ENVIRONMENT IMPACT ASSESMENT FOR FOUR LANING OF NH-64 FROM ZIRAKPUR TO PATIALA

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In

Environmental Science and Technology

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DECLARATION

I hereby declare that the thesis entitled **"Environment impact assessment for four laning of NH-64 from Zirakpur to Patiala"**, is an authentic record of my own work carried out as requirements for the award of degree of Master of Technology in Environmental Science & Technology from Thapar University, Patiala, under the guidance of Mr. Amit Dhir (Assistant Professor, Department of Biotechnology and Environmental Sciences) & Mr Tanuj Chopra (Assistant Professor, Department of Civil Engineering) during January to June 2012.

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ABSTRACT

The Environmental Impact Assessment (EIA) is a systematic investigation of both positive and negative impacts on the physical, biological socioeconomic environment, which would be caused or induced due to a proposed developmental project. EIA helps to develop environmental friendly projects and seeks to reduce environmental degradation caused by developmental activities. It also provides a plan to reduce the negative environmental effects of proposed development project through alternative approaches, design modifications and remedial measures .Highway construction is a major activity of economic development especially in developing countries. Road development is major source of damage to the environment, including ecological destabilization, habitat disturbance and damage to flora and fauna. The present report analyses the environmental impacts likely to occur due to the proposed widening of a 50 km stretch of NH-64 from Zirakpur to Patiala. The report highlights the importance of EIA in the sustainable development of highway project with a case study of vital link of about 50 Kilometers. The study concentrates on the environment impact assessment of the project in the light of the existing situation at the site. The parameters covered in study are Socio-Economic, Biological, Air (Dust), Water, Noise, Ecological & Soil. Samples of air, water & soil were taken to analyze their present conditions. Data was also collected from various Government offices like the forest department and town & country planning department . The results demonstrated that the fluoride content exceeded the prescribed limits in most of the groundwater samples, $PM_{2.5}$ concentrations at all locations also exceeded the prescribed limits. Noise levels were found within permissible limits. Minimal soil contamination was observed. Highway capacity was analyzed and it was observed that the present two lane highway is insufficient to handle the current traffic volume so the section requires four laning immediately to accommodate more traffic. After analyzing different parameters and discussing the probable impacts suggestions are made regarding the mitigation measures that can be taken at different stages in order to reduce the environmental impacts. To check its feasibility the project is then evaluated with the help of matrix method.

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CHAPTER 1
INTRODUCTION TO ENVIRONMENTAL IMPACT ASSESSMENT

1.1 WHAT IS ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Environmental Impact Assessment is a tool used for decision making regarding projects, developments and programmes such as incinerators, airport runways, pig rearing and peat extraction. EIA is intended to identify the Environmental, Social and Economic impacts of a proposed development prior to decision-making. This means that it is easy to identify

1. The most environmentally suitable option at an early stage
2. The best practicable environmental option
3. Alternative processes

The project managers can then address these problems in order to avoid or minimize environmental impacts in conjunction with their project planning. This results in the likelihood of the project planning stages running smoother The Environmental Assessment is carried out by the Developer although the task is often carried out by Environmental Consultants. Environmental Assessment is carried out in order to produce an Environmental Statement. The Environmental Statement must include:

- A description of the project: location, design, scale, size etc
- Description of significant effects
- Mitigating Measures
- A Non-Technical summary

1.2 THE EIA PROCESS

There are two steps in EIA. The two stages are

- Preliminary Assessment: Carried out in the early stages of planning
- Detailed Assessment: Carried out during project planning until the project plan is completed and are reported formally as an Environmental Statement

1.3 DEFINING IMPACT ASSESSMENT

Environmental impact assessment is, in its simplest form, a planning tool that is now generally regarded as an integral component of sound decision-making. As a planning tool it has both information gathering and decision making component, which provides the decision maker with an objective basis for granting or denying approval for a proposed development.

Justice La Forest, Friends of the Oldman v. Canada et al. (1991)

Environmental Impact Assessment (EIA) may be defined as a formal process used to predict the environmental consequences of any development project. EIA thus ensures that the potential problems are foreseen and addressed at an early stage in the projects planing and design.

Manu and Anshu, UEMRI-India

EIA Definitions ... a process or set of activities designed to contribute pertinent environmental information to project or programme decision making. ... A process which attempts to identify, predict and assess the likely consequences of proposed development activities. ... a planning aid concerned with identifying, predicting and assessing impacts arising from proposed activities such as policies, programmes, plans and development projects which may affect the environment. ... A basic tool for the sound assessment of development proposals to determine the potential environmental, social and health effects of a proposed development

Unknown

The purpose of the environmental assessment process is: (a) to support the goals of environmental protection and sustainable development. (b) To integrate environmental protection and economic decisions at the earliest stages of planing an activity. (c) to predict environmental, social, economic, and cultural consequences of a proposed activity and to assess plans to mitigate any adverse impacts resulting from the proposed activity, and (d) to provide for the involvement of the public, department of the Government and Government agencies in the review of the proposed activities.

Alberta Environmental Assessment and Enhancement Act (38)

Balanced assessment of effects on the environment should encompass a number of considerations. Depending on the nature, scope and significance of the project or proposal the assessment may include consideration of ecological, economic, cultural, aesthetic, health and safety, social and amenity impacts in relation to decisions on the sustainable management of natural and physical resources.

A Guide to Health Impact Assessment

Environmental Impact Assessment is a planning tool that its main purpose is: "to give the environment its due place in the decision making process by clearly evaluating the environmental consequences of a proposed activity before action is taken. The concept has ramifications in the long run for almost all development activity because sustainable development depends on protecting the natural resources which is the foundation for further development".

Alan Gilpin (1995) Environmental Impact Assessment - Cutting Edge for the twenty-first century, Cambridge University Press.

Environmental Impact Assessment (EIA) is a tool used to identify the environmental, social and economic impacts of a project prior to decision-making. It aims to predict

environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers. By using EIA both environmental and economic benefits can be achieved, such as reduced cost and time of project implementation and design, avoided treatment/clean-up costs and impacts of laws and regulations.

The key elements of an EIA are (a) Scoping: identify key issues and concerns of interested parties; (b) Screening: decide whether an EIA is required based on information collected; (c) Identifying and evaluating alternatives: list alternative sites and techniques and the impacts of each; (d) Mitigating measures dealing with uncertainty: review proposed action to prevent or minimize the potential adverse effects of the project; and (e) Issuing environmental statements: report the findings of the EIA.

UNEP-DTIE

1.4 ENVIRONMENTAL CONSIDERATIONS IN HIGHWAY PROJECTS

Road development can have wide-ranging environmental impacts compared to many other development projects. This is because road extend over long distance and, by promoting rapid communication, they can catalyze dramatic changes in land-use patterns not only in the immediate vicinity but also in the adjacent hinterlands. Road development is very important for the socio-economic development of any region. Development of industry, mining forestry, agriculture, trade and tourism etc. depends to a large extent on the existence of efficient transport network. In order to increase the efficiency of transportation system new roads are being constructed and existing roads being improved.

Road project are generally intended to improve the economic and social well being of people. Increased road capacity and improved pavements can reduce travel time and lower the costs of vehicle use, while increasing access to markets, jobs, education and health services and reducing transport cost for both freight and passengers. For all the

positive aspects of roads, they may also have significant negative impacts on nearby communities and natural environment. The environmental problems, which are associated with the highways, strangulate the road system in most of the cases. The most common problems are:

1. Air Pollution
2. Noise Pollution
3. Water pollution
4. Vibration
5. Discharge of effluents on the road sides
6. Wildlife disturbance
7. Deforestation
8. Contamination of soil
9. Setting up of Brick Kilns and other industries along the highways
10. Visual intrusion and degrading of aesthetics
11. Socio economic impacts

1) Air Pollution: Air pollution takes the form of poisonous fumes and smell caused by the emissions from the engine exhaust. The major pollutants are carbon monoxide, oxidizes of nitrogen lead particulars and smoke. Smoke in combination with fog can cause sway, which is hazardous to driving. The hot mix plants which are used in the construction of highways create a large amount of pollution.

2) Water Pollution: A number of factors related to project actions, plans, programmes, and policies affect water quantity and quality directly and indirectly. It is a major task of the EIA exercise to identify such factors and assess their impact on water and aquatic environment. Some of the crucial factors linked with water related impacts on highway projects can be listed as follows:-

- Surface stream discharge
- BOD
- Suspended solids
- Turbidity

- Total dissolved solids
- Phosphorous
- Chlorides
- Ground water quantity and quality
- Erosion
- Sedimentation

3) Socio-Economics: H/R projects can provide beneficial impacts through increased access, which in turn can lead to the proliferation of new industries, hotels, restaurants, resorts and other employment opportunities. However, these secondary developments could have adverse environmental impacts in term of an increased load of pollution.

H/R development can have significant effects on communities. H/R projects in urban areas often require displacing or disrupting segments of residential or business communities and may thus isolate certain portions of a community. Certain business may benefit or suffer on account of new roads. Proximity effects such as noise and vibration can change or alter the character of facilities and services and thus must be described / analyzed.

H/R projects can have significant impacts on adjacent land costs. A problem that may occur in the rural areas is unequal distribution of access to markets is caused by poor planning that results in road system bringing a surplus of access to some markets while not meeting the needs of other markets.

4) Ecological Resources:

i. **Forestry:** The effects of the H/R projects on forestry are primarily caused by the site clearance for the roadbed and right-of-way, improved accessibility leading to encroachments by the people. The forest composition, the types and number of trees to be cut down during the construction, the estimated loss of forest productivity and the estimated impacts of this loss on sub-national and national levels, should be described.

ii. **Wild Life:** The wild life species likely to be affected by the project should be listed, and those species that are of sub-national/ national/ international significance should be identified. If possible, there should be assessment of the intrinsic value of the wild life resources in the overall national resource context to determine whether alternative routing can be given to preserving wildlife travel routes, especially for such susceptible species as arboreal animals and deep-forest birds.

5) Noise: Proximity effects such as noise and vibration can change or alter the character of facilities and services and thus must be described / analyzed.

6) Traffic: The transport system including road network has become one of the major factor in the overall progress and instrumental for economic development. This has induced tremendous growth of traffic creating multi faceted problems for the movement of men and material within the state. Preliminary investigations should be done at the project site in order to formulate the basis of the project study. Traffic surveys are conducted on the project road in order to derive the appropriate design of the road, to identify present and future problems, and to identify solutions.

7) **Soil:** Soil at and around a construction site may get contaminated by deposition of construction contaminants due to air transport as well as water runoff of construction contaminants .Soil may constitute a sink for pollutants and some of those may accumulate in soil and persists over longer periods of time

1.5 METHODOLOGY FOLLOWED

To cover up all parameters of the proposed dissertation in a systematic and time bound manner following steps are followed:

1. **Reconnaissance survey**: Reconnaissance survey is conducted for gathering initial information about the physical features of the site and locating certain important points along the site.

2. **Data collection**: Next step is to collect data on various parameters. This would include data on:

   Water characteristics: Samples from various locations throughout the stretch were taken

   Air (Dust) characteristics: The dust sample was taken from site on a filter paper with the help of Personal Dust Monitor.

   Biological Characteristics (Flora & Fauna): For collection of Biological characteristics, various government agencies were consulted for getting data on various species of trees along the proposed site.

   Soil Characteristics: Different soil samples were collected from different sites alongside highway.

   Socio-Economic Characteristics: For collection of Socio-Economic data, a questionnaire was prepared for conducting site interviews.

   Noise: Three different locations were selected and noise was measured with the help of noise meter. Noise was measured at the regular interval of 10 minutes for one hour at each location during peak hours and off peak hours.

3. **Testing**: Various samples of Water and Air (Dust) shall be tested in laboratory. Following are some of the tests which were conducted:

   Water: DO, BOD, pH value, Chloride Content and Hardness.

Air (Dust): Dust collected on the filter paper was tested in laboratory for Dust load/ Suspended Particulate Matter (SPM) & Respirable Particulate Matter (RSPM)

Biological Characteristics (Flora& Fauna): Data was collected from different government departments mainly forest department.

Soil: Contamination tests were performed on different soil samples.

Socio- Economic: Data collected through the surveys was analyzed.

Noise: The data collected was analyzed by comparing it with the standard values.

4. Data analysis: The data so collected above was analyzed and comparisons will be made, for various parameters, between the standards as given by ministry of environment and forest and the values/measurements obtained from the site under consideration. Graphical representations in the form of Bar/Pie charts of the same were made.

5. Recommendations: Once the analysis is complete recommendations will be made for further improvement of the environment of the site in view of public comfort, economy and health.

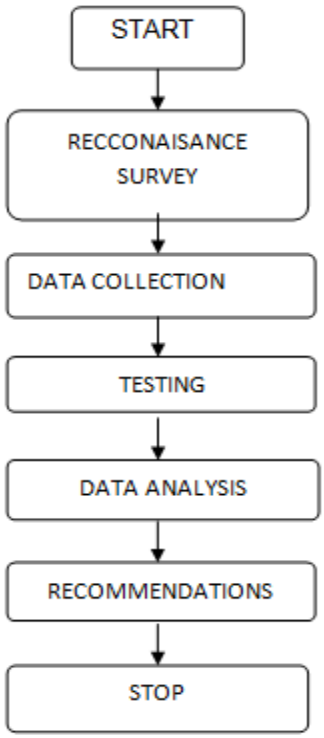


Fig No 1.1: Flow Chart of EIA Methodology

CHAPTER 2
REVIEW OF LITERATURE

Environmental Impact Assessment is an important tool for decision making regarding projects, developments and programmes. By analyzing the baseline information and predicting the impacts, alternative processes are suggested so that the most environmentally suitable options are adopted. The literature review addresses various studies made to review the EIA process & aims to analyze its effectiveness and suggesting measures to overcome the shortcomings. The review also aims to study new methodologies that can be incorporated to make the process more effective and less time consuming.

2.1 GLOBAL SCENARIO

The merits of the map overlay method and the matrix method was integrated and Geographic Information System (GIS) based map overlay method was developed by **Xiugang et al. (1999)** to analyze comprehensively the environmental vulnerability around road and its impact on the environment. He observed that new technologies, as GIS, remote sensing and CAD are more efficient and convenient to collect, manage and analyze data, and visualize the results of assessment. GIS is used to manage and analyze extensive environmental data and is regarded as the right tool. Both environmental vulnerability grade and road impact extent were analyzed. This method has been proved practicable in the assessment application in the road under study

The use of an Integrated Landscape Ecological Approach on the evaluation of the impact of a proposed highway over a high sensitive habitat of the highly endangered was described by **Fernandes (2000) .**Study on landscape ecology, conservation management was conducted, and further evaluation of the alternatives in a highway EIA process was done. The method described prevents the occurrence of common errors in the decision making process by allowing an increased knowledge of the ecological constraints of the project .The conflict of arguments on the consistency of the conclusions of the method was also described. The example given and the methodology proposed showed that

Landscape Ecology (LE) is a powerful and useful tool for landscape management. It allows the evaluation of the cost of maintenance of given habitats or structures in certain sites and the identification of cumulative ecological impacts, thus avoiding biased conclusions or statements derived from an insufficient knowledge of the ecology of the target species or habitats. It was thus concluded that there is the urgent need for an integrated ecological evaluation of plans and policies at the regional and national levels, where the landscape will not be considered as a "white sheet" (considering only the economical and social infrastructures and uses), but as a complex structural and functional system where economy, culture, and environment are irreversibly bounded. With methodology proposed it is possible to develop a consistent habitat analysis based on scarce ecological data on a target species population which contributes to the reduction of errors.

Problems with the development of alternatives, based on a study of EIAs in the US, was investigated by **Steinemann (2001)** and ways to improve environmental decision-making was proposed Inadequate alternatives can undermine the goals of EIA . Public participation often occurs too late. In addition, the EIA process often occurs too late in agency decision-making to consider a full range of alternatives. Results of the study emphasized the importance of alternatives, and the need to improve alternatives development and the EIA process. Important recommendations were given like: incorporating environmental considerations earlier in the agency planning process, moving up EIA in the agency planning process, not easily eliminating the more environmentally sound alternatives & in developing alternatives, agencies should more fully consider the irreversibility of an action before making an irreversible commitment of environmental resources.

A new methodology for impact assessment-SIAM (Spatial Impact Assessment Methodology) was presented by **Antunes et al. (2001)** which is based on the assumption that the importance of environmental impacts is dependent, among other things, on the spatial distribution of the effects and of the affected environment. SIAM was demonstrated as a toll to improve the effectiveness of EIA. The information generated by the use of Geographical Information Systems (GIS) in impact identification and prediction stages of Environmental Impact Assessment (EIA) was used in the assessment

of impact significance by the computation of a set of impact indices. For each environmental component (e.g., air pollution, water resources, biological resources), impact indices were calculated based on the spatial distribution of impacts. A case study of impact evaluation of a proposed highway in Central Portugal illustrated the application of the methodology and showed its capabilities that can be adapted to the particular characteristics of a given EIA problem. It was thus concluded that SIAM could be applied to the EIA of any proposed project where the spatial distribution of the impacts is relevant & the application of this methodology can contribute to a more effective use of the information generated in all EIA stages for impact evaluation

The environmental impacts of abandoned coal mines was studied .It was mentioned that even after coal mining has ceased, emissions of methane and other hydrocarbons from coal seams continues & even if the mine entries are sealed there is sufficient gas remaining in the unmined coal seams. The possible risks to the public, and to redeveloped coalfield areas, from uncontrolled migration of gas from closed mines were not yet recognized & were still under investigation. Methods for estimating abandoned resources and mine methane (AMM) reserves were developed and technologies for extracting and using methane from abandoned mines were mentioned. Thus the most effective approaches to reducing methane emissions after mine closure are ,Extraction and utilization of methane from the mine after sealing & allowing the mine workings to flood as soon as possible after cessation of coal production thus preventing gas release and migration . It was suggested that prior to closure of a gassy mine, the feasibility of constructing an AMM extraction and utilization scheme should be undertaken. **Armstrong et al. (2003)**

The applicability of the RIAM method (rapid impact assessment matrix) is in the context of impact significance assessment was evaluated. The methodological issues considered in the study were: to test the possibilities of enlarging the scoring system used in the method, and to compare the significance classifications of RIAM and unaided decision-making to estimate the consistency between these methods. Cases were evaluated with respect to their environmental, social and economic impacts using an assessment panel. The study exemplified that how the RIAM method can be modified with respect to the

assessment situation at hand and thus be made more responsive to the demands of the evaluation process itself. It was demonstrated that with a more flexible scoring framework and evaluation criteria, it is possible for an evaluator to more closely define the aspects he wants to bring to the analysis while taking advantage of the transparent basic structure of the method. The comparison of the RIAM method and unaided judgment showed that the essential conceptual characteristics of impact significance can be captured and assessed with RIAM, although some differences were also observed in the results . **Markku et al. (2010)**

2.2 INDIAN SCENARIO

The use of a multi-criteria technique, namely the analytic hierarchy process (AHP) was proposed, for the EIA by **Ramanathan (2001)**. AHP has the flexibility to combine quantitative and qualitative factors, to handle different groups of actors, to combine the opinions expressed by many experts, and can help in stakeholder analysis. The use of AHP was illustrated for a case study involving socio- economic impact assessment. In the case study, AHP was used for capturing the perceptions of stakeholders on the relative severity of different socio-economic impacts, which will help the authorities in prioritizing their environmental management plan, and can also help in allocating the budget available for mitigating adverse socio-economic impacts. Thus several advantages of using the (AHP) as a tool while carrying out an environmental impact assessment was highlighted. It was concluded that AHP can be a useful tool for systematically analyzing the opinions of several groups of experts belonging to diverse fields in an environmental impact assessment study.

Paliwal (2006) evaluated EIA process in India through Strength, Weakness, Opportunity and Threat (SWOT) analysis & she suggested that in India Environmental Impact Assessment (EIA) relied on the institutional framework that has a strong supporting legislative, administrative and procedural set-up. Both central and state authorities together are sharing the responsibility of its development and management. The SWOT analysis taken up of the EIA suggested that there are several issues that need to be readdressed. Several constraints, ranging from improper screening and scoping guidelines to ineffective monitoring and post project evaluation were highlighted. The

opportunities addressed for improving EIA were increasing public awareness, initiatives of environmental groups, business community, and forward thinking to integrate environmental consideration into plans and policies. Poor governance, rapid economic reforms, and favors to small-scale units were identified some of the foreseen threats to the system. It was mentioned that improved effectiveness would also depend on strength of government agency coordination, integrated decision-making adequate training to various stake holders and supporting infrastructure for purposeful monitoring and enforcement. It was suggested that the EIA system should be regularly revisited for progressive refinement that should not only remove existing constraints but also take care of future challenges. It was further recommended that project level EIA needs immediate attention but efforts should also be targeted to include environmental conservation concerns at policy and planning level. Such initiatives would help in filling up the gaps in coordination between various government authorities involved in planning and execution.

A report on Environmental Impact Assessment (EIA) for the proposed improvements to the Project Road from Chengapalli (Km 100+000) to Walayar (Km 182+250) was presented by **Wilber Smith Associates (2008)** to National Highways Authority of India (NHAI) .The report was prepared according to the structure of the EIA Report presented in the EIA Notification, 2006 by Ministry of Environment and Forests, Government of India. The EIA was based on detailed field reconnaissance surveys, inventories and available secondary information. No significant adverse impacts were anticipated on the environment due to the proposed improvements. However, temporary impacts are anticipated on air quality, noise levels, water quality, soil quality, flora & fauna and socio-economic environment of the project area. Further, an increase in ambient noise level is expected along the project road during the operation stage. Proper mitigation measures were proposed in the EMP for mitigating the negative impacts. The environmental monitoring plan and reporting mechanism proposed as part of the EMP will ensure the proper implementation of the EMP.

EIA for nuclear facilities was studied & how environmental, health, social impacts and public inputs have been taken into account was examined. It was observed that there are concerns that are specific to nuclear facilities in addition to generic problems associated with the EIA process for all kinds of projects in India. **Ramana et**

al. (2010) observed that some nuclear facilities are exempted from the environmental clearance process. That data regarding radiation baseline levels and future releases is controlled entirely by the nuclear establishment & members of the nuclear establishment take part in almost every level of the environmental clearance procedure thus making the EIA process is of dubious quality. Regarding the public consultation it was observed that the administrative authorities conducting the public hearings are clearly sided with project proponents & ignored the views of locals is .Thus some steps were suggested to improve the situation like: subjecting all facilities, including reprocessing plants to the EIA process , the proposer should be required to go through the public comment process again with revised EIA if an EIA is found to be faulty at the technical or factual levels and setting up an agency , completely independent of the nuclear establishment. It was proposed that Atomic Energy Regulatory Board should be kept outside the administrative and financial purview of the Atomic Energy Commission & steps should be taken to make public participation more meaningful & radiation levels should be measured time to time.

An environmental impact assessment report on proposed 6/8 lane highway connecting Noida to Agra was presented by **Jaiprakash Associates Ltd** in 2010 and described the situation existing currently and effectively predicted the degree of the effects the impacts related to project can cause. Socio-Economic impacts were carefully observed and it was made sure that public consultation must be taken regarding the project. It was concluded that both negative and positive impacts are associated with the project. It was also made sure that ecological sensitive areas were avoided. Since in the project environmental considerations have been taken care of from the project design stage itself barring a few unavoidable negative impacts no major impact is anticipated. On the other hand, a number of positive long-term environmental benefits can be derived from the project. With all the environmental considerations in mind, plantation in terms of number of trees per km and type of trees to be planted was suggested for each of the two rows. The two sides of the road are to be planted as per the same plan. Suggestions were also made regarding the technologies used during the construction so that there is minimal effect on the current prevailing environmental conditions.

An environmental impact assessment report for four laning of NH-95 from Chandigarh to Ludhiana was presented by **Consulting Engineering services** in 2010. It described the current existing situation and effectively predicted the degree of the effects the impacts related to project can cause. The EIA study was prepared in accordance to the TOR. The EIA fulfills the requirements of Government of Punjab & Chandigarh and conforms in content with Ministry of Environment & Forests (Govt. of India). The report covered major finding on present environmental scenario, legal & administrative framework, and evaluation of potential environmental impacts due to construction of four to six lane and construction of new proposed bypass on the corridor. It was concluded that both negative and positive impacts are associated with the project and thus mitigation measures were also suggested. Different environmental issues were discussed in detail & the protection and preventive measures to be taken by contractor were also mentioned. To make sure that the construction work was carried out in sound environmental standards Environmental Management Plan (EMP) was also included. The EMP envisages the plans for effective implementation of mitigation measures to minimize adverse impacts due to project activity. Environmental Monitoring Programme during construction and operation was also advised.

Strategic issues of EIA for highway projects with a case study of Indian national highway NH-21(Mohali to Ropar district connecting Kharar & Kurli) was analysed by **Chopra et al. (2011)**. The analysis highlighted the importance of EIA in the sustainable development of highway project with a case study of vital link of about 20 Kilometers. The study concentrated on the environment impact assessment of the above project in the light of the existing situation at the site. The parameters covered in the work were Socio-Economic, Biological, Air (Dust), Water, Noise, Ecological, Soil and Cultural/Historical. Based on existing data and the assessment/ evaluation and analysis of the potential impacts, total impact was calculated by the matrix method. Based on nature and type of impacts, an appropriate mitigation / enhancement measure were suggested that will be implemented during construction and operation phase. It was thus concluded that though there are some major impacts associated with the road construction the overall project was environmentally beneficial.

From the literature review, it can be concluded that effectiveness of EIA process suffers from failures stemming not from one domain, but from different ones: technical, methodological & procedural. Public participation is an important component of the whole process and it should be strictly incorporated and monitored. The EIA process should be improved & improved effectiveness will depend on strength of government agency coordination, integrated decision-making adequate training to various stake holders and supporting infrastructure for purposeful monitoring and enforcement. To remove existing constraints the EIA system should be regularly revisited for progressive refinement. Inclusion of new methodologies like Geographic Information System (GIS) based map overlay method , SIAM (Spatial Impact Assessment Methodology), RIAM method (rapid impact assessment matrix) ,analytic hierarchy process (AHP) etc will help a great deal to make the process more effective and less time consuming.

CHAPTER 3
PROJECT DESCRIPTION

3.1 INTRODUCTION

Any developmental project would give rise to certain direct and indirect impacts on various environmental and social attributes like air, water, soil, noise, flora and fauna, private property, livelihoods and on the community property resources. The developmental projects like widening of road infrastructure would improve the socio-economic status of the local population, bring a better connectivity, and improve industry and tourism in the area. Infrastructure development particularly faster movement and transportation of goods in a country like India is a guiding factor for economic development. Proper transportation of goods requires comprehensive transport systems and increasing road traffic requires better roads. Hence, it becomes necessary to widen the existing road carriageways, in the form of new bypasses and roads.

The government of India has requested the assistance of the World Bank for upgrading and rehabilitation of state highways, major district roads and other district roads in the state of Punjab. The Punjab roads & bridges development board (PRBDB) will be the executing agency for the project. A strategic option study (SOS), carried out for the public works department (PWD), has prioritized road sections for improvement from the 1698 km of state highways (SH), major district roads (MDR) and other district roads (ODR). The government of Punjab has selected the roads for phase-1 which total approximately 367km (comprising approx 252 km roads for rehabilitation and another 115 km for upgrading works).

Ministry of Shipping road Transport and Highways, Govt of India through , Public Works Department (Bridges & Roadshave decided to upgrade four lane divided carriageway from existing two lane carriageway from Zirakpur to Bhatinda National Highway in a portion/section of Zirakpur Patiala section from 0.00 to 50.700 km. It is proposed that the existing two Lane National Highway section of 50.700 km be rehabilitated and upgraded to four lane divided carriageway configuration existing two lane carriageway will be widened by constructing two additional lanes and a central

median along the existing two lanes between the eccentric as well as concentric configuration. The project will be executed on public private partnership (PPP) venture in a Develop, Built, Finance, Operate and Transfer (DBFOT) Pattern.

3.2 SOCIO ECONOMIC PROFILE IN THE PROJECT INFLUENCE AREA (PIA)

3.2.1 GENERAL

State of Punjab is situated in North West of India, bordered by Pakistan on West, the Indian states of Jammu & Kashmir on the North, Himachal Pradesh on North its East & Haryana & Rajasthan to its south state lies on the globe at 29^0 $30^/$ North latitude and 73^0 55' North and 76^0 50' East longitude. Chandigarh is the administrative capital of Punjab. Most of Punjab is a fertile plain. Towards the southeast of Punjab one finds semi-arid and desert landscape and in the northeast, there is a belt of undulating hills at the foot of the Himalayas. Four rivers, the Ravi, Beas, Sutlej and Ghaggar flow across the state in a southwesterly direction. They have numerous small and seasonal tributaries. In addition, Punjab is watered by an extensive canal system.

Table 3.1 Socio-economic snapshot of Punjab

Parameters	
Capital	Chandigarh
Geographical Area (sq km)	50, 362
Administrative districts (no.)	20
Population Density	550
Total Population (million)	27.7
Male Population	14.6
Female population	13
Sex Ratio	893
Literacy Rate (%)	76.7
Male Literacy Rate (%)	81.48
Female Literacy Rate (%)	71.34

Source: Punjab Government Website, census (2011)

Agriculture is the main occupation of the people of Punjab and forms the backbone of the state economy. The state has widespread Highways and district roads and every village is

well connected with village roads i.e. 100% coverage and 13 national highways pass through the state.

3.2.2 CLIMATE

Predominantly there are three main seasons in the project area, these are summer, monsoon and winter. The summer begins in early March and last till June; average temperature during summer sometimes reaches up to 47^0C. The monsoon begins in late June. During monsoon project area receives average rainfall of 149 to 464 mm. The monsoon season lasts until the end of September and average temperature during this season is 39.3^0C. Winter starts in December and lasts until late February the minimum temperature touches the freezing point occasionally.

3.2.3 MAJOR LAND FEATURES AND SOIL TOPOGRAPGY

Most of the land is fertile plain; towards south-west, one finds semi arid regions .Except for some hills of Shivalik system situated along its border with Himachal Pradesh in north. Punjab state is a vast monotonous plain having an average elevation ranging from 180-290 m above the mean sea level. The plain is an outcome of the alluvial deposits of Indo – Gangetic river systems ranging in age from Pleistocene to recent periods. The following deposits of alluvium are recognized as 'Bhangar' old alluvium that occupies the higher ground forming small plateau and containing much 'Kankar" and 'Khadar": newer alluvium that occupies lower level than 'Bhangar" these have clay with less 'Kankar'. State is irrigated with extensive canal system after construction of Bhakda Dam on river Sutlej. Based on seismic classification the all district of project area lies in moderate magnitude seismic Zone III.

3.2.4 AREA & POPULATION

Punjab state comprises of 50,362 sq km area and occupies 1.54% of country's total geographic area. Population according to 2011 census report population of Punjab is 2, 77, 04,236 with Population Density (per sq km) - 550. Of the 27.7 million, 14.6 million are males, while 13 million are female. There are 157 towns and 12673 villages. The capital of Punjab is Chandigarh Union Territory. The highest growth rate of population has been in Mohali, Patiala and Tarn Taran, districts. Barnala has the lowest population

with only 5.96 lakh people. Sex ratio of the state is 893 and literacy rate is 76.7 %.Hoshiarpur has the highest literacy at 85.4 per cent, followed by Mohali (84.9) and Muktsar and Mansa are at the bottom with 60 and 56 per cent literacy, respectively.

