"ENVIRONMENTAL IMPACT ASSESSMENT FOR NH- 64 FROM PATIALA TO SANGRUR (KM 50.00 TO KM 113.00)"

A Dissertation Submitted
In Partial Fulfillment of the Requirements
for the degree of

MASTERS OF ENGINEERING
IN
INFRASTRUCTURE ENGINEERING

Submitted by:
ASHISH SINGH
(ROLL NO. 801223004)

UNDER THE SUPERVISION OF

TANUJ CHOPRA
Assistant Professor
Department of Civil Engineering
Thapar University, Patiala

DWARIKANATH RATH
Assistant Professor
Department of Civil Engineering
Thapar University, Patiala

DEPARTMENT OF CIVIL ENGINEERING
THAPAR UNIVERSITY,
PATIALA-147004
JULY 2014

DECLARATION

I, Ashish singh, hereby declare that this thesis entitled **"Environmental Impact Assessment for NH- 64 from Patiala to Sangrur (at km 50.00 to km 113.00)"** is an authentic record of my study carried out as requirements for the award of degree of **Master of Engineering** in **Infrastructure Engineering** in the Civil Engineering Department, Thapar University, Patiala under the supervision of **Mr. Tanuj Chopra, Assistant Professor and Mr. Dwarikanathrath, Assistant Professor,** Department of Civil Engineering, Thapar University, Patiala during July 2013 to July 2014. This matter embodied in this report has not been submitted in part or full to any other university or institute for the award of any degree.

(Ashish Singh)
Roll No. :801223004

Date: 18/07/2014

CERTIFICATE

This is to certify that above statement made by the student concerned is correct and true to the best of my knowledge and belief.

Mr. Tanuj Chopra
Assistant Professor
Department of Civil Engineering
Thapar University, Patiala

18/07/2014
Mr. DwarikanathRath
Assistant Professor
Department of Civil Engineering
Thapar University, Patiala

Countersigned by

Dr. Naveen Kwatra
Associate Professor & Head
Department of Civil Engineering
Thapar University, Patiala- 147004

Dr. S.K.Mohapātra
Dean of Academic Affairs
Thapar University, Patiala-147004

ACKNOWLEDGMENT

A thesis cannot be completed without the help of many people who contribute directly or indirectly through their constructive criticism in the evolution and preparation of this work. It would not be fair on my part, if I don't say a word of thanks to all those whose sincere advice made this period a real educative, enlightening, pleasurable and memorable one.

First of all, a special debt of gratitude is owned to my supervisors, **Mr. Tanuj Chopra, Assistant Professor and**my co-guide **Mr. DwarikanathRath, Assistant Professor,** Department of Civil Engineering, Thapar University, Patiala for their gracious efforts and keen pursuits, which has remained as a valuable asset for the successful completion of research work. Their dynamism and diligent enthusiasm has been highly instrumental in keeping my spirit high. His flawless and forthright suggestion blended with an innate intelligent application has crowned my task a success.

I would like to express my gratitude to **Dr. Naveen Kwatra, Head of department of Civil Engineering**, Thapar University, Patiala for his kind cooperation and encouragement which helped in the completion of work.

I am extremely thankful **to Department of Environmental Energy and Science** for helping me carry out experimental work.

I would also like to thank my parents, sister and my friends for their constant encouragement during the entire course of my thesis work.

Ashish Singh

(801223004)

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 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. In this study analyses the environmental impacts likely to occur due to the proposed widening of a 55 km stretch of NH-64 from Patiala to Sangrur. The report highlights the importance of EIA in the sustainable development of highway project with a case study of vital link of about 55 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, Accidental, 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 urban town & country planning department of Patiala and the accidental data was collected from police stations along the highway. The results demonstrated that the Total Dissolved Solids content exceeded the prescribed limits in most of the groundwater samples, PM 10 concentrations at all locations also exceeded the prescribed limits. Noise levels were found exceeded permissible limits. Drainage system of the stretch which was found very poor at some locations. 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 was then evaluated with the help of matrix method.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION TO ENVIRONMENTAL IMPACT ASSESSMENT

1.1 Environmental Impact Assessment (EIA)

Highway development enhances mobility and is critical to the economic growth of a community and a country as a whole. Unfortunately, inappropriately planned, designed, and constructed highways can aggravate the conditions of the poor, and harm the natural and socio-economic environment. The common adverse impacts of highway development include damage of natural landscape, habitat and bio-diversity, destruction of cultural and social structure of affected communities, creation of air and water pollution, and generation of noise and vibration. To minimize adverse environmental and socio-economic impacts, highway infrastructure must be built to a high quality and maintained to a high standard. This can be achieved by integrating environmental considerations into highway development planning, design, and construction. The process consists of three key elements:

1. Identification of the full range of possible impacts on the natural and socio- economic environment;
2. Evaluation and quantification of these impacts.
3. Formulation of measures to avoid, mitigate and compensate for the anticipate impacts.

The above process which systematically deals with these elements is called Environmental Impact Assessment (EIA).

1.2 EIA Process

The following are the major steps in an EIA process:

Step 1: Perform ES (Environmental Screening)

Step 2: Perform environmental scoping and IEEs

Step 3: Prepare TOR for EIA

Step 4: Perform EIA study and prepare EIA Report

Step 5: Review and approve EIA Report

Step 6: Formulate EMP and monitor implementation of recommended environmental protection measure

Step 7: Conduct post construction environmental audit and evaluation

1.3 Defining Impact Assessment

- 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 (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 planning and design.

  Manu and Anshu, UEMRI-India

- The purpose of the environmental assessment process is:
  1. To support the goals of environmental protection and sustainable development.
  2. To integrate environmental protection and economic decisions at the earliest stages of planning an activity.
  3. 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.
  4. To provide for the involvement of the public, department of the Government andGovernment agencies in the review of the

proposed activities. Alberta Environmental Assessment and Enhancement Act.

- 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 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)

1.4 Environmental consideration in Highway Projects

Roads impact on the environment in many different ways. This applies from the initial construction to maintenance, upgrading and usage. Roads that impede drainage or cause run-off to be concentrated or polluted, can seriously degrade the environment. Vehicles travelling on roads can add to ambient noise and reduce air quality, which has the potential to affect people's health. All road development proposals must go through a process of consultation with other government agencies to identify possible impacts on the Environment and the community.Depending on the size and potential impact of the project, a formal assessment may be required under the Northern Territory's Environmental Assessment Act. For example, a large road project with potential for adverse

environmental impact or public concern may be subject to a Public Environmental Report (PER) or a more detailed examination through an Environmental Impact Statement (EIS).

Projects with limited environmental impact, such as the widening or duplication of a road, require an environmental clearance from the Office of Environmentand Heritage, which administers the Environmental Assessment Act.Routine maintenance does not usually need environmental assessment under the Act. The environmental impact of roads does not end with construction and maintenance. Motor vehicles using roads can cause problems such as traffic noise, reduce air quality, dust pollution and contamination of natural water resources as well as landscape degradation and soil erosion.

The environmental problemswhich 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. Wild life disturbances
7. Deforestation
8. Accidental data
9. Contamination of soil
10. Setting up of brick kilns and other industries along the highway
11. Socio economic impacts

1) Air pollution: Air pollution is one such form that refers to the contamination of the air, irrespective of indoors or outside. Pollution emission from vehicles including trucks, jeeps, cars, trains, cause immense amount of pollutant. we rely on them to fulfill our daily basic needs of transportation .But there overuse is killing our environment as dangerous gases are polluting the environment carbon monoxide caused by improper or incomplete combustion and generally emitted from vehicles is another. Major pollutant along with nitrogen oxides.

2) **Water pollution:** The factor which is related to project affects water quantity and quality directly and indirectly. It is a measure part of EIA to identify such factors and access their impact on water and aquatic environment. The factors of water which impacts on highway projects can be listed as follows:

- Surface stream discharge
- BOD
- Suspended solids
- Turbidity
- Total dissolved solids
- Phosphorus
- Chlorides
- Ground water Quantity and quality
- Erosion
- Sedimentation

3) **Socio-Economics:** Highway 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.

Highway development can have significant effects on communities. Highway 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.

4) Ecological resources: The effects of the Highway projects on forestry are primarily caused by the site clearance for the road bed 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.

5) **Noise:** Noise Pollution takes place when there is either excessive amount of noise or an impleasent sound that causes temporary disruption in the natural balance. Large no of vehicles on roads produce heavy noise and people get it difficult to get accustomed to that. The high noise leads to a situation where in a normal person lose the ability to hear properly.

6) **Traffic:** All required safety precautions and traffic management plans will be prepared and implemented during construction in accordance with the IRC:SP:55(Guidelines of safety in road construction zones) will be followed. There will be conscious effort to ensure that the road users and the communities near the work site suffer minimal discomfort during the construction phase of different stretches of the road. A suitable Traffic Management Plan will be prepared especially for construction sites and bridge locations and their approaches.

7) **Soil:** Soil is the most important natural resource of Punjab. The Punjab plain lies in the indo gangetic drainage system and is formed by the deposition of alluvium brought down from the Himalayas. The soils of Punjab show three stages of soil development beginning with entisol and ending with alfisol. The soils that belong to the initial stage are entisol and lacks profile development.

8) **Accidental Data:** Data was collected from the police stations of various locations that data is in FIR (First Information Report) register in the police station. Causes of accidents were found of that location.

1.5 Methodology Followed

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

1. **Reconnaissance Survey:** Reconnaissance survey is conducted for collecting all types of initial information about project and physical features of the site and locating important points along the site.
2. **Data collection:** Collection of data is the next step of different parameters. This would include data on:

   Water characteristics: Samples were taken from various locations of the project.

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

   Soil characteristics: Different soil samples were collected from different sites along side highways.

   Socio-Economic characteristics: socio economic data was collected with the help of to prepare a questionnaire 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.

   Testing: Samples of water and air which collected from the throughout the stretch shall be tested in laboratory.

   Following are some of the test which was conducted:

   - Water: pH value, Chloride Content and Turbidity,Conductivity,TDS.
   - 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.

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 in chapter 6.

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

1.6 Outline of Thesis

The objective of the EIA report is to understand the impacts on social and cultural environment of the road during the construction of highway projects. The Thesis has been divided into seven chapters.

- Chapter 1 is about General introduction, major steps involves in EIA process, methodology followed in EIA.
- Chapter 2nd is about the thorough literature review of the EIA reports.
- Chapter 3rd In this chapter Project road details are described from an environmental prospective with the salient features such as ROW, pavement condition, Community facilities, traffic projection, parameters considered etc;
- Chapter 4th In this chapter detail description of Environmental and Social impacts, impact matrix score etc;
- Chapter 5th deals with the experimental programme means testing results of the various parameters which were taken from the different location of the project corridor.
- Chapter 6th deals with the results analysis with the graphs.
- Chapter 7th is about the Analysis of pavement drainage.
- Chapter 8th is about the mitigation measures of the environmental impacts.

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, alternatives processes are suggested so that the most environmentally suitable options are adopted. 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.

Fernandez et al.(2000) 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 Iberian Lynx (*Lynx pardon L*) is described. This method prevents the occurrence of common errors in the decision making process by allowing an increased knowledge of the ecological constraints of the project. paper describes how, within an Environmental Impact Assessment (EIA) Process of a highway running through a highly sensitive ecological area, the Integrated Landscape Ecological Analysis (ILA) produces an evaluation and prediction of the target species ecology, allowing a comparative

evaluation of alternatives without the bias of prejudgments over "less negative" alternatives. The project objective of the EIA process considers the construction, in the short term (2000–2001), of a highway between Lisbon (the capital) and Algarve (the southern part of Portugal). paper considers the EIA of the projected highway section crossing the chain of mountains that separate the Algarve from the rest of the country and should be located approximately 50 km eastward from the present main access road that, together with the railway, follows a valley through a natural geological fault.

Kuitunen et al.(2007) discussed about the results of EIA and SEA compared by using Rapid Impact Assessment Matrix (RIAM) Method. There are many techniques that have been developed for use in impact assessment processes, including scoping, checklists, matrices, qualitative and quantitative models, literature reviews, and decision-support systems RIAM was originally developed to compare the impact of alternative procedures in a single project. In this study, we used RIAM to compare the environmental and social impact of different projects, plans and programs realized within the same geographical area. RIAM scoring is based on five separate criteria. The RIAM criteria were applied to the impact that was considered to be the most significant in the evaluated cases, and scores were given both on environmental and social impact. Our results revealed that the RIAM method could be used for comparison and ranking of separate and distinct projects, plans, programs and policies, based on their negative or positive impact. One of the purposes of Environmental Impact Assessment (EIA) is in advance to identify and evaluate the important environmental consequences of proposed projects. The World Commission on Environment and Development, also known as the Brunt land Report, brought together environmental and developmental aspects that emphasize sustainable development and the integration of environmental aspects with economic and social aspects. The data included 142 projects, plans and programs from the area of Central Finland that is covered by the Regional Council of Central Finland. We were able to evaluate 85% (117/142) of the cases. The remaining 25 cases were not evaluated, either due to the lack of a statement from the official EIA team of Central Finland or the expert panel was not able to form an impression on the

project based on statements and other information .The data covered various types of projects, ranging from road construction to education programs, that EU funding was applied for According to the environmental impact, we found 54 cases to be positive, 56 cases negative, and seven cases neutral in their relationship with the environment. The social impact assessment produced 113 positive, four negative and no neutral cases respectively .The RIAM scores varied from −91 to 108 for environmental impact, and from −72 to 108 for social impact. The environmental impact was as often negative as it was positive, whereas social impact was mostly positive. However, the scores obtained were dependent largely on the character of the project . The water treatment projects received the most positive scores and the road construction projects the most negative scores for environmental impact. However, social impact did not vary significantly regardless of the character of different projects. Any significant correlation ($r_s=0.14$, $n=142$, $p=0.09$) was not found between the environmental scores and the social scores, which implies that these indexes measured different issues. However, all projects receiving positive scores for their environmental impact also received positive scores for social impact. There were only four projects that received negative scores for their social impact. Each of them received negative scores for their environmental impact as well, and was concerned with tourism and leisure time. No projects were found to have positive environmental impact and negative social impact. the RIAM method is then dependent on project descriptions and results of environmental assessments. The method does not exclude other methods such as checklists or other matrices. On the contrary, those methods could be useful when combined with RIAM as they provide the raw material for the expert panelists to find all the necessary variables to be taken into account for assessing the importance of different variables.

Tullos et al.(2008) Analysis of the EIA process for the Three Gorges Project (TGP) in China as a case study for evaluating this feedback between the EIA and science and policy this paper presents an investigation into whether patterns exist between the scientific interest (via number of publications) in environmental impacts

(a) The identification of impacts as uncertain or priority by the EIA.

(b) Decisions or political events associated with the dam.

(c) Impact type recommendations about those institutional changes needed to improve the feedback between the science and policy, and ultimately the environmental sustainability, of large dams. Large dams offer society many benefits but simultaneously impose adverse, and often irreversible, impacts on the environment As climate change increases the potential for flooding and drought and the global demand for energy and of a growing human population also increase, a surge in new large dam projects is likely to occur. However, without comprehensive investigation of the potential impacts of a major project, irreversible and impacts to the environment will occur. For the EIA process to constructively support the minimization and mitigation of the environmental effects of large dams, the links between hierarchical and interrelated impacts science and policy need to be to recognized and additional commitments of time and resources should be made to advance the science and sustainability of hydropower development. There are several lessons to be learned from the EIA process for the world's largest dam. This review has revealed discrepancies and omissions in impact significance and certainty that could have been reduced had systematically, and coherently planned, monitoring programs been implemented. As suggested by De Jonah for all development projects (1992), the EIA process for TGP would have benefited from the integration of a more formal and interdisciplinary approach for characterizing the uncertainty of impact projections. recognition of the interdependence of science and policy is critical within any public process, including the SEA framework. In the case of large dams, science is needed to establish an understanding of the interactions between, the uncertainty around, and the significance of environmental impacts. Policy is needed both to fund scientific study and to enforce EIA recommendations throughout a long-term monitoring and environmental permitting process that is informed by the science before during and after dam construction. Only through the continued engagement of unbiased science throughout the planning, design, construction, and operation of dams can hydro development approach the sustainability necessary in the arriving era of water and energy instability.

ZHOU et al. (2011) China's EIA Law came into effect in 2003 and formally requires road transport infrastructure development actions to be subject to Environmental

Impact Assessment (EIA). EIAs (including project EIA and plan EIA, or strategic environmental impact assessment, SEA) have been being widely applied in the expressway infrastructure planning field. Three case studies (one expressway project EIA and two PLEI plan SEAs) were examined to understand currently how EIAs are applied to expressway infrastructure development planning. The reasons causing those problems are analyzed and possible solutions are suggested aimed at enhancing EIA practice, helping deliver better decision-making and ultimately improving the environmental performance of expressway infrastructure. From the case studies, the key issue to emerge was the institutional and governance failure to provide the appropriate level of assessment to the relevant scale of infrastructure and decision making. The lack of programme level SEA and the misapplication of project-level EIA to strategic infrastructure e is the root of the problem for the PLEI network programme assessment. The answer, we suggest, lies in the appropriate packaging of small EIA projects into larger, but still manageable, EIAs, which in turn sit under the application of SEA to the higher level PLEI programme (and those in turn under the application of SEA to PLEI plans), thereby creating a more logically tiered structure than currently exists. The SEA team should, therefore, pre-identify those key environmental issues (the scope) which project-level EIAs should focus on, including potential alternatives and mitigation measures. The SEA team should also clearly identify those major issues properly to be the responsibility of the SEA and leave other local and less crucial issues, and/or issuesneeding detailed analyses to the EIA. This arrangement has the potential to improve the effectiveness of SEA application . Furthermore the SEA team should also propose the appropriate application process for those lower level EIAs. In other words, the SEA team should provide “substantive” and “procedural” guidance to lower level EIA .By revising the system along the lines proposed, the current incomplete EIA application hierarchy in expressway infrastructure planning becomes complete in theory as well as in practice may go some way at least to ensure that the most appropriate form of assessment is applied to the appropriate level of infrastructure planning and construction.

King et al. (2011) The Irish National Roads Authority (NRA) recently completed over twenty post environmental impact assessment evaluations of noise chapters prepared as part of Environmental Impact Statements (EISs) for new national road schemes in Ireland. The primary focus of the study was to assess the actual noise impacts of national road scheme developments and to revise, where necessary, methodologies recommended in the current NRA guidance document describing the treatment of noise on national road schemes. To integrate environmental issues into the planning, construction and operation of national road schemes in Ireland, the Irish National Roads Authority (NRA)set out a four stage strategy as part of an environmental integration model (EIM). The four key phases of the EIM include:

Phase 1: The development of Environmental Assessment Guidelines for a range of environmental issues to underpin the effectiveness of the NRA's National Roads Project Management Guidelines1in integrating environmental issues into road scheme planning and development.

Phase 2: Development of best practice guidelines to minimize construction impacts.

Phase 3: Development and implementation of Environmental Operating Plans to ensure the implementation of mitigation measures identified in the Environmental Impact Statement (EIS) during the construction phase.

Phase 4: Undertake post-EIA evaluation studies to assess the actual impacts of the scheme and to validate or revise the recommended prediction methodologies.

Paper discussed on the environmental issue of road traffic noise and, in particular, outlines how the fourth phase of the strategy was implemented with regard to the treatment of noise on national road schemes.post-Environmental Impact Assessment evaluation of noise assessments contained in the corresponding Environmental Impact Statement along with evaluating the effectiveness of the associated mitigation measures on national road schemes in Ireland. A number of issues in the current approach to noise assessment have been highlighted. These include:

1. A failure to adequately address noise issues in the early stages of project planning.
2. The over reliance on noise barriers, particularly timber noise barriers, as a form of noise mitigation.

3. Inadequacies in the reporting of measurement and predictive techniques contained in the EIS.

The current NRA design goal of 60 dB L den appears to be in line with current EU practice. Whilst the phase four review has highlighted a number of deficiencies in the current approach it also suggests a number of improvements for consideration in the revision of the current NRA Guidelines, including:

4. A revision of the use of the three conditions in conjunction with thedesign goal.
5. A clear definition of the term "sustainable" as it pertains to noisemitigation measures.
6. A revision of references to laboratory based tests for noise barriersin an effort to encourage the use of alternatives to timber noisebarriers.
7. Clear guidance regarding measurement and predictive techniques,including flowcharts, diagrams and checklists, where necessary.

Villarroya et al. (2012) Discussed about reduction ecological impacts caused by development projects, avoidance, minimization and compensation techniques have to be taken together into consideration along Environmental Impact Assessment (EIA) procedures Environmental impact assessment (EIA) aims at improving the sustainability of certain environmentally regulated projects, by identifying their significant environmental impacts and proposing measures to counter new practices in EIA have to be fostered together with new conceptualizations if we want to attain more sustainable projects. And not only are new concepts and practices needed but also specific proposals to push them to be undertaken across real EIA contexts. Impact avoidance and minimization are present not only in the mindset of EIA professionals in Spain but also in their everyday practice. Something similar should be promoted for compensation. The central role of ecological evaluation and the way it operates in EIA procedures may be unnoticed by the public. As a result, ecological impact remains partly shadowed, particularly regarding residual impacts and ecological compensation neglected in some EIA contexts, as in cases in Spain. The review of 72 road and railway Records of Decision (RODs) in Spain showed that most RODs (and, consequently, EIA) in Spain prioritize impact avoidance and minimization measures over compensation,and furthermore that ecological evaluation and residual impact

evaluation—the base and measure for ensuing compensation practice—is very weak, if not missing in one of the main legally binding, publicly available documentary sources on EIA decision making

2.2 Indian Scenario

Sharma et al. (2005) discussed about the salient features of the revised EIA procedures and guidelines with particular reference to roads and highways and compares vis-à-vis earlier May 1994 notification. The extensive list of 32 projects in the pre –revised (MAY 1994)EIA Notification has been replaced and regrouped into 8 main heads and sub heads(i.e. categories and sub categories)(based on threshold of pollution potential.

The regrouping has been done on the basis of need of environmental clearance between central government (category A) and state government (category B).The projects under category A necessarily require environmental clearance from EAC (i.e. MOEF at central level) whereas the project following under category B may further classified in Category B1 and B2 require environmental clearance decided by the state environmental impact assessment authority at state level .Various road and highway projects have been categories into category A and category B projects [category 7f] depending upon the screening criteria specified revised EIA notification. ALL road highway projects coming into category A and category B1 will have to necessarily carried out public consultation including public hearing as per the revised procedure specified under revised 2006 notification.

Paliwal et al. (2006) evaluated EIA process in India through strength , weakness , opportunity and threat (SWOT) analysis and she suggested that in India environmental impact assessment (EIA) relied on the institutional frame work 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 pollutation. 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 purpose full monitoring and enforcement. 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.

Chopra et al. (2011) The analysis highlighted the importance of EIA in the sustainable development of highway project with 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. 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 different ones; technical methodology and procedural, public participitation is an important component of the whole process and it should be strictly in corporate and monitored. The EIA process should improved and 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),etc will help a great deal to make the process more effective and less time consuming.

Panigarhi et al. (2012) Environmental impact assessment (EIA) was first introduced in India based on the Environmental Protection Act (EPA), 1986. But formally it came in to effect, when Ministry of Environment and Forest (MOEF) has the main purpose of EIA is to provide information to decision makers and public about the environmental implications of the proposed project activity before decisions are made. Besides providing information, it also suggests measures for preventing or reducing those impacts and mitigation plans paper evaluates the EIA system of India. It is based on:

(1) Review of relevant literature on evaluation of EIA practice

(2) Analysis to various legal provisions, guidelines and procedures by Government of India.

(3) Secondary data on various projects and approval process of EIA reports in the country.

(4) Opinions of Government officials, Present and Ex- members of EIA Approval committee, Environmental Consultants, Research Laboratories, Project proponents, NGOs, Expert professionals from various background In the past, a number of methodologies have been developed to evaluate the effectiveness of EIA processes. India is one of the developing countries that has sound legal framework for EIA. Furthermore, a comprehensive package of EIA guidelines exists. It appears that EIA in India is evolving steadily; an overall evaluation of the EIA system reveals several weaknesses, not only in the institutional framework, but also in implementation and actual practice.

CHAPTER 3

PROJECT DESCRIPTION

3.1 Introduction

Any project would give rise to certain impacts on various environmental and social attributes like air, water, soil, noise, flora and fauna. Widening of road improves the socio-economic status of the local populations, brings a better connectivity and improves industry and tourism in the area. Due to increasing road traffic requires better road and proper transport system. It is very necessary to widen the exits road carriageways in the form of new roads.

Ministry of Road Transport & Highways (MORTH), Government of India (GOI) has decided to take up various National Highway Corridors for augmentation of capacity for safe and efficient movement of traffic by strengthening and upgrading to required width. Some of these highways are proposed to be taken up through the assistance from World Bank.

