Industries Interceptor Oil And Grease Trap Box

₹ 12,000 Get Latest Price

Water Source	Sewage Water
Brand/Make	Delux Industries
Installation Service	No
Function	Oil Separation
Bar Thickness	1.5 mm

Interceptor Oil And Grease Trap Box usually can hold between 1, 000 to 2, 000 gallons and are buried in the ground outside the building, between the plumbing and the sewer system. If you've ever seen grease in the water, you'll know that it...

View Complete Details

Get Latest Price
Request a quote

Delux Industries

Mumbai, Maharashtra
3/5 ★★★☆☆ (3)
GST- 27AAKFM2591A1ZE
Import Export Code (IEC) - 98204*****

View Mobile Number
68% Response Rate

TrustSEAL Verified | Manufacturer
Company Video

Contact Supplier

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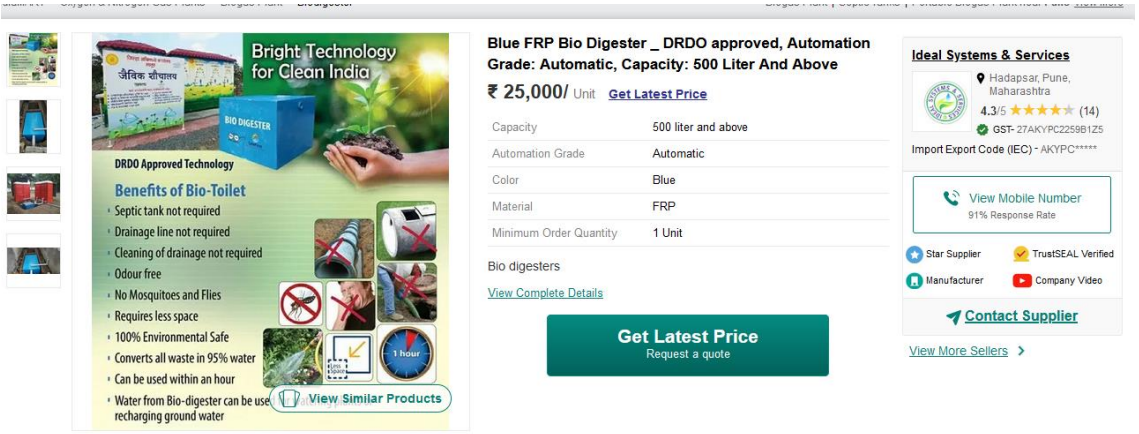

View Similar Products

Blue FRP Bio Digester _ DRDO approved, Automation Grade: Automatic, Capacity: 500 Liter And Above

₹ 25,000/ Unit Get Latest Price

Capacity	500 liter and above
Automation Grade	Automatic
Color	Blue
Material	FRP
Minimum Order Quantity	1 Unit

Bio digesters

View Complete Details

Get Latest Price
Request a quote

Ideal Systems & Services

Hadapsar, Pune, Maharashtra
4.3/5 ★★★★☆ (14)
GST- 27AKYPC2259B1Z5
Import Export Code (IEC) - AKYPC*****

View Mobile Number
91% Response Rate

Star Supplier | TrustSEAL Verified
Manufacturer | Company Video

Contact Supplier

View More Sellers

Delux Industries Interceptor Oil And Grease Trap Box

₹ 12,000 Get Latest Price

Water Source	Sewage Water
Brand/Make	Delux Industries
Installation Service	No
Function	Oil Separation
Bar Thickness	1.5 mm

Interceptor Oil And Grease Trap Box usually can hold between 1, 000 to 2, 000 gallons and are buried in the ground outside the building, between the plumbing and the sewer system. If you've ever seen grease in the water, you'll know that it...

View Complete Details

Get Latest Price
Request a quote

Delux Industries
Mumbai, Maharashtra
3/5 (3)
GST- 27AAKFM2591A1ZE
Import Export Code (IEC) - 98204*****
View Mobile Number
68% Response Rate
TrustSEAL Verified Manufacturer
Company Video
Contact Supplier
View More Sellers

Blue FRP Bio Digester _ DRDO approved, Automation Grade: Automatic, Capacity: 500 Liter And Above

₹ 25,000/ Unit Get Latest Price

Capacity	500 liter and above
Automation Grade	Automatic
Color	Blue
Material	FRP
Minimum Order Quantity	1 Unit