3.2.5 IMPORTANT LINKAGES

At present Punjab has 1739.15 km length 13 number of National Highways (including length of bye-pass at Abohar & Gurudaspur)

Table 3.2: National Highways in Punjab

S.No	NH	AREAS COVERED	LENGTH
1	1	Punjab/Haryana Border-Raipura-Khanna-Ludhiana-Lodhowal-Phillaur-Goraya-Phagwara-Jalandhar-Sara Nussi-Kartarpur-Beas-Butari-Tangra-Amritsar-Atari-Punjab/Pak Border.	272.42
2	1A	Jalandhra-Sanaura-Dasuya-Bhangala-Pathankot-Punjab/J&K Border	112.97
3	10	Punjab/Haryana Border-Mandi Dabwali-Lambi-Abul Kharana-Malaut-Abohar-Nihalkhera-Fazilka-Indo/Pak Border.	109.06
4	15	Amritsar-Gohtwar Varpal-Taran Taran-Sirhali-Makhu-Zira-Faridkot-Kot-Lambwali-Bhatinda-Fakarsar-Malaut-Abohar-Bakayanwala-Punjab/Rajasthan Border.	360.87
5	20	Pathankot and upto H.P. Border	11.975
6	21	Punjab/Chandigarh Border-Kharar-Kurali-Rupnagar-Ghanauli-Nirmohgarh-Punjab/H.P. Border	82.0
7	22	Punjab/Haryana Border-Lalru-Basi upto Haryana Border.	30.99
8	64	Punjab/Haryana Border-Banur-Rajpura-Patiala-Sangrur-Dhanaula-Barnala-Tapa-RampuraPhil-Bathinda-Punjab/Rajasthan Border.	209.5
9	64-A	Bhatinda –Dabawali upto Haryana border	40.44
10	70	Jalandhar-Adampur-Nasrala-Hoshiarpur-Punjab/H.P. Border	57.62
11	71	Jalandhra-Nakodar-Mahatpur-Moga-Dala-Barnala-Dhanaula-Sangrur-Dirba-Dogal-Punjab/Haryana Border.	203.99
12	72	Punjab/Haryana Border and up to Punjab/Haryana Border.	4.52
13	95	Kharar-Marinda-Khamnon-Samrala-Ludhiana-Jagraon-Moga-Ferozpur-Husainiwala Cantt.	211.55
Sub – Total			**1739.15**

3.2.6 PATIALA DISTRICT

Patiala district is one of the famous princely states of erstwhile Punjab. Forming the southeastern part of the state, it lies between 29°49’ and 30°47’ north latitude, 75°58’ and 76°54' east longitude.It is surrounded by the districts of Fatehgarh Sahib & Rupnagar and the Union Territory of Chandigarh in the north, Sangrur district in the west, Ambala and Kurukshetra districts of neighboring state of Haryana in the east and Kaithal district of Haryana in the south.

The Sikhs and the Hindus are the predominant communities in the district. The Sikh form 55% of the population whiles the Hindus form 42%, the remaining being the Christians, the Muslim, the Jains and the Buddhists.

The district forms a part of the Indo- Gangetic plain and consists of three types of region

1. The Upland Plain
2. The Cho-infested Foothill Plain
3. The Floodplain of the Ghaggar River

Apart from this, the district has a complex drainage system consisting of canals and rivers. The river Ghaghar is the most important water channel of the district. It is essentially a seasonal stream, remaining dry during most part of the year. A number of subsidiary rivulets join the Ghaggar River, the most important ones being the Tangri Nadi, Patiala-Wali-Nadi, Sirhind Choe and the Jhambowali Choe. Apart from the natural drainage line, the district also has three important canals. The Bhakra Main Line canal, the Nawana Branch, and the Ghaghar Link. These canals provide much needed irrigation water to the district. Before these canals were constructed, Patiala district was a water scarce area. These irrigation canals have helped to transform the parched fields into fertile, double-crop lands.

The project falls in Mohali district and in northeast part of Patiala districts commencing and emerging from junction of NH-21 and NH-22 at Zirakpur in Mohali district. The road crust in the entire stretch is good and functional performance can be visualized trough present high traffic density the crust thickness seems to be insufficient to match its

functional performance as two lane National Highway, since lot of crack distress signs have been started to appear at widened portions and longitudinal joints of the carriageway and hard shoulders.

3.3 SUMMARY OF INVESTIGATIONS AND FINDINGS

3.3.1 TOPOGRAPHIC SURVEY

The topographic survey using the the total station and auto level was carried out generally in a corridor width of 60 m. The survey width are suitaibly adjusted to accommodate the improvement needs identified during the inventory . Control stations with GPS were also established at 5 km interval.

3.3.2 TRAFFIC SURVEY AND FORECAST

Traffic forecast depends on several factors including socio-economic and demographic trends. As per IRC Publication, SP: 30-1993, the rate of growth of traffic is normally 8 % -10 % per annum on highways. It has also been experienced from various traffic studies under different conditions that traffic volume increases at the rate of 5%-8% per annum. As per latest guidelines of Ministry of Shipping, Road Transportation and highways, Govt of India has specified the growth rates to be adopted as 7.5% in the first five years after the construction period, 5.5% in the next five years and 5% in the subsequent time period. The growth rate of traffic of 5.0% per annum is adopted. Thus to avoid any ambiguity the growth rate specified by MOSRT&H has been adopted for the project

The project road travels though rural and urban areas. The design of the facility depends on average daily traffic volume as well as peak our traffic volume.

It is assumed that the design capacity of the road will increase under the ideal conditions. As per IRC:SP-84: Manual of Standards and Specifications for Four laning of Highways through PPP , the design service volume in plain terrain condition is 30,000 PCUs/day at ‘A’ Level of Service (LOS), 40000 PCUs/day at ‘B’ LOS and 60,000 PCUs/day at ‘C’ LOS.

3.4 PROJECT ROAD

The national highway 64 is a two lane carriageway with flexible pavement originating from 0.00 kms at Zirakpur from NH-22 i.e Ambala-Chandigarh-Shimla National Highway. It passes through Banur Chauk at Ch 14.0 Km and crosses NH-1 at Rajpura chainage at 28.110 kms. It straggers along with NH-1 upto bypass "T" Junction about 2.5 Km and then the same chainage of 28.110 kms taken at divergence from NH-1 to bahadurgarh (Ch 45.655) and extends upto 50.700 kms Patiala. In some urban stretches like Ziakpur town (0 m – 300m) and Banur Town (Chainage 13,400 km- 15800 km) and bahadurgarh (Chainage 45.665 km) to Patiala (50.700 km) , there are four lane divided carriageway with exixting shoulders 1.5 m paved and 1.0-2.0 m earthen.Ugradation to four laning is to be done from chainage 0.00 km to chainage 45.665 km i.e zirakpur – Bahadurgarh and upgradation of already four lane divided carriageway from chainage 45.665 to chainage 50.700 km as per IRC – 84-2009 specifications.

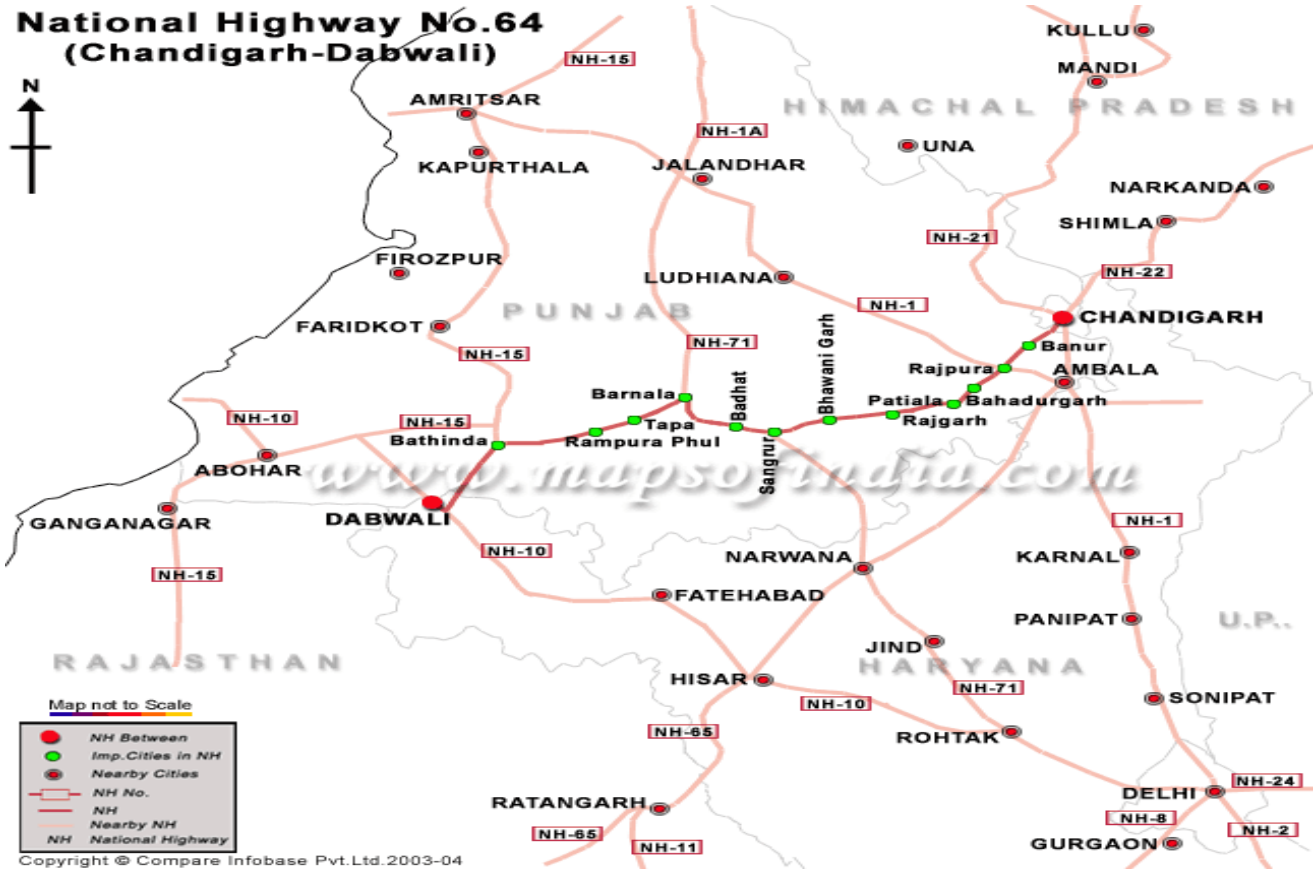


Fig No. 3.1: Map showing study area

3.4.1 AVAILABLE RIGHT OF WAY (ROW)

Table 3.3: Available Right Of Way

S.No	Section	Length	Width
1	Zirakpur- Rajpura Section	0 km - 28.111 kms	28.0 m to 54.0m variable
2	Rajpura- Bahadurgarh Section	28.110km - 45.665 km	38.14 to 60.0 m variable
3	Bahadurgarh- Patiala Section	45.665 km – 50.700km	34.0 m to 46.58 m variable

Table 3.4: Available ROW in town areas and other important points

S. No	Section/Location	Length (km)	Available ROW (m)
1	Zirakpur Town	0.00-1.600	39.0
2	Zirakpur- Banur	1.600- 13.400	54.0
3	Banur Town	13.400-16.015	54.0
4	Banur – Rajpura	16.015 – 28.110	28.0
5	Rajpura Bye- pass	28.110 – 32.365	60.0
6	Rajpura Bye-pass to Bahadurgarh	32.365- 45.665	38- 43.0
7	Bahadurgarh- Patiala	45.665 – 50.700	34.0- 43.58

3.4.2 ALIGNMENT

Alignment is proposed as eccentric as well as concentric for widening the road to four lane divided carriageway along the present allignment for for maximum utization for available arow and to avoid aquisation of land due to its combersome and time consuming process and being expensive in nature involving litigation. In zirakpur town four laning is proposed concentrically upto 1600 m length within the ROW with service roads on both sides . Median in zirakpur will be restricted to 2.0 m excluding paved portions with crash barriers and drain of 1.5 m provided & foothpath of 2.0 m will be provided at the edge with the service road on 5.50 on both sides.

After 1.600 km the existing alignment of two lane is left untouched and a new 2 lane carriageway is proposed to constructed left side of road since the number of trees is less , curvature bends towards the left and at the bridge site at ch 3300m there is space on the left side for the provision of new 2-lane bridge From 9000-9900 m the toll plaza approach starts and the allignment will be eccentric left to concentric for 16 lanes

merging/demerging upto 9900 m and then merge to four lane divided carriageway . The new eccentric alignment on the left side will continue upto ch 13400m. From 13400m to 13600 m the alignment will merge from 4 lane to 8 lane. 14000 m is the starting approach of the grade seperator which will cross the Banur Chowk at ch 14650. The concentric alignment of four lane carriageway will continue upto ch 28100 m.

3.4.3 SERVICE ROADS

Service roads are proposed for Urban/Build up areas for effective seggregation of traffic to enforce access control measures. Carriageway width of 7.0/ 5.5 m is proposed as per latest guidelines of Ministry of shipping , Road transport and highways. The provison of service roads has been made as as follows

Table 3.5: Proposed Service Roads

S.N0	Section (In Km)	Location	Provision & Planing		
			4- Laning	6/8/10 Laning	Service Roads
1	0.00-1.600	Zirakpur town	4- laning with two mtr median	-	0.0 – 1.600 km on both sides with 5.50 m on both sides
2	13.400-15.900	Banur	-	8 Laning	2 lane both side for truck parking and 7.0 m on both sides with divider (with main C/W specifications)
3	25.100-28.100	Rajpura	4 Lane	-	7.0 meter on each side of project road
4	30.300-31.730	ROB approaches	4 – Lane	-	Both sides

3.4.4 PLANTATION

For widening the project road from two to four lane it is estimated that around 4000 trees will be cut and the proposal has to be moved out to Forest Department for clearance. This will be accomplished only after the finalization of new allignment of the project. 10 times quantity tree will be planted on the sides of the project road or any suitable land to be arranged by the Forest Department as per the requirement under the trees cut or uprooted. Necessary amount at the Rs 2.50 lac/hectare as plantation expenses and land Plans &

Value/Management at the rate of 9.20 lacs/hectere i.e Rs 11.70 lacs/hectare will be deposited with the forest department when they arrange the land themselves. Punjab Forest Department plants 1000 trees/hectare and it is proposed that 2.5 hectare land will be needed for plantation of 1.0 lacs trees in view of uprooted trees.

3.4.5 SAFETY MEASURES

The safety measures proposed are listed below (for all optiones and stages)

i. Provision of Metal Beam Crash Barrier at embankments with height more than 3m, approaches to bridges and underpass

ii. Concrete railing has been proposed on bridges and underpass

iii. Pedestrian guardrails have been proposed along footpaths in urban sections

iv. Road delineators and studs are proposed at horizontal curves with radius less then 1000 m and intersections etc

v. Street-lighting may also be provided for Highway alignment passing through potentially hazards locations such as urban areas, appproaches, of bridges and ROB

3.5 OBJECTIVE OF STUDY

The major objectives of carrying out an environmental study in order to prepare feasibility cum preliminary design report for the proposed development are as follows:

- Collection of baseline data on various components of the environment
- Determination of magnitude of environmental impacts so that due consideration is given to them during planning, construction and operational phases of the project
- Assessment of the socio-economic conditions of the project affected persons and suggestions for their improvement
- Identification of areas and aspects, which are environmentally or socio-economically significant
- Submission of Environmental Enhancement Plan and Environmental Management Plans for enhancing and mitigating the negative impacts

- Development of the road alignment in such a way that the environment and settlements are least affected
- Presentation of public view on various environmental and socio-economic aspects

3.6 SCOPE OF THE WORK

The summary of the scope of work related to environmental study is:

- Defining the study area for carrying out Environmental Impact Assessment due to intervention of proposed project activities
- Identification of the valued environmental components (VECs) in the project influence area e.g. agricultural land, heritage and religious sites, forestland, flora and fauna of the area
- Collection of information on existing environmental scenario from secondary sources and identification of data gaps to be filled from primary surveys
- Primary surveys for baseline (air, water, and noise) pollution status in the project area
- Stakeholder consultation with communities likely to be affected, NGOs, and Govt. agencies etc
- Analysis of impacts especially on the identified VECs
- Preparation of Environment Management Plan (EMP) to mitigate adverse environmental impacts and enhance positive impacts
- Social impact assessment
- Location and layout of toll plazas, bus shelters, bus lay byes & truck lay byes

Primary Tasks: The general scope of services covers but not limited to the following major tasks

I. Review of all available reports and published information about the roads and the project influence area

II. Environmental and social impact assessment, including such as related to cultural properties, natural habitats, involuntary resettlement etc. Public consultation including consultation with communities located along the road, other stakeholders and relevant Govt Depts. at all the different stages of the assignment (such as inception stage, feasibility stage and preliminary design stage)

III. Detailed reconnaissance

IV. Identification of possible improvements in existing alignment and bypassing congested locations with alternatives, evaluations of different alternatives comparisons on techno economic and other considerations and recommendations regarding most appropriate options

V. Traffic studies including traffic surveys and axle load survey and demand forecasting

VI. Inventory and conditions survey of roads

VII. Inventory and condition survey for bridges, cross drainage structures and drainage provisions

VIII. Detailed topographic surveys using Total Stations & GPS

IX. Pavement investigations

X. Sub-grade characteristics and strength investigation of required sub-grade and sub soil characteristics and strength of road and embankment design and sub soil investigation

XI. Identification and sources of construction materials

XII. Detailed design of road, its x-sections, horizontal and vertical alignment and design of embankment of height more than 6m and also in poor granular soil conditions and where density consideration require, even lesser height embankment. Preliminary design of structures preparation of

GAD and construction drawings and cross-drainage structures and underpasses etc

XIII. Identification of the type and design intersections

XIV. Economic and financial analysis

XV. Strip plan indicating the scheme for carriageway widening, location of all existing utility services (both over and underground) and the scheme for their relocation, trees to be felled and planted and land acquisition requirements including schedule for LA: reports documents and drawings arrangement of estimates for cutting of trees and shifting of utilities from the concerned department

XVI. Financial viability of project

XVII. Preparation of Detailed Project Report, cost estimate, approved for construction drawings, rate analysis, detailed bill of quantities, bid documents for execution of civil works (b) on (a) on BOT basis

XVIII. Design of toll plaza and identification of their numbers and location and office cum residential complex including working drawings

a. Design of weighing stations, parking areas and rest areas
b. Any other user oriented facility enroot toll facility
c. Tie-in of ongoing /sanctioned works of MORT&H/Client/other agencies.
d. Preparation of social plans for the project affected people as per policy of the Govt. of India R & R Policy

CHAPTER 4
ENVIRONMENTAL AND SOCIAL IMPACTS

4.1 INTRODUCTION

The present chapter determines the extent of the impacts of the proposed project activity on the existing environment. The focus of this section is on the identification of probable impacts and thereafter-suggesting mitigation measures.

The impact assessment has been devised for the following stages:

- Planning and designing stage
- Construction stage
- Operational stage

Planning and design plans the road alignment, required bypasses, construction details, materials of construction etc., which ultimately decides the impact during later phases. Most of the impacts are during construction and operation phase. While some of the construction phase impacts are temporary, some also are permanent. Operation phase impacts are continuous in nature. To identify these impacts broadly on physical, ecological and social environment Impact Identification Matrix are developed. Environmental parameters are broadly classified into three groups.

1. Physical Environment
2. Biological Environment
3. Social Environment

Physical environment includes Water Resources, Water Quality, Air Quality, Noise and Land environment.

Biological Environment includes Flora, Terrestrial fauna, Avifauna, Aquatic flora & fauna, Plantation.

Social Environment includes Rehabilitation, Employment, Agriculture, Housing, Culture etc.

An Impact Identification Matrix for all the phases of the project and preliminary mitigation measures is presented in **Table 4.1**. (Annexure I)

4.2 PARAMETERS CONSIDERED

4.2.1 GROUNDWATER

Natural processes and human activities affect water quality. Water quality is the constituents dissolved or contained within the water. It is often thought that the chemical composition is the only factor involved. However, other conditions, such as biological, physical, and radiological factors should be considered when mentioning water quality. Various aspects of groundwater like pH, chlorine content, fluoride content hardness, DO & 5 day BOD were tested according to the procedures mentioned in Water and Waste Water Testing: Laboratory Manual by R.P Mathur. Undesirable effects outside the desirable limits are discussed below:

pH: Beyond desirable range the water will affect the mucous membrane and/or water supply system.

Total hardness: Primarily of concern because it requires more soap for effective cleaning, forms scum and curd, causes yellowing of fabrics, toughens vegetables cooked in the water and forms scales in boilers, water heaters, pipes and cooking utensils.

Chloride: High concentrations of chloride ions may result in an objectionable salty taste to water and the corrosion of plumbing in the hot water system. High chloride waters may also produce a laxative effect.

Fluoride: At concentrations greater than 1.0 mg/l, fluoride will cause fluorosis.

Dissolved Oxygen: High DO levels though makes drinking water taste better but speeds up corrosion in water pipes.

It is anticipated that to obtain water during construction and planting of trees the contractor will sink boreholes/tube wells. For this, the construction agency will be required to obtain sanction of Ground Water Board assisted by PWD in procuring sanction of concerned authorities. Water from Bhakda canal can also be used in the

construction purpose after obtaining permissions from Punjab irrigation department. However, the water level may get down if excessive water is consumed.

4.2.2 AIR

Air quality monitoring is carried out to assess the extent of pollution, ensure compliance with national legislation, evaluate control options, and provide data for air quality modeling. Various aspects of ambient air were tested according to the prescribed procedures (annexure VI). Undesirable effects outside the desirable limits are discussed below

1. People exposed to high particulate matter concentration are mainly to suffer from health problems mainly respiratory diseases like bronchitis, asthma etc
2. High concentrations of particulate matter also cause visibility impairment
3. High concentrations also cause soiling and damage to materials

The proposed project does not cover big urban and industrial areas, and hence there will not be major problem of pollution. At Rajpura, alignment is passing through the bye pass, which is already segregated from the city at Junction 32.500 km. The pollution of the traffic will not disturb the inhabitants. Emissions from the mobile and non mobile sources and dust produced during construction are the main sources of pollution during the implementation stages of the project.

4.2.3 SOIL

Soil at and around a construction site may become contaminated due to air transport followed by deposition of construction contaminants as well as water runoff of construction contaminants. Soil may constitute a sink for pollutants and some of those may accumulate in soil and persists over longer periods of time. Elevated levels of soil contaminants human health, elevated levels can negatively affect plant vigor, animal health, microbial processes, and overall soil health. Some contaminants may reduce yields or cause visible damage to crops. Even relatively low concentrations of certain contaminants can alter soil chemistry and impact organisms that depend on the soil or plants for their nutrition and habitat.

Selected quality soil is required for embankment portion of road. The existing road is in plain terrain and as such, there is minimum possibility of barrow areas becoming ponds to allow stagnation of water and create adverse effect on health and hygiene. Various aspects of soil like pH, texture, calcium, sodium, permeability & porosity were tested according to the procedures mentioned in Engineering soil testing manual by Samsher Prakash. Undesirable effects outside the desirable limits are discussed below

- In acidic soils, nutrients dissolve slowly or not at all. Critical plant nutrition is locked up in insoluble mineral compounds that plants cannot utilize. The high pH levels can also indicate high levels of sodium in the soil that can also negatively affect plant growth
- Excess sodium and calcium damages soil structure , clog soil pores & effects plant growth
- Low soil porosity can inhibit water entry into soil possibly increasing surface runoff and erosion

4.2.4 NOISE

Noise is usually associated with construction work although modern preventive measures may substantially reduce the amount of noise (in the neighboring community). Noise may adversely affect health including effects such as stress, sleep disturbance, high blood pressure and even hearing loss**.** Possible sound effects during the operation phase can be reduced buffering of noise due to vegetation loss during site clearance Increased noise level due to excavators/machinery etc, operation and maintenance of heavy vehicles and equipments, Asphalt preparation and crushing. Vibration from blasting operations.

4.2.5 ECOLOGICAL RESOURCES

The construction of highways can have a substantial impact on the degradation and loss of natural ecosystems, especially in less developed areas. Perhaps more importantly, the fragmentation of habitats caused by highway development is often severe. Transportation routes can be described as “disturbance corridors” that disrupt the natural, more homogeneous landscape. In forested environments, these disturbances can cause

(1) Dramatic physical disruption to the continuous vegetative community

(2) Disruption to the structure and function of habitat

(3) Impacts to resident wildlife, which must negotiate, tolerate, and cope with the habitat barriers

The project area is devoid of luxuriant forest cover but the cover but the plantation is sufficient thick and good on the road sides as well as on banks of drains , canals , rivers, rivulets etc The old trees are generally Neem , Shisam, Baniyan and Jamun , but the social forestry is generally with Eucalyptis. There is wild Sanctuary/Zoo by the name of "Chatbir Zoo" on left side of Zirakpur – Rajpura road located at 5.5 km that is quite famous for its tiger inhabitant population but is likely to be affected by the construction.

4.3 IMPACTS ON SOCIAL AND CULTURAL ENVIRONMENT

Based on the initial surveys, some of the immediate social issues is acquisition of private properties mainly buildings and the agriculture land, as the ROW is limited in most part of project road. Another important issue is encroachment within the ROW particularly near the major settlement sites. Efforts should be made to minimise the adverse impact on people as well as properties by integrating social aspects at different level of project design. The widening of the road may involve loss of livelihood and properties of affected persons, which should be addressed in the preliminary land acquisition / resettlement plan.

The project road has several roadsides villages and towns along roadside. Zirakpur is located at 0.00 km, Banur at 14.5 km, Rajpura at 28.100 km Bahadurgarh at 45.665 km and Patiala at the end of project road besides villages like Guddu Majra, Alampur, Jungpura, Ajipur , Sikhan Majra. These villages are connected by link roads, which are the logical social issues to be dealt with.

The available generally varies from 28-60 m, where at some location this land width of 28.0 m may be constrained to make the alignment homogenous. Land acquisition is required in 16.015-28.110 km where land width (ROW) off 28.0 m is available as much

as proposed to acquire additional land to make available 45.0 m ROW. Acquisition of land may cause problem and delay being located near urban areas and as much as 60.0 m ROW is being restricted to 45.0 mtr and is sufficient for four laning and in conformity to existing availability of ROW required for four laning is normally 36.0 m according to latest parameters. Visually there seems no rehabilitation problem along the road. No other major social issue has been noticed. However, number of affected structures is nominal.

The social environment could get affected due to employment in road construction and resultant in-flux, rise in food prices and lowering of its availability, business displacement, problem of resettlement and rehabilitation, and additional pressure on infrastructure within major settlement area. These adverse effects could be minimized by taking various steps such as encouraging local recruitments, early identification and entitlement of the project affected people, provision of subsidized food for workforce and regulation of development activities.

Social survey carried out by consultant indicates that built-up properties are likely to be affected due to the proposed highway, but majority of impact should be on private properties. The findings of the survey are summarized below

- **Residential Properties likely to be affected** - There are residential and commercial areas on the road. Only small markets do exist. They will be affected during the widening. Proper compunctions will be provided to the affected.
- **Public Health –** The noise pollution due to the construction equipment should be located to isolated location of mixing plant. After the completion of the project, the noise and the air pollution due to increased traffic will start but should be kept under control by providing good riding/surface of Bituminous Concrete of crumb Rubber Bitumen 60/ 70 and also divided carriageway will help in reducing the noise and air pollution as traffic congestion is avoided.
- **Encroachments-** The government land has been encroached in some areas and particularly in urban areas and it has to be vacated by persuasions. The existing Right of way normally is 18.82 to 60.0 meters, which would be sufficient four-lane road and the widening has been proposed concentrically where ROW is less.

- **Archaeological/Historical Value –** There are no sites of archeological/historic value in and around the project as the alignment proposed on the existing road.

4.4 MATRIX METHOD FOR IMPACT ASSESMENT

The matrix to be used for evaluation of impacts consists of project activities and environmental component, which will be affected due to that activity. Each activity has been connected by primary, secondary and tertiary impacts. Then each environmental component has been assigned a weightage on the basis of baseline data and prevailing or existing conditions and professional judgment.

Impact value ranges from 0 to 5 with positive and negative values due to various activities of project. Score for each environmental component has been assigned and lastly the total score has been determined. Matrix method has been used for impact assessment on a scale of 1 to 1000. Each component of the Environment was assigned a weightage in the light of the base line data and prevailing situation in the stretch.

Delphi Technique has been used for determining the weightage to each variable of the Environment. After assessing the scores of each item, over-all impact is minus without control measures. The criteria for assessment are as follows with type of impact and values corresponding:

Table 4.2: Severity criteria based on impact score

Severity Criteria	Impact Score
No Impact	0
No appreciable impact	1
Significant Impact (Short Term)	2
Major Impact (Long Term)	3
High Impact (reversible/long term)	4
Permanent Impact	5

The total impact score:

Total impact score for each Environmental parameter = (Weightage value of each component) x (Importance value)

After the calculation of overall impact score, the project is categorised into a category into which it falls. The same project is then analysed with the control measures. The category of the project is decided according to the total impact score. The current project is also analyzed with this technique in Chapter 7.

Table 4.3: Project category based on total impact score

Total Score	Category
+ve	Then accept the project
0-1000	No appreciable impact
1000-2000	Appreciable but reversible impact- control measures are needed
2000-3000	Significant impacts, mostly reversible factor – mitigation measures are crucial
3000-4000	Major impact, most irreversible, site selection is to be considered
> 40000	Permanent irreversible impact, look for alternate project.

CHAPTER 5

TESTING RESULTS

5.1- WATER

Groundwater samples were taken from different locations alongside the highway and were analyzed.