The PWD (B&R) Department of Punjab State Government represented by the secretary PWD (B&R) Government of Punjab for the Ministry of Shipping Road transport and Highways, Government of India is entrusted with the development and maintenance of National highways. As the part of this endeavor, PWD (B&R) has decided to undertake to up gradation of road to four lane from km 62.750 to Km 209.500 of Patiala-Sangrur-Bathinda Section of NH-64,here after termed as project road ,in the state of Punjab through public private partnership on design ,build, finance, operate and transfer (DBFOT) basis.

3.2 Socio Economic Profile of Project Influence Area (PIA)

3.2.1 General

Punjab is situated on the northern side of India. Punjab Peninsula at Latitude between $29^{o}32'$ to $32^{o}32'$N latitude and $73^{o}55'$ to $76^{0}50'$E longitude, occupying a land of 50. 362 sq. km in the north-western part of India.

The project road starts between latitude 30°20’38.4”N to 76°26’12.”E and ends at 30°14’14.09”E to 74°56’00.8”E latitude. The project road NH-64 takes-off from NH-22 at Panchkula and terminates at Bathinda after joining with NH-15.

Start point of proposed project is a part NH 64 (50.0 km) and end point of NH 64 (209.5 Km). The total length of project road is 166.445 km. The Project Road is located in the districts of Patiala, Sangrur, Barnala and Bathinda. The Project Road crosses Bhakra Main Line Canal ,Nidampur canal (84.5 km), Sirhind drain (100.00km) gabbdan, Kotla branch canal(134.31km) and passes through the important places like Bhawanigarh, Sangrur, Dhanoula, Rampura Phul and Bathinda in the State of Punjab.

3.2.2 Climate

Punjab Climate comprises of three seasons. They are the summer months that spans from April to the end of June; average temperature during summer sometimes reaches up to 45C. The rainy season in Punjab is from the months of early July to end of September. During monsoon project area average rainfall of 160mm to 474mm. The winter season in Punjab is experienced during the months of early December to the end of February. The transitional Seasons in Punjab are the post monsoon season and the post winter season.

The winter season in Punjab is mostly experienced in the month of January, when the temperature falls to 5C in the night and it is around 12C in the morning.

3.2.3 Major Land Features and Soil Topography

The Punjab is the north-western part of India. It is wedged between Pakistan on the west, Jammu and Kashmir on the North, Himachal Pradesh on the north-east and Haryana and Rajasthan on the south. Physically, the topography of Punjab can be divided into the upper portion of the sub-shivalik area and the rest of Punjab is situated on the Sutlej - Ghaggar river basin. The Shivalik area at an altitude of 400 to 700 meters above sea level is made up of fluvial deposits of conglomerates, clays and silts-all.

The low Shivalik Hills demarcates the Himalayas from the plains. Ropar, Hoshiarpur and Gudaspur districts falls in this zone and runs like a wall from north-west to southeast, dividing the Himachal valleys of Sirsa and Una. Topographical changes due to the formation of Himalayas in the recent geographical past gave a basin-like structure to Punjab. The plain lands of

Punjab lie between altitudes 180 meters and 300 meters above sea level. The gradient increases from west to east.

3.2.4 Area & Population

The Population of Punjab according to the 2011 census stands at about 27 million, making it the 15th most populated state in India. The state is spread over an area of about 50000 sq. km. making it the 19th largest state in the country in terms of area. The density of population per sq. Km. is about 550 which is inevitable given the opportunities of growth and development in the state. The literacy rate in the state is about 73% a figure that has improved tremendously in the last few years due to the consistent efforts of the government. The sex ratio in Punjab 895 for each 1000 male, which is below national average of 940 as per census 2011. The statistics in the Punjab Census 2011 reveal facts that can be instrumental in planning for a better development plan for the state.

Table 3.1: Show the growth of Punjab

Growth of Population in Punjab		
Census	**Population**	**% + / -**
1951	9,161,000	-
1961	11,135,000	21.5%
1971	13,551,000	21.7%
1981	16,788,915	23.9%
1991	20,281,969	20.8%
2001	24,289,296	19.8%
2011	27,704,236	14.1%
source:Census of India		

3.2.5 Patiala District

Patiala District lies between 29 49’ and 30 47’ north latitude, 75 58’ and 76 54' east longitude, in the southeast part of the state. It is surrounded by Fatehgarh Sahib, Rupnagar and Mohali to the north, FatehgarhSahib and Sangrur districts to the west, Ambala, Panchkula, Haryana to the North East and Kurukshetra districts of neighbouring Haryana state to the east, and Kaithaldistrict of Haryana to the south west.

In the Patiala district the main communities are Sikhs and Hindus. Sikhs are 55% of the population and Hindus are 42% of the population the remaining communities Christians, Muslims, the Jains and the Buddhists.

3.3 Summary of Investigations and Findings

3.3.1 Topographic Survey

The topography of the project area is plain and small section of the area is slightly rolling terrain near Sangrur. The aquifer is unconfined with the depth of water table ranging between 30 to40 below ground level during the pre monsoon season and 20 to 25 mbgl during post monsoon season.

3.3.2 Traffic Survey and Forecast

Classified traffic volumes are important inputs to financial analysis that is required for financial justification of the project road. It is also a major input for deciding improvement strategies for road sections and carrying out design for road/ bridges. Through traffic surveys, the extent of traffic diversion on to the project roads (in the event of their being improved/ upgraded) can be ascertained, quantified and used for the purposed of economic analysis and road design.

Backbone of any feasibility study is the traffic study and its analysis since the financial feasibility requires the future probable traffic volumes expected on the stretch under consideration for computing the benefits expected out of the project improvement.

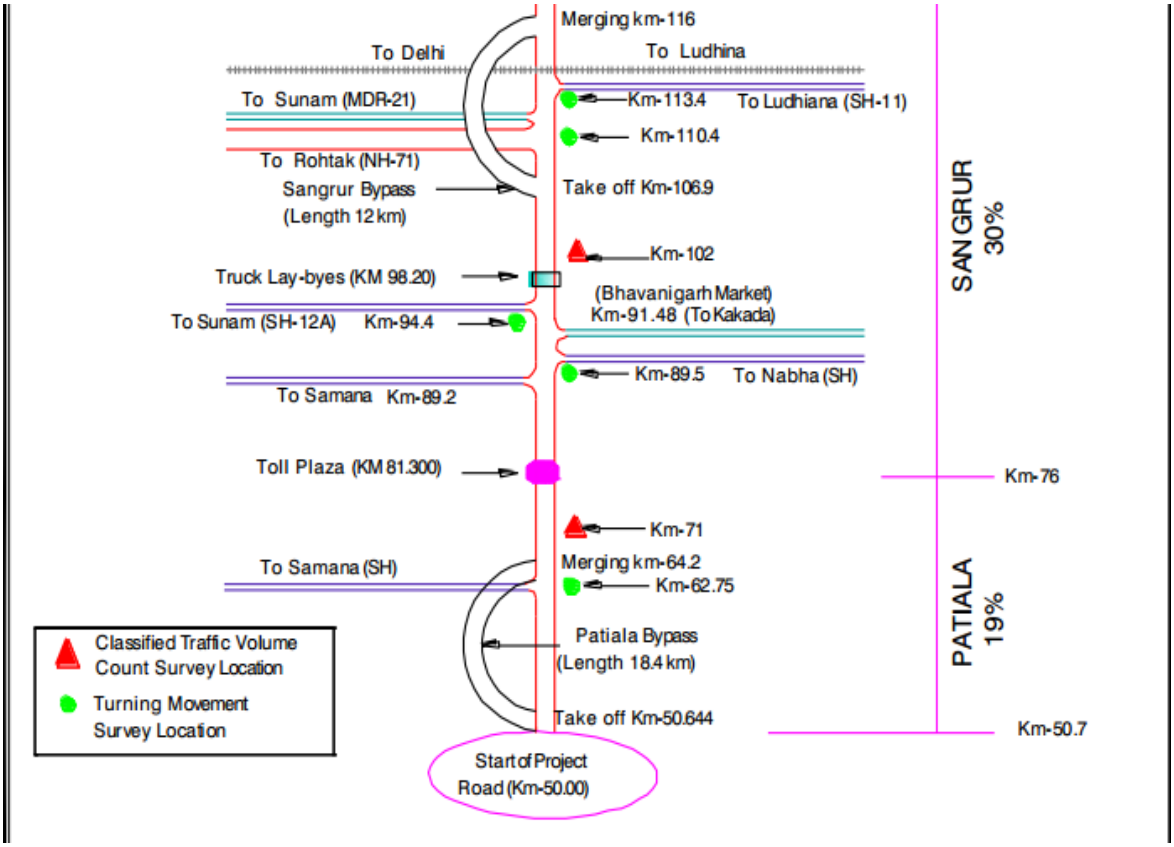


Fig .3.1: Schematic Diagram of the project road

3.3.2.1 Traffic Growth Rate

The traffic growth rate of Punjab, as recorded by PWD Punjab, has been achieved 6.2% for all vehicles, 7.2% for two wheelers, 11.4% for cars and jeeps, and 7.9% for Mini bus 6.3% for buses, 11.1% for LCV and 4.5% for Trucks.

3.3.3 Project Road

Project road is of 2-lane wide configuration except from km 90 to km 94.5 at Bhawanigarh, from km 119 to km 120 where project road has been widened to 4-lane divided carriageway configuration due to cultural/religious significance of GurusarMastona sahib. The project road corridor takes off (NH-64 takes off) from NH-22 at Panchkula and terminates at Bathinda after joining with NH-15. The project Road Corridor, with the revised scope of work, starts from Patiala at km 50.000 of NH-64 and ends at km 209.500 at Bathinda. The total length of project road is 166.445 km. The project Road crosses Bhakra Main Line Canal

and passes through the important places like Bhawanigarh, Sangrur, Dhanola in the state of Punjab. The whole terrain is plane from Patiala to dhanola by pass.

The project road does not pass through the reserve forest area except road side linear plantation declares as Protected Forest on NH land. Bir Moti Bag Wild life sanctuary, Patiala and Bir Aishwan Wild Life sanctuary, Sangrur is located within the 10km radius of the project area.

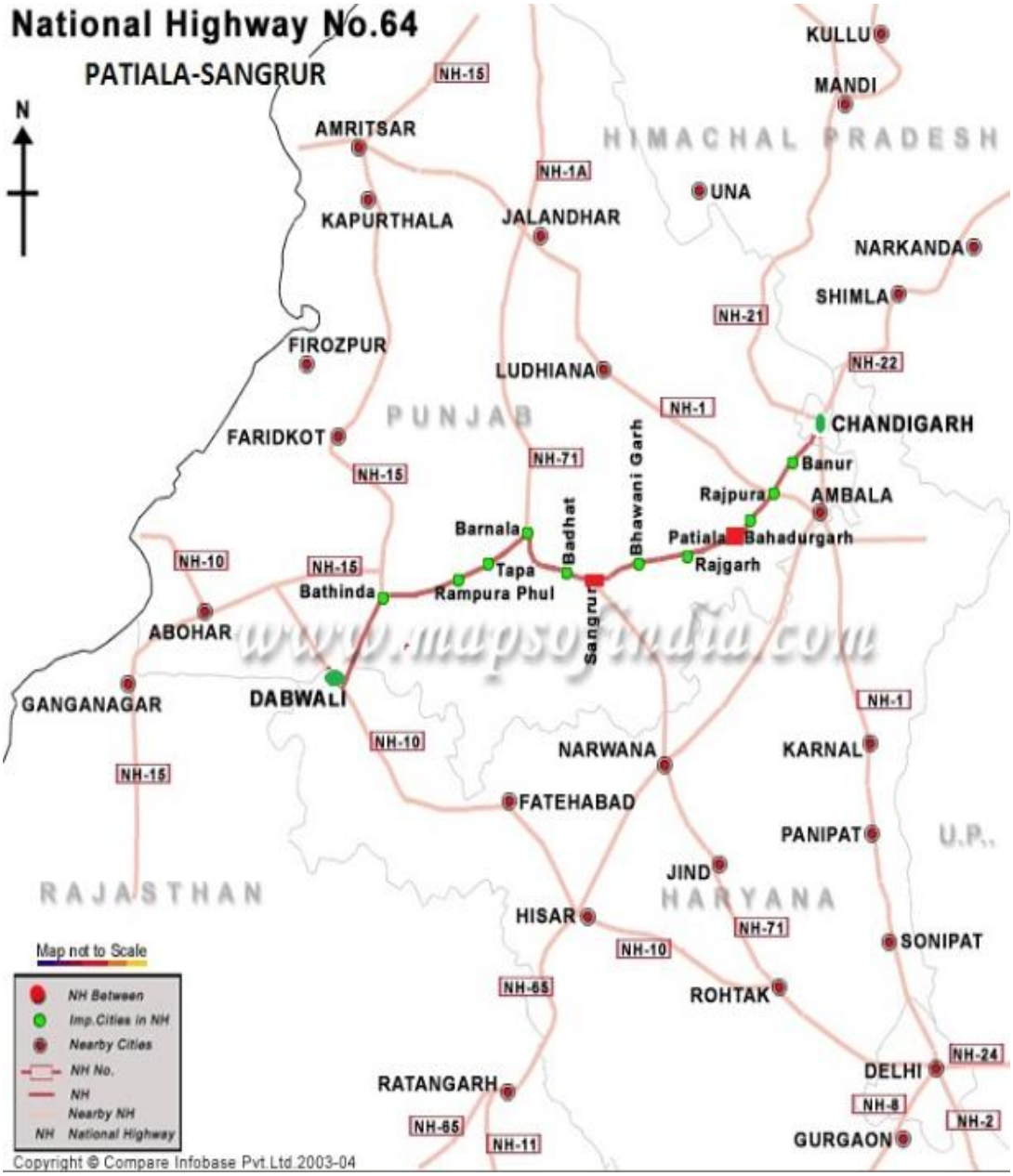


Fig. 3.2: Map showing study area

3.4 Project road description

3.4.1 Available Right of Way (ROW)

Table 3.2: Existing Right of Way

S.NO	Section	Length	Width
1	Patiala-Bhawanigarh section	50.00-93.88 kms	42.58m-35.20m Variable
2	Bhawanigarh-Sangrur section	93.88-113.60 kms	37.64m-20.11m Variable
3	Sangrur-Bhatinda section	113.60-209.50 kms	30.18m-45.73m Variable

3.4.2 Alignment

1) Horizontal Alignment and Vertical Alignment

The alignment of the existing 2 lane is curvilinear and curves are to the standards except at a few locations where sub standard curves are observed during detail survey. These sub standards curves are in km 100, km 133,km 135. Apart from these locations project road takes sharp turn from junction in km 95, km 114. The geometrics generally conform to 2 lane National Highway standards.

The project road from km 110 to km 114 (4km) passes through Sangrur town. Project road in this stretch has 7 km wide carriageway and 1.5 m wide shoulder on both sides. Available row in the town is 44 m but on ground it varies from 25m to 40 m. The geometrics of the existing road are not good and have two sharp bends.

The vertical alignment is mostly flat with the gradients in the range of 0.5 percent to 1 percent excepting the bridge approaches where the gradients are in excess of 3.0 percent.

3.4.3 Pavement Condition

Carriageway of project road has flexible pavement. It is observed that the pavement condition of the project road is generally in good to fair to poor condition. At many places cracks and other distress are developing and require preventive measures. The observed pavement condition of the project road, based on crack area ,pot hole area, and raveling area, has been divided into three categories good, fair and poor.km 80 to km 83,km 87,km 89,km 91,km 121, are the locations where cracks and other distresses are quite pronounced and require immediate remedial measures.

Fig 3.3: Cracking coupled with raveling at km 95.000

3.4.4 Major intersections

The entire alignment of project road crosses important roads and highways at some locations. Major junction of the project road is presented in **Table 3.3**

Table 3.3: Major Intersections

S.No.	Location	Existing Chainage (Km)	Design Chainage (Km)	Name of Intersecting Roads
1	Starting of Patiala by pass	50.630	50.630	Start of Project road
2	Merging of Patiala by pass	64.070	68.782	End of Patiala by pass
3	Starting of Sangrur by pass	106.930	111.482	Starting of Sangrur by pass
4	End of Sangrur by pass	116.010	122.982	End of Sangrur by pass
5	Starting of Dhanoula Bypass	138.290	145.532	Starting of Dhanoula Bypass
6	End of Dhanoula By Pass	142.780	149.268	End of Dhanoula By Pass

Fig 3.4 Major intersection at km 45.000

3.4.5 Design Standards

For four laning of National Highways, MORTH Government of India prepared standards **(i.e. IRC: SP: 84-2009).** It shall be used as main guidelines along with other relevant IRC codes. Design standards for the Project road is presented in Table 3.4.

Table 3.4: Geometric Design Standards for the Project Road

S.NO	Description	Standards for 4 lane paved Shoulders Highway
1	Design speed Ruling Minimum	 100 Kmph 80/60 Kmph
2	Roadway i)Lane width ii) Paved shoulder iii) Earthen shoulder width on outer side	 3.5m 1.5m 1.0m
3	Shyness i)Median side-Rural	 0.25m
4	Sight distance i)Stopping(minimum for 100 kmph) ii)Stopping(minimum for 80 kmph) iii)Stopping(minimum for 80 kmph)	 180m 130m 90m
5	Gradient i)Ruling ii)Limiting iii)Desirable	 3.3% 5% 2%
6	Super elevation Maximum	7%
7	Rate of change of super elevation	1in150

8	Embankment slope i)In normal section ii)In pitching proposed sections	 2H:1V 1.5H:1V
9	Vertical clearance to road bridge over road	5.5m

3.5 OBJECTIVE OF STUDY

The main objective is to establish the EIA report of the project and to prepare EIA report for 4-Laning of Patiala –Bathinda section of Nh-64. The feasibility of the project shall be established in a manner which ensures:

- Enhanced safety of the traffic, the road users and the people living adjacent to the highway.
- Enhanced operational efficiency of the highway.
- Minimal adverse impact on environment.
- Minimal additional acquisition of land.
- Minimal adverse impact on the road users and the local population due to construction.
- Feasible and constructible options for the project with least cost options.
- Development of the road alignment in such a way that the environment settlements are least affected.

3.6 SCOPE OF THE WORK

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

- Collection of baseline data on various components of the environment along the project road within COI.
- Identification and collection of eco-sensitive environmental data within 10 km on either side of the project road.
- Identification of areas and aspects that is environmentally or socio-economically significant.
- Development of the road alignment broadly ensuring that the environment and settlements are affected the least .

- 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.
- Preparation of environment management plans for enhancing the positive impacts and mitigating the negative impacts.
- Analysis of impacts especially on the identified VECs.

CHAPTER 4

ENVIRONMENTAL AND SOCIAL IMPACTS

4.1 Introduction

In this chapter determines the impacts of the project activity on the existing environment. The main part of this chapter is to identify the impacts and suggest the mitigation measures.

There are three stages of the impact assessment:

- Planning and designing stage
- Construction stage
- Operational stage

In the first stage Planning and design construction details, materials of construction etc are necessary which ultimately decides the impact during later phases. During construction and operation phase more impacts are identified. Construction phase has two types of impacts some are temporary and some are permanent. To identify the impacts Physical, ecological, and social impact identification matrix are developed. Environmental parameters are divided into three groups.

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

Physical Environment includes: Water quality, Air quality, Noise andLand Environment

Biological Environment includes: Flora, Fauna, Aquatic Flora and fauna, Plantation.

Social Environment includes: Employment, Agriculture, Housing culture etc

4.2 Parameters Considered

4.2.1 Ground Water

Human activity affects the water quality. Chemical composition of water is the only factor involved .Various aspects of ground water like pH, Turbidity, TDS (Total dissolved solids), Conductivity, chloride 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: Outside the permissible limit of pH of a drinking water affects the water supply system.

TDS: Outside the permissible limit of TDS drinking water affects the water supply system.

Chloride: High concentration of chloride gives salty taste to water. Excessive chloride in water gives laxative effect.

Turbidity: High values of Turbidity gives salty taste to water.

4.2.2 Air

Air quality monitoring is the major part of the parameters which are considered. The air quality of the project road is influenced by emissions from stationary sources from various settlements, stone crushers operating along the road side and from mobile sources like the vehicles plying along the road. All these sources contribute to the local air pollution level. Various aspects of the ambient air quality were tested according to the prescribed procedure. Effects of air quality outside the desirable limits are discussed below

1. People are affected from the high particulate matter concentration mainly suffer from the health problems like asthma, and other respiratory diseases etc.

2. Visibility problems are also come due to high concentrations of particulate matter

3. It also cause soiling and damage to materials

On the project there will be no major problems of air pollution. Only PM10 particulate matter reaches outside the desirable limits. Other particulate matters are within the prescribed limits. Dust produced during construction is the main sources of pollution during the implementation stages of the project.

4.2.3 Soil

Soil contamination may take place in the construction stage through construction of labor-camps, stockyards and construction of camping sites for parking of construction machinery equipment, movement of construction machinery, vehicles during construction especially haul roads.

- Scarified bitumen wastes
- Operation of the emulsion sprayer and laying of hot mix.
- Operation of the residential facilities for the labour and staff
- Storage and stockyards of bitumen and emulsion
- Excess production of the hot mix and rejected materials.

During the operation stage possibility of soil contamination by spills from accidents or leakage from vehicles carrying hazardous chemicals. Extraction of materials from soil borrow areas can result in direct or indirect impact on local environment. The earth will be taken from borrow areas which may result in loss of productive soil, Change in topography.

Various parameters like texture, Permeability, porosity were tested according to the procedures mentioned in engineering soil testing manual by smasher parkas.

- Low soil porosity can inhibit water entry into soil possibly increasing surface runoff and erosion

4.2.4 Noise

Ambient noise quality was monitored at three locations repersentive of a residential area and commercial area . At these locations noise level crosses the prescribed limit. Noise causes the stress, sleep disturbance, high blood pressure

and even hearing loss. During operation phase noise level will slightly decreases due to traffic decongestion of traffic on this project road. The noise levels indicated for various construction activities/equipments, though far in excess of the permissible standards, due to their intermittent nature. The impact of increased noise levels would only be temporary. Even so, the extremely high sound levels present a risk to the workers on the site.

4.2.5 Ecological Resources

The impact will be significant at the construction stage, as the tree cover with in the proposed ROW will be removed in phases as the project road work progresses. This will affect the aesthetics of the corridor. The construction of highways can have a impact on the degradation and loss of natural ecosystem, especially in less developed areas. Out of the 11 sanctuaries in Punjab, two wild life sanctuaries Moti Bir WLS, Patiala and Bir Aishwan WLS, Sangrur located within the 10 km radius of the project area. In light of MOEF notification 2006 and its amendment 2009 "Proposal has been submitted to concern Divisional Wild Life in –charge.

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 minimize 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. Patiala is located at 62.00 km, Channo at 14.5 km, Bhawanigarh at 30.100 km Phagguwala at 40.665 km and Sangrur at the end of project road besides villages like GajjuMajra, Nidampur, Gabbdan, Harditpura , Khurana. 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 28.0m 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 R OW. 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 45.0m 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.

Archaeological/Historical Value –There are sites of archeological/historic value in and around the project as the alignment proposed on the existing road.

4.4 Matrix Method for Impact Assessment

Matrix Method is used for evaluate the impacts of project activities and environmental component, which will be affected due to that activity. A quantitative analysis of the impact of all construction activities on various environmental, social, institutional, and economic factors is provided in matrix format in chapter 7.

Various environmental, social, institutional and economic parameters are weighted as to their perceived importance and within a total of 1000. The weights are professional judgement concerning:

i) The importance of baseline conditions
ii) The factors themselves.

Scores ranging from -5 to 0 to 5 represent in table 4.2 were given to the presumed level of impact from each of nine construction activities and an average calculated. A positive number indicates a positive impact and a negative number, a negative impact- "0" indicates no impact.

The Delphi Technique was used assign the scores relating to the likely impact of each parameter on each category of activity. The Delphi process is the synthesis of professional judgement and an interactive way of determining the impact of project activities.

Table 4.2: Criteria for awarding scores

Score	Level of impact
5	Permanent positive impact
4	Major long term positive impacts

3	Significant positive impacts
2	Short term positive impacts
1	Minimal positive impacts
0	No impact
-1	Minimal negative impacts
-2	Significant reversible short term impacts
-3	Significant irreversible impacts
-4	Major long term reversible impacts
-5	Permanent negative impact

The total impact score

The "*Total Impact Score" = "**Weightage Applied to Each Factor**" × "**Average Score againstEach Construction Activity**"*

From the calculations of all the impact score, the project might, thus, be characterized as having, generally significant, positive and, mostly reversible, negative impacts it is represent in table 4.3. The project analyzed in chapter 8 briefly.

