ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY

DETAILED DESIGN FOR WIDENING & IMPROVEMENT OF PRIORITY SECTIONS OF N5 (487 KM)

(April 2025)

VOLUME 1: MAIN REPORT ESIA (PHASE 1A)

Package 2: Ranipur to Rohri
Package 7: Rawalpindi to Burhan
Package 8: Nowshera to Peshawar

Detailed Design for widening & improvement of Priority Sections of N5 (487 Km) - Phase 1A

Environmental and Social Impact Assessment (ESIA)

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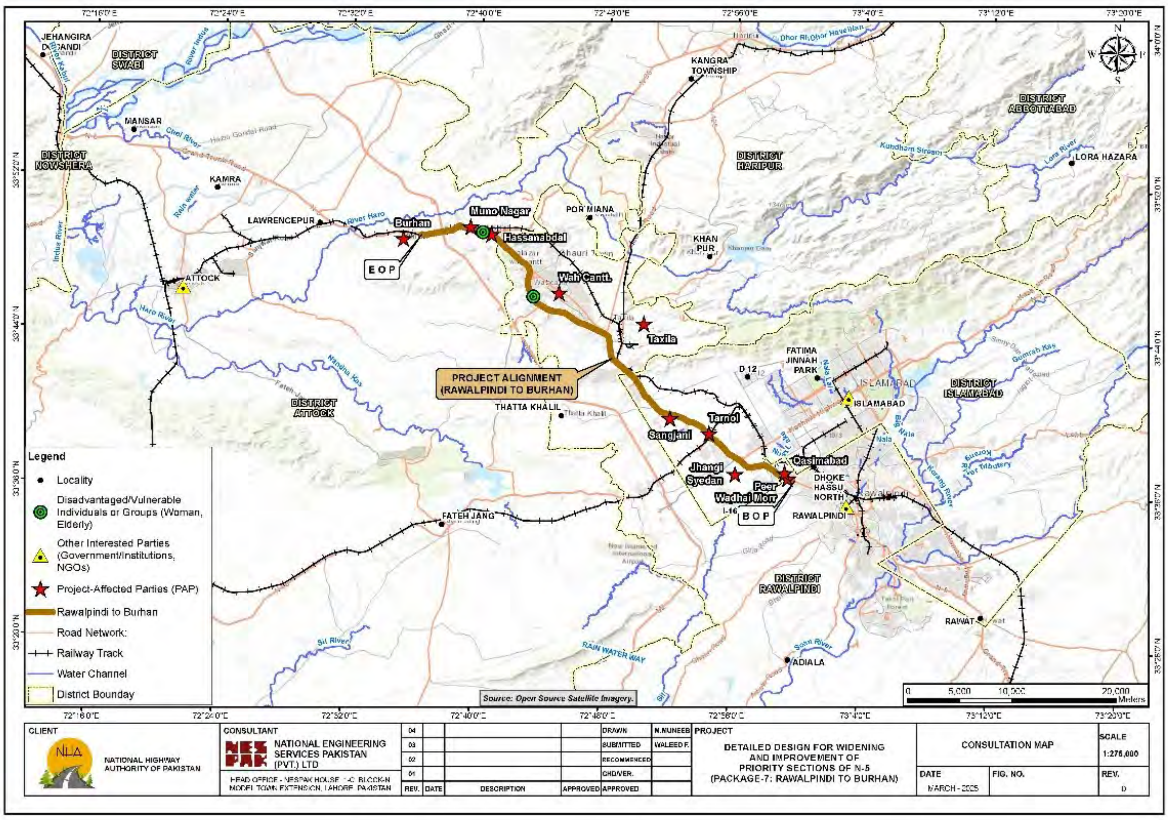


LIST OF ABBREVIATONS

AIIB	Asian Infrastructure Investment Bank
AOI	Area of Influence
BCP	Building Code of Pakistan
BOD	Biological Oxygen Demand
CDA	Capital Development Authority
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CoI	Corridor of Impact
COVID-19	Coronavirus disease
CPEC	China Pakistan Economic Corridor
CSC	Construction Supervision Consultant
E&S	Environmental and Social
EALS	Environment, Afforestation and Land Section
EC	Employment of Children Act
ECP	Environmental Code of Practice
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessments
EP&CCD	Punjab Environmental Protection and Climate Change Department
EPA	Environmental Protection Agency
EPA-KP	Environmental Protection Agency Khyber Pakhtunkhwa
ESF	Environmental and Social Framework
ESHS	Environmental, Social, Health and Safety
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMPF	Environmental and Social Management Planning Framework
ESP	Environmental and Social Policy
ESS	Environmental and Social Standards
FGDs	Focused Group Discussions
FI	Financial Intermediary
GBV	Gender Based Violence
GHG	Greenhouse Gas
GIS	Geographical Information System
GoP	Government of Pakistan
GoPb	Government of Punjab
GRM	grievance redress mechanism
H&S	Health and Safety
HSE	Health Safety & Environment
IA	Implementing Agency
ICT	Islamabad Capital Territory
IEE	Initial Environmental Examination
IFC	International Finance Corporation
ILO	International Labour Organization
KP	Khyber Pukhtunkhwa
KPH	Kilometres Per Hour
LAA	Land Acquisition Act
LC	Least Concern
MSDS	Material Safety Data Sheets
NCS	Pakistan National Conservation Strategy
NEQS	National Environemental Quality Standards
NESPAK	National Engineering Services Pakistan
NGO's	Non-Governmental Organizations
NHA	National Highway Authority
NO	Nitrogen Oxide

NOC	No Objection Certificate
O&M	Operation and Maintenance
OHS	Occupational Health and Safety
Pak-EPA	Pakistan Environmental Protection Agency
PAPs	Project Affected Persons
PEPA	Punjab Environmental Protection Agency
PEQS	Punjab Environemental Quality Standards
PGA	Peak Ground Acceleration
PHA	Parks & Horticulture Authority
PIU	Project Implementation Unit
PM	Particulate Matter
PMU	Project Management Unit
PPE	Personnel Protective Equipment
PRSP	Punjab Rural Support Program
PSHA	Probabilistic Seismic Hazard Assessment
RAP	Resettlement Action Plan
RE	Resident Engineer
ROW	Right Of Way
RWMC	Rawalpindi Waste Management Company
SC	Supervision Consultant
SEP	Stakeholder Engagement Plan
SO2	Sulfur Dioxide
SOP	Standard Operating Procedures
STDs	Sexually-Transmitted Disease
TMP	Traffic Management Plan
UBC	Uniform Building Code
UTC	Coordinated Universal Time
WHO	World Health Organisation

EXECUTIVE SUMMARY

ES1 INTRODUCTION

The Government of Pakistan (GOP), through the National Highway Authority (NHA), is reconstructing 487 km of the N5 Highway in two phases, including 100 km damaged by the 2022 floods. The project aims to expand the existing 4-lane dual carriageway to 6 lanes where necessary and add 7.3-meter-wide service roads in urban areas to improve accessibility.

With financing from the Asian Infrastructure Investment Bank (AIIB) and other partners, NHA has launched the "Reconstruction of National Highway N5 under Pakistan's Resilient Recovery, Rehabilitation, and Reconstruction Framework Project." AIIB's Multi-phase Program (MPP) funds the reconstruction of 209 km. Phase 1A (the Project) involves the reconstruction of 141 km, covering key sections across four regions:

- Section 2: Ranipur to Sukkur (70 km) – Sindh
- Section 7: Rawalpindi to Hassanabdal (40 km) – Punjab & Islamabad Capital Territory
- Section 8: Nowshera to Peshawar (31 km) – Khyber Pakhtunkhwa

The Project includes geometric enhancements, dual-side service roads in urban areas, and advanced road safety features, such as:

- Flyovers & improved underpasses for smoother traffic flow
- Pedestrian crossings & protected U-turns to enhance safety
- Modern bus bays for improved public transport access

Key benefits of the Project include:

- Reduced congestion and improved pavement conditions, addressing flood damage
- Dedicated lanes for heavy traffic to extend road lifespan
- Protected U-turns and service lanes for efficient local traffic management
- Upgraded road safety standards to at least 3-Star ratings

This modernization aligns with NHA's 20-year strategic plan and AIIB's Project Objectives, ensuring a safer, high-speed, and disaster-resilient highway that strengthens Pakistan's economic growth, connectivity, and climate resilience.

This ESIA should be read in conjunction with other E&S documents prepared for the Phase 1A Project and the subsequent Phases, such as the ESMPF, RAP, RAPF, GAP, GAPF, SEP, LMP, etc.

ES2 REGULATORY AND POLICY REVIEW

National and provincial regulations require the Project Proponent to conduct an environmental and social assessment and obtain approval from the relevant provincial environmental protection agency before implementation.

To secure financing from the Asian Infrastructure Investment Bank (AIIB), the project must comply with AIIB's Environmental and Social Framework (ESF) and applicable Environmental and Social Standards (ESSs), specifically:

- ESS 1: Environmental and Social Assessment and Management
- ESS 2: Land Acquisition and Involuntary Resettlement

As per the Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021, Punjab Environmental Protection Agency (Review of IEE and EIA) Regulations, 2022, Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000, and Khyber Pakhtunkhwa Environmental Assessment Rules, 2021, along with AIIB's ESF, the Phase 1A Project is classified as Category A, requiring a comprehensive Environmental and Social Impact Assessment (EIA/ESIA) before construction can commence.

ES3 DESCRIPTION OF THE PROJECT

The Phase 1A Project focuses on three key sections of N5, covering a total of 141 km: Ranipur to Sukkur (70 km) in Sindh Province, Rawalpindi to Hassanabdal (40 km) in Punjab Province and the Islamabad Capital Territory, and Nowshera to Peshawar (31 km) in KP Province. Phase 1A also includes, 57.19 km service road, 2 flyovers, 18 weigh stations, 21 bus bays, mud cleaning and reconstruction of 16 bridges and 22 culverts, 35 pedestrian bridges and 7 underpasses, 51 looped U-turns, and 2 toll plazas.

Project Area of Influence

The Project Areas of Influence for both the construction and operation phases of the project. During construction, the physical footprint includes the immediate work area with a 100-meter buffer, while the buffer zone extends up to 500 meters to account for impacts such as noise, dust, and vibration. Access roads used for transporting materials have a 50-meter buffer on each side, and traffic diversions may influence areas up to 2,000 meters away. Environmental impacts, including effects on soil, water, and air quality, are considered within a 500-meter zone.

In the operation phase, the road's influence on traffic flow and economic activity extends up to 5,000 meters, reflecting broader regional impacts. Air quality and noise changes are expected to affect areas within a 500-meter radius, depending on traffic conditions and vehicle types.

Implementation Schedule

The tentative implementation period for proposed Project is Thirty-Four months (34) for Section 2 and Twenty-Four (24) months for Section 7 and Section 8, respectively.

ES4 ANALYSIS OF ALTERNATIVES

Without Project Alternative

Phase 1A of the N5 Highway faces severe congestion, slower speeds, longer travel times, and increased pollution due to dense urbanization and unprotected U-turns at key locations across Sindh, Punjab, and Khyber Pakhtunkhwa. The situation is worsened by traffic from the Nowshera-Chitral road (N45) and the China-Pakistan Economic Corridor (CPEC) Economic Zone in Rashakai, which have significantly increased vehicle flow.

The 2022 floods have further deteriorated road conditions, and traffic projections indicate worsening congestion over time. Without intervention, the situation will lead to:

- Longer travel times and increased vehicle queuing
- Higher levels of dust, emissions, and noise pollution
- Greater accident risks due to deteriorating road conditions
- Restricted access to cities, limiting education, healthcare, and emergency response

A "No Project Option" would hinder economic growth, disrupt local and regional development, and reduce the quality of life for communities along the corridor.

Alternatives Considered in Design

The analysis of alternatives has been carried out mainly based on the technical analysis of various alternative options, such as, flyovers/ underpasses, U-turns, road crossings, traffic diversion during construction, pavement type, workforce Options, to meet the desired objective in the most cost-effective and environmentally sound and socially benign manner.

Alternatives evaluated, and the rationale for selecting the preferred options are presented below:

- For major intersections, flyovers at Fateh Jang and Amangarh were chosen over underpasses or at-grade crossings to improve traffic flow and safety.
- Looped U-turns were selected as a cost-effective and safer option compared to other designs.
- New pedestrian bridges were preferred for road crossings to enhance pedestrian safety and accessibility.
- Traffic diversion during construction will rely on existing parallel roads and staged use of the right-of-way (RoW) to minimize disruptions.
- Asphalt pavement was selected for its cost-effectiveness and smoother driving experience.
- Finally, a workforce composition of 70% local and 30% migrant workers was chosen to balance cost, efficiency, and community integration.

The selected options ensure that the N5 Highway reconstruction meets long-term traffic efficiency, safety, cost-effectiveness, social acceptance, and environmental sustainability goals.

ES5 DESCRIPTION OF THE ENVIRONMENT

Considering the potential impacts of the Phase 1A Project, existing baseline environmental conditions in the Project Area of Influence (AoI) were assessed for the physical, ecological and socio-economic conditions. Following section provides a summary of the baseline data:

Physical Environment

The data presented in the Phase 1A has been collected from the primary and secondary sources. For primary data acquisition, the Environment and Social team conducted field visits, environmental quality monitoring, socioeconomic and census surveys during the months of October and December 2024 and January and February 2025.

Geology: The geology of the Project area consists of the following:

- Ranipur to Rohri region is characterized by deposits from extinct streams (Qmx and Qfx) and older terrace deposits (Qcm), consisting of compacted layers of gravel, sand, and clay. The region also features sedimentary rocks like limestone and shale in some areas, along with alluvial deposits of clay, silt, and sand in floodplains.
- Rawalpindi to Hassanabdal region is primarily characterized by Mesozoic (Mz) rocks, including sedimentary formations such as limestone and shale, along with Holocene (Q) deposits of recent alluvial soils.
- Nowshera to Peshawar region is primarily characterized by Holocene (Q) deposits, consisting of recent alluvial soils formed by river activity. These fertile deposits, rich in sand, silt, and clay, pose challenges for construction due to their susceptibility to erosion, waterlogging, and shifting groundwater levels. Careful attention to drainage, foundation design, and soil stabilization is essential, especially during seasonal flooding.

Seismicity: The Phase 1A Project as per Building Code of Pakistan (BCP), 2007 (Seismic Provisions) falls entirely in the zone-2B (Moderate Hazard) category with PGA 0.16 to 0.24g for Section 7 & 8 while in the zone-2A (Moderate Hazard) category with PGA 0.08 to 0.16g for Section 2.

Climate and Meteorology: The climate and meteorology data are obtained from the published data of Climate Normal of Pakistan (1991 to 2020) for each section. For Section 2, reliance is made on Rohri weather station, for Section 7 reliance is made on Islamabad weather station and for Section 8 Peshawar weather station.

Waste Management: Ranipur Municipal Committee and Rohri Municipal Committee are responsible to ensure efficient collection, transportation, recovery, treatment and disposal of waste generated in Ranipur to Rohri Section. Rawalpindi Waste Management Company (RWMC), Capital Development Authority (CDA) is responsible to ensure efficient collection, transportation, recovery, treatment and disposal of waste generated in Rawalpindi to Burhan Section, while Municipal Corporation Peshawar is responsible for the solid waste management in Nowshera to Peshawar Section.

Landuse: The land use of the Phase 1A Project area mainly includes existing road, residential and commercial areas, masjid, health facilities and educational institutions within the AoI.

Environmental Quality: Ambient air quality monitoring at the Phase 1A Project Site measured NO_2, NO, SO_2, CO, $PM_{2.5}$, and PM_{10} over 24 hours with one-hour intervals. SO_2, $PM_{2.5}$, and PM_{10} exceeded NEQS limits, likely due to high diesel traffic.
Noise monitoring, conducted using Sound Meter found levels exceeding NEQS across all highway sections of Phase 1A highway.

Drinking water, surface water, and wastewater samples were analyzed for physical, chemical, and microbiological parameters. Drinking water met standards except for minor odour and taste issues. Surface water complied except for elevated COD in some samples. Wastewater exceeded limits for BOD, COD, and TSS in certain cases.

Ecological Environment

Ranipur to Rohri: Section 2 of the Phase 1A Project road lies in the Tropical Thorn Zone, with roadside plantations dominated by Conocarpus (98%), along with Shisham, Beri, Kikar, Date Palm, Farash, Eucalyptus, and Neem. While the district hosts diverse wildlife, the project area is degraded with no designated habitats.

Rawalpindi to Burhan: Section 7 of the Phase 1A Project road has a humid subtropical and dry climate with five seasons, lying in the sub-tropical scrub zone. Dominant tree species include Acacia modesta, Olea ferruginea, Dodonaea viscosa, and others, providing fodder for wildlife and livestock. While the district hosts various wildlife species, the project area is degraded and lacks designated habitats.

Nowshera to Peshawar: Section 8 of the Project Road is located in semi-arid region, has a dry climate year-round with seasonal rains (July–September). It features Tropical Thorn Forests dominated by thorny leguminous species like Prosopis cineraria, Capparis decidua, Zizyphus mauritiana, Tamarix aphylla, and Acacia nilotica. Historically, these forests covered the Indus plain before irrigation, agriculture, and urbanization.

Requirements of No Objection Certificate from Forest Department

The N5 Highway, tracing the historic Grand Trunk Road, is renowned for its tree-lined avenues that serve ecological and cultural functions. Post-independence, roadside plantations continued, especially along the N5, Pakistan’s main transport corridor. While some historic trees still remain under Forest Department care, many were lost to road expansion. Recent plantings have been led by the NHA, which is now inventorying trees along Phase 1A. Any removal of surviving historic trees requires a No Objection Certificate (NOC), compensation to the Forest Department, and replanting—typically 10 saplings per tree removed.

ES6 SOCIO-ECONOMIC ENVIRONMENT

Demography: A socio-economic survey of 126 AHs, comprising 756 individuals, found a male-to-female ratio of 51:49 and an average household size of six. The sex ratio was 104 men per 100 women. Regarding family structure, 31% lived in extended/joint families, while 69% were in nuclear households. Age distribution showed 17% were up to 25 years, 48% between 26–35, 21% between 36–45, and 14% over 45, indicating respondents were mature enough to assess the project's impact.

Religion and Language: The vast majority (99.5%) of the subproject area's population follows Islam, with a small Hindu minority (0.5%).

Sindhi is the dominant mother tongue, though Saraiki and Urdu are also spoken. Despite linguistic diversity, Urdu is widely understood and used for communication. The affected population includes various social subdivisions, with key castes such as Ujjan, Mangri, Lashari, Jokihia, Jatoi, Mirani, Khoro, Syed, Domki, Rajput, Chandio, Wasan, Talpur, Abro, Memon, Arain, and the Hindu caste Kholi.

Education and Literacy: The census found that 41% of AHs are illiterate, while 59% are literate—slightly above the 50.14% national literacy rate (Census 2023).

Occupational and Livelihood: The survey found 41% of household members as dependents, including children under 10, housewives, and the unemployed. The remaining members are engaged in various professions, with 19% in shopkeeping - operating general stores, selling food items, or running roadside eateries - while 9% work in private jobs.

Household Income and Expenditure: The survey found that 12% of AHs earn up to PKR 37,000 monthly, 39% earn PKR 37,001–45,000, 21% earn PKR 45,001–55,000, 16% earn PKR 55,001–65,000, and 12% earn above PKR 65,000. With PKR 37,000 as Pakistan's poverty threshold, about 5% of AHs are considered poor.

Housing Condition and Ownership: A majority of the AHs members in the project area (58%) are living in Pacca houses which are constructed with solid building materials while 25% respondents had semi Pacca houses which are made of masonry bricks with mud mortar. Only 15% of the respondents mentioned that they live in Katcha houses made of mud and straws while 2% live in temporary hut houses. Generally, poor households live in Katcha and hut houses while lower income households would live in Semi-Pacca houses. Those who can afford to live in Pacca households are generally not poor. The data shows high-level social disparity among well-off families and poorer households in the project area. The survey revealed that 83% of households have access to schooling and electricity, 51% to healthcare, 31% to gas, 9% to water, 28% to sewerage, and 89% to mobile services.

Access to Infrastructure and Services: The socioeconomic survey revealed that 83% of households have access to schooling and electricity, 51% to healthcare, 31% to gas, 9% to water, 28% to sewerage, and 89% to mobile services. The primary water source depends on location. In the project area, 81% of households rely on hand pumps/bore water, while 9% use public supply. Hand pumps are mainly near irrigation channels, with water collection typically done by women. However, 82% of respondents are dissatisfied with water quality.

Gender Assessment: The gender assessment highlights barriers women face, including limited resources, mobility, education, and employment due to cultural norms. Challenges in KP province include restricted survey participation, underreporting of issues like domestic violence, lack of public transport, job opportunities, safety, healthcare, and workplace discrimination. While the project cannot fully address these issues, efforts will ensure women's equal access to work, vocational training, and grievance redress mechanisms while promoting gender-sensitive transport design. A detailed gender action plan is included in the RAP.

ES7 PUBLIC CONSULTATION

A series of consultations were conducted to get the feedback/concerns of the different stakeholders including government departments, Project Affected Persons (PAPs), local community and other general public residing in the Project Area. Consultation process included Focus Group Discussions, semi-structured interviews, one to one meeting and interviews with the government and private institutions. Basic concerns of the stakeholders were related to land procurement, construction phase impacts including dust, air and noise pollution, health and safety and privacy issues etc. and implementation of mitigation measures.

Consultations were also carried out with the women (gender consultations) at ten (10) locations for Section 2, at two locations for Section 7 and two locations for Section 8. Local females raised concerns and suggestions including privacy issues, health concerns, and limited access to education and employment, for which proposed measures to mitigate these issues are proposed such as establishing a functional Grievance Redressal Mechanism (GRM), providing job opportunities for local females, and incorporating special provisions for women's safety and convenience.

Consultations showed overall support from communities and government agencies, with requests to enhance local benefits through social development services. Key issues, suggestions, and project commitments are summarized in **Table ES.4**.

Table ES.4: Feedback from affected communities

Issue Raised by Participants	Suggestions from Participants	Commitments by Project Proponent
Access problems due to construction	Local people should not be restricted from their settlements and farmland.	Proper access will be provided to the local people to reach surrounding areas easily.
Disturbance to social amenities	Social amenities should be restored after the construction completes to avoid inconvenience.	Social amenities will be restored after construction and before the operation of the road.
Restricted movement, especially for women, due to labor influx	Construction should be scheduled to allow free movement after working hours.	People should be informed about construction schedules to ensure safe movement.
Dust and noise disturbances to residential and commercial areas	Protective measures should be taken to safeguard the local community.	Contractors must follow dust suppression measures as per the recommendation of the ESMP and other precautionary measures to protect public health and property.
Employment opportunities for local workers	Skilled and unskilled labor should be hired from the local community to improve project acceptance.	Contractors will be encouraged to prioritize hiring local workers. The ESIA aims for up to 70% local workforce, and ESMP will propose training programs through a skill development program for the local

Issue Raised by Participants	Suggestions from Participants	Commitments by Project Proponent
		unemployed youths.
Poor drainage system causing waterlogging	A proper drainage system should be designed alongside the road.	The Design Consultant evaluated the drainage system, identifying bottlenecks based on 2022 flood damages and future projections. To improve climate resilience, cross-drainage structures and mitigation measures were incorporated into the design. Many culverts and bridges were clogged with mud, obstructing flow. The climate change assessment recommended increasing capacity for 10 bridges and 10 culverts, clearing mud from 8 culverts and 7 bridges, and replacing 1 bridge and 8 culverts.
Minimizing disruption during civil works	Construction should be done in small patches and completed quickly to reduce community disturbance.	Contractor's construction schedule will be sustainable in nature to minimize delays and disruptions and allow diversion route to detour traffic.
Traffic congestion due to construction vehicles	A traffic management plan should be prepared, and alternative routes should be provided.	Contractors will be required to prepare and implement a Traffic Management Plan (TMP).
Dust pollution causing health issues	Regular water sprinkling should be done to control dust.	Contractors must follow dust suppression measures as per the recommendation of the ESMP and other precautionary measures to protect public health.

A Stakeholder Engagement Plan has been developed in accordance with the AIIB ESF guidelines and presented in the Phase 1A SEP.

ES8 ENVIRONMENTAL AND SOCIAL IMPACTS AND RISKS AND MITIGATION MEASURES

Significant efforts were made to identify the main environmental issues related to the design, construction and operation of the Phase 1A Project. The impacts and risks of substantial significance and their mitigation measures are presented in **Table ES.5**.

Table ES.5: Impacts and Risks assessment for the Project

ESF Standards, Environmental Impacts and Social Risks	Risk Ratings before Mitigation and Control		Rationale	Mitigation	Risk Ratings after Mitigation and Control	
	Construction Stage	Operation Stage			Construction Stage	Operation Stage
ESS1: Assessment and Management of E&S Risks and Impacts						
Lack of appropriate E&S personnel with Construction Supervision Consultant (CSC), Contractors and the Implementing Agency (IA)	Substantial	Low	Appropriate E&S personnel are essential to implement, supervise, and monitor the ESMP, LMP, and OCHS Plan. Supervision and monitoring during project implementation provide information about key environmental and social aspects of the project and the effectiveness of mitigation measures. Such information enables the IA and the Bank to evaluate the success of mitigation and allows corrective action to be taken when needed. Inadequate resources will lead to major impacts and risk in the physical, biological and social environment and eventual harms to environment and non-compliances with ESMP requirements.	Mitigation measures include compliance of this ESIA particularly following guidance for creating different plans and staff requirements with education, experience and training in the ESMP and in the bidding documents.	Low	Low
Inadequate implementation of ESMP, LMP, OCHSMP.	Substantial	Low	Lack of experience of the contractor in implementing environmental, health and safety standards required by the ESF. Lack of resources and qualified Environment, Health, and Safety (EHS) staffs with various organization will become bottlenecks for the correct implementation, supervision, and monitoring of the ESMP. The ESMP and other plans identify measures and actions in accordance with the mitigation hierarchy and	• Recruit qualified contractors who maintains environmental sustainability in corporate strategy. • Avoid contractors with poor environmental, health, and safety management. • Contractor's qualifications stated in the ESMP are included as the pre-qualification criteria in the short-listing process. • Ensure that the conditions of the ESMP is correctly	Low	Low

	Risk Ratings before Mitigation and Control				Risk Ratings after Mitigation and Control	
ESF Standards, Environmental Impacts and Social Risks			**Rationale**	**Mitigation**		
			hierarchy of control that reduce potentially adverse environmental impacts and social risks to acceptable levels. Inadequate implementation will result in major concern from the community and risking the health and safety of the workforces and lead to major injuries and illness.	reflected in the contractor's bidding documents and the supervision consultant's TOR. • EHS bills of quantities are included in the specifications. • Education, qualification and training requirements of personnel are included in the bidding documents and considered by the supervision consultant when they give approval to the contractor. • Prepare Contractor's Environmental and Social Management Plan (C-ESMP), OCHSMP based on the ESMP. • Recruit qualified staffs to implement the C-ESMP, OCHSMP.		
ESS1: Labor and Working Condition						
Occupational Health and Safety (OHS)	substantial	Substantial	• Occupational health and safety risks in Pakistan are heightened due to weak safety practices, poor labor rights enforcement, and inadequate worker accommodations. Key hazards include heavy equipment operation, man/machine interaction, hazardous materials, trip and fall risks, dust, noise, falling objects, and electrical dangers, especially during construction. • While risks decrease in the operational phase, maintenance work near live	• Contractors will prepare and implement OHS management plan that would include standard operating procedures (SOPs) for all works, requirement of conducting Job Hazard Analysis and preparing Method Statements containing OHS aspects, traffic interface planning, working at height and hot work permit, barricading, OHS training requirements, incident recording and reporting protocols.	Moderate	Moderate

ESF Standards, Environmental Impacts and Social Risks	Risk Ratings before Mitigation and Control		Rationale	Mitigation	Risk Ratings after Mitigation and Control	
			equipment and energized overhead lines still presents significant hazards.	• NHA will prepare a similar Plan/System for the operation phase.		
Employment generation	Positive		Approximately 2,500 jobs are expected to be created during the construction phase (625 skilled and 1,875 unskilled or low skilled). Most unskilled positions are likely to be sourced from the local districts and communities, thereby sharing project benefits with affected communities. They will be in roles as laborers, security, catering, cleaning, and drivers of vehicles. Employment generation will contribute to household income and will improve households' socioeconomic conditions, providing greater security and reducing people's sensitivity to socioeconomic shocks and impoverishment risks. For the local impoverished people, this can increase their wellbeing and resilience. The employment will also contribute to skills development and professional experience, therefore making the beneficiaries more employable in the future, further reducing vulnerability.	• A skill development plan is proposed to train local workers in construction trade, such as, welding, mechanic, operation of heavy equipment and construction machinery, etc.	-	-
Enhancement of economic growth due to improved road connectivity	Moderate		The proposed reconstruction of Phase 1A N5 will reduce congestion, enhance traffic flow, ease movement of road users and goods and thus generate movement of more cargo by road and correspondingly economic growth.	• AIIB supports sustainable infrastructure and productive sectors to foster economic growth and improve lives. Aligned with the SDGs, it integrates economic, social, and		

	Risk Ratings before Mitigation and Control				Risk Ratings after Mitigation and Control	
ESF Standards, Environmental Impacts and Social Risks			**Rationale**	**Mitigation** environmental dimensions of sustainability. The Bank adheres to sustainable development principles in project planning and execution, as outlined in its Environmental and Social Policy.		
ESS1: Resource Efficiency and Pollution Prevention						
Land use change	Substantial	Low	Land will be cleared for the highway expansion (141 km 2-lane), service road (36.99 km 2-lane both way), 9 new bus bays, 33 controlled U-turn using median strips and to build access roads for material transportation. About 64.6 ha land clearance will occur during the early stage of construction period for a limited amount of time. The sensitivity of the soil at the construction site is considered medium since it is susceptible to erosion. In addition, there will be about 1,500 land required for the construction camp and yard for each section of the road.	Mitigation measures would include proper land clearance planning, spoil management measures, vegetation clearance and erosion management, sediment management, design of storm water drainage in construction areas as well as design and implementation of site erosion control.	Low	Low
Air pollution	Substantial	Moderate	Ambient air quality monitoring found very high concentration of SO_2 (54.8 □g/m^3 in average in Section 7 and 49.4 □g/m^3 in Section 8 against the national standard of 40 □g/m^3), PM10 (127.5 □g/m^3 in average in Section 7 and 100.5 □g/m^3 in Section 8 against the national standard of 45 □g/m^3), and PM2.5 (44.5 □g/m^3 in average in Section 7 and 41 □g/m^3 in	Mitigation measures would include emissions management from construction vehicles, frequent sprinkling of water on unpaved roads, regular maintenance of vehicles and construction equipment, and preventing the release of emission from burning waste materials. Dust control measures will consist of regular vehicle and equipment	Moderate	Low

	Risk Ratings before Mitigation and Control				**Risk Ratings after Mitigation and Control**	
ESF Standards, Environmental Impacts and Social Risks			**Rationale**	**Mitigation**		
			Section 8 against the national standard of 15 $\mu g/m^3$), exceeding the NAAQS. Airshed in major cities of Pakistan are already degraded as transboundary pollution is a major contributor to fine particulate matter in South Asia, while elevated SO_2 concentrations primarily result from the high prevalence of diesel-fueled vehicles, traffic congestion at intersections, deteriorating pavement conditions, and emissions from coal-fired power plants.	maintenance program, proper construction materials planning, dust management, and frequent water sprinkling. The NHA in collaboration with provincial and federal EPAs and the Climate Change Division (CCD), may establish a Continuous Emission Monitoring System (CEMS) to assess air quality in the project area. This system will monitor major intersections and sensitive receptors in accordance with the NEQS and		
			Local air quality including dust is expected to deteriorate further due to emissions from construction plants, equipment, and exacerbation by traffic congestion. The impact on air quality is considered significant, driven by activities such as construction plant operations, traffic diversions, site clearance, earthwork, and excavation. These emissions will be concentrated along the highway corridor during the construction phase. Dust generation, particularly in dry conditions, will have substantial effects extending beyond the immediate vicinity. A major source of dust pollution will be the resuspension of particles from unpaved roads	Provincial EQS for a specified duration, capturing air quality concentrations during the operational phase. Additionally, planting greenbelts along the highway is a preferred method to mitigate air pollution.		

ESF Standards, Environmental Impacts and Social Risks	Risk Ratings before Mitigation and Control		Baseline	Mitigation	Risk Ratings after Mitigation and Control	
			due to construction traffic. Given the limited capacity of the local community to adapt, the potential degradation of air quality is a significant concern. During the operation phase, the expanded highway capacity, along with service roads for local traffic, protected U-turns, pedestrian bridges, flyovers, and underpasses, will enhance traffic flow, reducing congestion and lowering overall traffic emissions, thereby contributing to improved air quality.			
Disturbance due to noise and vibration	Moderate	Substantial	Baseline surveys along the Phase 1A highway revealed high noise levels, with average daytime readings of 58.5 dBA at Section 2, 75 dBA at Section 7 and 70.75 dBA at Section 8, exceeding the standard of 65 dBA for commercial area. Nighttime levels were also elevated at 53 dBA, 64 dBA and 63.5 dBA, surpassing the 55 dBA standard. Construction activities may further disturb nearby settlements and businesses due to noise and vibrations from vehicles and equipment on service roads and the highway, as well as from construction camps, potentially disrupting local wildlife. Operational noise impacts are expected to increase due to higher traffic volumes due to uninterrupted flow in the 6-lane	• Mitigation measures include requiring contractors to add provisions for noise and vibration management, organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise on the work site. • Avoiding/minimizing noisy works during the night time as far as possible and maintaining community liaison to aware people about the construction activity. • Noise barriers along highways are effective structures designed to mitigate noise pollution from traffic. Depending on the topography and sensitivity of receptors, any of the	Low	Moderate

ESF Standards, Environmental Impacts and Social Risks	Risk Ratings before Mitigation and Control		Rationale	Mitigation	Risk Ratings after Mitigation and Control	
			main highway and traffic segregation. Preliminary forecasts from the Traffic Noise Model (TNM 3.0) anticipate average noise levels along Section 7 highway, will rise to 86.2 dBA by 2030 and 88.2 dBA by 2045.	following noise barriers can be considered: o earth mounds (berms) that absorb sound, o solid barriers made from materials like concrete, wood, or metal, which can reflect sound, o transparent barriers often made of acrylic or glass, these allow visibility while reducing noise. • Vibration measurement during construction phase by the contractor near the settlements/sensitive receptors. • Timing of the construction works to be conducted during the recommended operational hours, to reduce vibration levels to residential properties; • Residents to be pre-warned of high vibration events.		
ESS 1: Conserving Biodiversity and Sustainable Management of Natural Resources						
Losses of trees and terrestrial habitat due to land clearance	Substantial	Low	There may be temporary and permanent terrestrial habitat loss and degradation at construction, camp, and yard area. It is estimated that 645,730 m^2 (64.6 ha) land will be cleared for 3 sections of the highway construction affecting a total of 8,390 trees, which include beneficial and medicinal trees as	• Mitigation measures include minimizing land clearance, restricting activities to designated areas, and properly planning camps, machinery movement, and temporary roads to protect vegetation. • Construction camps	Low	Low

	Risk Ratings before Mitigation and Control				Risk Ratings after Mitigation and Control	
			well. This will result in the direct loss of plants and habitats and displacement of fauna. Soil erosion arising from clearance could result in loss of plant species.	should be established in areas with little to no vegetation, and alternate routes for access and diversion road should be chosen to avoid environmental impact.		
				• Camp locations will be selected to minimize environmental effects, reduce costs, and limit land use. • Compensate each tree with 10 trees planted with a total of 83,900 saplings, through a plantation enhancement program.		
ESS 2: Land Acquisition and Involuntary Resettlement						
Resettlement of affected people	Substantial	Low	All work related to reconstruction of the Phase 1A N5 shall be carried out within the existing RoW of NHA, therefore no permanent land acquisition will be required. However, the Project activities will pose resettlement related impacts which include impact on houses and secondary structures (49), shops/hotels and secondary structures (1,448), kiosks and huts etc. (702), filling stations/ petrol pumps (49), misc. (113), mosques, shrine and other assets (190) (detailed provided in RAP) during the Project implementation.	• Fair and timely compensation will be provided to all affected individuals losing their livelihoods along the route. • Relevant stakeholders, including affected individuals, will be actively engaged in designing effective livelihood restoration measures. • The Resettlement Action Plan (RAP) will include a comprehensive livelihood restoration plan, with continuous monitoring of commercial activity recovery. • An initial compensation assessment for income loss will be conducted based on the	Low	Low

ESF Standards	Risk Ratings before Mitigation and Control		Rationale	Mitigation	Risk Ratings after Mitigation and Control	
				preliminary road alignment and construction camp locations, with updates following the final alignment determination.		
				• Awareness programs and training sessions will be conducted to inform affected individuals about project benefits, land acquisition reasons, and compensation procedures.		

ES9 OCCUPATIONAL AND COMMUNITY HEALTH AND SAFETY (OCHS)

The OCHS Management System (OCHSMS) includes the Contractors' high-level corporate policies, processes, and Standard Operating Procedures (SOPs). A guidance is provided for all operational activities related to the Project. Some of the key high-risk activities may involve the following:

- Vehicles and driving;
- Operation of mobile equipment on site and on community roads including passenger vehicles, material transport trucks, mill/planer, cranes, excavator, compactor, rollers, etc.;
- Excavation Operation and associated risk to community members.
- Work at height and dropped objects;
- Material haulage;
- Manual handling;
- Lifting and crainage;
- Scaffolding;
- Operation of Batching and Asphalt Mixing plants;
- Hot work (asphalt);
- Maintenance and operation of the site camp and other facilities like workshop and first aid center;
- Use of security forces; and
- Electrical works.

ES10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

The ESMP of the Phase 1A mainly comprises of employer’s requirement to pre-qualify contractors and environmental, health and safety requirements in the bidding documents, management plans, institutional setup, capacity building and training, presents key monitoring and performance indicators, and grievance redress mechanism, trainings, and reporting and documentation. Total cost of ESMP implementation is $ 18,701,211. The budget for Civil Works with the Contractor is $ 5,982,300 and the PIU-HQ cost is $ 12,718,911.

1 INTRODUCTION

1.1 Background

The Government of Pakistan (GOP), through the National Highway Authority (NHA), plans to reconstruct eight sections of the N5 Highway, covering a total of 487 kilometers, spanning 8-sections in two phases, including 100 kilometers damaged during the 2022 floods. The reconstruction aims to upgrade the existing infrastructure by expanding the current 4-lane dual carriageway to a 6-lane dual carriageway where needed. In urban areas, a 7.3-meter-wide service road (or as allowed by the available right of way) will be constructed. The intervention also focuses on enhancing the road corridor with climate-resilient infrastructure by adding cross-drainage structures and implementing other adaptive measures. Additionally, it includes widening and upgrading existing bridge structures, rehabilitating deteriorated road sections, and improving highway safety through geometric enhancements, the installation of road safety devices, pedestrian crossings, and dedicated U-turns, among other safety features.

NHA with support from the Asian Infrastructure Investment Bank (AIIB) and potential additional financiers, has launched the "Reconstruction of National Highway N5 under Pakistan's Resilient Recovery, Rehabilitation, and Reconstruction Framework Project”.

To ensure robust project planning and regulatory compliance, NHA has engaged National Engineering Services Pakistan (NESPAK) Pvt. Ltd. as the Engineering and Design (E&D) consultant. NESPAK is responsible for preparing technical designs and developing Environmental and Social (E&S) instruments, including the Environmental and Social Impact Assessment (ESIA), in accordance with Pakistan’s national and provincial regulations and AIIB’s Environmental and Social Framework (ESF).

AIIB’s Multi-phase Program (MPP) focuses on Phase 1, encompassing four sections of the N5, totaling 209 km across Islamabad Capital Territory, Punjab, Khyber Pakhtunkhwa (KP), and Sindh provinces, and the reconstruction of a 1-km-long bridge in Sindh province. The Phase 1A Project (the “Project”) focuses on three key sections of N5, covering a total of 141 km: Ranipur to Sukkur (70 km) in Sindh Province, Rawalpindi to Hassanabdal (40 km) in Punjab Province and the Islamabad Capital Territory, and Nowshera to Peshawar (31 km) in KP Province. Phase 1A also includes, 57.19 km service road, 2 flyovers, 18 weigh stations, 21 bus bays, mud cleaning and reconstruction of 16 bridges and 22 culverts, 35 pedestrian bridges and 7 underpasses, 51 looped U-turns, and 2 toll plazas. The Phase 1B will focus on another key section of N5: Lahore to Gujranwala (68 km) in Punjab province, alongside the reconstruction of 1 km long Nai Baran Bridge in Sindh Province.

This strategic investment aims to strengthen Pakistan’s transportation network, ensuring long-term sustainability and improved connectivity. The initiative aims to enhance climate resilience, improve operational efficiency, and strengthen road safety in critical sections of N5, aligning with the Project Objectives (POs).

The priority sections of the N5 highway are heavily trafficked and congested, causing significant delays and inconvenience for commuters. This issue is further worsened by the deteriorating pavement conditions, particularly due to damage from the 2022 floods. Both the northbound and southbound lanes are in poor condition and require urgent rehabilitation, except for a few stretches where the road remains in fair condition.

The Project will ensure that the N5 provides safe, high-speed, sustainable and disaster resilient road corridor, provide dedicated lane for heavy traffic to minimize the road deterioration, provide service lane in urban areas to manage the local traffic and reduce their direct accessibility on main carriageway, plan protected U-Turns for smooth flow and to minimize the accident, and enhance road safety through Star Rating improvements up to 3 Star or better.

1.2 Environmental and Social Impact Assessment (ESIA) Study

The draft ESIA has been prepared by NESPAK team hired by NHA. This ESIA should be read in conjunction with other E&S documents prepared for the Phase 1A Project and the subsequent Phases, such as the ESMPF, RAP, RAPF, GAP, GAPF, SEP, LMP , etc. The draft ESIA reviewed and updated by Independent Environmental and Social (E&S) Consultants with support and additional input from NESPAK ESIA team. Based on the information presented in the draft ESIA further analysis of the impacts and risks and mitigation and control measures for the Project was performed and presented in the updated ESIA. This updated ESIA is in compliance with the mitigation hierarchy as per the AIIB's ESF. This ESIA is conducted for Phase 1A.

1.2.1 ESIA Objectives

The objectives of this ESIA are to identify and address the environmental impacts and social and risks of the Phase 1A road sections. The specific objectives include:

- Identify and assess the potential environmental impacts and social and risks stemming from the project in the planning, construction and operation phases (direct, indirect and cumulative impacts).
- Design appropriate mitigation, management, and monitoring measures (to avoid, minimize, mitigate, offset or compensate for them), to implement an environmentally benign and socially responsible project without compromising its technical and economic feasibility and to help determine crucial elements that facilitate the making of choices and decisions as per AIIB's Environmental and Social Standards 1 (ESS1).
- Analyze occupational and community health and safety during construction and operation stages and ensure corresponding measures using hierarchy of controls as per ESS1.
- Provide complete documents that will satisfy the requirements of Sindh, Punjab and Khyber Pakhtunkhwa (KP) Environmental and Protection Agencies (EPAs) and the AIIB's ESF and ESSs.
- Ensure that effects on people and the environment to be taken into account at the earliest possible stage in the technical design and decision-making processes.
- Assess the capacity of the implementation agency in environment, social, health and safety management and recommend measures to strengthen the capacity in terms of human resources, logistics, skills development, and training.

- Carry out consultations with the key stakeholders and obtain their views and concerns on the project and its impacts on environment and people, in compliance with AIIB's ESS1.
- Prepare an environment and social management plan addressing implementation arrangements, employer's requirements, and various mitigation and enhancement measures.

1.2.2 Area of Influence

The area of influence (AoI) covers all land or water, directly or indirectly impacted by the Project. This includes communities and areas adjacent to the AoI that may experience impacts (e.g., traffic safety, aesthetic or noise impacts) during the construction and operation of the Project, despite being located outside of the area in which the Project will be implemented. Direct AoI includes all the areas, where activities related to the construction will take place. **Table 1.1** defines the AoI whereas, **Figure 1 -1** shows Section 2 AoI, **Figure 1 -2** shows Section 7 AoI and **Figure 1 -3** shows Section 8 AoI, which will be considered in the impact assessment. All areas include a core and buffer area, the extent of the buffer (measured from the outer boundary of the RoW) is determined by the reach of impacts such as noise and air pollution.