Fig No. 5.1 (a): Locations for Water Sampling

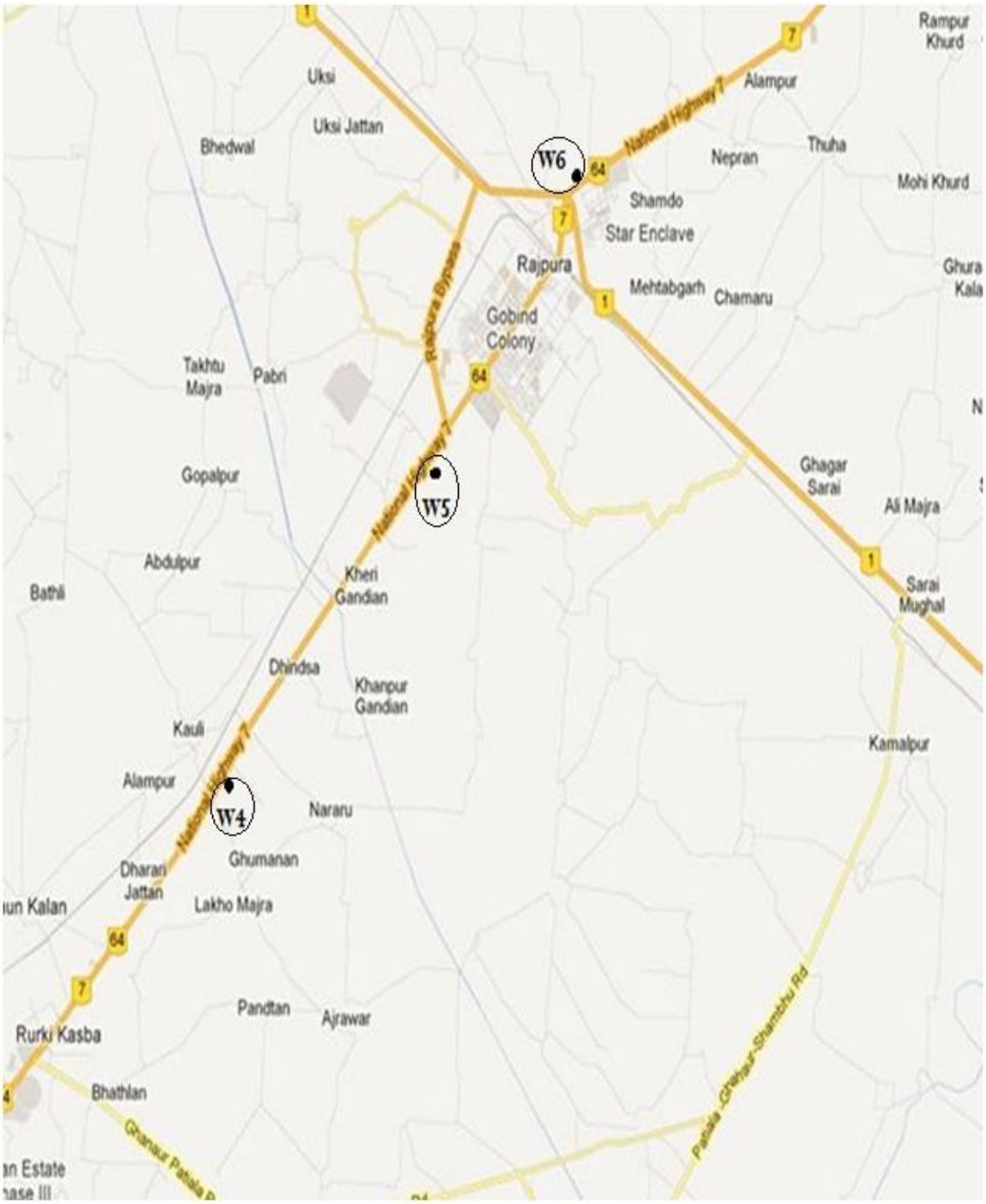


Fig No. 5.1 (b): Locations for Water Sampling

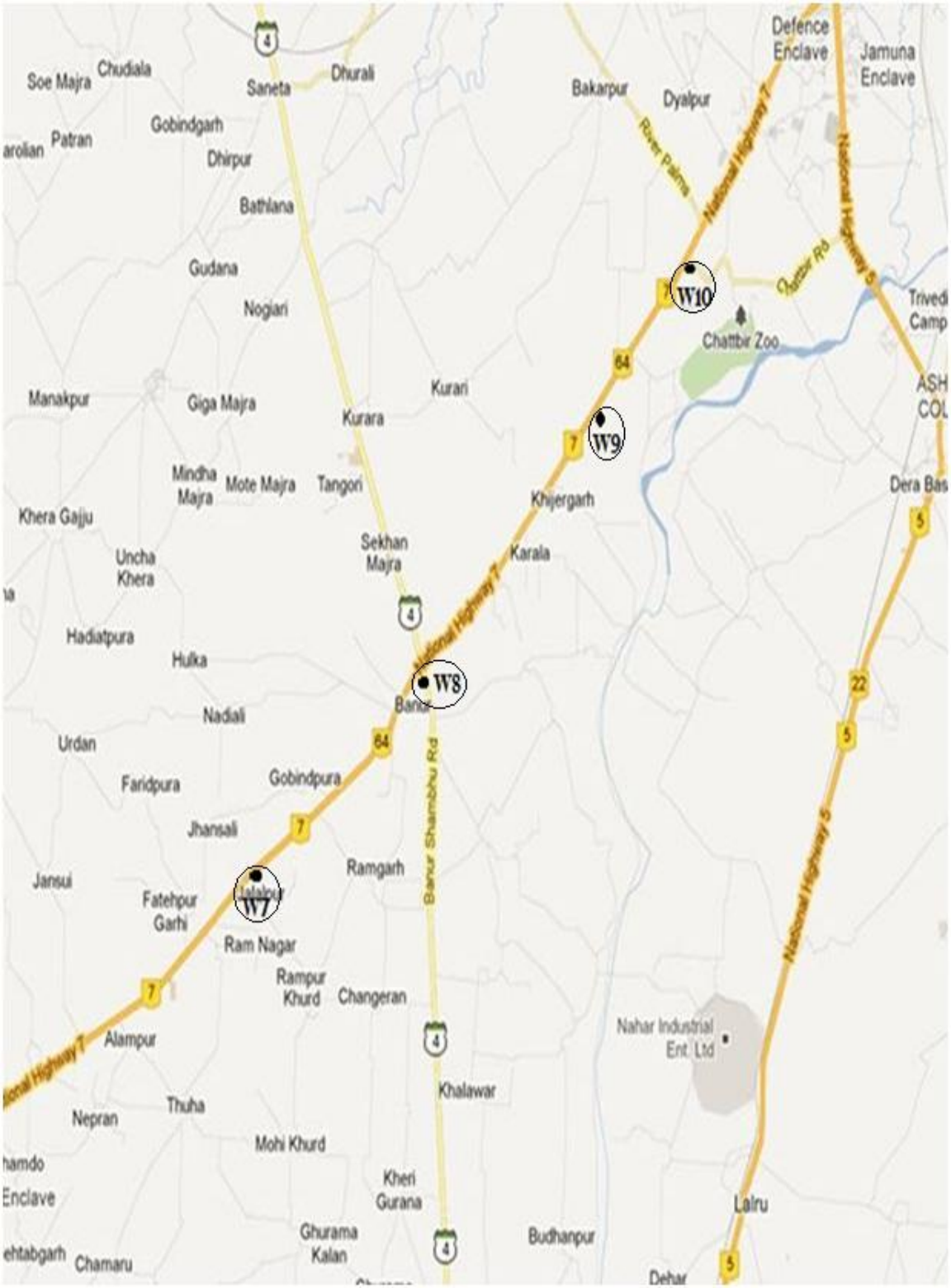


Fig No. 5.1 (c): Locations for Water Sampling

Following results were obtained :

Table 5.1 Water testing results of site samples

S. No	Location	Characteristics						
		pH Value	Hardness (mg/l)		Chloride Content (mg/l)	DO Content (mg/l)	Fluoride content (mg/l)	5-Day BOD (mg/l)
			Total	Permanent				
1	Patiala	7.62	292	90	-	9.2	2.35	2.4
2	Location-2	7.04	200	102	45	8.35	1.79	1.3
3	Bahadurgarh	6.95	366	116	80	9.25	1.24	-
4	Kauli Patiala	6.98	270	138	110	8.5	1.21	-
5	Near Rajpura	7.20	302	256	165	8.75	.987	0.8
6	Rajpura	7.91	584	510	187.5	6.6	2.2	2.7
7	Chitkara Institute	7.35	318	176	127.5	7.0	0.92	0.6
8	Banur	7.66	294	48	137.5	7.15	1.09	1.2
9	Ajitnagar	8.00	186	82	42.5	7.25	1.28	1.5
10	Chatt	7.61	214	88	65	7.3	2.28	0.8
Standards		6.5-8.5	300 mg/l		250 mg/l	10mg/l	1.5 mg/l	0 mg/l

All the sources of water from which samples have been taken are underground sources mainly from hand pumps just near to the Highway. The data so collected has been analyzed and comparisons are made, for various parameters, between the standards as given by ministry of environment and forest and the values/measurements obtained from the site under consideration.

5.2- AIR

Four different locations were selected for the analysis of ambient air around the highway.

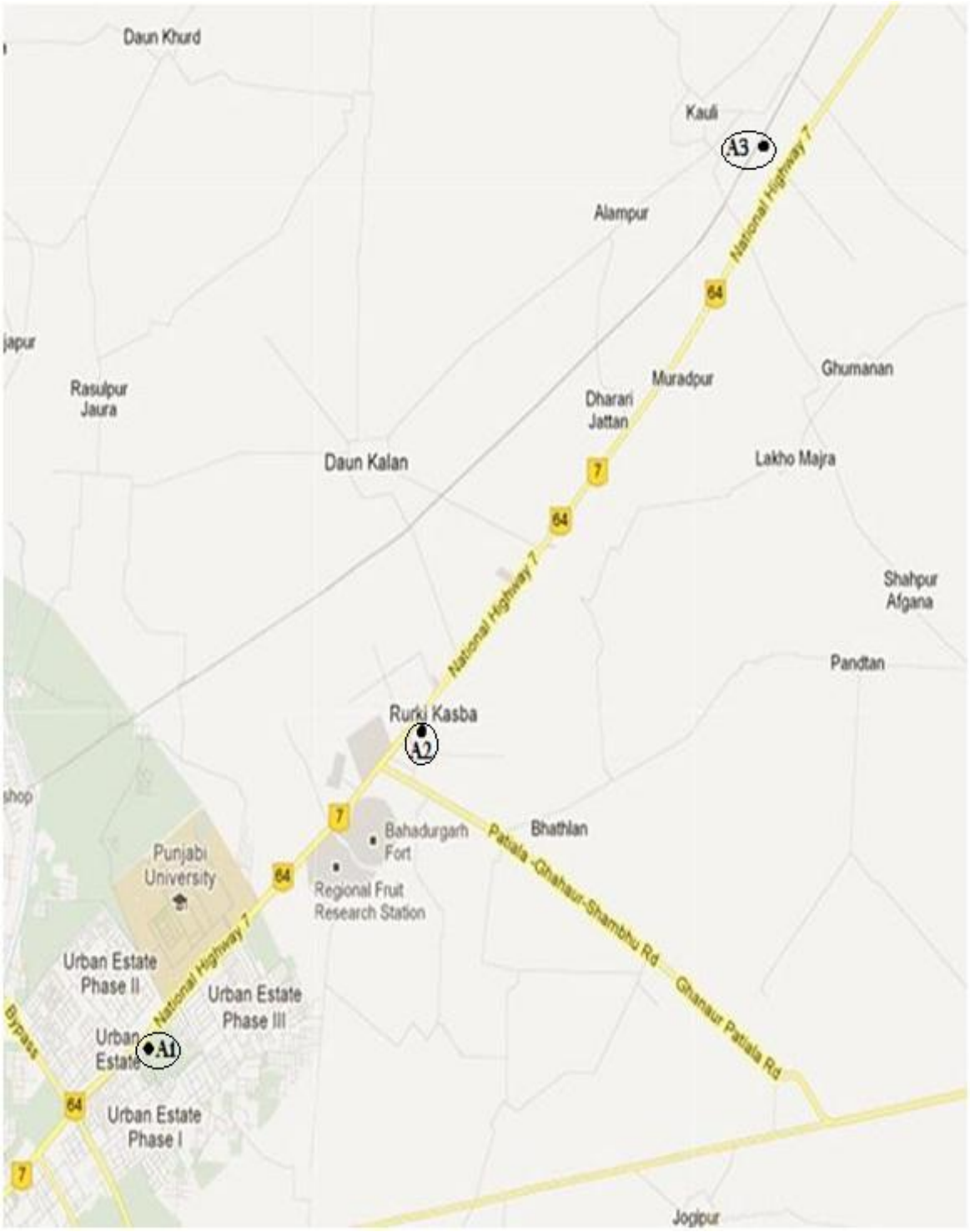


Fig No. 5.2 (a): Locations for Air Sampling

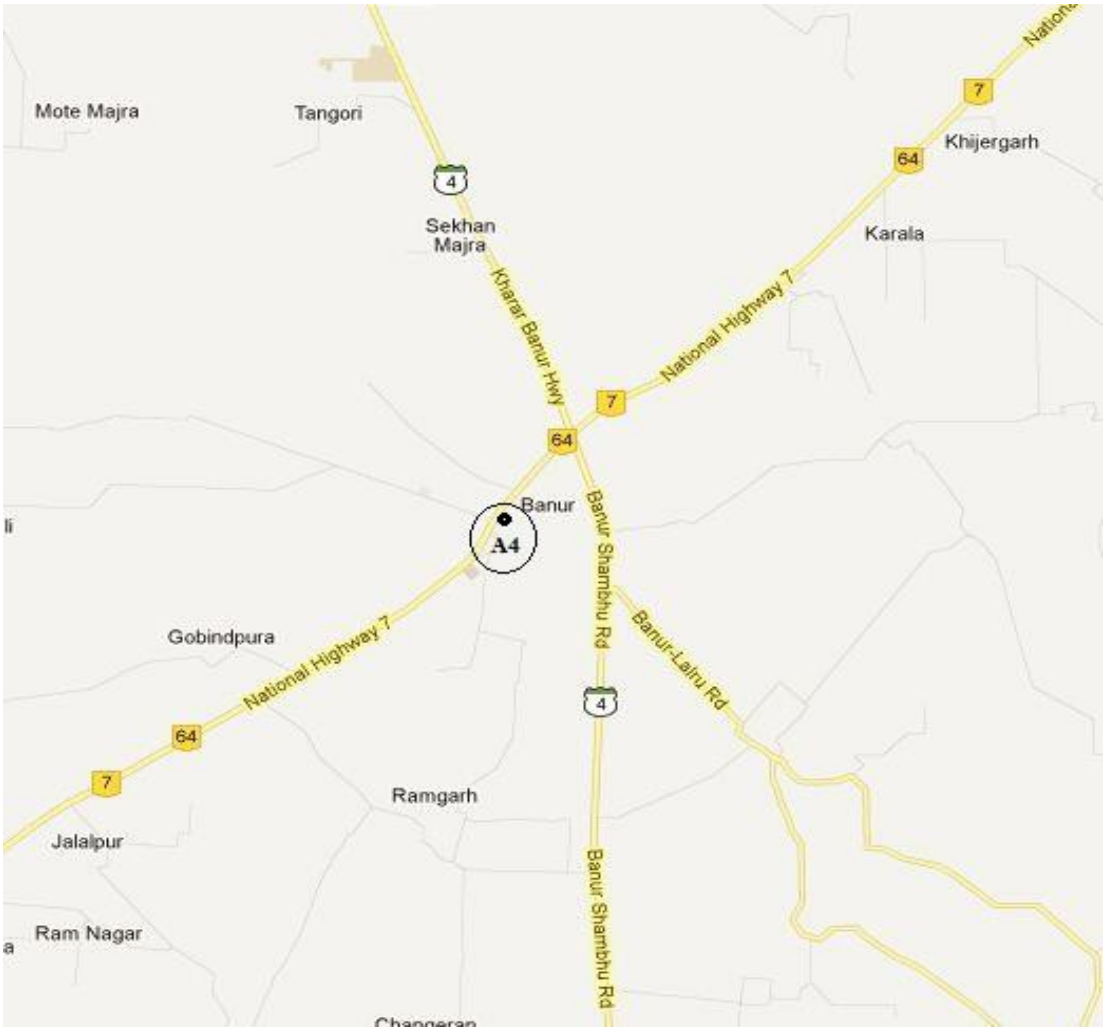


Fig No. 5.2 (b): Locations for Air Sampling

The results are as follows:

Table 5.2: Air testing results of site samples

S.No	Parameter	Patiala	Location 2	Kauli Patiala	Near Banur
1	Sulphur Dioxide (SO_2) µg/m^3	15.91	29.4	22.2	22.24
2	Oxides of Nitrogen as (NO_2) µg/m^3	12.07	22.43	19.83	27.11
3	Suspended Particulate Matter (SPM) µg/m^3 (PM 10)	94.68	101.32	119.32	124.58
4	Respirable Particulate matter (RPM) (size less than 10 microns) µg/m^3 (PM 2.5)	65.3	71.45	82.45	84.94

5.3 TRAFFIC ANALYSIS

5.3.1 TRAFFIC STUDY

The relevant data considered useful for the study purpose has been collected by conducting traffic surveys. The survey locations have been selected to provide comprehensive information about the travel pattern of the corridor. A considerable data collected through the surveys has been given due weight age to know trends, trends growth & comparison of travel characteristic.

5.3.2 PASSANGER CAR UNITS

In order to generalize the traffic volume on study roads, the standards of passenger car units (PCUs) has been adopted from IRC-64 for rural roads, which is more suited to the state highways, and major district roads. For the study, purpose following PCUs values has been adopted.

Table 5.3: Passenger Car Units (PCUs) Equivalents

S.NO	MODE	PCUS VALUE
FAST VEHICLES		
1	Car/Taxi/Jeep/Auto Rickshaw/ Van	1.0
2	Bus	3.0
3	Truck (Single Axle)	3.0
4	Truck (Multi Axle)	4.5
5	LCV	1.5
6	Two Wheeler	0.5
7	Tractor(without trolley)	1.5
8	Tractor(with trolley)	4.5
SLOW VEHICLES		
9	Cycle	0.5
10	Cycle Rickshaw	2.0
11	Horse Drawn Vehicle	4.0
12	Bullock cart	8.0
13	Others	3.0

5.3.3 TRAFFIC DATA COLLECTION

Data was collected at different locations at different time i.e. peak hours and off peak hours traffic pattern was observed for minimum one hour. The results obtained are as follows

Peak hours: *Morning:* 8 a.m. to 11a.m. *Evening*: 5 p.m. to 8 p.m.
Off Peak Hours: *Afternoon:* 12.00 p.m. to 3.00 p.m.

Location No	1	2	3
Distance from Zirakpur	42 Km	26 Km	12 Km

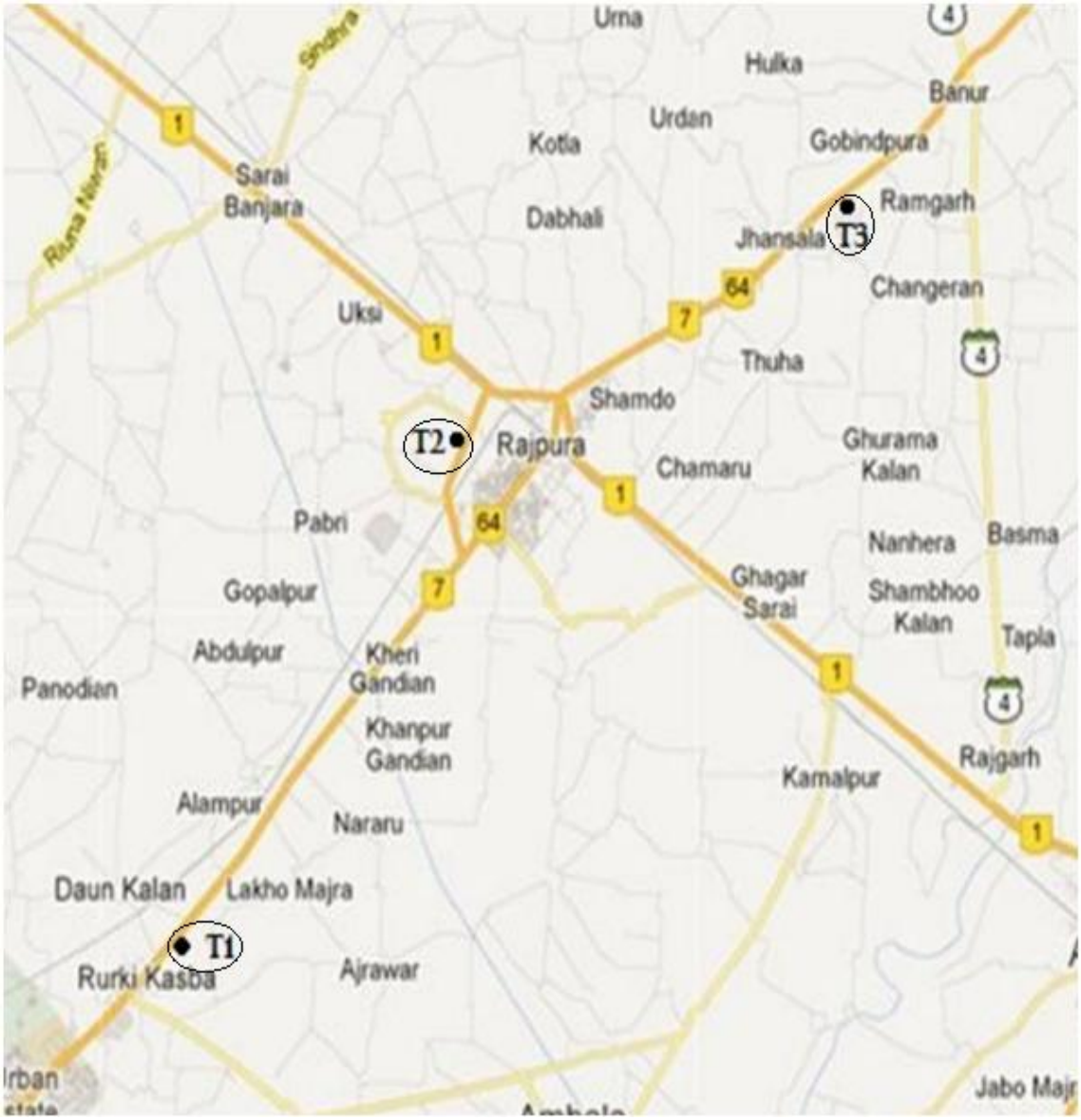


Fig No. 5.3: Locations for Traffic Analysis

A- Location 1

Table 5.4: Traffic Count at Location 1

Time	Car	Bus	Two Wheeler	Truck	Three Wheeler	Tractor	Total Vehicle	Total PCUs
Peak Hours (Morning)	800	113	749	130	184	7	1983	2143.5
Off peak Hours (Noon)	695	123	370	120	93	30	1431	1783.5
Peak Hours (Evening)	972	113	473	103	104	4	1769	1997

B- Location 2

Table 5.5: Traffic Count at Location 2

Time	Car	Bus	Two Wheeler	Truck	Three Wheeler	Tractor	Total Vehicles	Total PCUs
Peak Hours (Morning)	121	67	201	120	12	6	527	849
Off peak Hours (Noon)	228	189	140	135	32	7	731	1334
Peak Hours (Evening)	215	42	117	142	76	24	616	963.5

C- Location 3

Table 5.6: Traffic Count at Location 3

Time	Car	Bus	Two Wheeler	Truck	Three Wheeler	Tractor	Total Vehicles	Total PCUs
Peak Hours (Morning)	782	144	497	115	147	23	1718	2020
Off peak Hours (Noon)	834	82	663	150	211	18	1958	2133
Peak Hours (Evening)	972	82	467	71	110	16	1718	1827.5

5.4-Public consultation

5.4.1 The Consultation Process

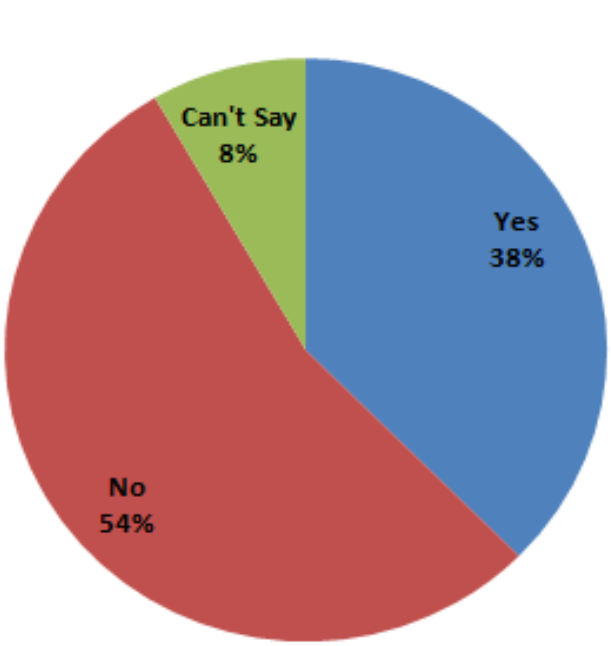
Carried out with a basic objective of the incorporation of the local and location-specific issues into the design of the project, a consultation programme in the stages of project planing and implementation stage was carried out. The community should not only be consulted they should be actively involved in environmental matters. The consultation

programme is used as a tool to inform and educate the stakeholders about the acceptability of the proposed project both, before and after the development decisions are made and to understand the nature and extent of environmental/social impacts due to the project. A questionnaire (Annexure) was prepared and the people living near the present highway NH-64 were consulted

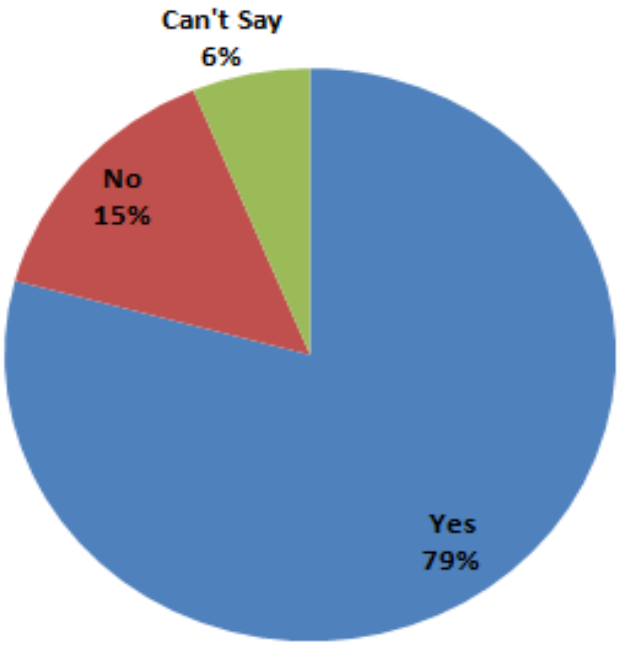
5.4.2 The Consultation Results

Following results were obtained based on the questionnaire

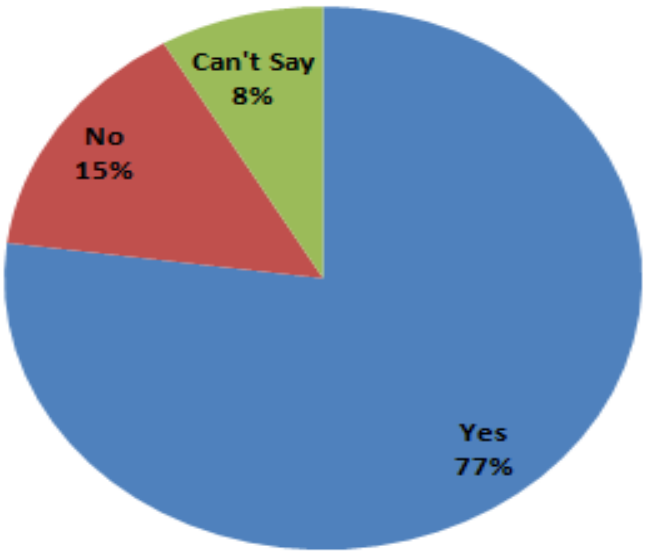
Fig No. 5.4: Graphical Representation of the results obtained



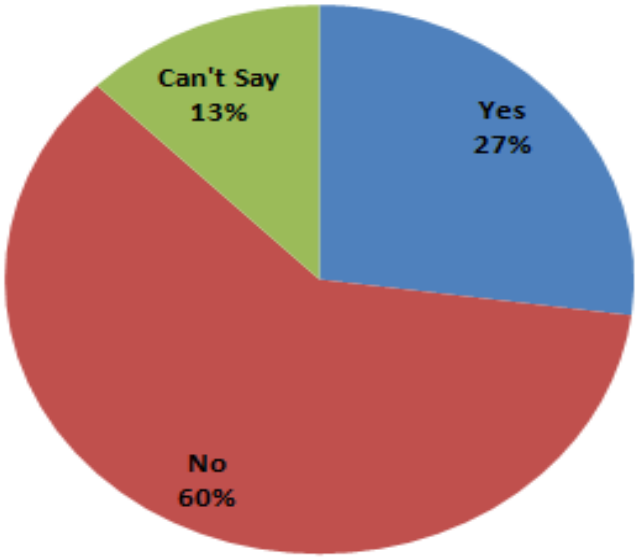
Are you satisfied with the present highway



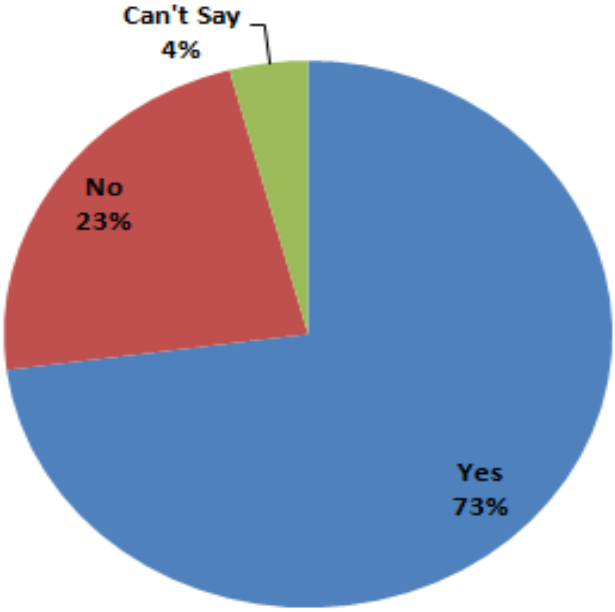
Is the highway providing you with proper connectivity with other parts of the state



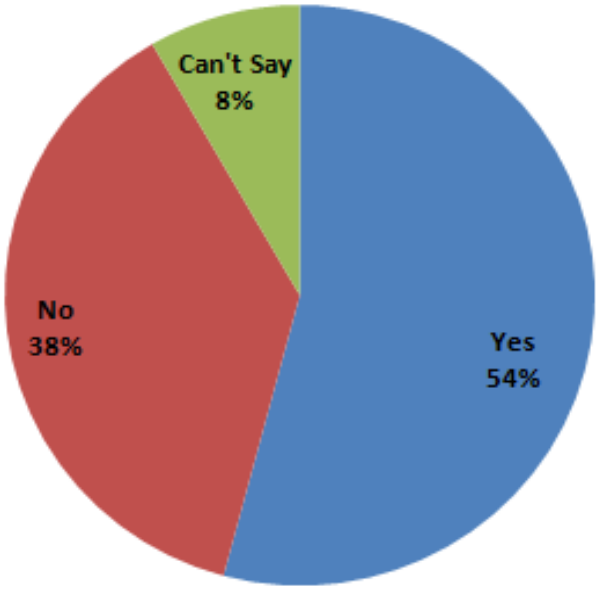
Is there a problem of traffic congestion due to present highway facility



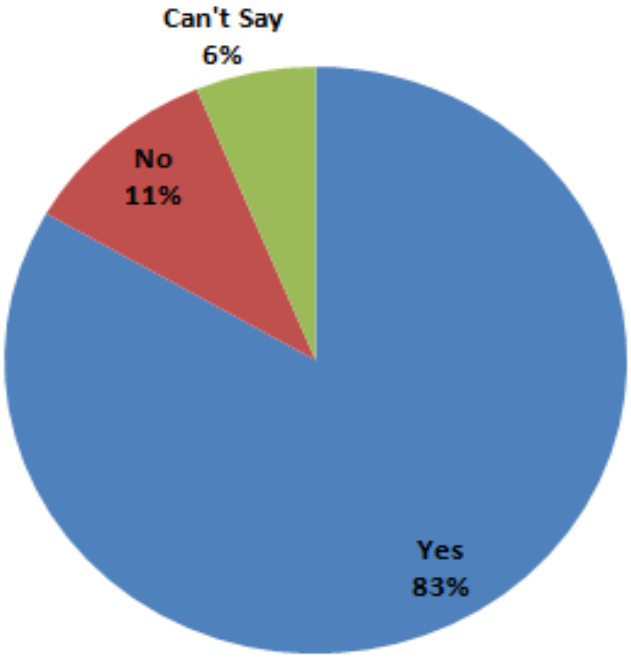
Do you feel that road safety is up to the mark



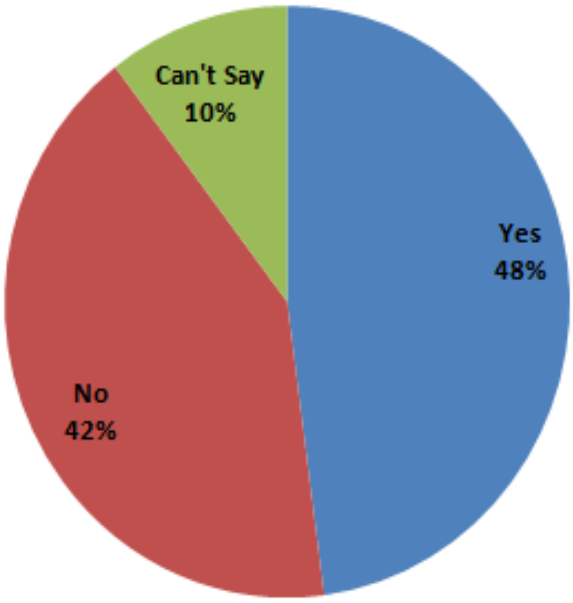
Is there proper rainwater drainage on and along the roadside.