Table 4.3: Project category according to the impact score

TOTAL SCORE	CATEGORY
>400	Permanent positive impacts. Project highly recommended.
300-400	Major long term positive impacts.
200-300	Long and short term positive impacts and negative but reversible impacts. Control measures are needed.
100-200	Significant positive impacts and mostly reversible negative impacts.
0-100	Positive and negative impacts closely balanced- an alternate project site might be considered.
-ve	Positive and negative impacts closely balanced- permanent irreversible negative impacts may be occurring.
+ve	Then accept the project

CHAPTER 5

TESTING RESULT

5.1 Water

Analysis of Groundwater sample taken from different locations alongside the highway was done:

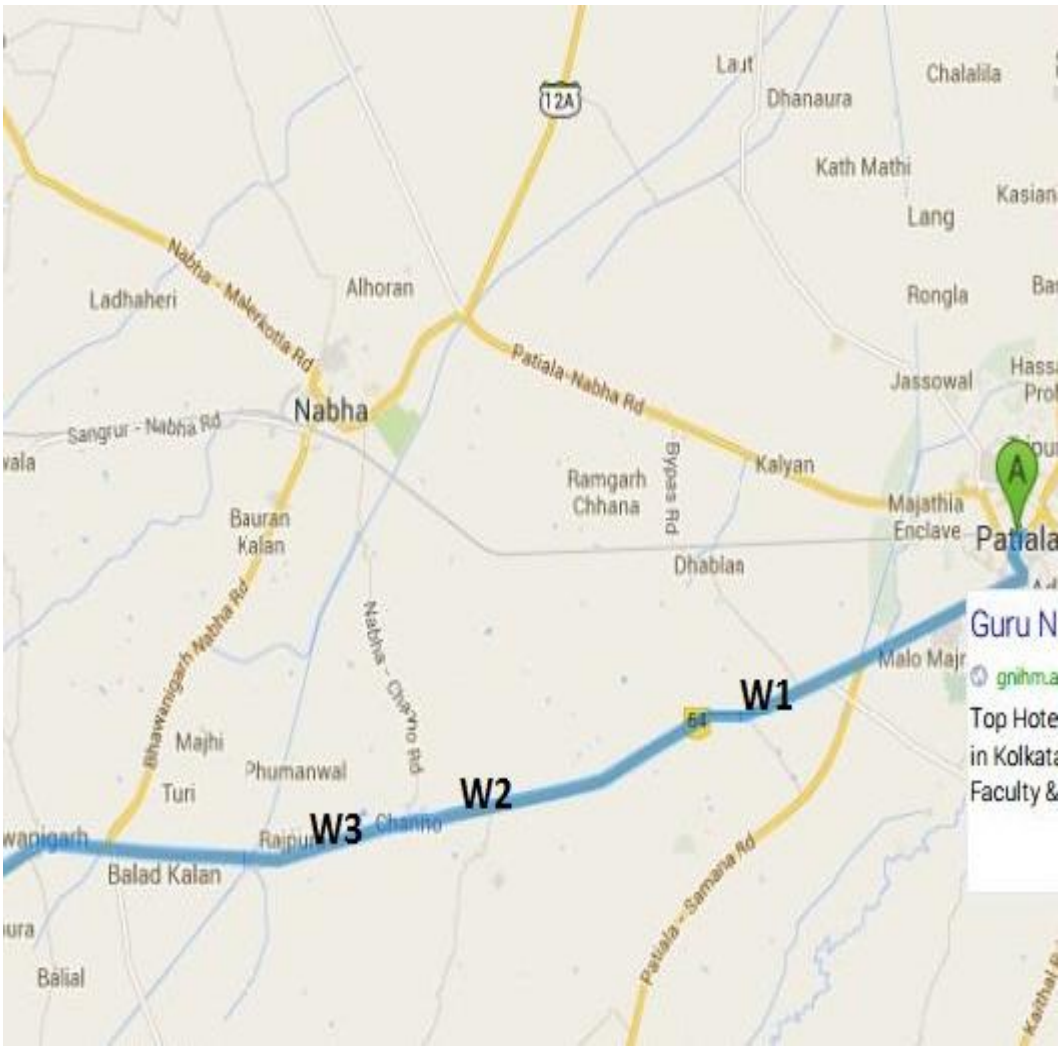


Fig 5.1(a) Location of water sampling

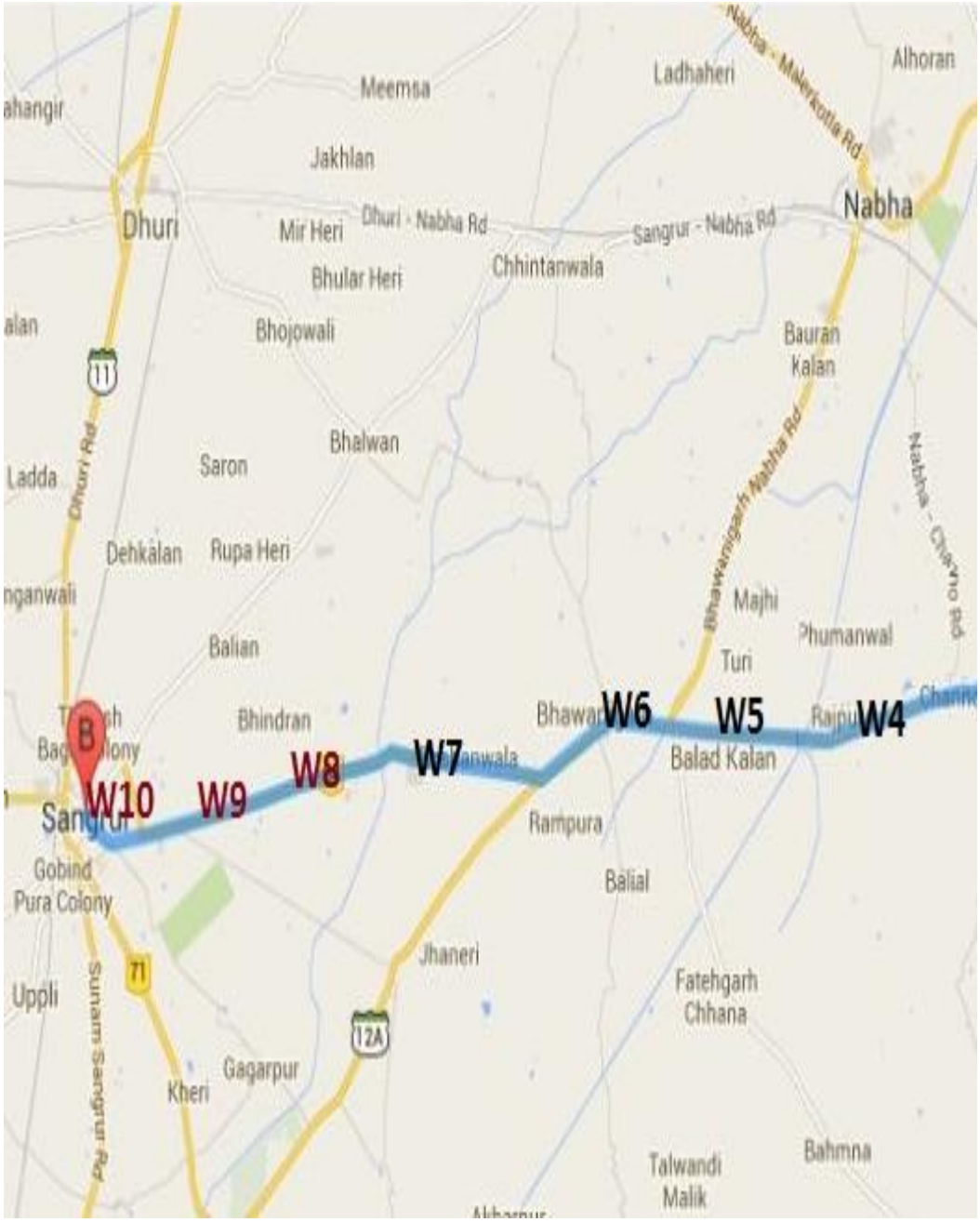


Fig. 5.1(b) Location of water sampling

Following results were obtained:

Table 5.1: Water testing results of the site samples

S.NO	Locations	Characteristics					
		pH value	Turbidity (NTU)	TDS (PPM)	Temp	Conductivity µs/cm	Chloride mg/lit
1	Bhakranadi	7.42	0.24	396	32.3	596	15.91
2	Rajgarh	7.28	0.35	657	32	1007	14.14
3	Sultanpur	7.41	0.15	554	30.8	886	20.91
4	GajjuMajra	7.57	0.43	316	30.9	677	12.76
5	Channo	7.76	0.19	466	33.4	709	17.25
6	Harditpura	7.86	0.27	486	30.8	816	20.91
7	Bhawanigarh	7.20	0.87	624	32.1	940	13.82
8	Phagguwala	7.94	0.19	390	30.7	686	12.76
9	GhabdanPind	7.42	0.59	535	30.8	728	16.17
10	Sangrur	7.15	0.37	590	31.0	841	14.18
Standards		6.5-8.5	5	500		_	250(mg/l)

All the samples of water have been collected from underground sources like hand pumps just near to the Highway. Collected data has been analyzed for different parameters, between the standards as given by the ministry of environment & forest.

5.2: Air : Three different locations were selected for the analysis of ambient air quality along the highway. The results are as follows:

Fig. 5.2 Location of air sampling

Table.5.2: Air testing results of the site samples

S.No.	Parameter	Units of Measurements	Patiala Km 62.300	Bhawani Garh Km 89.400	Sangrur Km 116.500	Prescribed Limits
1	PM_{10}	$\mu g/m^3$	110	115	124	100
2	$PM_{2.5}$	$\mu g/m^3$	35	38	40	60
3	SO_2	$\mu g/m^3$	17	17	18	80
4	NO_X	$\mu g/m^3$	20	26	24	80
5	CO	$\mu g/m^3$	840	1200	940	4000

5.3.Noise: Noise was measured from noise meter. Three different locations were selected. Noise pollution measured during peak hours (Morning, Evening).

Fig. 5.3: Location of Noise Analysis

The results were obtained from noise analysis:

Table.5.3: Noise Data at Location 1

TIME	MAXIMUM (DB)	MINIUM(DB)
Peak hours (Morning)	92.5	61.3
Peak hours (Evening)	101.5	60.2

Table.5.4: Noise Data at Location 2

TIME	MAXIMUM (DB)	MINIUM(DB)
Peak hours (Morning)	96.1	59.5
Peak hours (Evening)	97.5	64.3

Table.5.5: Noise Data at Location 3

TIME	MAXIMUM (DB)	MINIUM(DB)
Peak hours (Morning)	85.7	58.7
Peak hours (Evening)	87.5	53.5

5.4-Soil

The soil samples were taken alongside the highway from different locations and Analyzed.

Table.5.6: Soil testing result of site samples

S.NO.	Locations	Characteristics		
		Texture	Permeability (cm/sec)	Porosity %
1	Bhakranadi	Sandy loam	1.1×10^{-4}	48
2	Rajgarh	Silt loam	1.6×10^{-4}	43
3	Sultanpur	Sandy loam	1.8×10^{-4}	37
4	GajjuMajra	Sandy loam	1.9×10^{-4}	39
5	Channo	Clay loam	2×10^{-4}	56
6	Harditpura	Silt loam	1.4×10^{-4}	49
7	Bhawanigarh	Silt loam	1.8×10^{-4}	46
8	Phagguwala	Silt loam	1.5×10^{-4}	53
9	GhabdanPind	Silt loam	1.3×10^{-4}	55
10	Sangrur	Silt loam	1.9×10^{-4}	52

5.5 Public consultation

5.5.1 The Consultation Process

The main focus ofall infrastructure development projects is to enhance and increase facilities for the society and improve their living conditions. The road projects will bring overall benefits to the people in the area as well as to thoseliving close to the corridor. However, a few are likely to experience negative impacts, which can be overcome through proper mitigation measures. Consultations with the community on social and natural environmental concerns form an integral part of an Environmental Assessment of road projects. People affected by the project are those living and working along the

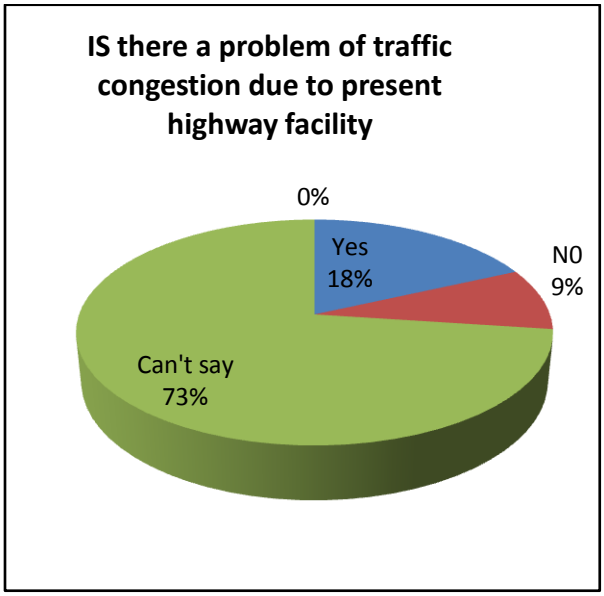
corridor and included businessmen, residents, farmers, agricultural workers, squatters and encroachers. Some religious and cultural properties within the area of impact, may need relocation. Throughout the process of consultation, the focus was on understanding community impacts and to obtain their feedback to effectively establish appropriate road design and implementation. Other objectives of the consultation process are given below.

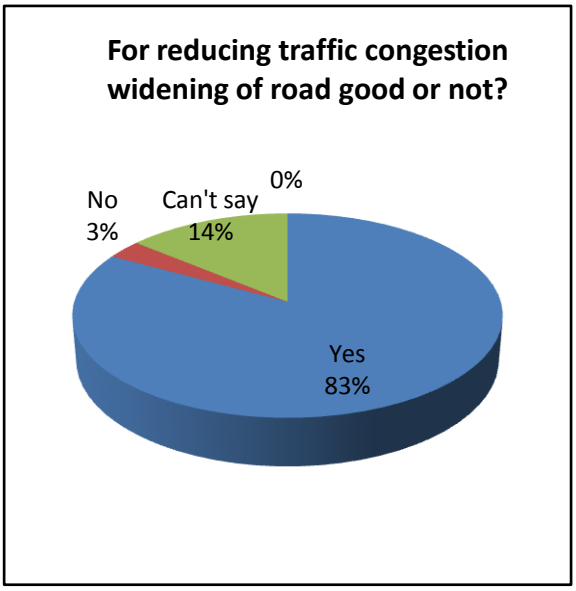
- To promote public awareness about the proposed Project especially amongst the Potentially impacted communities/individuals.
- To educate the potentially impacted communities/individuals about the proposed course of action and the Project alternatives.
- To solicit the views of affected communities/individuals on environmental and social problems.
- To gather inputs from the affected communities/individuals in crucial decisions regarding mitigation of the identified environmental and social issues.

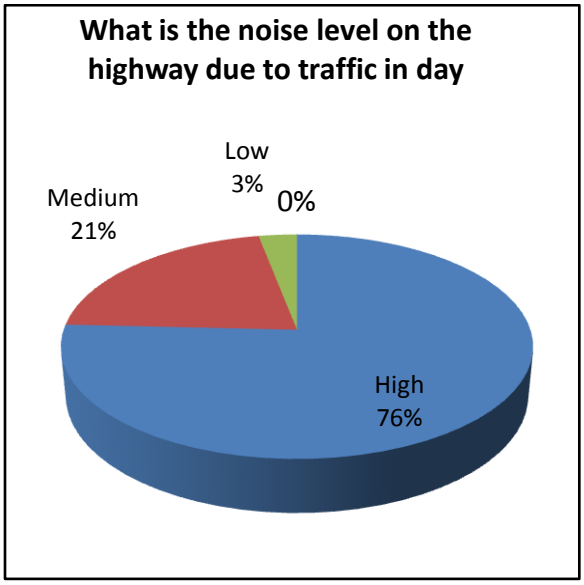
- To stimulate community self evaluation and analysis. To ensure lessening of public resistance to change by providing them a platform in the decision making process.

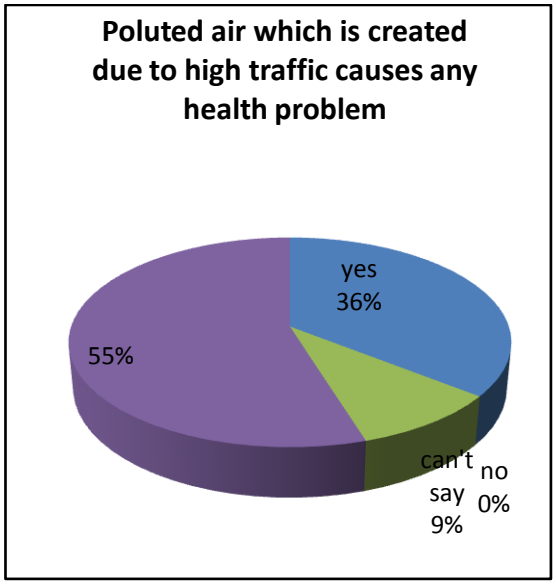
5.5.2- The Consultation Result

On the basis of questionnaire results were obtained as follows:

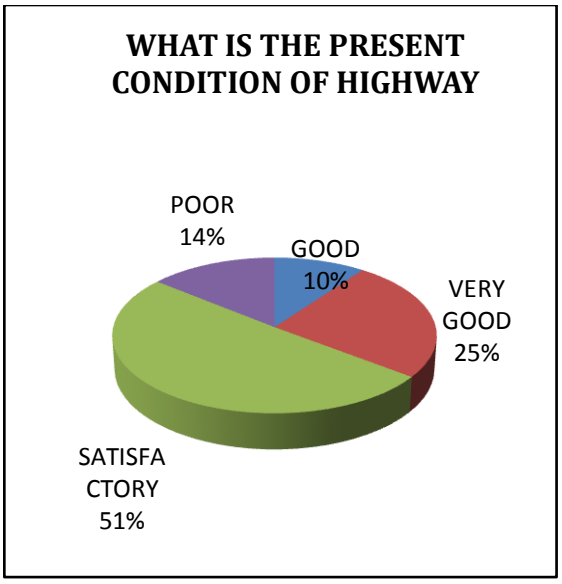


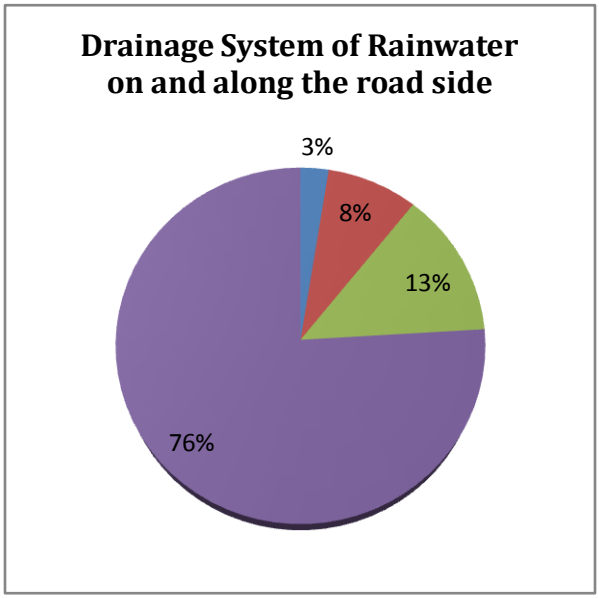


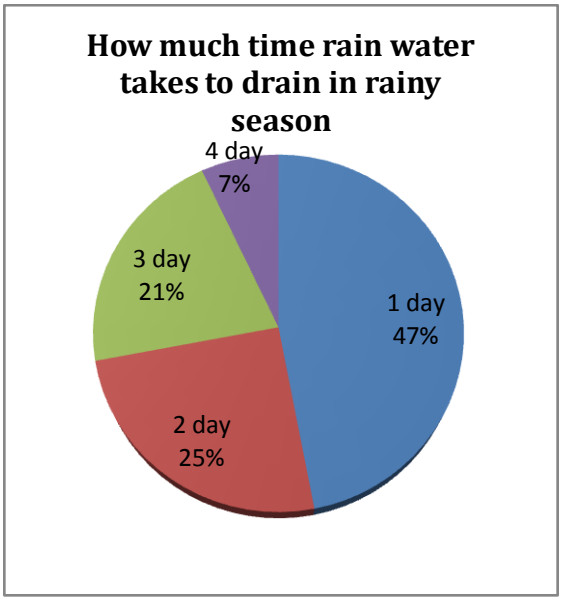





Does construction of highway affects business/employment/near by aeas
yes
15%
no
1%
may be
26%
can't say
58%


WHAT IS THE PRESENT CONDITION OF HIGHWAY
POOR
14%
GOOD
10%
VERY
GOOD
25%
SATISFA
CTORY
51%


Drainage System of Rainwater on and along the road side
3%
8%
13%
76%


How much time rain water takes to drain in rainy season
4 day
7%
3 day
21%
1 day
47%
2 day
25%

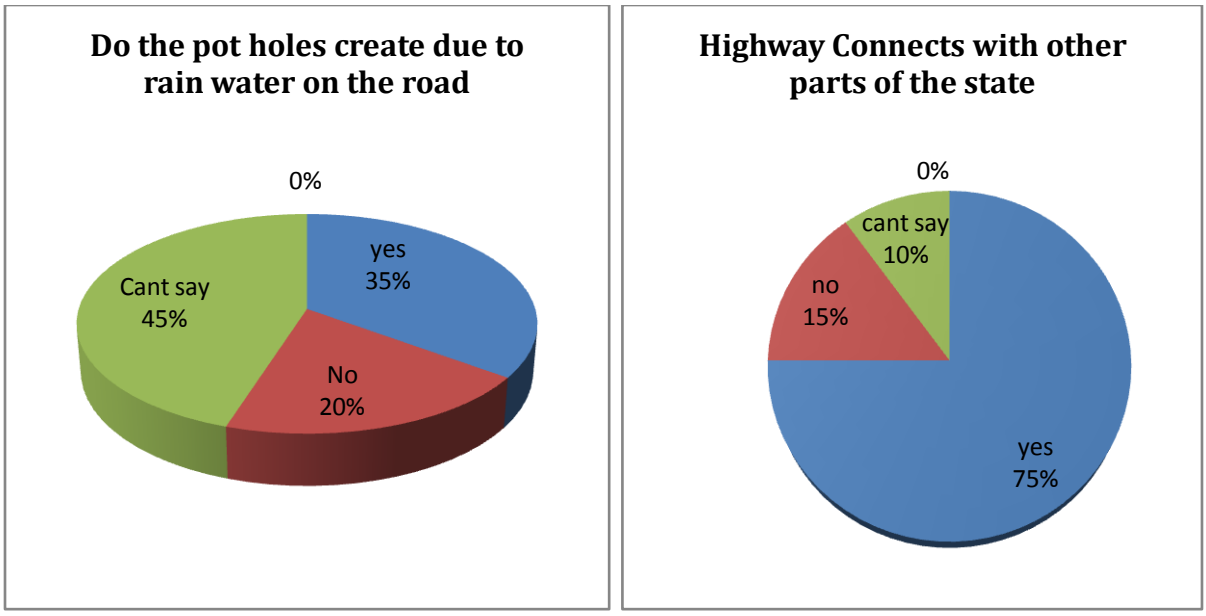


Fig. 5.4: Graphical Representation of the result

Fig. 5.5: Public Consultation along the road

5.6 Ecological Resources

5.6.1 Forest Data

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

SPECIES	No. of tress (L/S of NH-64)					
	57-58 km	58-59km	59-60km	60-61km	61-62km	62-63 km
SHISAM	6	12	11	7	1	3
KIKAR	0	11	9	9	4	3
EUCLYPTUS	1	5	1	26	112	83
MULBURY	0	1	1	1	1	2
MISC	37	55	31	77	19	17
TOTAL	44	84	53	120	137	108

(source : Forest department Patiala)

SPECIES	No. of trees (R/S of NH-64)					
	57-58 km	58-59 km	59-60km	60-61km	61-62km	62-63km
SHISAM	15	9	8	10	4	1
KIKAR	1	22	15	5	4	2
EUCLYPTUS	41	0	11	1	4	94
MULBURY	0	1	0	0	3	7
MISC	36	152	111	41	22	0
TOTAL	93	184	145	57	37	104

Table 5.8: Abstract of trees on road strips in Patiala range.

KM	Total Species	
	R/H	L/S
64-65km	366	411
65-66km	330	380
66-68km	231	224
68-69km	259	NIL
69-70km	638	331
70-71km	338	267
71-72km	128	106
72-73km	186	229
73-74km	50	102
74-75km	98	84

Fig. 5.6: Felling of trees along the road side

5.6.2-Local Fauna (Wildlife Species):

There are 11 sanctuaries in Punjab, Two wild life sanctuaries MotiBir WLS, Patiala and BirAishwan WLS, Sangrur located within the 10 km radius of the project area. There are some dominant fauna are available in the project area.