Table 1-1: Project Areas of Influence

Areas of Influence	Description	Buffer Distance (m)
Physical Footprint	The immediate construction site, including the road, sidewalks, medians, and construction staging areas. A 100 m buffer from the actual footprint is considered.	100
Buffer Zone	Adjacent areas potentially affected by noise, dust, vibration, and safety risks.	500
Access roads	Access roads that will be used for material transportation, will experience increase in traffic during construction. A 50-meter buffer is considered each side of the roads to account for potential noise, dust, and safety risk.	50
Traffic Diversions	Areas influenced by detours, alternative routes, and changes in traffic patterns.	2,000
Environmental Impact Zone	Areas where soil, water, and air quality might be impacted by construction activities, including quarries, run-off zones, and habitats affected by noise or habitat disruption.	500
Operation		
Traffic Influence	The extent of the new or improved road's effect on traffic flow, congestion, and safety in surrounding areas.	5,000
Economic Zone	Areas experiencing economic impacts due to improved access, such as businesses, markets, and residential zones.	5,000
Air Quality and Noise Influence	The area where changes in emissions and noise levels could affect public health, often influenced by vehicle type, speed, and volume.	500

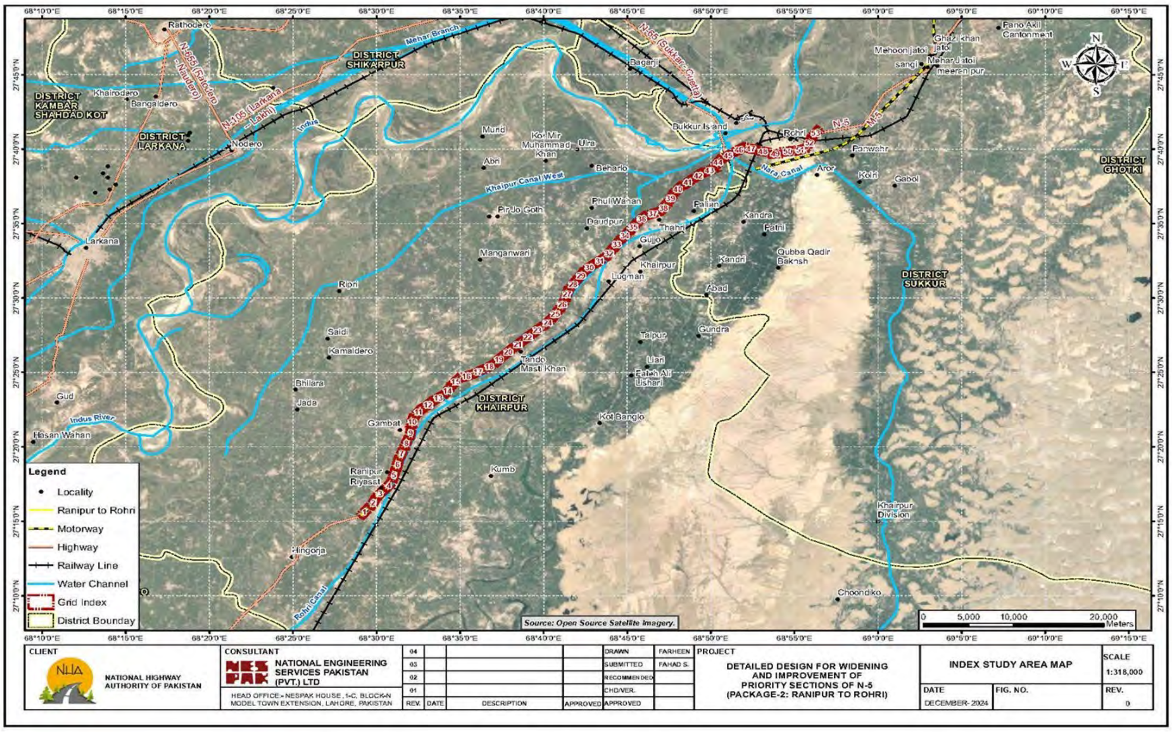


Figure 1-1: Area of Influence of Section 2: Ranipur to Rohri

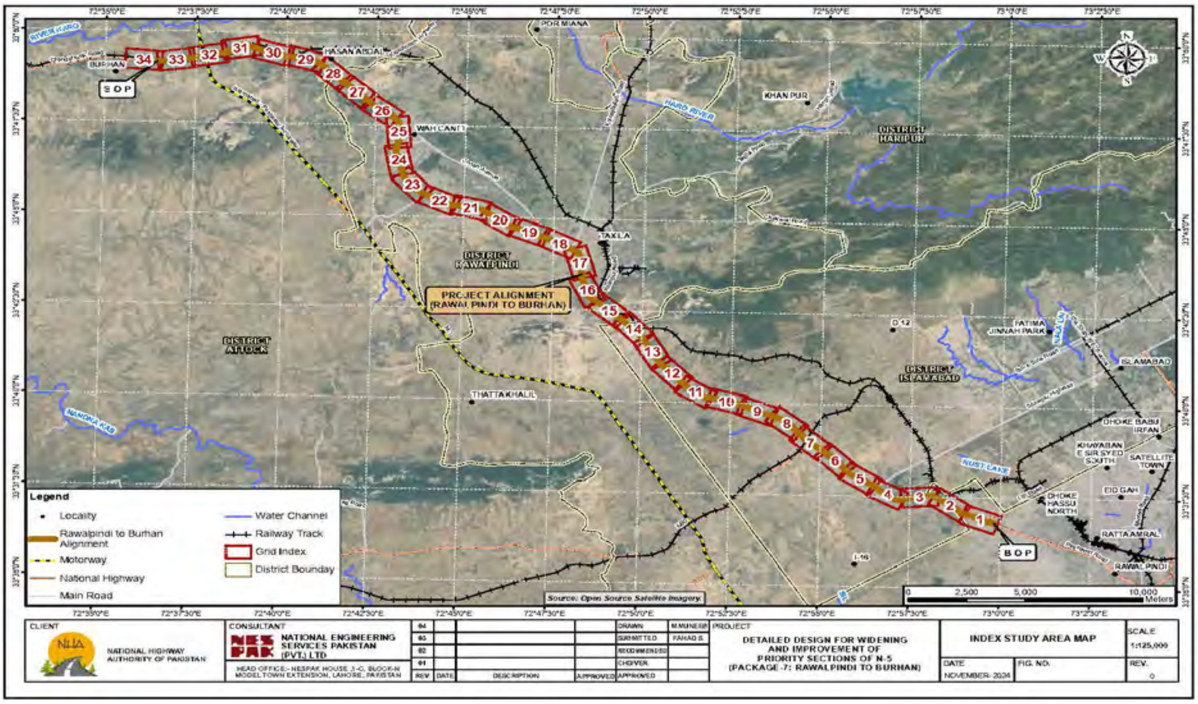


Figure 1-2: Area of Influence of Section 7: Rawalpindi to Burhan

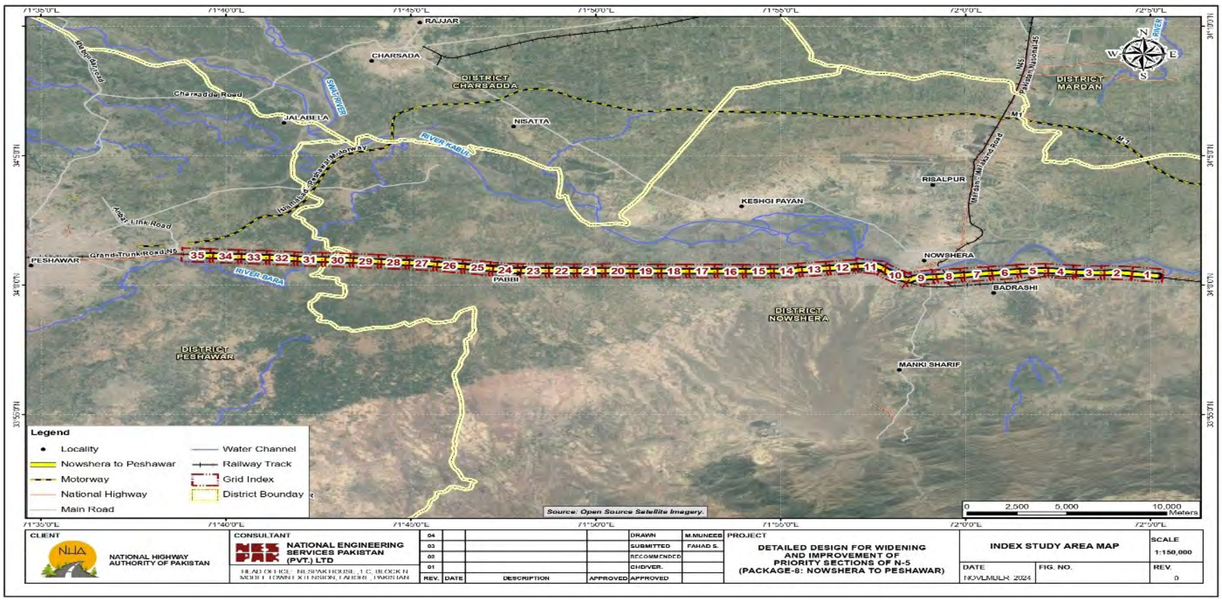


Figure 1-3: Area of Influence of Section 8: Nowshera to Peshawar

1.2.3 ESIA Study Team

This is an updated version of the draft ESIA prepared by the NESPAK team and updated by two Independent Consultants with support from NESPAK. The Independent Consultants consists of the following specialists:

- Dr. Masud Karim, International Environmental Consultant
- Razaak Ghani, International Social Development Consultant

NESPAK Team consists of the following individual presented in **Table 1.2**.

Table 1-2: Team Composition for the EIA Study

Sl.	Name	Designation
1.	Mrs. Uzma Iqbal	Head (Environment and Resettlement) / Team Leader E&S Assessment Studies - Quality Assurance (QA) Expert
2.	Mr. Fahad Saleem	Sr. Environmental Engineer
3.	Mr. Wasim Abbas	Sr. Sociologist - Resettlement Expert
4.	Mr. Muhammad Sajjad	Stakeholder Engagement Specialist
5.	Mr. Ibadullah Khan	Sr. Ecologist
6.	Mr. Muhammad Abdul Basit	OHS Expert
7.	Mr. Waleed Farooq	Environmental Monitoring Expert
8.	Mr. Ashraf Wahla	Sr. Sociologist – Field Mobilizer (I)
9.	Mr. Shahid Anwar Bajwa	Sr. Sociologist – Field Mobilizer (II)
10.	Mr. M. Muneeb Yousaf	GIS Analyst

1.2.4 ESIA methodology

During the ESIA study, a comprehensive assessment was conducted to evaluate the potential Environmental, Social, Health, and Safety (ESHS) effects and risks associated with the project's design, construction, and operation phases. The analysis leveraged site surveys, such as, socioeconomic, census, environmental quality monitoring, and biodiversity, conducted during September 2024 to February 2025), existing secondary data from government published literatures, such as census, statistical yearbook etc., stakeholder consultations, and professional insights drawn from similar projects. Details of these surveys and consultation are presented in Chapters 5, 6, and 7.

Each receptor was assessed for its sensitivity to changes in its external environment. Potential project-induced changes and hazards associated with project activities were analyzed to determine their potential impacts on receptors, as well as the risks posed to workers and the surrounding community.

By combining receptor sensitivity with the magnitude of potential impacts, the significance of each impact on each receptor was estimated. Based on this assessment, appropriate mitigation measures, risk controls, and management and monitoring strategies were developed to eliminate, avoid, minimize, or compensate for potential impacts and risks effectively.

1.3 Stakeholders Consultation and Focus Group Discussions

The ESIA Team were engaged in consultation with various stakeholders, including NHA, local and national institutions, NGOs, project affected communities, and public consultations/ public hearing in locations of project interventions and provincial headquarters with EPAs. Specific discussion sessions were conducted to include vulnerable groups (elderly, women, children, etc.). The outcome of these consultations has been utilized for identifying the important/valued environmental and social components and designing the mitigation, focusing the actual field scenario by fulfilling the expectation of the stakeholders.

1.4 Document Structure

Chapter 2: **Policy, Legal and Institutional Framework -** The legal provisions related to environmental protection relevant to the planning stage and operational activities of the Project are identified and discussed under the scope of the ESIA study. World Bank's ESF, ESS and EHSG are introduced along with the comparison of ESF and National Guidelines and how to fill the gaps.

Chapter 3: **Project Description** - The details of the technical features of the Project have been presented in this chapter based on the Technical Report of the Design Consultant. The details include the project overview, locations and description of the sites, major components, construction activities, type of equipment used, resources required. waste to be generated, costs and implementation schedule of the project.

Chapter 4: **Analysis of Alternatives -** The alternatives considered during project planning and design phase have been discussed in this chapter. It also includes a comparison between the project and without project alternative.

Chapter 5: **Environmental and Biodiversity Baseline** - Baseline environmental conditions covering the climatic conditions, physical environment including land, air, water, noise, aesthetic, waste, and traffic conditions in the project area of influence. The Chapter also presents biodiversity of the project area covering ecosystem, protected areas, habitats of important species, description of flora and fauna, mammals, birds, and fish.

Chapter 6: **Socioeconomic Baseline** - To provide a baseline of socio-economic and demographic indicators against which to measure the impacts of the Project over time, this chapter assesses the influence area against a number of social economic indicators, such as agriculture, health care, education, infrastructure, gender relations, and labor rights.

Chapter 7: **Stakeholder Consultations** - This chapter describes the process and outcome of the consultations carried out involving various types of stakeholders for determining the environmental and social impacts and risks associated with project implementation, along with the feedbacks/concerns/views on the Project.

Chapter 8: **Environmental and Social Impacts and Risks** - This chapter assessed potential risks and impacts of the project on physical, biological and socioeconomic environment using the mitigation hierarchy of ESS1. A cumulative impact assessment is also included in this chapter.

Chapter 9: **Occupational and Community Health and Safety** - This chapter describes all activities related to Occupational Health and Safety (OHS) and Community Health and Safety (CHS) which are planned and directed with consistent, approved, health and safety management practices, procedures or standards, in compliance with ESS1.

Chapter 10: **Environmental and Social Management Plan** - This chapter presents the environmental and social management plan (ESMP) of the project which is based on ESMP implementation practices in other Bank funded projects in the region and other good international industry practices. The basic objective of the ESMP is to manage adverse impacts and risks of proposed project interventions in a way that minimizes the impact and risk on the environment, workers, and community. The chapter also presents the implementation mechanism of the ESMP. This chapter also includes the present institutional arrangements and capacity building ability of the Project Implementation Unit in Headquarter (PIU-HQ) and the description of arrangements of Project Implementation Unit (PIU) for each section, consultant, and contractor.

2 POLICY, LEGAL, AND INSTITUTIONAL FRAMEWORK

2.1 General

This Chapter summarizes the national, provincial, AIIB and international environmental and social legislation, regulations, standards, and treaties relevant to this ESIA of the Project. The footprint of the Project is located in the administrative boundaries of two three provinces of Pakistan, i.e., Section 2: Ranipur – Rohri falls in districts of Khairpur and Sukkur which is in the province of Sindh, Section 7: Rawalpindi to Hassanabdal falls in the districts of Rawalpindi and Attock, in the province of Punjab, and Islamabad Capital Territory, while Section 8: Nowshera to Peshawar falls in the district of Nowshera and Peshawar which is in the province of Khyber Pakhtunkhwa. Hence, the rules, regulations and standards applicable in the three provinces are applicable to this Project in respective Sections. AIIB's ESF and the ESS relevant to this project are duly described in this section. World Bank's EHS Guidelines shall also be followed to make the project implementation in compliance with these guidelines.

2.2 Review of the National and Provincial Environmental Requirements

The applicable Environmental and Social (E&S) legislations and regulations are briefly described in **Table 2-1**.

Table 2-3: Applicable National and Provincial Acts

National/Provincial Acts (Year of implementation)	Relevance/Applicability
Pakistan Environmental Protection Act, 1997	The Pakistan Environmental Protection Act, 1997 (PEPA-1997) is the apex legislative tool empowering the federal government to frame regulations for the protection of the environment through federal agency. However, after 18th amendment, the powers have been delegated to provincial EPAs.
Sindh Environmental Protection Act, 2014	This Act has a direct bearing on the proposed Project as the subproject Section located in Sindh require environmental assessment studies.
Sindh Environmental Protection Agency, (Review of EC, IEE and EIA) Regulations, 2021	The provisions of these regulations are applicable for environmental screening of the project (section 2).
Sindh Environmental Quality Standards (2016)	All projects to be implemented in Sindh must conform to SEQS during all the phases, i.e., construction and operation.
Khyber Pakhtunkhwa Environment Protection Act, 2014	Khyber Pakhtunkhwa Environmental Protection Act 2014 is relevant to the proposed project, to protect the environment in the provincial boundaries of KP, requiring an Environmental Impact Assessment (EIA) to be prepared and submitted for this project for approval.
Khyber Pakhtunkhwa Environmental Assessment Rules, 2021	KP EPA has notified Environmental Assessment Rules, 2021 are applicable to the proposed intervention for Review of EIA and General Environment Approval, as project falls under Schedule-II (D).
Punjab Environment Protection Act-1997 (amended upto Act 35 of 2012)	PEPA 2012 (amended act) is the provincial version of PEPA-1997 relevant to the proposed project for activities to be carried out in the vicinity of the province of Punjab.
Punjab Environmental Protection	Schedule II of these regulations considers the proposed

National/Provincial Acts (Year of implementation)	Relevance/Applicability
(Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations 2022	project to file an EIA. Provisions of Regulation 11 to be applied to such project. Environmental approval from Punjab Environmental Protection Agency will be communicated to the Project proponent using Form prescribed in Schedule VI.
Pakistan Climate Change Act 2017	Under the Pakistan Climate Change Act 2017, any intervention in the country must take measures for comprehensive climate change mitigations and adaptations in line with country level commitments to United Nations Framework Convention on Climate Change (UNFCCC).
Sindh Forest Act, 2012	This act is applicable to the proposed project as the cutting of trees will be involved. The act will also be applicable if any forest areas are identified along the Section 2 in Sindh.
The Forest Act (1927) and Forest (Amendment in 2010)	The Forest Act of 1927 establishes the right of GoP to designate areas of reserved forest, village forest and protected forest. It has been confirmed through consultations that no such areas are present within the Project AoI.
Punjab Forest (Amended) Bill, 2016	To use reserved/protected forest land for a national project of strategic importance, an organization must: • Provide written, compelling reasons proving no alternative exists. • Offer land that is: o At least as large as the reserved/protected forest land. o Compact and preferably near the original forest. • Allocate funds for immediate planting and maintenance of the substitute land. The government will then officially designate the substitute land as a reserved/protected forest through a notification.
Punjab Hazardous Substances Rules, 2018	These rules apply to: • Involving hazardous chemicals that meet criteria in Schedule 1 (Part I: Toxic Chemicals) or are listed in Schedule 1 (Part II, Column 2). • Of hazardous chemicals listed in Schedule 2, in quantities equal to or exceeding the specified threshold (Column 3). An occupier in control of such activities must: • Recognize major accident risks. • Prevent major accidents and minimize their impact on people and the environment. • Provide workers with information, training, equipment, and antidotes to ensure safety.
The Punjab Emergency Services Act, 2006	Establish an emergency service for the purpose of maintaining a state of preparedness to deal with emergencies, provide timely response, rescue and emergency medical treatment to the persons affected by emergencies and recommending measures to be taken by related organizations to avoid emergencies.
Punjab Environmental Protection's (Motor Vehicles) Rules, 2013	A person shall not operate a motor vehicle from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the Environmental quality standards or where applicable the standards established under Clause (g) of subsection (1) of section 6 of the Act.
Protection of Trees and Brushwood Act (1949)	The Protection of Trees and Brushwood Act of 1949 prohibits the cutting or lopping of trees in the project area. This ESIA has been prepared in consistence with this Act. Contractor and sub-contractor will have to comply with this Act.

National/Provincial Acts (Year of implementation)	Relevance/Applicability
Antiquity Act (1975) Sindh Cultural Heritage (Preservation) Act, 1994 Punjab Antiquities Amendment Act 2012 Khyber Pakhtunkhwa Antiquities Act 2016	The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. These acts is applicable to the project and the Archaeology Departments in both provinces shall be informed in case of any resource found. As for now, there are no known antiquities in the project area.
Sindh Wildlife Protection, Preservation, Conservation and Management Act 2020	The act will be applicable if any wildlife protected areas/reserves are located in the vicinity of the section 2 in Sindh.
Punjab Wildlife (Protection, Preservation, Conservation and Management) Act, 1974	This Act requires measures for direct protection to the wildlife resources in Punjab province and indirect protection to other natural resources and allows the project to work on the principles of no harm.
Khyber Pakhtunkhwa Wildlife and Biodiversity (Protection, Preservation, Conservation and Management) Act, 2015	This Act consolidate the laws relating to protection, preservation, conservation and management of wildlife and Biodiversity in the Province Allows the Project to work on the principles of no harm and conserve biological diversity and realization of its intrinsic and extrinsic values through sustainable use and community participation.
Pakistan Labour laws 1973	Labor rights in Pakistan specified under Article 11 and 17 of the constitution of Pakistan, shall be applicable to the proposed project. More specific laws are described separately.
Factories Act, 1934	This is an act to consolidate and amend laws on labor rights and for matters connected to their safety, basic welfare facilities including living, food, occupational health including infectious diseases and protection from those infectious diseases; it also covers the work-related hazards and protection from those hazards, shelters facilities during rest time, restriction of working hours and holidays rules etc.
Sindh Factories (Amendment) Act, 2021	This act is applicable for the Project workers as well as belonging community including men, adults, women, adolescent working in and near the section located in Sindh (during construction phase).
Punjab Factories Act (amended), 2012	This is an amended law for the rights of labor works in the province of Punjab and applicable to the proposed works in Punjab jurisdiction.
KP Factories Act, 2013	This act provides regulation for labor rights in the Province of KP and for matters related to workers safety and protection, for any activity in the KP province.
KP Industrial Relations Act, 2010	An Act to regulate formation of trade unions, regulation, and improvement of relations between employers and workmen and the avoidance and settlement of any differences or disputes arising between them and ancillary matters.
The Sindh Occupational Safety and Health Act, (2017)	The act applies in any Project situation where worker's rights and protections are enforced. This law is applicable to construction and Project workers and will be complied during construction and operation phases.
KP Occupational Safety and Health Act, 2022	The act make provisions for the occupational safety and health of the persons at workplace and to protect them against risks arising out of the occupational hazards in order to promote safe and healthy working environment catering to the physical, and psychological needs of the workers at workplace and to provide for matters connected therewith or ancillary thereto.
The Punjab Occupational Safety and Health Act, 2019	This is a consolidated law for the OHS of the persons at workplace and to protect them against risks arising out of the occupational hazards; to promote safe and healthy working

National/Provincial Acts (Year of implementation)	Relevance/Applicability
	environment catering to the physiological and psychological needs of the employees at workplace.
Sindh Bonded Labor (Abolition) Act 2015	This act is applicable as the proposed project may involve the numbers of staff/worker having different religion, political affiliation, sect, color, caste, creed, ethnic background.
KP Bonded Labour System (Abolition) Act, 1995	The Bonded Labor System (Abolition) Act defines the `Bonded Labor System' as a system of forced, or partly forced, labor under which a debtor enters, or is presumed to have entered into an agreement with the creditor.
Sindh Minimum Wages Act, 2015	This Act will be applicable to the Project to ensure that the minimum wages and allowances should be given to the Project labor (skill and unskilled employed for the construction of the proposed Project.
The Sindh Differently Able Persons (Employment, Rehabilitation and Welfare (Amendment) Act, 2017	This act is applicable as the proposed project will involve serious occupation health and safety issues during construction phase and may cause serious injury to worker/staff causing permanent disability and differently able.
KP Minimum Wages for Unskilled Workers Ordinance	The ordinance states that every employer shall be responsible for the payment of minimum wages required to be paid under the ordinance to all unskilled workers employed, either directly or through a contractor, in his commercial or industrial establishment in KP province.
KP Workers Compensation Act, 2013	This act is expedient to provide for the payment by certain classes of employers to their workers or their legal heirs of compensation for injury or death by accident.
Employment of Children Act (ECA), 1991	This Act disallows child labor in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth years of age. The ECA states that no child shall be employed or permitted to work in any occupation set forth in the ECA (such as transport sector, railways, construction, and ports) or in any workshop wherein any of the processes defined in the Act is carried out.
KP Prohibition of Employment of Children Act, 2015	An act to prohibit the employment of children and to regulate employment of adolescents in certain occupations and processes to be taken place in provincial boundaries.
The Punjab Restriction on Employment of Children Act, 2016	This Act is applicable in Punjab vicinity to prohibit and regulate employment of children less than 15 years.
The Sindh Commission on the Status of Women Act, 2015	This act is applicable as the proposed project may involve the numbers of female staff/worker as well as local resident women along the project corridor which are directly or indirectly linked with project activities.
The Protection Against Harassment of Women at the Workplace Act, 2010	The Protection Against Harassment of Women at the Workplace Act, 2010 is a legislative act in Pakistan that seeks to protect women from sexual harassment at their place of work, and equally applicable to this project.
Disabled Persons (Employment and Rehabilitation) Act 2015	The Disabled Persons (Employment) and Rehabilitation (Amendment) Act 2015 seeks to reinforce the rights of people with disabilities in Pakistan in terms of their employment and everyday livelihood benefits, under the domain of this project activities.
Transgender Person Act 2018.	The Act provides legal recognition to transgender persons and prohibits discrimination and harassment. It also places an obligation on local governments to provide for the welfare of the community.
Land Acquisition Act 1894	Empowers the government to acquire private land for projects in the national interest. However, this project requires no land

National/Provincial Acts (Year of implementation)	Relevance/Applicability
	acquisition, hence this law is not applicable.
Local Government Act (LGA) (2013 as amended)	The project will be required to follow the provisions of the LGA with regards to pollution of air, water and land.

2.3 Relevant Sections of Provincial Environmental Laws/Acts Triggered

Table 2-2 enlists the key sections of the Sindh, Punjab and KP Environment Protection Act that have a direct bearing on the project area:

Table 2-4: Key Sections of Federal, Sindh, Punjab and KP Environment Protection Acts and OHS Acts for Project

Environmental Legislation	EPA 1997	Sindh EPA 2014	KP EPA 2014	Punjab EPA 2012	Relevance with Project
Prohibition of Certain Discharges or Emissions: "No person shall discharge or emit, or allow the discharge or emission of, any effluent or waste or air pollutant or noise, load, concentration or level which is in excess of the Environmental Quality Standards." "No person shall discharge effluents, emissions or wastes in excess of load permitted in the conditions of environment permit or environmental approval or license."	Section 11 of Act	Section 11 of Act	Section 11 of Act	Section 11 of Act	**Triggered** The Project is required to show the compliance of provincial and international standards related with air pollution, effluents, noise level, and waste.
IEE and EIA: "No proponent of a project shall commence construction and operation unless he has filed with the EPA an IEE or, where the project is likely to cause an adverse environmental effect, an EIA, and has obtained from the Agency, environmental approval in respect thereof."	Section 12 of Act	Section 17 of Act	Section 13 of Act	Section 12 of Act	**Triggered** The Project is required to obtain environmental approval of this EIA/ESIA before commencement of work from both provinces under these sections of the acts.
Written statement of Occupational Health and Safety Every employer shall, except in such cases as may he prescribed. declare a statement in writing, duly approved by Chief Inspector. prepared in consultation with workers and their representatives of a general policy, with respect to the	-	Section 11 of OHS Act	Section 9 of OHS Act	Section 9 of OHS Act	**Triggered** The Project will prepare Occupational Health and Safety Management Plan by the Contractors and reviewed by the Project Proponent and

Environmental Legislation	EPA 1997	Sindh EPA 2014	KP EPA 2014	Punjab EPA 2012	Relevance with Project
safety and health of all persons at the workplace and the policy shall be reviewed and revised when: (a) alteration to the procedures for managing risks to safety is made: and (b) changes to the premises where persons work, to the systems or methods or work or to the plant or substances used for work are made that may affect safety. health or welfare.					the Engineer and accord approval.
Handling of Hazardous Substances "No person shall generate, collect, consign, transport, treat, dispose of, store, handle, or import any hazardous substance except (a) under a license issued by the EPA and in such manner as may be prescribed; or (b) in accordance with the provisions of any other law for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement, or other Instrument to which Pakistan is a party." Enforcement of this clause requires the EPA to issue regulations regarding licensing procedures and to define hazardous substance.	Section 14 of Act	Section 13	Section 15 of Act	Section 14 of Act	**Triggered** The Project is required to show the compliance of provincial and international standards related with Handling of Hazardous Substances, such as, bitumen and other petroleum products.
Regulation of Motor Vehicles "No person shall operate a motor vehicle from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the standards, or where the applicable standards established under clauses (g) and (h) of subsection (1) of section-6."	Section 15 of Act	Section 15 of Act	Section 16 of Act	Section 15 of Act	**Triggered** The Project is required to show the compliance of provincial and international standards related with Handling of Motor Vehicles.
Penalties Whoever contravenes or fails to comply with the provisions of section 11, 12/13, 13/14, 14/15, 15/16, and 17/18 or any order issued there under shall be punishable with fine which may extend to one million rupees, and in the	Section 17 of Act	Section 22 of Act	Section 18 of Act	Section 17 of Act	**Triggered** The Project proponent (NHA) is required to show the compliance of all regulatory requirements of

Environmental Legislation	EPA 1997	Sindh EPA 2014	KP EPA 2014	Punjab EPA 2012	Relevance with Project
case of a continuing contravention or failure, with an additional fine which may extend to one hundred thousand rupees for every day during which such contravention or failure continues: Provided that if contravention of the provisions of Section 11 also constitutes contravention of the provisions of section 15/16, such contravention shall be punishable under sub-section (2) only.					the Project.

2.4 Applicable National and Provincial Policies

Pakistan has in place a comprehensive constitutional, policy framework for the protection of the environment and people. This section is structured around the constitutional foundation and legislative hierarchy. An overview of relevant national policies is presented in
. The full list of relevant policies is provided in **Table 2 -3**.

Table 2-5: Applicable National and Provincial Policies and Guidelines

National Policies (Year of implementation)	Relevance / Applicability
National Conservation Strategy (NCS), 1992	The NCS requires the project to show the compliance of all 14 core areas specified in the policy for environmental protection, conservation of natural resources and environmental sustainability through efficient use of resources.
National Environment Policy, 2005	This policy gives directions for addressing environmental issues and provides means for promoting conservation and environmental protection in line with international obligations and following the principles of sustainable management of resources and economic growth.
KP Labour Policy, 2018	This policy aims at decent working conditions following the international labor standards and asks for improvement in health and safety of workers and timely payment of wages.
Punjab Labour Policy, 2018	This policy requires the stakeholders in developing strategies, plans and programs for the protection and promotion of the rights and benefits of working community without jeopardizing the genuine concerns of the employers, through any project /activity in the Punjab province.
Sindh Strategy for Sustainable Development, 2007	This strategy is applicable as the proposed subproject (Sindh Section) involves the improvement of country-wide transportation and trade carried out on national highway.
National Forest Policy (NFP), 2010	The NFP establishes emphasizes on restoration, development, conservation and sustainable management of forests and allied natural resources. It seeks the project to ensure the sustainability of ecosystem functions, services and benefits for present and future generations.
National Climate Change Policy, 2012	The policy commits for taking appropriate measures for mitigation and adaptation to climate change through tools of environmental assessment, environ mental management and environmental enhancement. The present ESIA has been prepared in consistence with

National Policies (Year of implementation)	Relevance / Applicability
	this policy.
National Water Policy, 2002	Objectives of this policy include, efficient management and conservation of existing water resources, optimal development of potential water resources and improved flood control and protective measures. This project has considered the goals of this policy.
Guidelines for Sensitive and Critical Areas, 1997	These Guidelines aim for protection of critical ecosystems such as biosphere reserves, national parks, wildlife sanctuaries and preserves, and archaeological sites. The project has considered the objectives of the policy.
Guidelines for Public Consultation, 1997	Public involvement can lead to a better and more acceptable decision for project implementation; hence, the project has considered these guidelines for preparatory work.

2.5 National Environmental Quality Standards, 2012

Powers for regulating Environmental Quality Standards (EQS) transferred from the national government to the provincial governments in 2012. The Provincial EQS (PEQS) are materially the same as the National EQS (NEQS) that were established in 1993 and were subject to amendment in 2000, 2009 and 2010. EQS set out in the PEQS (as amended) and relevant to the Project include:

- Municipal and liquid industrial effluents (32 parameters)
- Industrial gaseous emissions (18 parameters)
- Motor vehicle exhaust and noise (used and new vehicles)
- Ambient air quality (9 parameters)
- Drinking water quality (32 parameters)
- Noise (four zones during day and night).

2.6 International Treaties and Conventions

Pakistan is a signatory to a number of international environment and social related treaties, conventions, declarations and protocols. The following are the relevant international treaties and conventions to which Pakistan is a party:

- Convention on the Conservation of Migratory Species of Wild Animals — Bonn Convention, 1983
    - Conserve terrestrial, aquatic and avian migratory species throughout their range.
    - Migratory species threatened with extinction are listed in Appendix A of the Convention.
    - Strive towards strictly protecting these animals, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them.
- Convention on Wetlands of International Importance
- Convention concerning the Protection of World Culture and Natural Heritage
- Convention on the International Trade in Endangered Species
- International plant protection convention

- International Covenant on Economic, Social and Cultural Rights
- Kyoto Protocol to the Convention United Nations Framework on Climate Change
- Stockholm Convention on Persistent Organic Pollutants
- Convention on Biological Diversity
    - o Conservation of biological diversity,
    - o Sustainable use of its component, and
- Fair and equitable sharing of benefits arising from genetic resources United Nations Convention on the Rights of the Child
- UNFCCC

ILO's Fundamental Conventions – Ratified by Pakistan
The following ILO's fundamental convention shall be applicable.

- Forced Labour Convention, 1930 (Convention No. 29)
- Freedom of Association and Protection of the Right to Organize Convention, 1948 (Convention No. 87)
- Right to Organize and Collective Bargaining Convention, 1949 (Convention No. 98)
- Equal Remuneration Convention, 1951 (Convention No. 100)
- Abolition of Forced Labour Convention, 1957 (Convention No. 105)
- Discrimination (Employment and Occupation) Convention, 1958 (Convention No. 111)
- Minimum Age Convention, 1973 (Convention No. 138) Minimum age specified: 14 years
- Worst Forms of Child Labour Convention, 1999 (Convention No. 182)

2.7 World Bank Environmental, Health and Safety Guidelines

World Bank Group's Environmental, Health, and Safety (EHS) Guidelines are applicable to the proposed project. In particular, contractors will be required to implement the General EHS Guidelines (April 2007) and the EHS Guidelines for Construction Materials Extraction (April 2007).

2.8 AIIB's Environmental and Social Framework

AIIB's Environmental and Social Framework (ESF) sets out the commitment to sustainable development, through an Environmental and Social Policy (ESP) and a set of Environmental and Social Standard (ESS) that are designed for environmental and social sustainability. There are 3 ESS and their applicability on project is given in **Table 2 -6**.

Table 2-6: AIIB Environmental and Social Standards Applicable to the Project

Sl.	Environmental and Social Standards	Description	Requirements and Gaps between ESF and Local Legislation	Relevance with Project and Actions (to be) Taken
ESS 1	Environmental and Social Assessment and Management	Identify Project-related risks to and impacts in the Project's area of influence. Engage in meaningful consultation with stakeholders during the Project's preparation and implementation. Apply a mitigation hierarchy approach by anticipating and avoiding risks and impacts; minimizing or reducing risks and impacts; and compensate for or offset them, where technically and financially feasible.	Assess the Project and its E&S risks and impacts; prepare Project's E&S documentation and furnish them to the bank, engage in consultation with Project-affected people and other relevant stakeholders, implement the Project in accordance with its E&S obligations under the Legal Agreements, and include the relevant E&S requirements in the bidding documents. **Relevant local Laws/Regulation** (a) PEPA 1997 (b) Punjab Environment Protection Act 2012 (c) Punjab IEE and EIA Regulations, 2000 (d) KP Environment Protection Act-2014 (e) KP Environmental Assessment Rules, 2021 **<u>Gaps:</u>** (i) The Schedules of IEE/EIA Regulations 2000 and the Environment Protection Acts of both provinces do not cover explicitly all of the AIIB's ESS in their statutory description. (ii) Limited Stakeholder/Social engagement is focused in Environment Protection Acts of both provinces, however, ESS1 through Stakeholder Engagement plan involves the consultations with all Stakeholders during project planning and implementation. (iii) The EIA require economic alternatives, their selection and rejection criteria. (iv) Employer's E&S requirements in the bidding document are not required by the Provincial laws.	(i) Project components were thoroughly screened to ensure that they are covered by and meet the requirements of ESS1 and Government laws and regulation. (ii) Extensive and meaningful consultations were conducted during the preparation of E&S documents. An SEP has been prepared to continue consultation during the implementation phase. (iii) E&S risks and Impacts have been identified in the ESIA based on surveys and consultations with primary stakeholders including communities and implementing agency. (iv) Environmental and Social Management Plan (ESMP) has been prepared based on the screening outcome and impact and risk assessment in the ESIA. ESMP will also include Employer's E&S requirements in the bidding documents. (v) The ESIA will be disclosed both in the NHA and Bank's websites. (vi) Monitoring and reporting on E&S performance will be carried out during implementation.
ESS 1	Health and Safety of Workers and Communities	Assess health and safety risks to Project workers and Project-affected communities. Promote the fair treatment, non-discrimination, and equal	Requirements for the Borrower to prepare and adopt labor management procedures. Provisions on the treatment of direct, contracted, community, and primary supply workers, and government civil servants.	Project will recruit the following types of workers: (i) Direct workers will include the project managers and supervisors, who are employees of NHA; (ii) All workforces deployed by the Contractors and the Project

Sl.	Environmental and Social Standards	Description	Requirements and Gaps between ESF and Local Legislation	Relevance with Project and Actions (to be) Taken
		opportunity of project workers. Protect project workers, with particular emphasis on vulnerable workers. Prevent the use of all forms of forced labor and child labor. Support the principles of freedom of association and collective bargaining of project workers in a manner consistent with national law. Provide project workers with accessible means to raise workplace concerns. Assess and appropriately manage the risks of adverse impacts on communities that may result from temporary Project-induced labor influx. If	Requirements on terms and conditions of work, non-discrimination and equal opportunity and workers organizations. Provisions on child labor and forced labor. Requirements on occupational health and safety, in keeping with the World Bank Group's Environmental, Health, and Safety Guidelines (EHSG). **Relevant Local Laws/Regulation** a) Pakistan Labour laws b) The Punjab Occupational Safety and Health Act, 2019 c) KP Occupational Safety and Health Act, 2022 d) Employment of Children Act, 1991 e) KP Industrial Relations Act, 2010 f) KP Bonded Labour System (Abolition) Act, 1995 g) KP Minimum Wages for Unskilled Workers Ordinance h) KP Factories Act, 2013 i) KP Workers Compensation Act, 2013 **<u>Gaps</u>** (i) The labor act does not make it mandatory for development interventions to be assessed and reviewed in terms of labor and working conditions, including OHS before approval. (ii) The labor act does not require development projects to prepare labor management plans / procedure or OCHSMP. (iii) No national OHS standards/guidelines are available for comparison or for implementation during the project.	Supervision Consultant under the NHA will be deemed to be contracted workers. The Engineering, Procurement and Construction (EPC) Contractor might further engage multiple subcontractors; (iii) Influx of migrant labor from other districts for construction works is a norm, however, will be minimized by employing local skilled workers to avoid influx. (i) A Labor Management Procedure (LMP) has been prepared to regulate working condition and management of workers relation including worker specific Grievance Redress Mechanism (GRM), terms and conditions of employment, nondiscrimination and equal opportunity, Sexual Exploitation and Abuse/Sexual Harassments (SEA/SH), protection of workforce, the prohibition of child /forced labor (including in source country and supply chain) and provision of OHS management. High likelihood of direct exposure to increased construction related traffic and equipment especially at access road traversing settlement area with limited carriageway/ roadway width and poor condition, and sensitive receptors such as schools, religious place, health center/hospitals; and high dust levels from earthworks, high noise and emission level from traffic congestion and idling of vehicles, and operation on batching and bitumen plant. (ii) Occupational and community health and safety (OCHS) will be addressed in the ESIA through an OCHS Framework by identifying major occupational safety and health risks for the workers during construction.

Sl.	Environmental and Social Standards	Description	Requirements and Gaps between ESF and Local Legislation	Relevance with Project and Actions (to be) Taken
				(iii) World Bank's EHS Guidelines and Good International Industry Practice, such as, OSHA will be used for guidance.
ESS 1	Resource Efficiency	Implement technically and financially feasible measures and sustainable use of resources, including energy, water, and raw materials. Avoid or minimize adverse impacts on human health and the environment caused by pollution from project activities. Avoid or minimize project-related emissions of short and long-lived climate pollutants. Avoid or minimize generation of hazardous and non-hazardous waste. Minimize and manage the risks and impacts associated with pesticide use. Requires technically and financially feasible measures to improve efficient consumption of energy, water, and raw materials, and introduces specific requirements for water efficiency where a project has high water demand.	Requires an estimate of gross greenhouse gas emissions resulting from project (unless minor), where technically and financially feasible. Requirements on management of wastes, chemical and hazardous materials, and contains provisions to address historical pollution. In comparison with ESS1, both provincial environmental laws, i.e., Punjab and KP EPAs exclusively prohibit the pollutants emission (under section 11 of Acts) and in case of violation penalize the proponent/s under Section 16 and 17 of the acts, respectively. ESS1 does not penalize the proponent/s, however give emphasis to avoid / minimize the pollution through Good International Industry and Management Practices. **Gaps**: There is no major gaps with the national regulations and standards except the ambient air quality standards (AAQS). National AAQS is relax for some pollutants compared with World Bank Group's Guidelines, e.g., standard for particulate concentrations.	With respect to Resource Efficiency, the project preparation and the ESIA process have identified feasible measures for efficient (a) energy use; (b) water usage and management to minimize water usage during construction, conservation measures to offset total construction water demand and maintain balance for demand of water resources; and (c) raw materials use by exploring use of local materials, recycled construction materials, use of innovative design so as to minimize project's footprints on finite water bodies. With respect to Pollution Management, based on past NHA project experiences, the project has developed, as part of the ESIA process, prevention and management measures to offset risks and impacts of pollution from potential sources such as dust and emission from operation of construction equipment, material haulage vehicles, batching and bitumen plants; effluents and wastewater from labor camps, construction camp; spillage or leakage during handling of hazardous materials like petroleum fuel, battery wastes etc.; and disposal of nonhazardous wastes (cardboards, panel boxes) generated during project implementation period.
ESS 1	Conserving Biodiversity	Protect and conserve biodiversity, sustainably managing terrestrial and aquatic natural resources and maintaining core ecological	Requirements for projects affecting areas that are legally protected designated for protection or regionally/internationally recognized to be of high biodiversity value. Requirements on sustainable management of natural resources,	Site clearance activities for project footprint will involve removal of vegetation and felling of trees. The biodiversity baseline studies have indicated that there are potential impacts on biodiversity, with flora and fauna,

Sl.	Environmental and Social Standards	Description	Requirements and Gaps between ESF and Local Legislation	Relevance with Project and Actions (to be) Taken
		functions and services are fundamental to sustainable development.	by making balance with a commitment to sustainable use of the multiple economic, social and cultural values of biodiversity and natural resources in an optimized manner. **Relevant Laws and regulations** a) Pakistan Environmental Protection Act, 1997 b) KP Environment Protection Act-2014 c) Punjab Environment Protection Act-2012 d) Guidelines for Sensitive and Critical Areas, 1997 e) Forest Act (1927) and Forest (Amendment Act 2010) f) Punjab Wildlife (Protection, Preservation, Conservation and Management) Act, 1974 g) Khyber Pakhtunkhwa Wildlife Protection, Preservation, Conservation and Management Act (1975) (the KP Wildlife Act) h) Protection of Trees and Brushwood Act (1949) **<u>Gaps</u>** The national laws do not describe quantitatively the compensatory plans of wildlife and forestry, i.e., how many numbers of trees to be planted against cutting of one tree. While sufficient penalty clauses are available in national laws.	however most of the affected species are indigenous and least concern as per IUCN category. ESMP will consider compensatory measures for each tree felt during the construction, recommended numbers are 1:5 (1 tree felt will be compensated by 5 saplings planting).
ESS 1	Stakeholder Engagement and Information Disclosure	Establish a systematic approach to stakeholder engagement that helps Borrowers identify stakeholders and maintain a constructive relationship with them. Assess stakeholder interest and support for the project and enable stakeholders' views to be	Requires engaging with Project-affected people and other relevant stakeholders, through: (i) timely disclosure of the Project's environmental and social information; (ii) meaningful consultation; and (iii) Project-level grievance redress mechanisms (GRMs), which can be readily accessed by Project-affected people. Stakeholder engagement throughout the project life cycle, and preparation and	Relevant as the project will involve a wide variety of stakeholders during its project cycle including Forest Department that are associated with ESMP implementation and community consultation for health and Safety, especially traffic safety. The project will ensure: i) Relevant stakeholders for the project are properly identified. ii) Stakeholders have been consulted during

Sl.	Environmental and Social Standards	Description	Requirements and Gaps between ESF and Local Legislation	Relevance with Project and Actions (to be) Taken
		taken into account in project design. Promote and provide means for effective and inclusive engagement with project affected parties throughout the project life-cycle. Ensure that appropriate project information is disclosed to stakeholders in a timely, understandable, accessible and appropriate manner.	implementation of a Stakeholder Engagement Plan (SEP). Requires early identification of stakeholders, both project-affected parties and other interested parties, and clarification on how effective engagement takes place. Stakeholder engagement to be conducted in a manner proportionate to the nature, scale, risks and impacts of the project, and appropriate to stakeholders' interests. Specifies what is required for information disclosure and to achieve meaningful consultation. **Relevant Laws/Regulation** (a) PEPA 1997 (b) Punjab Environment Protection Act 2012 (c) Punjab IEE and EIA Regulations, 2000 (d) KP Environment Protection Act-2014 (e) KP Environmental Assessment Rules, 2021 **Gaps** Limited Stakeholder/Social engagement is focused in Environment Protection Acts of both provinces; however, ESS through SEP involves the Stakeholder engagement till the completion of project.	the preparation of the ESIA. iii) A Stakeholder Engagement Plan (SEP) has been prepared to be followed during the implementation of the project.

2.9 Project Categorization

2.9.1 KP EPA

Schedule II of the Environmental Assessment Rules (EAR) 2021, Categories of projects requiring Environmental Impact Assessment (EIA), listed under Transport Category Bullet 2: Federal or Provincial Highways. Therefore, Phase 1A Section 8 of N5 reconstruction and expansion will require an EIA as per the Rule 4 of the EAR 2021.

2.9.2 Punjab EPA

Schedule II of the Punjab Environmental Protection (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations 2022, Categories of projects requiring Environmental Impact Assessment, listed under Transport Category Bullet 2: Highways, Motorways and Expressways or major roads. Therefore, Phase 1A Section 7 of N5 reconstruction and expansion will require an EIA as per the Article 4 of the 2022 Regulations.