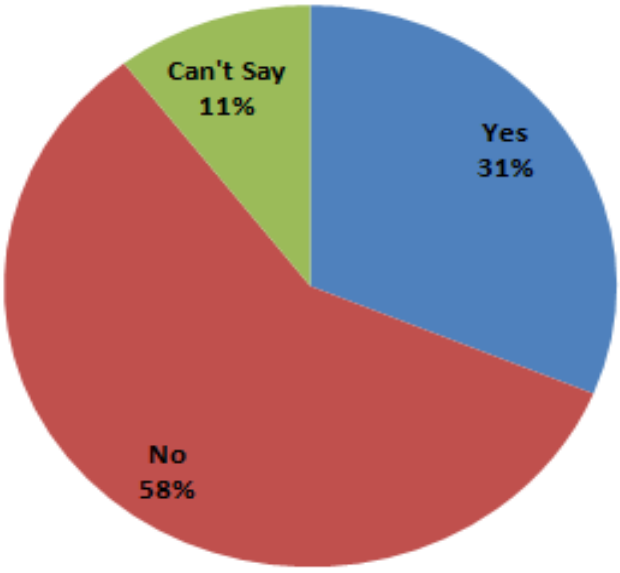
Do you feel your business will improve with the improved highway



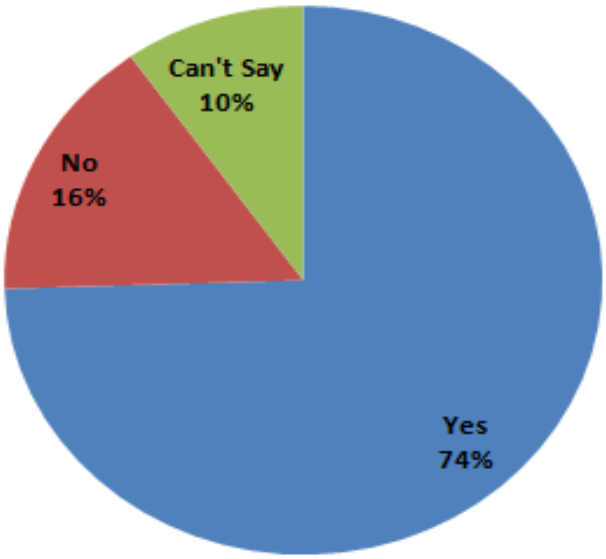
Do you think the road widening is would be appropriate for reducing traffic congestion



Is the quality of air, which you breathe healthy and clean



Have air pollution caused health and psychological problems



Do you think the job opportunities will increase with the improved highway.

5.5 ECOLOGICAL RESOURCES

5.5.1 Forest Data

Table 5.7: Abstract of trees on road strips in the highway

SPECIES	**NO. OF TREES (R/S OF NH-64)**					
	9-10 KM	**10-11 KM**	**11-12 KM**	**12-13 KM**	**13-14 KM**	**14-15 KM**
EUCLYPTUS	109	67	117	30	134	14
SHISHAM	27	24	17	15	25	21
KIKAR	10	2	*	*	2	2
FRUIT TREES	18	28	9	*	2	*
MISC.	38	20	29	14	16	32
TOTAL	**202**	**141**	**172**	**59**	**179**	**69**

SPECIES	**NO. OF TREES (L/S OF NH-64)**					
	9-10 KM	**10-11 KM**	**11-12 KM**	**12-13 KM**	**13-14 KM**	**14-15 KM**
EUCLYPTUS	151	66	100	78	60	23
SHISHAM	19	3	16	13	9	12
KIKAR	9	10	1	4	4	2
FRUIT TREES	13	32	16	2	*	*
MISC.	32	29	28	13	12	4
TOTAL	**224**	**140**	**161**	**110**	**85**	**41**

Table 5.8: Abstract of Trees on Road Strips in Patiala Range.

KM	TOTAL SPECIES	
	R/H	L/S
20-21	366	411
21-22	330	380
22-23	231	224
23-24	259	NIL
24-25	638	331
25-26	338	267
26-27	128	106
27-28	186	229
28-29	50	102
29-30	98	84
30-31	124	39
31-32	4	18

5.5.2 LOCAL FAUNA (WILDLIFE SPECIES):

There is no reported wild life along the project except for domesticated animals and birds. The area harbours granivorous avian fauna because agricultural grains in the field provide food for such birds. The mammalian fauna mainly constitutes domesticated animals and rodents. Toads, lizards and snakes represent amphibian and reptilian fauna.

Table 5.9: List of common mammals and birds around project corridor.

Sl. No.	Mammals	Sl. No.	Birds
1	Five Lined Squirrels	1	Ruddy Shelduck
2	Buffalo	2	Greylag Goose
3	Cows	3	Mallard
4	Goats/Sheep	4	Euarisian Wigeon
5	Cat	5	Gadwall
6	Dog	6	Nothern Pintail
		7	Common Teal
		8	Garganey
		9	Northern Shoveler
		10	Common Pochard
		11	Comb Duck
		12	Tree Duck
		13	Bar headed goose
		14	Tufted Duck
		15	Cotton Teal
		16	House Sparrows
		17	Brahmin Myna
		18	Common Myna
		19	Koel
		20	House Sparrows
		21	White Peafowl
		22	Peacock
		23	Pigeon
		24	Wood-Pecker
		25	Paddy Bird

5.6- NOISE

Three different locations were selected and noise was measured with the help of noise meter. Noise was measured at the regular interval of 10 minutes for one hour at each location during peak hours and off peak hours.

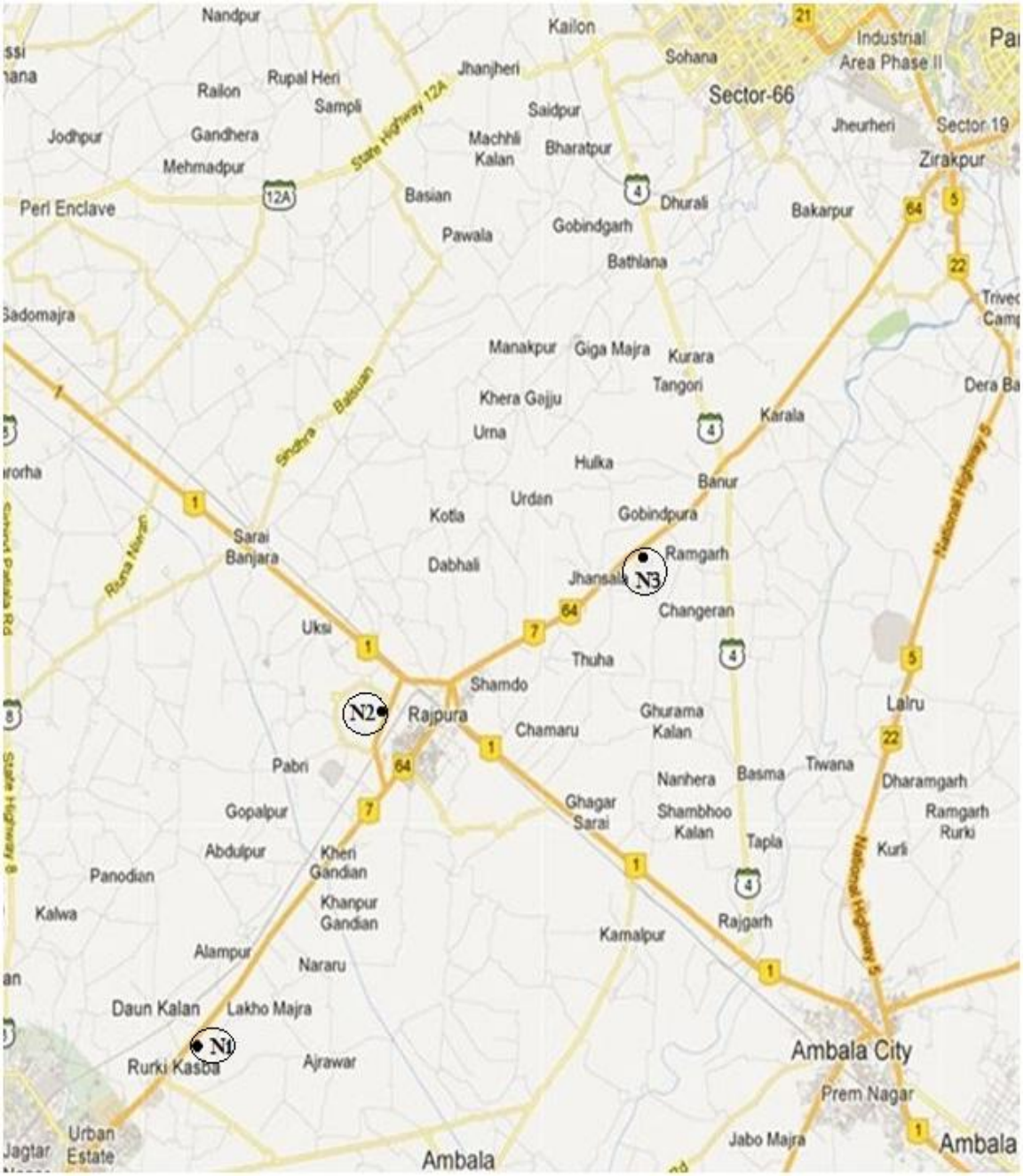


Fig No. 5.5: Locations for Noise Analysis

Following results were obtained after noise analysis.

Table 5.10: Noise Data at Location 1

Time	Maximum (dB)	Minimum (dB)
Peak Hours (Morning)	90.8	59.5
Off peak Hours (Noon)	91.4	61.4
Peak Hours (Evening)	89.7	61.1

Table 5.11: Noise Data at Location 2

Time	Maximum (dB)	Minimum (dB)
Peak Hours (Morning)	85.9	57.2
Off peak Hours (Noon)	89.1	58.0
Peak Hours (Evening)	103.5	65.1

Table 5.12: Noise Data at Location 3

Time	Maximum (dB)	Minimum (dB)
Peak Hours (Morning)	90.6	60.8
Off peak Hours (Noon)	89.2	55.1
Peak Hours (Evening)	91.3	57.3

5.7- SOIL

Soil samples were taken from different locations alongside the highway and were analyzed.

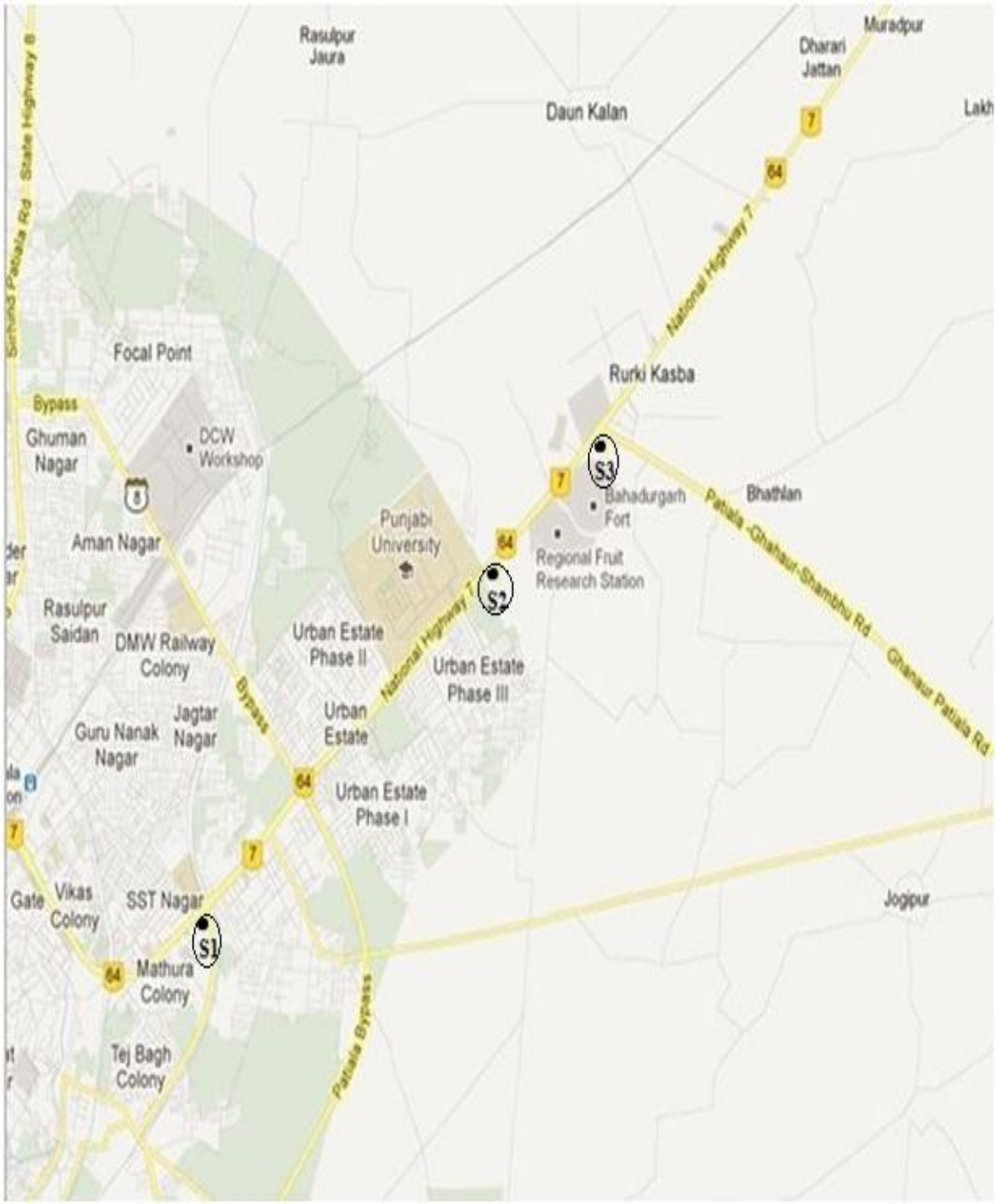


Fig No. 5.6 (a) Locations for Soil Analysis

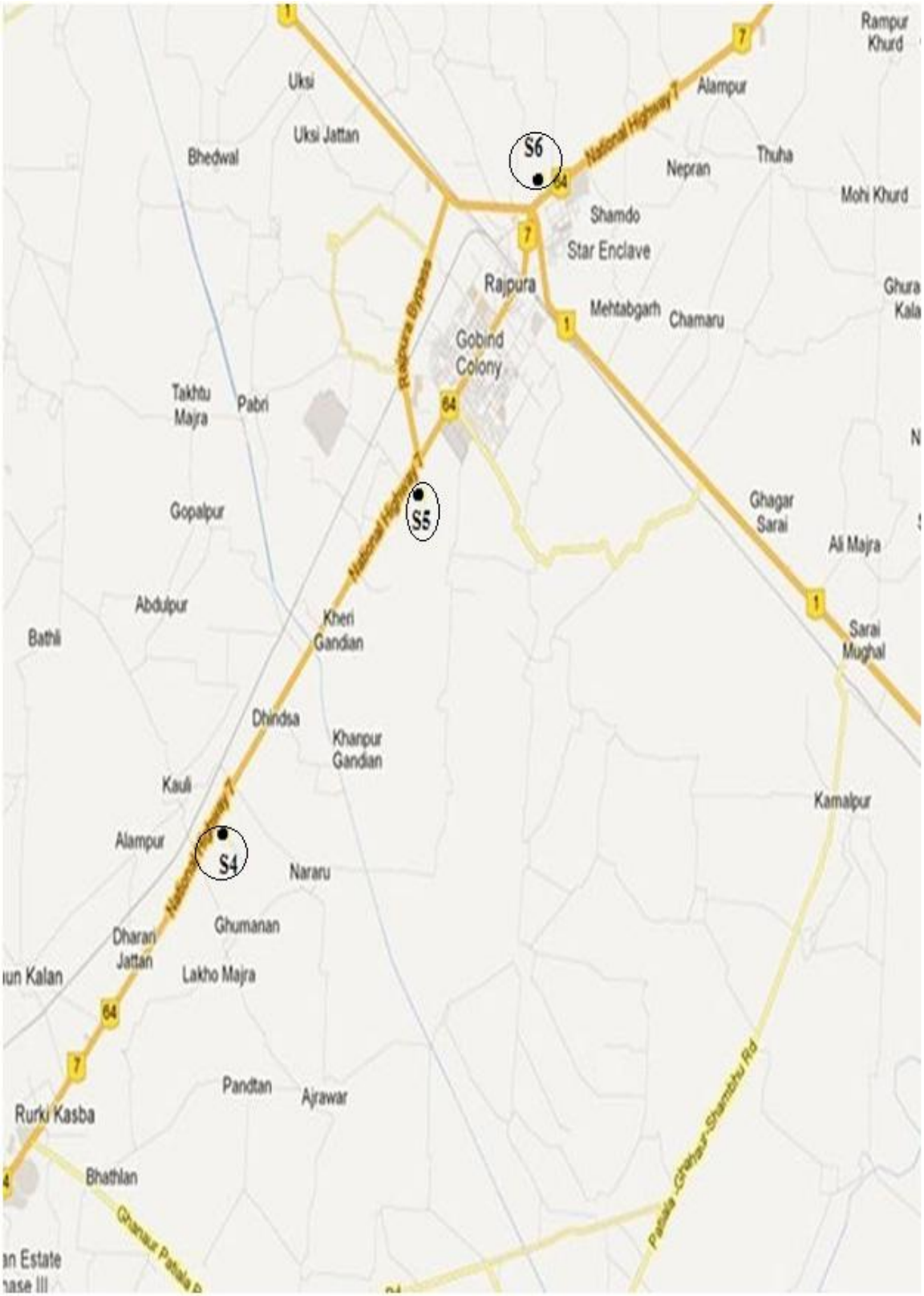


Fig No. 5.6(b): Locations for Soil Analysis

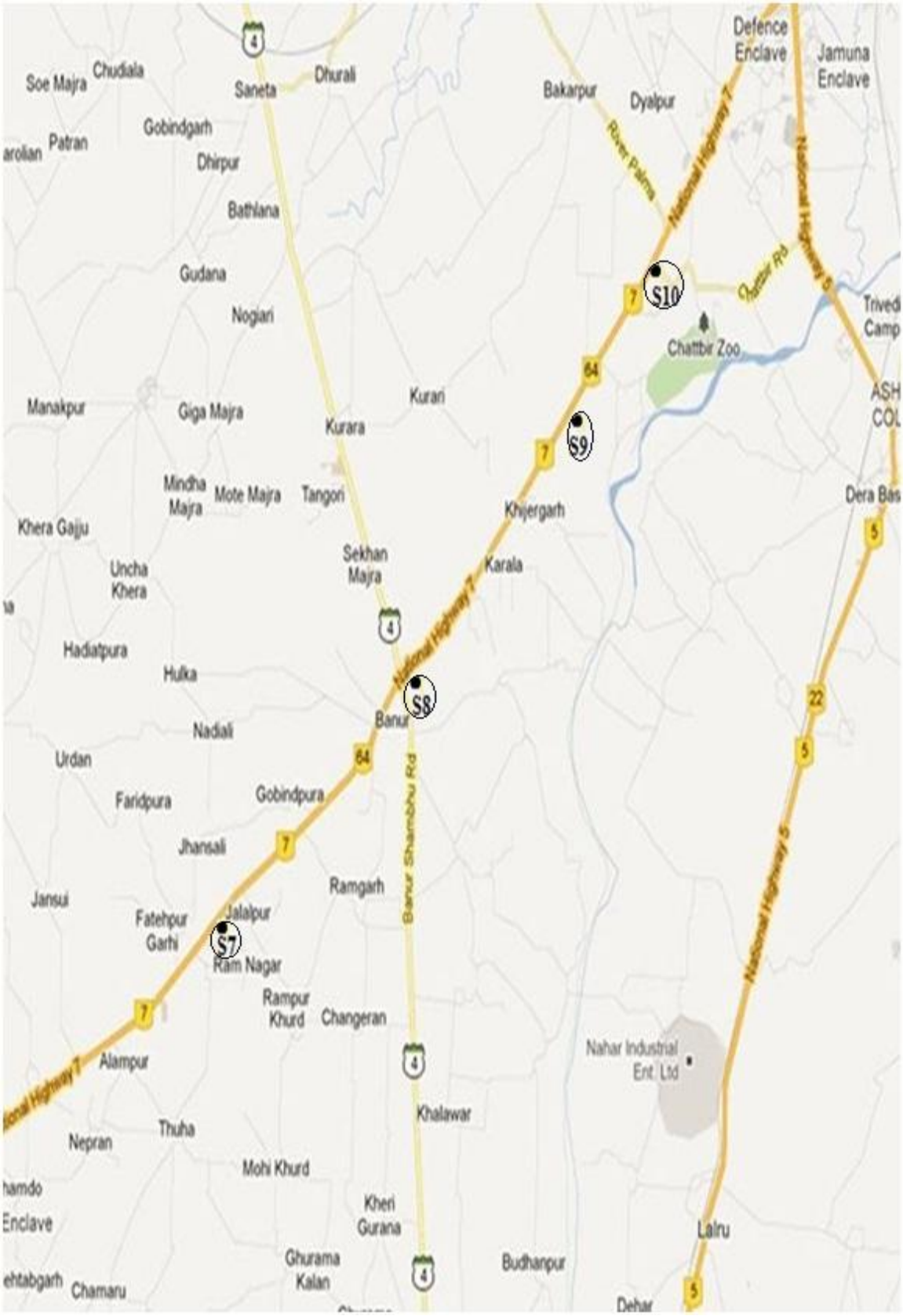


Fig No. 5.6 (c): Locations for Soil Analysis

Following results were obtained after the analysis:

Table 5.13: Soil testing results of soil samples

S. No	Location	Parameters					
		pH	Texture	Calcium mg/g	Sodium mg/g	Permeability (cm/sec)	Porosity %
1	Patiala	7.3	Sandy Loam	70	50	1.9×10^{-4}	46
2	Location-2	7.1	Sandy Loam	80	60	1.2×10^{-4}	39
3	Bahadurgarh	6.6	Sandy Loam	120	60	1.1×10^{-4}	55
4	Kauli Patiala	7.1	Silt Loam	60	50	1.2×10^{-4}	45
5	Near Rajpura	6.7	Clay Loam	90	70	1.6×10^{-4}	38
6	Rajpura	7.0	Silt Loam	120	100	1.5×10^{-4}	39
7	Chitkara Institute	7.4	Clay Loam	130	120	1.3×10^{-4}	52
8	Banur	6.4	Silt Loam	150	140	2.0×10^{-4}	55
9	Ajitnagar	7.1	Clay Loam	80	70	1.9×10^{-4}	44
10	Chatt	7.0	Silt Loam	110	83	1.8×10^{-4}	50

CHAPTER 6
RESULTS ANALYSIS

The results obtained after the analyses of different parameters was compared to the standard values prescribed by the Ministry of Environment & Forests (mentioned in annexure) and following inferences were drawn after the analysis.

6.1 –WATER

1) pH Value: pH value of all the samples were found to be within the prescribed limit i.e. within 6.5-8.5.

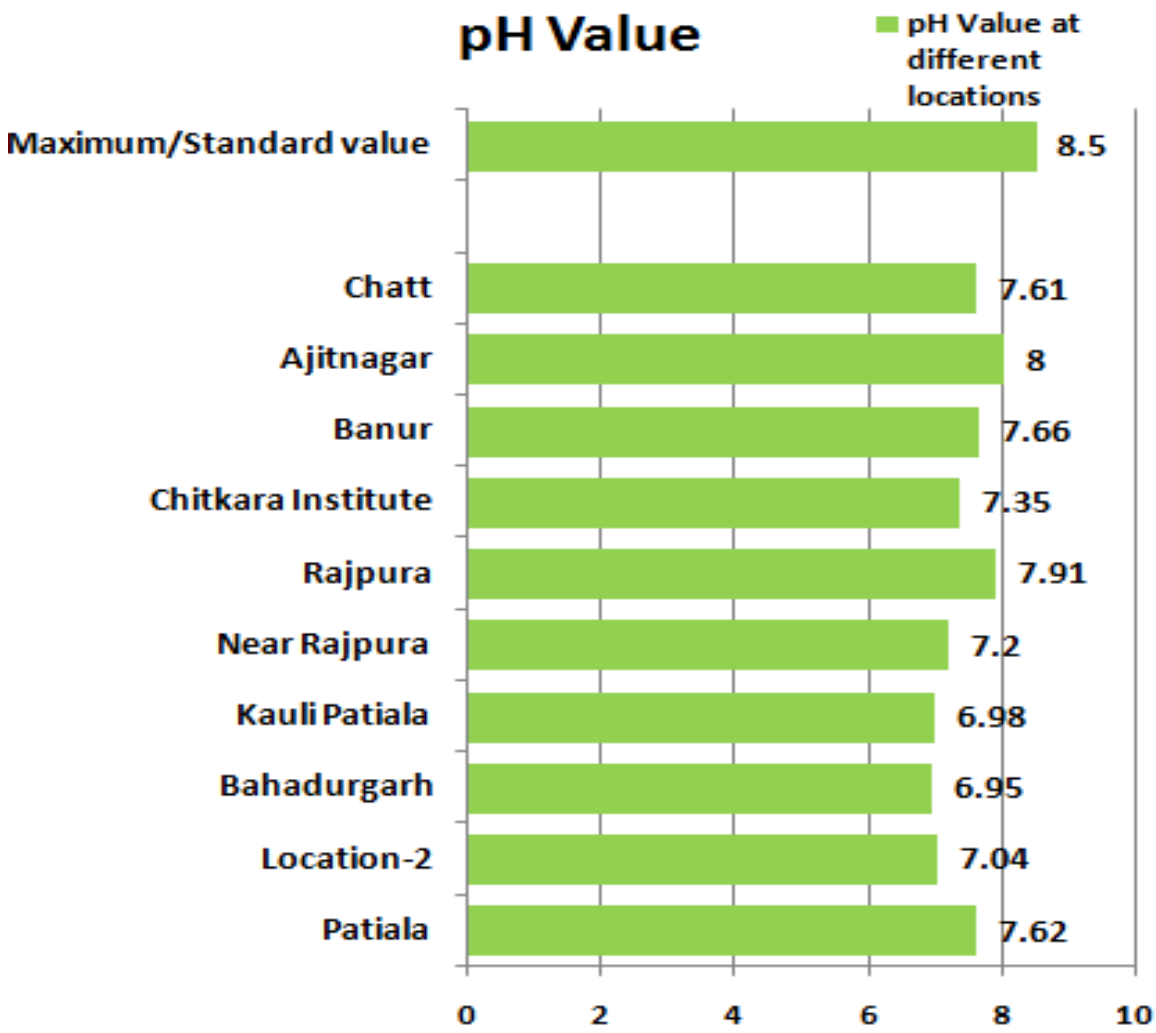


Fig No. 6.1: pH Value Measured At Different Locations

2) Hardness: Total hardness for most of the groundwater samples were found within the prescribed limit except for the samples collected from Rajpura, near Rajpura and the sample collected near Chitkara Institute respectively. The total hardness value exceeded in all three samples i.e. 300mg/l.

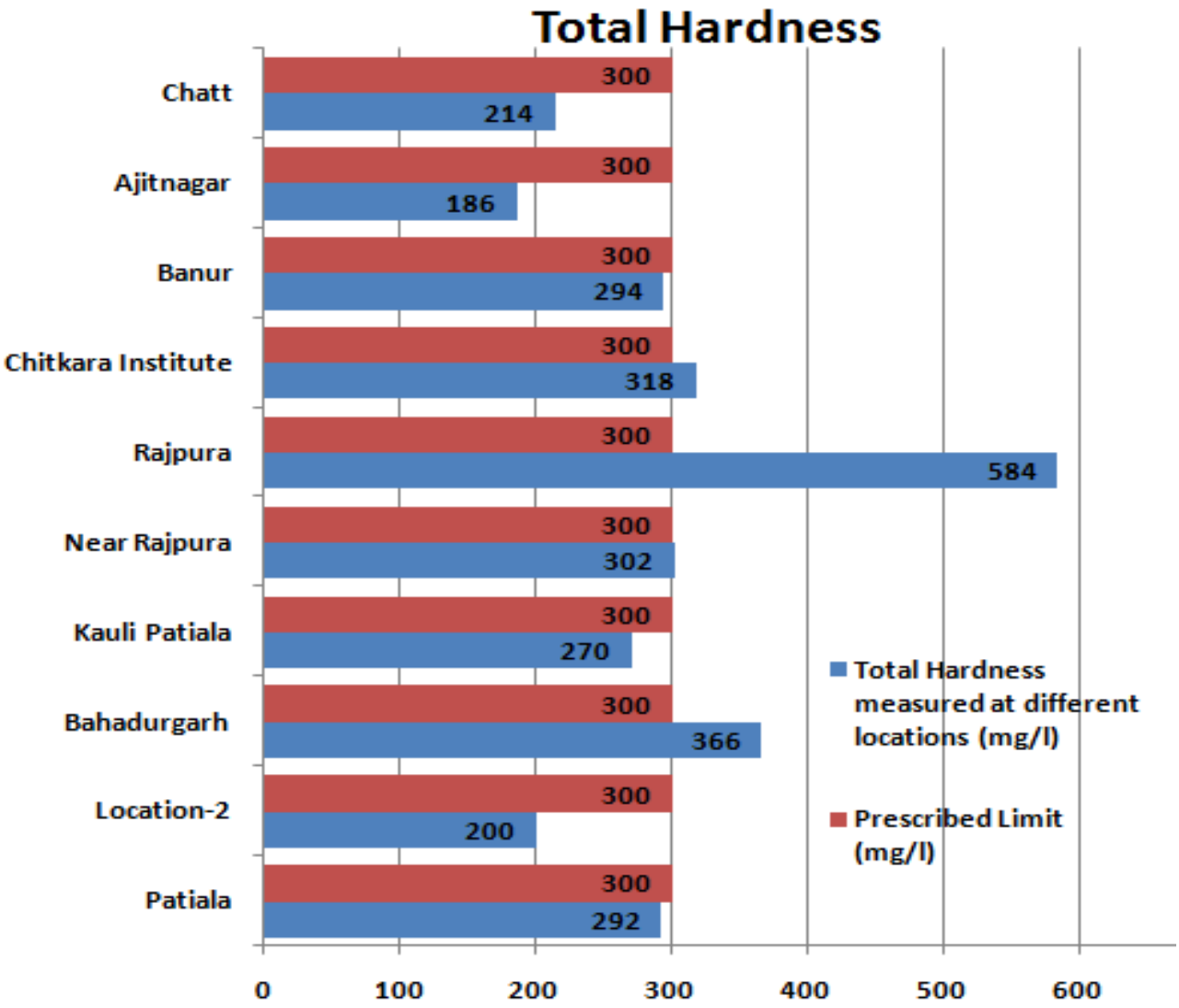


Fig No. 6.2: Total Hardness Measured At Different Locations

3) Chloride Content: Chloride content of all the samples was found to be within the prescribed limit i.e. less than 250 mg/l.

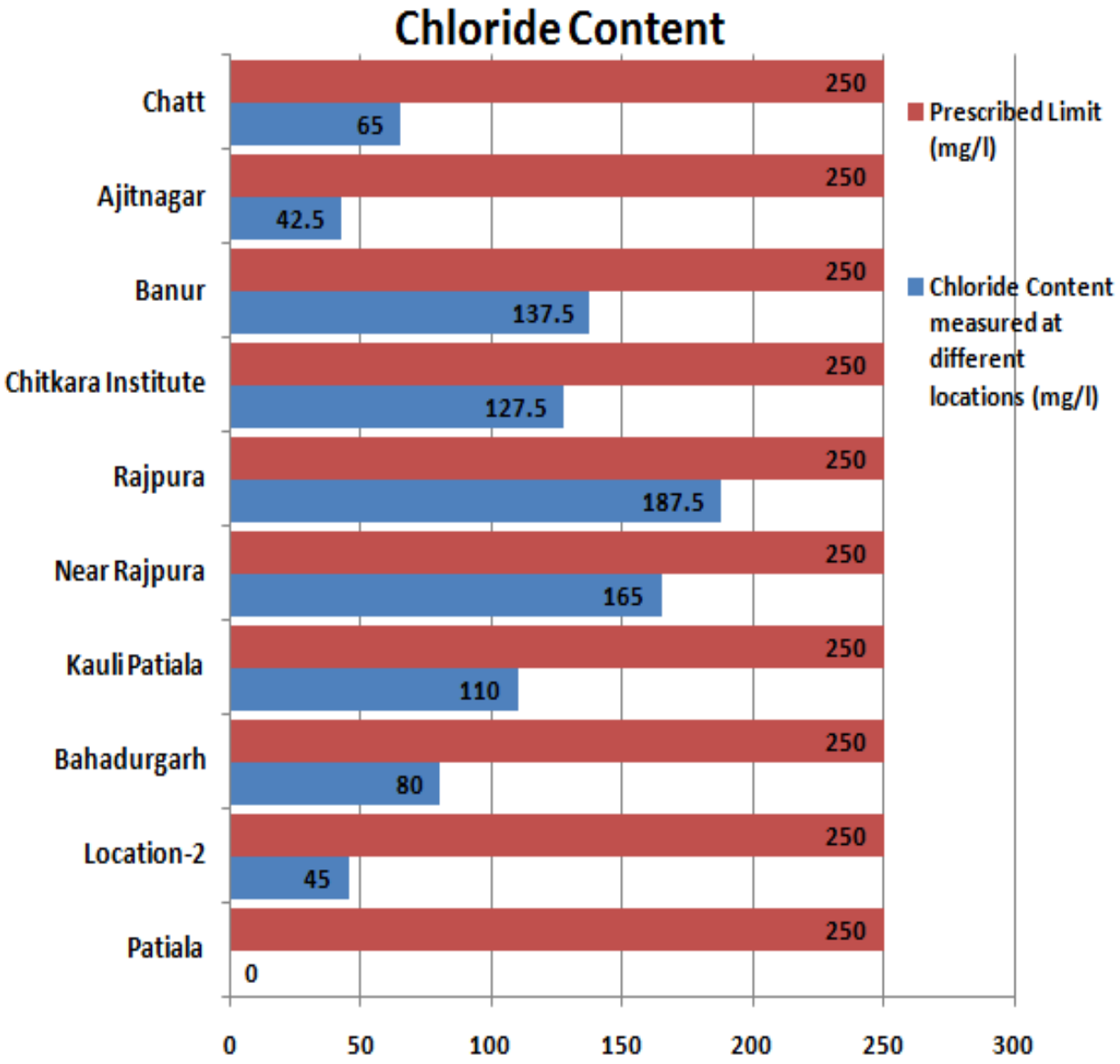


Fig No. 6.3: Chloride Content Measured At Different Locations

4) D.O Content: Dissolved Oxygen content of all the samples was found to be within the prescribed limit i.e. less than 10 mg/l.