Table.5.9: List of common mammals and birds available of the project road.

S.NO.	MAMMALS	S.NO.	BIRDS
1	Buffalo	1	Peacock
2	Cow	2	Gadwall Dog
3	Monkey	3	Nothern Pintail
4	Fox	4	Common Teal
5	Neelgai	5	Garganey
		6	Northern Shoveler
		7	Common Pochard
		8	Comb Duck
		9	Tree Duck
		10	Bar headed goose
		11	Tufted Duck
		12	Cotton Teal

5.7-Road Accident data analysis

Accidents records were compiled from police stations for the year 2012 to 2014. This covered the Black Spot Area of the project road.

- **Black Spot:-**Black spot were to be identified on analysis of accidental data on fatal and grievous injury accident . Hazardous spots with accident severity index (ASI) more than threshold value (average severity+1.5 standard deviation) are treated as Black spot.

Table.5.10: Accidental data collected from the project corridor (2012-2013)

Locations	Two-wheeler	Four – wheeler	Minor	Grievous	Fatal
Harditpura	**1**	**1**			**1**
PindRajpura	**1**	**1**			**1**
Channo	**1**	**1**		**1**	
Channo	**1**	**1**	**1**		
Bhawanigarh Bus stand	**1**	**1**	**1**		
Bhawanigarh	**1**	**1(truck)**			**1**
Nidampur	**1**	**1**		**1**	
Rampura	**1**	**1**	**1**	**1**	
Balad-kothi	**1-1**			**1**	
Phagguwala	**1**	**1**			**1**

Table.5.11: Accidental data collected from the project corridor (2013-2014)

Locations	Two-wheeler	Four – wheeler	Minor	Grievous	Fatal
Channo	1	1	1		
Channo	1	1		1	
Channo bus stop	1	1		1	
Bhawanigarh	1	1			2
Nidampur	1	1			1
Phagguwala	1	1			1
Sultanpur	1	1		1	
Gajju Majra	1	1	2		

Pind Rajpura	1	1		4	
Rampura	1	1		1	1

From the survey of the project road many reasons behind the accidents were found are as follows:

- At location one Harditpura it was found that Excessive speed is the biggest cause of accidents on these roads.
- At location two PindRajpura many accidents happen when it is foggy.
- At location three Channo it was found that there is no informatory sign like speed limit board, and other traffic sign which is prevent the accidents.
- At location four Bhawanigarh bus stand main cause of accident at this place is traffic congestion in day time.
- At location five Nidampur it was found that some vehicles carry loads that overhang too far over the back or sides of the vehicle.
- At location six Rampuraproblem arise due to the slow –moving agricultural tractors and faster vehicles.

5.8 Traffic Analysis

5.8.1 Traffic Study

Traffic Study is the most important part of the EIA report. The traffic study data has been collected by the surveys. The locations of the survey were selected from the information of project corridor.

5.8.2 Passenger Car Unit

Different types of vehicles in a traffic stream have different characteristics like width, Length and height sometimes it produces inconvenience for other vehicles, so for expressing highway capacity a unit is also called Passenger Car Unit. In this one car is considered as one unit. The standards of Passenger Car Unit have been adopted from the

IRC-64 for rural roads. The adopted standards of PCU are as follows. Which is suited for state highways and MDR (Major District Road)?

Table 5.12: Passenger Car Unit Equivalents

S.NO.	MODE	PCUs VALUE
FAST MOVING VEHICLES		
1	Scooter/Motor Cycle	0.5
2	Auto Rickhaw	1.0
3	Car/Jeep/Van	1.0
4	Mini Bus	1.5
5	Bus	3.0
6	Tempo/LCV	1.5
7	2 Axle	3.0
8	3 Axle	3.0
9	Tractor	1.5
10	Tractor Trailor	4.5
SLOW MOVING VEHICLES		
1	Cycle	0.5
2	Cycle Rickshaw	2.0
3	Others	3

5.8.3 Traffic Data Collection

Data were collected from the different locations of the site. Data was collected in peak hours in (morning)and peak hours in (Evening) for minimum one hour. There are Three locations where results are obtained as follows:

Fig. 5.8: Location of Traffic Analysis

- **LOCATION 1 (Channo km 79.00)**

Table 5.13: Traffic Count At Location 1

TIME	MOTOR CYCLE	CAR	BUS	TEMPO	TRUCK	TRACTOR	TOTAL VEHICE	TOTAL PCUs
Peak hours (Morning)	1834	3906	547	645	497	32	7461	8970
Peak hours (Evening)	2518	4715	533	632	737	40	9175	10792

- **LOCATION 2(Bhawanigarh km 91.839)**

Table 5.14: Traffic Count at Location 2

TIME	MOTOR CYCLE	CAR	BUS	TEMPO	TRUCK	TRACTOR	TOTAL VEHICE	TOTAL PCUs
Peak hours (Morning)	2229	3254	473	883	638	31	7508	9074
Peak hours (Evening)	2818	3528	481	637	723	128	8315	9697

- **LOCATION 3 (Phagguwala km 95.636)**

Table 5.15: Traffic Count at Location 3

TIME	MOTOR CYCLE	CAR	BUS	TEMPO	TRUCK	TRACTOR	TOTAL VEHICE	TOTAL PCUs
Peak hours (Morning)	3549	3712	458	642	895	36	9292	10563
Peak hours (Evening)	3038	4056	464	760	841	99	9258	10779

CHAPTER 6

RESULTS AND DISCUSSION

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

6.1- Water

1) pH value:pH value of all the samples were found within the prescribed limit i.e.within 6.5-8.5 and it is represented in fig. 6.1.

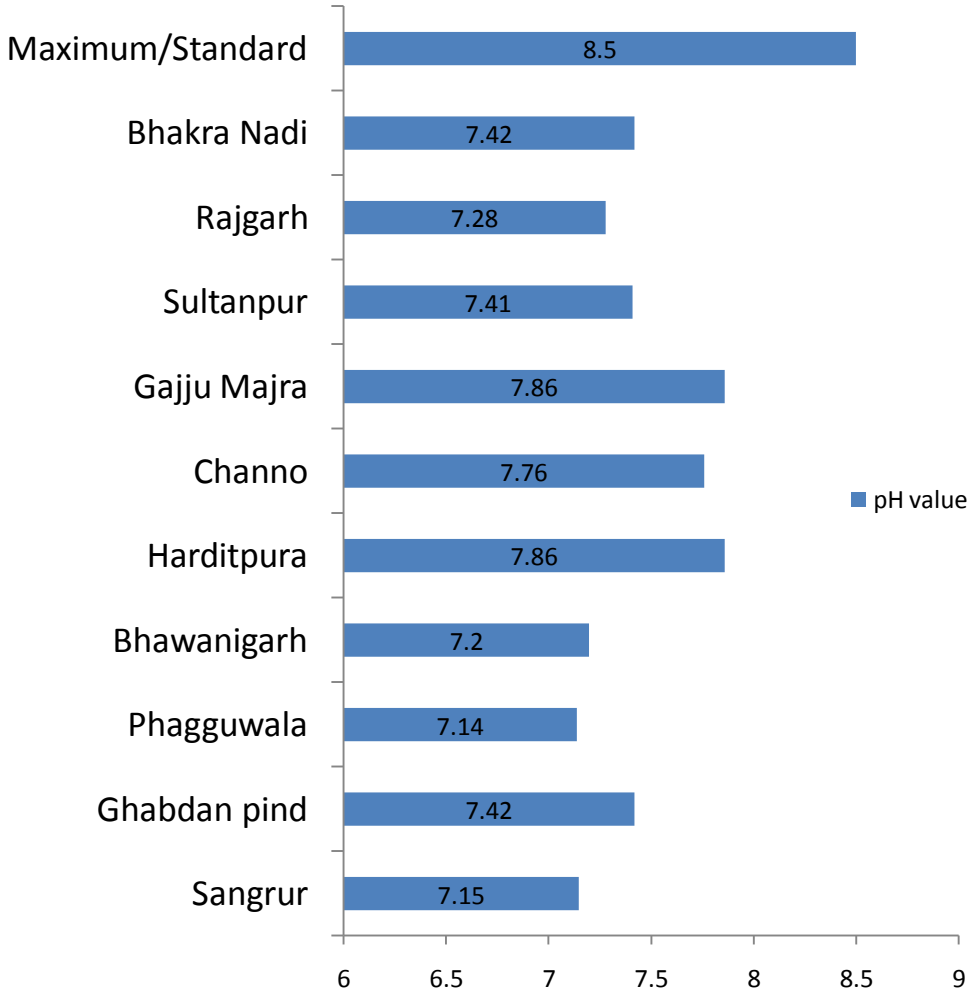


Fig.6.1:pH value measured at different locations

2) Turbidity: Turbidity most of the groundwater samples within the permissible limit. The total value of Turbidity is 5 NTU and it is represented in fig 6.2.

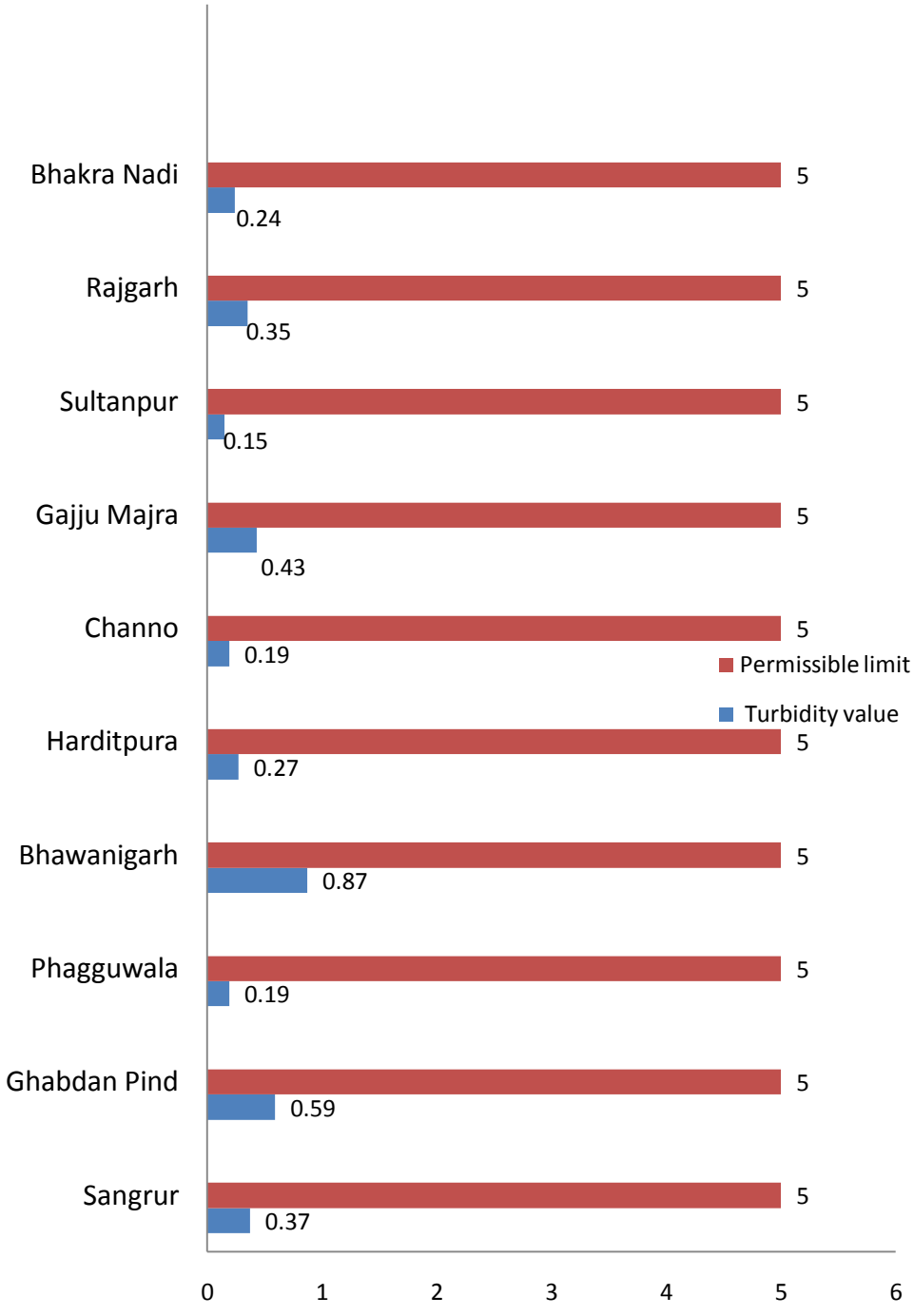


Fig. 6.2: Turbidity values at different locations

3)Total Dissolved Solids(TDS): Total Dissolved Solids most of the ground water samples were found in within permissible limit except from the samples collected Rajgarh, Sultanpur, Bhawanigarh, Gabbdanpind, Sangrur respectively. The Total dissolved Solids values exceeded in all five samples that is 500ppm and it is represented in fig 6.3.

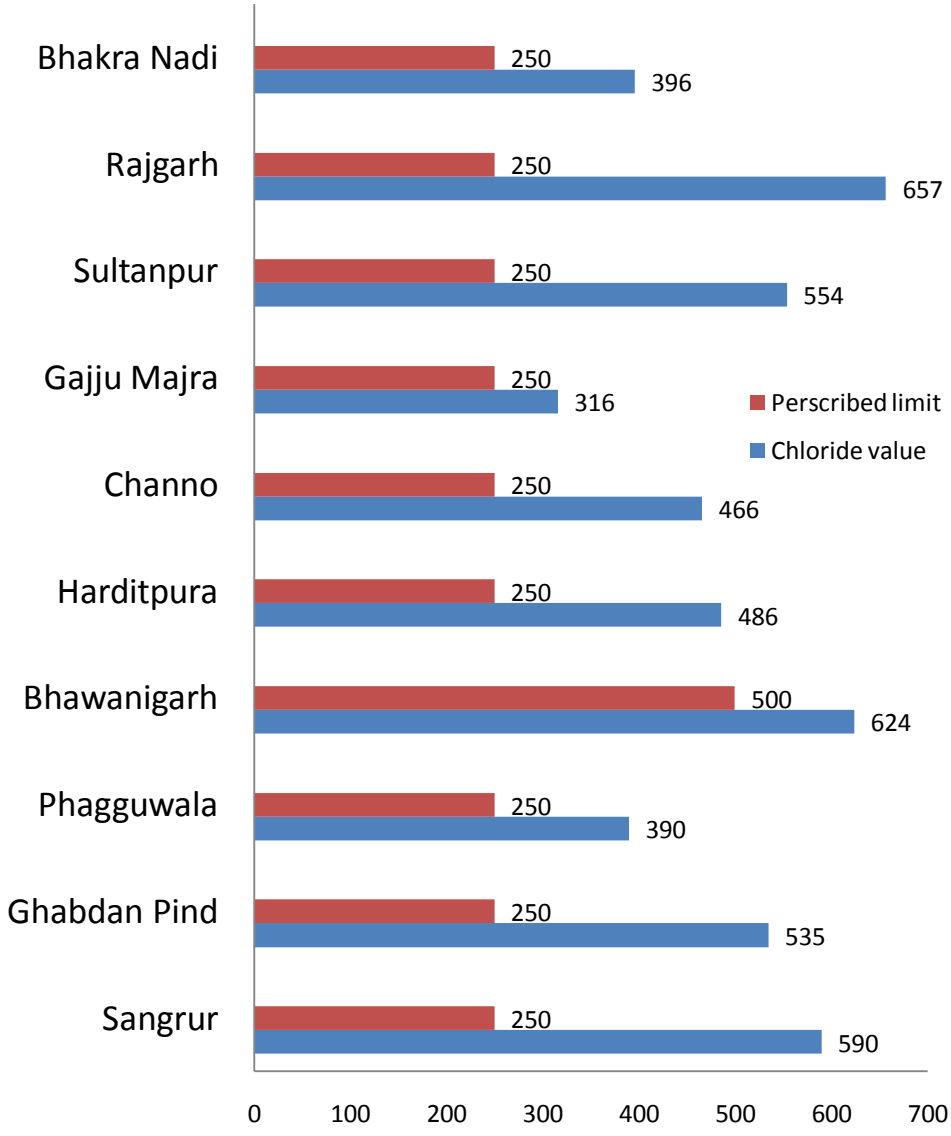


Fig. 6.3: TDS values of different locations

4) Chloride Content: The values of chloride content of the samples which is collected from the different locations was in within prescribed limit i.e. less than 250mg/l and it is represented in fig,6.4.

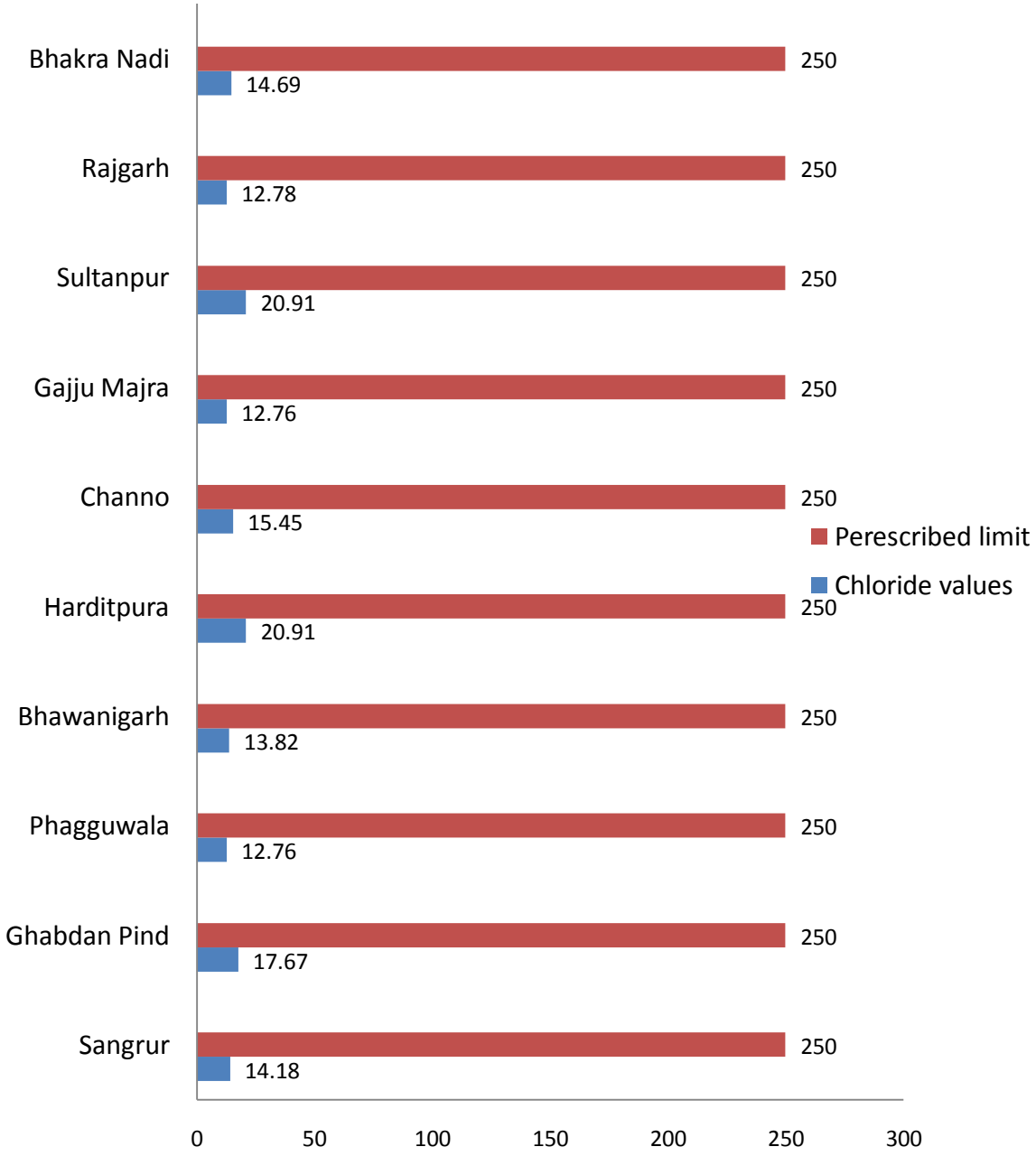


Fig. 6.4: Chloride content values of different locations

5) Conductivity: All the samples of ground water with in permissible limit of conductivity which is set for drinking water and it is represent in fig. 6.5.

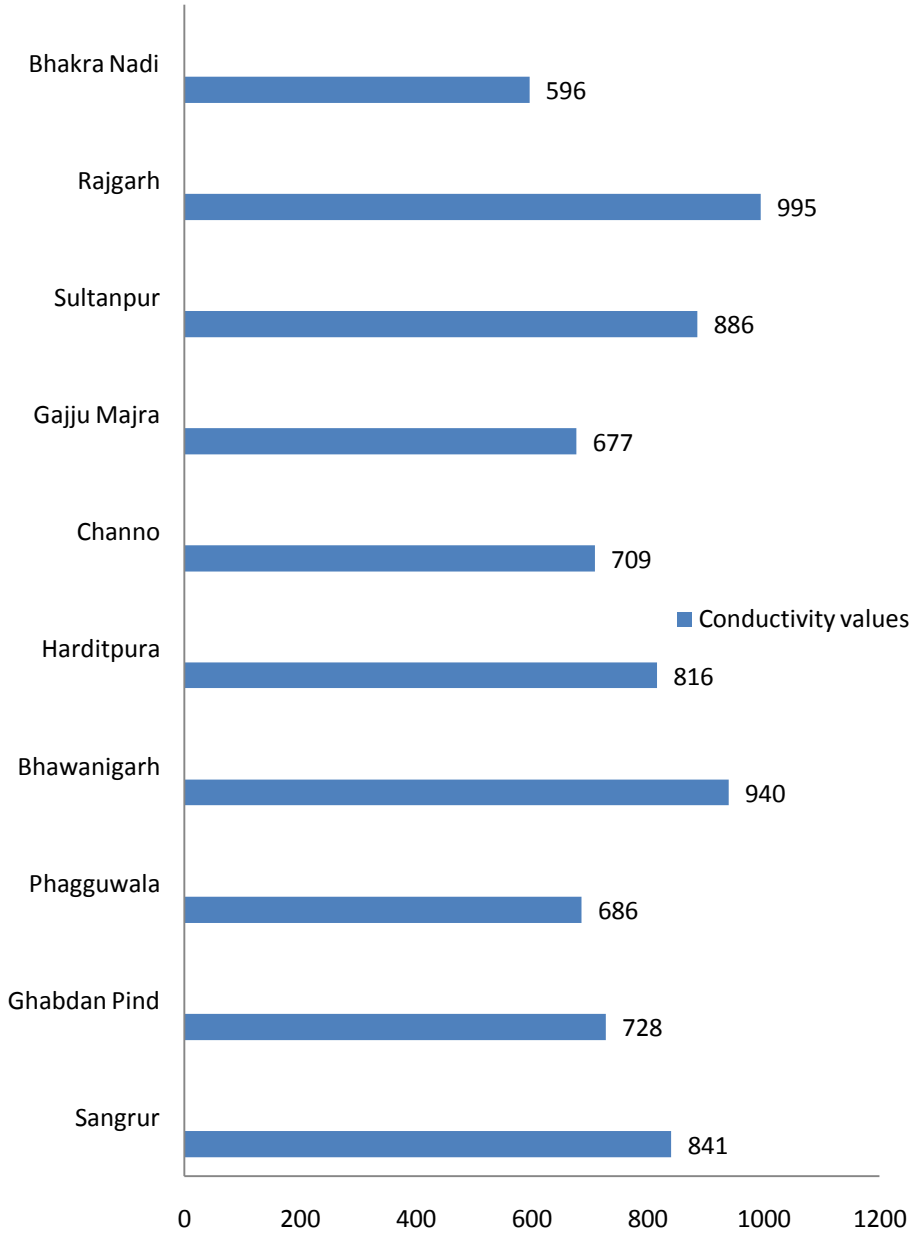


Fig. 6.5: Conductivity values of different locations

6.2- Air:

Nitrogen Dioxide (NO_2): The Nitrogen content at all the locations were found to be in the prescribed limit i.e. 80µg/m^3 (24 hour average) and it is represent in fig.6.6.