Bio digesters

View Complete Details

Get Latest Price
Request a quote

Ideal Systems & Services
Hadapsar, Pune, Maharashtra
4.3/5 (14)
GST- 27AKYPC2259B1Z5
Import Export Code (IEC) - AKYPC*****
View Mobile Number
91% Response Rate
Star Supplier TrustSEAL Verified
Manufacturer Company Video
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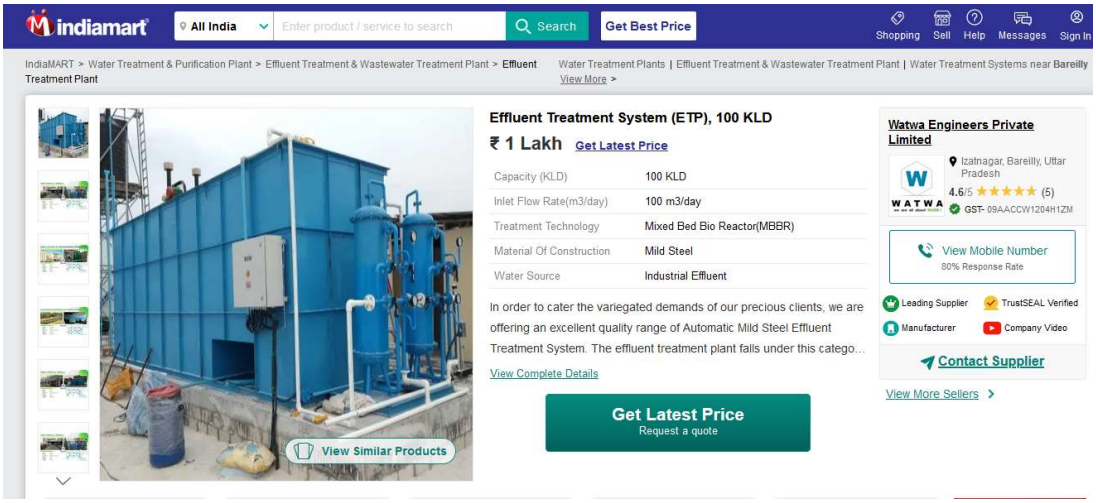

Effluent Treatment System (ETP), 100 KLD

₹ 1 Lakh Get Latest Price

Capacity (KLD)	100 KLD
Inlet Flow Rate(m3/day)	100 m3/day
Treatment Technology	Mixed Bed Bio Reactor(MBBR)
Material Of Construction	Mild Steel
Water Source	Industrial Effluent

In order to cater the variegated demands of our precious clients, we are offering an excellent quality range of Automatic Mild Steel Effluent Treatment System. The effluent treatment plant falls under this catego...

View Complete Details

Get Latest Price
Request a quote

Watwa Engineers Private Limited
Izatnagar, Bareilly, Uttar Pradesh
4.6/5 (5)
GST- 09AACCW1204H1ZM
View Mobile Number
80% Response Rate
Leading Supplier TrustSEAL Verified
Manufacturer Company Video
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D. Rain Water Harvesting Pit arrived as per KPWD Schedule of Rates

Item No.	Description	No.	Length	Breadth	Height	Area	Unit	Quantity	Rate	Amount in Rupees
1.01	Earth work excavation by manual means for trenches, foundation and such similar works in all kinds of soils , as per drawing and technical specifications, including setting out, shoring, strutting, barricading, caution lights, removal of stumps and other deleterious matter, excavated surface leveled and sides neatly dressed disposing off the excavated stuff or sorting & stacking the selected stuff for reuse in a radius of 50 m and lift upto 1.5 m including cost of labour, tools & other appurtenances required to complete the work.						Cum	**9.00**	186.00	1,674.00
		1			4.50	1.767		7.95		
		1			15.00	0.020		0.30		
1.02	Providing and laying 100mm thick pre-cast cover slabs over Rain water harvesting pit of width not exceeding 1000 mm using M20 concrete reinforced with TMT bars Fe 500 @ 6kg/m2, slabs jointed in CM 1:3 proportion and nicely finished Including providing holes in the Cover slabs wherever necessary for easy drainage of surface water including of labour, materials, scaffolding, usage of machinery, curing, lead and lift charges etc, Complete.						Sqm	**0.16**	1,114.00	180.00
		1			0.10	1.767		0.18		
	Deductions for perforation	78			0.10	0.002		(0.02)		
1.03	Providing and laying in position Circular concrete rings with holes as per specifications and Engineer in charge with all costs with necessary arrangements for Inlet and Outlets						Cum	**7.18**	10,000.00	71,800.00
		15			0.30	1.595		7.18		
1.04	Supplying, Fitting and Placing TMT Fe 500 & above Reinforcement in Foundation / Substructure /						MT	**0.10**	76,376.00	7,300.00
		45	4.48			0.222		44.71		

	Superstructure complete as per Drawing and Technical Specifications.	675	0.30			0.222		44.95		
		20	0.75			0.395		5.92		
1.05	Supplying, filling, spreading &leveling coarse sand of size range 1.5mm to 2 mm in recharge pit, in required thickness over gravel layer, for all leads & lifts, all complete as per direction of Engineer -in-charge.						cum	**0.48**	397.00	191.00
		1			0.30	1.595		0.48		
1.06	Supplying, filling, spreading &leveling gravels of size range 5 mm to 10 mm, in the recharge pit, over the existing layer of boulders, in required thickness, for all leads & lifts, all complete as per direction of Engineer-in-charge.						cum	**0.78**	372.00	290.00
		1			0.30	1.595		0.48		
		1			15.00	0.020		0.30		
1.07	Supplying PVC ringtite pipes conforming to IS 4985:2000 with latest amendments and conveying to worksite, rolling and lowering into trenches, laying true to line and level and perfect linking at joints, testing and commissioning, including loading unloading at both destinations and cuts of pipes wherever necessary including jointing of PVC pipes and specials (excluding cost of specials) with jointing of approved type, with all labour with all lead & lift including encasing the pipe alround to a depth of not less than 15 cms. with soft gravel or selected earth available fromthe excavation etc. complete and giving necessary hydraulic test to the required pressure as per ISS (Contractor will make his own arrangements for procuring water for testing) etc.	1	17.00				m	17.00	599.00	10,183.00
	PVC pipes 160mm dia., 6 kg/sqcm & class 3									
	Total									**91,700.00**