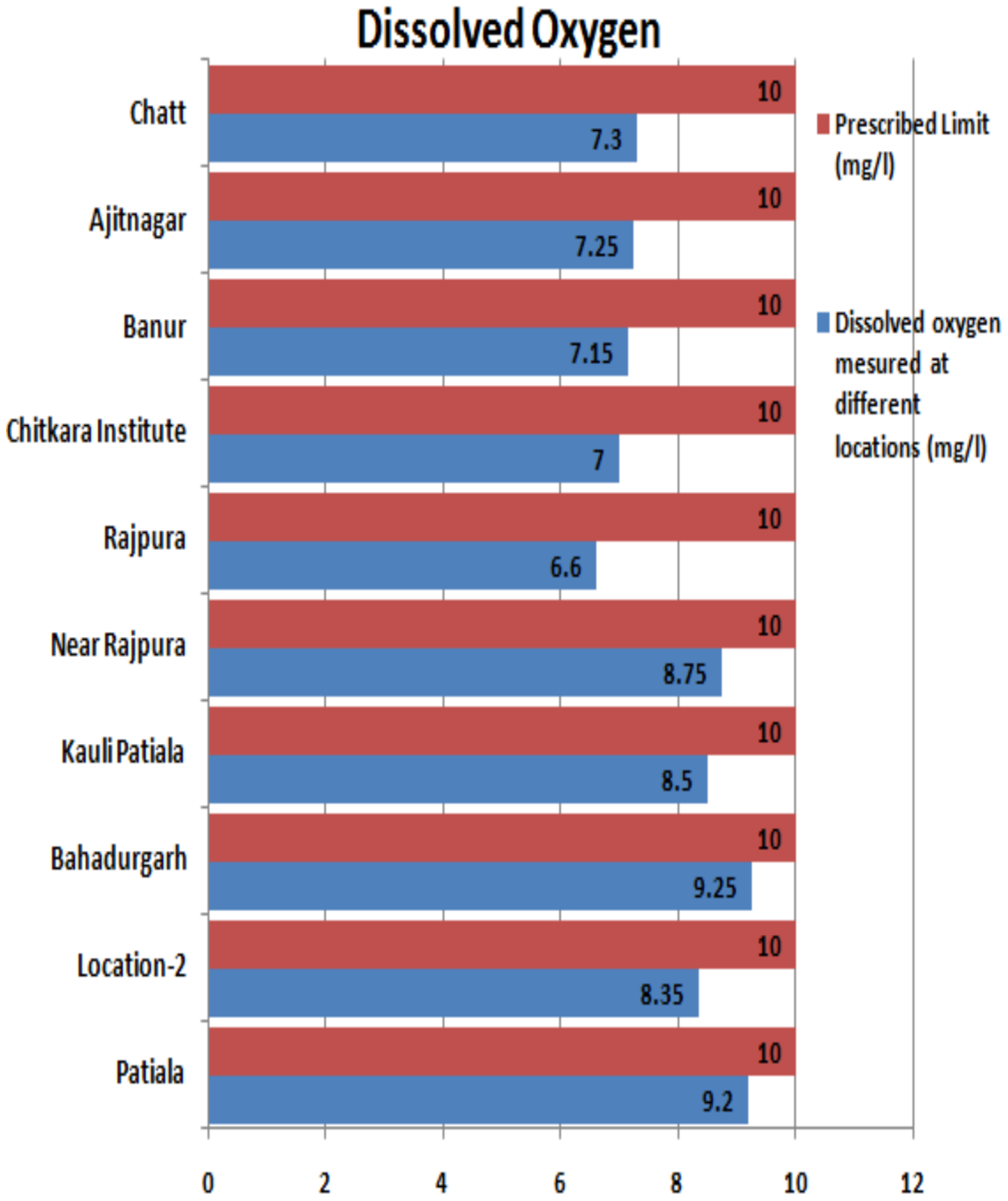


Fig No. 6.4: Dissolved Oxygen Measured At Different Locations

5) Fluoride content: In most samples, **f**luoride content was found to be greater than the permissible limit i.e. 1.5mg/l.

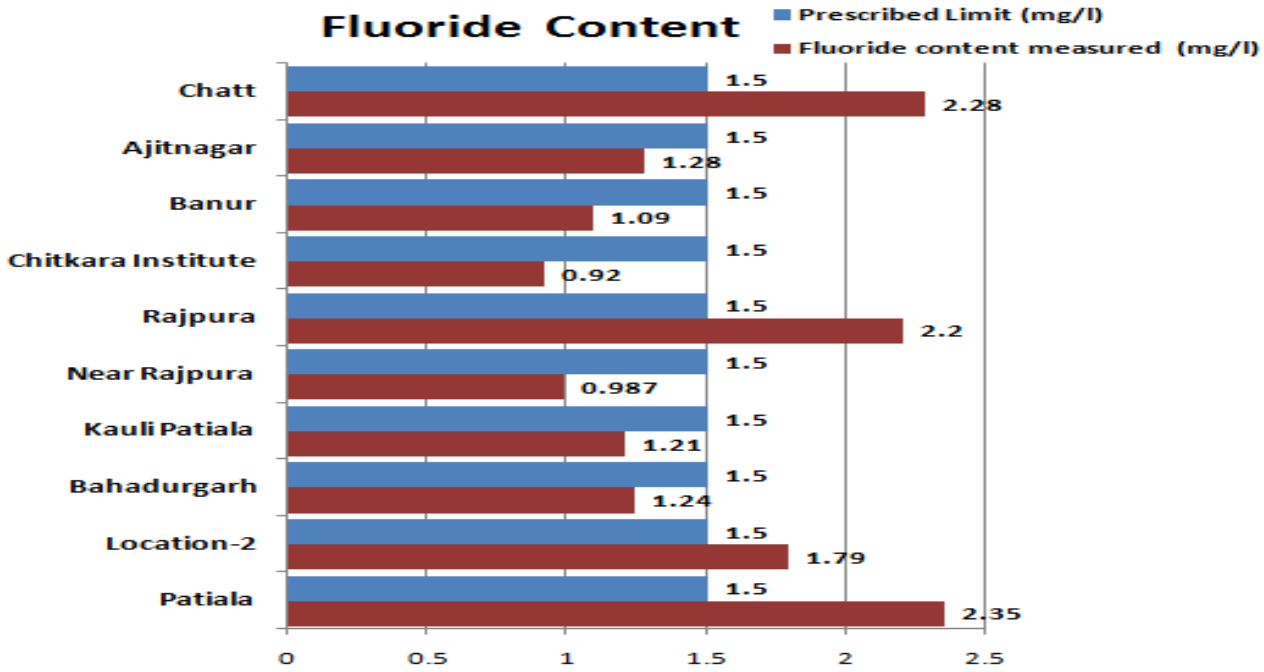


Fig No. 6.5: Fluoride Content Measured At Different Locations

5-Day BOD: In all samples, 5 day BOD was found to be within the prescribed limit set for drinking water.

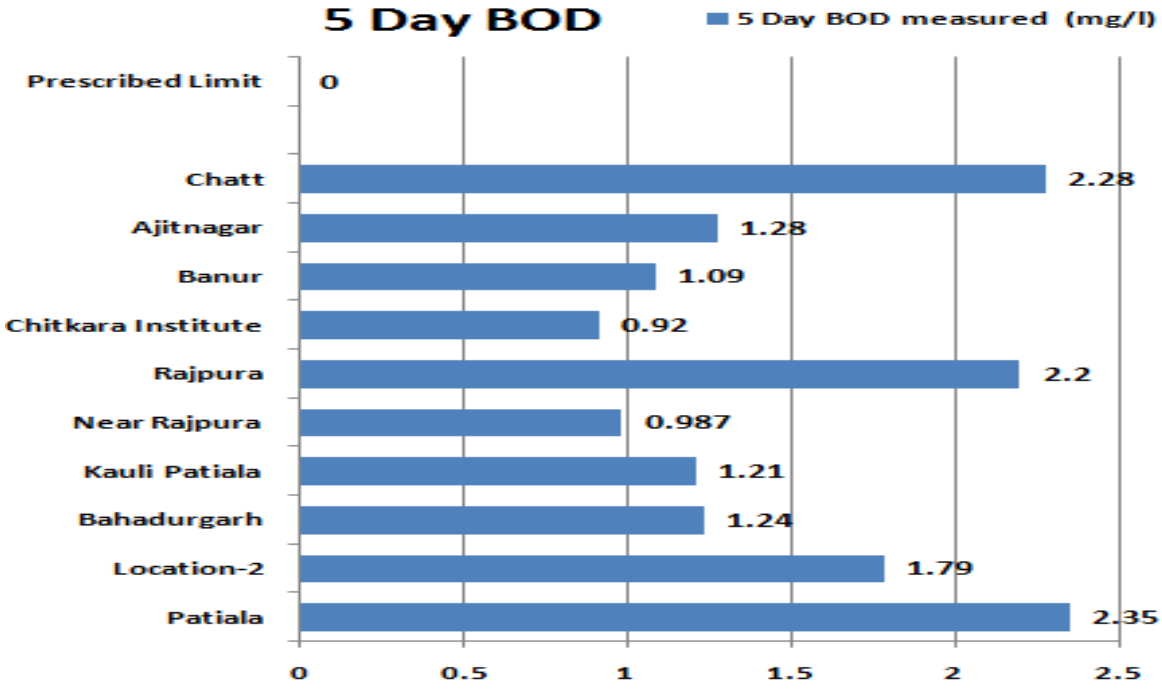


Fig No. 6.6: 5 Day BOD Measured At Different Locations

6.2- AIR

Sulphur Dioxide (SO_2): The Sulphur Dioxide (SO_2) content in the ambient air of all the locations were found to be within the prescribed limit i.e. 80 µg/m^3 (24 Hour average)

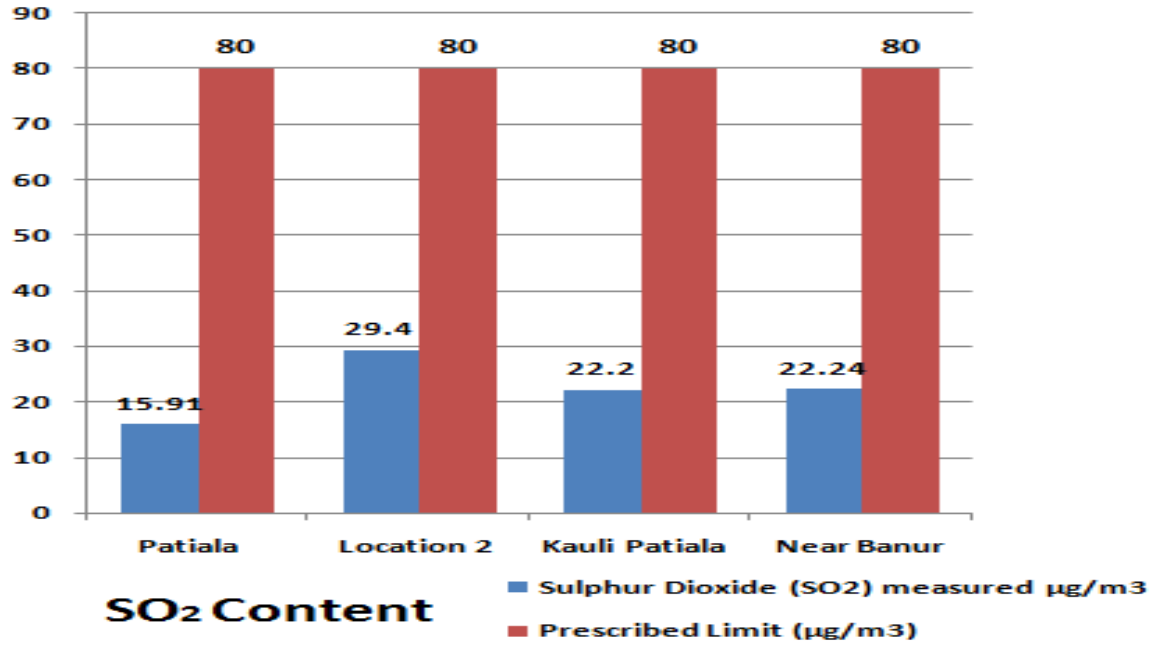


Fig No. 6.7: SO_2 content Measured At Different Locations

Oxides of Nitrogen as (NO_2): The Nitrogen Dioxide (NO_2) content in the ambient air of all the locations were found to be within the prescribed limit i.e. 80µg/m^3 (24 Hour average).

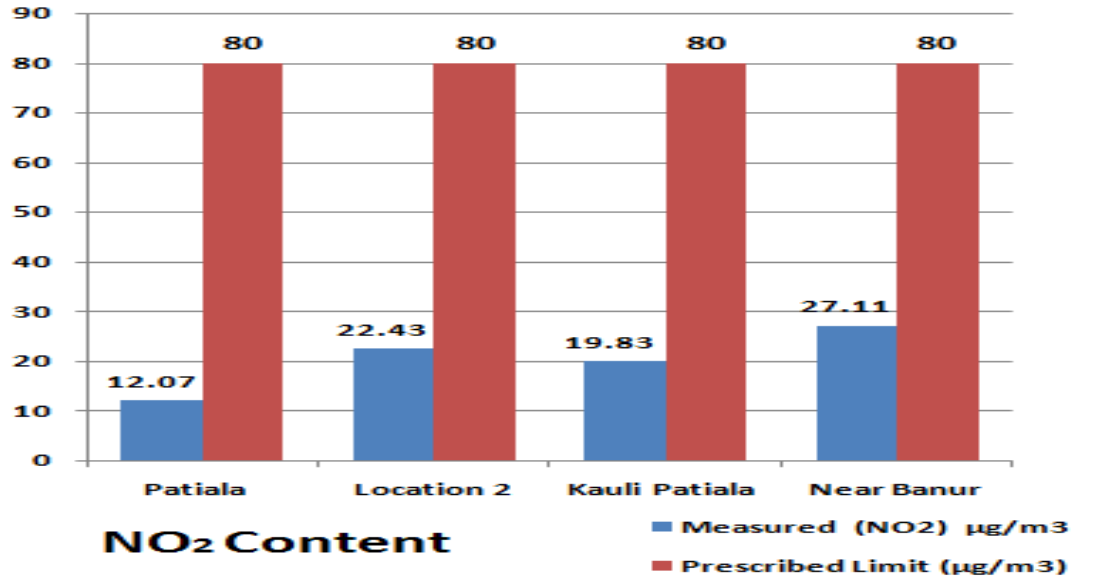


Fig No. 6.8: NO_2 content Measured At Different Locations

Suspended Particulate Matter (SPM): Suspended Particulate Matter (SPM) content in the ambient air of location 1 was within the prescribed limit but in all other locations it slightly exceeded the prescribed limit i.e. 100µg/m^3 (24 Hour average)

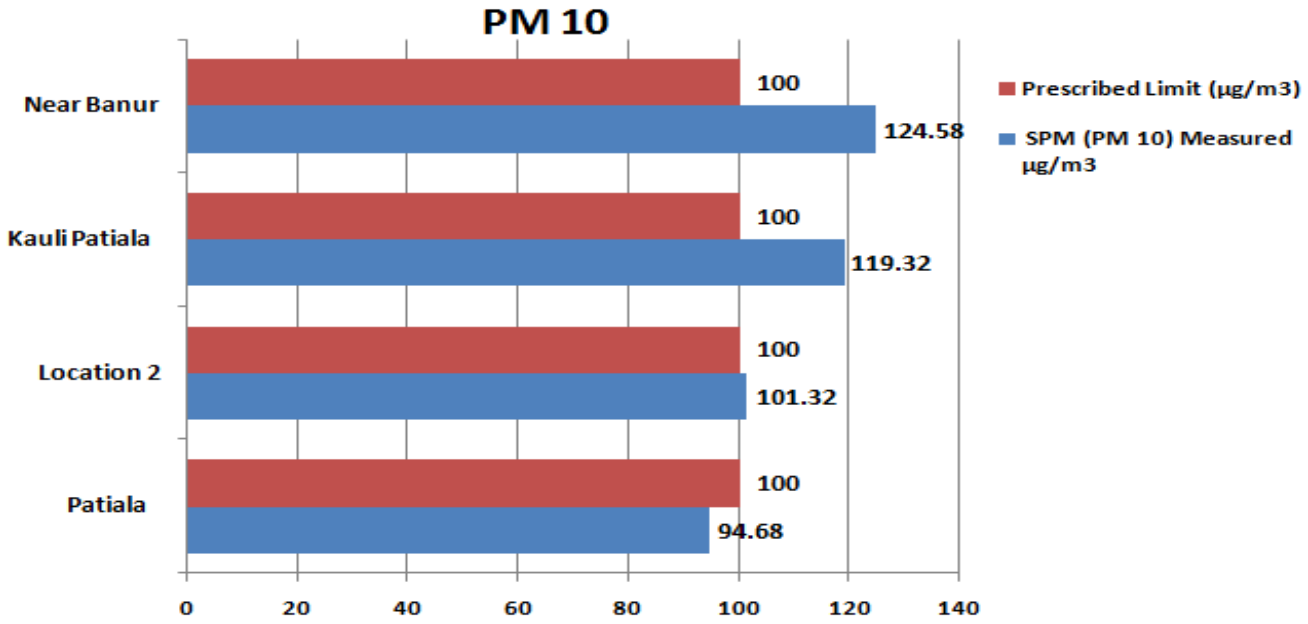


Fig No. 6.9: PM 10 Measured At Different Locations

Respirable Particulate matter (RPM) $PM_{2.5}$: Respirable Particulate matter (particle size less than 10 microns) content in the ambient air of all the locations were found to be exceeding the prescribed limit i.e. 60 µg/m^3 (24 Hour average)

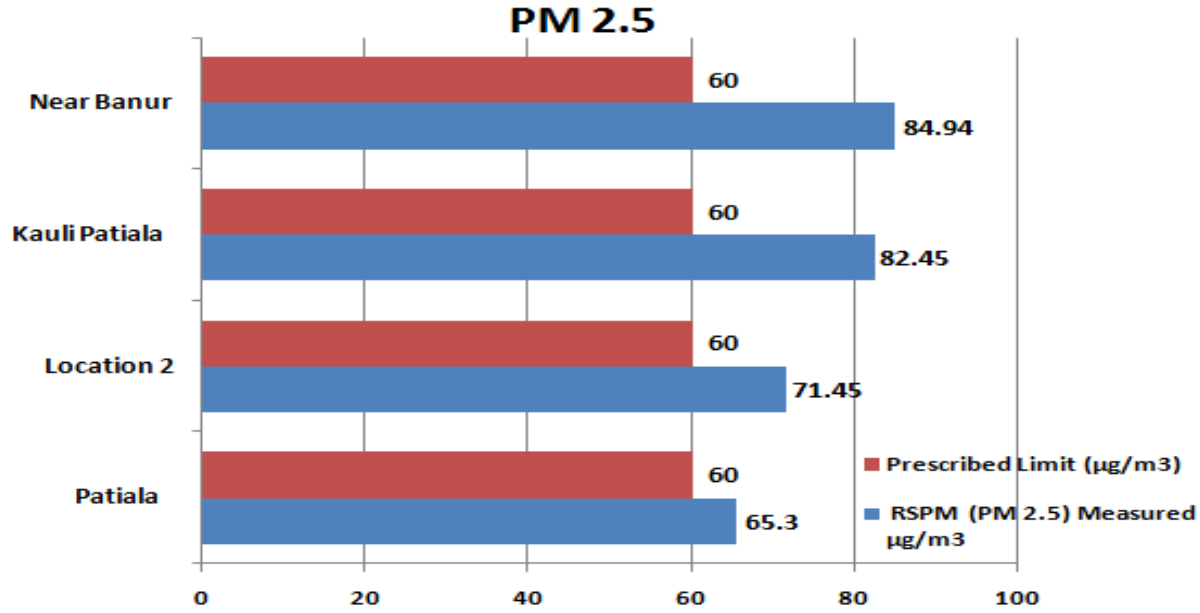


Fig No. 6.10: $PM_{2.5}$ Measured At Different Locations

6.3 TRAFFIC DATA ANALYSIS

6.3.1 LOCATION 1

Location one was selected on the Patiala- Rajpura highway The analysis indicated that traffic volume on Location 1 during preak hours is in both directions is 1983 vehicles equivalent to 2143.5 PCUs (morning) & 1769 vehicles equivalent to 1997 PCUs (evening). During off peak hours traffic volume in both directions is 1431 vehicles equivalent to 1783.5 PCUs . It was observed that during peak hours out of total traffic volume the the maximum volume composed of cars i.e. 40.34 % in the morning peak hours and 55 % in the evening peak hours. After cars,two whleers contributes most to the traffic volume with 37.77 % during morning peak hours , 26.74% during off peak hours and 25.86% during evening peak hours. Tractors contributed least to the traffic volume and were observed less than 3% of the total traffic volume.

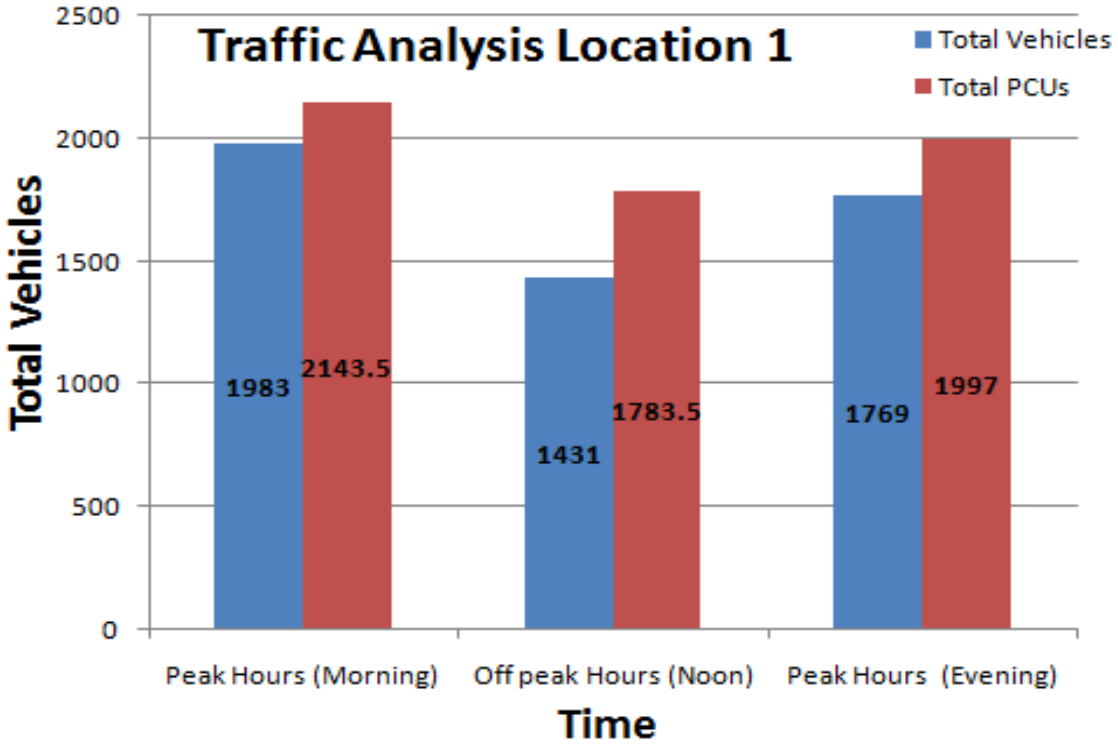


Fig No. 6.11: Traffic Volume at Location 1

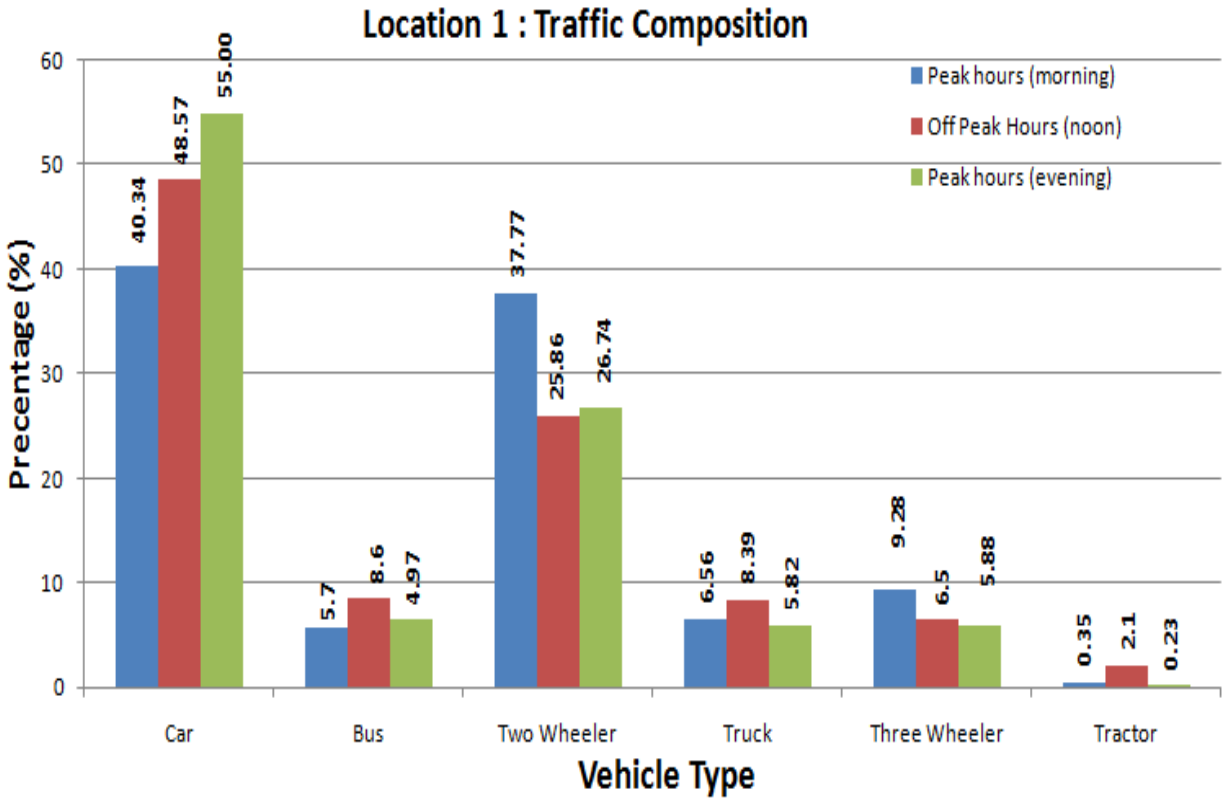


Fig No. 6.12: Traffic Composition at Location 1

6.3.2 LOCATION 2

Rajpura Bypass was selected as location two. The traffic density is less on this road .The analysis indicated that traffic volume on Location 2 during preak hours is in both directions is 527 vehicles equivalent to 849 PCUs (morning) & 616 vehicles equivalent to 963.5 PCUs (evening). During off peak hours traffic volume in both directions is 731 vehicles equivalent to 1334 PCUs . It was observed that during morning peak hours out of total traffic volume the the maximum volume composed of Two wheelers i.e. 38.14 % followed by cars i.e. 22.96%, trucks (22.7%),buses (12.71%), three wheelers (2.28%) & tractor(1.14%). During off peak hours out of total traffic volume the the maximum volume composed of cars i.e. 31.39 % followed by buses i.e. 25.85%, two wheelers (19.5%). trucks (8.47%), three wheelers (4.38%) & tractor (0.96%). During evening peak hours out of total traffic volume the the maximum volume composed of cars i.e. 34.90%, trucks (23.09%) , two wheelers i.e. 18.99%, , three wheelers (12.34%), buses (4.97%) &

tractors (3.9%).Tractors contributed least to the traffic volume and were observed less than 4% of the total traffic volume.