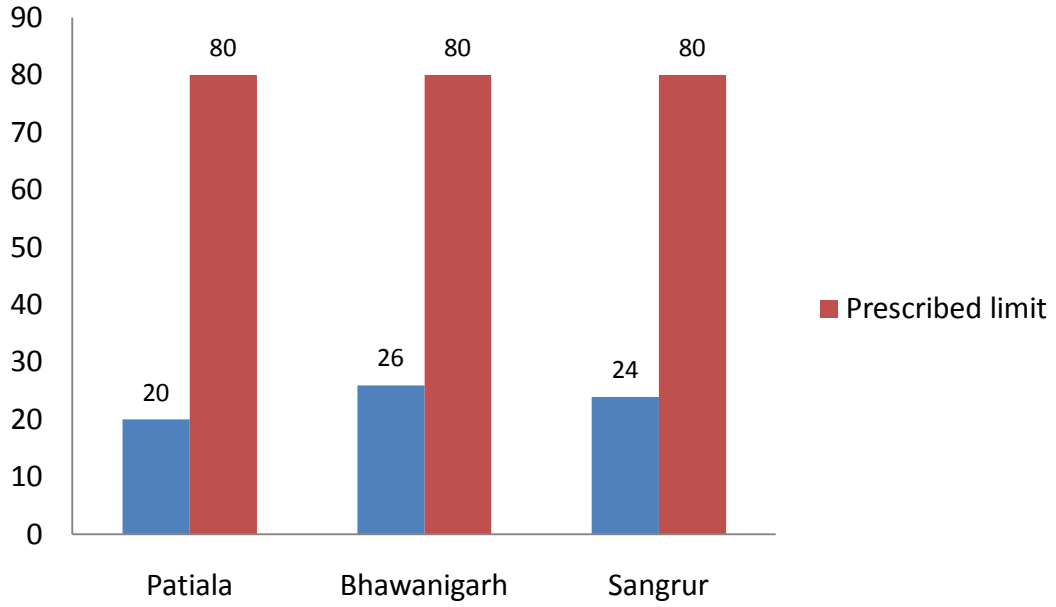


Fig. 6.6: NO_2 content measured at different locations

Sulphur Dioxide (SO_2): The Sulphurdioxide in the ambient air was found to be within prescribed limit at all locations i.e. 80µg/$m^3$and it is represent in fig.6.7.

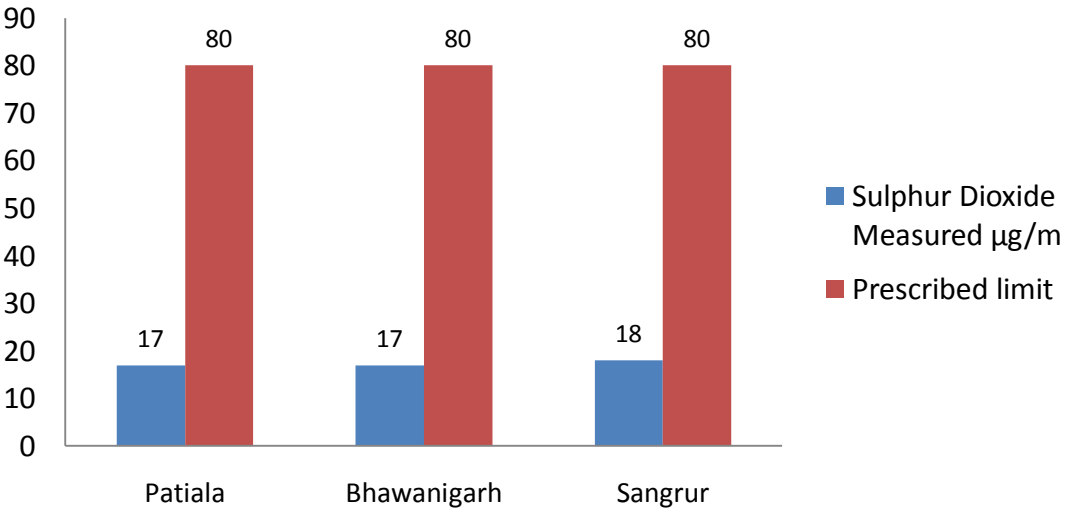


Fig. 6.7:Sulphur dioxide measured at all locations

Suspended Particulate Matter (SPM): Suspended particulatematter measured at different locations at all locations it slightly exceeded the prescribed limit i.e. 100µg/m^3 and it is represent in fig 6.8.

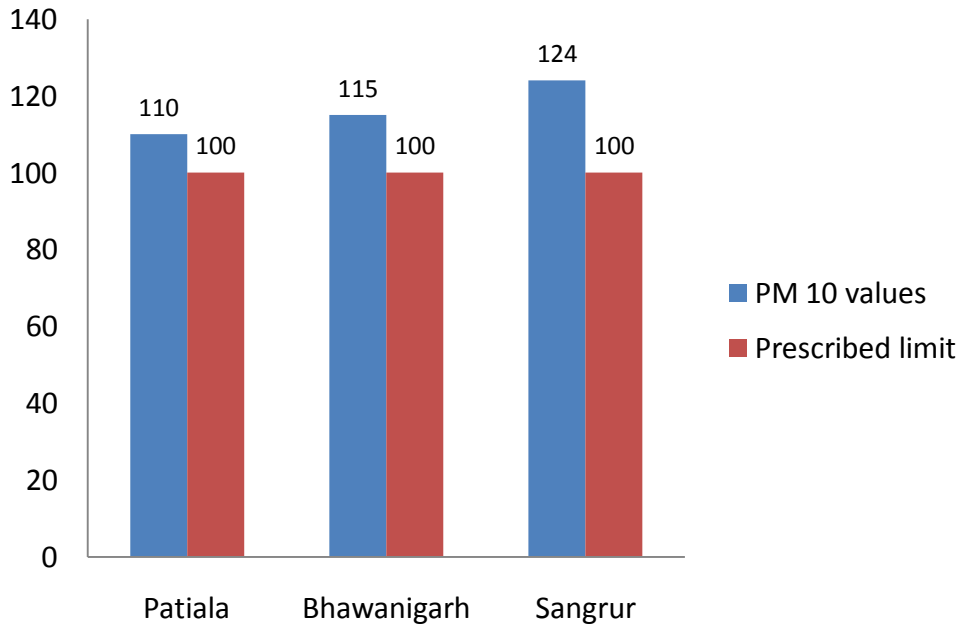


Fig. 6.8: PM 10 values at different locations

Respirable Particulate Matter(RPM) $PM_{2.5}$: Respirable particulate matter (size less than 10 microns) in the ambient air quality at all the locations were found in the prescribed limit i.e. 60µg/m^3(24 hour average).

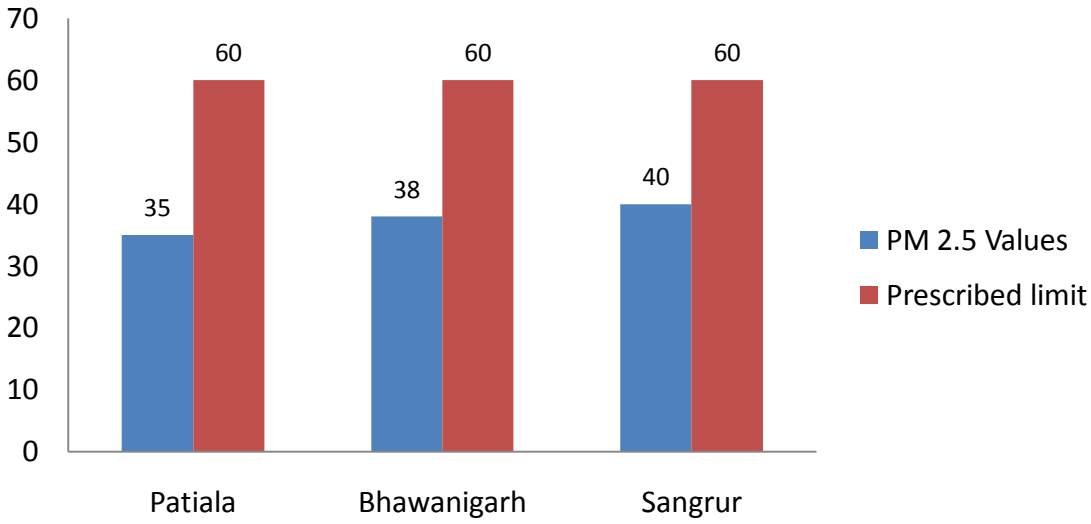


Fig. 6.9: $PM_{2.5}$ values at different locations

6.3 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 exceeded the prescribed limit and it is represented in fig.6.9.

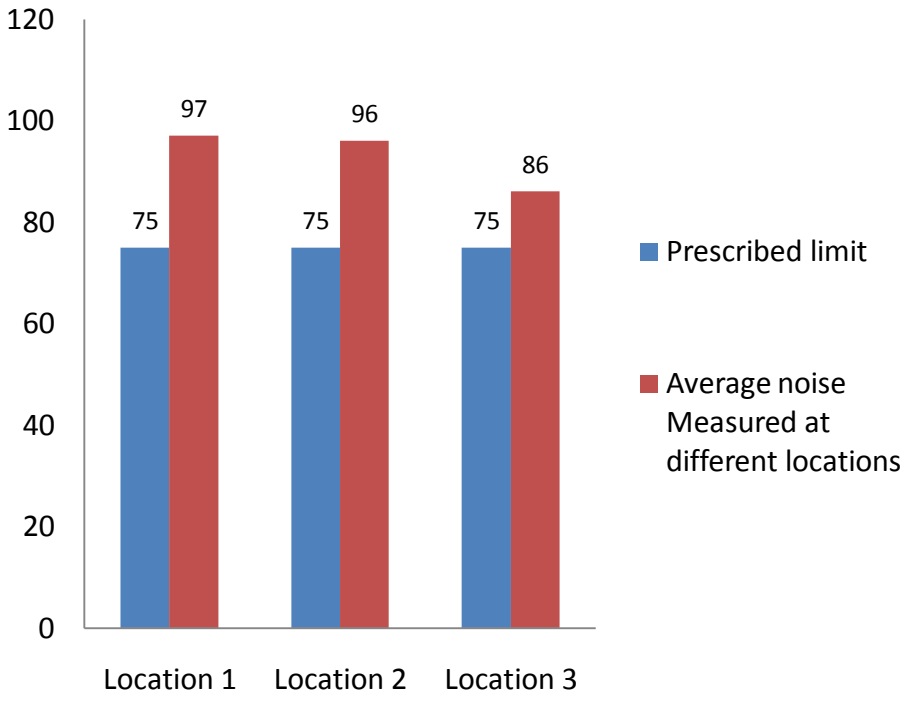


Fig. 6.10: Values of Noise level at different locations

6.4-Soil:

Various parameters of soil were tested like texture, permeability, Porosity. The results obtained were as follows.

- The permeability of all the soils samples was found complying with their texture.
- The porosity of all the soil samples was found complying with their texture
- From the analysis of soil there is no significant contamination with respect to the soil. Due to construction machinery used for road works there is a chance of contamination during construction years.

6.5 Traffic Data Analysis:

6.5.1 Location 1

Location one was selected on the Patiala- Sangrur highway. According to the analysis of the traffic volume on location 1 during peak hours is in both directions is 7461 vehicles equivalent to 8970 PCU's (morning) & 9175 vehicles equivalent to 10792 PCU's (evening). After observation of peak hours out of total volume the maximum volume composed of cars i.e. 53% in the morning peak hours and 57% in the evening peak hours. Two wheelers contributes most to the traffic volume with 24.5% during peak hours, 27.4% during peak hours in the evening .Heavy vehicles like buses and trucks, buses contributes to the traffic volume 7.3% in the morning peak hours, and 5.8% in the evening peak hours, and trucks contributes 6.6% in the morning peak hours and 8% in the evening peak hours. Tractor contributes least to the traffic volume and was observed less than 3% total traffic volumeand it is represent in fig.6.10 and as well as fig.6.11 shows the

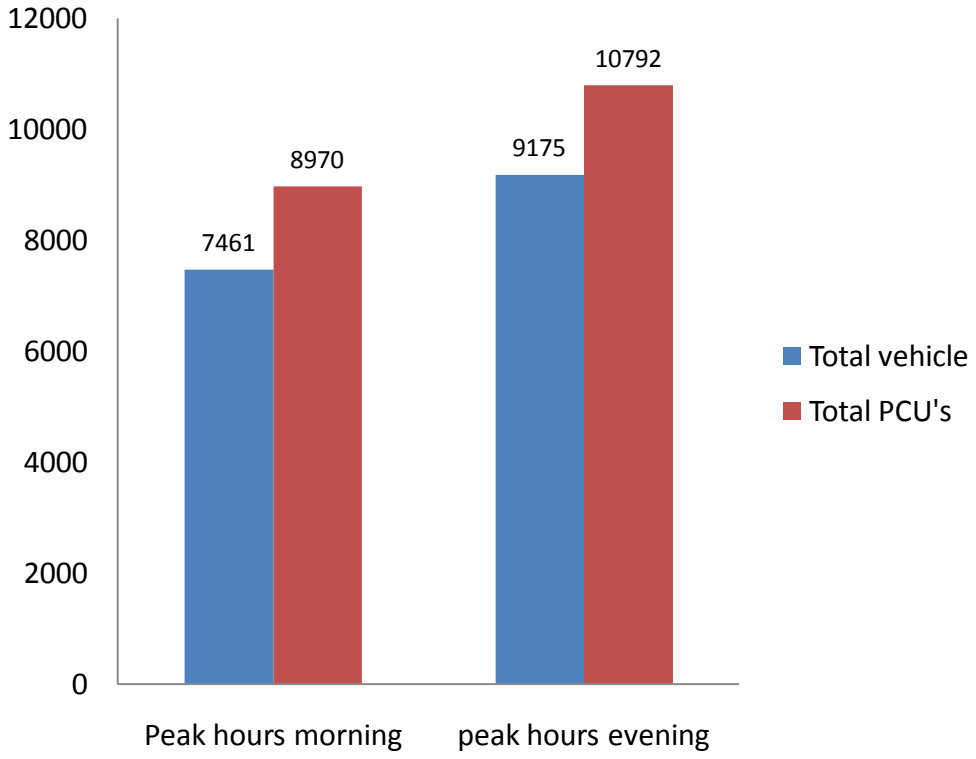


Fig .6.11: Traffic Analysis at location 1

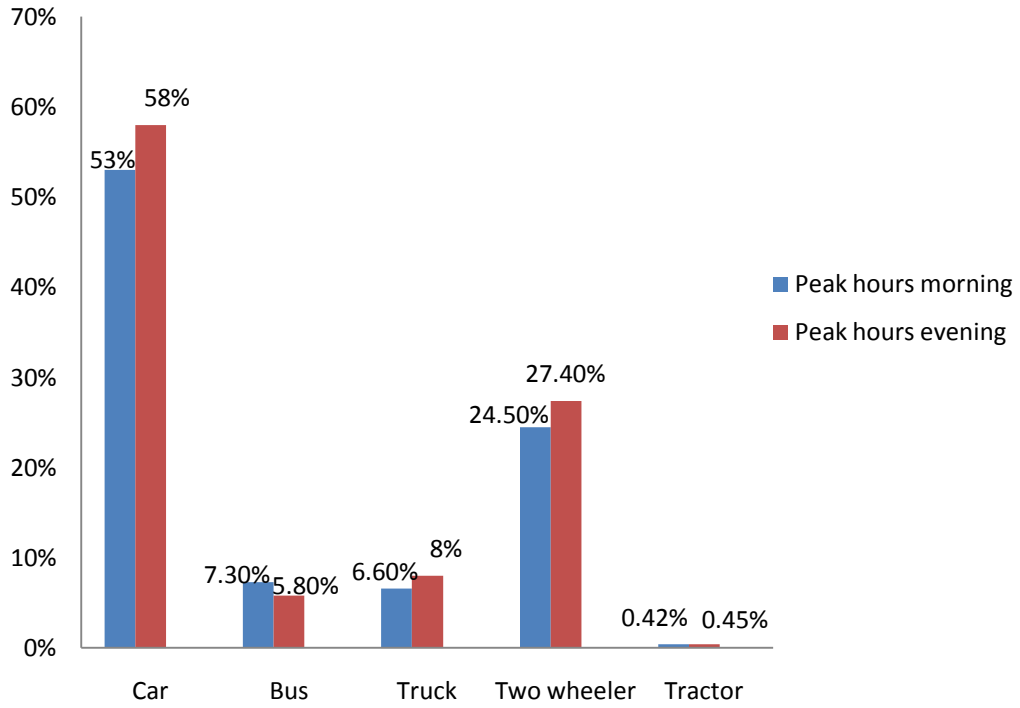


Fig. 6.12: Traffic Composition at Location 1

6.5.2 Location 2:

Bhawanigarh was selected as location 2. According to the analysis of the traffic volume on location 2 during peak hours is in both directions is 7508 vehicles equivalent to 9074 PCU's (morning) & 8315 vehicles equivalent to 9697 PCU's (evening). After observation of peak hours out of total volume the maximum volume composed of cars i.e. 43.34% in the morning peak hours and 36.3% in the evening peak hours. Two wheelers contributes most to the traffic volume with 29.65% during peak hours, 33.85% during peak hours in the evening .Heavy vehicles like buses and trucks, buses contributes to the traffic volume 6.2% in the morning peak hours, and 5.7% in the evening peak hours, and trucks contributes 8.4% in the morning peak hours and 8.6% in the evening peak hours. Tractor contributes least to the traffic volume and was observed less than 4% total traffic volume and it is represent in fig.6.12.

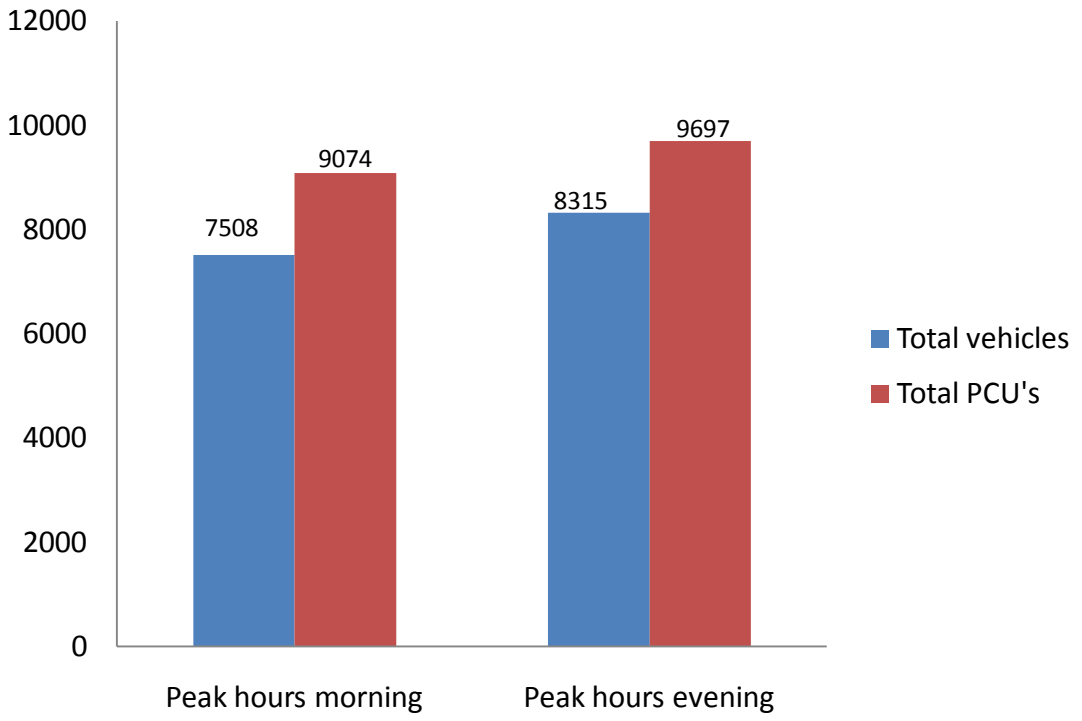


Fig. 6.13: Traffic Analysis at Location 2

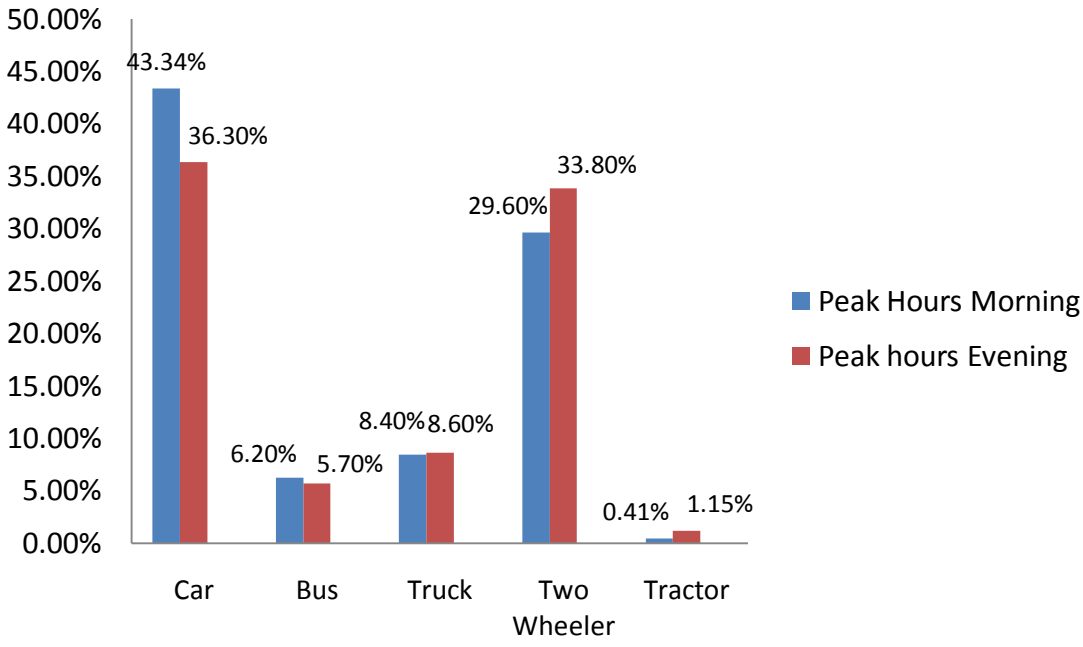


Fig. 6.14*:* Traffic composition at location 2

6.5.3Location 3:

Sangrur bye-pass was selected as location 3. According to the analysis of the traffic volume on location 3 during peak hours is in both directions is 9292 vehicles equivalent to 10563 PCU's (morning) & 9258 vehicles equivalent to 10779 PCU's (evening). After observation of peak hours out of total volume the maximum volume composed of cars i.e. 39.9% in the morning peak hours and 43.8% in the evening peak hours. Two wheelers contributes most to the traffic volume with 38.1% during peak hours, 32.8% during peak hours in the evening .Heavy vehicles like buses and trucks, buses contributes to the traffic volume 4.9% in the morning peak hours, and 5.0% in the evening peak hours, and trucks contributes 9.6% in the morning peak hours and 9% in the evening peak hours. Tractor contributes least to the traffic volume and was observed less than 3% total traffic volume and it is represent in fig.6.13.