2.9.3 Environmental and Social Framework of AIIB

AIIB Environmental and Social Framework uses categories of A (significant), B (limited), C (minimal) or FI (provision of funds through a financial intermediary). Category A with significant adverse environmental and social impacts, requires an ESIA along with Environmental and Social Management Plan (ESMP). Category B with limited potentially adverse environmental and social impacts and require an ESMP or an ESMPF. Category C with minimal environmental and social impacts Bank does not require an environmental and social assessment, but does require the Client to prepare an analysis of the environmental and social aspects of the Project.

AIIB, in its environmental and social review, classified the Project as ‘A’ with high risk as per the Environmental and Social Risk Classification. Potential environmental impacts and social risks are identified, including construction and expansion of the Phase 1A of N5, air pollution due to dust and bitumen plant; high noise level and vibrations from construction vehicles and machinery; road safety for communities due to high volume of construction vehicles using local access road; traffic congestion and associated air pollution during diversion of traffic from N5; water logging during the reconstruction of drainage structures; accidental spills, particularly from fuel and lubricants used in construction machinery; occupational health and safety risks during construction; potential capacity constraints within the NHA in ensuring environmental and social compliance, considering the extensive geographic scope of the proposed intervention; and improper site reinstatement, where construction sites are inadequately restored post-project. The Project will also contribute to environmental benefits by reducing fuel consumption through smoother traffic flow and lower congestion.

2.9.4 Environment Category and E&S Risk Classification

A review of the project based on available information suggests the project falls under ‘Schedule III’ of KP EP Act and “Schedule I” of Punjab EP Act, and ‘high risk’ as per the AIIB’s E&S Screening and Categorization. This is because the potential adverse risks and impacts on human populations and the environment are likely to be significant. The Project involve activities that have a high potential for harming people or the environment and is located away from environmentally or socially sensitive areas. As such, the potential risks and impacts and issues are likely to have the following characteristics:

- Irreversible, cumulative, diverse or unprecedented. These impacts may affect an area larger than the footprint, subject to physical works and may be temporary or permanent in nature.
- High in magnitude
- Wide coverage, with likelihood of impacts beyond the actual footprint of the Project
- High probability of serious adverse effects to human health and/or the environment

2.10 Environment Regulatory Authorities

2.10.1 Overview

The project will be implemented and operated by NHA with the involvement of government ministries, departments and agencies, where these hold responsibilities relevant to the Project and / or represent key stakeholder interests. Private sector companies will also play a role particularly during construction.

2.10.2 Statutory organizations

A summary of the key E&S regulatory institutions and their relationship with the project in accordance with national, provincial, and international requirements is provided in **Table 2 - 7**.

Table 2-7: Roles of statutory organizations

Organization	Functions / Role
KP Environmental Protection Agency (KP-EPA) & Punjab Environment Protection Department	Both the EPAs are responsible for: • Regulating the environmental issues. • Reviewing and checking environmental assessment report prepared as per the legal requirements. • Environmental approvals of the Project. • Ensuring the implementation of government policies, during the project implementation. • Ensuring compliance and reviewing the performance of environmental management plans implementation.
Forest Departments (KP & Punjab)	The forest departments are responsible for: • Administration and enforcement of Provincial Forest Ordinances. • Protection of forests, waste lands and its biodiversity from project interventions, denudation etc. • Promotion of suggesting measures for forest management involving community and project resources. • Conservation and improvement of ecology and natural habitat.
KP Wildlife Department & Punjab Wildlife and Parks Department	The wildlife departments are responsible for: • Enforcing the National Wildlife (Protection, Preservation, Conservation and Management) Act of 1975 and the rules made there under • Identifying, notifying, and managing National Parks, Wildlife Parks, Wildlife Refuges, Wildlife Sanctuaries and

Organization	Functions / Role
	Game Reserves. • Protecting the wildlife from any intervention. • Replenishing the depleted wildlife population through protection and/or reintroduction measures.
Labour Department, KP & Labour and Human Resource Department, Punjab	The labour departments in both provinces are responsible for: • Guaranteeing the rights of the workers like the right to organize, the right to collective bargaining, participation in the affairs of the implementing agency, health & safety, minimum wages, compensation, etc., are followed in the project.
Zakat Ushr, Social Welfare, Special Education and Women Empowerment Department – KP & Women Development Department, Punjab	These departments are responsible for: • Transformation of the government into an organization that actively practices and promotes gender equality and women empowerment. • Mainstreaming gender equality perspective across public policies, laws, programs, and projects by departments and agencies of the government with a focus on women empowerment. • looking after various marginalized segments of population such as poor, persons with disabilities, orphans, victims of violence and specifically women to ensure the welfare and support the marginalized group of society.
KP Workers Welfare Board & Punjab Workers Welfare Fund	The workers welfare boards are responsible for: • provision of housing, education, health and other welfare facilities to the workers and their families. • Promoting the same through projects.
Employees' Old Age Benefit Institution	The EOBI is responsible for: • Making sure that workers are benefitted after retirement from the collected/raised funds.

2.11 APPROVALS FROM RELEVANT GOVERNMENT DEPARTMENTS

The proposed project will require various approvals from relevant government departments during implementation as summarized **Table 2 -8** in below.

Table 2-8: Approvals and Permits Required during Project Implementation

Sl.	Approval Required	Issuing Authority	Requirements	Responsible Agency	Schedule
1.	Clearance of ESIAs/ESMPs, RAPs, and other required instruments as described in the ESMPF and RPF	AIIB	Submission of site-specific E&S instruments	PIU-HQ-NHA	Prior to initiation of subproject construction works
2.	Environmental approval for the construction works	Concerned EPAs	Submission of EIA(s)	PIU-HQ-NHA	Prior to initiation of subproject construction works
3.	Approval for notified forest & wildlife areas, and clearing of trees	Concerned Forest and Wildlife Department of each province	Submission of request with detailed project layout/plans	PIU-HQ-NHA	During construction phase

Sl.	Approval Required	Issuing Authority	Requirements	Responsible Agency	Schedule
4.	Approval for River, Stream, Nullah and Canal Crossings	Concerned Irrigation Department	Submission of request with detailed project layout/plans	PIU-HQ-NHA	During construction phase
5.	Approval for the use of quarry and excavated material	Concerned Mines and Minerals Department	Submission of request with location map of the quarry area	PIU-HQ-NHA	During construction phase
6.	Approval for disposal of solid and liquid waste	Concerned Municipal Authorities	Submission of request with detailed project layout, location map and Waste Management Plan	PIU-HQ-NHA	During construction phase
7.	Approval for crossing of public utilities	Concerned Agencies	Submission of request with detailed project layout, location map and site-specific details of utilities	PIU-HQ-NHA	During construction phase
8.	Approval for crossing of notified archeological and cultural sites	Concerned Archeological Department	Submission of request with detailed project layout, location mapand Chance Find Procedures	PIU-HQ-NHA	During construction phase

3 DESCRIPTION OF PROJECT

3.1 Project Background

The National Highway Authority (NHA) has developed a comprehensive 20-year plan to reconstruct and widen the entire 1,819-kilometer-long N5 highway in four phases. This strategic initiative aims to enhance connectivity, improve road safety, and boost economic activity across Pakistan.

The Project aims to enhance climate resilience, operational efficiency, and road safety by reconstructing and upgrading critical four-lane segments into a climate-resilient six-lane dual carriageway. AIIB's financing, referred to as the "Multi-phase Program" (MPP), supports the reconstruction of four sections of the N5 highway in Phase 1, spanning 209 km across Islamabad Capital Territory, Punjab, Khyber Pakhtunkhwa, and Sindh provinces. Phase 1 has divided into Phase 1A consisting of three Sections (2, 7, and 8) with 141 km road and Phase 1B is covering 68 km road and 1 km long Nai Baran bridge.
The reconstruction and upgrades include geometric enhancements, service roads on both sides in urban areas, the installation of advanced road safety devices, flyovers, improved underpasses, pedestrian crossings, protected U-turns, and newly designed or modified bus bays.

The Project also aims to minimize congestion and delays by expanding capacity with additional lanes, improving accessibility, and enhancing the road's ability to accommodate higher traffic volumes for the efficient movement of goods and passengers. Key benefits include reduced vehicle operating costs and travel time, improved road safety with a lower accident rate, and strengthened socio-economic conditions in surrounding areas. By fostering employment opportunities, supporting local businesses, and facilitating smoother transportation of raw materials and finished goods to markets, the project will contribute to economic growth. Additionally, the improved geometric road design will help prevent accidents and ensure the timely delivery of perishable goods, reducing spoilage and logistical inefficiencies.

The upgraded N5 will be designed with climate resilience, road safety, and operational efficiency in mind:

- **Climate Resilience** – The use of climate-adaptive materials and designs will strengthen the highway's ability to withstand extreme weather events, such as flooding and heat damage, minimizing disruptions and maintenance costs.
- **Road Safety** – Modernized Road designs and advanced traffic management systems will significantly reduce accident rates, ensuring safer travel for commuters and freight operators.
- **Intelligent Transportation Systems (ITS)** – The integration of ITS will enhance real-time traffic monitoring, congestion management, and incident response, leading to improved transport efficiency for logistics companies and everyday travelers.

By making the N5 highway safer, more resilient, and better managed, the Project is set to deliver long-term economic and social benefits for Pakistan, reinforcing its role as a vital transport corridor for trade and commerce.

3.2 Project location

Phase 1A of the project (the "Project") prioritizes the reconstruction and expansion of three critical sections of the N5 highway, covering a total of 141 kilometers:

- **Section 2: Ranipur to Rohri (70 km)** – This section is located in Sukkur and Khairpur districts of Sindh province and serves as a crucial link in the transportation of goods and passengers between Karachi and northern Pakistan. The upgrade aims to improve road capacity and reduce travel time.
- **Section 7: Rawalpindi to Burhan (40 km)** – Situated in Rawalpindi and Attock districts of Punjab province and in Islamabad Capital Territory (ICT), this stretch is a vital part of the highway connecting the northern region with the federal capital and beyond. Its reconstruction is expected to enhance mobility and safety for commuters and freight transport.
- **Section 8: Nowshera to Peshawar (31 km)** – This segment, located in Nowshera and Peshawar districts of Khyber Pakhtunkhwa province, connects key urban centers and supports regional trade and economic activities. The planned improvements will facilitate smoother traffic flow and strengthen regional connectivity.

The location maps of each Section are presented in **Figure 1.1, Figure 1.2, and Figure 1.3** for Section 7, Section 8, and Section 2, respectively.

3.3 Project Salient Features

The Phase 1A Project involves widening and improvement of the existing section of the Ranipur to Rohri, Rawalpindi-Burhan, and Peshawar-Nowshera sections of N5 Highway. It also involves the provision of service roads close to urban settings, extension of existing and construction of new structures which include bridges, culverts, flyover and relocation of existing drains (locations are provided in Vol. 3 - Climate Change Assessment Report) and existing utilities (where required). The salient features of the Project are presented in
.

Table 3-9: Salient design features of the Phase 1A highway

Project Feature	Ranipur to Rohri	Rawalpindi – Burhan	Peshawar – Nowshera
Length (km)	70	40	31
Design Speed (Rural/Semi Urban/ Urban) (km/h)	100 / 80 / 60	100 / 80 / 60	100 / 80 / 60
Design Vehicle	WB-20 (6 Axle Articulated Trailer)	WB-20 (6 Axle Articulated Trailer)	WB-20 (6 Axle Articulated Trailer)
Flyovers Railways	01 (2+2 lanes) Retained at Railway crossing	01 (3+3 lanes) Fateh Jang Railway crossing	01 (3 lanes) South Bound Carriageway over railway crossing of Amangarh, Right side 3-lanes existing

Project Feature	Ranipur to Rohri	Rawalpindi – Burhan	Peshawar – Nowshera
			flyover to be retained
Service Roads (km)	20.20 km (both side)	24.24 (both side)	12.75 (both side)
Weigh Stations	15 Locations, Existing to be retained=11 Modified = 04 locations (3 bays each)	02 Locations, (2+2 lanes, existing to be modified)	01 Location (2- lanes, existing to be modified)
Bus bays	12 (Proposed)	08 (Proposed) (Existing to be retained)	10 (Proposed = 01) (Existing to be modified = 09)
Drainage Structures	Mud cleaning 3 culverts and 1 bridge Increase capacity of 1 culvert Replacement of 7 culverts	Mud cleaning and maintenance 5 culverts 6 bridges Increase capacity of 3 culverts	Increase capacity of 5 bridges and 6 culverts Replacement of 1 bridge and 1 culvert
Pedestrian Bridges/ Pedestrian Underpasses	22 (widening = 01, new = 21)	34 (Pedestrian Bridges widening = 22, new = 12), 07 (Pedestrian Underpasses retained)	03 (Pedestrian Bridges widening = 01, new = 02
U-turns	18 (Proposed)	20 (Proposed)	13 (Proposed)
Toll Plaza	01 at Ranipur The existing toll booth, canopy, bays, pavement, and electrical/electronic works are to be modified with a new design. Renovation of the building adjacent to the toll	01 at Sangjani, Existing to be modified with new design of toll booth, canopy, bays, pavement and electrical/ electronic works. Renovation of toll adjacent building.	Nil

Pavement designs of all three sections of the road will follow AASHTO guidelines and presented in **Table 3.2**.

Table 3-10: Pavement design for all three sections of the highway

Item	Unit	Ranipur to Rohri	Rawalpindi – Burhan	Peshawar – Nowshera
Widening Section				
Asphalt Concrete Wearing Course	mm	50	50	50
Asphalt Concrete Base Course	mm	190	180	180
Aggregate Base Course	mm	300	300	300
Granular Subbase	mm	250	250	250
Rehabilitation of existing road				
Asphalt Concrete Wearing Course	mm	50	50	50
Asphalt Concrete Base Course	mm	190	180	180
Aggregate Base Course	mm	150	150	150
Proposed Pavement for Service Road				
Asphalt Concrete Wearing Course	mm	50	50	50
Asphalt Concrete Base Course	mm	250	80	250
Aggregate Base Course	mm		250	
Granular Subbase	mm	150	150	150
Subgrade shall have a minimum soaked CBR	%	8% @95% M.D.D.		
Design period	Year	10		

The typical cross section of the Phase 1A Project highway is presented in **Figure 3.1**.

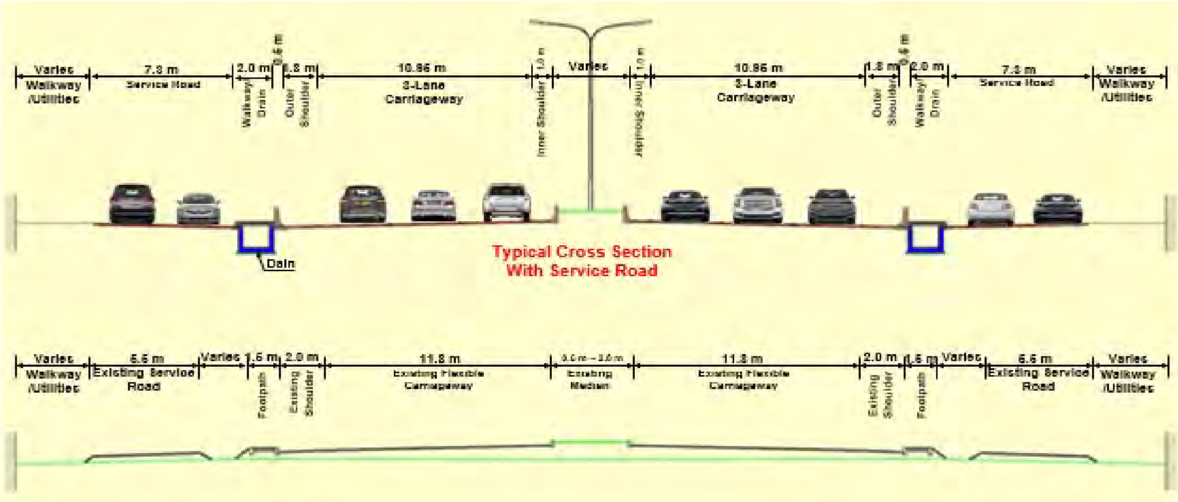


Figure 3-4: Typical Cross Section of the 6 Lane highway with Service Road

3.4 Traffic DATA

The main objective of Traffic Studies is to assess the volumes and composition of traffic load likely to use the proposed road immediately after the Project implementation. The projected volumes of traffic for the future years are used to predict air quality and noise level. NHA provided traffic counts data of 2024, along with forecasted traffic of 2030 and 2045 and are presented in Table 3 -11.

NHA forecasts regional traffic volume based on the relevant provisions of Highway Capacity Manual (2017 Edition, People's Communications Press). NHA estimated the maximum service traffic volume corresponding to the traffic demand under the design conditions and the design service level. It aims to determine whether the construction and implementation conditions of the Project can ensure that the planned Class-C II highway can operate under the required Level -IV service level in future after the reconstruction of the Phase 1A highway.

In 2024, the average two-way daily traffic was recorded as 39,266 vehicles/day for Section 2, 116,628 vehicles/day for Section 7, and 73,327 vehicles/day for Section 8.

By 2030, the projected two-way daily traffic is expected to increase after the reconstructed highway is operational to 47,526 vehicles/day for Section 2, 142,226 vehicles/day for Section 7, and 90,967 vehicles/day for Section 8, respectively.

Looking further ahead to 2045, the forecasted two-way daily traffic is estimated to reach 72,914 vehicles/day for Section 2, 222,000 vehicles/day for Section 7, and 148,195 vehicles/day for Section 8.

Table 3-11: Current and forecasted Traffic on Section 2, Section 7 and Section 8

Year	Directions	Motor Cycles	Ricksh -aws	Cars/ Jeeps	Wagons/ Pick ups	Mini Bus/ Trucks	Buses / Coasters	Trucks		Trucks (Articulated)			Tractors Trolley	Total Traffic (VPD)	Total PCUs
								2-Axles	3-Axles	4-Axles	5-Axles	6-Axles			
SECTION 2: RANIPUR – ROHRI (Two-Way Traffic)															
2024	Ranipur to Tando Masti	1174	159	4733	820	798	837	975	1139	1568	724	1880	141	14948	30263
	Tando Masti to Rohri	4719	982	7407	1774	1019	1018	1426	1282	1513	723	2137	319	24318	39594
2030	Ranipur to Tando Masti	1499	196	5800	972	926	971	1155	1350	1858	858	2228	167	17979	36031
	Tando Masti to Rohri	6023	1214	9076	2103	1182	1180	1690	1520	1793	857	2533	378	29547	47373
2045	Ranipur to Tando Masti	2460	307	8969	1488	1341	1406	1726	2016	2777	1282	3328	249	27349	54118
	Tando Masti to Rohri	9886	1902	14035	3220	1711	1710	2524	2270	2678	1280	3784	564	45565	71627
SECTION –7: RAWALPINDI – BURHAN (Two-Way Traffic)															
2024	Tarnol to Taxila	10893	1596	30928	3622	1386	279	727	5037	166	62	200	66	54962	59592
	Taxila to Hassanabdal	21385	6103	21727	2839	1242	326	656	5350	144	44	163	110	60090	58899
2030	Tarnol to Taxila	13903	1972	37898	4295	1607	324	862	5969	197	74	237	78	67415	72360
	Taxila to Hassanabdal	27296	7542	26624	3366	1441	378	777	6340	170	53	193	131	74311	71832
2045	Tarnol to Taxila	22823	3091	58602	6575	2327	469	1288	8918	294	110	353	117	104967	111242

Year	Directions	Motor Cycles	Ricksh -aws	Cars/ Jeeps	Wagons/ Pick ups	Mini Bus/ Trucks	Buses / Coasters	Trucks		Trucks (Articulated)			Tractors Trolley	Total Traffic (VPD)	Total PCUs
								2-Axles	3-Axles	4-Axles	5-Axles	6-Axles			
	Taxila to Hassanabdal	44807	11819	41169	5153	2087	548	1161	9472	254	79	289	196	117033	111147
SECTION – 8: NOWSHERA – PESHAWAR (Two-Way Traffic)															
2024	Nowshera to Pabbi	7119	4791	16975	3298	651	126	879	1415	130	75	360	206	36027	36734
	Pabbi to Peshawar	8913	6191	18762	3130	609	138	1041	1352	158	77	584	219	41173	41465
2030	Nowshera to Pabbi	9087	5921	20801	3911	755	146	1042	1677	154	89	427	245	44255	44705
	Pabbi to Peshawar	11376	7651	22990	3712	706	160	1233	1602	187	92	692	259	50661	50524
2045	Nowshera to Pabbi	14916	9279	32164	5987	1094	212	1556	2505	231	133	638	366	69081	68970
	Pabbi to Peshawar	18674	11990	35549	5682	1023	232	1843	2393	280	137	1034	388	79225	78042

Source: PC1

3.5 Associated facility

There is no associated facility in Phase 1A Project.

3.6 Construction Materials

The materials used in construction would include coarse aggregates (crush), fine aggregates (sand), soil, water, asphalt, reinforcement, cement etc. Almost all these raw materials are locally available in the area. Additionally, the project will require the consumption of bitumen for asphalt plant, petrol, diesel, and lubricants/oil for vehicles and construction machinery. The construction material will be procured from approved quarries (Taxila for Section 7 & 8) and no new quarry will be required by the contractors. The quantity of construction material required for the proposed project has been estimated tentatively and provided in **Table 3.4**.

Table 3-12: Quantification of Construction Material

Sl.	Description	Unit	Section 2 Ranipur-Rohri (70 km)	Section 7 Rawalpindi-Burhan (40 km)	Section 8 Nowshera-Peshawar (31 km)
1	Concrete	m^3	433,461	247,692	23,339
2	Cement	Bag	3,700,080	2,114,332	199,223
		ton	185,004	105,717	9,961
3	Reinforced Steel	ton	35,811	20,463	1,928
4	Excavation	m^3	8,557,272	54,599	5,145
5	Embankment	m^3	1,674,145	4,889,870	460,748
6	Subbase	m^3	1,093,065	956,654	90,141
7	Aggregate Base	m^3	8,557,272	624,609	58,854

3.6.1 Borrow Soil for Embankment

Topography of the project area is plain and borrow soil for road embankment is locally available along road alignment. It is estimated that 90,390 m^3 of borrow materials will be required for Section 2 highway construction. On the other hand, surplus materials generated from excavation in Section 7 and 8 will be used for embankment preparation.

3.6.2 Borrow Material for Sub Base

Suitable sub-base materials are locally available, making them a cost-effective choice. These materials may include pit-run or bed-run gravel, sand-gravel mixtures, or soil aggregates. Numerous seasonal nullahs (streams) cross the road alignment, and their material can be used as sub-base after removing particles larger than 2 inches. Sample testing of locally sourced materials will be conducted before final selection. The Provincial Mines and Minerals Departments lease these streams and nullahs to designated vendors. Therefore, the Contractor must coordinate with the approved vendors to source materials from these locations. To ensure environmental compliance, the use of riverbed material will be strictly prohibited, and only materials from designated quarry sites in Taxila and Sakhi Sarwar will be permitted.

a) Crushed Aggregate

Aggregates of different sizes are naturally available along the Phase 1A Project area. Aggregate will be tested by the design consultant, as well as the Contractor and approved by the Supervision Consultant before use.

b) Fine Aggregate

Sand will be obtained locally from the designated quarry sites, which are licensed by relevant department of the government, complying with environmental regulations. It will be ensured that river bed material will not be allowed to use. Samples of sand available from approved quarry sites will be tested by the design consultant, as well as the Contractor for their gradation to meet the desired requirements as per standards for concrete.

c) Subgrade Material

Large quantity of sub–grade (soil) is abundantly available at various locations, e.g., Nowshera, Taxilla, Sakhisarwar, Ranipur) along the Project alignment. Borrow pits of suitable material at a reasonable reach will be selected, complying provincial EPA requirements and international good practices. The testing for index properties, sulfate, chloride contents and organic contents will be performed.

d) Asphalt, Reinforcement and Cement

Asphalt, reinforcement and cement will be transported from local markets. The testing of available material will be done as per the Project requirements.

3.7 Construction Activities

Construction of the Phase 1A highway involve the following major tasks:

- Site Clearance (clearing of vegetation/ trees);
- Earth work (Excavation and filling of unsuitable material and top soil);
- Establishment of Camps and Workshops;
- Transportation and Storage of Materials;
- Use of Construction Vehicle and Heavy Machinery;
- Installation and operation of Batching and Asphalt Plants;
- Spoil Disposal;
- Structural Works;
- Drainage Work;
- Roadwork (milling, levelling, preparation of sub grade, sub base, base and wearing course including asphalt and concrete mixing); and
- Miscellaneous Work (Road Ancillaries, Traffic Signs and Signals etc.)

The right-of-way of all three Sections lie in plain land and do not pass through any mountainous terrain, hence drilling and blasting will not be needed. The reconstruction and widening of the Phase 1A highway include but not limited to the following:

- The project involves comprehensive road infrastructure improvements, including milling and removal of the existing surface, excavation and grading for elevation adjustments, installation of a new base layer, and pavement overlay with asphalt.

Compaction will ensure stability. Bridge construction includes deck, superstructure, and substructure work, along with the improvement of seven underpasses, construction of 14 new pedestrian bridges, and widening of 23 existing ones. Additionally, a six-lane and a three-lane flyover will be built. Structural enhancements include the installation of new expansion joints, bearings, and guardrails.

- Culvert reconstruction involves removing old structures, installing new concrete or corrugated metal culverts, backfilling, and compaction. Road shoulders will be reinforced, graded, and shaped to prevent erosion, with appropriate materials such as aggregate or asphalt applied. Road safety measures include installing new lane markings, crosswalks, stop bars, and signage for traffic guidance and compliance with safety standards.
- Maintenance and rehabilitation efforts include patching and resurfacing road defects, crack sealing, and leveling surfaces. Bridges will undergo repairs for spalling, cracks, and structural deterioration, including expansion joint and bearing rehabilitation. Existing culverts will be cleaned, maintained, repaired, or relined to extend their lifespan. Additional measures include refreshing road markings and signage, replacing damaged signs, maintaining shoulders through grading and re-graveling, and clearing obstructions from culverts and ditches to improve drainage.

3.8 Construction Equipment

The list of the machinery and the equipment required for the construction of the Project is provided in **Table 3.5**. The machinery and equipment used for the proposed Project will typically result in the release of oil spills and gaseous emissions.

Table 3-13: Machinery and Equipment Requirement

Sl.	Type of Machinery/ Equipment	Sl.	Type of Machinery/ Equipment
1	Mill/Planer	11	Self-Propelled Pneumatic Roller
2	Dump Truck	12	Asphalt Distributor
3	Front End Loader and Dozer	13	Batching Plant/ Crusher
4	Grader	14	Concrete Transit Truck
5	Vibratory Roller	15	Concrete Pump
6	Water Tankers	16	Excavator
7	Aggregate Spreaders	17	Water Pumps
8	Third Wheel Rollers	18	Cranes
9	Tandem Roller	19	Vibrators
10	Asphalt Plant	20	Generators

3.9 Construction Camps and Yards

Camp sites will be selected based on following considerations:

- Number of workforces deployed;
- Type and quantity of machinery mobilized;
- Availability of adequate area for establishing camp sites including parking areas for machinery, stores and workshops;
- Access to communication and local markets and away from the local population settlements; and
- Appropriate distance from sensitive areas including settlements and religious and/or cultural facilities.

Based on the above criteria and consultant's experience, three (03) construction camps including Contractor's office, construction equipment yard, material stock piling, parking spaces etc. will be required for each Section. However, final locations will be selected by the Contractor in association with the Employer and the Supervision Consultant employed by the Concessionaire, which will be finalized after the approval from Project Director. Care will be taken to safeguard the existing environment of the area and location shall be selected away from settlements. It will not be possible to locate camp sites within the RoW. The contractors may acquire land on lease from private landowners.

The contractors while selecting the locations of construction camps and yard will be required to consider the following criteria:

- Temporary lease of land from the private owner with an agreed price.
- Resettlement of people and houses must be avoided while selecting the location of the camps and yards;
- Camp and yard site will be away from the residential areas and sensitive receptors;
- Selection of sites shall be near the Project area having proper access to the nearby main/link road;
- The site must be located in a place where the drainage from and through the camps will not threat any domestic or public water supply;
- Camp and yard site must be adequate in size to prevent overcrowding of necessary structures (about 1500 m2 land is required for each camp site as per designers' recommendation, which may be finalized during implementation phase as per requirement);
- The site will avoid any damage of property, vegetation, irrigation, and drinking water supply systems;
- The camp site must not be subject to periodic flooding; and
- The site must be away from ecologically sensitive areas, e.g., wildlife sanctuaries, game reserves, national parks, etc.

3.10 Work Force

The workforce required for Phase 1A of the 6-lane highway construction depends on various factors, including construction methods, mechanization levels, project timelines, and labor productivity. However, based on industry standards and previous large-scale road construction projects, the Consultant has estimated the required workforce, as presented in **Table 3 -14**. The actual workforce for each Section will be determined by the contractors during the construction phase.

Road construction is a significant employment-generating industry, and the country has a well-established pool of skilled workers, including those with experience from the Middle East. It is anticipated that less than 30% of the workforce during the peak construction period will be migrant workers, primarily for specialized tasks requiring advanced technical skills and management staff.

Table 3-14: Estimated workforces for 3 Sections of Phase 1A Project

Sections	Length (km)	Total No of Workers	Skilled Workers	Unskilled Workers
Section 2	70	1,000	250	750
Section 7	40	800	200	600
Section 8	31	700	175	525

3.11 Security Personnel

A total of 30-45 security personnel (approximately) shall be deployed for each Section under the Project. Detailed project site security plan has been provided in the Labor Management Plan (LMP) document (please refer to Annexure II of the LMP).

3.12 Water Requirement

The source of water for construction purpose during the construction phase will be transported using water bowser tanks from local sources and drinking water from reliable groundwater (if available after testing water quality parameters eligible for drinking purpose) will be used. The water consumption in the camp for human use is estimated to be 40,000 liters/day[1] for Section 2, 32,000 liters/day for Section 7, and 28,000 liters/day for Section 8. It is estimated that 0.083 million m^3 of water for construction purpose during the entire construction period (about 116 m^3 per day) will be utilized for concreting activities.

3.13 Energy Sources

Energy resources will be essential for operating Project vehicles, construction machinery, batching plants, asphalt plants, offices, residential colonies, and labor camps. The primary energy sources required for the Project include diesel, petrol, natural gas, and electricity.

It is estimated that the total energy demand across all sources will be approximately 517 terajoules for Section 2, 307 terajoules for Section 7, and 217 terajoules for Section 8, respectively. However, contractors will be responsible for maintaining detailed records of fuel consumption for various energy sources throughout the construction phase.

Diesel, petrol, and natural gas will be sourced from the nearest fuel stations, which are readily available in cities, towns, and along existing highways. Electricity will be supplied through local power distribution companies, with connections established from the nearest substations and distribution lines.

1

Tentative Work Force Requirements Including Client and Contractor Staff"
= (1,000) x (40) = 40,000 liters/day
Water Demand = Design Standards of Pakistan https://pecongress.org.pk/images/upload/books/Paper418.pdf

3.14 Project Implementation Schedule

The tentative implementation period for proposed Project is Thirty-four months (34) for Section 2 and Twenty-Four (24) months each for Section 7 and Section 8, respectively.

3.15 Cost of the Project

Total Phase 1A Project cost is estimated about PKR39.17 billion for Section 2, PKR 31.09 billion for Section 7, and PKR 22.77 billion for Section 8, respectively.

4 ANALYSIS OF ALTERNATIVES

4.1 General

This chapter provides a detailed examination of the alternatives considered for various components of Phase 1A of the N5 Highway reconstruction during the design phase. It outlines the different design options explored for key project elements, including roadway alignment, pavement materials, drainage systems, and structural improvements such as bridges, culverts, and interchanges.

The analysis evaluates the technical robustness of each alternative, assessing factors such as structural integrity, durability, ease of maintenance, and compliance with engineering standards and regulatory requirements. Additionally, the cost implications of each option are examined, considering both initial construction expenses and long-term operational and maintenance costs to determine overall economic viability.

Furthermore, the chapter investigates the social impact of the proposed alternatives, including potential effects on local communities, accessibility, traffic flow, and road safety. Public concerns, stakeholder interests, and the potential for displacement or disruption to nearby residents and businesses are also considered.

Finally, the environmental consequences of each alternative are assessed, focusing on factors such as land use, air quality, noise pollution, water management, and ecological impacts. The evaluation ensures that the selected alternative aligns with sustainability principles while minimizing negative effects on the surrounding environment.

Through this comparative analysis, the chapter aims to identify the most balanced and optimal solution that ensures the long-term success and sustainability of the N5 Highway reconstruction under Phase 1A.

The first section includes an analysis of the no project option compared with the Project, followed by an analysis of alternative to Flyovers, Controlled U-turns, New Pedestrian bridges, Alternative routes for diverting traffic, Pavement alternatives (Asphalt vs. Concrete), and finally a summary of the selected options.

4.2 No Project Alternative

The Phase 1A Project of the N5 Road has become a major congestion point, characterized by slower speeds, longer travel times, and increased vehicle queuing. This is primarily due to the dense urbanization in the area, which has also led to higher levels of noise and air pollution. The unprotected U-turns along key locations on N5—specifically at Baberloi, Khairpur, Thehri Bypass, Waris Ghambir, Shah Hussain Chowk, Khairpur Special Economic Zone, Tando Masti, and Moosani in Section2 (Ranipur to Rohri); at Tarnol, Taxila, and Islamabad Capital Territory areas in Section 7 (Rawalpindi-Burhan), and Pabbi, Tarru Jabba, and Amangarh in Section 8 (Peshawar-Nowshera)—are exacerbating the situation. Additionally, the Nowshera-Chitral road (N45) also utilizes the Nowshera-Peshawar section of N5, further contributing to traffic strain.

Since the launch of the China-Pakistan Economic Corridor (CPEC) project, Rashakai Town in Nowshera has been designated as an Economic Zone for Khyber Pakhtunkhwa, which has further increased traffic in the area.

Currently, the capacity of Phase 1A of the N5 highway is insufficient to ensure smooth traffic flow. The road condition has further deteriorated due to the 2022 flood damage. Traffic volume is expected to rise over time, as indicated by traffic projection surveys, which will lead to even more congestion in the future. Without intervention, these increased traffic volumes will result in longer travel times, higher levels of dust, vehicular emissions, noise, and a greater risk of accidents and traffic conflicts.

The highway's worsening condition will lead to increased wear and tear on vehicles and higher accident probabilities. Additionally, access to the main city from nearby villages will remain difficult, limiting residents' access to better educational and healthcare facilities. In emergency situations, rescue services will struggle to reach affected or safe areas, further exacerbating risks.

The proposed project will upgrade the road from 4 to 6 lanes, incorporating service roads, pedestrian bridges, underpasses, flyovers, and controlled U-turns to enhance traffic flow, reduce congestion, improve air quality, and high noise levels due to high speed traffic movement. However, project implementation will involve resettlement impacts, affecting 49 houses and secondary structures, 1,448 shops/hotels, 702 kiosks and huts, 49 filling stations, 113 miscellaneous structures, and 190 mosques, shrines, and other assets.

Given these concerns, it is clear that the "No Project Option" would not only impede national economic growth but also negatively impact local and regional development and the overall quality of life for the communities along the N5 corridor.

4.3 Flyovers and Underpasses at Railway Crossings

Alternatives Considered:

- **Option 1:** Constructing a 6-lane flyover (both ways) at Fateh Jang Railway crossing and a 3-lane southbound flyover at Amangarh Railway crossing.
- **Option 2:** Constructing grade-separated underpasses instead of flyovers.
- **Option 3:** Retaining at-grade railway crossings with signalization and upgraded safety measures.

Evaluation:

- **Cost:** Flyovers and underpasses are costly compared to at-grade crossings. Flyovers require extensive structural work, while underpasses need excavation, dewatering, and drainage solutions.
- **Construction Issues:** Flyovers involve elevated structures with significant land acquisition, whereas underpasses require excavation and may be unsuitable in flood-prone areas.
- **Social Impact:** Flyovers and underpasses improve safety and reduce congestion but may require resettlement. At-grade crossings increase delays and accident risks.

- **Environmental Impact:** Flyovers and underpasses reduce idling time, lowering emissions. However, construction activities may cause temporary noise and air pollution.

Selected Option: Flyovers at both railway crossings due to their long-term efficiency, safety benefits, and minimal water drainage concerns.

4.4 Dedicated U-Turns

Alternatives Considered:

- **Option 1:** Implementing designated controlled U-turns with signalized management.
- **Option 2:** Constructing elevated U-turn ramps for grade separation.
- **Option 3:** Using loop U-turn intersections to redirect traffic.
- **Option 4:** Maintaining existing uncontrolled U-turns.

Evaluation:

- **Cost:** Controlled U-turns and loop U-turn intersections are cost-effective, while elevated U-turn ramps require high construction costs.
- **Construction Issues:** Elevated U-turns require additional structural work, increasing complexity. Loop U-turns need more land but reduce congestion.
- **Social Impact:** Controlled U-turns enhance safety and traffic flow. Elevated ramps eliminate intersection conflicts but may inconvenience local access.
- **Environmental Impact:** Reduced vehicle idling decreases emissions; however, construction activities may disrupt traffic temporarily.

Selected Option: Since all sections of Phase 1A highway has median, which can be used for constructing loop U-turns, to balance safety, cost-effectiveness, and traffic efficiency.

4.5 New Pedestrian Bridges

Alternatives Considered:

- **Option 1:** Constructing pedestrian bridges at key locations.
- **Option 2:** Installing pedestrian underpasses.
- **Option 3:** Enhancing existing zebra crossings with traffic signals.

Evaluation:

- **Cost:** Pedestrian bridges are moderately expensive but provide long-term benefits. Underpasses require high excavation and maintenance costs.
- **Construction Issues:** Bridges are easier to construct, while underpasses need proper lighting, ground support, and security measures to ensure usability.
- **Social Impact:** Bridges improve pedestrian safety and accessibility. Underpasses may be less attractive due to safety concerns.
- **Environmental Impact:** Bridges have minimal environmental impact, while underpasses require significant excavation and land disturbance.

Selected Option: Pedestrian bridges to enhance safety and minimize construction challenges.

4.6 Alternative Routes for Traffic Diversion During Construction

Alternatives Considered:

- **Option 1:** Utilizing parallel roads and existing bypasses.
- **Option 2:** Constructing temporary roads adjacent to the construction site.
- **Option 3:** Implementing staged construction with partial road closures.

Evaluation:

- **Cost:** Using existing roads is the most cost-effective option, while temporary diversion road using the RoW may reduce the cost, without land acquisition.
- **Construction Issues:** Service/diversion roads using the existing RoW in one side and widening on the other side vis-versa, while partial closures of the existing highway will cause congestion.
- **Social Impact:** Properly planned diversions minimize inconvenience for commuters and businesses.
- **Environmental Impact:** Utilizing existing RoW reduces land disturbance and construction waste.

Selected Option: A combination of parallel roads using the RoW, bypasses, and staged construction to balance cost and minimize disruption.

4.7 Pavement Alternatives

Alternatives Considered:

- **Option 1:** Asphalt pavement.
- **Option 2:** Concrete pavement.
- **Option 3:** Composite pavement (asphalt over concrete).

Evaluation:

- **Cost:** Asphalt is cheaper initially but requires frequent maintenance. Concrete has a higher upfront cost but longer lifespan.
- **Construction Issues:** Concrete takes longer to cure, delaying project completion. Asphalt allows faster installation and phased construction.
- **Social Impact:** Asphalt provides a smoother ride but wears out faster. Concrete is more durable, especially for heavy traffic.
- **Environmental Impact:** Asphalt emits more CO_2 during production, smooth driving experience and less noise, whereas concrete is more sustainable in the long run but generates high noise level.

Selected Option: Due to its low initial investment cost asphalt pavement is considered in the design.

4.8 Alternative Workforce Options

Alternatives Considered

- **Option 1:** Local Worker
- **Option 2**: Migrant Worker

- **Option 3:** Mixture of Local and Migrant Workers

Evaluation

- **Cost:** Recruiting a mix of local and migrant worker provides an optimal balance between cost efficiency and workforce availability. Relying solely on local labor may reduce transportation and accommodation costs but could lead to inefficiencies due to skill gaps. Conversely, bringing in an entirely external workforce increases costs associated with travel, housing, and allowances. A blended approach ensures cost-effectiveness while maintaining quality and productivity.
- **Construction:** The feasibility of construction depends on having a workforce with the right skill set. Local worker alone may not provide the necessary mix of skilled, semi-skilled, and unskilled workers, leading to potential delays. Hiring all worker from outside might address skill shortages but could disrupt workflow integration and increase logistical challenges. A combination of local and external labor ensures a balanced workforce capable of meeting the project's technical requirements while maintaining steady progress.
- **Social Impact:** The social implications of worker rcruitment are significant. Employing a majority of local workers supports community livelihoods, fosters social cohesion, and minimizes displacement risks. Over-reliance on migrant worker could cause social disruptions and resentment within the local community. Public consultations have emphasized the importance of prioritizing local employment opportunities, recommending that at least 70% of the workforce be sourced locally.
- **Environmental Impact:** A mixed labor approach also has environmental benefits. Hiring more local workers reduces transportation-related carbon emissions and minimizes the environmental footprint of worker accommodations. On the other hand, bringing in a large number of migrant workers could strain local resources such as water, energy, and housing. Therefore, adopting a strategy where the majority of labor is hired locally helps mitigate negative environmental impacts.

Selected Option: Considering these factors, it is recommended that a minimum of 70% of the labor force be recruited from local areas, with external hires limited to specialized skills and management. This approach ensures cost efficiency, timely construction, social acceptance, and minimal environmental disruption.

4.9 Summary of Selected Options

Component	Selected Alternative	Justification
Reconstruction of Phase 1A N5 Highway	6-lane highway expansion with associated facilities	Enhance traffic flow, reduce congestion, improve air quality, and high noise levels due to high speed traffic movement.
Flyovers/ Underpasses	Flyovers at Fateh Jang and Amangarh	Improves traffic flow, enhances safety, and reduces maintenance concerns.
U-Turns	Looped U-turns	Balances cost, safety, and traffic efficiency.
Road crossings	New pedestrian bridges	Ensures pedestrian safety and ease of access with minimal construction issues.
Traffic Diversion during construction	Use of parallel or diversion roads using the RoW in one side and staged construction on the side	Using the existing RoW for temporary diversion roads can help keep construction moving without disrupting the primary road’s capacity, which can

Component	Selected Alternative	Justification
		help reduce costs related to delays and interruptions.
Pavement Type	Asphalt pavement	Initial low investment cost, smooth driving experience, and less noise.
Workforce Options	Ideal mix of local (70%) and migrant (30%) workers.	Ensures cost efficiency, timely construction, social acceptance, and minimal environmental impact.

The selected options ensure that the N5 Highway reconstruction meets long-term traffic efficiency, safety, cost-effectiveness, social acceptance, and environmental sustainability goals.

5 ENVIRONMENTAL AND BIODIVERSITY BASELINE

5.1 General

For any development project, the prevailing E&S conditions need to be assessed prior to the stages of planning, designing and execution of the Phase 1A Project. The existing E&S conditions of the proposed project have been considered within the AoI as shown in **Figure 1.1, Figure 1.2, and Figure 1.3** with respect to physical, biological and socio-economic aspects. The Study Area is selected on the basis of the Phase 1A Project's potential environmental and social impacts on the local resources and their mitigation measures.

Information has been collected from variety of sources, including published literature, DCRs, field observations and surveys, conducted specifically for this Phase 1A Project have been analyzed for this study. Consultations were also held with the general public and other relevant stakeholders of the Phase 1A Project area in order to seek the public opinion on the implementation of the proposed Phase 1A Project. Survey tool used for public consultation for baseline data collection during field visit is attached as **Annex 5-1**. For primary data acquisition, the Environment and Social team conducted the field visit during the months of October and December 2024.

5.2 Physical Resources

5.2.1 Topography

The topography of the proposed Phase 1A Project Sections is discussed as under:

<u>Section 2: Ranipur to Rohri</u>

The proposed Phase 1A Project passes through Sukkar and Khairpur districts of Sindh. The main tehsils in two districts of Sindh where the route passes are Gambat, Khairpur (District Khairpur) and Rohri (District Sukkur). The elevation of this Section ranges from 45 meters to 87 meters. The terrain is primarily flat with minor undulations. The proximity to the Indus River increases the vulnerability to flooding, particularly during the monsoon season.

<u>Section 7: Rawalpindi to Burhan</u>

The proposed Phase 1A Project Section 7 passes through Rawalpindi and Attock districts of Punjab and Islamabad Capital Territory. The main tehsils in two districts of Punjab where the route passes are Gujar Khan, Rawalpindi, Taxila (District Rawalpindi) and Burhan (District Attock). The elevation of this Section ranges from 375 meters to 600 meters. This section near the foothills of Margalla Hills National Park (located 2,017 m away from the buffer zones of the AoI) transitions into mountainous terrain, presenting challenges such as steep gradients, and potential flooding, however, landslide is not expected in this Section of the highway.

<u>Section 8: Nowshera to Peshawar</u>

The proposed Phase 1A Project Section 8 passes through Nowshera and Peshawar districts of Khyber Pakhtunkhwa. The main tehsils in two districts where the route passes are Nowshera, Pabbi, Jehangira (District Nowshera) and Town-II, Town-III (District Peshawar). The elevation of this Section ranges from 282 meters to 315 meters. This section near the foothills of Margalla Hills National Park transitions into mountainous terrain, presenting challenges such as steep gradients, and potential flooding.

Figure 5.1, 5.2 and 5.3 represents the topography of the AoI of the proposed Phase 1A Project Section2, Section 7 and Section 8 respectively.