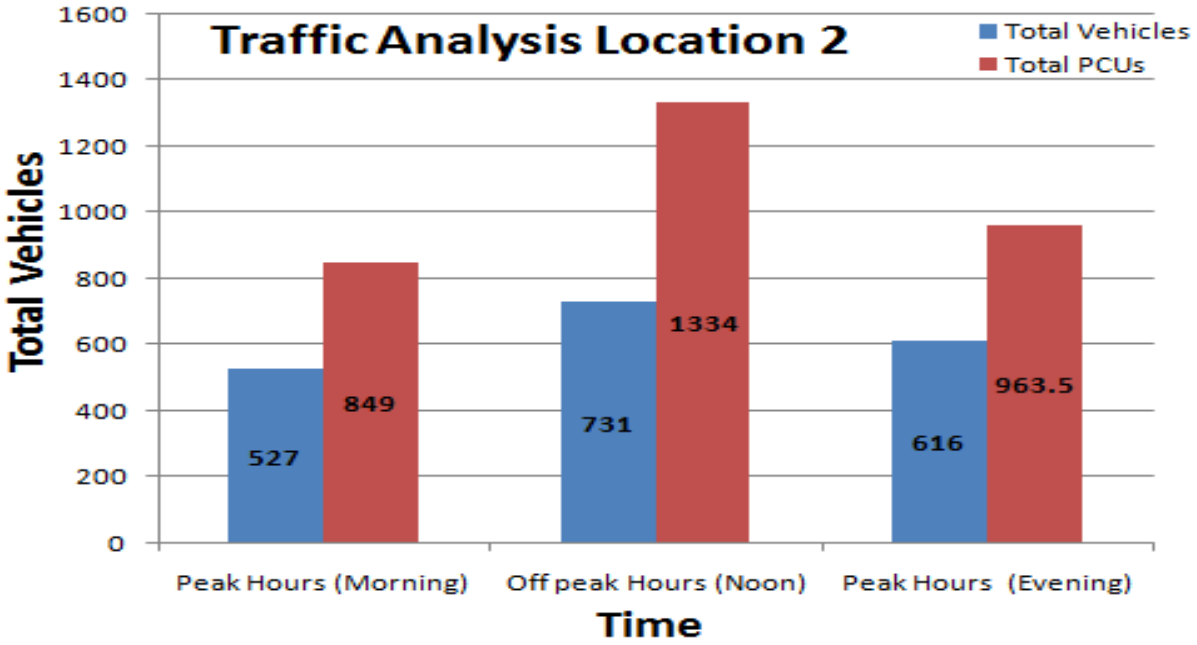


Fig No. 6.13: Traffic Volume at Location 2

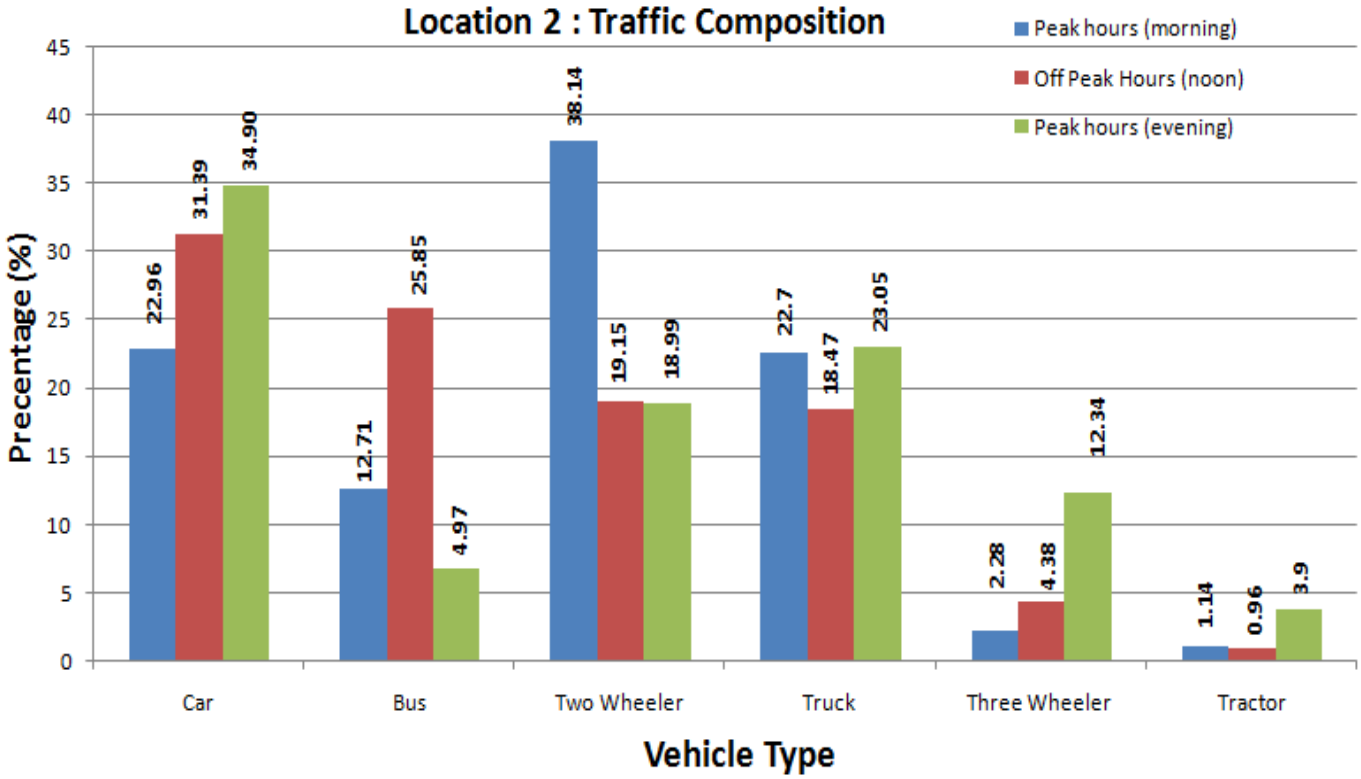


Fig No. 6.14: Traffic Composition at Location 2

6.3.3 LOCATION 3

Location three was selected on the Rajpura-Zirakpur highway.The anlysis indicated that traffic volume on Location 3 during peak hours is in both directions is 1708 vehicles equivalent to 2015 PCUs (morning) & 1718 vehicles equivalent to 1827.5 PCUs (evening). During off peak hours traffic volume in both directions was 1958 vehicles equivalent to 2133 PCUs . It was observed that during morning peak hours out of total traffic volume the the maximum volume composed of cars i.e. 45.22 % followed by two wheelers i.e. 28.93%, three wheelers (8.56%) ,buses (8.38%) ,trucks (6.69%), & tractors (1.34%). During off peak hours out of total traffic volume the the maximum volume composed of cars i.e. 42.59 % followed by two wheelers i.e. 33.86%, three wheelers (8.56%), buses (8.38%) ,trucks (6.69%), three wheelers (10.78%) & tractor (1.34%). During evening peak hours out of total traffic volume the the maximum volume composed of cars i.e. 56.58% two wheelers i.e. 27.18%, three wheelers (6.4%), trucks (4.13%), buses (4.97 %) & tractors (0.93%).Tractors contributed least to the traffic volume and were observed less than 3% of the total traffic volume.

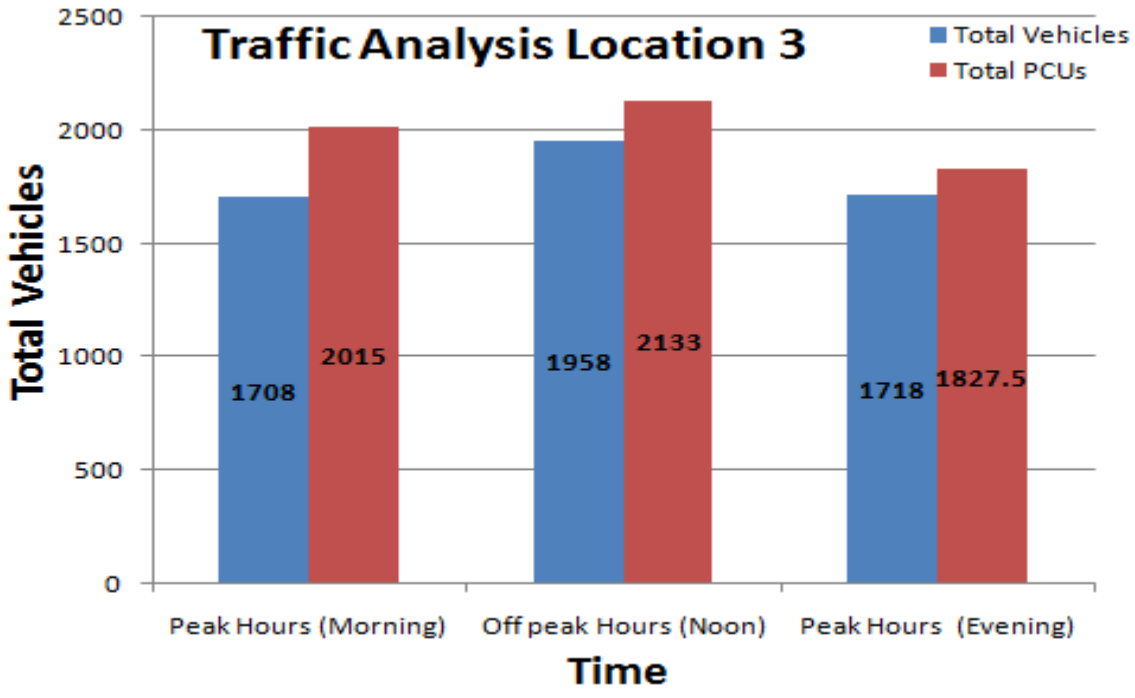


Fig No. 6.15: Traffic Volume at Location 3

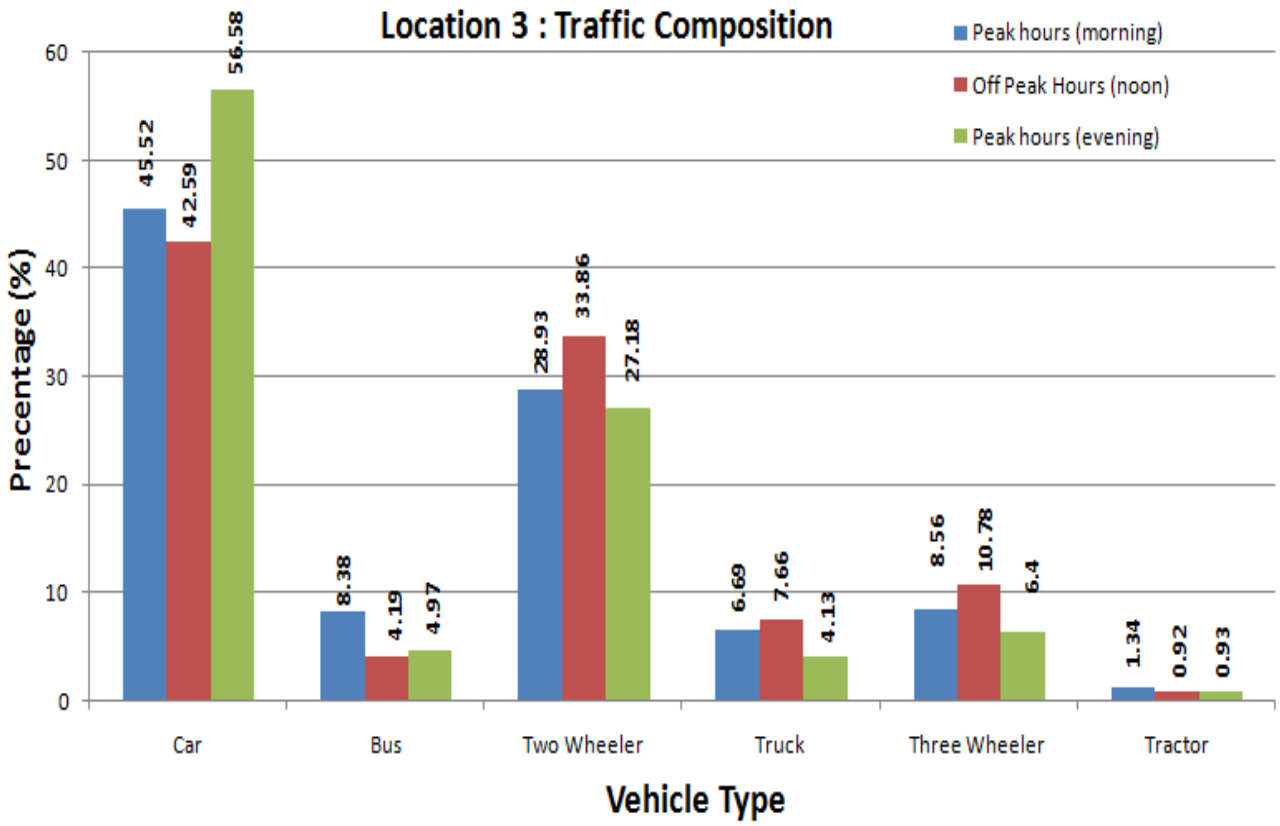


Fig No. 6.16: Traffic Composition at Location 3

6.3.4 INFERENCES DRAWN FROM THE DATA COLLECTED

1. Out of the total traffic density cars contributed the most in Location 1 & location 3 (greater than 40 % in both occasions) followed by the two wheelers. While in location 2 two wheelers contributed most to the traffic density.
2. Traffic density was much less at location 2 since it's a bypass road and most of the traffic gets diverted towards Rajpura.
3. Talking in terms of PCUs, the PCUs on location 1 in both peak hours and non peak hours exeeded the PCU capacity per hour value for a two lane (14.0 m) highway (i.e. 1200 pPCUs / hr for road with frontage acess, no standing vehicle and high capacity intersections). In location 3 the PCU value exeeded the standard value in both peak hours and non peak hours.
4. According to IRC-SP-84, the capacity of highway has to be agrumented as per the traffic requirement. The data shows that the present two lane highway is insufficient to handle the current traffic volume. Since, it's a plain terrain and as

per IRC-SP-84 , this section will require four lane immidiatly to capacitate more traffic.

5. Since traffic growth rate is normally 8%-10% per annum on highways (IRC SP:30-1993) so this section will require 4 lane to capacitate more traffic.
6. PCU capacity for a four lane (14.0m) one way highway with frontage acess, no standing vehicle and high capacity intersections is 3000 PCUs/hr, which will be sufficient to handle the amount of traffic passes through the highway.

6.4- NOISE

Noise was measured at the interval of every 10 minutes at different locations for one hour and the average value was calculated .The noise levels were found within the prescribed limits.

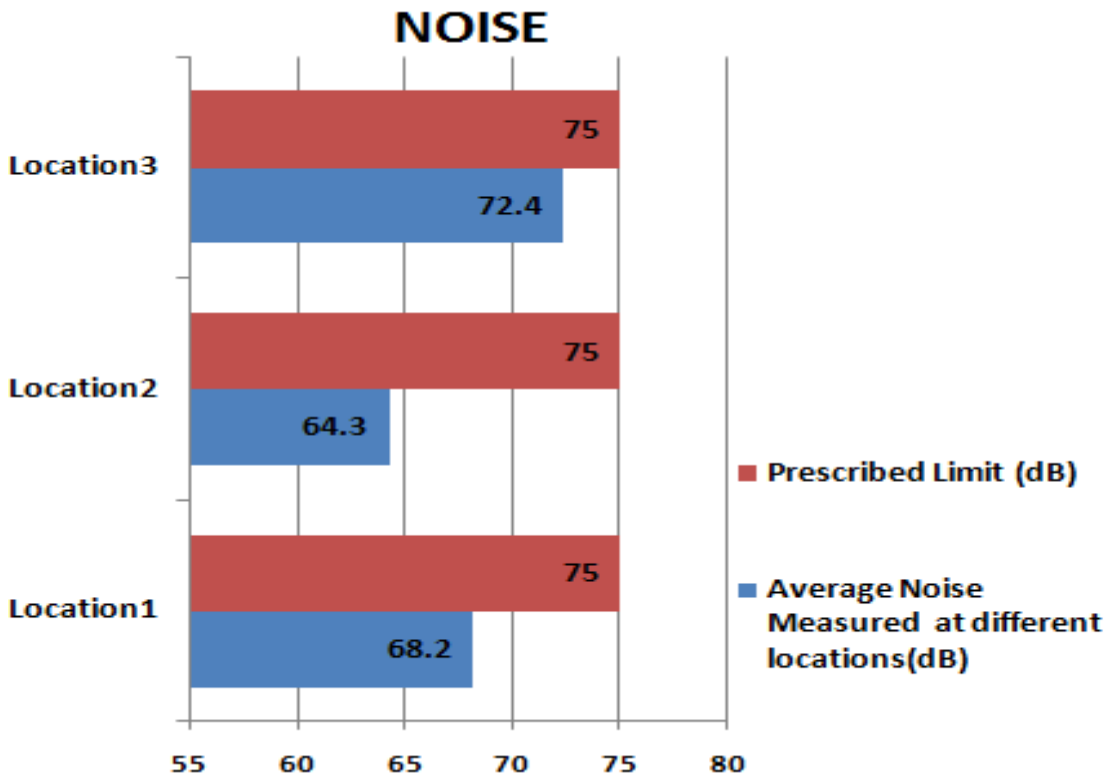


Fig No. 6.17: Noise Measured at Different Locations

6.5 PUBLIC CONSULTATION

A consultation programme was carried out by asking them few important questions regarding the present & future state of highway. The information is presented below:

1. 54% people are unsatisfied with the current state of the highway, 79% believed that the highway is providing proper connectivity with other parts of the state.
2. Traffic congestion emerged as a big concern as 77% people said that the problem of traffic congestion persists in the present highway & 83% people said that widening of road would be appropriate for reducing traffic congestions. 60% people also felt that the road safety was not up to the mark.
3. The present highway was appreciated in terms of rainwater drainage as 73% people said that there is proper rainwater drainage on and along the roadside.
4. Only 54% of people believed that their business will improve with the widen highway but 72% people believed that job opportunities will increase with improved highway.
5. People had diversified opinions on the quality of air they breathe, 48% people were satisfied while 42% were not satisfied with the quality of air they breathe. 58 % people said that they have not experienced any health and psychological problems due to pollution.

6.6 ECOLOGICAL RESOURCES

The Ecological data was collected from the forest departments and the information regarding the local flora of the project region was provided.

1. It was observed that Eucalyptus is the dominating species accounting for 60.6 % of the total tree population followed by shisham (12.58%), fruit trees (7.61%), kikar (2.9%) and miscellaneous species contributed 16.82 %.
2. For the widening of project road, the proposal for tree cutting has to be projected to the forest department for clearance and re-plantation. As per Punjab forest department norms, re-plantation to be carried out is 10 times the no. of trees uprooted. Approximate 4000 trees will be uprooted.

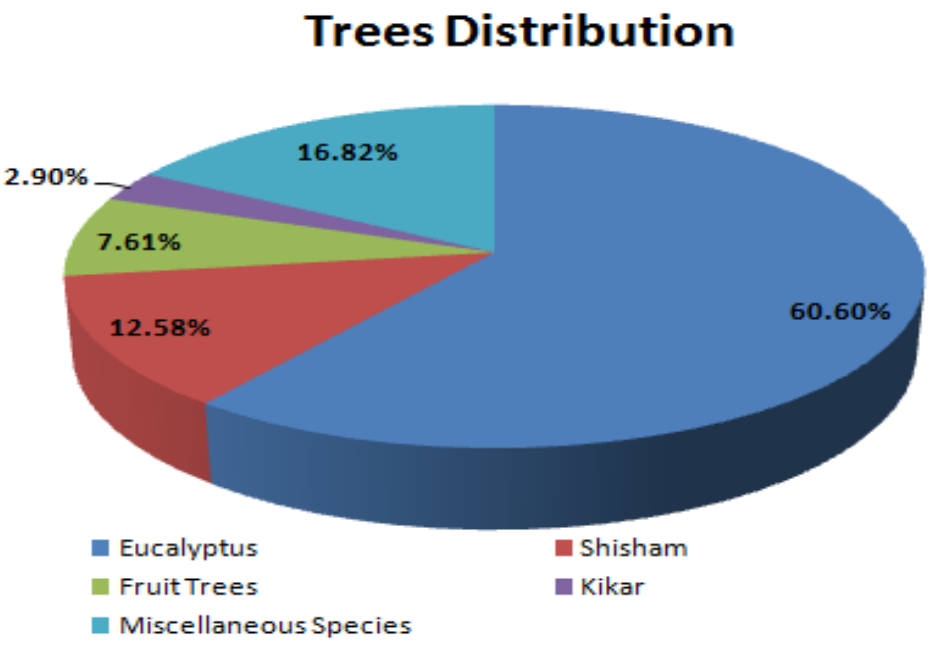


Fig No. 6.18: Trees distribution pattern along the project area

6.7 SOIL ANALYSIS

Different parameters of soil were tested like pH, texture, calcium, sodium, permeably& porosity. The results obtained were as follows

- The pH analysis of different samples revealed that soil is neutral (i.e. 6.6-7.3) at all locations except the location near Chitkara Institute where soil is slightly alkaline i.e. 7.4
- The permeability of all the soil samples was found complying with their texture
- The porosity of all the soil samples was found complying with their texture
- The Calcium content was found maximum at Banur (150 mg/g) & minimum at Kauli Patiala (60 mg/g). The Sodium content was found maximum at Banur (140 mg/g) & minimum at Kauli Patiala (50 mg/g)

The overall analysis revealed that there is no significant contamination with respect to soil, but there are many likely chances of occurrence of contamination during two years of construction because of the construction machinery to be used for road building project.

CHAPTER 7
MITIGATION & CONCLUSIONS

Based on surveys and the data analysis it can be said that the construction and widening of road are likely to have long-term benefits for all road users and for inhabitants of villages/ towns near the road. Road users will be benefited from reduced travel time, vehicle operating cost, traffic congestion, road accidents and saving of fuel. Local residents have increased economic employment opportunities, improved access to facilities, educational institutions, hospitals, nursing homes industries, roadside amenities hotels and eating-places. The provision of four laning and service roads interconnected by underpasses, ROB, flyovers will remove conflict between slow non- motorized traffic and fast motorized traffic for local residents and therefore making their daily life routine safer.

Since, during the project, designing state land acquisition issue was considered so the land acquisition has been minimized and the four laning is being proposed within the existing ROW, the project will have minimum adverse effect on physical, biological and socio economic environment. However, during construction, temporary and short disruption of utilities, plantation of new trees in place of felled trees, accident risks, risks of transmission of communicable diseases transmitted through contact of residents with road workers will have very little negative socio economic aspects. Publicity and education of residents and road users and workers by the State Government Department, Contractor, Supervision Consultant, Forest Department, Medical Department can have a impact in mitigating the short term problems and inconveniences

7.1 MITIGATION MEASURES

It is recognized that it is seldom possible to eliminate an adverse environmental impact altogether, but it is often feasible to reduce its intensity. This reduction is referred to as mitigation. For each potential adverse impact, the plan for its mitigation at each stage of the project should be documented and its cost assessed. It is essential that these costs of mitigation be adequately assessed and be fully documented. This is very important in the selection of the preferred alternative. Mitigation is a critical component of the EIA

process. It aims to prevent adverse impacts from happening and to keep those that do occur within an acceptable level. Opportunities for impact mitigation will occur throughout the project cycle.

The objectives of mitigation are to:

- Find better alternatives and ways of doing things
- Enhance the environmental and social benefits of a proposal
- Avoid, minimize or remedy adverse impacts
- Ensure that residual adverse impacts are kept within acceptable levels

Thus after the analysis of different parameters following mitigation measures are suggested for the project road. The impact assessment and mitigation measures have been devised for the following stages:

- Planning and designing stage
- Construction stage
- Operational stage

While some of the construction phase impacts are temporary, some also are permanent. Operation phase impacts are continuous in nature. To identify these impacts broadly on physical, ecological and social environment Impact Identification Matrix are developed.

1) DESIGN STAGE

The major impact associated with Design stage deals with loss of land, properties and livelihood due to acquisition of land and properties. The design of alignment also decides the acquiring or impacting water bodies, forest, cultural sites etc. Design phase study these issues along with environmental and social specialists to minimize the impact. Besides the impact on environment and social factors, there should also be consideration for legal issues so that the project can be operated with ease.

In case of present highway project, the major issue at design stage has been the tree cutting and land acquisition for the proposed alignment.

Major mitigative major measures proposed during this phase are proposing bypasses and realignment. Bypasses should be provided wherever major structures are involved. Various impacts that are likely to be caused during this phase and corresponding

mitigative measures to minimize adverse impacts are given below in **Table 7.1.** With adopting proper design adverse impacts would be considerably reduced.

Table 7.1: Mitigation Measures during design phase

Impacts	**Mitigation Measures**
Increased Traffic Density	In order to effectively control the traffic density a flyover and a vehicular underpass must be constructed at Banur Town. A rail over bridge should be constructed near Rajpura bypass (Ch 30- 31 Km) in order to effectively manage the traffic congestion created near the railway crossing. The highway passes through various important institutes like Gian Sagar Medical College, Chitkara institute etc, so the provisions should be made for pedestrian crossing. Provisions should be made to segregate the traffic from the local activities thus foot over bridges should be provided at important junctions like Zirakpur, Government school Banur, Gyan Sagar Medical College & Hospital, Bahadurgarh & Rajpura. A dedicated carriageway should be constructed along NH-1 from free movement of traffic from Gagan Chowk to Bye-pass at "T" junction along NH-1
Land Acquisition	Alignment design should be such that it minimizes the land acquisition.
Removal of Trees	Alignment design to reduce the number, widening on The side of the road where less tree will be cut. Compensatory afforestation programme should be implemented in consultation with state forest department
Impact on public utilities	Alignment design should consider the effects. In case of removal, alternate arrangement to be done before.
Impact on Cultural Sites	Alignment design should consider the effects consult public if impact cannot be avoided
Access Restriction.	Design should include required alternatives, underpasses, proper signposts for people
Congestion in settlement areas.	Provide service roads .
Borrow pits.	Select locations considering minimum loss of productive land and redevelopment.

2) CONSTRUCTION STAGE

Maximum impacts are expected during construction phase of the highway project. Impact on various environmental components and their mitigative measures are being proposed considering the following sub them are:

- Land Environment
- Air and Noise Pollution
- Water Resources
- Flora &Fauna
- Safety
- Workers Camp

These are summarized in **Table 7.2 to 7.8** .Once these mitigative measures are followed, the possible adverse impacts would be drastically reduced.

Table 7.2: Mitigation Measures for land environment

Impacts	Mitigation Measures
Soil Erosion	Proper planning for slope stabilization, topsoil storage plantation and turfing on slopes.
Loss of vegetation cover due to borrows excavation & back filling.	Use fly ash for construction if available within 100 km of road. Top soil of borrows should be conserved and led over the site after the borrows exhausted. For reducing the effects of accidental spills lubricants and oil and molten asphalt should be avoided following good environmental management practices. Sacrificed asphalt should be re-utilized in fillings, if any.
Disposal of Construction Waste	No haphazard dumping of construction waste. Only pre-selected location maintaining local environmental regulations to be used
Disposal of Solid Waste	Specific landfill sites should be identified to manage solid waste generated from habitation of construction workers.

Table 7.3: Mitigation Measures for Air & Noise Pollution.

Impacts	Mitigation Measures
Generation of dust	Spray water during construction phase, in each handling sites, asphalt-mixing sites and other excavation areas for Suppression of dust. When fly ash is used, dust emission during its unloading, storage at open place and handling for road construction can be suppressed by water sprinkling at regular interval. Dust emission from piles of excavated material should also be controlled by spraying water on the piles. Special care should be taken when working near schools and medical facilities. Workers are exposed to high level of dust pollution in the Stone Crushing activates. Ensure that stone crushers supplying materials for this project implement air pollution control and workers are provided with masks.
Gaseous Pollution	Vehicles and machineries will be regularly maintained to conform to the emission standards stipulated under Environment protection rules 1986. Asphalt mixing sites should be sufficiently away from residential quarters and not in forest area. Workers working in asphalt mixing and subsequent application of asphalt mix on road surface are exposed to high level of carcinogenic emission thus should be provided with masks
Noise Pollution	Noise levels of machineries used shall conform to relevant standards prescribed in Environment (Protection) Rules, 1986. Workers shall not be exposed to noise level more than permitted for Industrial premises, i.e. 90 dB for 8 hours. Workers exposed to high noise level should use ear plugs. Construction work generating noise pollution near the nursing home and residential areas should be stopped during night. No work should be carried out after daylight in forest areas. Noise attenuation measures e.g. planting of trees, noise attenuation structures should be built as required.

Table 7.4: Measures for Protection of Water Resources

Impacts	Mitigation Measures
Loss or impact on water bodies	The water body or a part if lost should be replaced immediately. The embankments of water bodies should be raised to prevent any contamination from road run-off.
Siltation into water bodies	Cofferdams or similar measures should be implemented during construction on rivers or major watercourses. Vegetation should be done where possible on any steep slopes to prevent erosion, which causes siltation. No dumping of solid waste near the water bodies or rivers.
Flooding due to Siltation of drainage channel.	Excavated earth, fly ash and other construction materials should be stored away to prevent washing away.
Water use for construction	Select water sources so that local availability is not affected. Local water bodies, tube wells, wells should not be used. Borehole should be done with permission from State Ground Water Board.
Contamination from waste	All practical measures should be taken to prevent any uncontrolled effluent discharge from construction workers camps and storages to water sources. Provided campsite with proper drainage connected with local drain.
Contamination from fuel	Vehicle maintenance should be carried out in a confined area, away from water sources, ensure that used oil or lubricants are not disposed to watercourses.
Sanitation and Water use in Construction Camps	Organize construction camp in a planned manner. Proper sanitation facilities should be provided to workers. Camps should have water supply facilities like tube wells or from other sources such as that, local water sources are not affected.

Table 7.5: Mitigation measures for Tree cut

Impacts	Mitigation measures
Tree cutting	Tree felling must be restricted to requirement of widening of road activities only. Alignment should be designed in a manner that would save trees as far as possible. Compensatory forestation must be done in the ratio of 1:2 There should be more plantations on roadsides where there are no trees at

	present. Total length of the road including bypasses will be about 50 km. Trees must be planted for compensation. To compensate the felling of trees and improve environmental quality trees should be planted in nearby areas beyond the project site. Select species depending on site, plantation design and in consultation with local community in the plantation programme and forest department.
Forest Flora	Efforts should be made to save medicinal trees and rare plants when afforestation programme will be taken up.

Table 7.6: Mitigation measures for Fauna

Impacts	Mitigation Measures
Loss of Habitat for avifauna	Compensatory Plantation programme should be taken up. There should also be protection for water bodies for water birds.
Impact on Wildlife	No construction work should be done after evening in the forest areas. No use of surface water sources inside the forest. No camp site inside forest area No harvesting of wild foods or hunting of animals. Speed restriction in night in forest areas

Table 7.7: Safety measures

Impacts	Mitigation Measures
Information to public	Signs should be posted on road before construction areas informing public and travelers about the work and safety provisions
Restriction to access	Safe and convenient passage for vehicles, pedestrians and livestock's to and from the side roads and property across the road should be arranged during construction work.
Increase in accidents due to traffic disruptions.	Proper traffic diversion and management should be ensured during construction as per IRC-2001-67,SP-55 and as per provisions under the contract agreements. Speed limit in the construction zones.
Occupational safety for construction workers.	All safety measures for workers should arranged by contractor as per Factories Act
Occupational safety for asphalt plant workers and crusher plant	All workers employed on mixing asphaltic material cement, lime mortars, concrete etc., should be provided with protective footwear and protective goggles. For crusher workers masks should be provided.

Table 7.8: Mitigation measures for workers camp.

Issues	Measures
Location	Workers camps should be located 1 km away from water bodies, schools, and residential areas and at least 5 Kms away from the forest areas.
Construction	Construct camps with proper accommodation facilities, should look aesthetically good as this should be a roadside feature during construction period.
Water	Potable water supply for the workers should be arranged by contractor so that local water sources are not disturbed. Bore well for the camp should be suitable for this region.
Sanitation	Provided workers with proper sanitation facilities, toilets with septic tank and soak pits.
Fuel	LPG can be used as fuel.
Waste Management	Wastewater from domestic uses, solid wastes should be disposed without violating environmental norms. The measures should be site specific.
Other Amenities	Crèche, first aid, canteen etc. as required under Factories Act.

3) OPERATIONAL PHASE

This phase of the project is expected to rather smooth due to improved road conditions, widening of road, proper tree plantation etc. However, various components that are likely to get impacted and corresponding mitigative measures for these are given in **Table 7.9**

Table 7.9: Operational Phase Mitigation Measures.

Impacts	Mitigation Measures
Dust	Maintain roads properly in order to avoid dust generation.
Gaseous Pollution	All vehicles should be checked for "Pollution Under Control" certificates and occasional spot testing of emission from vehicles should be carried out.
Noise	Post signs to restrict blowing of horns in front of sensitive locations
Surface run off	Do not dispose surface runoff from the road directly in the water bodies used by people for domestic purposes. Surface runoff should also not be disposed directly in to any watercourse with good water quality
Wild life	There should be speed restrictions through specific forest area in the night to prevent accident with wild animals.
Flora	Monitor tree plantations continuously.
Safety	Safety signs should be kept clean and updated.
Public amenities	Bus stops, underpasses etc. should be kept in order.

7.2 IMPACT MATRIX

Different activities will be undertaken during the construction and operation stages of the Project each of these activities associated with project will have implications to the immediate environment. The scale of the impact will vary according to the activity being undertaken and these can be best illustrated in matrix format. The criteria for evaluation based on impact score has been calculated as given in table 4.2.

Table 7.10: Evaluation of project without control measures

Environmental Components	Weightage	Activities							
		Acquisition of Land	Site Clearing	Earth Work and Excavation	Movement of Construction Vehicles	Processing of Construction Material	Construction Operation	Road in Operation	Impact
Air Quality	95		-1	-1	-2	-1	-2	-1	-760
Noise Level	85		-1	-2	-2	-1	-2	-1	-765
Surface Water Quality	20		-1						-20
Ground Water Quality	70			-1		-1	-1		-210
Soil Quality	70	-1		-1	-1				-210
Flora & Fauna	85		-2		-1		-1	1	-425
Aesthetics	90		2	-1		-1	-1	3	180
Land Use	100	-1	1	-1	-1	-1	1	3	100
Human Health	55		1	-2	-1	-1	-1	2	-110
Quality of Life	70		2		-1	-1	-1	3	140
Employment	40		2	2	1	2	3	1	440
Trade and Commerce	130	-1	-1	-1	-1	-1	2	3	0
Economy & Income Level	50	-1		1			1	3	200
Historic & and Cultural Resources	40	-1	-1	-1		-1		1	-120
	1000	**Total**							**-1560**

The values for these weightage factors have been taken from the average of the various EIA reports of the Indian highways and the experience from the local site conditions of NH-64

Table 7.11: Evaluation of project with control measures

Environmental Components	Weightage	Activities							
		Acquisition of Land	Site Clearing	Earth Work and Excavation	Movement of Construction Vehicles	Processing of Construction Material	Construction Operation	Road in Operation	Impact
Air Quality	95		-1	-1	-1		-1	-1	-475
Noise Level	85		-1	-1	-1		-1	1	-255
Surface Water Quality	20		-1						-20
Ground Water Quality	70								0
Soil Quality	70	-1		-1				-1	-210
Flora & Fauna	85		-1		-1		-1	-1	-340
Aesthetics	90		3	-1			-1	4	450
Land Use	100	-1	3	-1	-1		-1		-100
Human Health	55			-1	-1	-1	-1	3	-55
Quality of Life	70		3				-1	3	350
Employment	40	-1	2	2	1	2	3	1	400
Trade and Commerce	130			2			2	4	1040
Economy & Income Level	50	-1		1			1	4	250
Historic & and Cultural Resources	40			-1		-1		2	0
	1000	**Total**							**1035**

7.3 CONCLUSIONS

- Traffic congestion is a major problem along the highway, which is just two-lane two-way type. In the survey 77% said that they are facing the problem of traffic congestion due to existing highway.
- Road safety is not up to the mark and immediate attention is required to avoid major accidents.
- As per the reports of water testing, hand pumps near the highway showed high Hardness & Fluoride value close to/ greater than the permissible values thus rendering them unfit for potability .
- Results of RSPM & SPM testing have been found to be exceeding the permissible & the values of SO_2 & NO_2 are below the permissible limits.
- As far as flora is concerned there are no trees found in the area, which are on the endangered list, though if a widening project is to be undertaken a rule of "One-tree cut ten plants planted" may be followed.
- The noise values at the selected locations are within the permissible values, hence the impact caused by noise pollution due to the existing phase of NH – 64 is minimal but proper mitigation measures should be taken during the construction phase to keep the noise values under the permissible limits.
- By the analysis of traffic data it can be concluded that the present two lane highway is insufficient to handle the current traffic volume. Since, it's a plain terrain and as per IRC-SP-84 , this section will require four lane immidiatly to capacitate more traffic.
- The soil analysis revealed that there is no significant contamination with respect to soil, but there are many likely chances of occurrence of contamination during two years of construction because of the construction machinery to be used for road building project.
- The groundwater water level may get down if excessive water is consumed , so proper monitoring is required to keep a check on its use & water recharging units should be established .