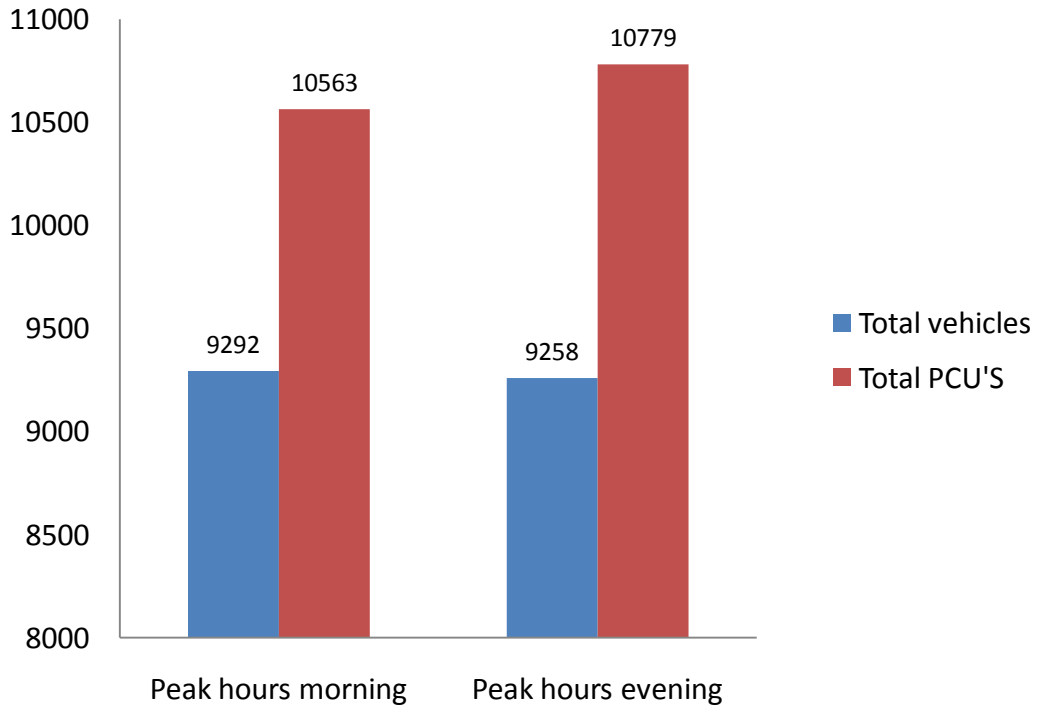


Fig .6.15: Traffic Analysis at location 3

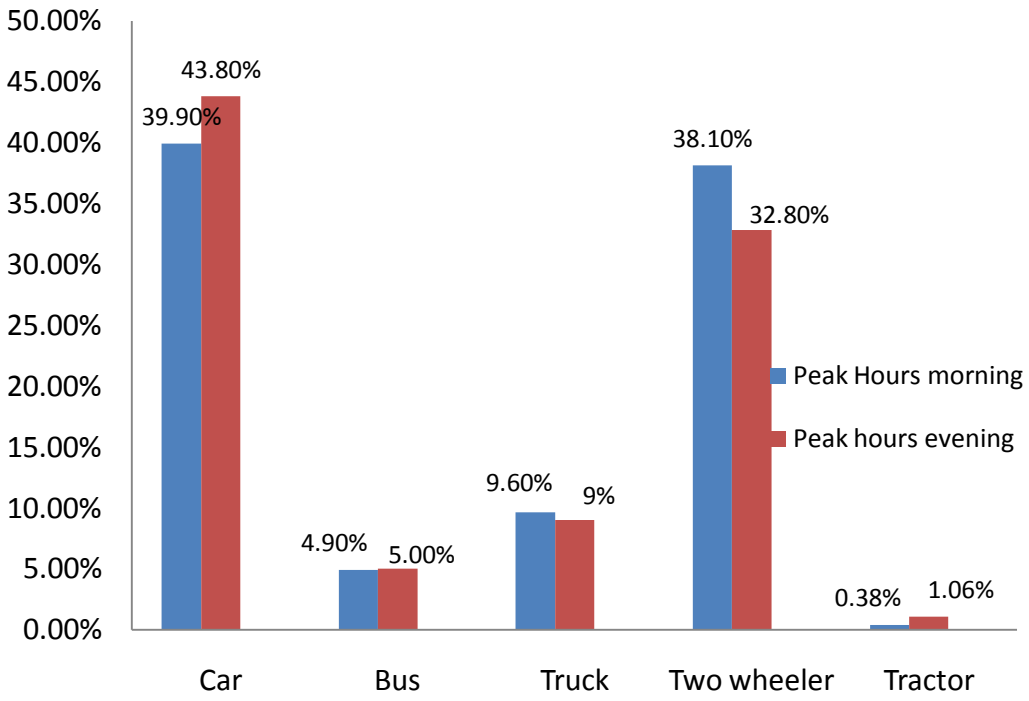


Fig. 6.16: Traffic composition at location 3

6.5.2 Inferences Drawn From the Data Collected

- Car density in both of the locations 1& 2 is more it is (more than 40% at both the occasions) followed by two wheelers. Density of two wheelers is most at location 3 it is more than from both the locations.
- Traffic density at location 3 was not much more due it is bypass location most of the traffic diverted towards Sangrur.
- Talking in terms of PCUs, the PCUs on location 1 in both peak hours and exceeded the PCU capacity per hour value for a two lane (14.0 m) highway (i.e. 1200 PCUs / hr for road with frontage access, no standing vehicle and high capacity intersections). In location 3 the PCU value exceeded the standard value in both peak hours.
- According to IRC-SP-84 capacity of highway measured. According to data the present two lane highway is insufficient to handle the current traffic volume. Since It's Plain terrain and acc to IRC-SP-84, this section will require four lane immediately to capacity more traffic.
- 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.
- PCU capacity for a four lane (14.0m) one way highwaywith front age access, 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.

6.6Public Consultation:

During a Consultation Programme a questionnaire was prepared regarding present & future state of highway. The information is present below.

1.) 62% people are unsatisfied with the drainage system of rain water along the road side, 47% people said that there is no proper rain water drainage on and along the road side.
2.) Traffic congestion emerged as a big concern as 73% 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.76% people are affected on the highway due to the noise level of the traffic in day time as well as night time.
3.) 36% people said that due to smoke of vehicles it causes asthma and many health diseases. 55% people said there is as such no problem.9% people said they have not experienced any health and psychological problem due to pollution.
4.) Only 15% people believed that their business will affects from the construction of highway 58% people can't say anything about that and 26% people said it may be or may not be.
5.) 51% people satisfied from the present condition of the highway.

6.7 Ecological Resources:

From the forest department the data was collected and the information about flora and fauna of the project area was provided.

1. From the observation of data the miscellaneous trees is the dominating species accounting for 51.2% of the total tree population followed by Eucalyptus (32.5%),Shisham (7.4%),Kikar (7.2%), and Mulberry (1.45%) and it is represent in fig.6.16.

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 number of trees uprooted.

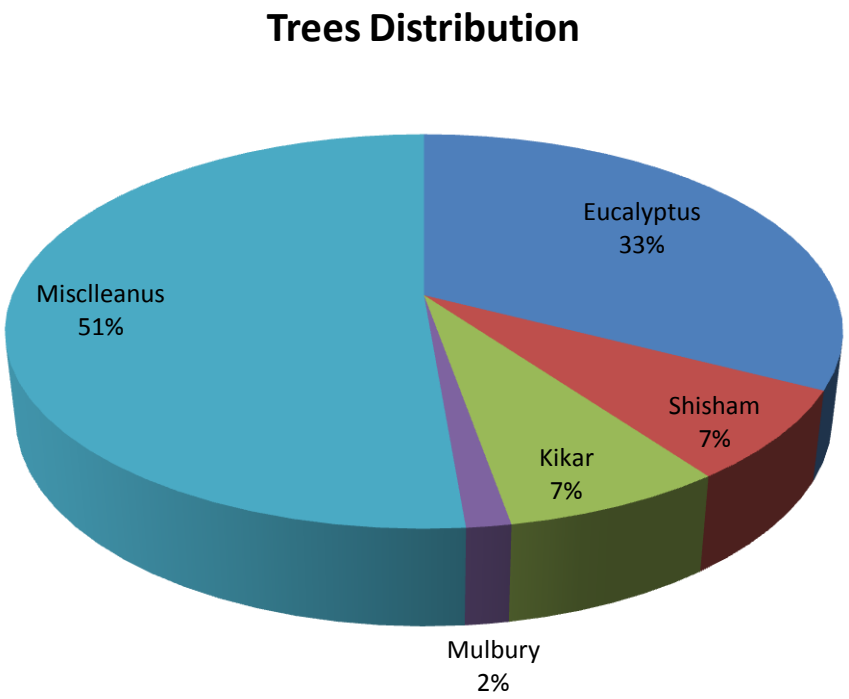


Fig. 6.17: Trees distribution pattern along the project area

Chapter 7

ANALYSIS OF PAVEMENT DRAINAGE

7.1 General

Adequate drainage is essential in the design of highways since it affects the highway's serviceability and usable life, including the pavement's structural strength. If ponding of water occurs nearby area of the highway, drainage is necessary in order to increase the life span as well as the safety. Drainage design providing facilities that collect, transport and remove storm waterfrom the highway. The design mustconsider the area from where the storm water comes and accumulate around the roadway embankment through natural stream flow.

A storm drain is the portion of the highway drainage system that receives surface water through inlets and conveys the water through conduits to an outfall. This chapter deals with drainage, procedures and guidance to be followed in achieving cost-effective design of Nh-64.

7.2 Need of Drainage

Drainage is required for increasing the strength of pavement or to prevent the deterioration of highway due to seepage of accumulated water. It is also necessary to provide the drain along the road where water logging problems are there. To avoid the water logging in low lying areas as well as the discharge of the heavy rainfall water from the road side, the drainage along the highway is necessary.

7.3 Necessity of drainage along the highway NH 64:

Due to lack of proper drainage arrangements water is getting accumulated on pavement especially in built up areas. Drainage problem areas along the project road are presented in table and fig shows poor drainage condition.

Table 7.1: Drainage problem areas along the project road

S.No.	From (km)	To(km)	Length(km)
1	91.00	94.00	2
2	95	96	1
3	97	99	2

Fig.7.1: Poor drainage condition at Chainage 91(No longitudinal drain)

Fig shows that there is a drainage problem atchainage91 and 97 due to which water logging is occurred on the highway because of heavy rainfall in this area. This shows that it is highly necessary to drain the accumulated water along the highways otherwise the condition of the road will deteriorate and life span of the highway will decrease.

7.4 Methodology:

The present study considers only the disposal of storm water. So thestorm water is not mixed with the sewerage discharge and it carries separately only storm water in the drains and disposed into the existing water bodies.

For designing the highway storm water drainage system following procedures are adopted:

- Collection of maps of the area, and the identification of the position of the existing various link drains, major drains and sources of disposal from the map.
- Collection of rainfall data from the Indian Metrological Department. Data was collected (2008-2010) from that data we found that maximum intensity rainfall in the month of June.
- Find the reduced level of the highway NH-64 and its surrounding area from the Google earth and identifying the area from where the storm water will flow towards the highway due to gravity and accumulates around the road surface.
- Calculate the area which contributes the storm water for drainage from the Google earth.
- Determine the quantity of water which is collected from the road side comes from the far away.

Fig 7.2: Shows the Study Area

7.4.1 Rainfall

The precipitation in the area occurs mainly due to south west and north east monsoon. However most of the precipitation is received through south westerly monsoon. A little but significant from agriculture point of view, rainfall occurs during the winter season due to North westerly monsoon. About 75% of the rainfall occurs during last week of June to mid September, July and August are the wettest months. The rest of the rainfall (25%) occurs during non monsoon period. Table presents the rainfall in the project district.

HYDROMET DIVISION
INDIA METEOROLOGICAL DEPARTMENT
DISTRICT RAINFALL (MM.) FOR LAST FIVE YEARS

District : PATIALA

Note : (1) The District Rainfall(mm.)(R/F) shown below are the arithmatic averages of Rainfall of Stations under the District.
(2) % Dep. are the Departures of rainfall from the long period averages of rainfall for the District.
(3) Blank Spaces show non-availability of Data.

YEAR	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.	R/F	%DEP.
2008	14.9	-48	2.8	-90	0.0	-100	19.5	95	176.8	922	481.1	944	101.8	-49	255.5	35	255.6	123	10.6	-44	1.7	-56	0.1	-99
2009	9.3	-67	10.1	-63	23.0	13	38.7	287	9.7	-44	14.3	-69	125.9	-36	118.0	-37	163.3	43	3.8	-80	0.4	-90	0.0	-100
2010	4.9	-83	6.2	-77	0.0	-100	0.4	-96	1.3	-92	120.0	160	363.0	83	75.8	-60	188.8	65	7.2	-62	0.0	-100	30.4	111
2011	5.1	-81	21.3	-14	7.7	-63	4.1	-56	10.4	-32	197.2	259	147.3	-38	142.5	-32	138.9	20	0.0	-100	0.0	-100	5.4	-63
2012	10.4	-61	0.1	-100	0.3	-99	17.9	92	3.7	-76	18.3	-67	127.4	-46	110.2	-47	74.1	-36	0.5	-98	0.9	-79	7.8	-46

7.4.2 Design Criteria

Table 7.2: Details of the drainage section

S.No.	Chainage	Details of drainage section	outfall
1	62-70	W = 1.96 m B=0.7m S=1 in 2300	Bhawanigarh Distributary (89.750)
2	70-80	W=0.65m B=1.44m S=1 in 2300	
3	80-89	W=0.75m B=2.25m S=1 in 2300	
4	91-98	W=0.78m B=2.43 S=1in 2300	Sirhind drain (100.00)

5	100-105	W=0.85 B=2.89 S=1IN 2300	SANGRUR DRAIN (105.00)

Following are the formulas adopt in designing of storm water drain.

$Y=0.5B^{1/2}$

$A=(B+Y)Y$

$Q=1/n\ A\ R^{2/3}\ S^{1/2}$

$P=(b+2\sqrt{2})y$

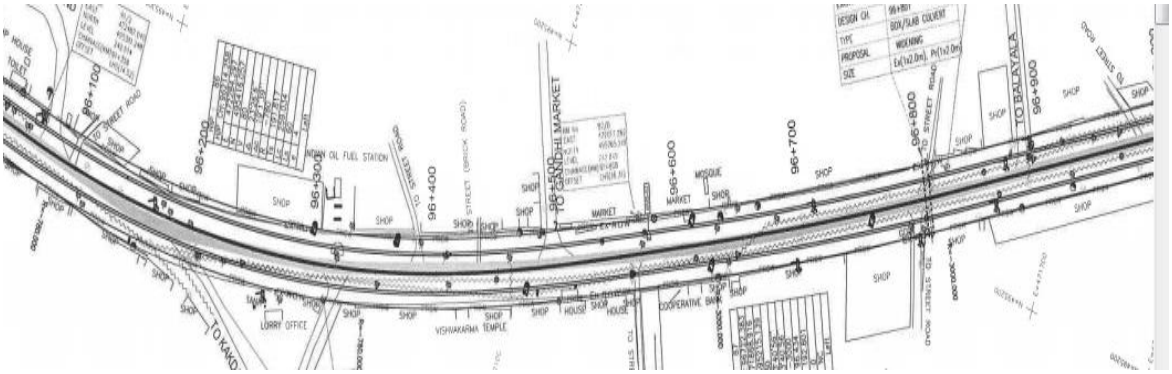


Fig.7.3: Cross section of the project

CHAPTER 8

MITIGATION & CONCLUSIONS

8.1 Mitigation Measures

As far as possible avoidance and reduction of adverse impacts approaches were adopted. For each impact, mitigation measure should be documented and its cost assessed. It is necessary that cost of the mitigation measure should be minimum and be fully documented. It is very important for selected alternative. Mitigation is the important part of the EIA report. It prevents the impacts of the project which is happen during the work. All identified impact will be either suitably mitigated or compensated ,so that the development will become eco friendly.

There are three stages in which impact assessment and mitigation measure are divided

- Design stage
- Construction stage
- Operational stage

In these stages some impacts are temporary some are permanent, and the some are continuous in nature. To identify these impacts we used impact identification matrix.

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.

Table 8.1: Mitigation measures during design phase

IMPACTS	MITIGATION MEASURES
Increased Traffic density	Highway passes through various important institutes like RayatBahra Group of institutions ,Asra Group of Colleges so the provisions should be made for pedestrian crossing.
Land Acquisition	Alignment design should be such that it minimizes the land acquisition.
Soil Erosion	Site clearance and cutting of trees may set the process of soil erosion.
Water Bodies	Such impacts will be short term and largely mitigable through management measures.
Air Environment	To ensure that all precautions shall be taken to reduce the level of dust emissions from crushers, batching and asphalt plants and from transportation of other materials. All vehicles, equipment and machinery used for construction work shall be regularly maintained.
Noise Environment	All construction equipment,plants, machinery and vehicles will follow prescribed noise standards. At construction sites within 150m of human settlements, noisy construction shall be stopped between 10.00 PM and 6.00 AM.
Borrow pits	Borrow operation plant and machinery will strictly conform to Central Pollution Control Board (CPCB) .
Congestion in settlement areas	Provide service roads.

2) CONSTRUCTION STAGE:

During Construction phase of the highway projects maximum impacts are done. The Environmental component which is affected by the impacts with their mitigative measures is as follows with sub them are:

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

From Table 8.2 to 8.8 discuss the mitigation measures of all the impacts. If measures followed it can reduced the drastically impacts.

Table 8.2: Mitigation measures for land environment

IMPACTS	MITIGATION MEASURES
Soil Erosion	Proper drainage system should be maintained during construction stage.
Disposal of construction waste	Before starting the construction there is a location should be selected where the construction waste could dump. Follow the local environmental regulations.
Disposal of solid waste	A landfill site should be selected for dispose the solid waste of the construction workers.

Table 8.3: Mitigation measures for air & noise pollution.

IMPACTS	MITIGATION MEASURES
Generation of dust	Batching plants and asphalt plants all are located at a distance of 500 m away from the nearest human settlement. The hot mix plant will be fitted with dust extraction unit. To prevent dust generation water will be sprayed on earth works and compacted sub-grade. Special care should be taken near residential and commercial areas. Mask should be provided to the workers during construction. To prevent from dust causes diseases. It shall be ensured that the dust emissions from the vibrating screen and crusher at the stone quarries do not exceed the emission standards set by CPCB
Generation of Polluting Gases	All vehicles, equipment and machinery used for construction work shall be regularly maintained to ensure that the pollution emission levels conform to the CPCB norms. To ensure that efficiency of the mitigation measures suggested, air quality monitoring shall be carried out at least once a month at all these locations to check whether the emission levels are within the norms as by CPCB.

Noise Pollution	All construction equipment plants, machinery and vehicles will follow prescribed noise standards. All construction equipment used for an 8 hour shift shall conform to a standard of less than 90 dB. At construction sites within 150m of human settlements, noisy construction shall be stopped between 10.00 PM and 6.00 AM; Hot mix plant batching or aggregate plants shall not be located within 500 m of sensitive land use as schools, hospitals etc;

Table 8.4: Mitigation measures for water resources

IMPACTS	MITIGATION MEASURES
Loss of water resources	Filling of water bodies along the road alignment will be minimized by providing retaining walls
Use of Construction water	Minimum use of existing water sources for construction will be ensured to minimize likely impacts on other uses.
Increase in sediment load	Sediment traps will be provided to reduce sediment load in construction wastewater.
Water pollution	Proper sanitation facilities will be provided in construction camp to prevent health related problems. All the construction activities will be carried out during dry seasons only.

Table 8.5: Mitigation measures for Tree cut

IMPACTS	MITIGATION MEASURES
Tree Cutting	In stretches where water logging occurs, on both sides of the road, the selection of tree species should be from amongst the moisture loving trees, for example, Eucalyptus, etc. Some of the trees like Pipal, Jamun have very weak wood and break easily in a wind storm. Roads become blocked and traffic is stopped for a long time. Such trees are unsuitable for road side avenues should only be planted in outer rows. Where there is no trees along the road side more plantation should be there.
Forest Flora	Meditation tree should be prevent before cutting

Table. 8.6: Mitigation measures for fauna

IMPACTS	MITIGATION MEASURES
Indication of Wild animal	Field indicate presence of any wild animal on / near the project road except Monkey, Rabbit, Fox and neelgai. In vicinity of sanctuary area both sides of the project road shall be barricade by boundary walls with wire mesh to avoid direct road crossing of wild animals
Impacts on wild life	Suitable no of cross drainage structure cattle underpass shall be provided for easy movement of wildlife animals from one parts of the road to the other parts. Road safety signage like no pressure horn, slow drive, wild life area shall be displayed on the road. Dense vegetation shall be grown within the ROW of bypasses to reduce noise intensity.

Table 8.7: Mitigation measures for safety measures

IMPACTS	MITIGATION MEASURES
Information to public	During the process of construction appropriate route diversion signage and management of traffic detours should be implemented.
Health for labours	First aid boxes with first aid leaflets will be placed at all work places and at least four sets in the each construction camp. Safety glasses for protection of eyes Face Shields and Masks for protection of face and nose Helmets and safety shoes for protection of head and feet
Increased in accidents due to traffic disruption	All required safety precautions and traffic management plans will be prepared and implemented during construction in accordance with the IRC:SP:55 should be followed. Sign of speed limit in the construction zone.

Table 8.8: Mitigation measures for construction camp

ISSUES	MITIGATION MEASURES
Location	These will be located at a distance of 1000 m away from any major settlement or village. These will never be located at a distance of less than 1000m from surface water sources.
Sanitation	Sanitation should be proper at construction camp with septic tank.
Fuel	LPG can be used as fuel
Water	Water facility should be proper at the site their should be no disturbance of local residential.
Working Hours	Plant and machinery operation should be restricted between the hours of 6am to 9 pm.
Restriction	There should be restriction on the movement of workers from the camps particularly during the hours of light.

3) OPERATIONAL PHASE

Different components of this stage that are impacted with their mitigative measures are given in the **Table 8.9**

Table 8.9: Operational phase mitigation measures

IMPACTS	MITIGATION MEASURES
Dust	Monthly monitoring shall be conducted at locations where earthworks or slope cutting operation shall be conducted.
Gaseous Pollution	To ensure the efficiency of the mitigation measures suggested, air quality monitoring shall be carried out at least once a month at all these locations to check as to whether the emission levels are within the norms.
Noise	Sign of horns should be posted at sensitive locations
Wild life	Their should be proper lightning on the forest area to prevent the accidents from the wild animals.
Safety	Adequate traffic safety measures e.g. crash barriers & pedestrian railings will be provided whenever required.
Flora & Fauna	Plantation along the ROW will be maintained properly and protected from illegal felling. Contingent actions will be taken in the event accidental spill of oil, fuel & toxic chemicals.

8.2 IMPACT MATRIX

Matrix methods identify interactions between various project actions and environmental parameters and components. They incorporate a list of project activities with a checklist of environmental components that might be affected by these activities. A matrix of potential interactions is produced by combining these two lists (placing one on the vertical axis and the other on the horizontal axis). One of the earliest matrix methods was developed by Leopold et al. (1971). In a Leopold matrix and its variants, the columns of the matrix correspond to project actions while the rows represent environmental conditions. The impact associated with the action columns and the environmental condition row is described in terms of its magnitude and significance. In the construction and operation stages of the project some activities will be undertaken which is associated with the project implicated to the environment. According to the activity scale of the impact will vary which can be illustrated in the matrix format. The criteria for awarding scores have been calculated as given in table 4.2. Analysis of project from the matrix method with or without the control measures represent in table 8.10 and 8.11.

Table 8.10: Project analysis without control measures

Environmental Components	Weightage	Acquisition of land	Removal of vegetation	Site clearing	Earth work and Exavation	Road surfacing activities	Transport of construction Material	Construction Operation	Operation of highway	Impact
Air Quality	90		-1	-1	-1	-2	-1	-2	-1	-810
Noise level	80			-1	-2		-1	-2	-1	-560
Water bodies and drainage	100		-1	-1	-2			-1	-1	-600
Ground water quality	60				-1		-1	-1		-180
Topography and soils	200	-1	-3		-1	-1				-1200
Flora & Fauna	75		-4	-2		-1		-1	1	-525
Aesthetics	100			2	-1		-1	-1	3	200
Protected areas	50			-1	-1				-1	-150
Human Health	45		1	1	-2		-1	-1	1	-45
Employment & Income	80	-1		2	2		1	3	1	480
Institutional Requirement	50		-2						3	50
Historic and Cultural Resources	50	-1	-1	-1			-1		1	-150
Community environment	20	-1	-1	-1				-1	-1	-100
	1000	TOTAL								-3590

Table 8.11: Project analysis with control measures

Environmental Components	Weightage	Acquisition land	Removal of vegetation	Site clearing	Earth work and Exavation	Road surfacing activities	Transport of construction Material	Construction Operation	Operation of highway	Impact
Air Quality	90			-1	-1			-1	-1	-360
Noise level	80			-1	-1		-1		1	-160
Water bodies and drainage	100		1	1						200
Ground water quality	60									0
Topography and soils	200		3							600
Flora & Fauna	75			-1				-1	-1	-225
Aesthetics	100			3	-1			-1	4	500
Protected areas	50									0
Human Health	45				-1		-1	-1	-1	-180
Employment & Income	80		2			2			3	560
Institutional Requirements	50								3	150
Historic and Cultural Resources	50				-1		-1		2	0
Community environment	20		1			-1				0
	1000	TOTAL								1085

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

8.3 Conclusions

- From the testing of water, ground water near the carriageway shows the high TDS value at some selected locations which is greater than the permissible values hence unfit for the drinking purposes.
- Results of SPM testing are exceeding the permissible limits & the values of SO2 , NO_2, & RSPM are below the limits.
- Noise values at the certain locations exceeded the permissible limits hence proper mitigation should be taken during the construction phase to keep the noise values under the permissible limits.
- There is no contamination with respect to soil, but there are many chances of occurrence of contamination during two years of construction.
- From the analysis of accidental data, it can be concluded that road safety is not up to the mark. Proper informatory signs, proper design of highways and road safety audit should be done to avoid the major accidents.
- Traffic congestion is a major problem along the highways.
- Pavement condition was very vulnerable proper drainage is required, at many places. During the survey, various pot holes and cracking were found on the selected stretch.
- From the analysis of traffic data it can be concluded that present two lane highway is insufficient to handle the current traffic volume. NH-64 is a plain terrain as per IRC-SP-84, this section will require four lane.