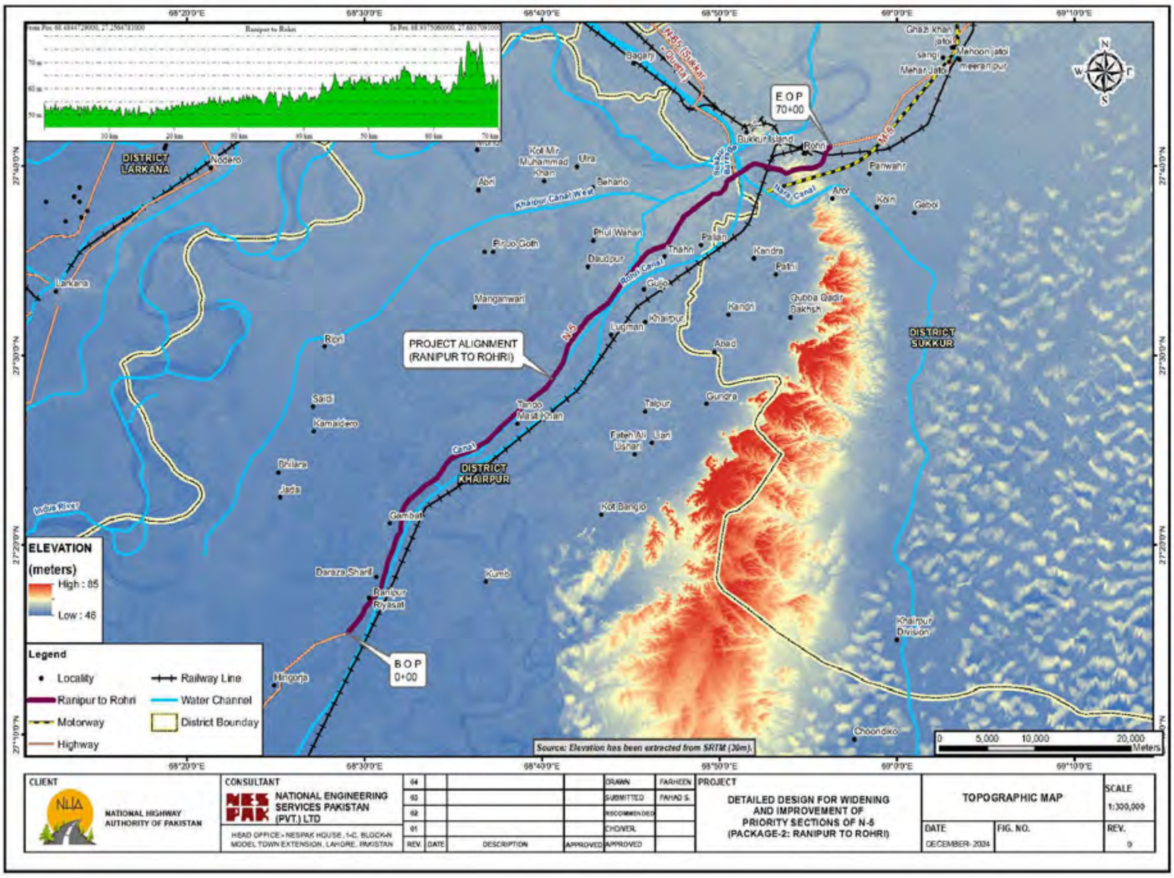


Figure 5-5: Topography Map of Section 2: Ranipur to Rohri

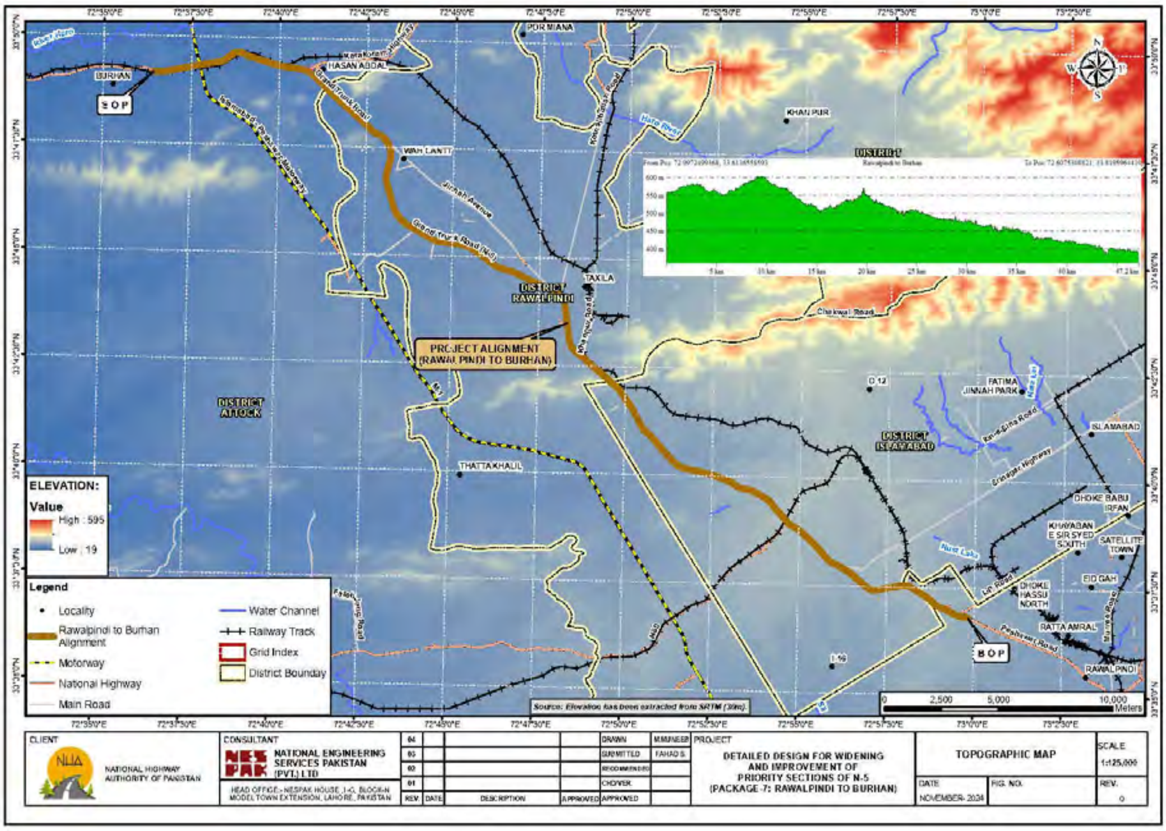


Figure 5-6: Topography Map of Section 7: Rawalpindi to Burhan

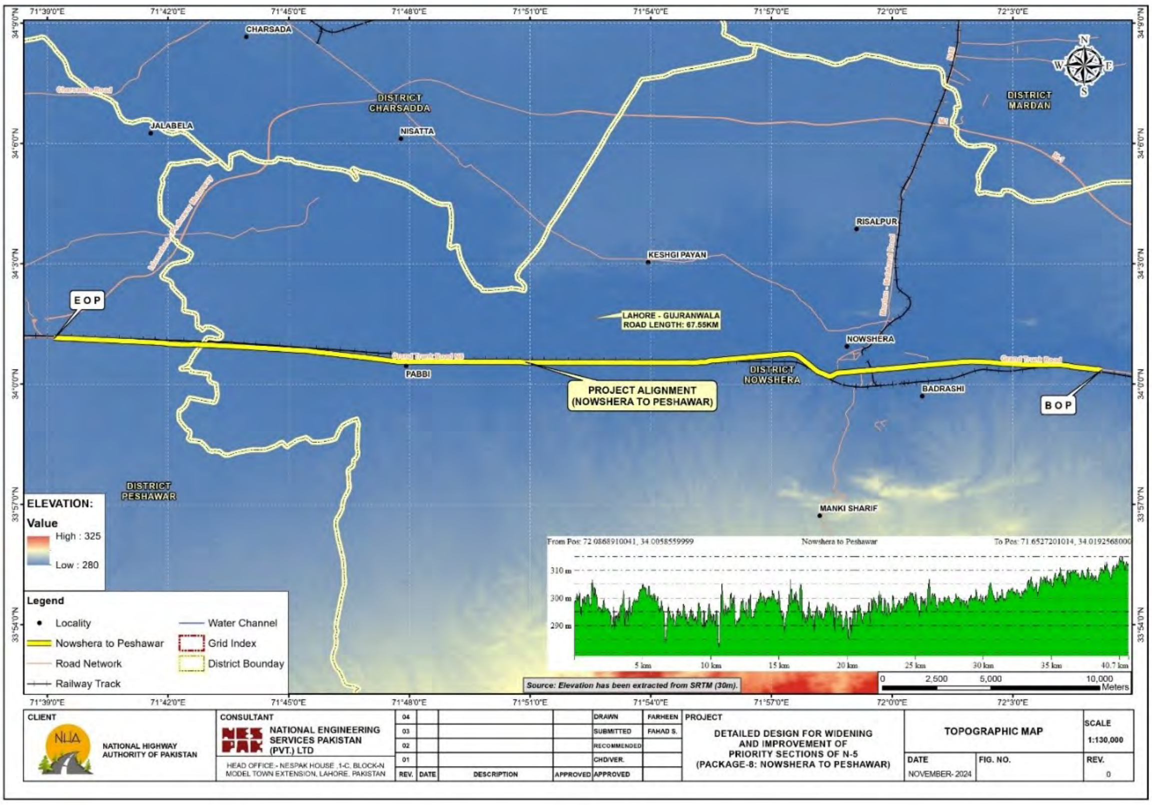


Figure 5-7: Topography Map of Section 8: Nowshera to Peshawar

5.2.2 Regional Geology

The N5 runs through a variety of terrains including rugged mountainous topography, gently sloping valley side slopes and nearly horizontal valley flats, and vast plains. The highlands among these terrains are generally covered by rocks which exhibit a great diversity among rock types, spatial distribution and their origin. Likewise, the soils covering the low-lands, intermountain valleys and vast plains, comprise a wide range of consolidated and unconsolidated sediments having discrete types and origin. Geological Map of the Section 2, Section 7 and Section 8 are shown in **Figure 5.4, 5.5** and **5.6,** respectively while geological features are discussed below.

<u>Section 2: Ranipur to Rohri</u>

The geology of the Ranipur to Rohri region is characterized by deposits from extinct streams (Qmx and Qfx)[2] ,older terrace deposits (Qcm)[3], consisting of compacted layers of gravel, sand, and clay. The region also features sedimentary rocks like limestone and shale in some areas, along with alluvial deposits of clay, silt, and sand in floodplains[4]. While these soils are fertile for agriculture, they present challenges for road construction due to uneven soil stability, erosion risks, and susceptibility to groundwater fluctuations.

<u>Section 7: Rawalpindi to Burhan</u>

The geology of the Rawalpindi to Burhan region is primarily characterized by Mesozoic (Mz) rocks[5], including sedimentary formations such as limestone and shale, along with Holocene (Q)[6] deposits of recent alluvial soils and Eocene and Paleocene Rocks (Tep)[7]. This section, including the area around Rawalpindi and the Margalla Hills, features more complex geology dominated by limestone, shale, and sandstone formations.

<u>Section 8: Nowshera to Peshawar</u>

The geology of the Nowshera to Peshawar region is primarily characterized by Holocene (Q)[8] deposits, consisting of recent alluvial soils formed by river activity. These fertile

2

Qmx, DEPOSITS OF EXTINT STREAMS: *Streamed and measnder belt deposits.* ***Qfx, DEPOSITS OF EXTINCT STREAMS:*** *Flood plains deposits.*

3

Qcm, OLDER TERRACE DEPOSITS: *Loess and flood plain deposits of the middle terrace*

4

Qf, FLOOD PLAINS DEPOSITS: *Flood plains deposits.*

5

Includes Cretaceous, Jurassic and Triassic rocks.

6

Unconsolicidated surficial deposits of silt, sand, and gravel.

7

Shallow marine foraminiferal limestone and grey fossiliferous shales, divided into several fonnations..

8

deposits, rich in sand, silt, and clay, pose challenges for construction due to their susceptibility to erosion, waterlogging, and shifting groundwater levels. The Peshawar region also features sedimentary rock formations, including limestone, sandstone, and shale, which can be difficult to excavate.

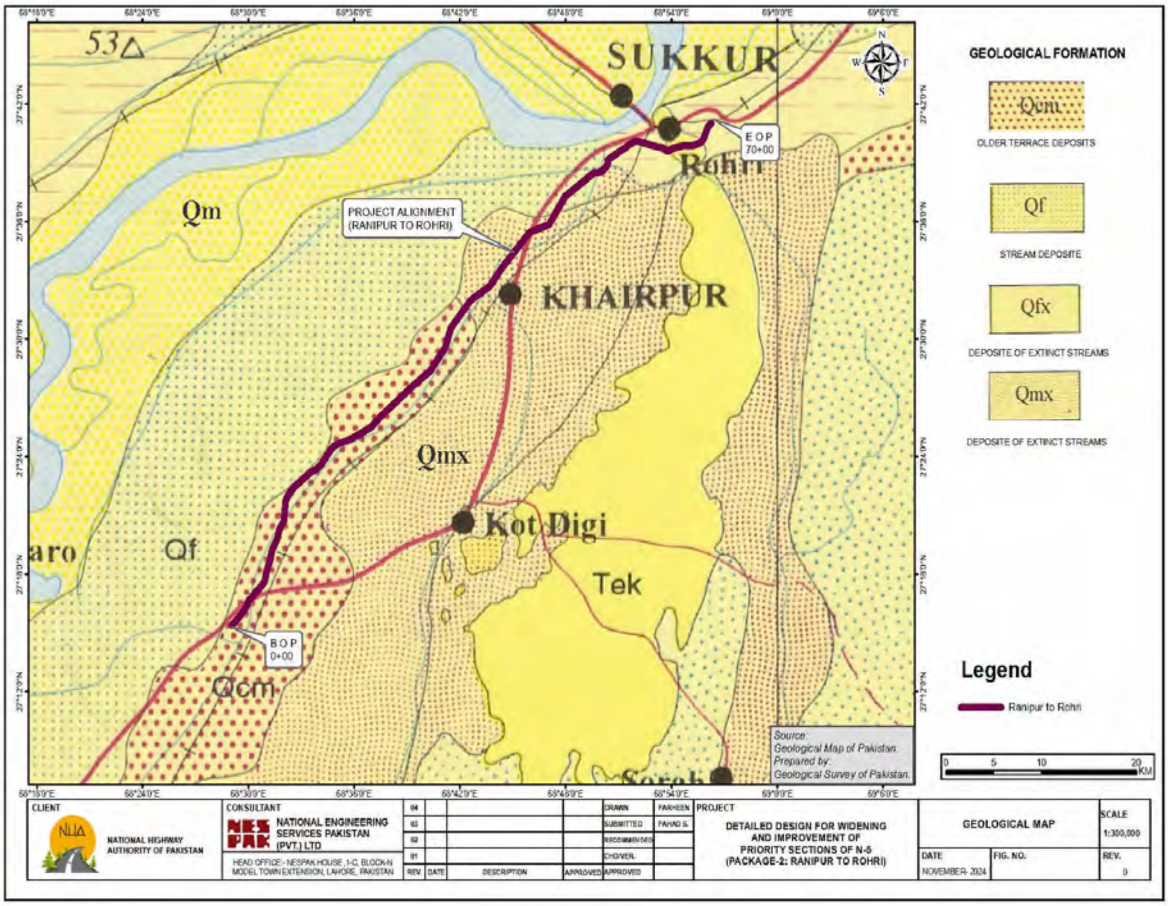


Figure 5-8: Regional Geological Map of Section 2: Ranipur to Rohri

Unconsolicidated surficial deposits of silt, sand, and gravel.

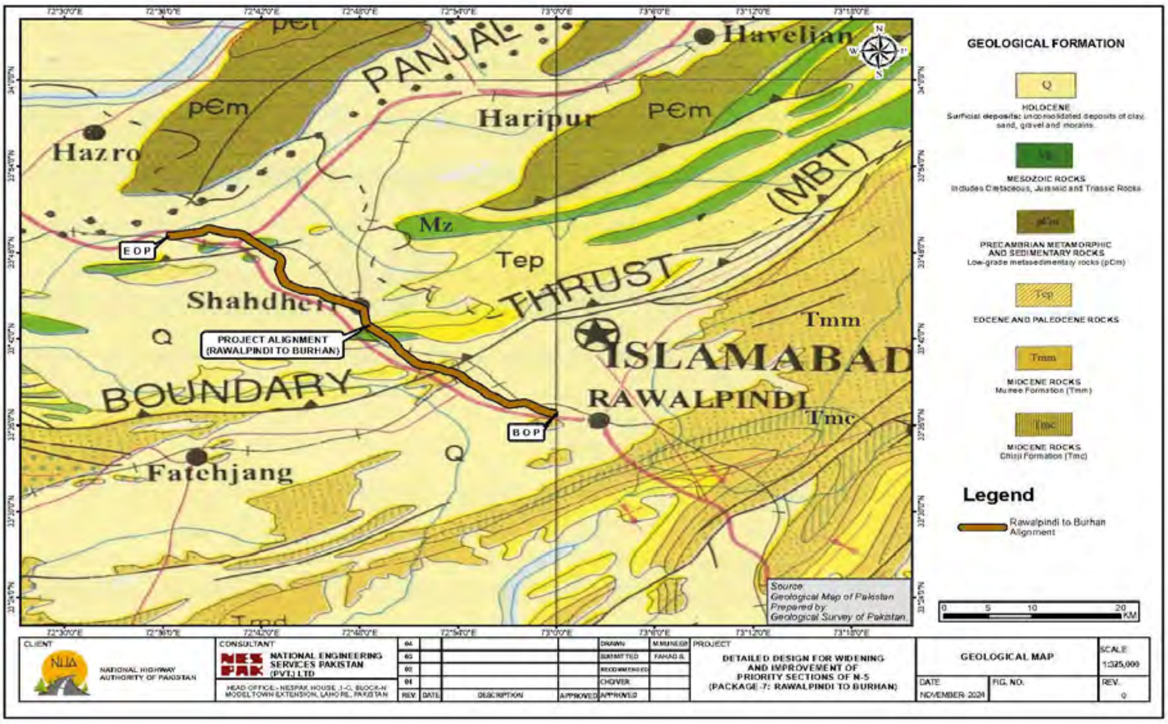


Figure 5-9: Regional Geological Map of Section 7: Rawalpindi to Burhan

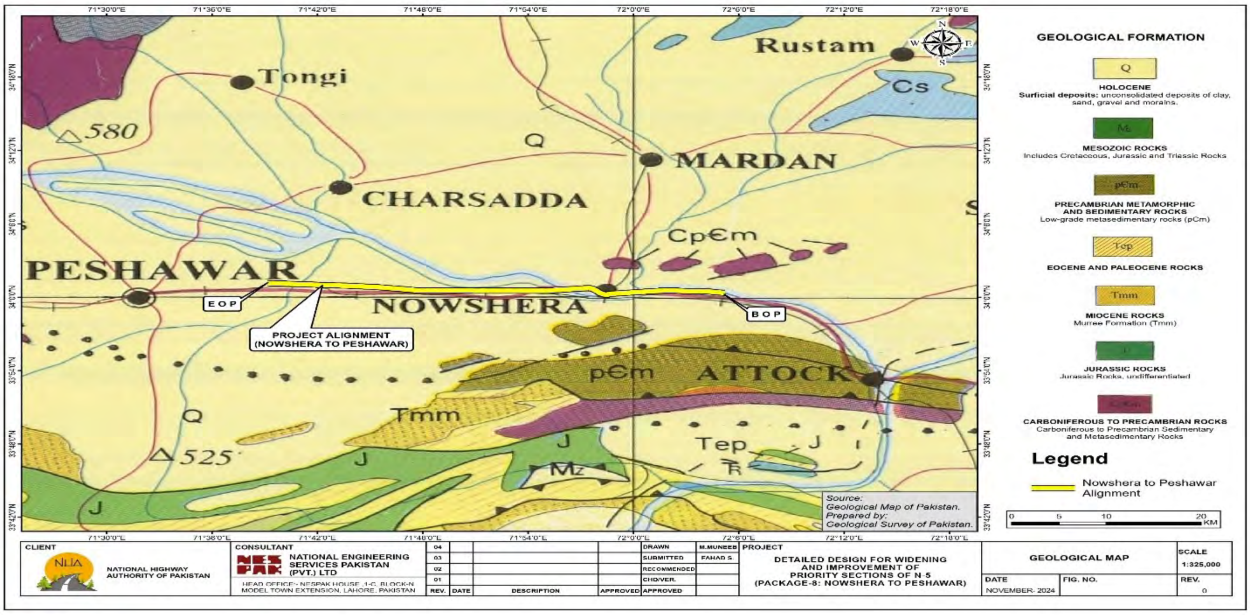


Figure 5-10: Regional Geological Map of Nowshera to Peshawar

5.2.3 Seismology

On the basis of Peak Ground Acceleration (PGA) values obtained through Probabilistic Seismic Hazard Assessment (PSHA), Pakistan is divided into five (05) seismic zones in line with the Uniform Building Code (UBC), 1997 of the Pakistan. The boundaries of these zones are defined on the basis as shown in **Table 5.1**.

Table 5-15: Values of Seismic Zones of Pakistan

Sl.	Zone	PGA (g)
1	1	0.05 to 0.08
2	2A	0.08 to 0.16
3	2B	0.16 to 0.24
4	3	0.24 to 0.32
5	4	> 0.32 g

As per the Building Code of Pakistan (BCP), 2007 (Seismic Provisions), Section 2 falls within zone 2A (Moderate Hazard), with a PGA 0.08 to 0.16g according to the seismic zonation map while Section 7 & 8 fall entirely within zone-2B (Moderate Hazard) with a PGA 0.16 to 0.24g, as shown in **Figure 5.7. 5.8** and **5.9** respectively**.** Therefore, all the applicable provisions of BCP should be met during the design and construction for safety against seismic hazards.[9]

5.2.4 Climate and Meteorology

The climate and meteorology data is obtained from the published data of Climate Normal of Pakistan (1991 to 2020) for each section. For Section 7 reliance is made on Islamabad weather station (coordinates 33^0 42' N and 73^0 05'E), for Section 8 Peshawar weather station (coordinates 34^0 01' N and 71^0 35'E) and for the Section 2 Rohri weather station (coordinates 270 42'N 680 54'E).

The monthly data for temperature, rainfall, relative humidity and wind speed from year (1991-2020) for the above mentioned Weather Stations for the Phase 1A Project Area are presented in subsequent section.

i. Temperature

Table 5.2 shows mean minimal and maximal temperatures observed for each month between 1991 and 2020 in the Study Area for Sections 2, 7, and 8.

Section 2 - Ranipur to Rohri: The highest temperature measured between 1991 and 2020 was 51.0 °C in June 01, 1996, and the lowest temperature was measured in December 15, 1986, i.e., -1.5 °C.

Section 7 - Rawalpindi to Burhan: The highest temperature measured between 1991 and 2020 was 46.5°C in June 21, 1994, and the lowest temperature was measured in January 26, 2008, i.e., -2.8°C.

Section 8 - Nowshera to Peshawar: The temperature rises rapidly until June and the temperature drops with advent of monsoon in July. From June the temperature starts

[9] *Building Code of Pakistan (Seismic Provisions – 2007), Ministry of Housing and Works*

decreasing and the minimum average temperature is recorded in January. The months of December and January are recorded to have lowest temperature.

Table 5-16: Mean Minimal and Maximum Temperatures between 1991 and 2020

Sl.	Months	Mean Minimal Temperature			Mean Maximum Temperature		
		Section 2	Section 7	Section 8	Section 2	Section 7	Section 8
1	January	8.3	10.2	4.4	22.6	18.0	18.6
2	February	10.8	13.3	7.0	25.6	20.1	20.1
3	March	15.9	17.4	11.8	31.2	24.8	24.4
4	April	21.7	22.5	16.8	38.1	30.4	30.6
5	May	26.1	27.4	22.0	43.0	35.8	36.7
6	June	27.7	30.3	25.5	43.5	37.9	40.1
7	July	27.1	29.4	26.6	4.05	35.1	37.7
8	August	26.0	28.6	25.9	38.3	33.5	35.9
9	September	24.4	26.8	23.0	37.8	33.0	35.1
10	October	19.9	22.2	16.3	35.2	30.5	31.2
11	November	14.2	16.5	9.9	30.0	25.4	25.7
12	December	9.6	12.0	5.3	24.3	20.6	20.5

Source: Climate Normal of Pakistan (1991-2020)

ii. Precipitation (Rainfall)

Table 5 -17 shows mean monthly precipitation observed in the Study Area from 1991 to 2020

Ranipur to Rohri (Section-2): Mean monthly precipitation observed in the Study Area from 1991 to 2020 with an annual average rainfall of 106.5 mm.

Rawalpindi to Burhan Section (Section-7): The recorded annual average rainfall in this section is 1320.7 mm.

Nowshera to Peshawar (Section-8): The maximum rainfall occurs during the month of March and August, which is about 50% of the annual rainfall. Winter rains generally occur during the months of January to April, whereas, November is normally the months with least precipitation.

Table 5-17: Mean Monthly Precipitation (1991-2020)

Sl.	Month	Precipitation (millimeters)		
		Section 2	Section 7	Section 8
1.	January	4.1	62.2	40.9
2.	February	5.5	96.0	60.1
3.	March	6.1	95.7	80.7
4.	April	4.9	63.7	62.1
5.	May	4.3	40.0	22.6
6.	June	6.4	78.4	20.4
7.	July	39.7	329.6	58.3
8.	August	24.8	332.0	77.1
9.	September	3.0	144.4	29.4
10.	October	2.5	33.4	22.1

Sl.	Month	Precipitation (millimeters)		
		Section 2	Section 7	Section 8
11.	November	0.2	16.4	13.8
12.	December	4.1	28.7	19.9
13.	**Annual**	**106.5**	**1320.7**	**507.9**

Source: Climate Normal of Pakistan (1991-2020)

iii. Relative Humidity

Table 5 -18 shows mean relative monthly humidity observed in the study area from 1991 to 2020 for Section 2, 7 and 8. The data reveals that at 00:00 hours, the relative humidity levels are generally higher while lower relative humidity levels are recorded at 12:00 hours.

Table 5-18: Mean Relative Humidity (1991-2020)

Sl.	Months	Relative Humidity (%)								
		Section 2			Section 7			Section 8		
		00 UTC	03 UTC	12 UTC	00 UTC	03 UTC	12 UTC	00 UTC	03 UTC	12 UTC
2.	January	77.5	76.3	39.1	91.5	90.8	52.7	80.2	78.8	49.1
3.	February	73.2	71.1	35.0	88.6	86.7	48.4	78.1	76.0	42.1
4.	March	69.6	66.4	32.0	86.9	80.7	43.3	79.4	75.1	43.9
5.	April	55.9	52.2	22.8	83.1	69.0	38.3	74.0	66.8	38.7
6.	May	54.9	51.7	20.7	71.8	54.3	30.9	60.9	51.3	29.8
7.	June	66.1	62.4	27.4	72.7	56.1	34.3	60.0	51.0	30.4
8.	July	75.3	72.1	42.3	86.7	77.3	56.2	73.4	67.9	47.8
9.	August	78.8	75.7	47.6	92.1	84.6	64.5	80.8	77.2	56.0
10.	September	79.0	73.9	41.4	91.5	82.9	58.4	79.3	75.2	49.6
11.	October	74.0	68.1	34.0	91.4	84.8	53.2	78.2	73.6	46.6
12.	November	76.4	71.1	35.3	92.7	89.8	56.4	78.6	76.5	53.3
13.	December	79.3	77.1	41.1	92.6	92.1	55.3	80.6	79.1	55.3

Source: Climate Normal of Pakistan (1991-2020)

iv. Wind Speed

Table 5 -19 depicts average wind speed and gust on a monthly basis in the Study Area from 1991 to 2020.

Table 5-19: Average Wind Speed (knots) (1991-2020)

Sl.	Months	Wind Speed (knots)								
		Section 2			Section 7			Section 8		
		00 UTC	03 UTC	12 UTC	00 UTC	03 UTC	12 UTC	00 UTC	03 UTC	12 UTC
1.	January	1.7	1.7	2.5	0.2	0.2	1.4	1.2	1.6	2.2
2.	February	1.9	2.1	2.8	0.3	0.3	2.4	1.5	2.0	4.6
3.	March	2.2	2.4	3.0	0.5	0.4	2.9	1.9	2.1	5.1
4.	April	2.2	2.5	3.1	0.5	0.6	2.5	2.1	2.1	6.4
5.	May	2.9	3.0	3.3	0.6	0.5	2.5	2.4	2.8	7.8
6.	June	3.7	3.7	3.4	0.4	0.6	2.8	2.8	3.4	8.5
7.	July	3.4	3.1	3.3	0.7	0.6	2.1	3.7	4.2	8.2
8.	August	3.0	2.9	3.0	0.5	0.5	1.3	3.1	3.6	7.4
9.	September	2.2	2.5	2.7	0.2	0.2	0.9	2.0	2.6	6.2
10.	October	1.4	1.7	2.3	0.1	0.2	0.7	1.1	1.3	3.2
11.	November	1.7	1.6	1.9	0.1	0.1	0.4	1.1	1.3	1.3
12.	December	1.1	1.3	2.0	0.1	0.1	0.7	1.1	1.5	1.3

Source: Climate Normal of Pakistan (1991-2020)

v. Surface Water Hydrology

The proposed Phase 1A Project is crossed by several major rivers, streams, and drainage systems that will affect the hydrological assessment of the Phase 1A Project. Hydrological map of the Phase 1A Project sections is shown in below **Figure 5 -11, Figure 5 -12 and** Figure 5 -13**Error: Reference source not found**

The Section wise crossings of the surface water resources with N5 are provided in Table 5 -20 below.

Table 5-20: Section wise Surface Water Crossings of N5

Section No.	Section Name	Surface Water Crossings
02	Ranipur To Rohri	Major water bodies include Rohri Canal, Mirwah Canal and Nara Canal are off taking from Sukkur Barrage crossing the road alignment (refer **Vol 3:** Climate Change Assessment Report).
07	Rawalpindi To Burhan	Major water bodies crossing include tributary of Haro River along with other Nullahs. The flow and quantities are provided in hydrological report (refer **Vol 3:** Climate Change Assessment Report).
08	Nowshera to Peshawar	Major water bodies crossing includes Nullahs and flood channels. Tributary of Kabul River also exists in nearby vicinity. The flow and quantities are provided in hydrological report (refer **Vol 3:** Climate Change Assessment Report).

Section 2: Considering the slopes, topography of the Phase 1A Project area and development on the sides of the road at some locations, the hydraulic analyses for the cross drainage structures have been taken up. As per hydraulic design guidelines the hydraulic design and review have been carried for the culverts against 25 year return period flood and

checked to pass 50 year return period flood, while, 100 year return period flood is used for the bridges. Here, in this reach the structures with individual estimated discharge have been reviewed for capacity check and proposed additional barrel where required. The results of the hydraulic analyses show that culverts at RD. 45+772 and 55+770 (both sides) are not capable of passing design floods. Hence, these culverts required to increase number of cells/barrels to achieve adequate capacity. Some culverts are moderately choked, minor damaged and filled with mud. Hence, required cleaning, repair and periodic maintenance for the proper drainage of the design floods. Some culverts with poor conditions are also suggested to replace with new box culverts. In this reach of road only one bridge existed at RD. 68+275 with a capacity of about 600 m^3/s and one side (R-S) of bridge is filled with mud that require cleaning

<u>Section 7:</u> Considering the slopes, topography of the subproject area and development on the sides of the road at some locations the hydraulic analyses for the cross drainage structures have been taken up. As per hydraulic design guidelines the hydraulic design and review have been carried for the culverts against 25 year return period flood and checked to pass 50 year return period flood, while, 100 year return period flood is used for the bridges Here, in this reach the structures with individual estimated discharge have been reviewed for capacity check and proposed additional barrel where required. Some structures are moderately choked and filled with mud. At some locations, the existing cross drainage structures with mud blockage and minor damages are required cleaning, repair and periodic maintenance for the proper drainage of the design floods. Culvert at three (03) locations are required an additional barrel for each of the size mentioned above for safely pass the flood discharge with climate change effect.

<u>Section 8:</u> Considering the topography of the subproject area and development on the sides of the road at some locations the hydraulic analyses for the cross drainage structures have been taken up. Here, in this reach the structures with individual design discharge have been reviewed as individual, while remaining structures are checked for capacity. The results of the hydraulic analyses show that bridges at RDs 1+272, 2+160, 5+202 and 6+332 are adequate for passing design floods. Whereas, bridges at RD 8+256, 10+599, 13+136, 17+497 and 25+118 are not capable of passing 100–yr. design flood. The bridges with insufficient capacity to pass design discharge are need to be increased number of bays. Culverts at RD. 0+465, 10+599, 21+210, 25+205,25+405 (both sides) and 15+500,20+468 (one side) are not capable of passing design floods. Hence, these culverts required to increase number of cells/barrels to achieve adequate capacity. Some cross drainage structures are moderately choked, minor damaged and filled with mud. Hence, required cleaning, repair and periodic maintenance for the proper drainage of the design floods.

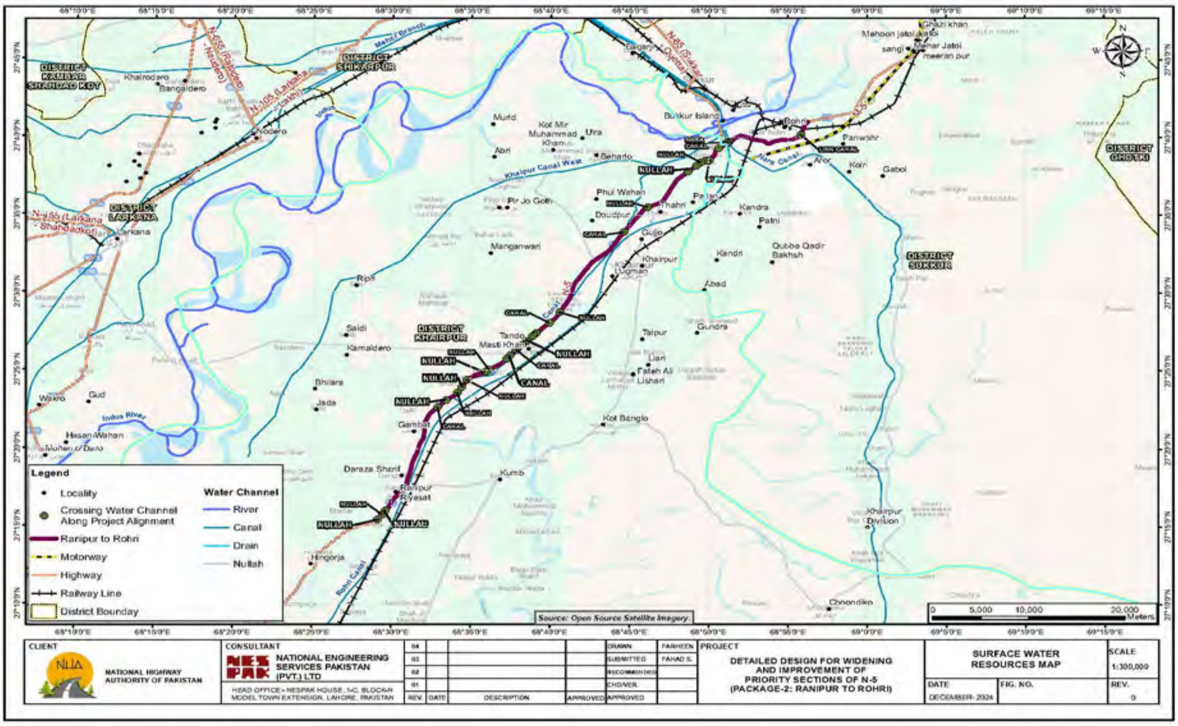


Figure 5-11: Surface Water Resources Map of the Ranipur to Rohri Section

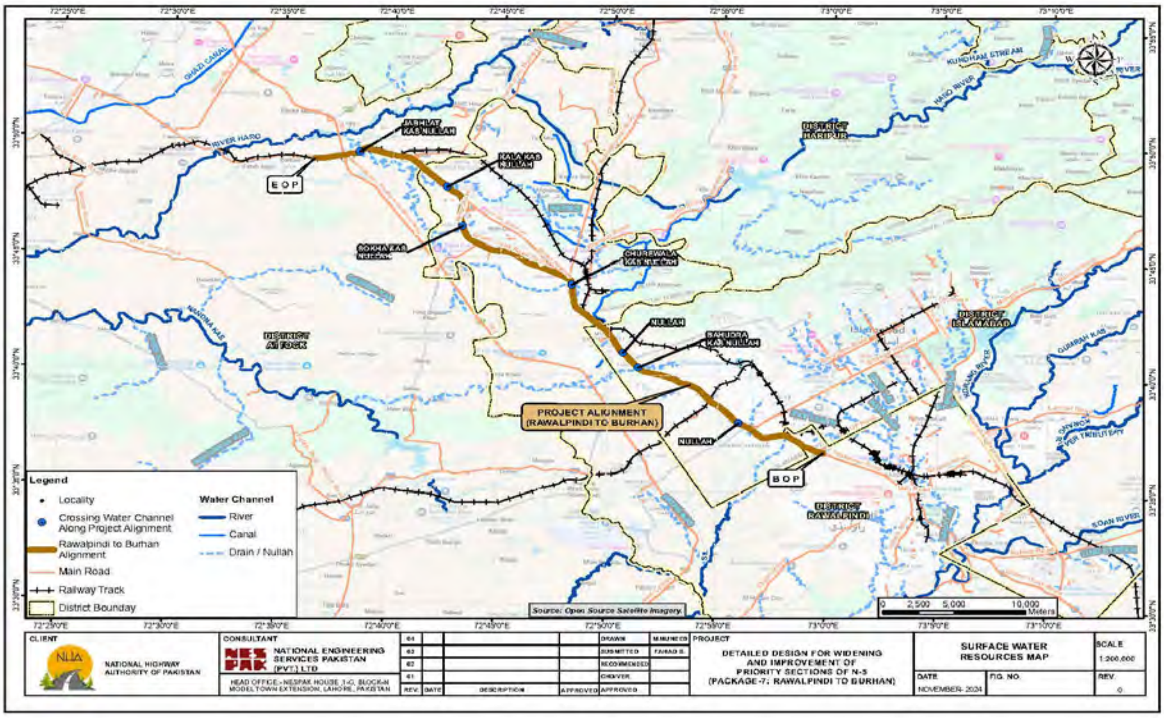


Figure 5-12: Surface Water Resources Map of the Rawalpindi to Burhan Section

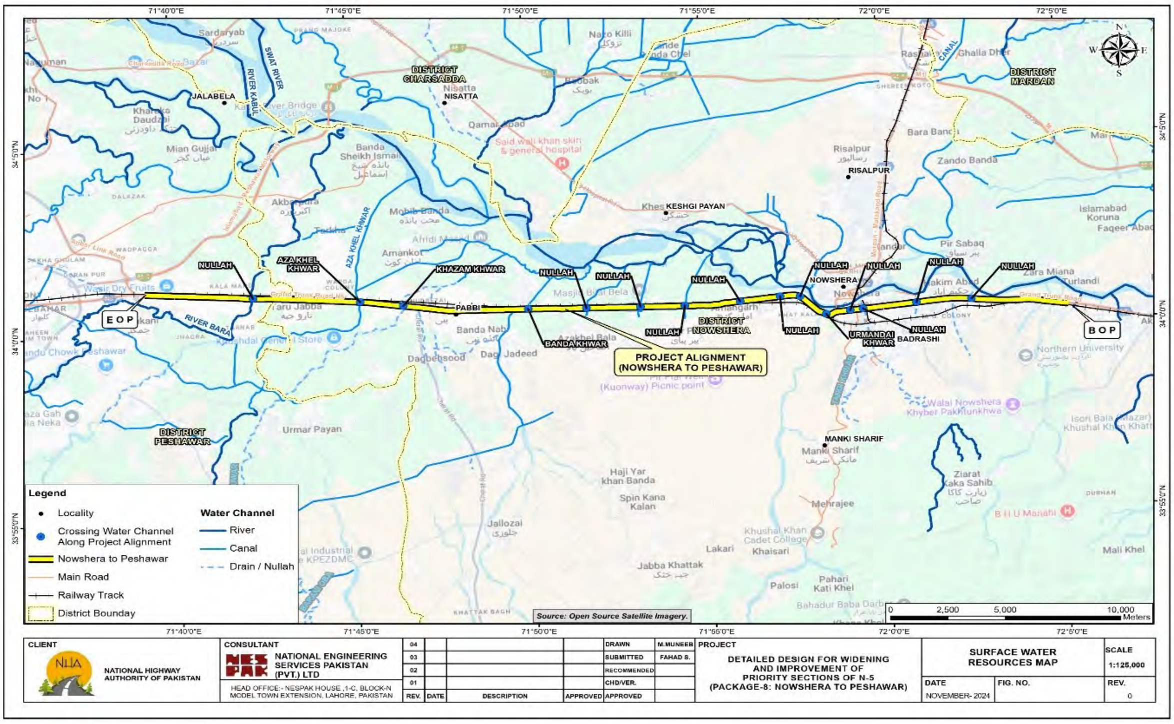


Figure 5-13: Surface Water Resources Map of the Nowshera to Peshawar

5.2.5 Groundwater

Ranipur to Rohri (Section- 2): Groundwater available in this area is saline and brackish. In Rohri and surrounding areas, water near the Indus River tends to be better in quality, but inland areas have high salinity and hardness.

Rawalpindi to Burhan (Section- 7): Groundwater resources are generally better, with fresh water available in many areas. However, in flood-prone zones (as mentioned in section 5.2.9), the groundwater table may rise during the monsoon season.

Nowshera to Peshawar (Section- 8): Due to the presence of Kabul River near the Phase 1A Project area, groundwater is available at 30-40 feet but the drinkable water is extracted at 150 feet depth which has also been contaminated since the 2010 and 2022 major Flood.

5.2.6 Solid Waste

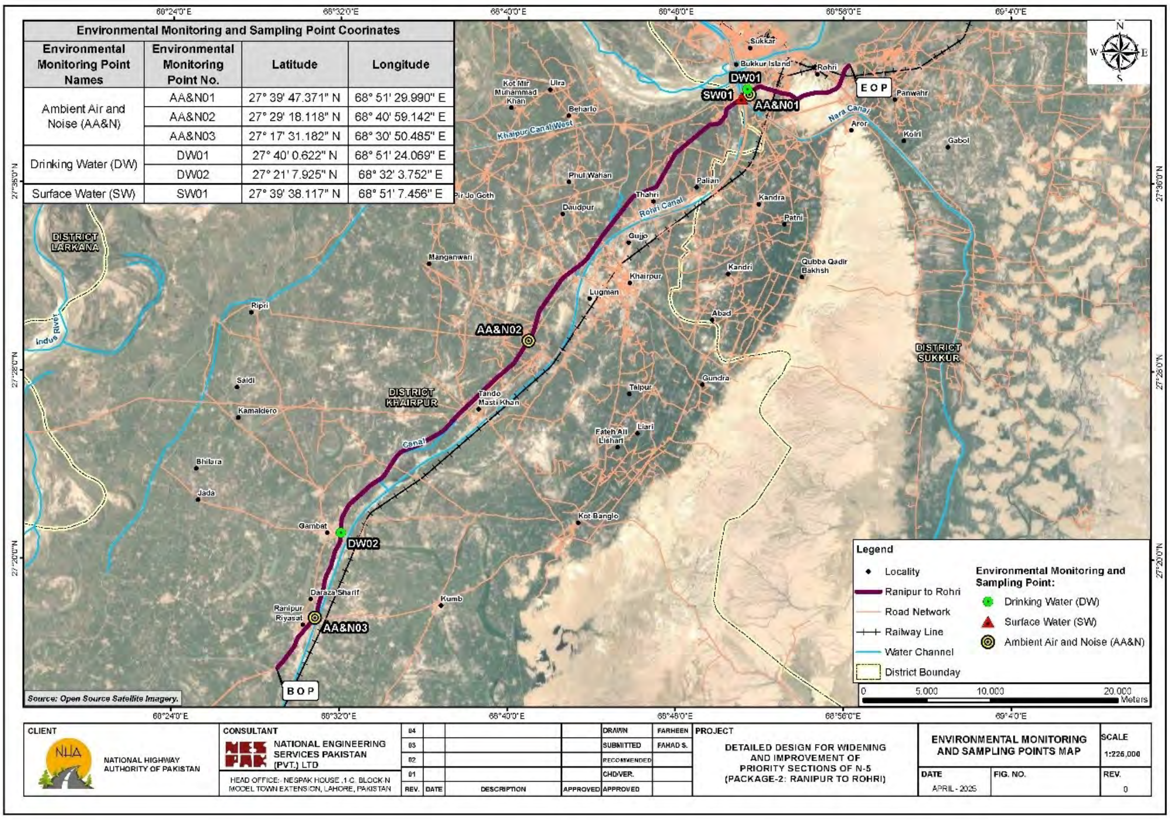
The waste generated in the Ranipur to Rohri, Rawalpindi to Burhan, and Nowshera to Peshawar sections is primarily municipal, including household, commercial, and some industrial waste. The quantity of waste is substantial, with a significant portion being organic. The primary sources of waste in each sections include residential areas, commercial centers, and industrial sites. The types of waste include organic waste, plastics, paper, glass, and metals. Additionally, there may be construction waste from ongoing domestic projects or past projects and potentially hazardous waste from industrial activities. Ranipur

Municipal Committee and Rohri Municipal Committee are responsible for waste management in the Phase 1A Project area. Rawalpindi Waste Management Company (RWMC) and Capital Development Authority (CDA) are responsible for waste management in the Rawalpindi area. They focus on collection, transportation, and disposal. In the Nowshera to Peshawar section, Municipal Corporation Peshawar oversees these activities. However, there are challenges in achieving efficient waste collection and disposal due to inadequate infrastructure and resources. All sections face issues with littering and pollution. Inadequate waste collection and disposal systems lead to open dumping, which contributes to environmental degradation and health risks. There is also a lack of proper management for hazardous and construction waste, exacerbating pollution concerns. The situation has been deteriorating due to increasing population, inadequate waste management infrastructure, and insufficient enforcement of waste disposal regulations. The proposed Phase 1A Project itself will generate construction waste, which needs to be managed effectively to prevent environmental impacts.