- The proposed project does not cover big urban and industrial areas, and hence there will not be major problem of pollution. Emissions from the mobile and non mobile sources and dust produced during construction will be the main sources of pollution during the implementation stages of the project. Proper mitigation measures should be followed to avoid the undesirable effects.

Overall, the present highway facility is unsatisfactory as per public opinion and needs improvement. Appropriate steps taken during design phase would go a long way in reducing the adverse impacts as described above. Construction impacts although rather severe in certain cases are of short duration and can be countered effectively to a large extent by appropriate mitigative measures. Operational phase adverse impacts are of rather minor magnitude and nature and can be effectively taken care of by mitigative methods proposed. On the basis of existing data and the assessment/ evaluation and analysis of the potential impacts, total impact has been calculated by the matrix method. It is found that the total impact score for the section is negative i.e. -1560, which shows that the section falls in the category of "appreciable but reversible impact-control measures are needed". On the basis of nature and type of impacts, an appropriate mitigation / enhancement measure has been suggested and should be implemented during construction and operation phase. The impact score with these mitigation measures become positive i.e. +1035, which means that the proposed project will be environmentally beneficial.

CHAPTER 8

REFERENCES

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ANNEXURE I

Table 4.1: Matrix of adverse Environmental Impacts due to the Project and Preliminary Mitigation Measures

Environmental Components	Impacts	Direct/ Indirect	Significance (Medium/ High/Low)	Duration of Impacts	Mitigation
Pre-Construction Phase					
	Land Acquisition	D	M	Long	The alignment selection should be in such manner to minimize the acquisition of land. As far as possible, the productive land area should be avoided to acquire.
Construction Phase					
Physical Resources	Damage to slopes, streams and fields from spoil disposal	D	M	Medium	Balanced earthworks; locate and operate disposal sites with care; avoid side casting.
Soil	Loss of top soil due to site and fields from spoil disposal	D	H	Long	Careful storage of top soil during site clearance and excavation and backfill the borrow area by spoils and top soil, revegetable the disturbed slope as early as possible.
	Soil compaction due to storage of quarry materials and other heavy equipments movements of heavy vehicles over agricultural at the site.	D	M	Long	Regulation of movement and parking of vehicles and equipment outside ROW. Storage of materials should be allowed only at wasteland or barren area.
Air Quality	Reduced buffering of air pollutants, hotter, drier microclimate due to tree felling and vegetation loss during site clearance.	I	L	Short	Tree plantation

	Dust generation due to earth excavation, transportation & heavy vehicles maintenance or operation, construction of structures and earth works, asphalt & crusher plants	I	L	Short	Vehicles delivering materials should be covered. Water should be sprayed during construction phase, in the line and earth mixing sites, asphalt mixing site, and temporary roads. After the impacting, water spraying should be regular to prevent dust.
	Toxic gas emissions during asphalt preparation, bituminous heating	D	M	Short	The mixing equipment should be well sealed and equipment should be equipped with dust removing devices. Asphalt mixing plants to be located at least 500 m away from settlement area towards downward wind direction.
Noise Quality	Reduced buffering of noise due to vegetation loss during site clearance	D	L	Short	Minimize the tree cutting, replanting of tree should be done immediately prior to construction starts.
	Increased noise level due to excavators/machinery etc., operation and maintenance of heavy vehicles and equipments Asphalt preparation and crushing.	D	L	Short	Enforce Noise standards strictly. Proper scheduling of the operation of these equipments.
	Vibration from blasting Operations	D	L	Short	Blasting operations shall be undertaken to produce minimum vibrations in sensitive areas.

Surface Water	Additional pressure on water demand due to the requirement for construction Works	D	M	Short	Alternative water supply system for construction should be ensured in such a way to prevent the additional pressure on public water supply system.
	Damage to surface water bodies like rivers, streams, canals, and irrigation tanks from excavation, filling and spoil disposal	D	M	Long	Prohibit activities which cause blockage or otherwise impede water flow.
	Blockage of water flow channels due to unmanaged excavation and earth filling	D	M	Medium	Proper excavation and disposal of the extra fill material.
	Contamination of water due to spillage, construction wastes	I	M	Medium	Strict regulation of traffic flow, waste disposals. Proper disposal system at equipment and vehicle service stations. Strict regulation of traffic flow, waste disposals.
	Impairment of surface water bodies, new water bodies due to Quarries/borrow pits	I	H	Long	Controlled quarrying and borrowing.
Ground Water	Minor disruption of aquifer recharge	D	L	Long	Establish water recharging unit.
	Ground water exploitation for construction works and workforce camp.	I	M	Short	Ground water extraction should be regulated .
Rain Water Harvesting	Ground Water table would rise over the years. Water scarcity will be less .	D	H	Long	Recharge wells to be properly designed and constructed at suitable location with proper filtering arrangement to avoid choking according to Guidelines of Central Ground Water Board

Drainage	Interference with natural drainage flow due to earth excavation dumping, disposal of wastes and surplus earth materials, and construction of structures and earthworks	D	M	Short	Regulation of dumping of waste materials and proper care should be taken at the site of construction to minimize the wastage. Clean fill material devoid of soil particles to prevent siltation and deposition on the way of natural drainage.
Ecological Resources	Loss of Trees due to cutting.	D/I	H	Long	Cut only those trees affected by permanent works; specify non-timber construction materials; banned use of wood for heating bitumen, control workforce, strengthen forest protection and management. Prohibition of clearing of trees for firewood, prohibiting on trapping and killing of wild life.
Social Environment	Economic losses as a result of property loss due to land take for widening	D	M	Long	The alignment selection should be done in such a way to minimize the land acquisition.
	Problem of Resettlement and Rehabilitation	D	H	Long	Early identification and entitlement of the project affected people
	Business displacement	D	H	Long	Early planning of rehabilitation and Resettlement.
	Additional pressure on infrastructure within major settlement area	I	M	Long	Regulation of development activities.
	Employment on road construction, and resultant flow	D	H	Short	Encourage local recruitment.

Health	Health problems to the local people settled near the construction sites because of toxic gaseous emissions due to asphalt preparation and crushing	D	M	Short	Appropriate siting of plant establishment, strict adherence to the emission standards laid by the Central Pollution Control Board, regular monitoring of emissions. Provision of emergency medical facility. .
	Possible spread of communicable diseases amongst and by workforce	D	H	Long	Siting of workforce camp at place with least possible pressure on local community. Proper sanitation and waste disposal plan at workforce camps, separate health clinic for workforce camp.
	Stress on existing health facilities	I	M/H	Medium	Strengthen health system.
Accidents	Accidents at work and on the road	D/I	M/H	Short	Safe working techniques; safety clothing's; proper training to workers and drivers.
Operational Phase					
Water Bodies	Contamination by fuel and lubricants/increased pollution due to induced development	I	L	Long	Separate provision for water supply to meet the water demand for construction works.
Noise level	Increased noise level due to increase traffic	D	M	Long	Provision of noise barriers, restriction zone at sensitive receptor sites.
Soil	Soil contamination due to accidents and spillage	I	L	Long	Process contaminated soil to remove the contamination. Spills on solid surfaces like concrete or asphalt can be soaked up with absorbent materials like sawdust or fibers.

ANNEXURE -II

Applicable Key Legislation for Protection of the Environment

Issues	Environment Related Measures
Environment Clearance	• The Environmental Impact Assessment (EIA) Notification, 1994 and its amendments • Environmental Public Hearing Notification, 1997 • National Environment Appellate Authority Act • National Environment Tribunal Act, 1995
Forests	• The Indian Forest Act, 1927 • The Forest Conservation Act, 1980 as amended in 1988; and Rules 1981 • The National Forest Policy, 1988
Air	• The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987 • The Environment Protection Act, 1986 • The Indian Explosives Act, 1908 • The Industries (Development and Regulation) Act, 1951 • The Factories Act, 1948, amended in 1987 • The Motor Vehicles Act, 1938, amended in 1988 and Rules, 1989 • The Environment (Protection) Second Amendment Rules, 2002 – Emission Standards for New Generator Sets
Noise	• The Environment Protection Act (EPA), 1986 and Environment (Protection) Second Amendment Rules, 2002 • Noise (Regulation & Control) Rules 2000
Water	• The Water (Prevention and Control of Pollution) Act, 1974; Rules 1975 and amendment 1988 • The Water (Prevention and Control of Pollution) Cess Act, 1977 • The Environment Protection Act, 1986 • The River Boards Act, 1956
Hazardous Substances & Wastes	• Manufacture Storage and Import of Hazardous Chemicals 1989 and amendment Rules 2000 • Hazardous Waste (Management and Handling) Rules, 1989 and amendment Rules 2000 and amendment 2003 • Environment Protection Act, 1986 and Rules • The Public Liability Insurance Act, 1991 and Rules 1991 • The Poisons Act, 1919 • The Industries (Development and Regulation) Act, 1951 • The Insecticides Act, 1968 • The Prevention and Food Alternative Act, 1954 • The Factories Act, 1948, as amended
Wildlife	• The Wild Birds and Animals Protection Act, 1912

	• The Wild Life (Protection) Act, 1972 and Rules 1973 • The Indian Arms Act, 1978
Pesticides	• The Insecticides Act, 1968 • The Factories Act, 1948 amended in 1957 • The Poison Act, 1919
Land Acquisition	• Land Acquisition Act, 1894 • The Punjab Tenancy Act, 1887 • The Punjab Village Common Lands (Regulation) Act, 1961 • The Punjab Land Revenue Act, 1967 • The Punjab Public Premises and Land (Eviction and Rent Recovery) Act, 1973 • The Punjab Religious Premises and Land (Eviction and Rent Recovery) Act, 1997
Environmental Emissions & Quality Standards	• Applicable environmental standards as specified by CPCB and by Punjab. State Environment Protection & Pollution Control Board. • Environmental Statement (Audit) Notification, 1992

ANNEXURE III

Environmental Clearance Requirements

GOI Requirements

The MoEF is responsible to enforce the regulations established pursuant to the National Conservation Strategy. National Forest Policy, the Policy for Abatement of Pollution (1992) and the Environmental (Protection) Act 1986, revised in 1994 and amended subsequently in 1997. The Environmental Impact Assessment Notification, 1994 identified highways (item 21 of Schedule-1) as one of the projects requiring prior clearance from the MoEF. Therefore, the environmental impact (EIA) is a statutory requirement for obtaining clearance. The guidelines/ comprehensive format for EIA preparation has been prescribed in the handbooks and other literature. In April 1997, a notification was issued by MoEF amending Schedule-1 of the EIA Notification, 1994 which lists projects requiring Environmental Clearance.The 1997 Notification States:

"Environmental Clearance from the MoEF is not required for Highway project relating to improvement work including widening and strengthening of roads with marginal land acquisition along the existing alignments provided the highways do not pass through ecologically sensitive areas such as National Parks, Sanctuaries, Tiger Reserve, Reserve Forests etc." ***Source Gazette Notification, Government of India, dated April 1997.***

As per the provisions of the EIA Notification of 27th January 94 and as amended on 10th April, 1997 environmental clearance is required for highway projects except projects relating to improvement work including widening and strengthening of roads with marginal land acquisition along the existing alignments provided they do not pass through ecologically sensitive areas such as national parks, sanctuaries, tiger reserves, reserve forests. It is hereby clarified that marginal land acquisition means land acquisition not exceeding a total width of 20 meters on either side of the existing alignment put together. Further, it is also clarified that bypasses would be treated as stand-along projects and would require environmental clearance only if the cost of the projects exceed Rs.100 crores each'.

(***Source. MOEF Circular No.21OIZI26-99-/A-M dated 13 October 1999).***

State Level Clearance Requirements

Besides, the GOI environmental clearance requirements, the project also requires clearance from some of the state level agencies as discussed below.

a) Forest Clearances

In 1986, when the MoEF enacted the Environmental Protection Act, linear stretches of roadside plantation along many of the Highways (including in Punjab) were declared as protected forest. Due to the protected status, clearance from the State Forest Department is required to cut roadside trees. Applicability of the provisions of Forest (Conservation) Act, 1980 to the linear (roadside) plantations was modified by a notification from the Union, MoEF dated 18th Feb 1998. Now, in the case of the `notified to be protected' roadside plantations, the clearance may be obtained from concerned Regional Offices of MoEF, irrespective of the area of plantation lost. If the concerned Regional Office does not accord the decision within 30 days of the receipt of fully completed application, the proponent agency may proceed with the widening/ expansion under intimation to the State Forest Department and MoEF. In the context of present project it can be said that project requires forest clearance from MoEF regional office to cut road side plantation and to convert forest land into highway.

b) State Pollution Control Board (SPCB) Requirements

Projects also require obtaining No Objection Certificate (NOC) and consent from Punjab State Pollution Control Boards in pursuant to the Water (Prevention and Control of Pollution) Act of 1974, the Cess Act of 1977 and the Air (prevention and Control of Pollution) Act of 1981.

c) **Public Hearings**

As per the EIA notification 2006, issued by Ministry of Environment & Forest public hearing to attend the concerns of project affected persons is a mandatory requirement for category A & B projects listed in the schedule of EIA notification 2006.

ANNEXURE IV

Clearance Requirements for the Project

The project would need the following environmental clearances.

- Forestry Clearance from the MoEF regional offices as the widening will require acquisition of forestland.
- No Objection Certificate (NOC) from the Punjab State Pollution Control Board.
- Clearance from the Punjab State Pollution Control Board under the Air Act, the Water Act and the Cess Act, if stipulated by the State Pollution Control Boards while giving the NOC.
- State Forest Department clearance for felling of trees from the RoW.
- Clearance from Ground water board for withdrawal of ground water for construction.

ANNEXURE V

Applicable Environmental Standards

1- Ambient air:

Revised National Ambient Air Quality Standards (2009-2010)

S.No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Govt.)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m3	Annual 24 hours	50 80	20 80	- Improved West and Gaeke - Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m3	Annual 24 hours	40 80	30 80	- Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM10µg/m3	Annual 24 hours	60 100	60 100	- Gravimetric - TOEM - Beta attenuation
4	Particulate Matter (size less than 2.5µm) or PM2.5µg/m3	Annual 24 hours	40 60	40 60	- Gravimetric - TOEM - Beta attenuation
5	Ozone (O3) µg/m3	8 hours 1 hour	100 180	100 180	- UV photometric - Chemilminescence - Chemical Method
6	Lead (Pb) µg/m3	Annual 24 hours	0.50 1.0	0.50 1.0	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
7	Carbon Monoxide (CO) mg/m3	8 hours 1 hour	02 04	02 04	- Non Dispersive Infra Red (NDIR) spectroscopy
8	Ammonia (NH3) µg/m3	Annual 24 hours	100 400	100 400	- Chemiluminescence - Indophenol blue Method
9	Benzene	Annual	05	05	- Gas chromatography

	(C6H6) µg/m3				based continuous analyzer - Adsorption and Desorption followed by GC analysis
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
10	Benzo(a)Pyrene (BaP)- particulate phase only, ng/m3	Annual	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m3	Annual	06	06	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m3	Annual	20	20	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper

Table .1 National ambient air quality standards for different building typologies as per CPCB

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

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be 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.

Note:- Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.

2- Water Quality- Ensure water from all sources such as ground water, municipal water meets the water quality norms as prescribed in the Indian Standards for drinking, IS: 10500-1911 and CPWD specifications to meet the specifications prescribed for construction water.

Parameter	Drinking water (IS 10500: 1991)	Parameter	Drinking water (IS 10500: 1991)
Total hardness (as CaCO3) (mg/litre)	300	Anionic detergents as MBAS (mg/l)	0.2
Total dissolved solids (mg/litre)	500	Arsenic (mg/litre)	0.05
Chlorides as chlorine (mg/litre)	250	Iron (mg/litre)	0.3
Colour (hazen)	5	Fluorides (mg/litre)	1
Turbidity (NTU)	5	Lead (mg/litre)	0.05
Alkalinity (mg/l)	200	Copper (mg/litre)	0.05
Calcium (as Ca), mg/l	75	Zinc (mg/litre)	5
Boron (mg/litre)	1	Phenolic compounds (as C6H5OH) (mg/l)	0.001
Sulphates (as SO4)(mg/litre)	200	Cyanide (mg/l)	0.05
Nitrates (as NO3) (mg/litre)	45	Chromium (mg/l)	0.05
Conductivity at 25o C (us/cm)	-		
pH	6.5 – 8.5		

Table .2 Water quality standard for drinking water Source:(IS 10500: 1991)

3- Noise Quality: Noise level survey should be carried out with respect to proposed project in order to assess the background levels and to ensure that the outdoor noise levels conform to the standards prescribed by Central pollution Control Board (CPCB) for industrial, commercial, residential and silence zones.

Area code	Area category	Limit in dB (A) Leq	
		Daytime	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence zone	50	40

Table 0.3: Ambient Standards for noise

(Daytime is reckoned in between 6 a.m and 9 p.m Nigh time is reckoned in between 9 p.m and 6 a.m)

ANNEXURE -VI

Air Sample analyses procedures

1-PM 2.5 analysis:

PM 2.5/10um or Fine dust sampler with WINS impactor assembly was used to find out the concentration of suspended particulate of size between 2.5um to 10um in the ambient air. Steps followed during sampling are as follows:

1. Install the tripod stand and place the instrument over it. Make sure that exhaust pipe at right rear of the instrument does not get stuck between the frame of the stand and the instrument body.
2. WINS impactor and the filter holder along with the vacuum pump and control module is covered by the instrument case. Mount the WINS impactor on filter holder cover.
3. Open WINS impactor assembly & place a fresh 37 mm diameter filter in the at the given place with pouring 1 ml of silicon oil over filter paper using a dropper.
4. Open the filter holder next to the WINS impactor having a filter cassette with metal wire mesh inside it. Place preconditioned and pre weighed PTFE 46.2 mm filter paper on it and snap it into filter cassette. Tight the entire assembly.
5. Set parameters like flow rate and sampling period in control module and allow the sampling to start.

Volume of air sampled is calculated by:

$$\mathbf{Va = (Q_1 + Q_2) \times T/2}$$

Where,

Va = volume of air sampled in m^3

Q_1 = flow rate measured before sampling

Q_2 = flow rate measured after sampling

T = time of sampling

Concentration of PM 2.5 is calculated by:

PM 2.5= $(W_f - W_i) \times 1000/V_a$

Where,

PM 2.5= Total mass concentration of PM 2.5 collected during the sampling period, ug/m^3

W_f, W_i= Final and Initial mass of PTFE filter paper, mg

V_a= Total air volume sampled, m^3

2-PM 10 analysis:

To find out concentration of suspended particulate of diameter higher than 10um within the air PM 2.5/10um or Fine dust sampler with PM 10-impactor assembly is used. For this WINS impactor assembly is removed and only one filter paper of 47mm diameter is used. Steps followed during sampling for PM 10 are as follows:

1. Install the tripod stand and place the instrument over it.Make sure that exhaust pipe at right rear of the instrument is not stuck between the frame of the stand and the instrument body.
2. In place of WINS impactor PM 10 impactor assembly was and all the joints are tightened each joint tightly.
3. Open the filter holder and place pre-weighed and preconditioned 47 mm diameter filter paper on in filter cassette. Tighten the entire assembly & cover the filter holder.
4. Set different parameters like flow rate and sampling period in control module

Volume of air sampled is calculated by

$Va = (Q_1 + Q_2) \times T/2$

Where,

Va = volume of air sampled in m^3

Q_1 = measured flow rate before sampling

Q_2 = measured flow rate after sampling

T = time of sampling

Concentration of PM 10 is calculated by

PM 10= $(W_f-W_i) \times 1000/V_a$

Where,

PM10 = Mass concentration of PM 10 collected during the sampling period, µg/m^3

W_f, W_i= Final and Initial mass of glass fiber filter paper, mg

V_a= Total air volume sampled, m^3

3-SO_2 analysis

SO_2 is gravimetrically estimated by adding barium chloride in slight excess in absorbing solution. H_2O_2 is used as an absorbing solution which gets converted to sulphuric acid during sampling (Eq. (1)).

$H_2O_2 + SO_2 \rightarrow H_2SO_4$ …….. (1)

$H_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2HCl$ ……(2)

When barium chloride reacts with sulphuric acid (Eq. (2)), it leads to the formation of barium sulphate which is estimated gravimetrically. With stoichiometric calculation, concentration sulphur dioxide in ambient air is estimated. Steps followed for SO_2 analysis are as follows:

- Fill impinge bottle with the absorbing solution and attach it to the high volume sampler with its gaseous extension.Set flow rate of air flow in between 0.2 to 1 LPM.
- After 24 hrs sampling, add $BaCl_2$ in excess to absorbing solution after slightly heating, as to precipitate SO_4^{2-} as $BaSO_4$.
- Once the precipitates formed , filter it on a pre-conditioned and pre-weighed Whattman filter paper. Dry the precipitates in an oven and record the final weight of filter paper.

- Amount of precipitates are found by difference of the final weight and initial weight of the filter paper. The concentration of SO_2 is calculated with the help of stoichiometric calculations, in the ambient atmosphere.

SO_2 concentration is calculated by

SO_2= (Mol. wt. of SO_2× W×10^6)/ (Mol. wt of $BaSO_4$×Va)

Where, SO_2= Concentration of SO_2, µg/m^3

V_a= Total air volume sampled, m^3

W= weight of $BaSO_4$ formed i.e. difference in filter paper weight before and after filtration, (g)

4-NO_2 analysis

To collect the ambient nitrogen dioxide (NO_2) bubble the air through a solution of sodium hydroxide. The concentration of nitrite ion (NO_2) produced during sampling is determined calorimetrically by reacting the nitrite ion with phosphoric acid, sulfanilamide, and N-(1-naphthyl)-ethylenediamine di-hydrochloride (NEDA) .Then absorbance of the highly coloured azo-dye at 540 nm is measured. Procedure for NO_2 sampling is as follows:

Preparation of Standards

1. Pipette 2, 4, 5, 6 ml of working standard solution in to 50 ml volumetric flask and fill to 20 ml mark with absorbing solution.
2. Prepared a reagent blank with 10 ml absorbing solution.
3. Pipette in 1 ml of hydrogen peroxide solution, 10 ml of sulphanilamide solution and 1.4 ml of NEDA solution and make up to 50 ml with distilled water.
4. Measure the absorbance of each standard and reagent blank against distilled water reference after 10 minute color development interval.
5. Standard curve is plotted having absorbance on Y-axis versus concentration at X-axis.

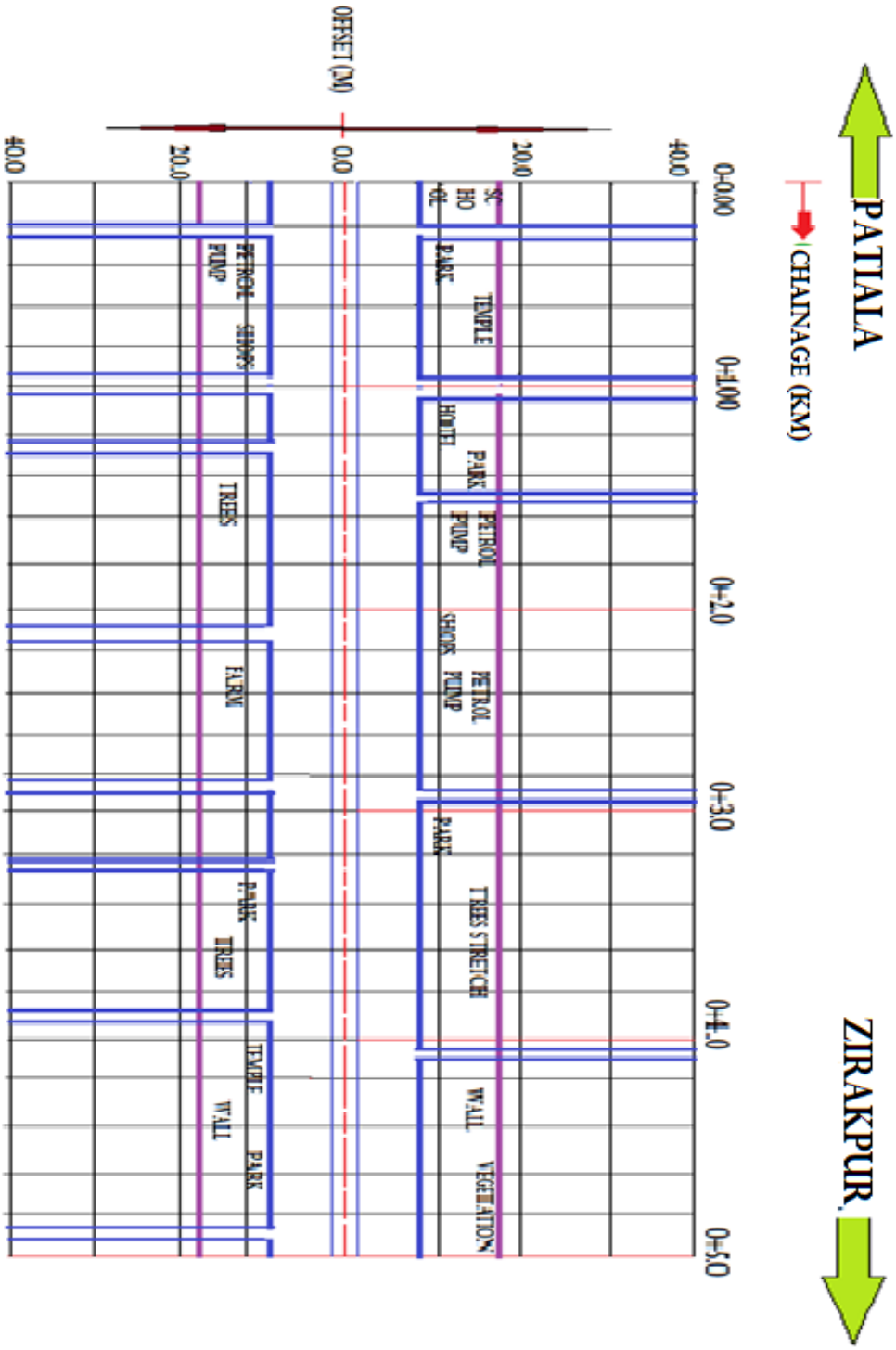
Sample Analysis

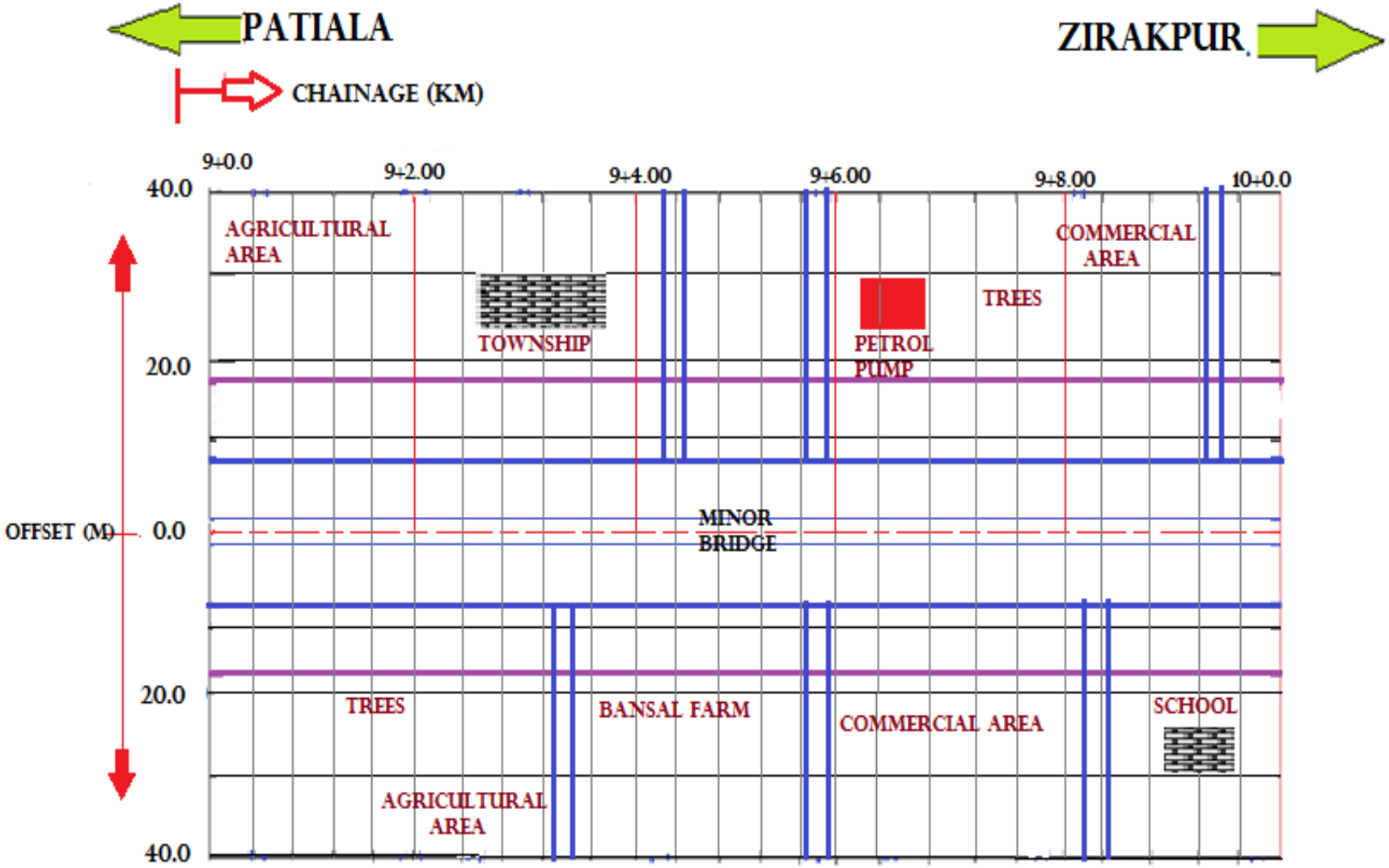
1. Prepare absorbing reagent (a solution of sodium hydroxide and arsenite) by dissolving 4g of sodium hydroxide and 1g of sodium arsenite in 1lit of distilled water. To remove interference of SO_2 a drop of H_2O_2 is added.
2. A 30 ml of absorbing solution is filled in an impinger bottle and are sampled for 24 hrs using after connecting it to a HVS at the flow rate of 0.2 to 1 L/min.
3. Measure the volume of sample and transfer to a sample storage bottle after sampling.
4. Water lost by evaporation during sampling is replaced by adding distilled water up to the calibration mark on the absorber, mix thoroughly.
5. Pipette out 10 ml of the collected sample into a 50 ml volumetric flask.
6. Pipette in 1 ml of hydrogen peroxide solution, 10 ml of sulphanilamide solution and 1.4 ml of NEDA solution and make up to 50 ml with distilled water after through mixing.
7. Prepare a blank in the same manner using 10 ml of unexposed absorbing reagent.
8. Measure and record the absorbance of samples and reagent blank at 540 nm after a 10 min color development interval, using distilled water as the optical reference.