From the public consultation it can be concluded that highway condition is not too much good. For reducing the impacts as described above proper mitigation measures are taken. Some impacts are of short duration it can be reduced by appropriate mitigation measures. Operation phase are also less magnitude can be prevent from mitigation measures. On the basis of existing data evaluation and analysis of the potential impacts, total impacts have been calculated by the matrix method. It was found that total impact score for the section is negative i.e -3590 if we analyse the project without measures it shows that the project category comes in 'appreciable but reversible impacts control measures are needed " On the basis of mitigation measures has been

suggested and should be implemented construction and operation phase. Impact score with the mitigation measures becomes +ve 1085 it concludes that the proposed project will be environmental friendly.

REFERENCES

- Antunes P, Santos R, Jordao L (2001), The application of Geographical Information Systems to determine environmental impact significance, Environmental Impact Assessment Review 21, 511 – 535
- Chopra T., Aggrawal M. and Chowdhry P. (2011), Analyzing Strategic Issues Of Environmental Impact Assessment For Highway Projects With A Case Study Of Indian National Highway, Presented in ICPT, 2011
- Environmental Impact Assessment of Nairobi river basin Project, Kenya (2002), United Nations Environment Programme (UNEP).
- Environmental Impact Assessment report for four laning of NH-95 from Chandigarh to Ludhiana (2010), Submitted by Consulting Engineering Services Private Ltd.
- Feasibility study for two lanes with paved shoulders from Km 357/00 to Km 557/000 of NH-11: Consulting Engineers Group Pvt Ltd.
- Fernandes J. (2000), Landscape ecology and conservation management—Evaluation of alternatives in a highway EIA process, Environmental Impact Assessment Review 20, 665–680.
- Ground Water Information Booklet Patiala District, Punjab (2007).
- Guidelines for Ambient Air Quality Monitoring (2003), Central Pollution Control Board.
- Highway Runoff and Water Quality Impacts (2000), East-West Gateway Coordinating Council.
- Ijäs A., Markku T., Kuitunen and Jalava K. (2010), Developing the RIAM method (rapid impact assessment matrix) in the context of impact significance assessment, Environmental Impact Assessment Review, 30, 82–89.
- Indian Standard Specifications for Drinking Water (1991), IS: 10500.
- IRC: 86-1980, GeometriDesign Standards for Rural (Non- Urban) Highways, Indian Roads Congress, New Delhi.
- IRC: 86-1983, Geometric Design Standards for Urban Roads in Plains, Indian Roads Congress, New Delhi.
- IRC: 104-1988, Guidelines for Environmental Impact Assessment of Highway Projects, Indian Roads Congress, New Delhi
- Khanna S, Justo CEG (2009). Highway Engineering, Nem Chand & Bros. Publications 8th Edition.
- Khitoliya,R., Aggarwal,M., and Chopra,T.(2006). "Environmental Impact Assessment of Highway Projects-A case study of national highway-21"(16-17).

- Manual on norms and standards for environment clearance of large construction projects;
- Mathur R.P., Water and Waste Water Testing (2005), Laboratory Manual, Nem Chand & Bros Publications
- Ministry of Environment and Forests, Government of India.
- Paliwal, R. (2006), EIA practice in India and its evaluation using SWOT analysis, Environment Impact Assessment Review 26, 492- 510.
- Panigarhi,K., and Amirapu,S.(2012). "An assessment of EIA system in India" Department of Marine Science,Berhampur university,volume(35),(16).
- Prakash, S. (2002), Engineering Soil Testing, NemChand & Bros. Publications 4th Edition.
- Sharma.N.,Nair.P., and Gangopadhyay,S. (2005). "Environmental Impact Assessment of Road Project: Salient Features Under Revised Notification" Ministry of Environment And Forest, (15).
- Steineman, A. (2001), Improving alternatives for environmental impact assessment, Environmental Impact Assessment Review, 21, 3-21.
- Wilber Smith Associates (2008), Environmental Impact Assessment (EIA) Report for the proposed improvements to the NH-47.
- www.Imd.com

ANNEXURE I

Table 1:Key legislation of Environmental Impact

Issues	Environmental Related Measures
Environmental Clearance	The Environmental Impact Assessment (EIA) Notification, 1994 and its amendments Environmental Public Hearing Notification, 1997 National Environmental Tribunal Act, 1995
Forests	The Indian Forest Act, 1927 The Forest Conservation Act, 1980 as amended in 1988; and Rules 1981 National Forest Policy, 1988
Air	The Environmental Protection Act, 1986 The Indian Explosives Act,1908 The Industries (Development and Regulation) Act,1951 The Factories Act, 1948, amended in 1987
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
Wildlife	The wild Birds and Animals Protection Act, 1912 The Indian Arms Act, 1978
Land Acquisition	Land Acquisition Act, 1894 The Punjab Tenancy Act, 1887 The Punjab Village Common Lands (Regulations) Act, 1961
Environmental Emissions & Quality Standards	Applicable environmental standards as specified by CPCB and by Punjab. State Environmental Protection & Pollution Control Board. Environmental Statement (Audit) Notification, 1992

ANNEXURE II

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, theenvironmental 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, and 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).

ANNEXURE III

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 roadsideplantation 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

1) Forestry Clearance from the MOEF regional offices as the widening will require acquisition of forestland.
2) No objection Certificate (NOC) from the Punjab State Pollution Control Board.
3) State Forest Department clearance for felling of trees from the ROW.
4) Clearance from Ground water board for withdrawal of ground water for construction.

ANNEXURE V

Environmental Standards

1) **Ambient Air:**

Table.2:National Ambient Air Quality Standards

S.No.	Pollutant	Time Weighted Average	Industrial, Residential, Rural and other Area	Ecological Sensitive Area (notified by Central Govt.)	Methods of measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m^3	Annual 24 hours	50 80	20 80	-Improved West and Gaeke - Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2),µg/m^3	Annual 24 hours	40 80	30 80	-Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
3	Particulate Matter (size less than 10 µm)or PM10 µg/m^3	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 60	100 180	- UV photometric Chemilminescence- Chemical

					Method
6	Lead (Pb) µg/m3	Annual 24 hours	0.50 1	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 InfraRed (NDIR) spectroscopy
8	Ammonia (NH_3) µg/m^3	Annual 24 hours	100 400	100 400	Chemiluminescence - Indophenol blue Method
9	Benzene	Annual	05	05	-Gas chromatography
10	Arsenic (As), ng/m3	Annual	06	06	-AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
11	Nickel (Ni),ng/m^3	Annual	20	20	-AAS/ICP method after sampling on EPM 2000 or equilatent filter paper

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: Indian Standards for drinking water, IS: 10500-1991 and CPWD Specifications for Construction water.

Table.3 : Water quality standards for drinking water source:(IS : 10500: 1991)

Parameter	Drinking water (IS 10500: 1991)
Total hardness (mg/liter)	300
Total dissolved solids (mg/liter)	500
Chloride (mg/liter)	250
Colour	5
Turbidity (NTU)	5
Alkalinity (mg/l)	200
Calcium , mg/l	75
Boron (mg/liter)	1
Sulphates (mg/litre)	200
Nitrates (mg/liter)	45
Conductivity at 250c (us/cm)	-
pH	6.5-8.5
Fluorides	1

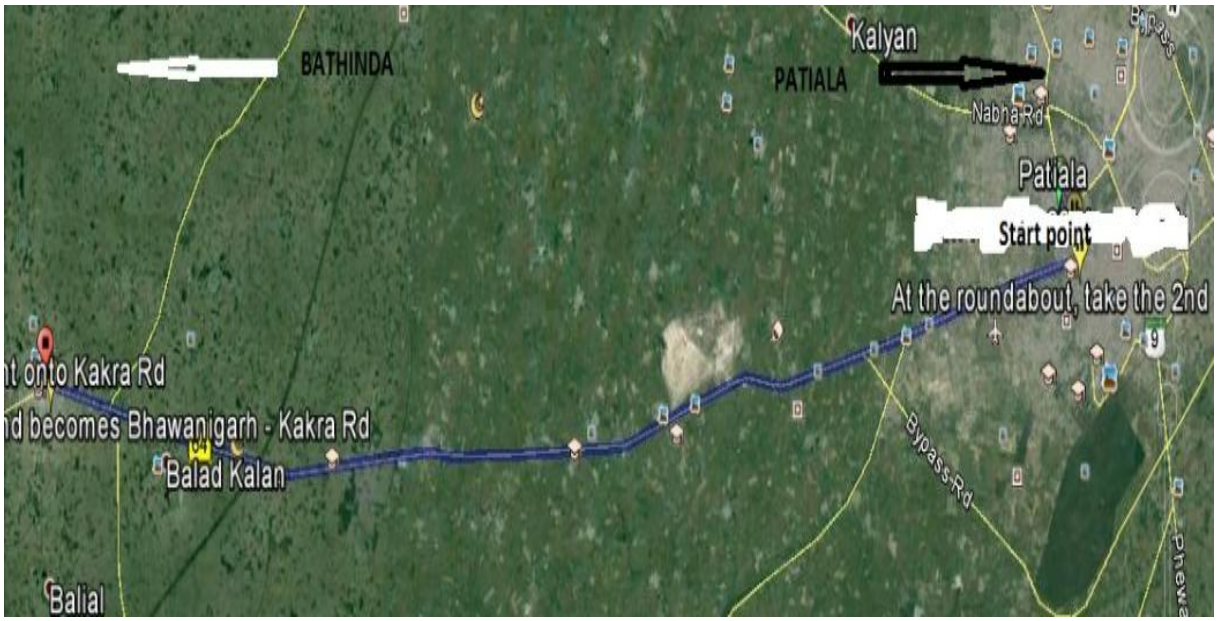
3- Noise Quality: Standards prescribed by Central pollution Control Board (CPCB) for industrial, Commercial, Residential and silence zones.

Table.4: Ambient Standards for Noise

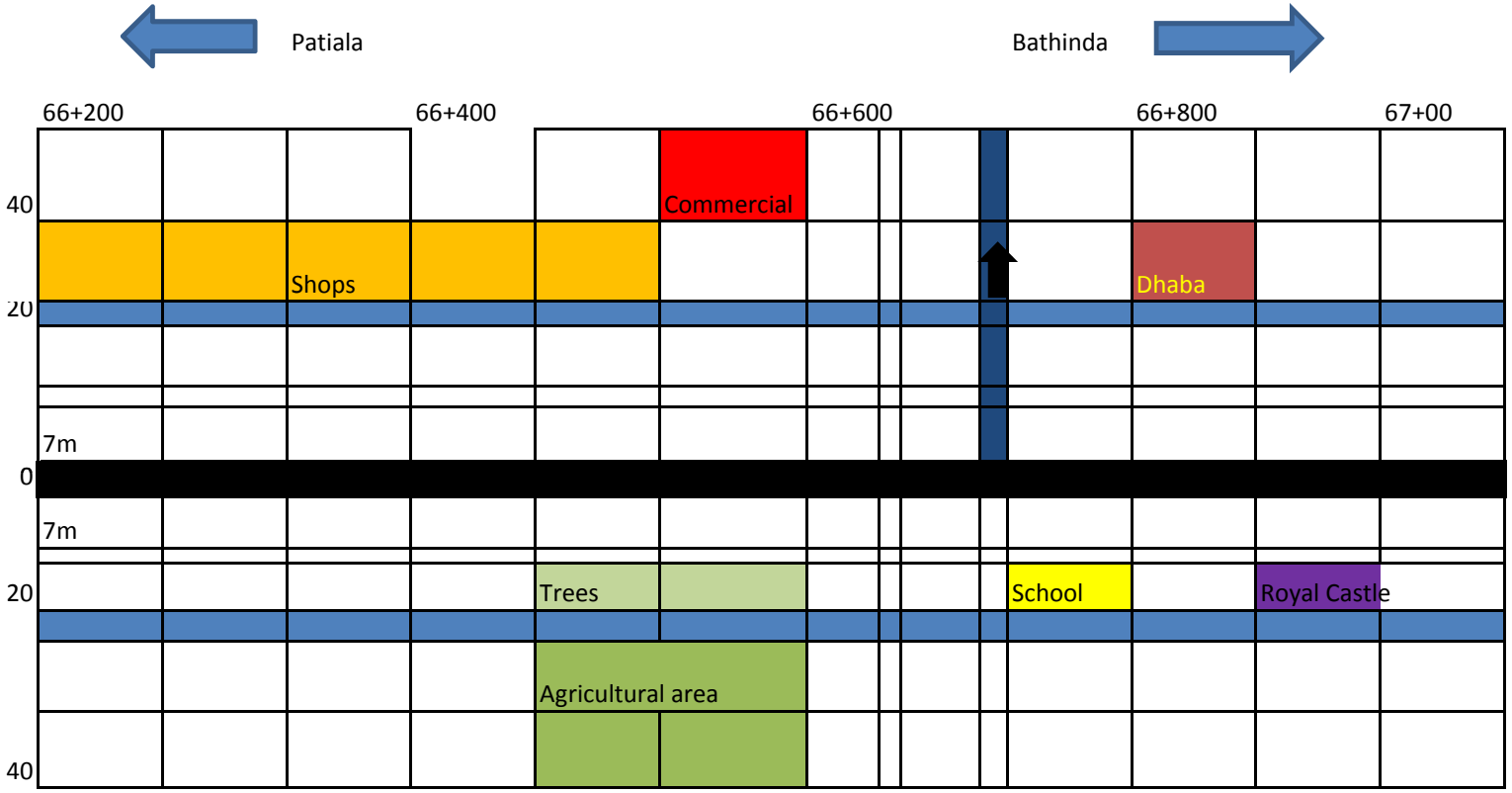
Area code	Area Category	Day time (dB)	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence zone	60	40

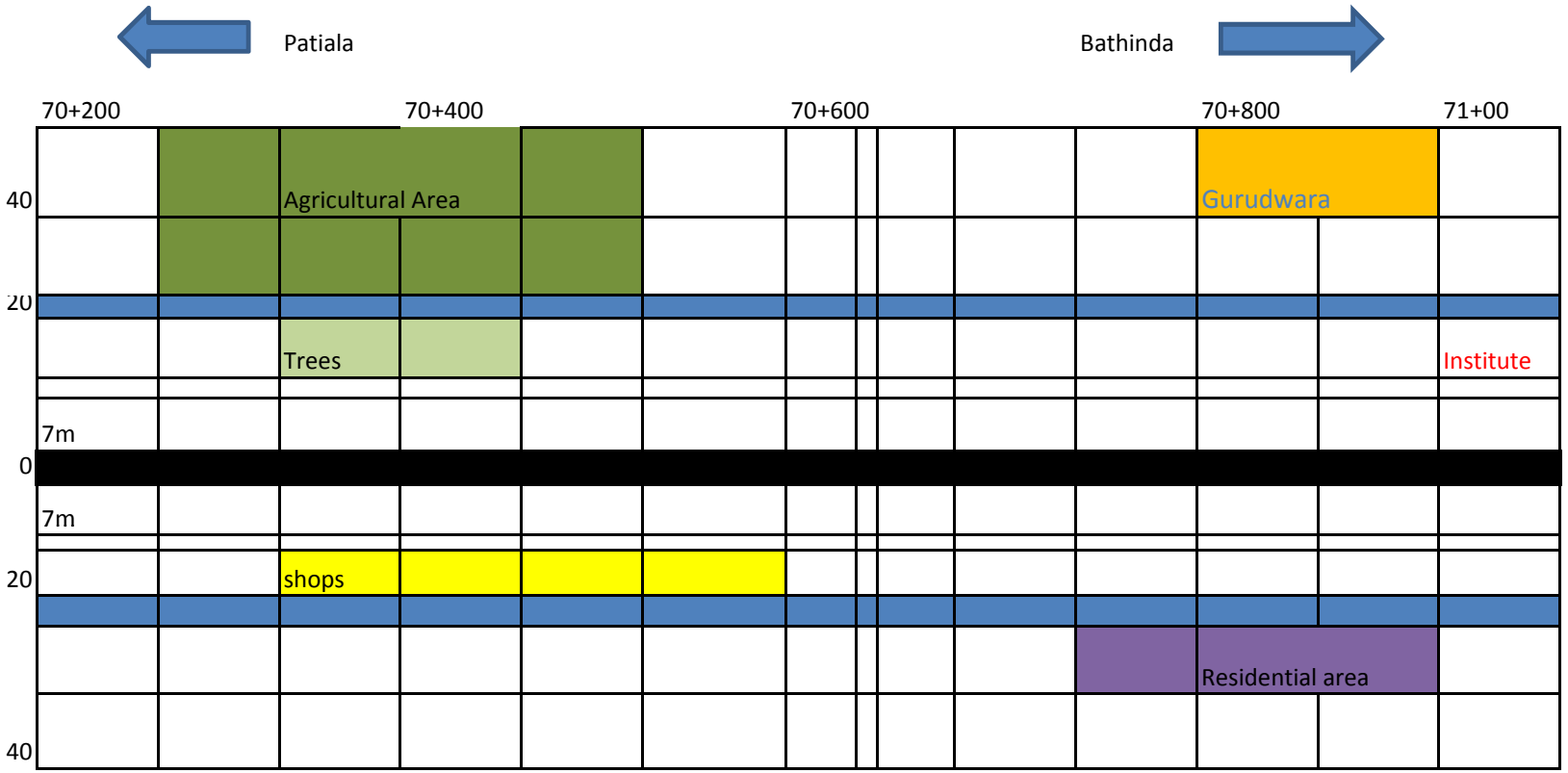
ANNEXURE VI

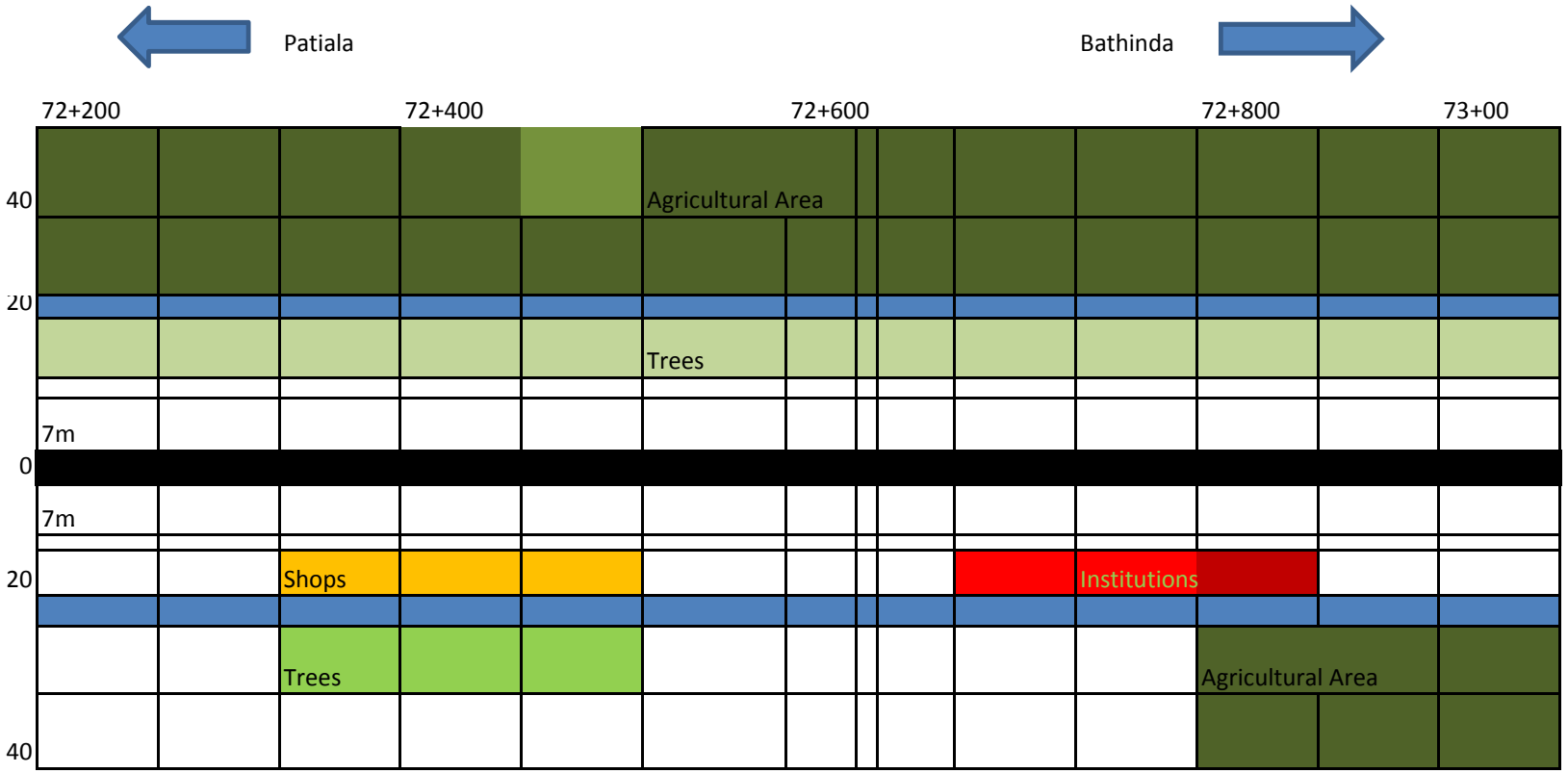
Alignment map from Patiala to Bhawanigarh