5.2.7 Environmental Quality

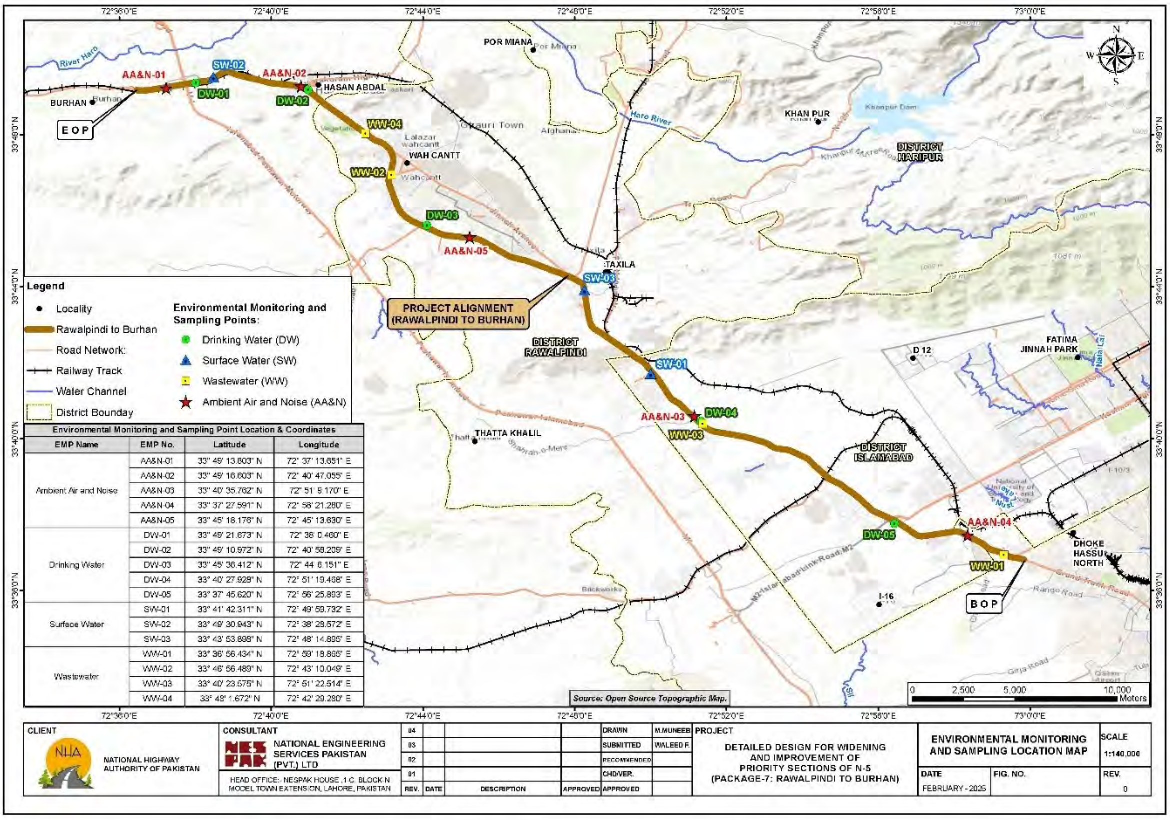
The environmental monitoring of parameters like ambient air quality, noise level, surface water, wastewater and groundwater help us to analyze the prevailing environment conditions in and around the study area, and to protect it from any adverse activities due to the proposed Phase 1A Project implementation.

The environmental parameters for ambient air, noise level, surface water, wastewater and groundwater were monitored/sampled at different locations of the proposed Phase 1A Project site in January and February, 2025 for establishing the baseline profile of the Study Area. The monitoring locations are presented in Figure 5 -14 for Section 2, Figure 5 -15 for Section 7, and Figure 5 -16 for Section 8. A third-party laboratory was procured for this activity i.e., M/s Asian Environmental Services (Pvt.) Ltd. The detailed reports are attached as Vol. 4.



Environmental Monitoring and Sampling Point Coorinates			
Environmental Monitoring Point Names	Environmental Monitoring Point No.	Latitude	Longitude
Ambient Air and Noise (AA&N)	AA&N01	27° 39' 47.371" N	68° 51' 29.990" E
	AA&N02	27° 29' 18.118" N	68° 40' 59.142" E
	AA&N03	27° 17' 31.182" N	68° 30' 50.485" E
Drinking Water (DW)	DW01	27° 40' 0.622" N	68° 51' 24.069" E
	DW02	27° 21' 7.925" N	68° 32' 3.752" E
Surface Water (SW)	SW01	27° 39' 38.117" N	68° 51' 7.456" E

Figure 5-14: Environmental Quality Monitoring Locations (Section 2)



Environmental Monitoring and Sampling Point Location & Coordinates			
EMP Name	EMP No.	Latitude	Longitude
Ambient Air and Noise	AA&N-01	33° 45' 13.803" N	72° 37' 13.651" E
	AA&N-02	33° 45' 16.603" N	72° 40' 47.055" E
	AA&N-03	33° 40' 35.762" N	72° 51' 5.170" E
	AA&N-04	33° 37' 27.591" N	72° 56' 21.280" E
	AA&N-05	33° 45' 18.176" N	72° 45' 13.630" E
Drinking Water	DW-01	33° 49' 21.673" N	72° 38' 0.460" E
	DW-02	33° 49' 10.972" N	72° 40' 58.209" E
	DW-03	33° 45' 36.412" N	72° 44' 6.151" E
	DW-04	33° 40' 27.928" N	72° 51' 19.468" E
	DW-05	33° 37' 45.620" N	72° 56' 25.803" E
Surface Water	SW-01	33° 41' 42.311" N	72° 49' 59.732" E
	SW-02	33° 49' 30.943" N	72° 38' 28.572" E
	SW-03	33° 43' 53.898" N	72° 48' 14.895" E
Wastewater	WW-01	33° 36' 56.434" N	72° 59' 19.865" E
	WW-02	33° 46' 56.489" N	72° 43' 10.049" E
	WW-03	33° 40' 23.575" N	72° 51' 22.514" E
	WW-04	33° 48' 1.672" N	72° 42' 29.280" E

Figure 5-15: Environmental Quality Monitoring Locations (Section 7)

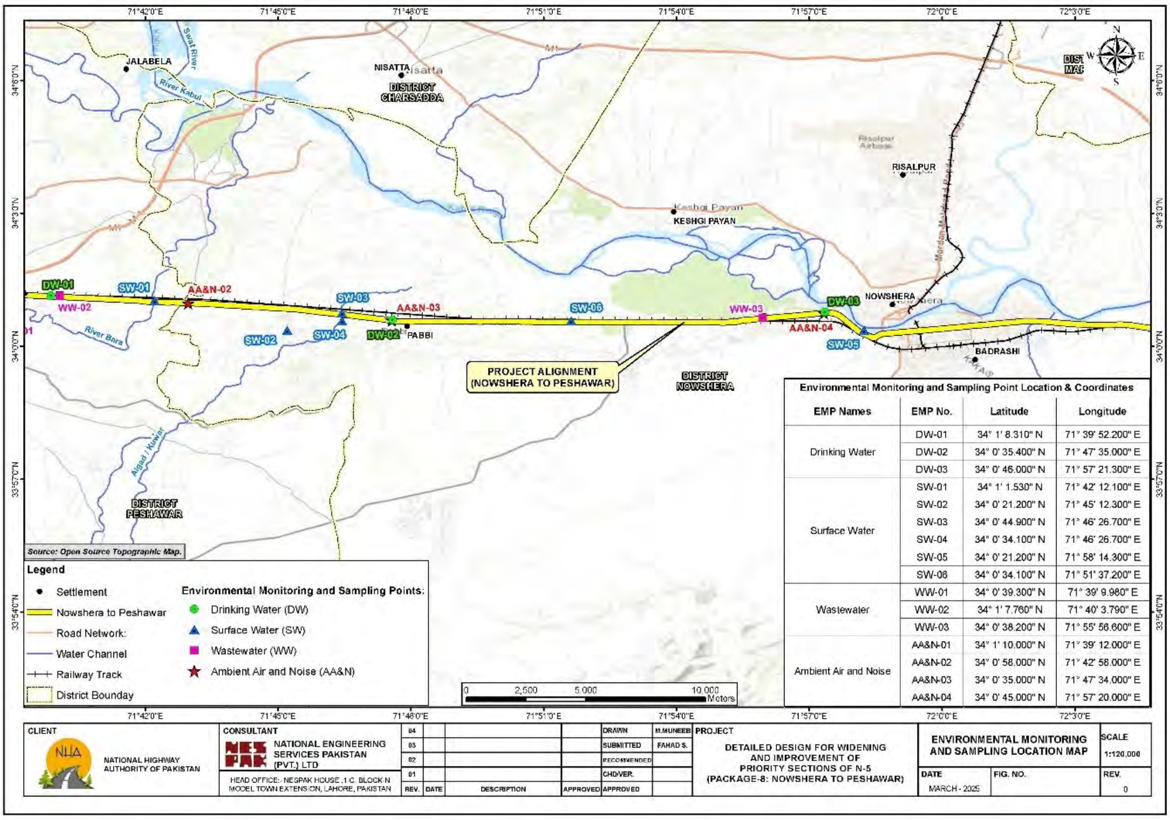


Figure 5-16: Environmental Quality Monitoring Locations (Section 8)

5.2.7.1 Air Quality

Ambient air quality monitoring for Nitrogen Dioxide (NO_2), Nitrogen Oxide (NO), Sulfur Dioxide (SO_2), Carbon Monoxide (CO), and Particulate Matter ($PM_{2.5}$ and PM_{10}) was conducted at the Phase 1A Project Site. Sampling was carried out over a 24-hour period, with measurements recorded at one-hour intervals for all parameters. The results indicate that concentrations of SO_2, $PM_{2.5}$, and PM_{10} exceed the standards stipulated in NEQS, likely due to the high traffic volume on the Phase 1A highway, particularly from diesel-powered vehicles.

5.2.7.2 Noise Level

Noise level monitoring was carried out at designated locations using a BENTECH Sound Meter. All measurements adhered to the guidelines outlined in BS 7445:2003. The monitoring process utilized 1/1 Octave band analysis in compliance with IEC 61260-1:2014 and ANSI S1.11-2004. To ensure accuracy, the meters were calibrated and verified before and after each measurement period using a sound level calibrator. Noise levels in all sections of the Phase 1A highway exceeds the standards NEQS.

5.2.7.3 Water Quality

Drinking water, surface water and wastewater samples were also collected in the study area and were analyzed for physical, chemical and microbiological parameters. The results of drinking water are in compliance with the stringent limits except for odour and taste issues in a few samples. The results of surface water are in compliance with the stringent limits except for COD issues in a few samples. The results of wastewater are in compliance with the stringent limits except for BOD, COD and TSS issues in a few samples.

5.2.8 Land Use Pattern

The land use of the Phase 1A Project area mainly includes existing road, agricultural land, water bodies, vegetation, residential and commercial areas, masjid, health facilities and educational institutions within the AoI. N5 is an existing road so subproject area/ROW is in same condition since long. However, around the N5/AoI, the settlements have expanded and commercial activities are increasing with time. **Table 5 -21** depicts land use cover of the Phase 1A Project area. The detailed land use maps are provided in **Vol. 5**.

Table 5-21: Land Use Type for each Section

Land use Type	Ranipur to Rohri Area (Acres)	Rawalpindi to Burhan Area (acres)	Nowshera to Peshawar Area (acres)
Barren / Open Area	1610.59	596.01	945.93
Brick Kiln	--	0.64	-
Builtup Area	840.28	1817.05	1,176.38
Communication Tower	--	0.09	-
Cultivated Land	1,221.10	218.34	354.75
Graveyard	--	14.46	24.31
Green Belt	2.57	116.07	60.57
Over Bridge	--	0.54	-
Play Ground	--	16.21	-
Railway	--	8.85	12.48
Reservoir	--	2.88	-
Road / Track	360.72	489.33	282.01
Water Bodies (Stream / Nullah, Pond)	81.84	14. 10	32.13
Trees / Bushes	83.76	224.86	114.99
Orchard	947.39	-	27.59
Total	**5,205.03**	**3,519.44**	**3,031.15**

5.2.9 Environmental and Social Sensitive Receptors

Sensitive receptors are people/places more susceptible to the adverse effects of exposure to the pollutants and social disturbance, due to the developmental projects. Thus, sensitive receptors are necessary to be identified, to evaluate the potential impacts of the proposed Phase 1A Project on public health and the environment and adopt necessary mitigation measures to minimize the impact.

The sensitive receptors identified within the Phase 1A Project AoI are: educational institutions, health institutes and religious places. They are prone to sensitivity during construction phase, due to emission of air pollutants, noise and vibration, temporary edifice of construction camps and mobilization issues. There is only one environmental/ecological sensitive receptor in the AoI of Section 7, located beyond the AoI, i.e., buffer zone of Margalla Hills National Park.

The sensitive receptor map of the proposed Phase 1A Project Section 2, Section 7 and Section 8 is shown in Figure 5 -17**Error: Reference source not found, Figure 5 -18 and Figure 5 -19.** The detailed list of sensitive receptors for all Sections is attached as **Annex 5-2.**

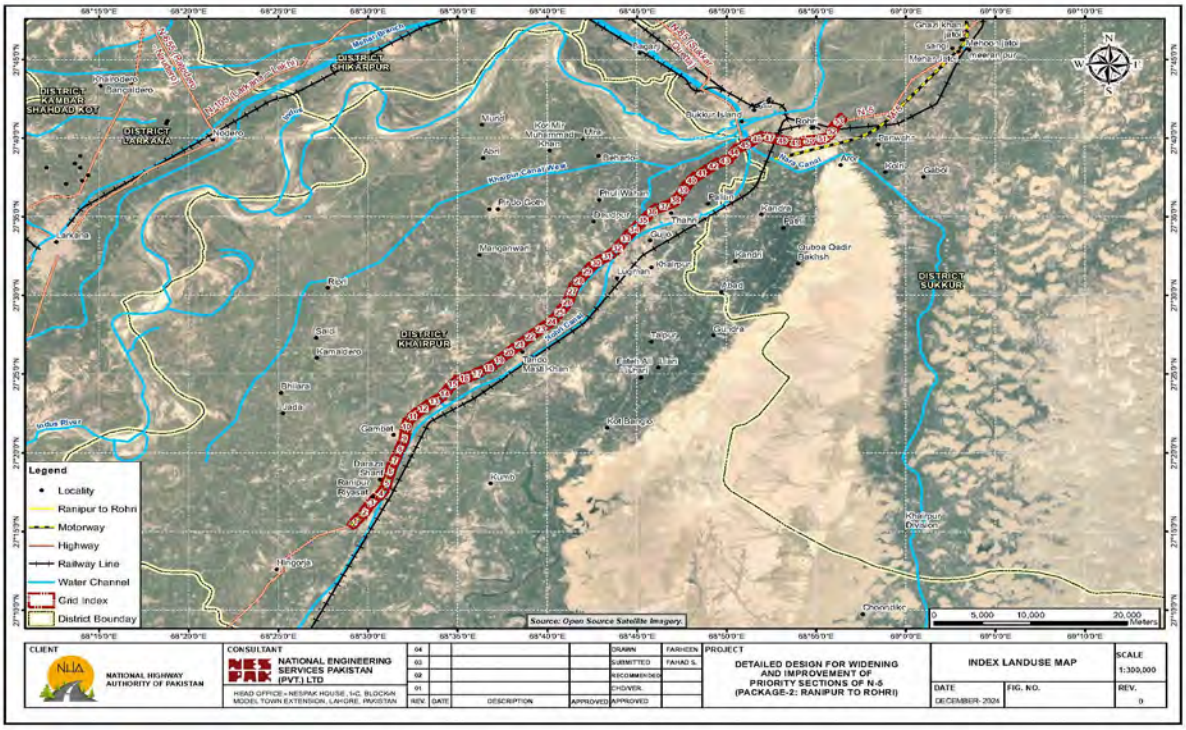


Figure 5-17: Sensitive Receptor Map of Ranipur to Rohri Section

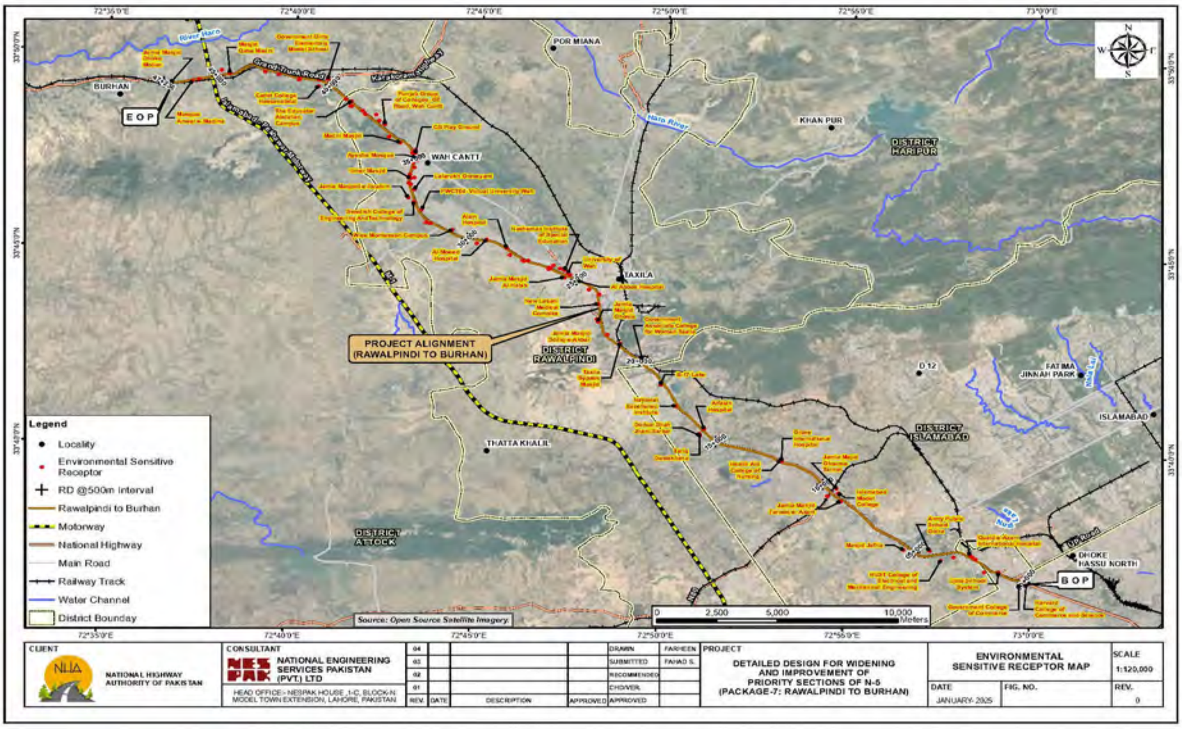


Figure 5-18: Sensitive Receptor Map of Rawalpindi to Burhan Section

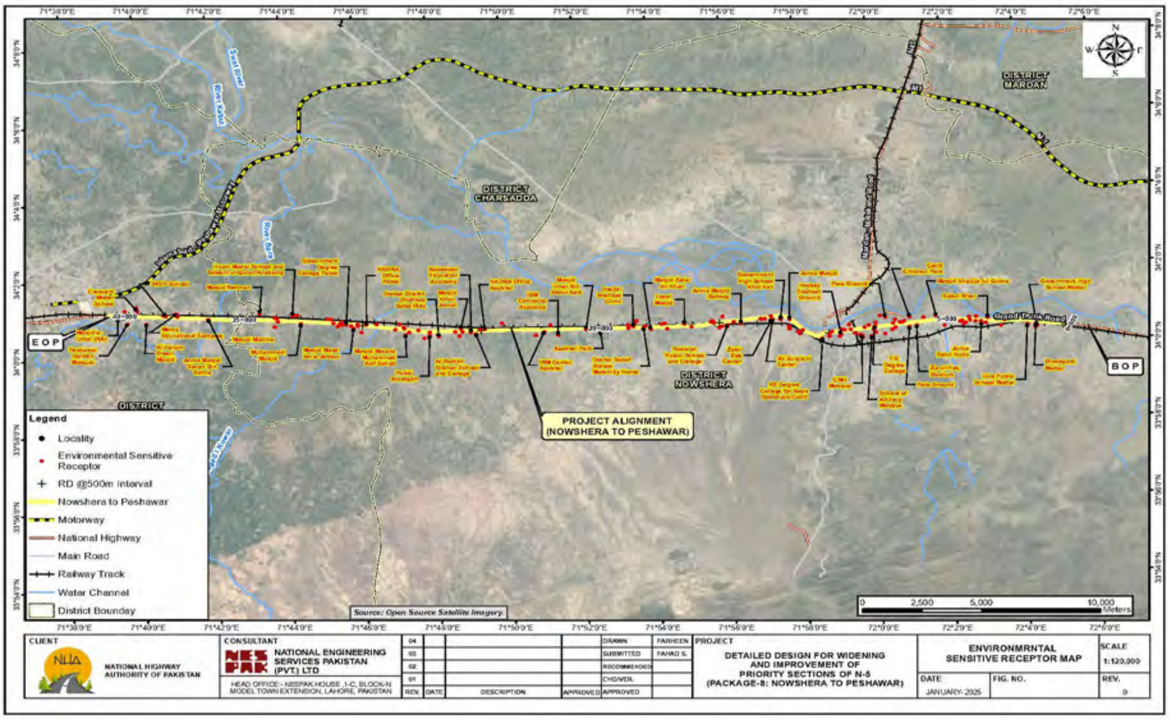


Figure 5-19: Sensitive Receptor Map of Nowshera to Peshawar Section

5.3 Ecological Resources

5.3.1 Methodology

All the available literature was thoroughly reviewed to have a better understanding of the Phase 1A Project area and its surroundings including habitat, flora, and fauna. The route alignment was thoroughly examined based on the primary and secondary data[10]. This survey broadly covers ecosystem sensitivities (If any), vegetation, other flora, and fauna. Consultations and field visits revealed that some areas of N5 (Section 2: Median and along the road, Section 7: Area between Sangjani Toll Plaza and Taxila bypass; Section 8: Median and along the road) contain dense vegetation and trees within the right-of way.

Section-wise ecology has been discussed in the subsequent sections.

i. Ranipur To Rohri Section

Ecosystem and Habitat

The climate of the area can be broadly defined as hot and arid. The characteristic features of this climatic zone are low rainfall (less than 250 mm per annum), absence of a well-defined rainy season, and high temperatures. The major ecological zone of this section of the Indus River Basin is the Tropical thorn forests region, which is also described as the Indo-Gangetic Plains. As per the global ranking of Eco regions, out of 238 globally designated Eco regions, three out of five designated Eco regions in Pakistan are located in Sindh[11].

The terrestrial and aquatic fauna of the Phase 1A Project area shows the degraded level of occurrence of resident and migratory species. The absence of reasonable numbers of small birds, birds of prey, mammals and reptiles indicates that the natural food chain and the required standard ecosystem health degraded, due to huge commercialization and unscientific agriculture practices in the region. The wildlife stays away from such areas or where habitat is degraded. The natural vegetation and greenery are vanishing due to overgrazing of domestic animals, salinity, water-logging and floods. The rapid growth of the population is also a principal cause of diminishing vegetation. The precious knowledge of flora is rapidly vanishing due to illiteracy among the local people and also due to the destruction of medicinal plants.

Further, the growing pressure of the human and livestock population is expanded towards undisturbed areas of the natural environment, which ultimately resulted in the decline of terrestrial and aquatic fauna.

10

Secondary data included but not limited to "Flora of Pakistan by MI-Sheikh", "Birds of Pakistan by ZB-Mirza", "Mammals of Pakistan by TJ Roberts" and "Manual of silviculture for Pakistan [1965] by Champion, Sir H.G.; Pakistan Forest Inst., Peshawar eng; Seth, S.K. Khattak, G.M."

11

Global ranking of the designated Eco regions based on the relative richness of biodiversity and occurrence of species of global importance.

Natural Vegetation

The area/region falls under the Tropical Thorn Zone, so Kikar, (*Acacia nilotica*), Tamarix and Shisham (*Dalbergia sissoo*) are the main species. Other species growing in the area are Eucalypts (*Eucalyptus camaldulensis*), Semul (Bombax ceiba), Bakain / Dharek (*Melia Azedarac*), Jaman (*Syzigium cumini*), Sukh chain (*Pongamia glabra*), Mulberry (*Morus alba),* Beri (*Ziziphus mauritiana*) and Khajoor (*Phoenix dactylifera*). The Natural vegetation including Karir (*Capparis aphylla*), Aak (*Calotropis procera),* Kana (*Saccharum bengalensis*), Khabbal (*Cynodon dactylon),* Lamb (*Aristida depressa*), Gorkha (*Lasiurus sindicus*) is present only in the graveyards or at open areas along the existing roads *and* canals.

The centre median and roadside plantations running parallel or across the Phase 1A Project area/road are dominated (approximately 98%) by Conocarpus species (Non-native species with huge water requirements and other environmental consequences). Table 5 -22 shows flora of the Phase 1A Project area. There is no species of conservation significance locally or internationally observed during the primary survey or secondary data analysis.

Table 5-22: List of Trees in the Phase 1A Project Area

Sl.	Common Name	Scientific Name
1.	Conocarpus	*Conocarpus erectus*
2.	Shisham	*Dalbergia sisso*
3.	Kikar	*Acacia nilotica*
4.	Farash	*Tamarix aphylla/dioca*
5.	Eucalyptus	*Eucalyptus camaldulensis*
6.	Neem	*Azadiracta indica*
7.	Khajoor/date	*Phoenix dactylifera*
8.	Beri	*Zizyphus mauritiana*

Fauna

As the Phase 1A Project area is highly degraded due to multiple reasons, no attraction for fauna was reported. Although, the Sukkur region is ecologically rich and enjoys the status of habitat to many nationally and internationally important species, however, these locations are distant away from the Phase 1A of N5 AoI. The fauna of the area comprises mammals, reptiles, amphibians and birds etc.

Mammals

There are no wild mammalian species observed in the Phase 1A Project area except some domesticated animals. However, the following **Table 5 -23** shows the list of mammalian species present in the region, as the Phase 1A Project area is to be considered highly degraded in terms of wild fauna.

Table 5-23: List of Mammals

Sl.	Common Name	Scientific Name	IUCN Status
1.	Golden Jackal	*Canis aureus*	LC[12]
2.	Jungle Cat	*Felis chaus*	LC
3.	Wild Boar	*Suss crofa cristatus*	LC
4.	Indian Hare	*Lepus nigricollis*	LC
5.	Small Indian mangoose	*Herpestes Javanicus*	LC
6.	Indian Porcupine	*Hystrix indica*	LC
7.	Hedgehog	*Hemiechinus spp.*	LC
8.	Fox	*Vulpes bengalensis*	LC
9.	Asiatic Jackal	*Canis aureus.*	LC

Reptiles

The status of reptiles found in the Phase 1A Project area reveals that as mentioned above, the Phase 1A Project area is highly degraded and commercialized, as a result, the Phase 1A Project does not support and offer safe homes to the wild fauna.

The reptiles found near or around the Study Area are given in **Table 5 -24.**

Table 5-24: Reptiles of the Study Area

Sl.	Common name	Scientific name	IUCN Status
1.	Marsh snake	*X. cerasogaster*	LC
2.	Cat snake	*Boiga trigonata*	LC
3.	Dhaman	*Ptyas mucosus*	LC
4.	Royal snake	*Sphalerosophis atriceps*	LC
5.	Sand snake	*Psammophis condanarus*	LC
6.	Krait	*Bungarus caeruleus*	LC
7.	Cobra	*Naja naja*	LC

Amphibians

Amphibians are represented in Pakistan by anurans i.e. frogs and toads and total 24 species of amphibians are reported in Pakistan. Amphibians found in the AoI are given in **Table 5 -25**.

Table 5-25: Amphibian Species in the AoI

Sl.	Common Name	Scientific Name	IUCN Status
1.	Common Frog	*Rana tigrine*	LC
2.	Common Toad	*Bufo bufo*	LC

12 LC-Least Concern. Species classified as LC are widespread and abundant in the wild, facing no immediate threat of extinction. It is the lowest risk category among the IUCN classification.

Avifauna

The Phase 1A Project area represents semi-diverse avifauna. The birds' fauna mostly consists of resident birds. The area also has key species of raptors such as Sparrow Hawks, Marsh Harriers and Kites. The common birds of the region are Small Egrets, Common Babblers, Sparrows, Myna, Indian Rollers, Pied Kingfishers, Rose-ringed Parakeet, Pond Heron, Collared Doves and little Brown Dove. Famous game birds including Black and Grey Partridges are found in the riverine habitat (away from the Phase 1A Project area) of the Indus River. The common birds observed and reported are given in Table 5 -26.

Table 5-26: Birds Found in Study Area

Sl.	Common name	Scientific name	IUCN Status
1.	Bank myna	*Acridotheres ginginianus*	LC
2.	Blue rock pigeon	*Columba livia*	LC
3.	Common Indian myna	*Acridotheres tristis*	LC
4.	Common sandpiper	*Actitis hypoleucos*	LC
5.	Common wood shrike	*Tephrodornis pondicerianus*	LC
6.	Coot	*Fulica atra*	LC
7.	Grey heron	*Ardea cinerea*	LC
8.	Grey partridge	*Perdix perdix*	LC
9.	House crow	*Corvus splendens*	LC
10.	Indian black kite	*Milvus migrans*	LC
11.	Indian house sparrow	*Passer domesticus*	LC
12.	Indian tree pie	*Dendrocitta vagabunda*	LC
13.	Koel	*Eudynamys scalopica*	LC
14.	Little egret	*Egretta garzetta*	LC
15.	Night heron	*Nycticorax nycticorax*	LC
16.	Pond heron	*Ardeola grayii*	LC
17.	Red-vented bulbul	*Pycnonotus caffer*	LC
18.	Rose ringed parakeet	*Psittacula krameri*	LC
19.	Sindh starling	*Sturnus roseus*	LC
20.	Small sky lark	*Alauda gulgula*	LC
21.	Sparrow hawk	*Accipiter virgatus*	LC

Aquatic Fauna

In the Phase 1A Project area, three (03) canals are passing/crossing the N5 near Sukkur. These canals are diverted from the river Indus through Sukkur barrage, i.e., Nara, Rohri and KF East/Abulwah.

Based on the site visit and departmental consultations following fish species (**Table 5-13**) were reported in all three canals.

Table 5-27: Major Fish Species

Sl.	Scientific Name	Local Name	IUCN Status
1.	*Labeo rohita*	Rohu	LC
2.	*Cirrhinus mrigala*	Mori	LC
3.	*Cyprinus/Eurasian carpio*	Gulfam	LC
4.	*Labeo catla*	Thaila	LC
5.	*Cat fish spp*	*Mujahid and Kaggahi*	LC
6.	*Lepidopus caudatus*	Morak	Data deficit

Endangered Fauna

There are no endangered species of fauna in the tract.

Wetlands

There are no wetlands in the Phase 1A Project Area of Section 7. However, few small water ponds exist (location shown in landuse map **Vol. 5**) along the N5 which is not directly impacted by the proposed Project, as they are situated outside the Project AoI.

Game Reserves/ Wildlife Sanctuaries/ National Parks

There is no key biodiversity area, game reserve, wild sanctuaries and National Park present in and around the Phase 1A Project Area. The Margalla Hills National Park buffer area is located in Section 7 of Phase 1A highway. The National Park boundary is 500 m away from the RoW.

ii. Rawalpindi to Burhan

Ecosystem and Habitat

The climate of the Phase 1A Project area of Section 7 has a typical version of a humid subtropical and dry climate, with five seasons. The study area majorly lies in the sub-tropical scrub zone. The dominant trees species of this natural zone are, Kau (*Olea ferruginea*), Phulai (*Acacia modesta*) and Sanatha (*Dodonaea viscosa*).

The subproject area is under immense anthropogenic/human pressure causes disturbance (illicit tree cuttings, Illegal hunting) and degradation to the natural resources of the zone falling under fully modified criteria. These areas having issues of conversion of green land into agricultural lands, road constructions, residential buildings and also possesses the considerable value of barren land due to external pressures. In this, the natural/original landscape and eco services of the area is almost vanishing and disappeared. Concretes and development by the locals and business development have altered the original conditions. The native species of flora and fauna both were observed and recorded in deteriorated and degraded conditions.

The entire local areas are under degradation due to hazards such as illegal tree cutting, overgrazing, over exploitation of resources, and other biotic factors. Greenery is being lost at a substantially greater rate than regeneration. The Study Area in general is under significant biotic pressure and under retrogression due to various factors such as unsustainable practices, Natural hazards causing the habitat loss, soil erosion and lack of proper functioning of ecosystems. For practical reasons, rarity is often the criterion by which a habitat’s value is determined.

Floristic Composition (Flora)

The study area falls in the sub-tropical broad-leaved evergreen scrub forest zone. Dominant tree species include Phulai (*Acacia modesta*), Wild olive (*Olea ferruginea*), Sanatha

(*Dodonaea viscosa*), Black Berries (*Monotheca buxifolia*), *Reptonia buxifolia*, Beri (*Zizyphus mauritiana*), Royle's Spike Thorn *(Gymnosporia royleana)*, Baikarh (*Adhatoda vasica*), Zebrawood (*Pistacia integerrima)*, *Tecoma undulate*, and *Capparis decidua* on drier slopes. These are low-branching, small evergreen trees with varying densities. Some of these tree species are thorny. Most of these tree and shrub species produce substantial feed and fodder for wildlife and livestock.. The details of vegetative species of the region are given in **Table 5 -28** below:

Table 5-28: Names of Trees/shrubs & Herbs of the Region

Sl.	Common Name	Scientific Name
1.	Banyan/Bhor	*Ficus benghalensis*
2.	Phulai	*Acacia modesta*
3.	Sanatha	*Dodonaea viscosa*
4.	Dhak	*Butea frondosa*
5.	Sukh Chain	*Pongamia pinnata*
6.	Bottle Brush	*Callistemon spp*
7.	Jasmine	*Jasminum humile*
8.	Beri	*Zizyphus mauritiana*
9.	Baikarh	*Adhatoda vasica*
10.	Poplar	*Populus sp.*
11.	Devil Tree	*Alstonia scholaris*
12.	Bougainvillea	*Bougainvillea spectabilis*
13.	Dharek	*Melia azedarach*
14.	Eucalyptus	*Eucalyptus camaldulensis*
15.	Shisham	*Dalbergia sissoo*
16.	Mulberry	*Morus rubra*

The surroundings, in which the Phase 1A Project site exists, were once covered with native vegetation consisting, of trees and a thick cover of bushy vegetation, with the onslaught of civilization, this vegetation was cleared for different commercial and agricultural purposes along the highway due to direct access and expansion of settlements.

The present ecological conditions of the Phase 1A Project area are considered in the category of degraded. The study area is dominated by commercial or residential land use, so no major activities were considered in the past to keep the ecological balance.

The Phase 1A Project area/both sides of the road are dominated by eucalyptus species which are artificially planted by Capital Development Authority (CDA) and Forest Department. No NOC needed from the forest department for plantation within the property of NHA located in ICT, Sindh, KP, and Punjab.

Fauna/Wildlife

Different areas in the district are home to various species of wildlife, including, exotic birds and carnivores, but specifically, the Phase 1A Project area is found degraded and does not support any designated habitats.

Mammals

There are no wild mammalian species observed in the Phase 1A Project area except some domesticated animals. However, the following **Table 5 -29** shows the list of mammalian species present in the region, as the Phase 1A Project area is to be considered highly degraded in terms of wild fauna. The following species are reported in the region.

Table 5-29: List of Mammals

Sl.	Mammals	Scientific Name	IUCN Status
1.	Jackal	*Canis aureus*	Least Concern (LC)
2.	Fox	*Vulpes vulpes*	LC
3.	Jungle Cat	*Felis chaus*	LC
4.	Palm Squirrel	*Funambulus palmarum*	LC
5.	Mongoose	*Herpestes auropunctatus*	LC
6.	Indian Mole Rat	*Rattus rattus*	LC
7.	Field Mouse	*Funambulus pennant*	LC
8.	Porcupine	*Hystrix indica*	LC
9.	Rabbit	*Oryctolagus cuniculus*	LC
10.	Cape Hare	*Lepus capensis*	LC
11.	Masked Palm Civet	*Paguma larvata*	LC
12.	Wild Boar	*Sus scrofa*	LC

Amphibians

The amphibians that are found near or around the Phase 1A Project area are given in the below.

Table 5-30: Amphibians of the Study Area

Sl.	Local/ English Name	Scientific Name	IUCN Status
	Common Frog	*Rana tigrine*	LC
	Common Toad	*Bufo bufo*	LC
	Marble Frog	*Uperodon systoma*	LC

Reptiles

Common Krait is the most common reptile in nearby areas and is occasionally witnessed by the locals. The reptiles that are found near or around the Study Area are given in **Table 5 - 31.**

Table 5-31: Reptiles of the Study Area

Sl.	Local/ English Name	Scientific Name	IUCN Status
1.	Fringed toed Lizard	*Acanthodactylus cantoris*	LC
2.	Common Krait	*Bungarus caeruleus*	LC
3.	Viper	*Vipera xanthina*	LC

Birds – Avifauna

Many bird species have been reported in and around the AoI. These include passage migrants, vagrant, resident, breeding and irregular visitors. The migratory birds descend from higher altitudes during the winter months. It is pertinent to mention that specifically in the subproject area, there is no major water ponds exist in the AoI and no migratory birds were observed. Furthermore, nests of common birds are also exist on the trees within the AoI and median of the road The common birds observed and reported are given in the **Table 5 -32** below:

Table 5-32: Birds Found in Study Area

Sl.	Common Name	*Scientific Name*	*IUCN Status*
1.	Rock Pigeon	*Columba livia*	LC
2.	Myna	*Acrido therestritis*	LC
3.	House Sparrow	*Passer domesticus*	LC
4.	Red-billed Chough	*Pyrrhocorax pyrrhocorax*	LC
5.	Magpie	*Pica pica*	LC
6.	Grey Shrikes	*Lanius excubitor*	LC
7.	Spotted Doves	*Spilopelia chinensis*	LC

Endangered Fauna

There are no endangered species of fauna in the AoI of subproject area.

Wetlands

There are no notified wetlands in and around the Phase 1A Project area of Section 7. However, an artificial private lake (B17) exist (location shown in landuse map **Vol. 5**) along the N5 which is not directly impacted by the proposed subproject.

Game Reserves/ Wildlife Sanctuaries

There is no key biodiversity area, game reserve and wild sanctuaries present in and around the AoI as proposed subproject fall in modified habitat as mentioned in section 5.3.2.1. The Margalla Hills National Park buffer area is near to AoI. The National Park buffer is 500 m away from the RoW. The national park buffer will not be affected directly due to the proposed Phase 1A Project activities. The above details are considered after consultation with the Director of Islamabad Wildlife Management Board (IWMB) followed by a joint field visit to verify the relevant boundaries and details/impacts.

iii. Nowshera to Peshawar

Ecosystem and Habitat of the AoI

The AoI is situated in the semi-arid region of Pakistan. The region is characterized by a dry climate both in summer and winter seasons. The water precipitation is in the form of occasional seasonal rains, during the rainy season (July– September).
The forest found in the region (no such type of forest falls in the AoI, but regionally) is Tropical thorn forests. These are low, open, and pronouncedly xerophytic forests in which thorny leguminous species predominate. This type occupies the whole of the Indus plain except the driest parts. The major tree species are *Prosopis cineraria* (Jhand), *Capparis decidua* (Karir, Karil), *Zizyphus mauritiana* (Ber), *Tamarix aphylla* (Farash) and Kikar (*Acacia nilotica*).

Based on climax vegetation, the whole Indus basin plain with the exception of parts of the few districts consists of tropical thorn forests. Prior to the development of irrigation, agriculture, and urbanization, the area extended from the foothills of the Himalayas and low hills in the south-west.

The roadside trees (designated) are managed by the Forest Department KP, prior to start the construction NOC from the KP Forest Department/competent authority is mandatory as per the Law of the land.

Vegetation of the area shows that it is suitable for the plantation of native species along the agriculture fields and roadside. Variation in diversity is caused due to climate, heterogeneity, biotic interaction and habitat. In the past, the area was covered with a huge amount of ground vegetation and dominated by trees but now the conditions are at the adverse side because the original or natural habitat has been modified and converted into barren land for construction and for agricultural purposes. This particular area has been accessible to humans for a long time resulting in low diversity and wildlife abundance. The area may be considered as degraded or modified habitat due to continuous urbanization and other climatic and anthropogenic threats in the region.

Natural Vegetation

Natural vegetation including Karir (*Capparis aphylla*), Aak (*Calotropis procera*), Kana (*Saccharum bengalensis*), Khabbal (*Cynodon dactylon*), Lamb (*Aristida depressa*), Gorkha (*Lasiuruss indicus*) is present only in the graveyards or at open areas along the existing roads and canals. Mesquit (*Prosopisg landulosa*) has invaded many open areas. Koondar (*Typha angustata*) grows along water ponds and wet places.
The Phase 1A Project area (including the corridor) is populated mostly by Eucalyptus (*Eucalyptus camaldulensis*).

Following are the tree species found in the Phase 1A Project area and AoI.

Table 5-33: List of Flora Found in the Phase 1A Project Area and AoI

Sl.	Common/English Name	Botanical Name
1	Shisham	*Dalbergia sisso*
2	Sumbal	*Bombax ceiba*
3	Mulberry	*Morus alba*
4	Dharek	*Melia azedarach*
5	Kikar	*Acacia nilotica*
6	Ber	*Zizyphus mauritiana*
7	Bottle brush	*Callistemon rigidus*
8	Sufaida/Lachi	*Eucalyptus camaldulensis*

Shrubs and Herbs

Shrubs and herbs which are commonly found in the study area are Jawan (*Alhajim aurorum*), Bhakra (*Tribulus terrestis*), AK (*Calatropis procera*) Lana (*Sueda fruticosa*), Phogs (*Calligonum polygonides*) Jantar (*Sesbania aculeata*) and Tumba (*Citrullusco locyntbus*). Juntar, Tumba and Bathu are found mostly grown in left over agricultural fields, while Arind is present mostly along the water channels. The remaining shrubs and herbs grow in open places.

Fauna

The tract is degraded in natural fauna and especially with mammals' presence. The avifauna is comparatively diversified and colorful. Fauna and flora are an essential part of the environment and depend on each other in many ways and as the flora is degraded and not enriched with lush green crops so, the conditions are not favorable for fauna to flourish. The fauna of the area comprises mammals, reptiles, amphibians and birds etc.

Mammals

The details are given in

.

Table 5-34: Faunal Species in the AoI

Sl.	Common Name	Scientific Name	IUCN Status
1	Jackal	*Canis aureus*	LC
2	Porcupine	*Hystrix indica*	LC
3	Squirrel	*Funambulus pennant*	LC
4	Mouse	*Funambulus pennant*	LC
5	Mongoose	*Herpestes auropunctatus*	LC
6	Indian mole rat	*Rattus rattus*	LC

Reptiles

No habitats of reptiles were observed in the subproject area Reptiles reported in the Study Area are enlisted in below **Table 5 -35**

Table 5-35: Reptiles in the AoI

Sl.	Common Name	Scientific Name	IUCN Status
1.	Brown Cobra	*Naja oxiana*	LC
2.	Indian Krait	*Bungarus caeruleus*	LC
3.	Fringed Toed Lizard	*Acanthodactylus cantoris*	LC

Amphibians

Amphibians found in the AoI are given in **Table 5 -36**

Table 5-36: Amphibian Species in the AoI

Sl.	Common Name	Scientific Name	IUCN Status
1.	Common Frog	*Rana tigrine*	*LC*
2.	Common Toad	*Bufo bufo*	*LC*

Avifauna

The original Species of the area are no more found due to human activities. A fairly diverse range of bird species is found living in some of the suitable areas of the area, including common species such as the dove, common myna, tree pie, crow, and sparrow. Rarely seen birds of prey include the common pariah kite is rare. As a level of threats/disturbance along the Phase 1A Project area is high but the occurrence or observation of occurrence of birds in the study area is low.

Birds of the track consist of small and medium-sized in insignificant numbers due to the non-availability of suitable habitat including food and shelter. Specifically, the project is not an attractive heaven to the birds but the nearby un disturbed or comparative less disturbed areas are providing attraction and habitats. Birds of the Phase 1A Project site are listed in **Table 5 -37**.

Table 5-37: Avifauna in the AoI

Sl.	Common Name	Scientific Name	IUCN Status
1	Koel	*Eudynamys scolopaceus*	*LC*
2	Tree Pie	*Dendrocitta vagabunda*	*LC*
3	Crow	*Corvus corax*	*LC*
4	Rock Dove	*Columba livia*	*LC*
5	Spotted doves	*Spilopelia chinensis*	*LC*
6	Grey Geese	*Anser anser*	*LC*
7	Myna	*Acrido therestritis*	*LC*
8	House Sparrow	*Passer domesticus*	LC
9	House Crow	*Corvus splendens*	*LC*
10	Asian Koel	*Eudynamys scolopacea*	*LC*
11	Rose Ringed Parakeet	*Psittacula krameri*	*LC*
12	Golden Orioles	*Oriolus oriolus*	*LC*
13	Blue Rock Pigeon	*Columba livia*	*LC*
14	Ducks/Mallard	*Anas platyrhynchos*	*LC*

Endangered Fauna

There are no endangered species of fauna in the tract.

Wetlands

There are no wetlands in the Phase 1A Project Area of Section 8. However, few small water ponds exist (location shown in landuse map in Vol. 5) along the N5 which is not directly impacted by the proposed subproject

Game Reserves/ Wildlife Sanctuaries/ National Parks

There is no key biodiversity area, game reserve, wild sanctuaries and National Park present in and around the Section 8 of Phase 1A Project Area.