Values of NO_2 concentration can be taken from the standard curve plotted between concentration and absorbance and then divided by the volume of air sampled.

ANNEXURE- VII

Layouts of important parts of NH-64

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ZIRAKPUR
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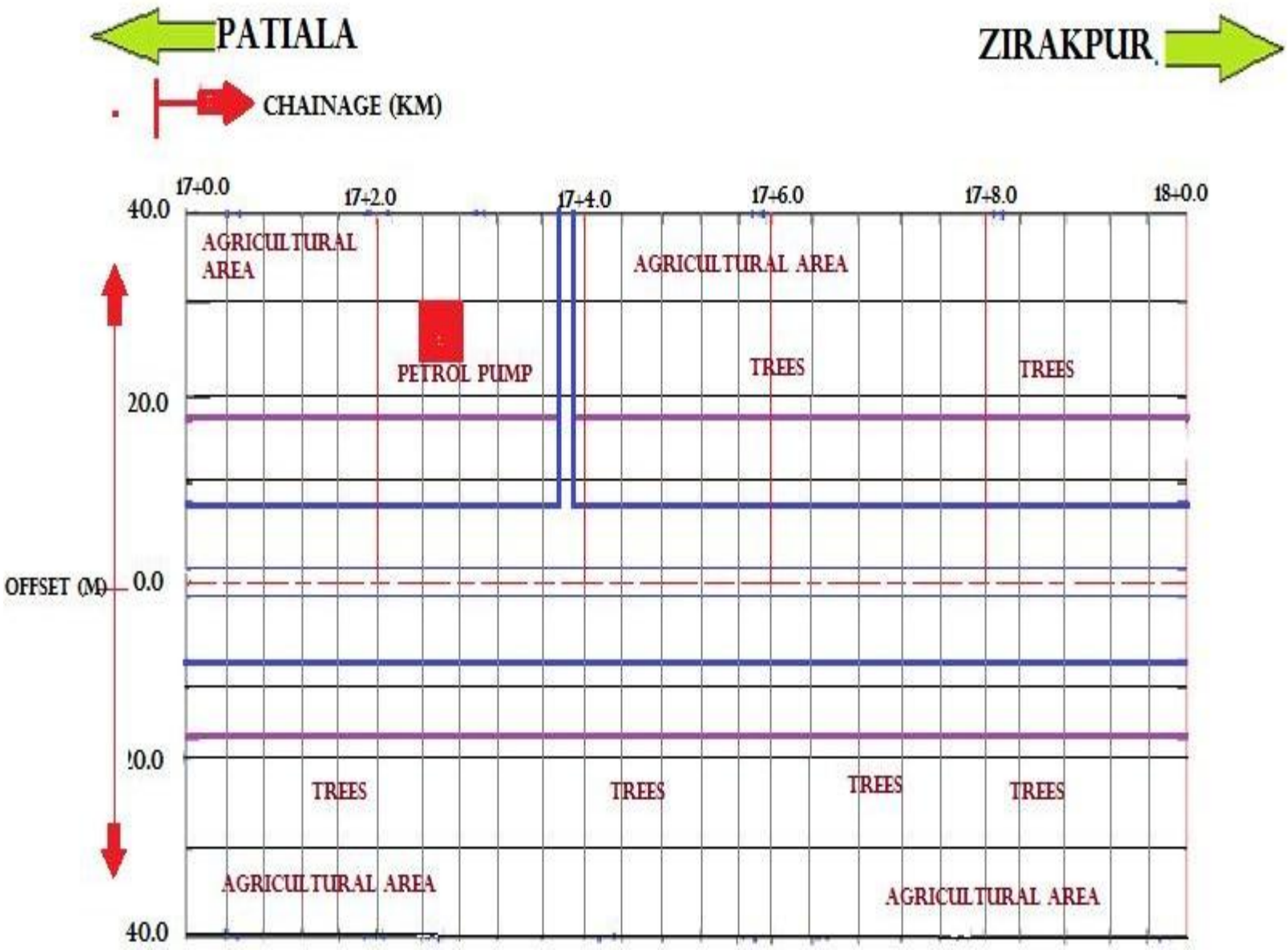
9+2.00
9+4.00
9+6.00
9+8.00
10+0.0
40.0
20.0
0.0
20.0
40.0
OFFSET (M)
AGRICULTURAL AREA
TOWNSHIP
PETROL PUMP
TREES
COMMERCIAL AREA
MINOR BRIDGE
TREES
BANSAL FARM
COMMERCIAL AREA
SCHOOL
AGRICULTURAL AREA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ZIRAKPUR
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20.0
0.0
OFFSET (M)
AGRICULTURAL AREA
AGRICULTURAL AREA
PETROL PUMP
TREES
TREES
TREES
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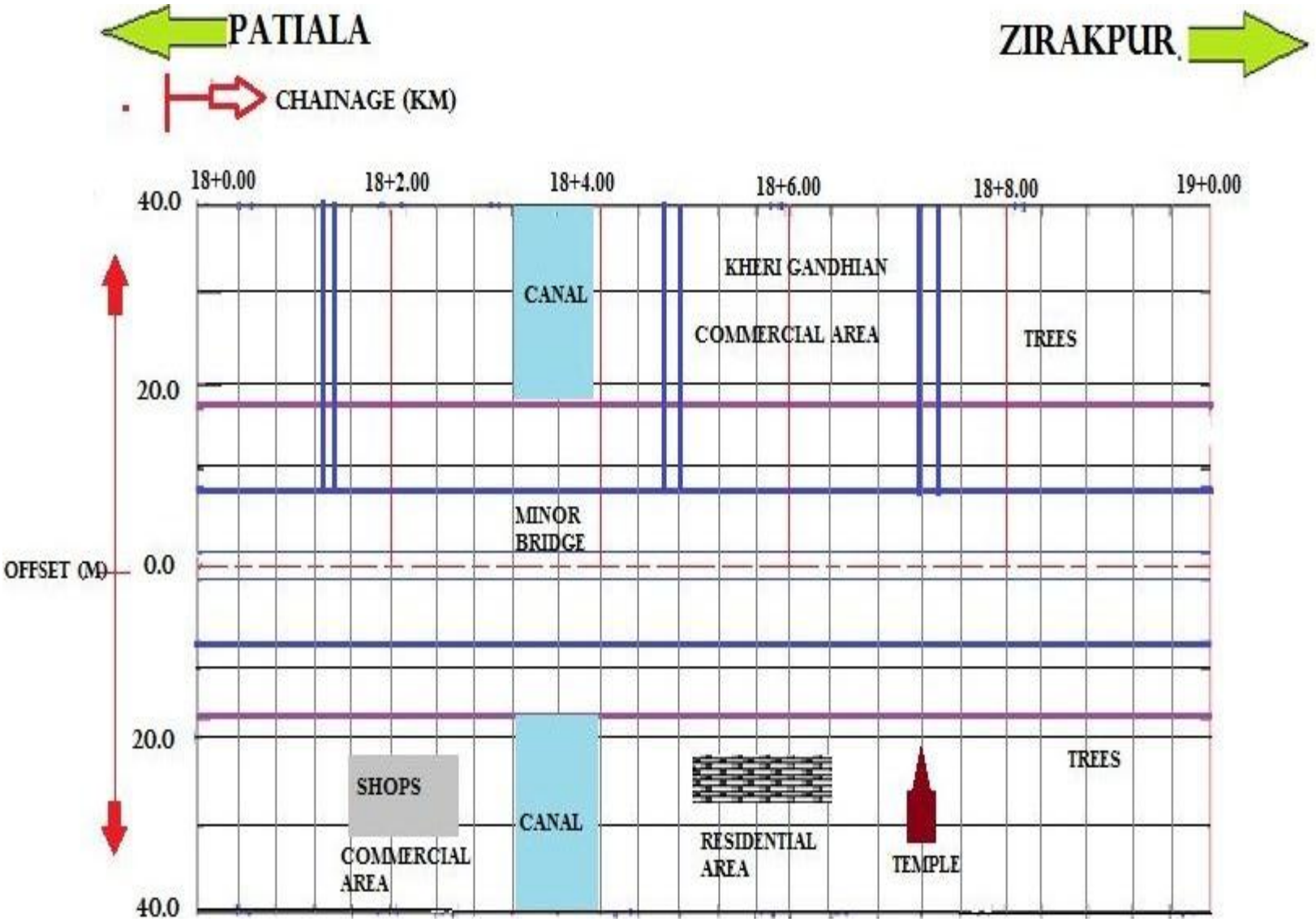
TREES
TREES
AGRICULTURAL AREA
AGRICULTURAL AREA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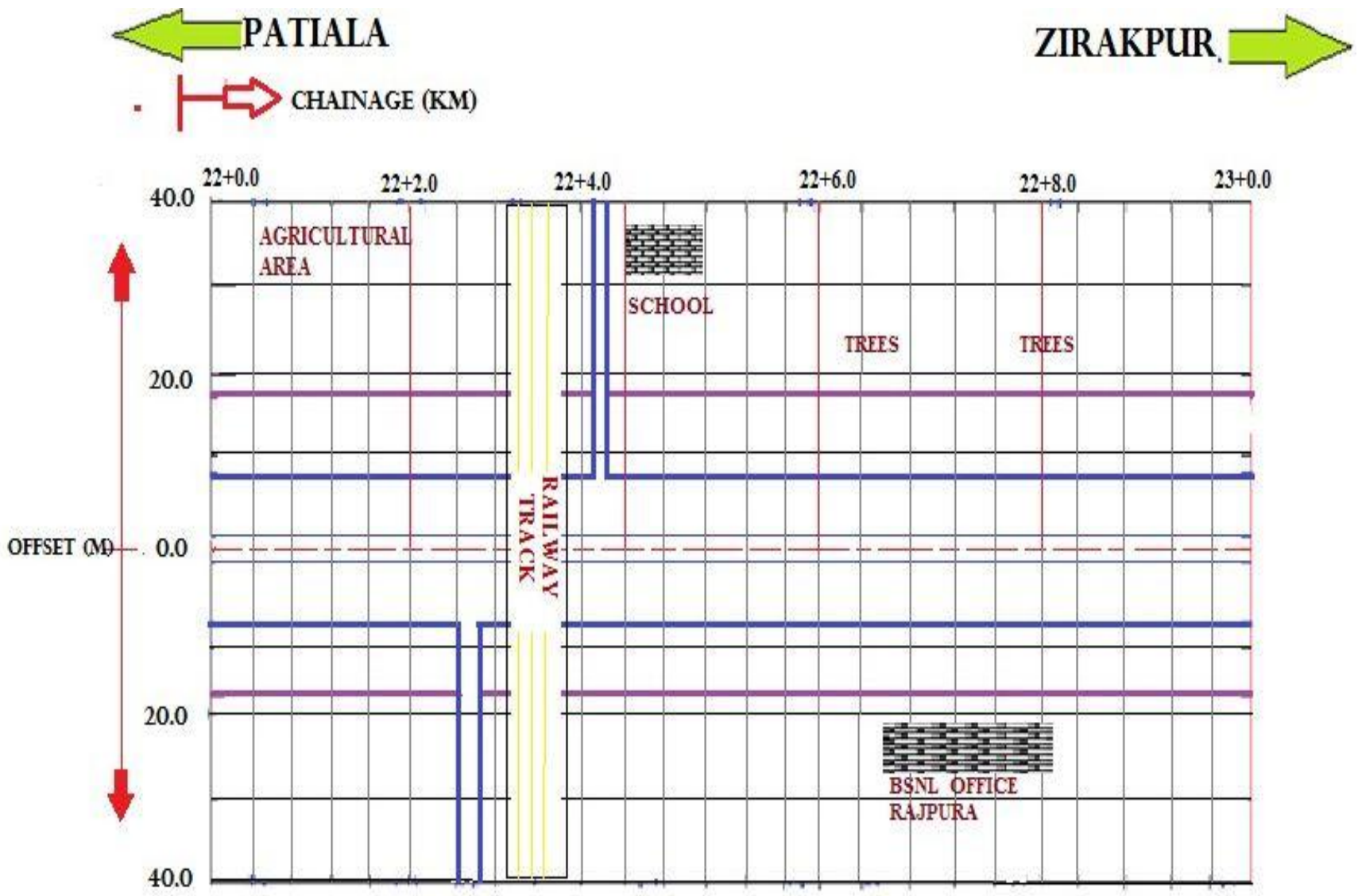
18+4.00
18+6.00
18+8.00
19+0.00
40.0
20.0
0.0
20.0
40.0
OFFSET (M)
CANAL
KHERI GANDHIAN
COMMERCIAL AREA
TREES
MINOR BRIDGE
SHOPS
COMMERCIAL AREA
CANAL
RESIDENTIAL AREA
TEMPLE
TREES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20.0
0.0
20.0
40.0
OFFSET (M)
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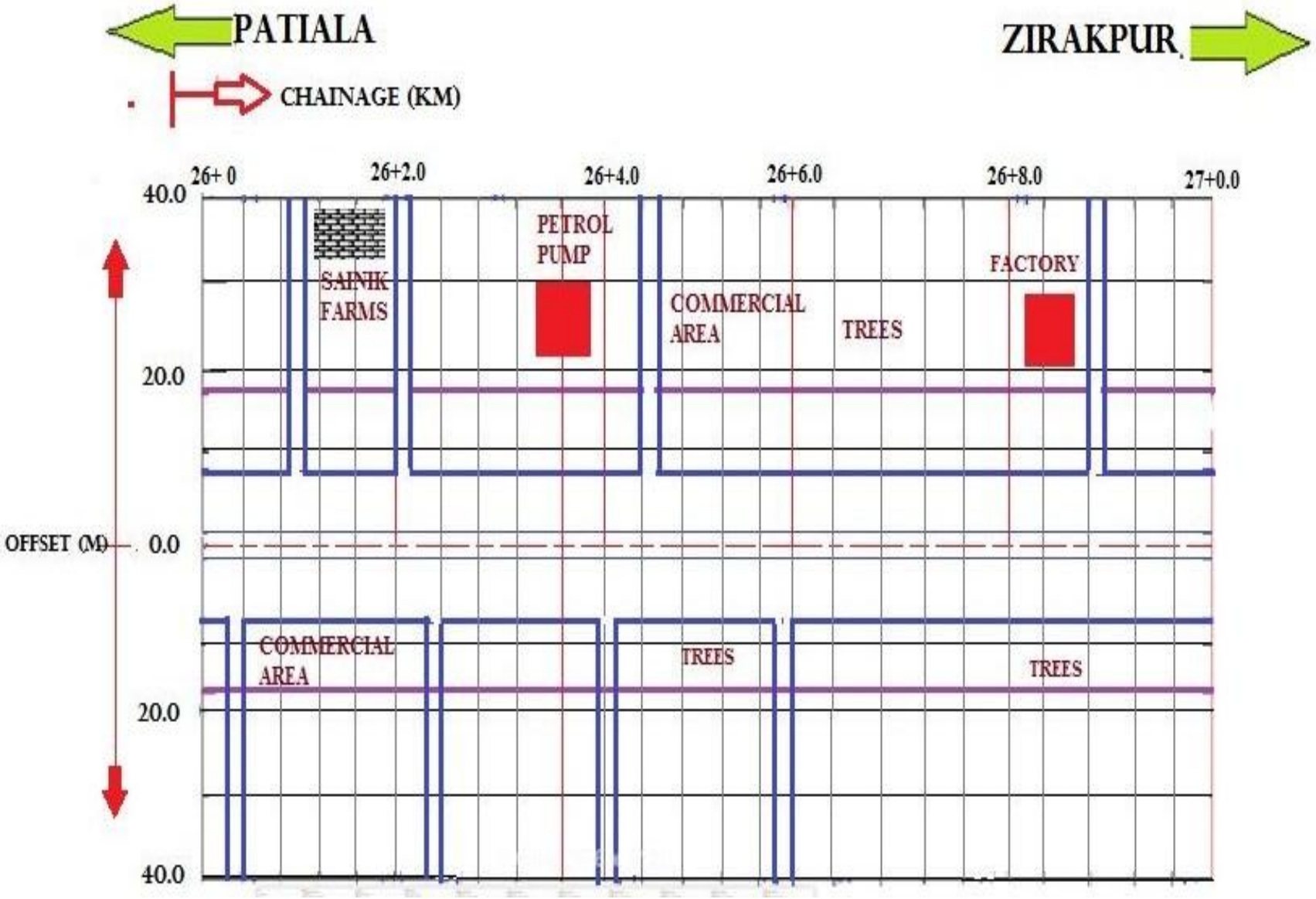
SCHOOL
TREES
TREES
RAILWAY TRACK
BSNL OFFICE RAJPURA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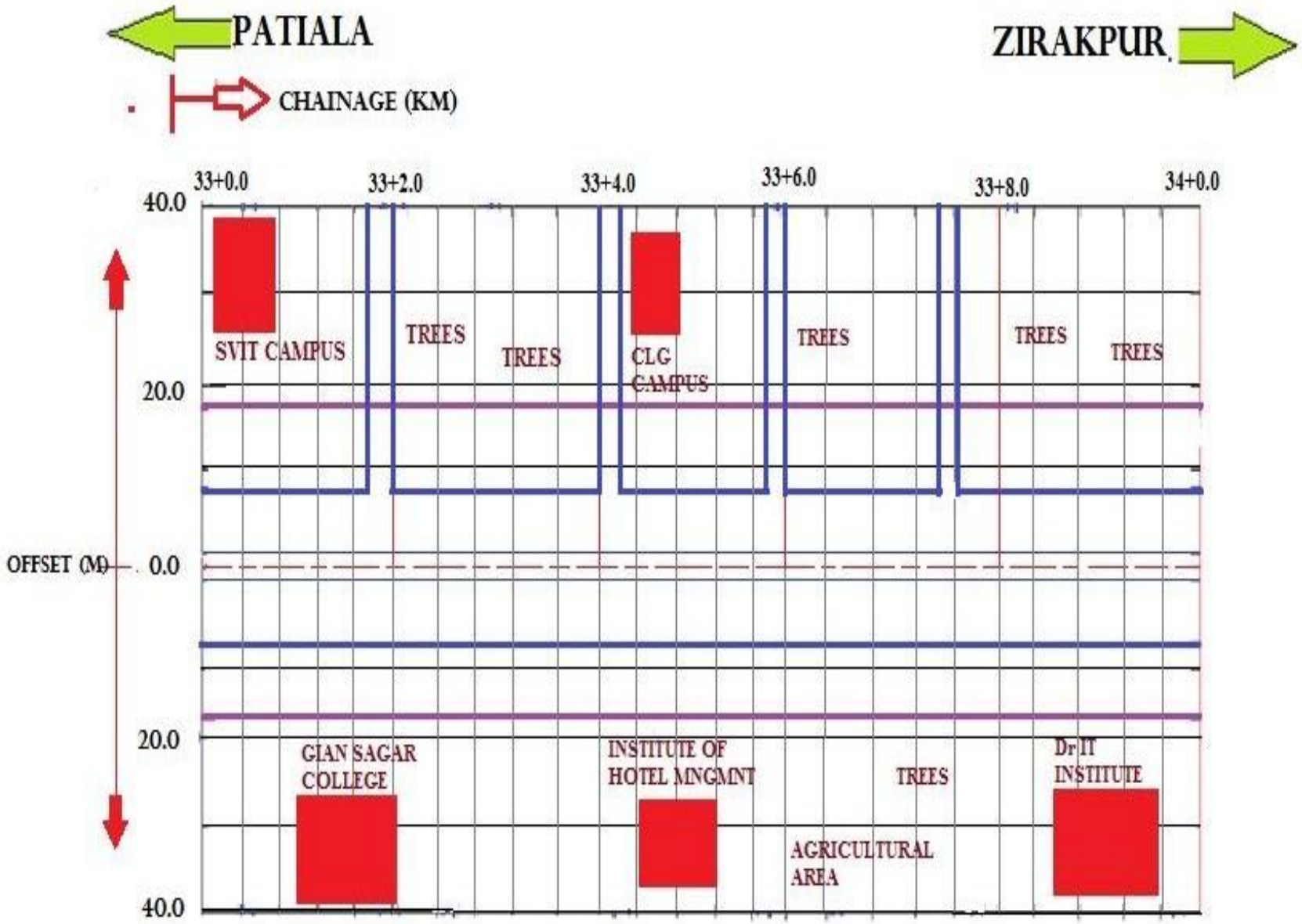
27+0.0
40.0
20.0
0.0
20.0
40.0
OFFSET (M)
SAINIK FARMS
PETROL PUMP
COMMERCIAL AREA
TREES
FACTORY
COMMERCIAL AREA
TREES
TREES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ZIRAKPUR
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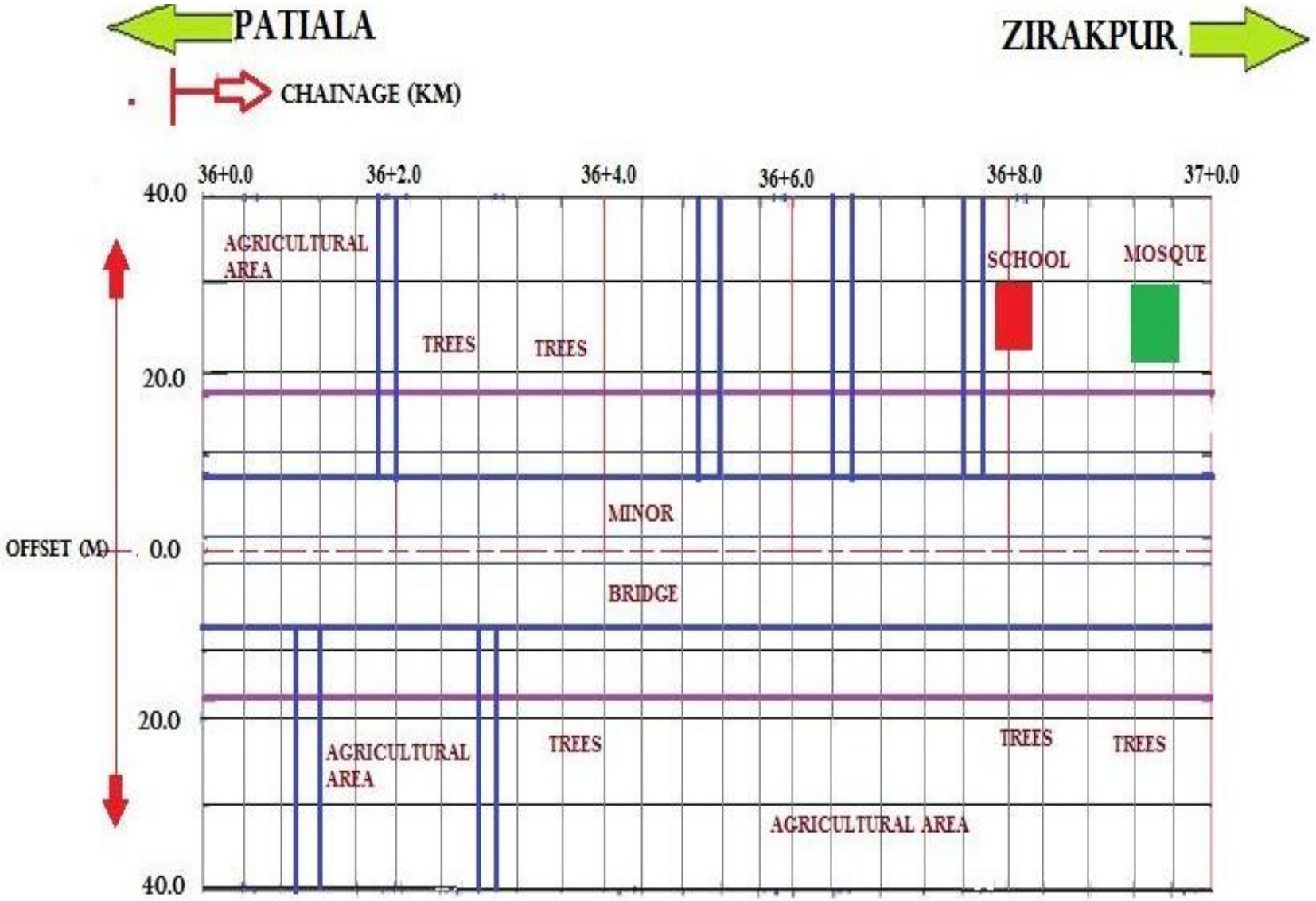
33+8.0
34+0.0
40.0
20.0
0.0
20.0
40.0
OFFSET (M)
SVIT CAMPUS
TREES
TREES
CLG CAMPUS
TREES
TREES
TREES
GIAN SAGAR COLLEGE
INSTITUTE OF HOTEL MNGMNT
TREES
Dr IT INSTITUTE
AGRICULTURAL AREA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ZIRAKPUR
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37+0.0
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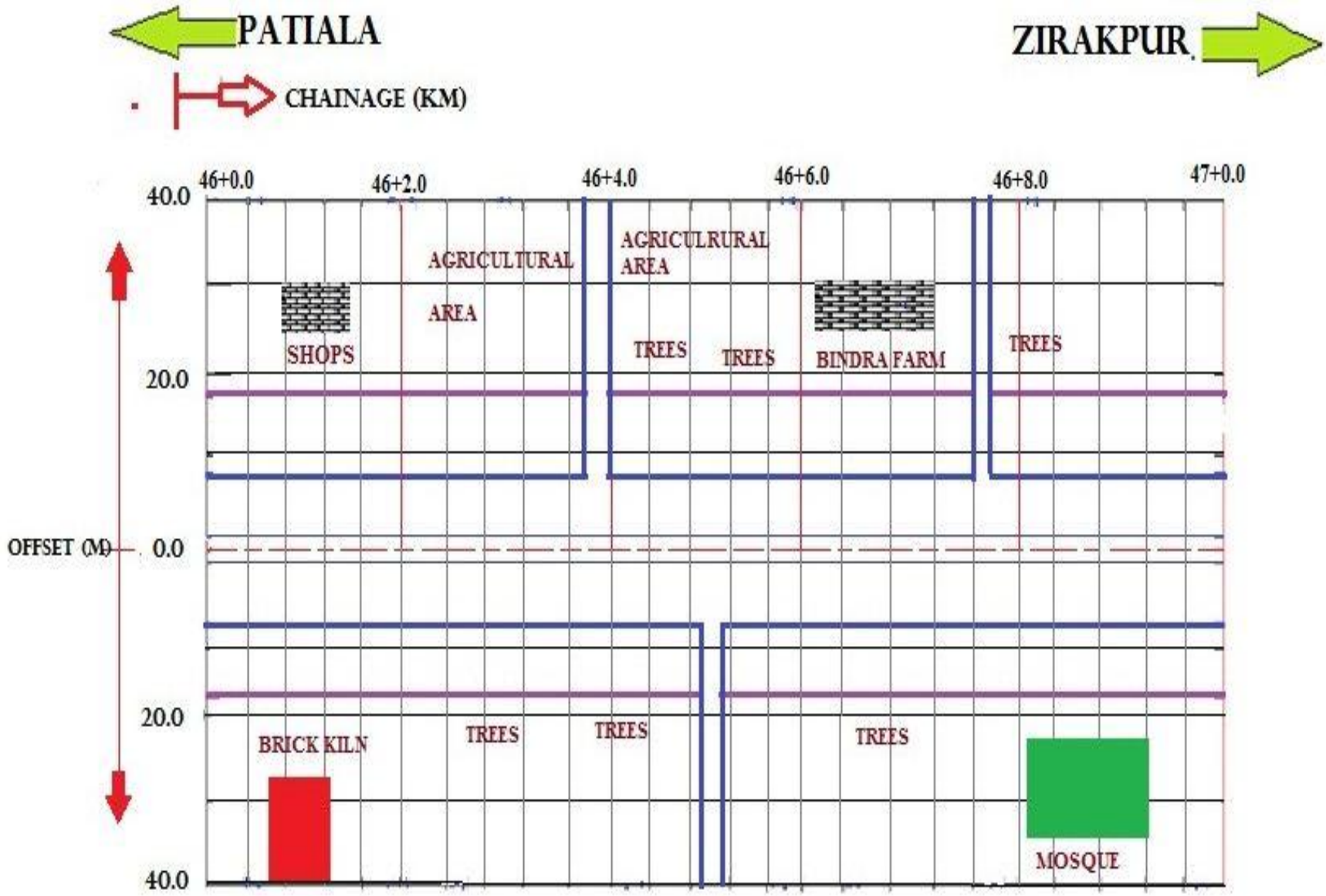
20.0
0.0
20.0
40.0
OFFSET (M)
AGRICULTURAL AREA
TREES
TREES
SCHOOL
MOSQUE
MINOR
BRIDGE
AGRICULTURAL AREA
TREES
TREES
TREES
AGRICULTURAL AREA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ZIRAKPUR
CHAINAGE (KM)
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46+8.0
47+0.0
40.0
20.0
0.0
20.0
40.0
OFFSET (M)
AGRICULTURAL AREA
AGRICULRURAL AREA
SHOPS
TREES
TREES
BINDRA FARM
TREES
BRICK KILN
TREES
TREES
TREES
MOSQUE

ANNEXURE -VIII

Photographs of NH-64

Traffic congestion on NH-64

Inadequate Width of Highway Section

Narrow Bridge Along NH-64

Encroachments Along Road Side

Development Along Roadside

Trees Along Road Side

Public Consultation

ANNEXURE-IX

Questionnaire for Environmental Appraisal (For Road/Highway Projects)

1. Are you satisfied with the present highway? Yes/ No/ Can't Say

2. Is the highway providing you with proper connectivity with other parts of the state?
   Yes/ No/ Can't Say

3. Is there a problem of traffic congestion due to present highway facility?
   Yes/ No/ Can't Say

4. Do you feel that road safety is up to the mark?
   Yes/ No/ Can't Say

5. Is there proper rainwater drainage on and along roadside?
   Yes/ No/ Can't Say

6. Do you think the widening of road will reduce the traffic congestion and other problems?
   Yes/ No/ Can't Say

7. Is the quality of air, which you breathe is healthy and clean?
   Yes/ No/ Can't Say

8. Have air pollution caused health and psychological problems?
   Yes/ No/ Can't Say

9. Has the job opportunities increased due to the existing highway facility?
   Yes/ No/ Can't Say

10. Do you feel your business has improved due to present highway facility?
    Yes/ No/ Can't Say

ANNEXURE-IX

Published Work

International Conference on
Role of Green Technologies for sustainable Development (RGTSD-2012)

GT-6:DEVELOPMENT OF GREEN ROADS RATING SYSTEM FOR MORE ENVIRONMENTALLY FRIENDLY ROADS FOR A BETTER TRANSPORTATION FUTURE.

1. Mr. Ashish Sharma, Research Scholar, Dept. of BTES, Thapar University, Patiala.
2. Mr. Tanuj Chopra, Assistant Professor, Dept. of Civil Engg. Thapar University, Patiala.
3. Mr. Amit Dhir, Assistant Professor, Dept. of BTES, Thapar University, Patiala.

ABSTRACT

Paper describes a methodology for designating a Road Construction Project as a Green Road Project by considering different parameters so that the project under consideration is not only environmentally acceptable but also environmentally beneficial. This exercise is to be carried out for the construction of new highway as well as for the widening of the existing highways to ensure that it will not in any way harm the environment on a short term or long term basis. Designating involves systematic investigation of both positive and negative impacts on the physical, biological socioeconomic environment & takes into account environmental, social, cultural and aesthetic considerations. It also provides a plan to reduce the negative environmental effects of development project through alternative approaches, design modifications and remedial measures. This paper highlights the procedure and guidelines for designating a road project as a Green Road Project in the sustainable development of infrastructure with a case study of around 50 Kilometer stretch of a National Highway on NH-64 (Patiala to Zirakpur). The parameters covered in present work are Socio-Economic, Biological, Air (Dust), Water, Noise, Ecological, & Soil.

INTRODUCTION

In this paper, we propose a methodology for designating a Road Construction Project as a Green Road Project.The approach integrates the environmental concerns in the developmental activities right at the time of initiation of the project by collecting the baseline information thus preparing a report which describes whether the project can be designated as green project or not. This new methodology describes the improvements required by considering different parameters so that the road project under consideration is not only environmentally acceptable