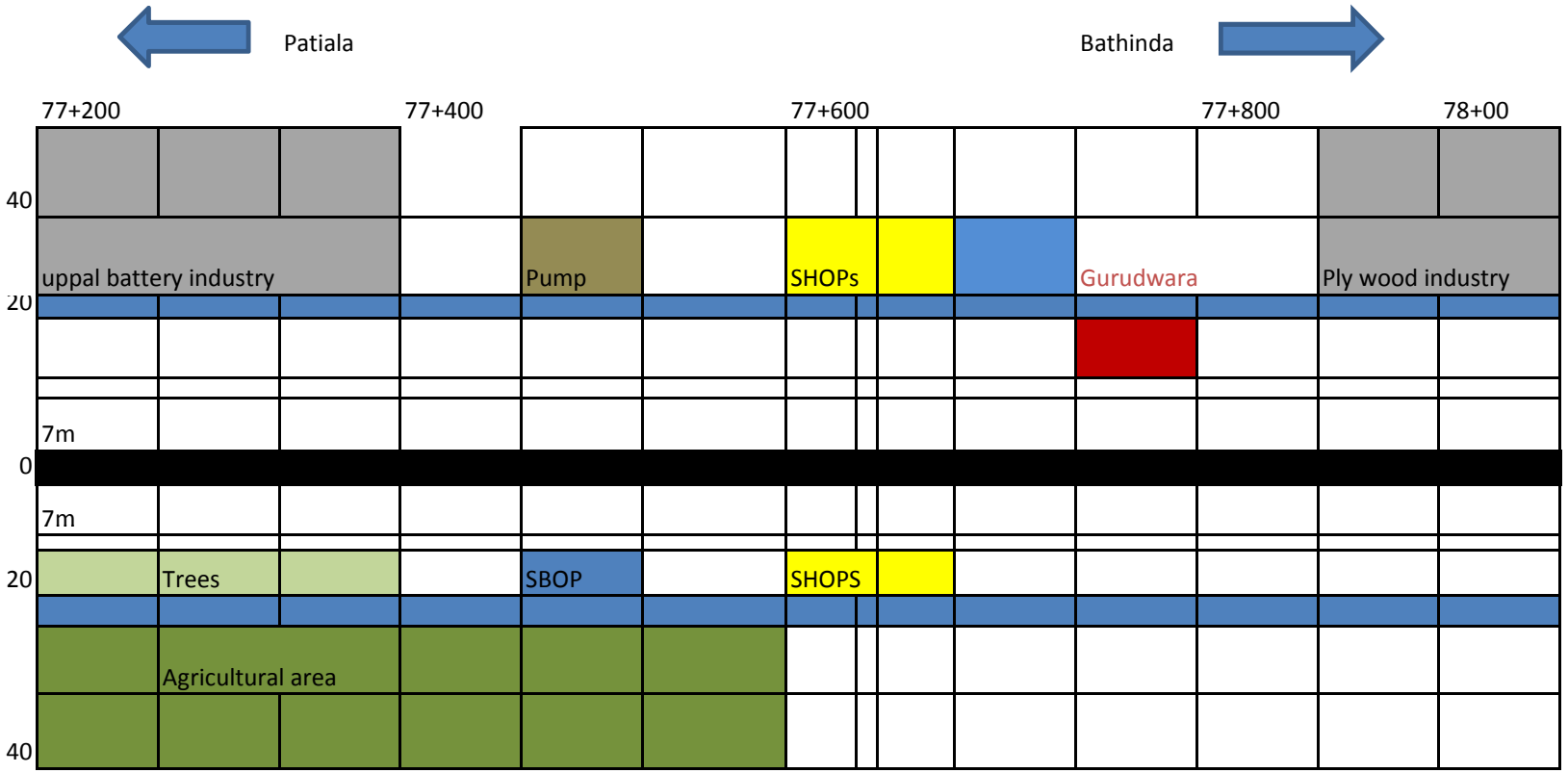


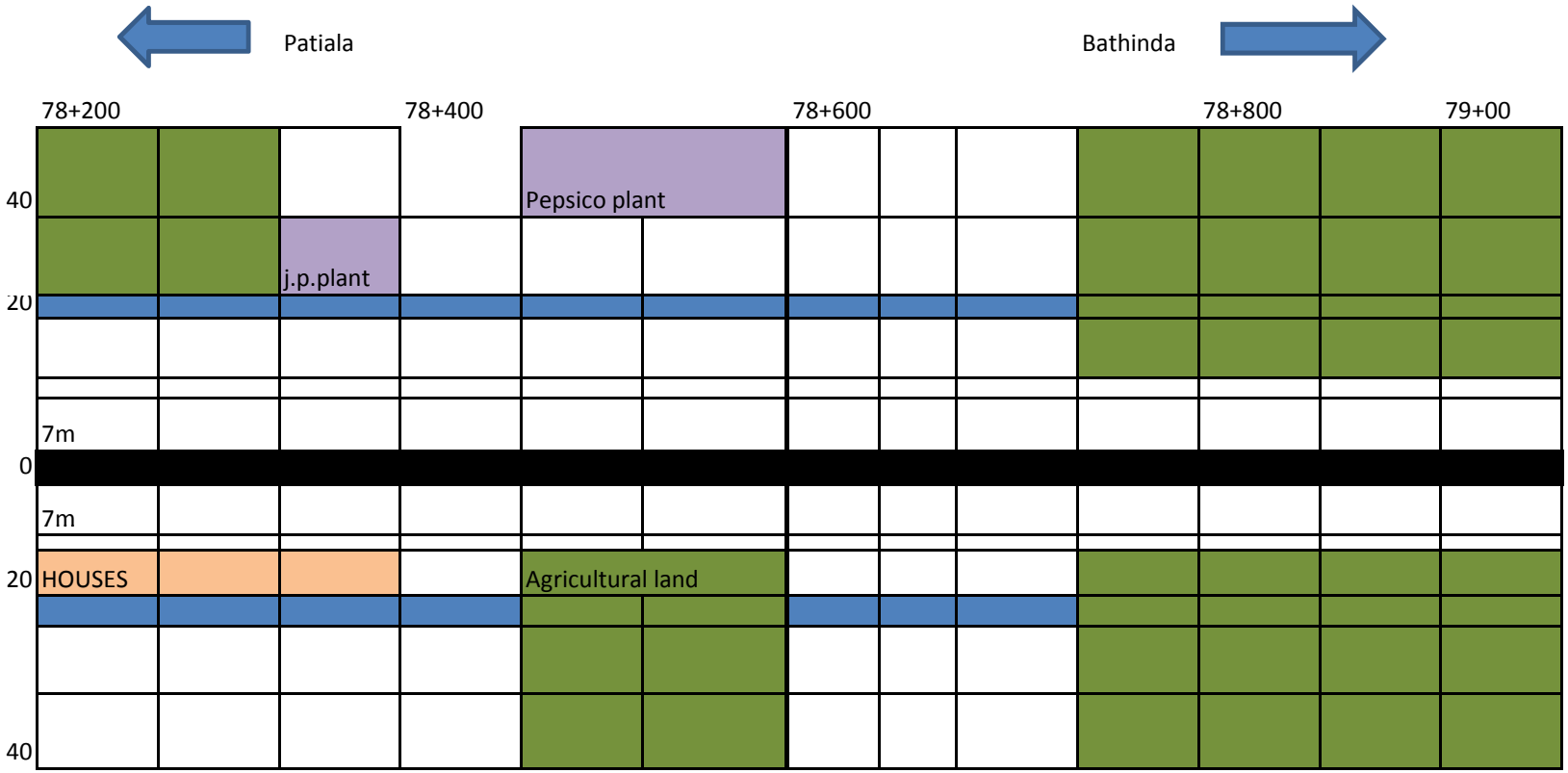
Alignment map from Bhawanigarh to Sangrur

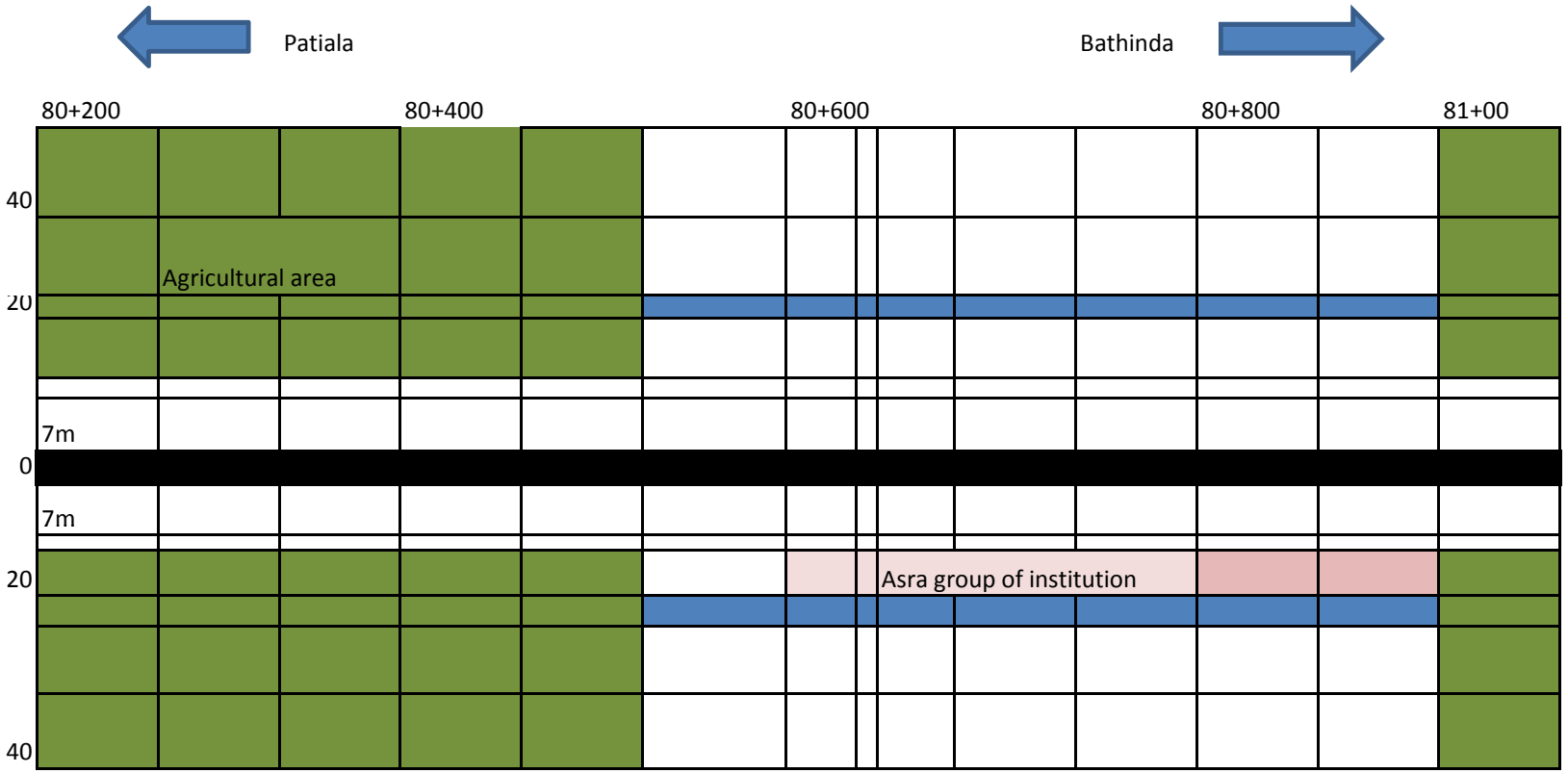

Patiala
Bathinda
66+200
66+400
66+600
66+800
67+00
40
20
0
20
40
7m
7m
Commercial
Shops
Dhaba
Trees
School
Royal Castle
Agricultural area

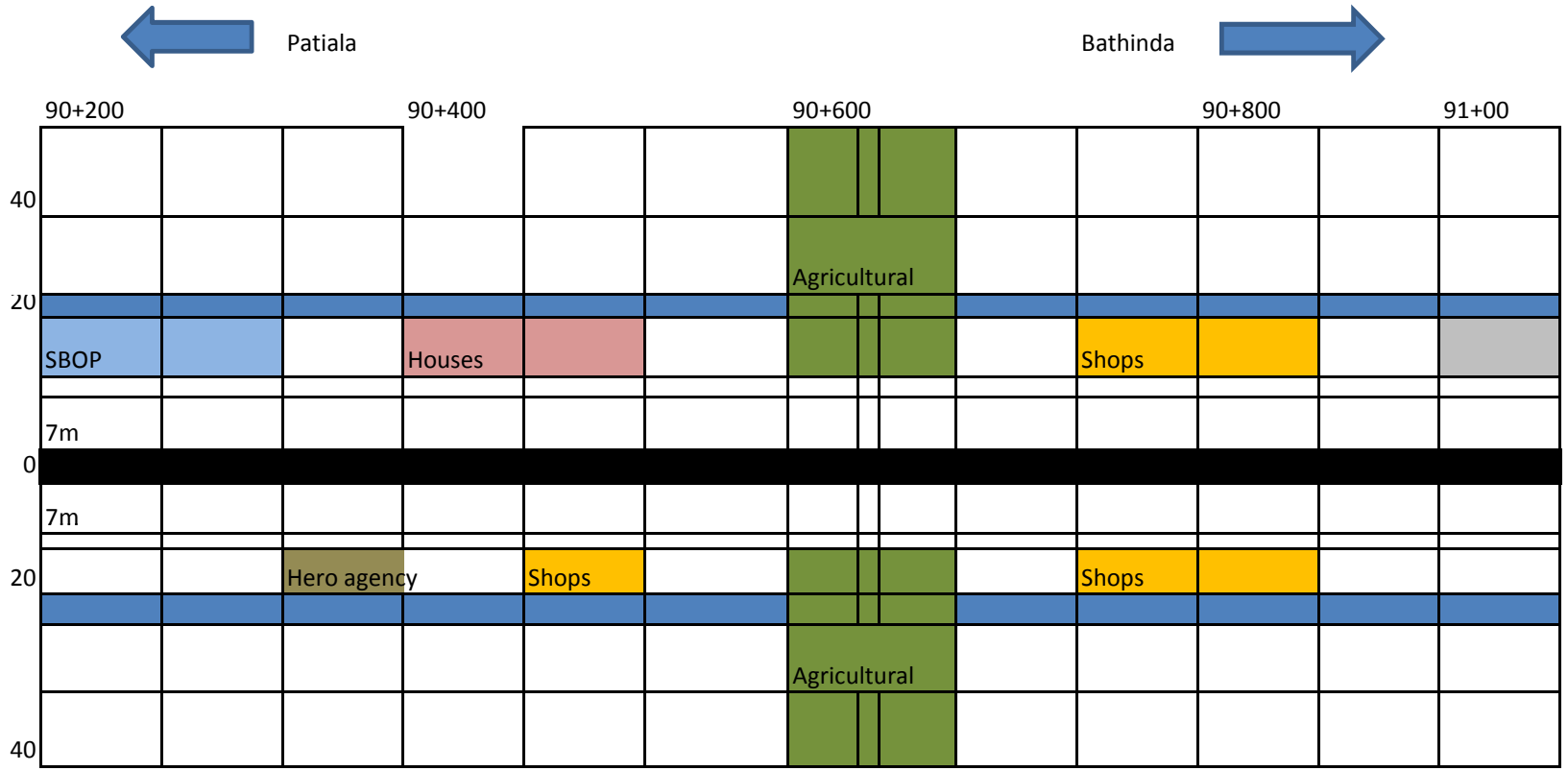

Patiala
Bathinda
70+200
70+400
70+600
70+800
71+00
Agricultural Area
Gurudwara
Trees
Institute
40
20
7m
0
7m
20
shops
Residential area
40

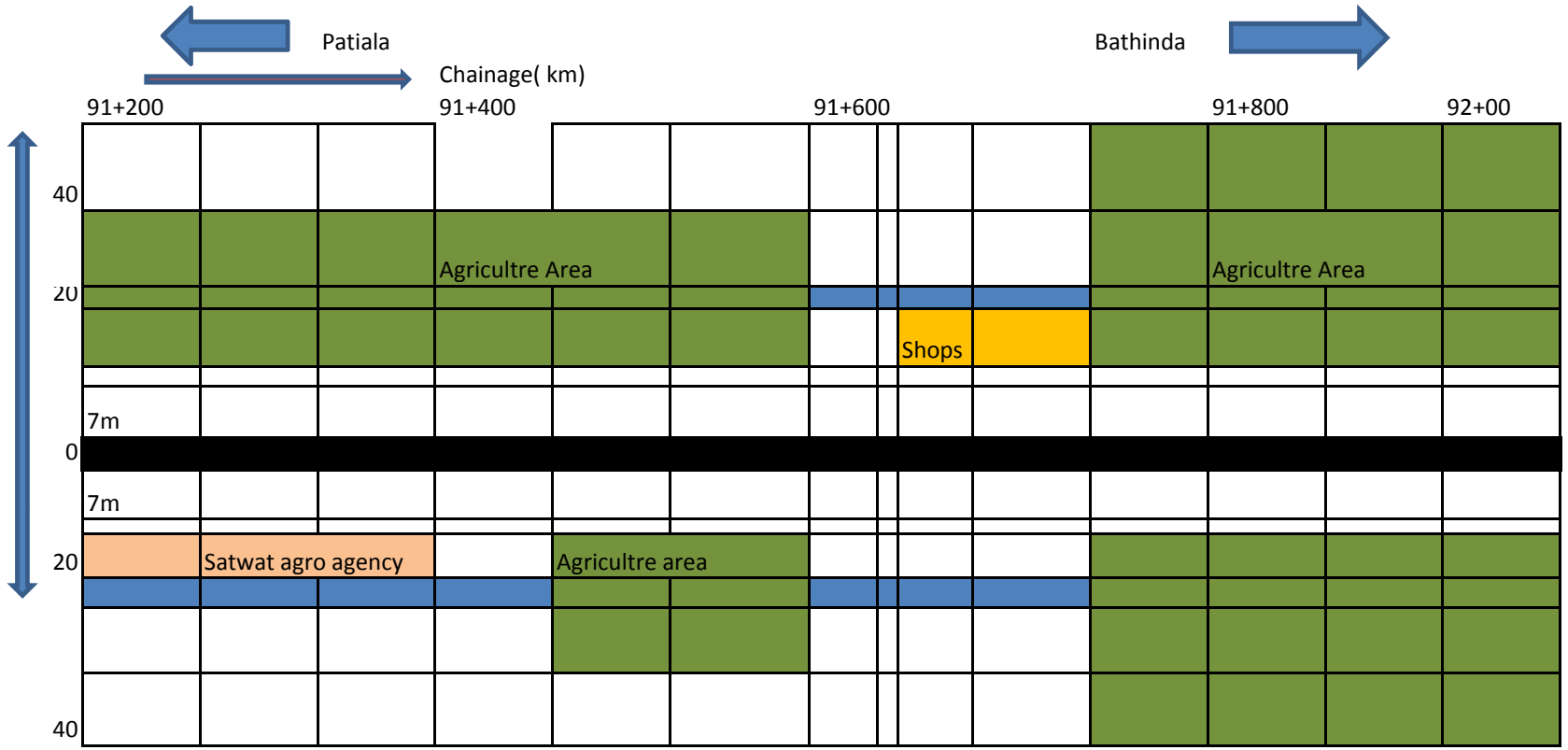

Patiala
Bathinda
72+200
72+400
72+600
72+800
73+00
40
20
0
20
40
Agricultural Area
Trees
7m
7m
Shops
Institutions
Trees
Agricultural Area

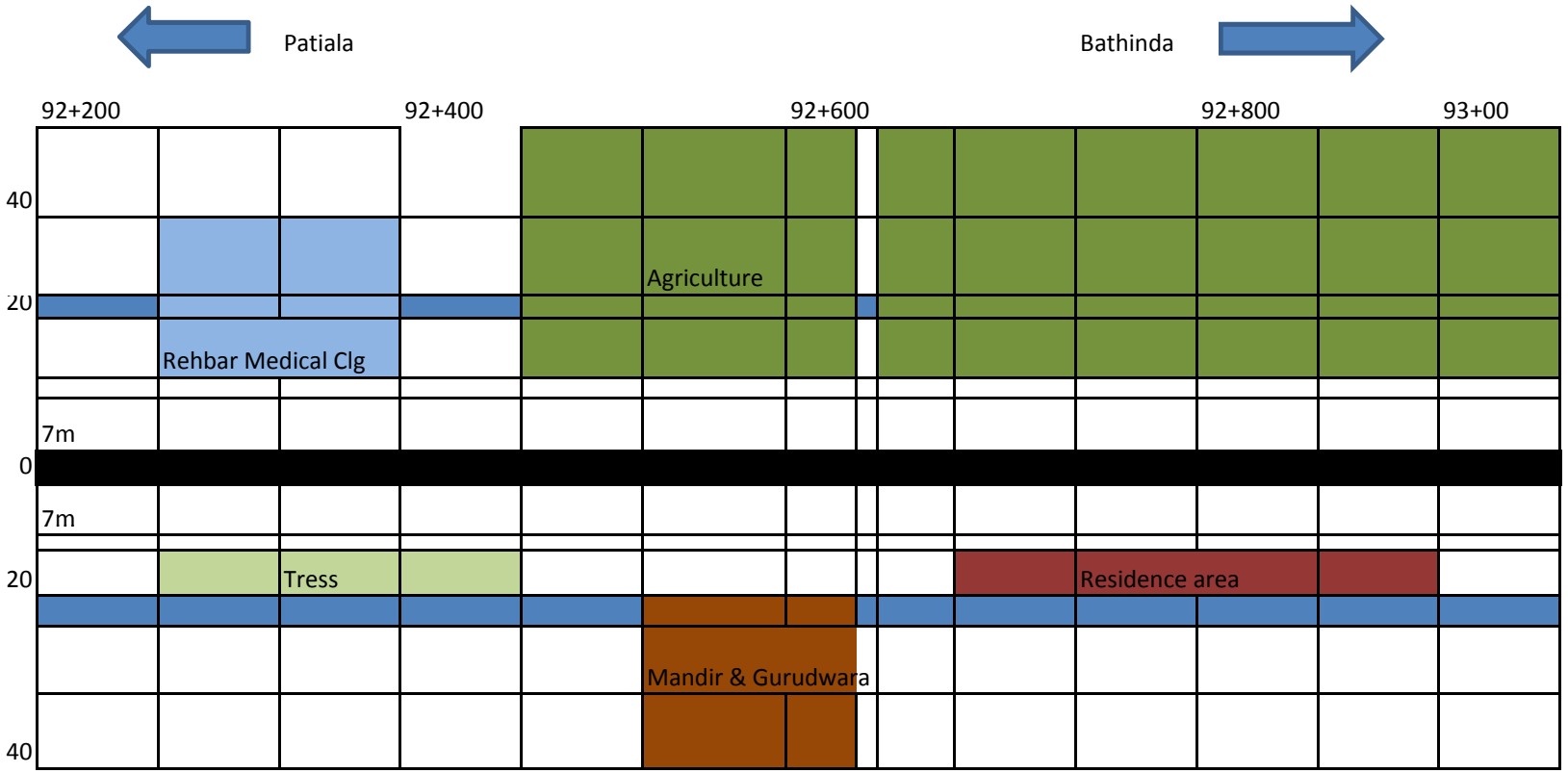

Patiala
Bathinda
77+200
77+400
77+600
77+800
78+00
40
20
0
20
40
uppal battery industry
Pump
SHOPs
Gurudwara
Ply wood industry
7m
7m
Trees
SBOP
SHOPS
Agricultural area

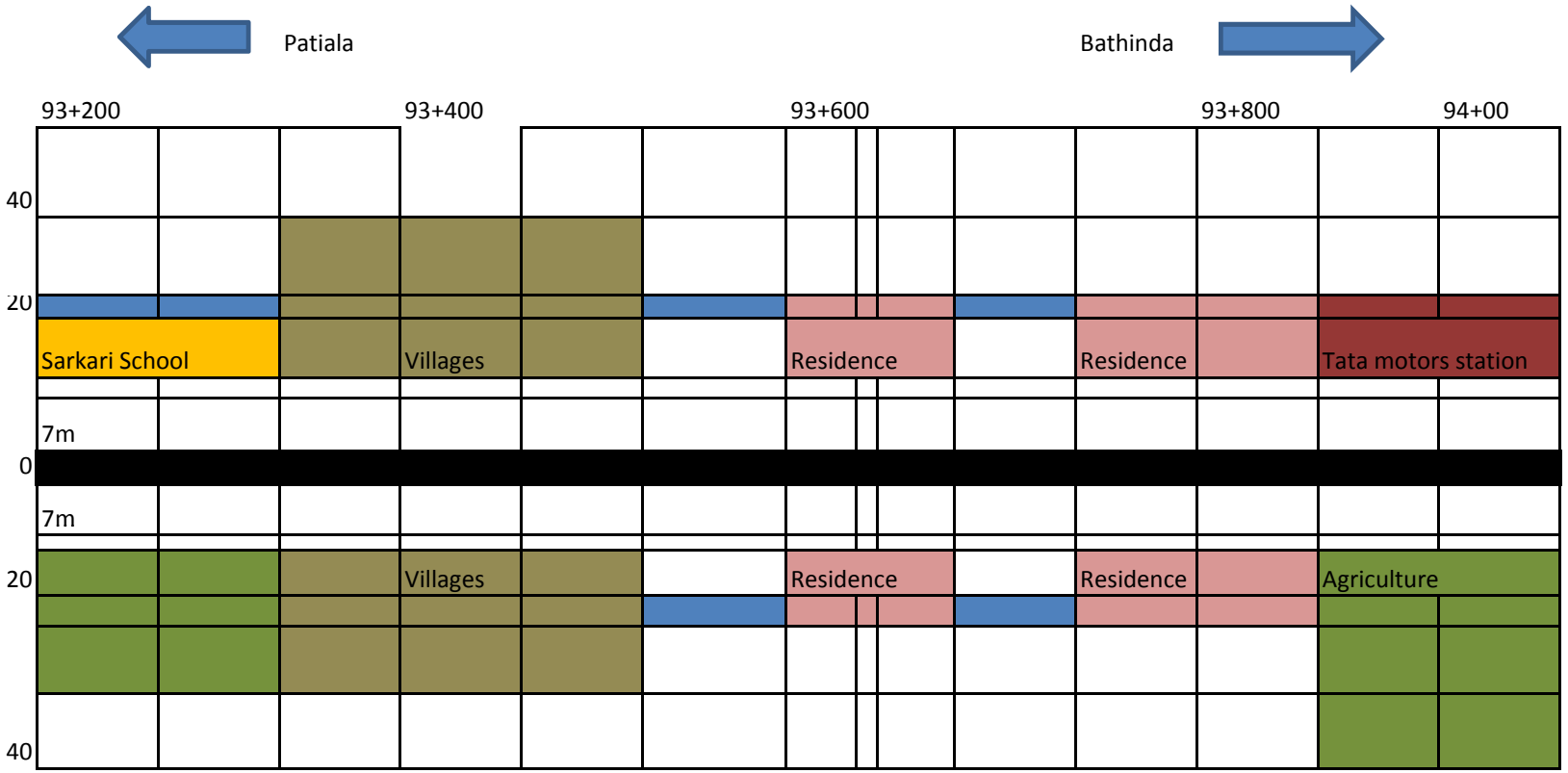

Patiala
Bathinda
78+200
78+400
78+600
78+800
79+00
40
20
0
20
40
7m
7m
Pepsico plant
j.p.plant
HOUSES
Agricultural land


Patiala
Bathinda
80+200
80+400
80+600
80+800
81+00
40
20
Agricultural area
7m
0
7m
20
Asra group of institution
40


Patiala
Bathinda
90+200
90+400
90+600
90+800
91+00
40
20
0
20
40
7m
7m
SBOP
Houses
Agricultural
Shops
Hero agency
Shops
Shops
Agricultural


Patiala
Bathinda
Chainage(km)
91+200
91+400
91+600
91+800
92+00
40
20
0
20
40
7m
7m
Agricultre Area
Agricultre Area
Shops
Satwat agro agency
Agricultre area


Patiala
Bathinda
92+200
92+400
92+600
92+800
93+00
40
20
0
20
40
7m
7m
Rehbar Medical Clg
Agriculture
Tress
Residence area
Mandir & Gurudwara


Patiala
Bathinda
93+200
93+400
93+600
93+800
94+00
40
20
Sarkari School
Villages
Residence
Residence
Tata motors station
7m
0
7m
20
Villages
Residence
Residence
Agriculture
40