5.4 Critical Habitats and Species of Conservation Significance

The Project area predominantly passes through urban settlements. Based on field evaluations, secondary data review, and stakeholder consultations, the area is classified as a “Modified Habitat.” Significant anthropogenic activities have altered the primary ecological functions and species composition within the Project AoI. No critical or natural habitats are present in the Project AoI, and no conservation-significant species have been reported. Additionally, the Phase 1A Project sections do not fall within any recognized biodiversity hotspots or key biodiversity areas.

6 SOCIOECONOMIC BASELINE

This section describes the socioeconomic baseline of the project area that covers three road sections Ranipur – Rohri road section (Section 2), Rawalpindi – Burhan (Section 7), and Nowshera – Peshawar (Section 8). The description has been prepared based on census and socioeconomic survey data collected through field research using quantitative and qualitative techniques. The information also gathered through consultation meetings and focused group discissions with project affected people as part of the environmental and social assessments conducted for the project. The data collection process was started during the last quarter of 2024 and completed in February 2025.

6.1 Methodology

A mixed method approach was used in the data collection. The data collection began with a census of all affected households within the project areas. Then, a sample survey of selected PAPs was carried out to gather socioeconomic information at household-level. Finally, a series of focus group discussions (FGDs), including separate FGDs for women were conducted. The FGDs provided avenues to present concerns by the project affected households and communities. The following sections describe the socioeconomic baseline including issues specific to women in each subproject location.

6.2 Section 2: Ranipur – Rohri

Ranipur-Rohri subproject (Section 2) falls in administrative jurisdiction of the Khairpur district and Sukkur District. Khairpur is in the Sukkur Division of the Khyber Pakhtunkhwa province f Pakistan. It is located between middle and northern Sindh. It is bounded on the north by Shikarpur District and Sukkur District, on the east by India, on the south by Sanghar District and Nawabshah District, and on the west by Larkana District, Naushahro Feroze District and Indus River. The revised area of the district is 15,910 km^2

As of the 2023 census, Khairpur district has 452,250 households and a population of 2,597,535. The district has a sex ratio of 102.69 males for every 100 females and a literacy rate 50.14%: Out of total population 50.7% for males and 49.3% for females. 891,260 individuals (34.31%) are under 10 years of age. Additionally, 844,263 (32.50%) reside in urban areas.

Sukkur district is in Sindh Province in Pakistan. Two districts have been split off from the territory of Sukkur: Shikarpur in 1977 and Ghotki in 1993. As of the 2023 census, Sukkur district has 268,588households and a population of 1,625,467. The district has a sex ratio of 113.04 males for every 100 females and a literacy rate of 58.26%: 68.10% for males and 47.20% for females for females. 539,351 individuals (33.18% are under 10 years of age. Additionally, 814,999 people (49.70%) reside in urban areas.

6.2.1 Demographic Characteristics

A socio-economic survey of 126 AHs was conducted which indicated that the population of the surveyed households was comprised of 756 persons and among them, there were more males (51%) than females (49%). The average size of the household is 6 people. The sex ratio based on the household is 104 men per 100 women.

As far as family structure is concerned, around 31% of households living as extended or joint families under the same roof, while 69% percent of respondents reported that they live in a nuclear family system.

Survey shows that 17% of the respondents are up to 25 years of age, 48% of the respondents are between 26 – 35 years, 21% are 36 – 45 years and the remaining 14% are more than 45 years of age. These figures show that respondents are mature enough to give their opinion about the proposed project and its impact. Details on the age composition are provided in **Table 6 -38**.

Table 6-38: Age Composition of Respondents

Sr. No.	Age Composition	Number of Respondent	Percentage
1	18-25	21	17
2	26-35	60	48
3	36-45	27	21
4	Above 45	18	14
Total		**126**	**100**

6.2.2 Religion and Language

Overwhelming majority (99.5%) of the population in the Phase 1A highway sections area follow Islam as their religion and only a tiny minority (0.5%) mentioned Hinduism as their religion.

The Sindhi was found dominant as mother language of the residents in the AoI and the nearby communities. However, Saraiki, and Urdu languages are also spoken in the project area and all over areas of the districts. It is worth mentioning that despite the prevailing mother language in the area, each person found very friendly in communicating in the national language - Urdu.
There are some social divisions among the affected population. Main subdivisions (castes) identified are Ujjan, Mangri, Lashari, Jokihia, Jatoi, Mirani, Khoro, Khushro, Syed, Domki, Rajput, Halapot, Bero, Chandio, Wasan, Merani. Talpur, Abro, memon Ujjan Arain and hindo caste Kholi

6.2.3 Education and Literacy

The census revealed that 41% of the AHs are illiterate. The literate population in the surveyed households is 59% which is slightly higher than the national literacy rate which is 50.14% according to census survey 2023 for both sexes. Educational status among the members of AHs in the subproject area is shown in **Table 6 -39.**

Table 6-39: Educational Status of AH's Members

Sr. No.	Educational Status	Number	Percentage
1	Illiterate	314	41
2	Primary	175	23
3	Middle	112	15
4	Matric	67	9
5	Intermediate	53	7
6	Graduation	15	2
7	Masters	20	3
Total		**756**	**100**

6.2.4 Occupational and Livelihood Sources

Among total surveyed 41% of the household members considered dependent who consists of children under 10 years, housewives, and unemployed individuals. The remaining members are engaged in various professions to earn a livelihood. Survey findings reveal that approximately 19% of the AH members are involved in shop keeping. These shopkeepers operate general stores, sell fruits, vegetables, chicken, tea, cold drinks, cigarettes, and pakoras/samosas, or run roadside eateries, among other activities. Additionally, about 9% are employed in private jobs to support themselves. Detailed statistics regarding the occupational status of the AH members are presented in **Table 6 -40.**

Table 6-40: Occupations of AH's Members

Sr. No.	Professional Status	Number	Percentage
1	Upto 10 year/Housewives/Idles	311	41
2	Agriculturist +Livestock	45	6
3	Shopkeeper	143	19
4	Business	49	7
5	Labor	64	8
6	Govt Job	45	6
7	Private job	70	9
8	Driver	19	3
9	Retired	10	1
Total		**756**	**100**

6.2.5 Household Income and Expenditure

Around 12% of the AHs earn up to rupees 37,000 per month, 39% AHs earn between rupees 37,001 to 45,000 per month, 21% AHs earn between rupees 45,001 to 55,000 per month and 16% are earning between ranges of 55,001 to 65,000. Moreover, 12% of AHs are earning above PKR. 65,000 per month. In Pakistan, household income of PKR 37,000 is taken as poverty threshold. Based on the household income data collected in the survey, about 5% of the AHs may be considered poor. The details of household average monthly income is presented in **Table 6 -41**.

Table 6-41: Average Monthly Household Income

Sr. No.	Household Average Monthly Income (PKR.)	Number	Percentage
1	Up to 37,000	15	12
2	37,001 to 45,000	49	39
3	45,001 to 55,000	26	21
4	55,001 to 65,000	20	16
5	Above 65,000	16	12

Sr. No.	Household Average Monthly Income (PKR.)	Number	Percentage
Total		**126**	**100**

Source: Census and socioeconomic survey of Ahs

However, household expenditure depends on the earnings of the families. Therefore, approximately 18% of the respondents reported a monthly expenditure of up to PKR 37,000, while 39% had monthly expenditures in the range of PKR 37,001 to 45,000. Additionally, 20% of the respondents reported their family expenditure between PKR 45,001 and 55,000. Meanwhile, 24% reported expenses between PKR 55,001 and 65,000 per month, and 9% of the households indicated an expenditure above PKR 65,000.

6.2.6 Housing Condition and Ownership

A majority of the AHs members in the project area (58%) are living in Pacca houses which are constructed with solid building materials while 25% respondents had semi Pacca houses which are made of masonry bricks with mud mortar. Only 15% of the respondents mentioned that they live in Katcha houses made of mud and straws while 2% live in temporary hut houses. Generally, poor households live in Katcha and hut houses while lower income households would live in Semi-Pacca houses. Those who can afford to live in Pacca households are generally not poor. The data shows high-level social disparity among well-off families and poorer households in the project area. **Table 6 -42** depicts the housing construction pattern in the project area.

Table 6-42: Housing Construction Pattern

Sr. No.	Type	Number	Percentage
1	Pacca	73	58
2	Semi-Pacca	31	25
3	Katcha	19	15
4	Hut	03	2
Total		**126**	**100**

Out of 126 respondents, the majority (75%) of the respondents have self-owned houses and the 23% are renters and remaining 2% were living in the houses that were provided by the landlords.

6.2.7 Access to Infrastructure and Services

The survey results revealed that 83% of the studied households have access to schooling and electricity. Access to health care is only a half of the population (51% of households) in the form of BHUs and THQs. Gas and water supply facilities are available to 31% and 9% of households, respectively. Similarly, sewerage and mobile services are available to 28% and 89% of households, respectively. Detailed information regarding access to social amenities is provided in **Table 6 -43.**

Table 6-43: Access to Social Amenities

Sr. No.	Facility	Number of Respondent	Available (%)
1	Electricity	105	83
2	School	97	76

Sr. No.	Facility	Number of Respondent	Available (%)
3	Hospital	64	51
4	Gas	40	31
5	Water Supply	11	9
6	Sewerage	35	28
7	Telephone/ Mobile	113	89

Source: Census and socioeconomic survey of AHs

The source of water depends on the location of the house. Households depend on mainly two sources of water for domestic use. Hand pumps/ bore water is the main source of water for domestic use in the proposed project area so majority of the respondents (81%) get water from this source, and 9% respondents use public water supply as source of drinking water. Hand pumps mostly installed near the irrigation channels from where water is fetched mostly dis duty is performed by the females. However, a large majority (82%) of the respondents are not satisfied with the quality of water they are using currently.

6.2.8 Access to Credit

There are two types of credit sources available to people: formal sources, such as banks and microfinance NGOs, and non-institutional sources, such as loans from friends and relatives. The survey findings revealed that 10% of the households (AHs) accessed credit, while 90% of the respondents did not borrow or depend on informal sources for urgent financial needs.

6.2.9 Land ownership

As revealed before, most of the people live in the state or NHA owned land. Only around 5% of AHs have farmland and the rest have no land but live in rented or illegally occupied state lands.

6.2.10 Gender Assessment

The gender assessment is highlighting the barriers women face, from limited access to resources to the impact of cultural norms and societal expectations. Special attention was given to understanding the constraints on women's mobility, education, and employment opportunities, as well as identifying potential solutions to improve gender equality and empower women.

Cultural norms and values in KP province present many challenges, such as limiting women's participation in surveys or leading to underreporting of sensitive issues like domestic violence or women's economic activities. From the assessment and FGDs, following issues emerged as key for their social and economic advancement Lack of Public Transport facilities; unemployment and lack of job opportunities, poor or lack of safety and privacy in public transport; insufficient health care facilities and discrimination agonist women in work and social spaces. Although the project interventions may not able to resolve or address such issues , efforts will be taken to provide women equal access to project related works, vocational and job training as part of livelihood restoration plans; Implement codes of conduct for project workers to prevent gender based violence, and establish specific grievance redress mechanism for women in project area to respond their complaints and grievances occurring due to project tasks and involve them in designing better transport facilities under the project . Detailed gender action plan is presented in the RAP of Phase 1A Project.

6.3 SOCIOECONOMIC STATUS OF CENSUS HOUSEHOLDS

6.3.1 Section 2: Ranipur – Rohri Subproject Area

Ranipur-Rohri subproject (Package-02) falls in administrative jurisdiction of the Khairpur district and Sukkur District. Khairpur is in the Sukkur Division of the Khyber Pakhtunkhwa province f Pakistan. It is located between middle and northern Sindh. It is bounded on the north by Shikarpur District and Sukkur District, on the east by India, on the south by Sanghar District and Nawabshah District, and on the west by Larkana District, Naushahro Feroze District and Indus River. The revised area of the district is 15,910 km^2

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6.3.1.1 Demographic Characteristics

A socio-economic survey of 126 AHs was conducted which indicated that the population of the surveyed households was comprised of 756 persons and among them, there were more males (51%) than females (49%). The average size of the household is 6 people. The sex ratio based on the household is 104 men per 100 women.

As far as family structure is concerned, around 31% of households living as extended or joint families under the same roof, while 69% percent of respondents reported that they live in a nuclear family system.
Survey shows that 17% of the respondents are up to 25 years of age, 48% of the respondents are between 26 – 35 years, 21% are 36 – 45 years and the remaining 14% are more than 45 years of age. These figures show that respondents are mature enough to give their opinion about the proposed project and its impact. Details on the age composition are provided in the **Table 6.7.**

Table 6-44: Age Composition of Respondents

Sr. No.	Age Composition	Number of Respondent	Percentage
1	18-25	21	17
2	26-35	60	48
3	36-45	27	21
4	Above 45	18	14
Total		**126**	**100**

6.3.1.2 Social Background

Overwhelming majority (99.5%) of the population in the subproject area follow Islam as their religion and only a tiny minority (0.5%) mentioned Hinduism as their religion.

The Sindhi was found dominant as mother language of the residents in the AoI and the nearby communities. However, Saraiki, and Urdu languages are also spoken in the project area and all over areas of the districts. It is worth mentioning that despite the prevailing mother language in the area, each person found very friendly in communicating in the national language - Urdu.

There are some social divisions among the affected population. Main subdivisions (castes) identified are Ujjan, Mangri, Lashari, Jokihia, Jatoi, Mirani, Khoro, Khushro, Syed, Domki, Rajput, Halapot, Bero, Chandio, Wasan, Merani. Talpur, Abro, memon Ujjan Arain and hindo caste Kholi

6.3.1.3 Education and Literacy

The census revealed that 41% of the AHs are illiterate. The literate population in the surveyed households is 59% which is slightly higher than the national literacy rate which is 50.14% according to census survey 2023 for both sexes. Educational status among the members of AHs in the subproject area is shown in **Table 6.8.**

Table 6-45: Educational Status of AH's Members

Sr. No.	Educational Status	Number	Percentage
1	Illiterate	314	41
2	Primary	175	23
3	Middle	112	15
4	Matric	67	9
5	Intermediate	53	7
6	Graduation	15	2
7	Masters	20	3
Total		**756**	**100**

6.3.1.4 Occupational and Livelihood Sources

Among total surveyed 41% of the household members considered dependent who consists of children under 10 years, housewives, and unemployed individuals. The remaining members are engaged in various professions to earn a livelihood. Survey findings reveal that approximately 19% of the AH members are involved in shop keeping. These shopkeepers operate general stores, sell fruits, vegetables, chicken, tea, cold drinks, cigarettes, and pakoras/samosas, or run roadside eateries, among other activities. Additionally, about 9%

are employed in private jobs to support themselves. Detailed statistics regarding the occupational status of the AH members are presented in **Table 6.9.**

Table 6-46: Occupations of AH's Members

Sr. No.	Professional Status	Number	Percentage
1	Upto 10 year/Housewives/Idles	311	41
2	Agriculturist +Livestock	45	6
3	Shopkeeper	143	19
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7	Private job	70	9
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Total		**756**	**100**

6.3.1.5 Household Income and Expenditure

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Table 6-47: Average Monthly Household Income

Sr. No.	Household Average Monthly Income (PKR.)	Number	Percentage
1	Up to 37,000	15	12
2	37,001 to 45,000	49	39
3	45,001 to 55,000	26	21
4	55,001 to 65,000	20	16
5	Above 65,000	16	12
Total		**126**	**100**

Source: Census and socioeconomic survey of Ahs

However, household expenditure depends on the earnings of the families. Therefore, approximately 18% of the respondents reported a monthly expenditure of up to PKR 37,000, while 39% had monthly expenditures in the range of PKR 37,001 to 45,000. Additionally, 20% of the respondents reported their family expenditure between PKR 45,001 and 55,000. Meanwhile, 24% reported expenses between PKR 55,001 and 65,000 per month, and 9% of the households indicated an expenditure above PKR 65,000.

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Table 6-48: Housing Construction Pattern

Sr. No.	Type	Number	Percentage
1	Pacca	73	58
2	Semi-Pacca	31	25
3	Katcha	19	15
4	Hut	03	2
Total		**126**	**100**

Out of 126 respondents, the majority (75%) of the respondents have self-owned houses and the 23% are renters and remaining 2% were living in the houses that were provided by the landlords.

6.3.1.7 Access to Infrastructure and Services

The survey results revealed that 83% of the studied households have access to schooling and electricity. Access to health care is only a half of the population (51% of households) in the form of BHUs and THQs. Gas and water supply facilities are available to 31% and 9% of households, respectively. Similarly, sewerage and mobile services are available to 28% and 89% of households, respectively. Detailed information regarding access to social amenities is provided in **Table 6.12.**

Table 6-49: Access to Social Amenities

Sr. No.	Facility	Number of Respondent	Available (%)
1	Electricity	105	83
2	School	97	76
3	Hospital	64	51
4	Gas	40	31
5	Water Supply	11	9
6	Sewerage	35	28
7	Telephone/ Mobile	113	89

Source: Census and socioeconomic survey of Ahs

The source of water depends on the location of the house. Households depend on mainly two sources of water for domestic use. Hand pumps/ bore water is the main source of water for domestic use in the proposed project area so majority of the respondents (81%) get water from this source, and 9% respondents use public water supply as source of drinking water. Hand pumps mostly installed near the irrigation channels from where water is fetched mostly dis duty is performed by the females. However, a large majority (82%) of the respondents are not satisfied with the quality of water they are using currently.

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6.3.1.9 Land ownership

As revealed before, most of the people live in the state or NHA owned land. Only around 5% of AHs have farmland and the rest have no land but live in rented or illegally occupied state lands.

6.3.1.10 Gender Assessment

The gender assessment is highlighting the barriers women face, from limited access to resources to the impact of cultural norms and societal expectations. Special attention was given to understanding the constraints on women’s mobility, education, and employment opportunities, as well as identifying potential solutions to improve gender equality and empower women.

Cultural norms and values in KP province present many challenges, such as limiting women’s participation in surveys or leading to underreporting of sensitive issues like domestic violence or women’s economic activities. From the assessment and FGDs, following issues emerged as key for their social and economic advancement Lack of Public Transport facilities; unemployment and lack of job opportunities, poor or lack of safety and privacy in public transport; insufficient health care facilities and discrimination agonist women in work and social spaces. Although the project interventions may not able to resolve or address such issues , efforts will be taken to provide women equal access to project related works, vocational and job training as part of livelihood restoration plans; Implement codes of conduct for project workers to prevent gender based violence, and establish specific grievance redress mechanism for women in project area to respond their complaints and grievances occurring due to project tasks and involve them in designing better transport facilities under the project . Detailed gender action plan is presented in the RAP of this subproject.

6.3.2 SECTION 7: RAWALPINDI TO BURHAN

The Rawalpindi-Burhan subproject (Section 7) falls in administrative jurisdiction of the Islamabad Capital Territory (ICT), District Rawalpindi and District Attock.

Islamabad Capital Territory- Islamabad, the capital city of Pakistan, is the country's tenth-most populous city and is administered directly by the federal government as part of the Islamabad Capital Territory. It was established in 1967 as a planned city to replace Karachi as the national capital. Islamabad is located at 33.43°N, 73.04°E, at the northern edge of the Pothohar Plateau and at the foot of the Margalla Hills. The city's elevation is 540 meters (1,770 feet).

Islamabad, along with the ancient Gakhar city of Rawalpindi, forms a conurbation commonly referred to as the "Twin Cities." To the northeast of Islamabad lies the colonial-era hill station of Murree, while to the north is the Haripur District of Khyber Pakhtunkhwa. Kahuta is situated to the southeast, and Taxila, Wah Cantt, and Attock District are located to the northwest. Gujar Khan, Rawat, and Mandrah are to the southeast, and the metropolis of Rawalpindi lies to the south and southwest.

The city covers an area of 906 square kilometers (350 square miles), with an additional 2,717 square kilometers (1,049 square miles) designated as the Specified Area, which includes the Margalla Hills in the north and northeast. The southern portion of Islamabad consists of an undulating plain, drained by the Kurang River, on which the Rawal Dam is located. As of the 2023 census, Islamabad district has a population of 2,363,863. According to census the male population was 51.48% and 48.51% were female, with a sex ratio of 106.12.

Rawalpindi District is a district located in the northernmost part of the Punjab province of Pakistan. The district has an area of 5,286 km^2 (2,041 sq mi). Originally, its area was 6,192 km^2 (2,391 sq mi) until the 1960s when Islamabad Capital Territory was carved out of the district, giving away an area of 906 km^2 (350 sq mi). It is situated on the southern slopes of the north-western extremities of the Himalayas, including large mountain tracts with rich valleys traversed by mountain rivers. The chief rivers are the Indus and the Jhelum, and it is noted for its milder climate and abundant rainfall due to its proximity to the foothills. As of the 2023 census, Rawalpindi district has 931,813 households and a population of 5,745,964.

Attock District known as Campbellpur District during British Raj, is a district, located on the Pothohar Plateau, in Punjab, Pakistan; created in April 1904. The district was established in April 1904 as Campbellpur District during the British Raj through the merging of tehsils from neighbouring districts. It is in the north of the Punjab province, bordered by Chakwal to the south, Mianwali to the southwest, Rawalpindi to the east, Kohat to the west, Nowshera to the northwest, and Swabi and Haripur to the north. The district consists of 6 tehsils: Attock, Fateh Jang, Hazro, Hassan Abdal, Jand and Pindi Gheb. As of the 2023 census, Attock district has 353,973 households and a population of 2,170,423. The district has a sex ratio of 100.83 males to 100 females.

6.3.2.1 Demographic Characteristics of Studied Households

The population of the surveyed households comprised of 1,272 persons and among them, there were more males (53%) than females (47%). The sex ratio is an important demographic indicator, which is defined as the “number of males per hundred females”. As per the social survey, the sex ratio based on the household is 112.7 men per 100 women. **Table 6 -50** depicts the demographic characteristics of the studied households.

Table 6-50: Population and Household Size of the AHs

Total Respondents	Population				Total Population	%
	Male	%	Female	%		
187	674	53	598	47	1,272	100

As far as family structure is concerned, about 54% of AHs are living in a joint family system where grandparents also live under the same roof, while 46% percent of respondents reported that they live in a nuclear family system.

6.3.2.2 Age composition of Respondents

Survey shows that 18% of the respondents are up to 25 years of age, 22% of the respondents are between 26 – 35 years, 35% are 36 – 45 years and the remaining 25% are more than 45 years of age. **Table 6 -51** depicts the age composition of the respondents.

Table 6-51: Age Composition of Respondents

Sr. No.	Age Composition	Number of Respondent	Percentage
1	18-25	33	18
2	26-35	41	22
3	36-45	65	35
4	Above 45	48	25
Total		**187**	**100**

6.3.2.3 Social Background

All the affected persons reported their religion as Islam. Hindko and Pashto are the predominant languages spoken by most respondents, with 88% using these languages as their primary language. Punjabi is also a major language spoken by a significant portion of the population. Additionally, Urdu is widely spoken and understood by most respondents, highlighting its importance as a national language. This bilingual and, in some cases, trilingual proficiency ensures effective communication across diverse social and cultural settings.

The socioeconomic survey also found that various tribes live within the project area. In the districts of Islamabad and Rawalpindi, the PAPs belong to tribes such as Rajpoot, Syed, Khattar, Dar, Raja, Abbasi, and several others. In District Attock, the PAPs represent different Pashtoon tribes, including Khatak and Orakzai, while other PAPs belong to families like Awan, Gheba, and Rajpoot. These tribes, with their diverse cultural and regional backgrounds, enrich the cultural fabric of the area. The area’s cultural diversity is not only a source of strength but also adds to its beauty, as it fosters a dynamic blend of traditions, languages, and customs that coexist harmoniously.

6.3.2.4 Educational and Literacy

The census survey revealed that 18% of the population of the AHs are illiterate. The literate population in the surveyed households is 82%, which is higher than the national literacy rate which is 59.13% according to census survey 2023 for both sexes. **Table 6 -52** depicts the education and literacy level among AH’s members.

Table 6-52: Educational Status AH’s Members

Sr. No.	Educational Status	Number	Percentage
1	Illiterate	227	18
2	Primary	197	15

Sr. No.	Educational Status	Number	Percentage
3	Middle	210	17
4	Matric	156	12
5	Intermediate	319	25
6	Graduation	107	8
7	Masters	56	4
Total		**1,272**	**100**

6.3.2.5 Occupational Status

Out of the total AH members, 44% of the population consists of children under 10 years, housewives, and unemployed individuals who are not working. The remaining members are engaged in various income earning activities such as daily wage labour and private sector jobs as well as shop keepers for livelihood. **Table 6 -53** depicts the occupational status of the AH's members.

Table 6-53: Occupations of AH's Members

Sr. No.	Professional Status	Number	Percentage
1	Up 10 year/unemployed	554	44
3	Shopkeeper	123	10
4	Business	107	8
5	Labor	89	7
6	Govt Job	63	5
7	Private job	265	21
9	Retired/Old	71	6
Total		**1,272**	**100**

6.3.2.6 Household Income and Expenditure

The income level of the surveyed AHs was grouped in five ranges. Around 25% of the AHs earn up to rupees 37,000 per month, while 43% AHs earn between rupees 45,001 to 55,000 per month. However, the details on household income are summarized in Table 6 -54

Table 6-54: Average Monthly Household Income

Sr. No.	Household Average Monthly Income (PKR.)	Number	Percentage
1	Up to 37,000	47	25
2	37,001 to 45,000	23	12
3	45,001 to 55,000	46	43
4	55,001 to 65,000	45	24
5	Above 65,000	26	14
Total		**187**	**100**

Approximately 11% of the respondents reported a monthly expenditure of up to PKR 37,000. The average monthly income of sizable number of people (43%) ranged between PKR 45,001 and 55,000.

6.3.2.7 Housing Condition and Ownership

People in the project area live in various types of houses. More than half (53%) of the respondents are living in permanent (Pacca) houses which are constructed with superior materials and workmanship. Around 6% of PAPs live in temporary houses with minimal facilities. Out of 187 survey respondents, the majority (88%) indicated that they live in self-owned houses and the remaining 12% live in rented/leased houses. The details on housing condition of the AHs are given in the **Table 6 -55**

Table 6-55: Housing Construction Pattern

Sr. No.	Type of House	Number of Respondent	Percentage
1	Pacca	99	53
2	Semi Pacca	77	41
3	Katcha	11	6
Total		**187**	**100**

6.3.2.8 Access to Infrastructure Services

Social infrastructure and amenities are readily available and in good condition. People have good household's dwelling, household amenities such as electricity and modern appliances, access to water, fuel for cooking (which is primarily a task for women), and the type of sanitation facilities available as primary indicators for assessing the standard of living. Findings of the survey show that majority of people have good access to health care, centricity schools etc. The details of available social amenities is provided in the Table 6 - 56.

Table 6-56: Access to Social Amenities

Sr. No.	Facility	Number of Respondent	Available (%)
1	Electricity	187	100
2	School	187	100
3	Hospital	187	100
4	Gas	147	79
5	Water Supply	117	63
6	Sewerage	182	97
7	Telephone/ Mobile	184	98

Households depend on several sources of water for domestic use. Public water supply is the main source of water for domestic use in the proposed project area so majority of the respondents, i.e., obtained water from this source, and 37% respondents use public water supply as source of drinking water. The majority (58%) of respondents are satisfied with the quality of water while 42% of respondents indicated that the quality of water is not satisfactory.

6.3.2.9 Access to credit

There are two types of credit sources available to people: formal sources, such as banks and microfinance NGOs, and non-institutional sources, such as loans from friends and relatives. The survey findings revealed that 12% of the households (AHs) availed the facility of credit, while 88% of the respondents did not borrow but use informal credit sources for urgent need of money.

6.3.2.10 Gender Assessment and Outcome

Women in the subproject areas, like in other project locations, face various challenges, such as limiting women's participation in economic activities, underreporting of sensitive issues like domestic violence or limited job opportunities for women' economic empowerment.

According to the gender assessment, there are several concerns that could potentially affect women within the subproject area. These concerns include access to resources, safety in public spaces, livelihood disruptions during construction, and the adequacy and fair treatment in compensation for affected women. Women also expressed their concern related to the unequal access to employment opportunities under the project, and the potential safety and protection from workers during the project implementation. The FGDs with women group suggested that targeted actions and strategies to be devised to ensure that women are equally informed and supported throughout the project's implementation. A detailed gender action plan has been devised in this regard and included in the subproject RAP.

6.3.3 SECTION 8: NOWSHERA – PESHAWAR

The subproject falls in administrative jurisdiction of the Peshawar district and Nowshera District. The socio-economic survey focused on the AHs of the project and relevant information related to the district.

Peshawar District is a district in the Peshawar Division of the Khyber Pakhtunkhwa province of Pakistan. It is located about 160 km west of the Pakistan's capital Islamabad. The district headquarters is the city of Peshawar, which is also the capital of Khyber Pakhtunkhwa. Peshawar district is divided into four towns. Each town in turn consists of 92 union councils in the district Peshawar.

As of the 2023 census, Peshawar district has 690,976 households and a population of 4,758,762. The district has a sex ratio of 103.99 males for every 100 females and a literacy rate of 53.28%, with 64.91% for males and 41.09% for females. A total of 1,355,625 individuals (28.54%) are under 10 years of age. It is also estimated that nearly 40% of the population live in urban areas.

Nowshera District is a subdivision of Peshawar until 1988, when it became a district. It is bordered by Peshawar District to the West, Mardan District to the North, Charsadda District to the North West, Swabi District to the North East, Kohat District to the South, Orakzai Agency to the South West & Attock District to the East. Previously it was known as Nowkhaar Province till it was annexed into British India via the Durand Line Agreement. Prior to its establishment as a separate district in 1990, Nowshera was part of Peshawar District. The district was also part of the Peshawar Division until the reforms of The Government of Pakistan.

As of the 2023 census, Nowshera district has 259,774 households and a population of 1,740,705. The district has a sex ratio of 103.78 males for every 100 females and a literacy rate of 56.78%, with 68.53% for males and 44.49% for females. A total of 478,985 individuals (27.6%) are under 10 years of age. However, this district is less urbanized and only around one fifth (19.6%) live in urban locations.

Census was carried out for all AHs within the ROW which is the basis for socio-economic profile of the AHs and is used to define the entitlements for relocation, rehabilitation and income restoration for the AHs in general and the vulnerable in particular. The socioeconomic (sample) survey of 319 AHs was carried out which represents one respondent per household.

6.3.3.1 Demographic Characteristics of Studied Households

Total population of the surveyed households was comprised of 2,074 persons and among them, there were more males (52%) than females (48%). The average size is 6.5 people per household. The gender-wise distribution of the respondents' households is given in **Table 6 -57**. The sex ratio based on the household is 108.23 men per 100 women.

Table 6-57: Population and Household Size of the AHs

Total Respondents	Population				Total Population	%
	Male	%	Female	%		
319	1078	52	996	48	2074	100

Source: Census and Socioeconomic Survey of PAPs

About 66% of AHs are living in a joint or extended family system where two or three generations of family members live under the same roof, while 34% percent of respondents reported that they live as single/ nuclear family stricture.

Survey shows that 13% of the respondents are up to 25 years of age, 21% of the respondents are between 26 – 35 years, 41% are 36 – 45 years and the remaining 25% are more than 45 years of age. These figures show that respondents are mature enough to give their opinion about the proposed project and its impact. Details on the age composition are provided in **Table 6 -58**

Table 6-58: **Age Composition of PAPs**

Sr. No.	Age Composition	Number of Respondent	Percentage
1	18-25	42	13
2	26-35	68	21
3	36-45	131	41
4	Above 45	78	25
Total		**319**	**100**

Total population of the subproject areas follow Islam as their religion. As far as language of communication, Pashto is the predominant language spoken by majority of the respondents, with 88% of them using it as their primary language. While around 12% respondents are Hindko speaking. Additionally, Urdu is widely spoken and understood by most of the respondents, reflecting its importance as a secondary language in the project area. This bilingual proficiency allows for effective communication across diverse social and cultural settings.

Population of the subproject area belong to various Pashtun tribes in the project area. The largest group of affected households are from the Khatak tribe, accounting for 22%, while other major tribes are listed in **Table 6 -59.** In addition to the major tribes depicted in the table, there are several other minority tribes along the project corridor, including Serbankhel, Sarwanan, Akhundzada, and Sheikham, among others. These tribes, originating from both Pashtun and Kashmiri Pathan backgrounds, also contribute to the cultural diversity of the area.

Table 6-59: Ethnic Structure of PAPs

Sr. No.	Major Tribes	Number of Respondent	Percentage
1	Khatak	71	22
2	Yousafzai	53	17
3	Afridi	37	12
4	Mohmand	31	10
5	Kashmiri Pathan	39	12
6	Others	88	28
Total		**319**	**100**

6.3.3.2 Education and Literacy

The census revealed that around one third of the population of the AHs are illiterate. The literate population in the surveyed households is 66% which is slightly higher than the national literacy rate which is 59.13% according to census survey 2023 for both sexes. Educational status among the members of AHs is shown in **Table 6 -60**

Table 6-60: Educational Status of AH's Members

Sr. No.	Educational Status	Number	Percentage
1	Illiterate	712	34
2	Primary	317	15
3	Middle	178	9
4	Matric	421	20
5	Intermediate	214	10
6	Graduation	143	7
7	Masters	89	4
Total		**2074**	**100**

6.3.3.3 Occupational Status

Survey findings reveal that approximately 19% of the AH members are involved in shopkeeping. These shopkeepers operate general stores, sell fruits, vegetables, chicken, tea, cold drinks, cigarettes, and pakoras/samosas, or run roadside eateries, among other activities. Additionally, about 10% are employed in private jobs to support themselves. Out of the total AH members, 54% of the population considered dependents consists of children under 10 years, housewives, and unemployed individuals who are not working. The remaining members are engaged in various professions to earn a livelihood. The occupational categories of the AH members are presented in the **Table 6 -61.** The findings indicate that the livelihood losses that may incur because of the subproject interventions may have significant impacts of overall households and population whose earing are largely depend on daily business and trading activities. This has been further assessed in the RAP of the subproject

Table 6-61: Occupations of AH's Members

Sr. No.	Professional Status	Number	Percentage
1	Upto 10 year/House Wives/Idles	1124	54
2	Agriculturist +Livestock	73	4
3	Shopkeeper	397	19
4	Business	89	4
5	Labor	64	3
6	Govt Job	34	2
7	Private job	210	10
8	Driver	35	2
9	Retired	48	2
Total		**2074**	**100**

6.3.3.4 Household Income and Expenditure

The income level of the AHs surveyed was grouped in five ranges. Around 5% of the AHs earn up to rupees 37,000 per month, 11% AHs earn between rupees 37,001 to 45,000 per month, 43% AHs earn between rupees 45,001 to 55,000 per month and 29% are earning between ranges of 55,001 to 65,000. Moreover, 12% of AHs are earning above PKR. 65,000 per month. In Pakistan, household income of PKR 37,000 is taken as poverty threshold. Based on the household income data collected in the survey, about 5% of the AHs may be considered poor. The details of average monthly income of the households are presented in **Table 6 -62**

Table 6-62: Average Monthly Household Income

Sr. No.	Household Average Monthly Income (PKR.)	Number	Percentage
1	Up to 37,000	17	5
2	37,001 to 45,000	35	11
3	45,001 to 55,000	137	43
4	55,001 to 65,000	91	29
5	Above 65,000	39	12
Total		**319**	**100**

Source: Census and socioeconomic survey of Ahs

Household expenditure depends on the earnings of the family members. As per the survey, approximately 16% of the respondents reported a monthly expenditure of up to PKR 37,000, while 24% had monthly expenditures in the range of PKR 37,001 to 45,000. However, the average monthly expenditure of households (43% of the respondents) ranged between PKR 45,001 and 55,000. Meanwhile, 26% reported expenses between PKR 55,001 and 65,000 per month, and 9% of the households indicated an expenditure above PKR 65,000. The monthly expenditure pattern of the respondents is provided in **Table 6 -63**.

Table 6-63: Average Monthly Household Expenditure

Sr. No.	Average Monthly Expenditures (PKR)	Number of Respondent	Percentage
1	Up to 37,000	52	16
2	37,001 to 45,000	77	24
3	45,001 to 55,000	79	43
4	55,001 to 65,000	82	26
5	Above 65,000	29	9
Total		**319**	**100**

Source: Census and socioeconomic survey of AHs

6.3.3.5 Housing Conditions and Ownership

Nearly half (49%) of the AHs in the subproject area are living in permanent (Pacca) houses which are constructed with solid materials and while 44% respondents had semi - permanent (Semi Pacca houses which are made of masonry bricks with mud mortar). A very small percentage (Only 7%) of the respondents mentioned that they live in temporary housing (Katcha houses made of mud and straws). This also shows the socioeconomic status of the people in the area. People who are upper class and well-off in Pacca houses while lower - middle income households live in semi-pacca houses. Most of the poor and vulnerable people live in Katcha houses. Table 6 -64 shows the construction pattern of houses among the AHs.

Table 6-64: Housing Construction Pattern

Sr. No.	Type of House	Number of Respondent	Percentage
1	Pacca	157	49
2	Semi Pacca	139	44
3	Katcha	23	7
Total		**319**	**100**

As far as ownership status is concerned, the majority (97%) of the respondents have self-owned houses and the remaining 3% are renters. This also shows the magnitude impacts of houses could be damaged during the road widening activities.

6.3.3.6 Access to Infrastructure and Services

In general, people have good access to all types of infrastructure and services. This assessment found relatively large household’s dwelling, have household amenities such as electricity and modern appliances, access to water, fuel for cooking (which is primarily a task for women), and the type of sanitation facilities available as primary indicators for assessing the standard of living.

The survey results revealed that 100% of the studied households have access to schooling and electricity. Health care facilities are available to 87% of households in the form of BHUs and THQs. Gas and water supply facilities are available to 24% and 18% of households, respectively. Similarly, sewerage and mobile services are available to 80% and 99% of households, respectively. Detailed information regarding access to social amenities is provided in **Table 6 -65**

Table 6-65: Access to Social Amenities

Sr. No.	Facility	Number of Respondent	Available (%)
1	Electricity	319	100
2	School	319	100
3	Hospital	278	87
4	Gas	77	24
5	Water Supply	59	18
6	Sewerage	255	80
7	Telephone/ Mobile	315	99

Source: Census and socioeconomic survey of AHs

Most of the people use hand pumps/ bore water as the main source of water for domestic use in the subproject area, so majority of the respondents i.e., 82% get water from this source, and only around 18% use public water supply as source of drinking water. The perception of households about water quality in the proposed project area is generally positive. Around 83% of respondents are satisfied with the quality of water while 17% respondents are not satisfied with the quality of water quality.

The survey findings also revealed only around 8% of the households (AHs) have access to credit, while 92% of the respondents did not borrow from formal microfinance NGOs or commercial banks. Most of them borrow money from informal sources, such as loans from friends and relatives.

6.3.3.7 Land Ownership Status

Land ownership status of the AHs is given in **Table 6 -66** which depicts that 21% of AHs have farmland. The remaining 79% are landless.

Table 6-66: Land Holding Status

Sr. No.	Land Holding	Number of Respondent	Percentage
1	Yes	68	21
2	No	251	79
Total		**319**	**100**

Source: Census and socioeconomic survey of AHs

6.3.3.8 Gender Assessment and Outcomes

As a part of socioeconomic survey, a series of focused groups discussions and consultations carried out with women of the affected households. The purpose of this assessment is to understand the specific issues, concerns, and need and get their feedback to develop the pros the project inclusive and beneficial to women. Structured interviews and questionnaires were utilized to gather information on women's participation in economic, educational, and healthcare sectors, as well as their involvement in household decision-making.

Results of the gender assessment reveal a number of issues that women are confronting. Among them, unemployment, lack of proper income sources and, insufficient educational facilities for girls, improper health facilities for females in the government hospitals, discrimination in public spaces including transport, lack of avenues for meaningful participation in economic and civic life as major issues. Though these are some of the common issues face by women in the country in general, the survey team made effort to find potential ways to involve women in the project and make it beneficial for them.

Women have suggested a several areas that the project in general can support. For example, they proposed to have vocational training as part of livelihood restoration, better class room facilities in schools in relocated areas, job opportunities in project related construction works, better water supply systems, ensuring privacy in public transport systems, and protection for women during construction period as main areas of project support. Please see details of gender assessment and action plaining in the respective RAPs.

7 STAKEHOLDER CONSULTATION AND DISCLOSURE

7.1 Introduction

Stakeholder engagement is an inclusive process that actively involves relevant stakeholders throughout the entire project lifecycle. This process requires open, transparent communication, coordination, and consultation to gather input and feedback on project planning, design, and implementation. As outlined in ESS1, "stakeholder consultation ensures that projects and policies align with the needs, expectations, and concerns of all relevant stakeholders. These consultations promote transparency, inclusivity, and sustainability in AIIB-funded initiatives." The Project proponent, NHA, also places significant importance on engaging stakeholders at every stage of the project.

This chapter outlines the objectives, process, and outcomes of the consultations conducted with various stakeholder groups as part of the environmental and social impact assessment. It provides a summary of the concerns and demands raised by stakeholders during the consultation meetings, along with the responses from the project proponent detailing the actions to be taken throughout the project lifecycle to address these concerns. Additionally, the chapter presents the rationale for any concerns or demands that were not accommodated by the project proponent.

7.2 Objectives of Stakeholders Consultations

The core objective of the consultation and participation of the stakeholders was to identify the concerns of the stakeholders about the impacts of the project and to address such issues as early as possible. The specific objectives of the consultation were:

(i) To obtain knowledge about the people living in the project vicinity and specifically in AoI.
(ii) Interaction with the local communities to get their views, concerns, and feedback about the Project.
(iii) Interaction with other interested parties to get their views, feedbacks, and concerns.
(iv) Collection of primary and secondary data about socio-economic conditions of people.
(v) To discuss the Project benefits and impacts.
(vi) Ensure public and community participation for social sustainability.
(vii) Increase transparency, stakeholders' understanding and their involvement in decision-making process.

7.3 Stakeholder Identification and Mapping

According to ESS1, "stakeholder" refers to the individuals or groups who: (i) are affected or likely to be affected by the Project (project-affected parties) (ii) may have interest in the Project (other interested parties or organization), (iii) development partners, and (iv) the disadvantaged (disability, literacy and/or language) and vulnerable groups (such as, women). The stakeholders for the N5 Project potentially include affected communities in the project vicinity, government departments and other interested parties, the details are given below:

7.3.1 Project-Affected Parties

Persons, groups and other entities within the project area that are directly influenced (actually or potentially) by the project and/or have been identified as most susceptible to change associated with the project, and who need to be closely engaged in identifying impacts and their significance, as well as in decision-making on mitigation and management measures. Though, FPV does not have any influence on the physical displacement or resettlement, however, the Project Affected Parties (PAPs) are categorized as the affected people residing in the surroundings. **Table 7 -67** provides a broad overview of the stakeholder groups identified as PAPs of the Project.

Table 7-67: Project Components and Stakeholder Group and its Impacts including Influence

Project Component	Key Stakeholders	Interest	Influence
Section 2: Ranipur to Rohri **Section 7: Rawalpindi to Burhan** **Section 8: Nowshera to Peshawar**	Residents and businesses situated along the road corridor and within the AoI - including those near construction camps, batching and bitumen mixing plants, or encroaching on the NHA-owned right-of-way - may experience direct impacts such as livelihood disruptions, social and cultural disturbances, increased noise and dust levels, and heightened vehicular traffic due to the rehabilitation work.	H	M
	Individuals whose businesses might be affected due to roadworks, access issues, or relocation.	H	M
	Communities in the vicinity of the road, including those who depend on the road for access to markets, healthcare, education, etc.	H	M
	Community Leaders in the main settlements	H	H
	Local Government Departments i.e., Tehsil Municipal Administration Offices, NHA field Offices, PIU-HQ, RIU.	H	H
	NGOs focused on environmental and social issues that may be affected by, or have a role in, the project's development.	H	M
Access Road	Squatters and petty businessmen around the access Road-AoI	H	L
	People residing or having land in project AoI, if any	H	L
Definitions: **H**= High (The peak level of interest and as per the law the highest power of influence, **M**= Moderate (Greater than normal/usual level of power and interest, **L**= Low (No/Less than the normal/usual level of interest and power)			

7.3.2 Disadvantaged/Vulnerable Individuals or Groups

Persons who may be disproportionately impacted or further disadvantaged by the project(s) as compared with any other groups due to their vulnerable status, and that may require special engagement efforts to ensure their equal representation in the consultation and decision-making process associated with the project. Engagement with all identified stakeholders will help ensure the greatest possible contribution from the stakeholder parties toward the successful implementation of the project and will enable the project to draw on their pre-existing expertise, networks, and agendas. The vulnerable individuals in the settlements along the Project AOI include and are not limited to the following:

- Women-headed households or single mothers with underage children.

- Elderly people, especially if they are living alone.
- Young unemployed persons especially from marginal families or communities.
- Persons with physical and mental disabilities and their care givers.
- Minority and transgender community (if any) within the area of influence of the project area.
- Low-income families' dependent on social allowances.
- Internally displaced group due to other interventions of NHA and its allied projects.

7.3.3 Other interested parties

Individuals/groups/entities that may not experience direct impact from the project but who consider or perceive their interests as being affected by the project and/or who could affect the project and the process of its implementation in some way. The projects' stakeholders other than PAPs are categorized as other interested parties and presented in **Table 7 -68**.

Table 7-68: Types of Stakeholders' Interest and Influence Concerning the Project

Project Sections	Key Stakeholders	Interest (High/Low)	Influence/Power (High/Low)
All Three Sections	Different Government Bodies (permitting and regulatory agencies at the federal and provincial levels) government officials.	May be interested to have a say in the Project from administrative and policy/ regulatory point of view, EPAs (Punjab and KP), Wildlife, Forest Departments, etc.	Have the power and influence of permitting and regulatory issues including environmental, technical, social protection and labor authorities.
	Residents of the nearby settlements within the project area but beyond the AoI.	Can get benefit from employment and training opportunities stemming from the Project.	May be impacted but have limited power and influence to the Project.
	NGOs on the international, regional, national, and local levels that pursue environmental, socio-economic, and gender related interests, i.e., Secours Islamique France, Foundation for Rural Development (FRD), Punjab Rural Support Program, etc.	May have high interest in the project and mobilization of local/national and even international opinion and intervention.	Organizations within this group are likely to be located outside the project's Direct Area of Influence.
	Locally influential people (political leaders, Community leaders not from the main settlements in AoI).	May be interested to have a strong say to keep their leadership and stronghold in the local power structure.	Have highest level of influence in the community.
	Truck and bus companies, traders and trade bodies both at local and national level.	Would be interested to have a share from the Project.	Business owners and providers of services, goods and materials within the Project area that will be involved in the Project's wider supply chain.
	Mass media and associated interest groups, including local, regional, and national printed	May be interested to have a say in the Project and mobilize for	Can influence the Project activity by publishing news and views, including

Project Sections	Key Stakeholders	Interest (High/Low)	Influence/Power (High/Low)
	and broadcasting media, digital/web-based entities, and their associations.	and/or against the Project.	construction.

7.4 Consultations Process and Methods Used

For stakeholders' consultations, the following main principles were followed:

(i) The scope, benefits and impacts of the Project are clarified at the outset.
(ii) The participation of stakeholders must be meaningful, fair and effective.
(iii) Inclusion of all relevant stakeholders including interested parties and making them understand the ownership of the project.
(iv) Be specific and do not oversell.

7.4.1 Scoping Sessions

The Consultants' team consisting of environment and social experts along with NHA/ESAL staffs conducted these sessions. The major stakeholders include business, households of the Project area, local residents, local Government representatives and other interested parties, i.e., local NGOs working in the Project area. Efforts were made to share Project information with the resident of local community about Phase 1A road Sections.

The scoping sessions were also held with the relevant government officials and institutional stakeholders. The Government offices consulted included the NHA, Departments of Wildlife, Climate Change, Communication and Works, Forest, and Fishery Officials.

7.4.2 Social Surveys, Meetings and Group Discussions

The consultations have been performed as part of the socioeconomic surveys by following three modes that include; 1) Individual Household Socio-economic Surveys; 2) meetings with PAPs, 3) community meetings/consultations and semi-structured interviews, 4) one-on-one meeting/ interviews with the government, private and civil society institutions. The details of the consultation methods with different stakeholders are given in **Table 7 -69**.

Table 7-69: Stakeholders Consultation Methods

Type of Stakeholder	Methods	Points Discussed
PAPs and Local Communities	• Meetings at designated place in the Community • Semi-structured interviews • Group Discussion with elders, local leaders, and businesses. • Household Surveys	• Participants were briefed about the Project objectives and scope. • Project components, activities, and main Social and Environmental impacts. • Needs, priorities and
Local	• Meetings through official	

Type of Stakeholder	Methods	Points Discussed
Government Bodies	communication • Group discussions	feedbacks on project interventions. • Grievances redress mechanism/ procedure • General information about project benefits. • Socio-economic conditions and general information about concerned villages in AOI. • Minutes of the consultations with other interested parties are presented in Annex 7-1.
Women	• Meetings in their respective homes • FGDs at place where women were conveniently available and were comfortable for discussions.	
Surrounding Communities	• Focused group discussions with communities along the access road • Surveys	
Other Interested Parties	• Consultative meetings with the officials of different Government Departments were done in their respective district and provincial offices.	

For community consultations, the community members were notified in advance to assemble in common/designated places. Mainly key informants were consulted for these meetings which were carried out in an open and frank atmosphere conducive to appreciation of the basic elements of the project and dissemination of information on beneficial and adverse impacts and mitigation for adverse impacts. Information on positive and negative impacts associated with construction and operational stage and proper mitigation of adverse impacts were shared at these consultations.

The main focus of the consultations remained mainly associated with the local communities living in the vicinity of the Phase 1A, Section 7 and Section 8 road. Locations of the settlements / urban areas where the household socioeconomic surveys, community consultations. and focus group discussions have been conducted are outlined in **Figure 7 -20**, **Figure 7 -21**, and **Figure 7 -22**.

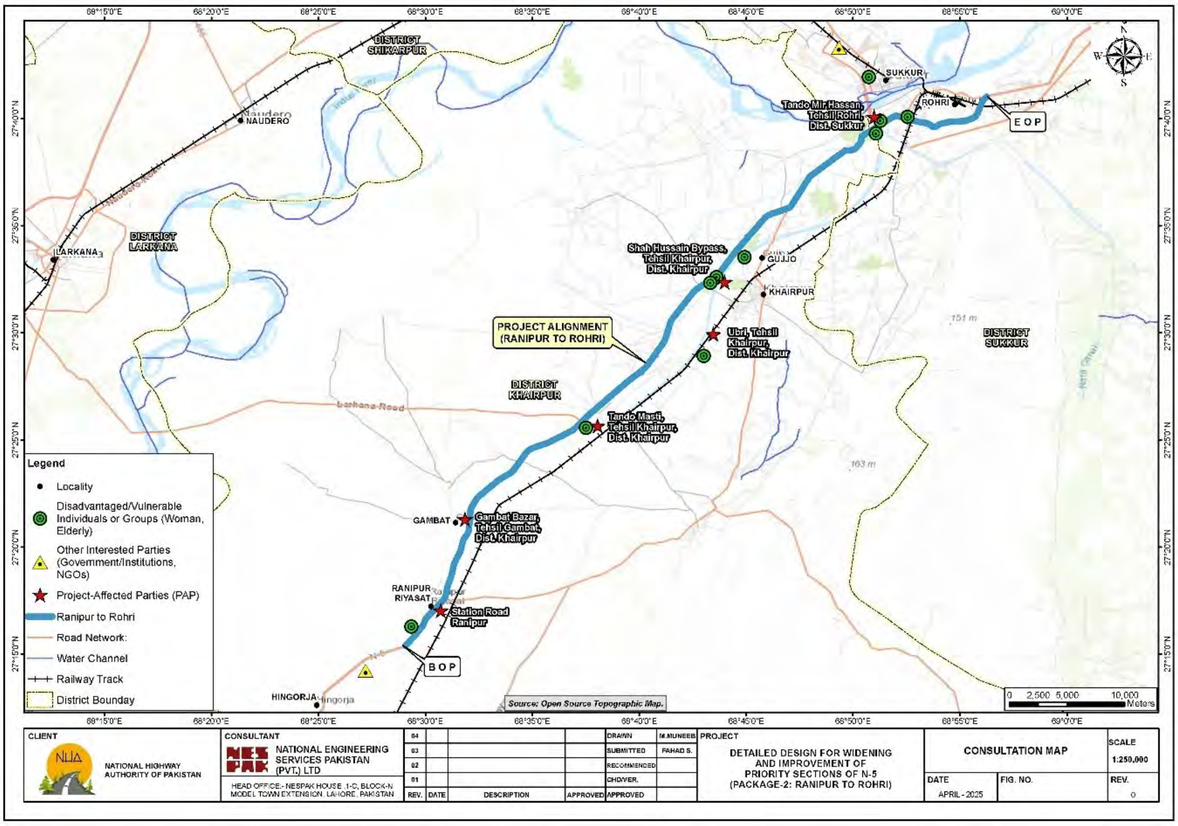

Figure 7-20: Consultation locations, Section 2 Project Area

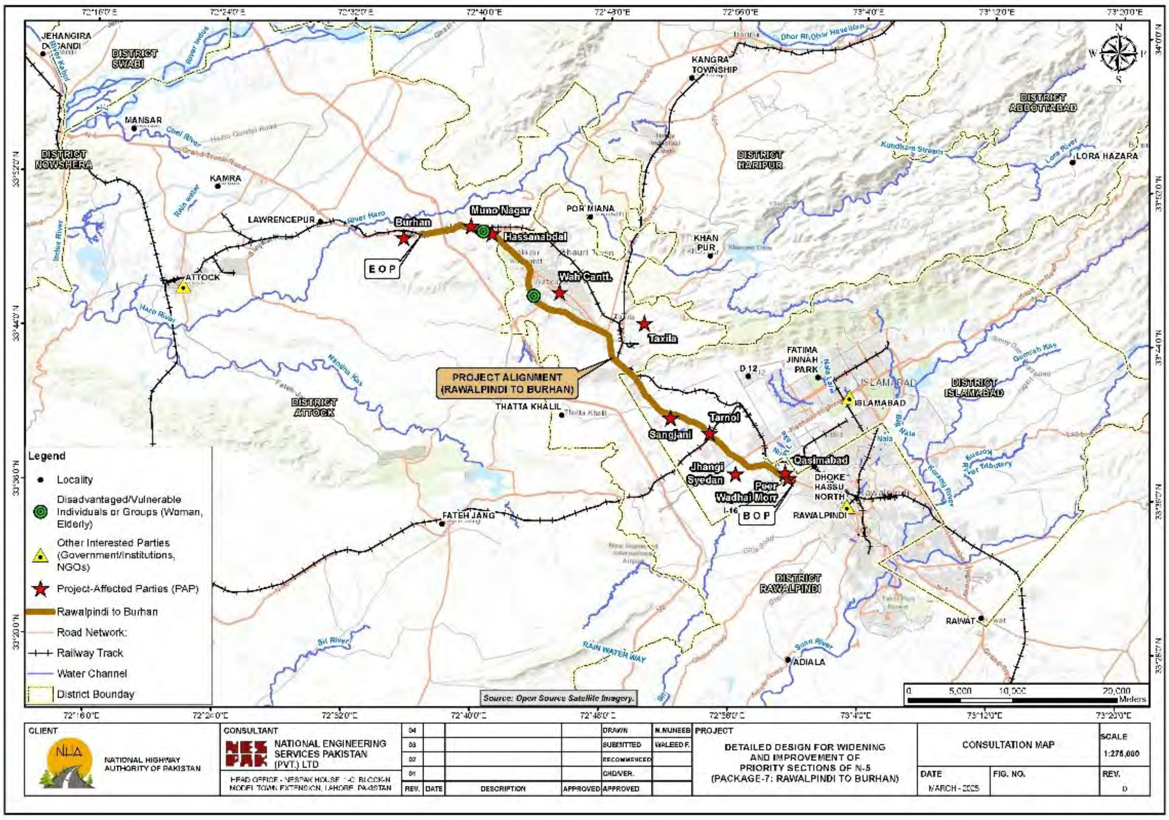

Figure 7-21: Consultation locations, Section 7 Project Area

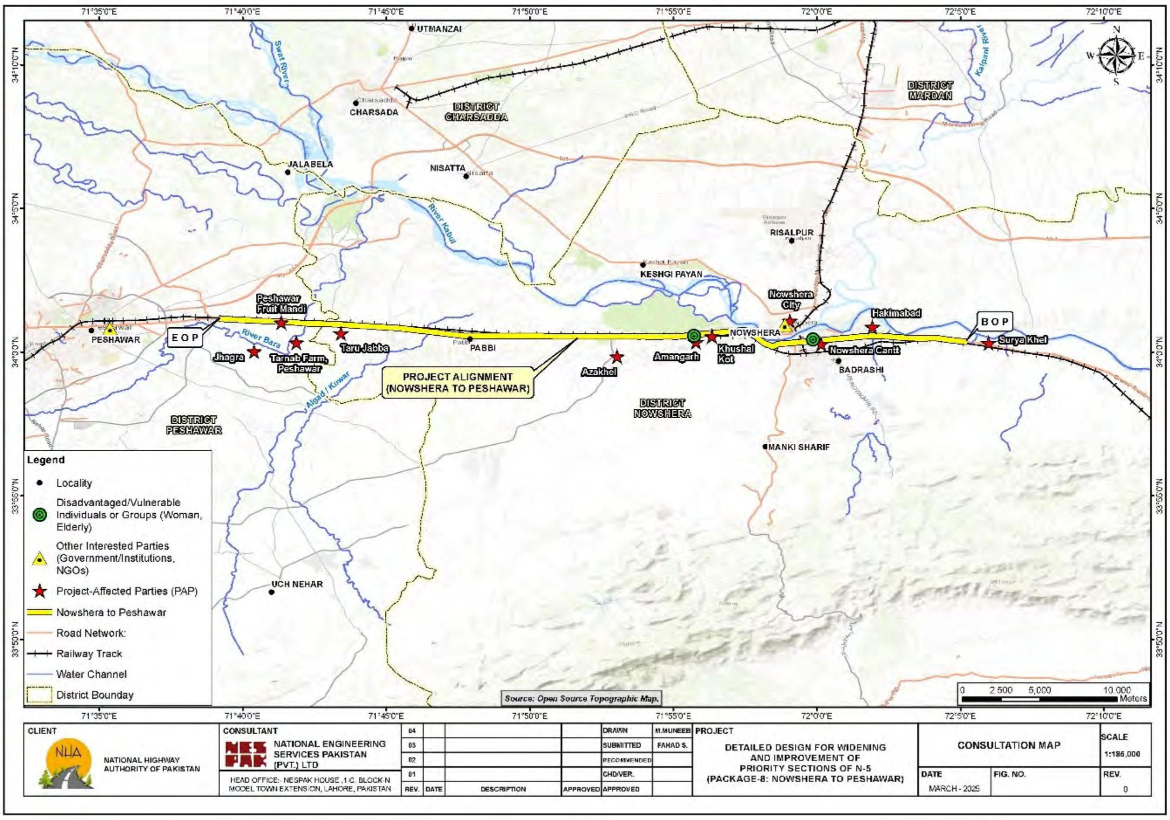

Figure 7-22: Consultation locations, Section 8 Project Area

7.5 Details of Consultations

The two stages consultation were carried out or planned, as:

(i) The consultations were conducted by the Social & Environment Team of the Design Consultant during September and November, 2024, in the project area while preparation of the design basis report. Total thirteen group discussions were carried out including with the women in the project area.

(ii) During the review and updating of ESIA by the Independent Review Consultant during February to April 2025. Detailed of the consultations to be carried out with the community, focused groups, local NGOs and with various institutional stakeholders will be presented in an updated version of the ESIA. In addition, as per the requirements of the KP and Punjab EPA public hearings of the draft ESIA/ EIA will be carries out at district level and will be presented in the updated version of the ESIA.

A total of 6,415 people were consulted during the Project preparatory stage by various team, including during the socioeconomic survey. Around 45% of Section 2, 21% of Section 7 and 33% of Section 8 households of closest settlements and urban centers like Kala, Taro Jaba, Naser Kaley, Margala Hills National Park, Ubri, Tando Mir Hassan, Tando Masti, Shah Hussain Bypass, Tando Mir Muhammad Hussain, Station Road Ranipur, Gambat Bazar, Taxila, Hassan Abdal, Wah Cantonment, Jamilabad, Peer Wadhai More, Pabbi, Chamkani, Nowshera Degree College, and Nowshera have been consulted. In addition, 71 people consulted from different government departments and NGOs. The details are presented in **Table 7 -70**.

Table 7-70: Consultation Meetings – Summary

Consultations	Type of Stakeholders	Number of persons Consulted
Section 2: September and October, 2024, and March 2025	Community / PAPs/Vulnerable	2,876
Section 7: September and October, 2024 April 2025	Community / PAPs/Vulnerable	1,327
Section 8: October 2024, April 2025	Community / PAPs/Vulnerable	2,141
Section 2, 7 and 8 October and November 2024	Other interested parties	71

7.5.1 Consultations – Scoping Sessions

The consultations during scoping session, held for the purpose of scoping and awareness, were held during September and November 2024. During Scoping Sessions, the consultations were held with the community including vulnerable groups, urban centers, Government Departments and NGOs in the project area. There was a total of 13 sessions held with the community, with a total of 113 participants. As for the government and NGOs, a total of 32 sessions were held. The main findings of the consultations and the response is summarized in Section below and the detailed Minutes of Meetings are presented in Annex 7-1.

List of the stakeholders and their signatures are presented in Annexure I of SEP, copies of the official communications to various government departments and NGOs in Annexure II of SEP, and photos taken during institutional and community consultations are presented in Annexure III of the SEP.

7.5.2 Consultations/Public Hearing-Draft ESIA Disclosure

The public hearing to fulfil the requirements of EPAs to obtain Environmental Approval/NOC and further community consultations, including women, will be held in the Project area during April 2025. Further information will be presented in the updated version.

7.5.3 Outcome of Consultations, views/concerns/Feedback

Feedback from the consultations was overall supportive of the project from both local communities and the government agencies, but a general request was made to enhance the benefits of the project to the local communities through the provision of social development services.

summarizes the issues raised, suggestions/demands from the community and the commitments made by the Project Proponent to address the issues raised. The main suggestions from institutions and responses are summarized in **Table 7 -72**.

Table 7-71: Feedback from Affected Communities

Issue Raised by Participants	Suggestions from Participants	Commitments by Project Proponent
Access problems due to construction	Local people should not be restricted from their settlements and farmland.	Proper access will be provided to the local people to reach surrounding areas easily.
Disturbance to social amenities	Social amenities should be restored after the construction completes to avoid inconvenience.	Social amenities will be restored after construction and before the operation of the road.
Restricted movement, especially for women, due to labor influx	Construction should be scheduled to allow free movement after working hours.	People should be informed about construction schedules to ensure safe movement.
Dust and noise disturbances to residential and commercial areas	Protective measures should be taken to safeguard the local community.	Contractors must follow dust suppression measures as per the recommendation of the ESMP and other precautionary measures to protect public health and property.
Employment opportunities for local workers	Skilled and unskilled labor should be hired from the local community to improve project acceptance.	Contractors will be encouraged to prioritize hiring local workers. The ESIA aims for up to 70% local workforce, and ESMP will propose training programs through a skill development program for the local unemployed youths.
Poor drainage system causing waterlogging	A proper drainage system should be designed alongside the road.	The Design Consultant evaluated the drainage system, identifying bottlenecks based on 2022 flood damages and future projections. To improve climate resilience, cross-drainage structures and mitigation measures were incorporated into the design. Many culverts and bridges were clogged with mud, obstructing flow. The climate change assessment recommended increasing capacity for 10 bridges and 10 culverts, clearing mud from 8 culverts and 7 bridges, and replacing 1 bridge and 8 culverts.
Minimizing disruption during civil works	Construction should be done in small patches and completed quickly to reduce community disturbance.	Contractor's construction schedule will be sustainable in nature to minimize delays and disruptions and allow diversion route to detour traffic.
Traffic congestion due to construction vehicles	A traffic management plan should be prepared, and alternative routes should be provided.	Contractors will be required to prepare and implement a Traffic Management Plan (TMP).
Dust pollution causing health issues	Regular water sprinkling should be done to control dust.	Contractors must follow dust suppression measures as per the recommendation of the ESMP and other precautionary measures to protect public health.
Disruptions of livelihood of seasonal fruits and vegetable vendors during construction at Kala, Taro Jaba, Naser Kaley	Providing daily compensation to affected vendors could significantly improve their livelihoods, particularly as many belong to extremely impoverished communities.	RAP will have provisions to compensate them.

Table 7-72: Feedback from other interested parties

Key Concern	Response/Action
Islamabad Capital Territory	
Officials highlighted that the Phase 1A, Section 7: Rawalpindi to Burhan of N5 passes near Margalla National Park, requiring wildlife protection measures during design and construction. Approval from Islamabad Wildlife Management Board (IWMB) will be required before construction begins.	Consultation with IWMB revealed that the Margalla Hills National Park buffer area is located 2,017 m away from the RoW. However, Project AoI falls 17 m away from the National Park buffer. The national park buffer will not be affected directly due to the Project construction. Thus, no direct impact on the protected area and endangered species of Flora and Fauna are expected.
The Federal EPA handles EIA/IEE matters and no cultural heritage sites were identified near the N5, though verification will be conducted after the final design. Officials recommended including a chance-find procedure and consulting stakeholders at every stage.	A chance-find procedure is included in the ESMP.
Key environmental considerations include minimizing tree cutting, identifying locations for construction camps, traffic diversion plans, material storage arrangements, dust control, and proper demolition of waste disposal.	ESIA has been addressed these issues in greater details with mitigation and compensation measures
Khyber Pakhtunkhwa Province	
Support for the Project: • The Environmental Protection Agency (EPA) supports the project, acknowledging its benefits in reducing traffic congestion and improving connectivity for local communities. • The project will enhance business opportunities and reduce road accidents.	• The primary objective of this AIIB investment is to alleviate traffic congestion on N5. • Additionally, Phase 1A will enhance climate resilience, operational efficiency, and road safety in key critical sections of the highway.
Environmental & Social Considerations: • Avoid tree cutting as much as possible; if necessary, approval from the Forest Department is required. A budget for tree plantation should be included. • Conduct thorough field surveys for ecological, environmental, and social impacts. • Implement traffic management plans in consultation with law enforcement to ensure smooth movement during construction.	• The ESMP includes compensation measures, such as planting five saplings for each tree felled. • Baseline environmental, social, and biodiversity surveys were conducted in the project's early stages. • Additionally, the contractor will develop and implement a TMP.
Infrastructure & Public Facilities Suggestions: • Build waiting rooms, prayer areas, and rest areas at major bus stops. • Construct zebra crossings, overhead bridges, and underground pedestrian crossings for safe passage. • Engage with stakeholders, local communities, and students to ensure smooth execution and raise awareness on potential risks. • Implement dust suppression measures to prevent respiratory diseases; establish medical camps during construction.	• All recommendations have been accepted and will be integrated into the engineering design. • Stakeholder consultations have been incorporated into the ESIA and are detailed in the SEP. • Additionally, water sprinkling measures will be included in the ESMP, with a dedicated budget allocation.
Mitigation of Social & Economic Impacts:	• The ESMP prioritizes the

Key Concern	Response/Action
• Prioritize hiring local skilled and unskilled labor. • Provide fair compensation to affected individuals and livelihood support programs. • Promote skill development programs (e.g., mobile repair, poultry farming, kitchen gardening) for community benefit.	employment of local workers to maximize community benefits. • A skill development plan has been proposed, with a dedicated budget in the ESMP, to provide training in project-related skills, such as welding, machine operation, and more.
Regulatory Compliance & Approvals: • No Objection Certificates are required from relevant authorities before construction. • Environmental Impact Assessment must be prepared as per KP Environmental Rules 2021.	• An EIA will be prepared based on this ESIA in compliance with KP EPA requirements and submit for NOC.
Punjab Province	
Regulatory & Environmental Compliance: • Dust control measures, including $CaCl_2$ spray, to be implemented. • Asphalt plants should have pollution control technology and be placed away from populated areas. • Proper disposal and transportation of construction materials as per legal requirements.	• Contractors will follow dust suppression measures as per the recommendation of the ESMP and other precautionary measures (such as $CaCl_2$) to protect public health and property. • Asphalt mixing plants must be compliant with EPA NOC requirements.
Archaeological & Wildlife Considerations: • Avoid impact on archaeological site Nicholson Tower located on top of the mountain within 100 m of the road RoW. • Special attention to Nicholson Tower at Tarnol Pass will be required during construction. • Wildlife corridors to be incorporated, and measures for aquatic life protection in the ESIA.	• Nicholson's Obelisk (memorial is located about 100 m from the Section 7 of Phase 1A of N5 on top of a hill, measures will be taken to avoid disturbance on the site. • There is no known wildlife corridor identified in Phase 1A.
Road & Safety Measures: • Safe crossings with overhead bridges and road fencing near schools. • Dedicated underpasses to prevent risky pedestrian crossings. • Installation of speed limit signboards and traffic control measures.	• The Phase 1A engineering design includes 37 pedestrian bridges, with 23 widened and 14 newly constructed, along with improvements to 7 underpasses and the installation of essential traffic signs. • The design also incorporates 36.99 km of service roads, 9 new and 9 modified bus bays, 33 controlled U-turns, and the construction of one new 6-lane flyover and one 3-lane flyover, all aimed at enhancing road infrastructure and traffic safety.
Community & Labor Welfare: • Local employment prioritized and child labor strictly prohibited. • Timely salary payments and adherence to minimum wage laws (PKR 37,000/month).	• A labor management plan is prepared for the Project, addressing labor rights, terms of employment, issuing an workers' ID, salary complying with

Key Concern	Response/Action
• PPE provision, overtime limit, and maternity leave for female workers. • Workers to receive job contracts, SOPs, and Job Description documentation.	national minimum wage requirements, and other benefits.
Infrastructure and Public Facilities: • Highway dividers to reduce glare and improve safety. • Emergency numbers and safety signs to be installed along the highway. • Rest areas every 20-25 km with dispensaries, washrooms, and law enforcement presence. • Anti-fog measures for improved visibility in low-visibility conditions.	• Phase 1A road will be designed based on NHA approved guidelines, which will consider dividers, road and traffic signs with emergency numbers, rest areas complying with National Highways standards, cat's eyes in selected locations with low visibility.

Four consultation sessions (two for each Section) were conducted with vulnerable groups, especially with women in the following locations:

- Section 2
  - Tando Mir Hassan, Rohri, Sukkur
  - Ubri, Tehsil Khairpur, Khairpur
  - Tande Masti, Tehsil Khairpur, Khairpur
  - Deli Muslim Society, Tehsil Sukkur, Sukkur
  - Ubri, Tehsil Khairpur, Khairpur
- Section 7
  - Horizon school of Nursing and Health Sciences, Hasanabdal GT road, Hasanabdal, District Attock
  - Wah Cantonment, Rawalpindi
- Section 8
  - Government Degree College for Women, Nowshera Cantt, Nowshera City.
  - Seasonal fruits and vegetable vendors at Kala, Taro Jaba, Naser Kaley.
  - Aman Garh Tehsil, District Nowshera

During consultations with women, a number of issues were raised, such as, design considerations for enhance safety, economic opportunities, and overall well-being for women, while minimizing cultural disruptions. A well-planned approach that respects religious sensitivities, ensures women's security, and mitigates resettlement impacts will lead to greater social acceptance and long-term sustainability of the project.
presents the feedback received from the vulnerable groups and corresponding responses.

Table 7-73: Feedback from the vulnerable group (women)

Key Concerns	Response/Action
• **Gender-Sensitive Highway Planning**: Dedicated waiting areas for women should be constructed at transport stops to ensure safety, privacy, and comfort. These stops should be well-lit, equipped with seating, and located in secure areas. • **Safe Routes to Schools**: Schools,	• Engineering design will consider dedicated waiting areas for women, sufficient benches, shade structures, and accessibility ramps for elderly women, pregnant women, and women with disabilities. • Enhancing pedestrian-friendly access in the

Key Concerns	Response/Action
especially those with female students, should have pedestrian-friendly access with zebra crossings, road over-bridges, and speed restrictions in school zones. • **Security Measures**: Deployment of female security personnel, CCTV surveillance, and emergency helpline numbers at transport stops to prevent harassment and ensure a safe commuting experience.	engineering design, such as, zebra crossings and marked pathways in the selected urban locations or pedestrian bridges and underpasses, and drop-off zones and walkability. • NHA will consider recruiting female security personnel in the woman only bus stops. • CCTV surveillance will be considered in all bus stops in urban centers. • Sign for emergency helpline numbers are considered in the design.
• Pink lanes and separate bus stops for women to prevent overcrowding and harassment. • Addressing women's essential needs, such as, clean drinking water, health facilities • Training and employment opportunities	• Pink lanes may not be possible, however, separate bus stops will be considered for women in the engineering design. • Clean drinking water and health facilities are beyond the jurisdiction of NHA. • ESMP has considered skill development program under Phase 1A and woman can have access to this training.
• Addressing resettlement issues and livelihood concerns • Privacy and security concerns during construction work • Avoid child labor	• RAP will address the resettlement, compensation and livelihood restoration. • The Project has considered Sexual Exploitation and Abuse (SEA)/Sexual Harassment (SH) and Gender Based Violence (GBV) Prevention Procedures in the LMP. • Child and Forced Labor Avoidance Procedures are developed in the LMP

7.6 Future Consultation

The primary objectives of the stakeholder engagement plan are to:

1. **Build and maintain constructive relationships** with identified stakeholders.
2. **Assess stakeholder interest and support** for the project while ensuring their views are considered in project design, as well as in environmental and social performance.
3. **Provide timely and accessible project-related information**—especially regarding potential impacts—in a clear, understandable, and appropriate format.
4. **Establish an inclusive grievance mechanism** that allows stakeholders to raise concerns and ensures that the National Highway Authority (NHA) can respond and manage grievances effectively.

Once the draft Environmental and Social Impact Assessment (ESIA) is prepared, its findings will be disclosed to the community to share project-related information. This will include addressing community concerns—highlighting those incorporated into the project, as well as those not included, along with the rationale for their exclusion.

As a standard practice, key project documents—including the ESIA, Environmental and Social Management Plan (ESMP), Environmental and Social Management Framework

(ESMPF), Stakeholder Engagement Plan (SEP), and Labor Management Plan (LMP)—will be made publicly available through NHA field offices, the project's dedicated website, and the official NHA website.

A comment register will be maintained for stakeholders to provide feedback, which will be formally documented by the Environmental, Social, Health, and Safety Section (ESHS Section). This approach will also be applied to any additional environmental and social (E&S) appraisal materials developed during the project.

To ensure accessibility, executive summaries of the ESIA, ESMPF, SEP, and other E&S documents will be made available in Urdu for public review. Additionally, the SEP will be published simultaneously with other E&S documents, including the ESIA and ESMPF reports.

For wider public access, free printed copies of project summaries, ESIA/ESMPF/ESMP reports, and the SEP will be provided in Urdu and English at the following key locations, ensuring transparency and inclusivity in the engagement process:

- The Project Management Unit in Islamabad
- The district administration office – Rawalpindi, Attock, ICT, Nowshera and Peshawar.
- Project ESHS Section
- Other designated public locations to ensure wide dissemination of the materials
- Newspapers, posters, radio, television
- Information centers and exhibitions or other visual displays
- Brochures, leaflets, posters, nontechnical summary documents and reports.

Electronic copies of the E&S documents (ESIA, ESMPF, SEP, LMP, etc.) on the project website will allow stakeholders with access to Internet to view the information about the planned development and to initiate their involvement in the public consultation process. The website will be equipped with an on-line feedback feature that will enable readers to leave their comments in relation to the disclosed materials. The mechanisms which will be used for facilitating input from stakeholders will include press releases and announcements in the media, notifications of the disclosed materials to local, regional, and national NGOs as well as other interested parties.

7.7 Stakeholder Engagement Plan

A Stakeholder Engagement Plan has been developed in accordance with the AIIB ESF guidelines. The SEP serves as a structured approach for the NHA and other relevant stakeholders to conduct socially and gender-inclusive consultations with both primary and secondary stakeholders. It facilitates the systematic documentation of stakeholder views and concerns while ensuring the implementation of appropriate mitigation measures.

The plan is designed to promote active and meaningful engagement, particularly among PAPs and vulnerable groups. It also guarantees the timely disclosure of project-related information. By effectively implementing the SEP, the project will enhance stakeholder relations, mitigate risks, and maintain transparent communication with PAPs and other affected communities throughout the project lifecycle.

7.8 Access to Information

The ESIA and its Executive Summary will be disclosed to stakeholders and submitted to the AIIB for publication on its external website. Additionally, the Urdu version of the Executive Summary will be shared with the community to ensure accessibility.

For public access, hard copies of these documents will be made available at local administration offices, the NHA Islamabad office, and NHA field offices.

8 ENVIRONMENTAL AND SOCIAL IMPACTS AND RISKS AND MITIGATION MEASURES

This Chapter assesses the suitability of the project and its site from E&S perspective and estimates the magnitude and significance of key E&S risks and impacts associated with the project.

8.1 Risk Screening

To study the risks and impacts involved with the project, risk screening criteria based on AIIB's ESF was employed as shown in the **Table 8 -74** and the risk assessment for this project is presented in the **Table 8 -75**. Mitigation measures for impacts that are substantial and higher in rating is presented in Section 8.2. Those with moderate to low ratings, mitigation measures are included in the rationale column in **Table 8 -75**.

Table 8-74: Impacts and Risk screening criteria

Risk Category	Screening Criteria
High	The resource/receptor would likely experience a large magnitude impact that would last for a long time, extend over a large area, exceed national/international standards, endanger public health and safety, threaten a species or habitat of national or international significance, and/or exceed a community's resilience and ability to adapt to change. The Project may have difficulty in complying with the applicable ESF requirement, and significant mitigation would likely be required.
Substantial	The resource/receptor would experience a clearly evident change from baseline conditions and would approach but not exceed applicable standards. The Project would comply with the applicable ESF requirement, but mitigation would be required.
Moderate	The resource/receptor would experience a noticeable effect, but the magnitude of the impact is sufficiently small (with or without mitigation) that the overall effect would remain well within applicable standards. The Project would comply with the applicable ESF requirement, but mitigation may be required.
Low	The resource/receptor will either not be affected or the likely effect would be imperceptible or indistinguishable from natural background variation. The Project would comply with the applicable ESF requirement and mitigation would typically not be required.

Table 8-75: Impacts and Risks assessment for the Project

ESF Standards, Environmental Impacts and Social Risks	Risk Ratings before Mitigation and Control		Rationale	Mitigation	Risk Ratings after Mitigation and Control	
	Construction Stage	Operation Stage			Construction Stage	Operation Stage
ESS1: Assessment and Management of E&S Risks and Impacts						
Cumulative impacts	Low	Low	There are no major cumulative impacts except the transportation of materials for local construction industry and the Project using local access or diversion roads when N5 is closed due to construction.	Mitigation measures include coordination between construction and local traffic under the monitoring of NHA to avoid major consequence.	Low	Low
Lack of appropriate E&S personnel with Construction Supervision Consultant (CSC), Contractors and the Implementing Agency (IA)	Substantial	Low	Appropriate E&S personnel are essential to implement, supervise, and monitor the ESMP, LMP, and OCHS Plan. Supervision and monitoring during project implementation provide information about key environmental and social aspects of the project and the effectiveness of mitigation measures. Such information enables the IA and the Bank to evaluate the success of mitigation and allows corrective action to be taken when needed. Inadequate resources will lead to major impacts and risk in the physical, biological and social environment and eventual harms to environment and non-compliances with ESMP requirements.	Mitigation measures include compliance of this ESIA particularly following guidance for creating different plans and staff requirements with education, experience and training in the ESMP and in the bidding documents.	Low	Low
Inadequate implementation of ESMP, LMP, OCHSMP.	Substantial	Low	Lack of experience of the contractor in implementing environmental, health and safety standards required by the ESF. Lack of resources and qualified Environment, Health, and Safety (EHS) staffs with various organization will become bottlenecks for the correct implementation, supervision, and monitoring of the ESMP. The ESMP and other plans identify measures and actions in accordance with the mitigation hierarchy and hierarchy of control that reduce potentially adverse environmental impacts and social risks to acceptable levels. Inadequate implementation will result in major concern from the community and risking the health and safety of the workforces and lead to major injuries and illness.	• Recruit qualified contractors who maintains environmental sustainability in corporate strategy. • Avoid contractors with poor environmental, health, and safety management. • Contractor's qualifications stated in the ESMP are included as the pre-qualification criteria in the short-listing process. • Ensure that the conditions of the ESMP is correctly reflected in the contractor's bidding documents and the supervision consultant's TOR. • EHS bills of quantities are included in the specifications. • Education, qualification and training requirements of personnel are included in the bidding documents and considered by the supervision consultant when they give approval to the contractor. • Prepare C-ESMP, and OCHSMP based on the Chapter 9 and Chapter 10 ESMP. • Recruit qualified staffs to implement the C-ESMP, and OCHSMP.	Low	Low
ESS1: Labor and Working Condition						
Working Conditions	Moderate	Low	Around 2,500 construction workers will be on project sites and 70 percentage of them will be sourced from the local communities. The local people are mostly poverty-stricken with lower incomes and poor access to social services. Poor enforcement of labor laws in Pakistan may lead to labor right abuses. Therefore, working condition is susceptible to not meet the standards due to the existing baseline condition.	• Mitigation measures include construction related skill development, employment of local workers by the Contractors, supervision from the PIU-HQ to ensure the Contractors are following the labor standards, training for the workers on the existing GRM so they know their rights and responsibilities, and availability of complaint box allowing for workers to report any wrongdoings. • Effective compliance of LMP.	Low	Low
Worker Accommodations	Moderate	Low	Workers will either be accommodated in their homes or on site in worker's camp. Poor sanitation and hygiene, overcrowding, fire safety issues, traffic safety, pest control, and poor ventilation are the likely impacts that need to be addressed in the dormitories assigned for workers since they can impose particular risks in cooking and washing facilities. Additionally, they are exposed to greater risks of being infected by communicable diseases due to difficulty in socially isolating in their given living condition.	Mitigation measures include having dedicated cleaning staff, routine checks of the conditions of the accommodations, penalties (to act as deterrent rather than with the intention for punishment) for workers who are careless and intentionally do not uphold the safety and hygiene standards. Preparation of Camp Management Plan by the contractor and its approval by CSC	Low	Low
Child and forced labor	Low	Low	As discussed previously, the baseline condition of the enforcement of labor rights is poor and since the local community faces high level of poverty, child labor and forced labor are one of the likely labor rights risks.	• Mitigation measures include adding legal requirements in Contractor contracts that they must not employ underage workers, and positive identification before hiring. • The contractor will comply with the labor laws of the Country. • When sourcing for primary suppliers, the project will require such suppliers to identify the risk of child labor/forced labor and serious safety risks.	Low	Low

	Risk Ratings before Mitigation and Control				Risk Ratings after Mitigation and Control	
Risk of falling in water or drowning during bridge construction and maintenance over water **ESF Standards, Environmental Impacts and Social Risks**	Moderate	Moderate	The construction of bridges and their maintenance over water will require many workers to be working on elevated structures. The controls of these risks to be considered in the Occupational and Community Health and Safety Management Plan of contractors and NHA. During operation risk of falling will be lower than the construction stage. **Rationale**	**Mitigation** • Contractors will prepare and implement Occupational Health and Safety (OHS) management plan that would include standard operating procedures (SOPs) for all works, requirement of conducting Job Hazard Analysis and preparing Method Statements containing OHS aspects, OHS training requirements, incident recording and reporting protocols. • Subcontract the work to a specialized company who has good track record. • Minimize manual works overwater and use mechanical equipment instead. • Provision should be made for: o As appropriate the passive safety system such as fencing, guard and mid-rails in the scaffold, safety nets to prevent workers from falling into water; o The rescue of workers in danger of drowning; o Safe and sufficient transport. o Availability and use of life jackets.	Low	Low
Occupational Health and Safety (OHS)	substantial	Substantial	• Occupational health and safety risks in Pakistan are heightened due to weak safety practices, poor labor rights enforcement, and inadequate worker accommodations. Key hazards include heavy equipment operation, man/machine interaction, hazardous materials, trip and fall risks, dust, noise, falling objects, and electrical dangers, especially during construction. • While risks decrease in the operational phase, maintenance work near live equipment and energized overhead lines still presents significant hazards.	• Contractors will prepare and implement OHS management plan that would include standard operating procedures (SOPs) for all works, requirement of conducting Job Hazard Analysis and preparing Method Statements containing OHS aspects, traffic interface planning, working at height and hot work permit, barricading, OHS training requirements, incident recording and reporting protocols. • NHA will prepare a similar Plan/System for the operation phase.	Moderate	Moderate
Employment generation	Positive		Approximately 2,500 jobs are expected to be created during the construction phase (625 skilled and 1,875 unskilled or low skilled). Most unskilled positions are likely to be sourced from the local districts and communities, thereby sharing project benefits with affected communities. They will be in roles as laborers, security, catering, cleaning, and drivers of vehicles. Employment generation will contribute to household income and will improve households' socioeconomic conditions, providing greater security and reducing people's sensitivity to socioeconomic shocks and impoverishment risks. For the local impoverished people, this can increase their wellbeing and resilience. The employment will also contribute to skills development and professional experience, therefore making the beneficiaries more employable in the future, further reducing vulnerability.	• A skill development plan is proposed to train local workers in construction trade, such as, welding, mechanic, operation of heavy equipment and construction machinery, etc.	-	-
Enhancement of economic growth due to improved road connectivity	Moderate		The proposed reconstruction of Phase 1A N5 will reduce congestion, enhance traffic flow, ease movement of road users and goods and thus generate movement of more cargo by road and correspondingly economic growth.	• AIIB supports sustainable infrastructure and productive sectors to foster economic growth and improve lives. Aligned with the SDGs, it integrates economic, social, and environmental dimensions of sustainability. The Bank adheres to sustainable development principles in project planning and execution, as outlined in its Environmental and Social Policy.		
ESS1: Resource Efficiency and Pollution Prevention						
Land use change	Substantial	Low	Land will be cleared for the highway expansion (141 km 2-lane), service road (36.99 km 2-lane both way), 9 new bus bays, 33 controlled U-turn using median strips and to build access roads for material transportation. About 64.6 ha land clearance will occur during the early stage of construction period for a limited amount of time. The sensitivity of the soil at the construction site is considered medium since it is susceptible to erosion. In addition, there will be about 1,500 m^2 land required for the construction camp and yard for each section of the road.	Mitigation measures would include proper land clearance planning, spoil management measures, vegetation clearance and erosion management, sediment management, design of storm water drainage in construction areas as well as design and implementation of site erosion control.	Low	Low
Landscape aesthetic	Moderate	Low	A change in the visual appearance of the landscape will occur during	Mitigation measures would involve careful siting of project	Low	Low

	Risk Ratings before Mitigation and Control				**Risk Ratings after Mitigation and Control**	
ESF Standards, Environmental Impacts and Social Risks			construction and operation phase when 2 flyovers, 37 pedestrian bridges, 36.99 km service roads and noise barriers will be constructed at selected urban locations. The new change in landscape might be deemed cause of concern to residents and visitors which could lead to complaints.	components and improve landscape through plantations. **Mitigation**		
Air pollution	Substantial	Moderate	Ambient air quality monitoring found very high concentration of SO_2 (54.8 µg/m^3 in average in Section 7 and 49.4 µg/m^3 in Section 8 against the national standard of 40 µg/m^3), PM10 (127.5 µg/m^3 in average in Section 7 and 100.5 µg/m^3 in Section 8 against the national standard of 45 µg/m^3), and PM2.5 (44.5 µg/m^3 in average in Section 7 and 41 µg/m^3 in Section 8 against the national standard of 15 µug/m^3), exceeding the NEQS and Provincial EQS. Airshed in major cities of Pakistan are already degraded as transboundary pollution is a major contributor to fine particulate matter in South Asia, while elevated SO_2 concentrations primarily result from the high prevalence of diesel-fueled vehicles, traffic congestion at intersections, deteriorating pavement conditions, and emissions from coal-fired power plants. Local air quality including dust is expected to deteriorate further due to emissions from construction plants, equipment, and exacerbation by traffic congestion. The impact on air quality is considered significant, driven by activities such as construction plant operations, traffic diversions, site clearance, earthwork, and excavation. These emissions will be concentrated along the highway corridor during the construction phase. Dust generation, particularly in dry conditions, will have substantial effects extending beyond the immediate vicinity. A major source of dust pollution will be the resuspension of particles from unpaved roads due to construction traffic. Given the limited capacity of the local community to adapt, the potential degradation of air quality is a significant concern. During the operation phase, the expanded highway capacity, along with service roads for local traffic, protected U-turns, pedestrian bridges, flyovers, and underpasses, will enhance traffic flow, reducing congestion and lowering overall traffic emissions, thereby contributing to improved air quality.	Mitigation measures would include emissions management from construction vehicles, frequent sprinkling of water on unpaved roads, regular maintenance of vehicles and construction equipment, and preventing the release of emission from burning waste materials. Dust control measures will consist of regular vehicle and equipment maintenance program, proper construction materials planning, dust management, and frequent water sprinkling. The NHA in collaboration with provincial and federal EPAs and the Climate Change Division (CCD), may establish a Continuous Emission Monitoring System (CEMS) to assess air quality in the project area. This system will monitor major intersections and sensitive receptors in accordance with the NEQS and Provincial EQS for a specified duration, capturing air quality concentrations during the operational phase. Additionally, planting greenbelts along the highway is a preferred method to mitigate air pollution.	Moderate	Low
Disturbance due to noise and vibration	Moderate	Substantial	• Baseline noise monitoring along the Phase 1A highway revealed high noise levels, with average daytime readings of 58.5 dBA at Section 2, 75 dBA at Section 7, and 70.75 dBA at Section 8, exceeding the standard of 65 dBA for commercial area. Nighttime levels were also elevated at 53 dBA, 64 dBA and 63.5 dBA, surpassing the 55 dBA standard. • Following a thorough review of the survey locations, it was found that noise monitoring was primarily conducted near the roadway rather than at receptor locations. Future monitoring should prioritize receptor sites to more accurately capture ambient noise levels, which are likely to be lower than those recorded near the road. • Construction activities may further disturb nearby settlements and businesses due to noise and vibrations from vehicles and equipment on service roads and the highway, as well as from construction camps, potentially disrupting local wildlife. • Operational noise impacts are expected to increase due to higher traffic volumes due to uninterrupted flow in the 6-lane main highway and traffic segregation. Preliminary forecasts from the Traffic Noise Model (TNM 3.0) anticipate average noise levels	• Mitigation measures include requiring contractors to add provisions for noise and vibration management, organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise on the work site. • Avoiding/minimizing noisy works during the night time as far as possible and maintaining community liaison to aware people about the construction activity. • Based on the detailed results of noise modeling at receptor locations, tailored noise mitigation measures will be implemented. This approach takes into account concerns from some affected groups who oppose physical barriers, as these may block visibility and access to their businesses, potentially discouraging customers. • Vibration measurement during construction phase by the contractor near the settlements/sensitive receptors. • Timing of the construction works to be conducted during the recommended operational hours, to reduce vibration levels to residential properties; • Residents to be pre-warned of high vibration events; • Noise barriers along highways are effective structures designed to mitigate noise pollution from traffic. Depending on the	Low	Moderate

ESF Standards, Environmental Impacts and Social Risks	Risk Ratings before Mitigation and Control		Rationale	Mitigation	Risk Ratings after Mitigation and Control	
			along Section 7 highway, will rise to 86.2 dBA by 2030 and 88.2 dBA by 2045.	topography and sensitivity of receptors, any of the following noise barriers can be considered: o earth mounds (berms) that absorb sound, o solid barriers made from materials like concrete, wood, or metal, which can reflect sound, o transparent barriers often made of acrylic or glass, these allow visibility while reducing noise.		
Potential hazards caused by fuels, bitumen and other toxic chemicals	Moderate	Low	Accidental spills of oils, fuels, bitumen, and lubricants from construction equipment, machineries, and asphalt plant are expected during the construction and operation phase to both the land and water sites.	• Spills and leaks will be contained through appropriate means such as bunding. Chemicals and oils will be stored on cemented platform and in a covered area with spill containment arrangements. • A waste management plan will be developed to deal with the wastewater produced from construction sites and camps as well as a design for spillage control and wastewater treatment.	Low	Low
Poor management of solid waste	Moderate	Low	Solid waste generated from campsites will primarily consist of paper, plastic, food, organic, and metal waste. The Contractor is responsible for ensuring proper segregation of waste on-site and for accurately recording the quantities of each type of waste generated. It is estimated that 1,125 kg/d solid waste will be generated from three sites. In addition, 534,550 m^3 of surplus construction spoil will be generated, some of the material will be utilized for embankment construction.	Mitigation measures include introducing waste management system to avoid, minimize, reduce and reuse waste including defining material ordering, use and handling measures. Moreover, waste material storage areas, borrow pits and materials laydown areas should be carefully designed and sited. Appropriate measures should also be introduced for materials storage, handling and use. Construction surplus spoils will be recycled as much as possible for embankment construction and other usage. The remaining unused spoil will be disposed of in designated approved area agreed by the NHA.	Low	Low
Pollution associated with borrow pits	Moderate	Low	Excavation activities associated with borrow and open pits may lead to land disputes, soil erosion, loss of arable land, vegetation depletion, and landscape degradation. Additionally, these pits can weaken road embankments and pose safety hazards to humans, livestock, and wildlife. If left unaddressed, they may become breeding grounds for mosquitoes, contributing to public health concerns and deteriorating hygiene conditions in the Project Area.	• Obtain necessary permits from competent authorities for new borrow pits and verify permits for existing ones. • Regulate excavation depth, ensuring slopes do not exceed a 1:4 gradient to maintain stability. • Monitor and control soil erosion around borrow pits to protect adjacent lands. • Prevent mosquito breeding by implementing proper drainage or other mitigation measures if water accumulates in borrow pits. • Manage excavation responsibly, preserving the top 20 cm of soil for future vegetation and utilizing pits for construction waste disposal. • Ensure safety by properly fencing borrow areas and restricting unauthorized access to prevent hazards to residents.	Low	Low
Pollution of surface water and groundwater resources from spills and leaks, and discharges from camps and office	Low	Low	Chemicals can be leached into water via the corrosion of metals and degradation of plastics which can affect aquatic ecology. This makes it crucial to carefully select project materials which would minimize the leaching of chemicals. Moreover, pollution events may arise from sediment release, chemical spillage or incorrect handling of wastewater can cause direct mortality of fauna and flora. It is estimated that wastewater will be produced from three project sections as, 32,000 liters/day from Section 2, 25,600 liters/day from Section 7, and 22,400 liters/day from Section 8 during construction, respectively. Spills and leaks which reach ground water will occur for the construction and operation phases). Spills and leaks which reach ground water may happen if a spill is able to reach a water table below a construction/maintenance site. The probability of spills and leaks which reach ground water occurring is considered low because good practice measures mean there should not be a spill of sufficient volume to reach the ground water, however, the magnitude of harm is significant.	• Avoid storing liquids where there is a high risk of water pollution or land contamination (e.g., on bare ground or unsealed surfaces, next to drains, creeks etc.). • Proper waste disposal system is to be implemented to minimize pollution • All fuel, oils, chemicals, hydraulic fluids, on-site toilets etc. must be stored in the construction site compound which shall be bunded • Optimize use of resources (oil, water, etc.) to minimize the amount needed • Make incidence reporting a priority in case of spills and leaks • Train staff to recognize spills and the appropriate measures to take • Keep continuous inspection for leaks prior to each construction activity (e.g., concrete pouring) • All pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents, etc. for outfalls must be completed in dry weather • Locations where concrete or other wet materials are to be used, bunded steel decks must be used to capture any spilled concrete, alkaline water displaced from inside tubular steel piles or spilled sealants or other materials • The fueling equipment should be equipped with breakaway" hose	Low	Low

ESF Standards, Environmental Impacts and Social Risks	Risk Ratings before Mitigation and Control		Rationale	Mitigation	Risk Ratings after Mitigation and Control	
				connections that provide emergency shutdown of flow in case of failure of connection. • Absorbents should be present at places of refueling. • All camps and other facilities will have appropriate effluent treatment and disposal mechanism • Regular monitoring of water quality near Project Area		
Hazardous Materials	Moderate	Moderate	Improper handling of hazardous materials such as petrochemicals during construction and operation, can contaminate both land and water emerging from various sources like construction activities, accidental spill during operation.	• Minimize use of hazardous materials. • Use standard operating procedures defined in the associated Material Safety Data Sheet (MSDS) • Providing training to the workers and awareness raising of the communities about hazardous material used at the site • Appropriate arrangements (cemented base and covered area) for storing hazardous materials • Security arrangements for storage of hazardous materials.	Low	Low
Changes in water quality from waste and as a result of accidental spills and leakages of petroleum products	Low	Low	The construction process may create plastic, other waste, and use of petroleum products, which if incorrectly managed could enter the water body and impact aquatic habitat and species.	Mitigation measures include requiring Contractors to prepare and implement a waste management plan, segregate and reuse or recycle all the wastes, and cemented base and bunded area for storing hazardous materials and train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process.	Low	Low
Flood	Moderate	Low	• Considering the slopes, topography of the Project area of Section 2, 7 and 8, 2022 flood impacts, and development on the sides of the road at some locations, caused the existing cross drainage structures (9 culverts and 7 bridges) choked with mud and minor damages. The hydraulic analyses for the cross drainage structures and culverts against 25 year return period flood and checked to pass 50 year return period flood, while, 100 year return period flood is used for the bridges, • Findings indicate that bridges at RDs 1+272, 2+160, 5+202, and 6+332 are adequate, while those at RDs 8+256, 10+599, 13+136, 17+497, and 25+118 require additional bays for sufficient capacity. Culverts at RDs 0+465, 10+599, 21+210, 25+205, 25+405 (both sides), 15+500, and 20+468 (one side) cannot pass design floods. • The main flood causes are monsoon rains and climate change-driven snowmelt. Flood restrictions alter natural flow, increasing risks if the road is not properly designed. The impact is moderate but requires mitigation.	• Regular cleaning, repair, and maintenance are needed for effective flood drainage. • Three culverts require an additional barrel each to accommodate increased flood discharge due to climate change. • Culverts need extra cells/barrels to ensure adequate capacity, as some are partially blocked or damaged. • Proper drainage structures with sufficient capacity should be provided to prevent flooding, especially during heavy rains. • Box culverts should be included to mitigate flood damage and protect road embankments. • Protection works and embankments must be designed for a flood return period of at least 20 years.	Low	Low
Climate change benefit and GHG emission	Low	Low	• The main sources of greenhouse gases (CO_2) during the construction activities will include both mobile and stationary sources. The mobile sources will be the construction machinery and vehicles while the stationary source will be the batching and asphalt plants. • During operation, it is estimated that CO_2 emission from daily traffic in the Phase 1A road operation will be 4.24 million ton in 2030 and 6.45 million ton in 2045 which will be higher than the 2024 emission of 3.53 million ton.	To minimize CO_2 emissions and environmental impact during construction, the following measures should be implemented: • Regular vehicle maintenance to ensure engine efficiency. • Minimizing idling of construction vehicles. • Exploring alternative energy sources where feasible. • Enforcing stringent emission standards (WHO, PEQS/NEQS, IFC) for construction vehicles and equipment.	Low	Low
ESS1: Community Health and Safety						
Traffic and Road Safety	Moderate	Low	There will be an increase in traffic due to construction as a large number of trucks will be hauling materials to the worksites. The expected increase could reduce the capacity of the existing road network, cause wear and tear due to the construction vehicles using the roads as well as contribute to noise, dust and safety issues. The rise in traffic volume would lead to a higher rate of traffic and road safety issues which makes it crucial to promote traffic safety awareness in communities in the Area of Influence and along the transportation route. School students from the settlements and towns along the Phase 1A highway are seen commuting and crossing the	• Mitigation measures include road condition surveys, controlling vehicle movement, final road diversion, and ensuring proper road maintenance. • The contractor will prepare and implement a traffic management plan that would include drivers' training in defensive driving techniques, speed control, placement of flagmen where needed (e.g., along the populated areas and markets), placement of sign boards, liaison with the community and increasing community awareness regarding project related traffic.	Low	Low

ESF Standards, Environmental Impacts and Social Risks	Risk Ratings before Mitigation and Control		Rationale	Mitigation	Risk Ratings after Mitigation and Control	
			highway, compromising their safety. This will aggravate during construction.			
Increase habitat for disease vector	Low	Moderate	Borrow pits and puddles most often in the perimeter of camps, create stagnant water pockets, which can become a breeding ground for midges and mosquitoes. If the project provides an increase in habitat for disease vectors, then there could be an increase in cases of vector-borne diseases such as malaria, chikungunya, and dengue within the local populations, particularly in those that are vulnerable. The increased risk will occur mainly in the operation phase when all panels and floats are installed.	• Develop support in nearby communities, and create community awareness by educating the communities about vector-borne diseases and transmission. • During construction, minimize the presence of stagnant water and puddles by improving the drainage facilities. • Monitoring regime will be implemented during the operation stage	Low	Low
Community Exposure to Health Issues and Labor Influx; Sexual Exploitation and Abuse (SEA) and Sexual Harassment (SH); Sexually transmitted diseases and substance use	Low	Low	• Crowded worker dormitories and a larger workforce could lead to a rise in the spread of certain diseases. • Labor influx in the project sites, particularly in impoverished communities, may increase the likelihood of exploitive and coercive sexual relations with community members, particularly minors in exchange for goods or money. Phase 1A highway traverses through conservative area and women are normally accompanied by their male guardians, therefore, it reduces the exposure of women to labor force and any exploitative actions. Workers' camp will be located in designated areas approved by NHA or close to communities, which will allow for greater supervision of the workers. • The influx of people may bring communicable diseases to the project area, including sexually transmitted diseases (STDs), or the incoming workers may be exposed to diseases to which they have low resistance. Workers with health concerns relating to substance abuse, mental issues or STDs may not wish to visit the project's medical facility and instead go anonymously to local medical providers, thereby placing further stress on local resources.	• Mitigation measures would include performing medical screening and requiring proof of vaccination prior to any employment. Moreover, the contractor should conduct induction training or workshops to introduce the basics of health and hygiene and the necessary preventive measures against them. • Establish workers' camps separated from local communities with strict protocols for interaction with local communities in order to avoid project impacts from labor influx. • Contractor will develop a Code of Conduct (CoC) for all site personnel. All site personnel will sign this CoC and will abide by it. • Project staff will receive training on the prevention of SEA/SH. Engagement of skilled trainers to raise awareness among project workers of the risks, expected behaviors, and consequences of violations, communicated through training, and publicized codes of conduct. It may also be important to raise awareness of the risks among community members and local health authorities and inform them about available grievance mechanisms. • Arrange and support local organizations and/or government initiatives on community STD education, prevention, and treatment programs. • Extensive training for awareness raising strategy which describes how workers and local communities will be sensitized to SEA and SH risks, and the worker's responsibilities under the CoC • The routes/places used by the women will be avoided as far as possible. If unavoidable, alternate routes will be identified for the communities, if required, especially along routes frequented by women folk, such as route to the local well or water source. • Construction crew will avoid entering villages and settlements. • Communities will be informed and consulted before commencing works inside or near the communities. • Provision related to SEA/SH will be incorporated in the bidding document, • Identification and mapping of the service providers.	Low	Low
Social and Cultural Conflicts	Moderate	Low	There is a potential for cultural conflicts between the contractor's workforce and local inhabitants, particularly due to differences in attitudes, increased demand for local resources, and competition between local and migrant job seekers. Social tensions may arise if local communities perceive an imbalance in employment opportunities or if international contractors are engaged. Resistance to the contractor's workforce and dissatisfaction with hiring practices could lead to social disturbances. Use of local amenities by project workers may overburden and eventually lead to conflicts.	• Establish formal communication channels with affected communities to foster engagement and trust. • Develop and implement a social grievance redress mechanism (GRM) to address concerns effectively. • Collaborate with local elders, community leaders, and NGOs to facilitate smooth interactions between the workforce and residents. • Provide cultural sensitivity training for non-local laborers to familiarize them with local customs and traditions. • Prioritize hiring local labor for construction activities to promote economic benefits for the community. • Ensure proper implementation of the framework GRM outlined in the Stakeholder Engagement Plan (SEP) to prevent community unrest.	Low	Low
Emergency Preparedness and	Low	Low	In the case of any internal or external emergency and natural disaster,	• Mitigation measures include preparing an emergency	Low	Low

ESF Standards, Environmental Impacts and Social Risks	Risk Ratings before Mitigation and Control		Rationale	Mitigation	Risk Ratings after Mitigation and Control	
Response			a response procedure should be available depending on the level of emergency of the situation and would require proper preparedness by the project stakeholders.	response plan (ERP) by the Contractor at site level as part of the OCHSMP and an Emergency Preparedness and Response Plan (EPRP) by NHA at the Project level to contain larger emergencies and framework is presented in Annex 8-1 • NHA will work with the local authorities to coordinate with the national emergency response network in the areas of influence and to ensure implementation of the project specific emergencies and make arrangements with external emergency services (Fire, ambulance, Rescue 1122, etc.), if the resources available with the Contractor is not sufficient to contain an emergency.		
ESS 1: Conserving Biodiversity and Sustainable Management of Natural Resources						
Losses of trees and terrestrial habitat due to land clearance	Substantial	Low	There may be temporary and permanent terrestrial habitat loss and degradation at construction, camp, and yard area. It is estimated that 645,730 m^2 (64.6 ha) land will be cleared for 3 sections of the highway construction affecting a total of 8,390 trees located within the RoW, which include beneficial and medicinal trees as well. This will result in the direct loss of plants and habitats and displacement of fauna. Soil erosion arising from clearance could result in loss of plant species.	• Camp selection will be made complying with E&S requirements and will follow ECP 15. • Mitigation measures include minimizing land clearance, restricting activities to designated areas, and properly planning camps, machinery movement, and temporary roads to protect vegetation. • Construction camps should be established in areas with little to no vegetation, and alternate routes for access and diversion road should be chosen to avoid environmental impact. • Camp locations will be selected to minimize environmental effects, reduce costs, and limit land use. • Compensate each tree with 10 trees planted with a total of 83,900 saplings, through a plantation enhancement program.	Low	Low
Introduction or spread of non-native invasive species	Low	Low	Construction of the Project will increase the potential for establishment and/or spread of alien invasive species (AIS) of plants, which in turn may contribute to the degradation of the habitats and exclusion of native species. Some of the terrestrial plant species recorded during the surveys were identified as AIS. There is potential for known alien or invasive plants to spread, or others to be introduced, with negative impacts on the habitats present. The spread of invasive alien plants species could also occur in aquatic habitats through seeds or plant fragments transported through equipment/machinery from outside the area, as well as algae and encrusting species. This may cause loss and degradation of aquatic habitats and changes in water quality and habitat suitability for aquatic species.	Mitigation measures include performing visual inspections to ensure the workers or materials do not have seed or pollen on them so as to prevent the movement of AIS between locations.	Low	Low
Killing or injury of species	Moderate	Low	Birds, with individuals likely to disperse from roads with approaching vehicles and from construction areas. There is potential for death to be caused through destruction of nests during habitat clearance (sociable lapwing are ground-nesting). Additionally, some species are hunted, trapped or susceptible to egg-collecting in parts of their range (including the sociable lapwing and vulture species). These may lead to negative impacts on populations present in the AoI. Effective mitigation will remove risk of poaching/hunting by personnel and reduce unintentional risk from vegetation clearance. A small chance of accidental killing remains, especially for ground-nesting or less mobile species. During construction, there may be increased pressure on fisheries due to the presence of construction staff and increase in local populations. However, the implementation of the existing fishing ban (standard good practice) should reduce the magnitude of change on fish to minor and the probability of this impact low.	Mitigation measures include introducing and enforcing speed limits for vehicles. A hunting ban imposed on Project staff alongside other standard mitigation for road safety and habitat clearance.	Low	Low
Fauna	Low	Moderate	The movement and operation of noisy machinery and vehicles during construction can disrupt wildlife by causing stress, altering their behavior, and potentially displacing them from their natural habitats. Loud noises, vibrations, and human activities may disturb breeding, feeding, and resting patterns of various species. Additionally, the	To mitigate the impact of noisy machinery and construction activities on wildlife and their habitats, the following measures can be implemented: • Noise Control: Use barriers, silencers, and low-noise machinery; schedule noisy activities during daylight hours.	Low	Low

	Risk Ratings before Mitigation and Control				Risk Ratings after Mitigation and Control	
			establishment of construction camps and frequent movement of heavy equipment can fragment habitats, block migration routes, and limit access to essential resources such as water and food. These disruptions may lead to long-term ecological imbalances, forcing wildlife to relocate or adapt to new, often less suitable, environments. To minimize these impacts, mitigation measures such as designated wildlife corridors, noise reduction strategies, and careful placement of construction sites should be considered.	• Wildlife-Friendly Planning: Avoid sensitive areas, establish wildlife corridors, and restrict access to critical habitats. • Regulated Machinery Movement: Designate specific routes, enforce speed limits, and use temporary bridges where needed. • Monitoring & Awareness: Conduct wildlife monitoring, train workers, and set up a grievance mechanism. • Habitat Restoration: Rehabilitate disturbed areas, minimize land clearance, and collaborate with conservation experts.		
			Expansion of Phase 1A highway from 4-lanes to 6-lanes and constructing service road in both sides will affect wildlife movement during operation.	• Biodiversity friendly cross-drainage structures must be planned based on the species and their movement patterns.		
ESS 1: Stakeholder Engagement and Information Disclosure						
Continuous engagement of stakeholders during implementation	Moderate	Moderate	The identified stakeholders have different types of stakes associated with various aspects of the project depending on their professions and involvements.	Mitigation measures include public consultations and participation of stakeholders throughout the project lifecycle. This would ensure that concerns about the impacts of the project are addressed earlier rather than later. A Stakeholder Engagement Plan (SEP) has been prepared for this purpose.	Low	Low
ESS 2: Land Acquisition and Involuntary Resettlement						
Resettlement of affected people	Substantial	Low	All work related to reconstruction of the Phase 1A N5 shall be carried out within the existing RoW of NHA, therefore no permanent land acquisition will be required. However, the Project activities will pose resettlement related impacts of 1,758 households and assets, which include impact on houses and secondary structures (32), shops/hotels and related secondary structures (907), movable kiosks and huts etc. (608), filling stations/ petrol pumps (30), misc. (69), mosques, shrine and other assets (112) (detailed provided in RAP) during the Project implementation. According to the engineering design of the road, resettlement issues on the existing road are substantial in nature. In addition, there are seasonal fruits and vegetable vendors in movable carts, which can be affected during construction, however, they can continue their trade during operation by just moving their carts back on the shoulders of the reconstructed N5.	• Fair and timely compensation will be provided to all affected individuals losing their livelihoods along the route. • Relevant stakeholders, including affected individuals, will be actively engaged in designing effective livelihood restoration measures. • The Resettlement Action Plans (RAPs) included livelihood restoration plans, with continuous monitoring of commercial activity recovery. • An initial compensation assessment for income loss will be conducted based on the preliminary road alignment and construction camp locations, with updates following the final alignment determination. • Awareness programs and training sessions will be conducted to inform affected individuals about project benefits, land acquisition reasons, and compensation procedures.	Low	Low
Temporary Land Acquisition	Moderate	Low	The Contractors will require temporary land acquisition for the development of Contractor camps and yards, i.e., material stockpile, workshops, equipment parking and washing areas. The approximate area required for the establishment of one Contractor's camp facilities will be tentatively 1,500 m^2. Land utilization for the Project activities and subsequent operation of the Project may induce temporary in the existing land use pattern. This impact can be categorized as moderate in nature.	• Construction camps will be established on acquired land to avoid leasing issues. If not feasible, land will be leased before construction, with agreements made directly between contractors and private landowners. The LAA, 1894 will not apply, as leases will be temporary and negotiated in the local language. • Camps will be at least 500 meters from settlements, built-up areas, and cultural sites. The contractor must submit a camp development/management plan for approval before construction. Wherever possible, waste or barren land at higher elevations will be used to minimize environmental impact.	Low	Low

8.2 Mitigation Measures

The section presents the key mitigation measures following mitigation hierarchy of ESS1 (Avoid, Minimize, Mitigate, and Compensate/Offset) for the substantial to higher risk rating evaluated in **Table 8 -75**. Impacts and risks assessed as moderate and low in **Table 8 -75** will be addressed by the mitigation measures proposed in **Table 8-2** and the Environment Code of Practices (ECPs) (discussed later in Chapter 9 in this document). The residual risks, which are risks after mitigation, are assessed for each of the impacts, with rationale provided for residual risks of moderate ranking and higher.

8.2.1 Inadequate Implementation of ESMP

Environmental and social management plan (ESMP) along with LMP, and OCHSMP are instruments that detail the mitigation and monitoring measures to be taken during the implementation and operation of the Project to eliminate or offset adverse environmental and social impacts, or to reduce them to acceptable levels; and the actions needed to implement these measures. **Table 8 -76** presents the mitigation measures for the risks of inadequate ESMP implementation.

Table 8-76: Risks of inadequate implementation of ESMP

Mitigation Hierarchy (ESS1)	Measures
Avoid	• Recruit qualified contractors and supervision consultant who maintains environmental sustainability in corporate strategy. • Avoid contractors with poor environmental, health, and safety management.
Minimize	• Contractor's qualifications stated in the ESMP are included as the pre-qualification criteria in the short-listing process of bidders. • Ensure that the conditions of the ESMP is correctly reflected in the contractor's bidding documents and the supervision consultant's TOR. • EHS bills of quantities are included in the specifications. • Education, qualification and training requirements of personnel are included in the bidding documents and considered by the supervision consultant when they give approval to the contractor.
Mitigate	• Prepare C-ESMP, and OCHSMP based on the Chapter 9 and Chapter 10 ESMP. • Recruit qualified staffs to implement the C-ESMP, and OCHSMP. • ESMP shall keep enough provisions of resources
Compensate/Offset	• Update C-ESMP, OCHSMP and Labour Management procedures when (a) there is a change in the scope of the project, (b) there is a change in construction methodology/technique based on site condition, (c) following significant incident, and (d) at the end of the Project (to allow for improvements in subsequent projects).

Residual risks: Low.

8.2.2 Occupational and Community Health and Safety

Details are presented Chapter 9 in the document.

Residual risks: *Moderate*; even with all safety measures in place, the consequences of failure of the measures are high as fatality may occur, resulting in the moderate residual rating.

8.2.3 Landuse Change

Approximately 64.6 ha of land will be cleared early in the highway expansion project, including service roads, bus bays, U-turns, and access roads. The soil, classified as medium sensitivity, is prone to erosion. Additionally, 1,500 m^2 per section will be required for construction camps and yards. **Table 8 -77** presents mitigation measures using the mitigation hierarchy for land use change impact.

Table 8-77: Impacts of landuse change

Mitigation Hierarchy (ESS1)	Measures
Avoid	• Optimize design to minimize land clearance, especially in ecologically sensitive areas. • Utilize existing cleared or degraded land for construction camps and material yards. • Avoid unnecessary removal of vegetation, especially in erosion-prone areas. • Restrict access roads to pre-existing routes where feasible to reduce additional land disturbance.
Minimize	• Implement phased construction to limit the area of active land clearance at any given time. • Apply soil stabilization techniques such as silt fences, mulching, and temporary vegetation cover to prevent erosion. • Maintain buffer zones and natural drainage patterns to reduce soil degradation. • Use dust suppression measures (e.g., water sprinkling) to prevent soil loss and air pollution. • Implement controlled excavation and regrading to reduce the extent of disturbed land.
Mitigate (restore)	• Rehabilitate cleared land post-construction through revegetation with native plant species. • Restore topsoil in disturbed areas to facilitate natural regeneration. • Implement slope stabilization and erosion control measures (e.g., terracing, geotextiles). • Convert temporary construction yards into green spaces or reuse them for community benefits.
Compensate/Offset	• Develop compensatory afforestation programs (5 saplings for each tree felt) in collaboration with local communities. • Implement soil conservation programs in nearby areas affected by land clearance. • Provide compensation or alternative livelihoods for affected landowners where applicable.

Residual Risk: *Low*

8.2.4 Impacts on Ambient Air Quality

Ambient air quality monitoring shows high SO_2, PM10, and PM2.5 levels exceeding national standards, with major sources including diesel vehicles, traffic congestion, and coal power plants. Construction activities will further degrade air quality through emissions from equipment, site clearance, and traffic diversions, with dust resuspension from unpaved roads worsening the impact. Given the community's limited ability to adapt, air quality degradation is a significant concern. Measures presented in **Table 8 -78** aim to reduce the construction-related air quality impact while supporting broader efforts to improve air conditions in the region.

Table 8-78: Impacts on ambient air quality

Mitigation Hierarchy (ESS1)	Measures
Avoid	• Select construction equipment and vehicles with lower emissions (e.g., Euro V or VI-compliant engines). • Use grid power or renewable energy sources for construction plants instead of diesel generators. • Plan construction activities to avoid peak traffic hours, reducing congestion-related emissions. • Identify alternative routes for material transport to minimize traffic congestion near urban areas.
Minimize	• Implement strict dust control measures, such as regular water sprinkling on unpaved roads and stockpiles and ensure ESMP keeps enough provision as a line item in the cost. • Enforce emission control measures for construction machinery, including regular maintenance and low-sulfur diesel use. • Install dust suppression barriers and windbreaks at construction sites. • Require trucks transporting fine materials (e.g., sand, cement) to be covered to prevent dust dispersal. • Optimize traffic flow by improving service road conditions in one side for construction traffic for smooth diversions to minimize congestion-related emissions, while construction takes place in the other side.
Mitigate	• Implement roadside vegetation and tree-planting programs to absorb dust and pollutants. • Stabilize exposed surfaces and reclaimed land post-construction to prevent long-term dust emissions. • Enhance road pavement conditions in affected areas to reduce resuspension of dust. • Conduct post-construction air quality monitoring to assess improvements and ensure compliance with standards.
Compensate/Offset	• Support local initiatives for air pollution control, such as promoting clean energy alternatives. • Implement community awareness programs on air pollution and mitigation strategies. • Collaborate with policymakers and development partners on regional air quality management efforts, particularly for transboundary pollution. • Develop a long-term emission reduction strategy, including incentives for public transport and cleaner fuels.

Residual Risk: *Low*

8.2.5 Noise Level during the Operation of Phase 1A Highway

Operational noise is expected to rise due to increased traffic on the reconstructed 6-lane highway with service road for local traffic. Measures presented in **Table 8 -79** to control and mitigate operational noise impacts while ensuring sustainable highway development.

Table 8-79: Impacts of noise on the sensitive receptors

Mitigation Hierarchy (ESS1)	Measures
Avoid	• Design the highway alignment to bypass densely populated or noise-sensitive areas. • Establish buffer zones between the highway and residential or commercial areas. • Encourage land use planning that restricts noise-sensitive developments near the highway.
Minimize	• Consider constructing noise barriers (e.g., vegetative barriers, sound walls, earthen berms) along high-impact sections of Sections 2, 7, and 8. • Use noise-reducing asphalt pavement to lower tire noise. • Implement speed restrictions in urban areas to minimize noise levels. • Promote traffic management measures to prevent congestion-related honking and acceleration noise. • Encourage the use of electric and hybrid vehicles through policy incentives.
Mitigate	• Based on the outcomes of noise modeling at receptor locations, customized noise mitigation measures will be implemented. This approach considers that some affected groups oppose physical barriers, as such structures could obstruct visibility and access to their businesses, potentially deterring customers. • Implement large-scale roadside tree planting to act as natural sound barriers. • Provide noise insulation solutions (e.g., double-glazed windows, soundproofing) for affected buildings through a partnership program between owners of the buildings and NHA. • Conduct post-construction noise monitoring and adjust mitigation strategies accordingly.
Compensate/Offset	• Establish a community noise impact fund to support affected residents with mitigation measures. • Collaborate with local authorities to develop long-term noise reduction strategies. • Invest in public transportation alternatives to reduce reliance on private vehicles and decrease traffic noise over time.

Residual Risk: *Low*

8.2.6 Losses of Trees and Terrestrial Habitats during Construction

Highway construction will clear 64.6 ha, affecting 8,390 trees, including medicinal species, leading to habitat loss, fauna displacement, and soil erosion. Measures presented in **Table 8 -80** aim to minimize habitat loss, promote ecological recovery, and enhance biodiversity conservation.

Table 8-80: Losses of trees and terrestrial habitats

Mitigation Hierarchy (ESS1)	Measures
Avoid	• Optimize highway alignment to minimize habitat disruption and avoid ecologically sensitive areas.

Mitigation Hierarchy (ESS1)	Measures
	• Designate alternative sites for construction camps and yards to reduce deforestation. • Preserve high-value trees, particularly medicinal and beneficial species, where feasible.
Minimize	• Implement phased clearing to reduce the extent of habitat disturbance at any given time. • Establish buffer zones around ecologically sensitive areas to protect remaining habitats. • Apply erosion control measures (e.g., silt fences, revegetation, terracing) to prevent soil degradation. • Relocate displaced fauna to suitable nearby habitats in consultation with wildlife experts.
Mitigate	• Replant native tree species in cleared areas, prioritizing beneficial and medicinal plants. • Restore degraded land with native vegetation post-construction. • Implement soil stabilization techniques to prevent long-term erosion and habitat loss.
Compensate/Offset	• Develop compensatory afforestation programs, planting at least 5 times the number of lost trees. • Support biodiversity conservation initiatives in affected regions. • Collaborate with local communities for sustainable forest management and restoration programs.

Residual Risk: *Low*

8.2.7 Resettlement of Affected People

Mitigation measures are presented in **Table 8 -81** for the potential impacts of spills and leaks of petroleum and other hazardous liquid through seepage in ground water.

Table 8-81: Impacts due to resettlement of Project Affected People

Mitigation Hierarchy (ESS2)	Measures
Avoid	• Adjust road design to minimize displacement of religious structures, businesses, and residences. • Utilize available space within the existing Right of Way (RoW) to reduce resettlement needs. • Plan construction phasing to avoid prolonged disruption to livelihoods and commercial activities.
Minimize	• Implement Resettlement Action Plan prepared under the Project with fair compensation and livelihood restoration strategies. • Provide advance notice and consultation with affected communities to ensure smooth transitions. • Establish alternative access routes or diversion to maintain business continuity and reduce economic losses. • Ensure temporary relocation sites are adequately equipped with essential services.
Mitigate	• Support displaced individuals with livelihood restoration programs, such as skill training or financial aid. • Restore public and religious structures at suitable locations in consultation with local communities.

Mitigation Hierarchy (ESS2)	Measures
	• Implement a grievance redress mechanism to address concerns efficiently.
Compensate/Offset	• Offer financial compensation, alternative business spaces, or land in case of unavoidable displacement. • Establish community development initiatives to enhance socio-economic resilience. • Engage local businesses in project-related supply chains to create new employment opportunities.

Residual risk: *Low*

8.2.8 Impact on Protected Area

There is no game reserve and wildlife sanctuaries present in the Project AoI. The Margalla Hills National Park buffer area is located in Section 7 of Phase 1A highway. Consultation with IWMB revealed that the Margalla Hills National Park buffer area is located 2,017 m away from the RoW. However, Project AoI falls 17 m away from the National Park buffer. The national park buffer will not be affected directly due to the Project construction. Thus, no direct impact on the protected area and endangered species of Flora and Fauna are expected.

8.3 Climate Change Risk and Vulnerability Assessment

Detailed climate change assessment for the N5 road expansion, was carried out for Section 2, 7 & 8 by using the climate models. The major findings of the assessment are as follow:

- In Section 2, the average monthly temperatures are projected to rise significantly by 2085, with increases as high as 4°C. Under the SSP 2-4.5 scenario, temperatures are expected to increase by 1.8°C by 2050 and 2.8°C by 2085, whereas under SSP 5-8.5, the rise could reach 2.4°C by 2050 and 4.9°C by 2085. Additionally, annual rainfall is anticipated to rise by 28.8% by 2050 and 43.5% by 2085 under SSP 2-4.5, while under SSP 5-8.5, rainfall could increase by 43% by 2050 and 76% by 2085. Floods and extreme temperatures are identified as key climate-related hazards that the road will face in the future. The analysis shows that extreme rainfall is expected to intensify. An ensemble of bias-corrected GCMs predicts no rise in rainfall under SSP 2-4.5 (low confidence of increase). Under SSP 5-8.5, the projected increases are 6.8%, 4.3%, and 2.2%, respectively with medium confidence, all of which have been incorporated into the Subproject's engineering design. It is recommended to adopt SSP 5-8.5 results in the design.
- In the Section 7, average monthly temperatures are projected to rise significantly by 2085, with increases as high as 4°C. Under the SSP 2-4.5 scenario, temperatures are expected to increase by 1.8°C by 2050 and 2.5°C by 2085, whereas under SSP 5-8.5, the rise could reach 2.9°C by 2050 and 4.9°C by 2085. Additionally, annual rainfall is anticipated to rise by 8.2% by 2050 and 7.4% by 2085 under SSP 2-4.5, while under SSP 5-8.5, rainfall could increase by 11% by 2050 and 21% by 2085. Floods and extreme temperatures are identified as key climate-related hazards that the road projects will face in the future. The analysis shows that extreme rainfall is expected to intensify. An ensemble of bias-corrected GCMs predicts a rise in rainfall

by 2.5% for a 25-year return period, 2.3% for a 50-year return period, and 2.1% for a 100-year return period under SSP 2-4.5. Under SSP 5-8.5, the projected increases are 3.9%, 4.1%, and 4.3%, respectively, all of which have been incorporated into the project's engineering design. It is recommended to adopt SSP 5-8.5 results in the design.

- In the Section 8, average monthly temperatures are projected to rise significantly by 2085, with increases as high as 4°C. Under the SSP 2-4.5 scenario, temperatures are expected to increase by 1.9°C by 2050 and 3.0°C by 2085, whereas under SSP 5-8.5, the rise could reach 2.5°C by 2050 and 5.3°C by 2085. Additionally, annual rainfall is anticipated to rise by 6.0% by 2050 and 5.0% by 2085 under SSP 2-4.5, while under SSP 5-8.5, rainfall could increase by 8.4% by 2050 and 15.4% by 2085. Floods and extreme temperatures are identified as key climate-related hazards that the road projects will face in the future. The analysis shows that extreme rainfall is expected to intensify. An ensemble of bias-corrected GCMs predicts a rise in rainfall by 3.6% for a 25-year return period, 3.7% for a 50-year return period, and 3.7% for a 100-year return period under SSP 2-4.5. Under SSP 5-8.5, the projected increases are 11.0%, 12.0%, and 13.4%, respectively, all of which have been incorporated into the project's engineering design. It is recommended to adopt SSP 5-8.5 results in the design.

The detailed report is attached in **Vol. 3: Climate Change Assessment.** The Assessment shows that by addressing climate-related risks upfront, it aims to ensure long-term sustainability and resilience of critical infrastructure in the face of future climate changes.

Furthermore, climate vulnerability and risk assessment of Section 2, 7 & 8 was carried out (refer ESMPF) by using the tool[13] which identified the four major hazard. The identified hazards and their measures are as follow:

Table 8.82: Climate Change Risks Identification and Preliminary Assessment

Sl.	Hazard	Section 2	Section 7	Section 8	Mitigation Measures
1	River Flood	High - Major water bodies crossing the alignment include Rohri, Mirwah and Nara Canals along with other distributaries and Nullahs	High – Major water bodies crossing include tributary of Haro River along with other Nullah	High - Major water bodies crossing includes Nullahs and flood channels. Tributary of Kabul River exists in close proximity of this Section.	Engineering and Design Measures (Climate Resilient Design of Cross Drainage Structures)
2	Earthquake	Medium– The impact of urban flooding is only expected in Rohri (Sukkur District)	Medium – Fall in 2B Zone (Moderate) as per the seismic zoning of	Medium – Fall in 2B Zone (Moderate) as per the seismic zoning of	Engineering and Design Measures (Earthquake Resilient Infrastructure)

13

Global Facility for Disaster Reduction and Recovery (GFDRR) in collaboration with the World Bank Group (WBG) developed a tool which has been utilized to consider the climate change impacts of disasters on new and existing development Subproject. The tool identifies and robustly assess the level of river flood, urban flood, coastal flood, earthquake, landslide, cyclone, water scarcity, extreme heat, wildfire, tsunami, volcano.

Sl.	Hazard	Section 2	Section 7	Section 8	Mitigation Measures
		where the proposed Subproject passes through the urban area.	Pakistan under BCP 2007/2021.	Pakistan under BCP 2007/2021.	
3	Water Scarcity	Medium – Fall in 2A Zone (Moderate) as per the seismic zoning of Pakistan under BCP 2007/2021.	Medium – there is no physical water scarcity issue in the project area, however, Pakistan is facing the economic water scarcity which will also be reported in proposed subproject area. The proposed subproject area falls under water stressed category.	Medium – there is no physical water scarcity issue in the subproject area, however, Pakistan is facing the economic water scarcity which will also be reported in proposed subproject area. The proposed subproject area falls under water stressed category.	Environmental and Nature-Based Solutions (Implement xeriscaping (low-water landscaping), Minimizing Water Use in Construction and optimize concrete mix designs to reduce water consumption) Policy and Planning Measures (Outline of Project Level Emergency Preparedness and Response Plan (Refer **Annex 8-1**)
4	Extreme Heat	Medium–There is no physical water scarcity issue in the Subproject area, however, Pakistan is facing the economic water scarcity, which will also be reported in proposed Subproject area. The proposed Subproject area falls under water stressed category.	High – During summer high temperature prevail during day time in the surrounding areas of the subproject	High – During summer high temperature prevail during day time in the surrounding areas of the proposed subproject.	Environmental and Nature-Based Solutions (Reforestation and Vegetation Zones: Plant trees along roadsides to provide shade and reduce pavement temperature, reduced soil erosion and reduce wind and storm impact) Policy and Planning Measures (Outline of Emergency Preparedness and Response Plan (Refer **Annex 8-1**)

9 OCCUPATIONAL AND COMMUNITY HEALTH AND SAFETY

This Chapter provides an in-depth examination of the Occupational and Community Health and Safety Management System (OCHSMS) during both the construction and operation stages. While Chapter 8 briefly addresses the occupational hazards and risks associated with these stages, this chapter expands on those discussions in greater detail. The OCHSMS includes the Contractors' high-level corporate policies, processes, and Standard Operating Procedures (SOPs). A list of these processes and SOPs relevant to Phase 1A of the Project is presented in this chapter, with the understanding that they will be further refined and developed by the Contractors during construction, incorporating site-specific and operational details.

9.1 Purpose

This chapter provides guidance to assist the Contractor in developing a comprehensive OCHSMP. Its primary objective is to ensure that all project activities are meticulously planned, executed, monitored, and managed in alignment with established health, safety, and management practices, procedures, and standards.

This chapter serves as a practical guidance for the Contractor, offering a structured approach to managing Occupational Health and Safety (OHS) and Community Health and Safety (CHS) risks. It aligns with the requirements of AIIB's Environmental and Social Standard 1 (ESS1), the World Bank Group Environmental Health and Safety Guidelines (EHSGs), and the relevant provincial OHS Acts and regulatory frameworks and requirements (refer to Chapter 2 for specific Acts and Regulations).

Additionally, the Contractor is encouraged to comply with the following international guidelines to enhance safety and management practices:

- ILO Code of Practice. 1992, Safety and Health in Construction Industry, ISBN 92-2-107104-9
- Safety and Health in Building and Civil Engineering Work, ILO Codes of Practices
- American National Standard Institute (ANSI) for Personal Protective Equipment (PPE). As for example, Eye and Face Protection (ANSI Z87.1-1989), Head Protection (ANSI Z89.1-1986), Foot Protection (ANSI Z41.1-1991) or equivalent acceptable to the Engineer.
- Good International Industry Practices (e.g., OSHA)

9.2 Scope

This guidance is applicable on all operational activities related to the Project. Some of the key high-risk activities may involve the following:

- Vehicles and driving;
- Scarifying existing pavement;
- Cutting of trees;
- Diversion of traffic;

- Operation of mobile equipment on site and on community roads;
- Work at height and dropped objects;
- Material haulage;
- Manual handling;
- Lifting and crainage;
- Scaffolding;
- Operation of Batching and Asphalt Mixing plants;
- Hot work (asphalt);
- Maintenance and operation of the site camp;
- Use of security forces; and
- Electrical works.

9.3 Objectives and Targets

This guidance is developed on the following objectives:

- Safe operation with Zero harm to community members and all site personnel including Contractor's Staff and visitors
- Meet or exceed the contractual safety obligations

Project specific measurable targets to achieve above objectives will be established by the Contractor. The determination of these targets will be based upon Contractor's continual improvement philosophy, external peer group benchmarking and stakeholders' input. The Contractor will establish targets for each project site for every fiscal year. Some examples of these targets are listed below to guide the contractor about the expectation from NHA:

- Total Recordable Injury Rate[14] of 1.5 or less (or based on the Contractor previous yearly trend)
- Lost Time Injury Frequency Rate[15] of 0.5 or less (or based on the Contractor previous yearly trend)

Senior Leaderships of the Employer, the Engineer, and the Contractor (General Manager, Project Manager, Resident Engineer, Construction Manager and Technical Director) will need to be fully committed to achieve the above-mentioned targets. Leading and lagging indicators should be established by the Contractor to drive performance to meet these targets. Following are some leading indicators showing senior management commitment. Complete details of all Key Performance Indicators (KPIs) should be presented in "PR12: Measurement" Process of Contractor's project specific OHS guidance (the OHS processes are discussed later on in this Chapter).

- All General Manager, Resident Engineers and Project Managers to complete 1 Walk-through Inspection per month.

14 A rate of injuries and illnesses computed from the following formula: (Number of injuries and illnesses X 200,000) / Employee hours worked.

15 A rate of lost time computed by: ([Number of lost time injuries in the reporting period] x 1,000,000) / (Total hours worked in the reporting period).

- All Construction Managers to complete 2 Walk-through Inspections per month with their assigned Health and Safety Officer.
- All OHS supervisors complete 1 site inspection weekly.

9.4 Risk Assessment

Risk assessment is a systematic process used to identify hazards and risk factors that could potentially cause harm (hazard identification), analyze and evaluate the associated risks (risk analysis and evaluation), and determine effective strategies to eliminate hazards or control risks when elimination is not feasible (risk control). Regularly conducting risk assessments enables construction and operation and maintenance (O&M) stakeholders to maintain regulatory compliance. Additionally, risk assessments support health, safety, and technical teams in implementing corrective measures to safeguard workers against health and safety threats throughout the construction and operational phases.

9.4.1 Risks Assessment Codes

The Risk Assessment System and the assignment of Risk Assessment Codes (RACs) are designed to systematically identify and manage workplace hazards. RACs are determined based on three key factors: the severity of the hazard, the probability of its occurrence, and the number of individuals exposed or potentially impacted in the event of an incident. While all hazards should be addressed promptly, the Hazard Risk Assessment System offers a structured method for ranking safety risks. It aids decision-makers in making well-informed choices about hazard control by providing a consistent and defensible approach to prioritizing safety hazard mitigation efforts. This prioritization considers available resources, competing demands, and organizational priorities to effectively allocate efforts where they are needed most.

9.4.2 Likelihood and Consequence of Hazards

RACs are determined by assigning values to the likelihood or probability of an outcome occurring and the consequence or severity of the potential outcome. These values are then plotted on a risk matrix, which helps visualize the hazard's position within the matrix. This position is used to assign an appropriate RAC number to the specific hazard or activity, facilitating a clear and consistent evaluation of risk levels.

The Likelihood or probability Code is considered numerical (1 to 5). These are presented in **Table 9 -83.**

Table 9-83: Likelihood ratings

Sl.	Likelihood	Definition
1	Remote (1)	Unlikely to occur but known in the sector; probability 0.1%-1%
2	Possible (2)	Likely to occur once or more during construction/ organization; probability 1%-10%
3	Occasional (3)	Likely to occur once every two years or more; probability 10%-50%
4	Likely (4)	Occurs more than once or twice per year, is continuous or certain to occur; probability 50%-80%
5	Frequent (5)	Multiple occurrences have happened frequently in the industry; probability

		>80% and above

Next is the Consequence or severity Code, varies from 1 to 5 and is presented in **Table 9 -84.**

Table 9-84: Consequence ratings

Sl.	Consequence	Definition
1	Incidental (1)	No impact or minor First Aid injury
2	Minor (2)	First aid injury (e.g., minor cuts and bruises, eye irritation from dust) or very minor health effect
3	Moderate (3)	Lost Time/ Non-Lost Time injury (e.g., sprains, fracture, cut, lacerations, burns or bruises) or health effect (i.e., deafness or dermatitis)
4	Serious (4)	Major injuries: amputations, major fractures, multiple injuries, or health effects: severely life shortening disease, occupational illness, Single Fatality (drowning)
5	Catastrophic (5)	Multiple fatalities or Multiple permanent disabilities

9.4.3 Risks Assessment Matrix

The risks assessment matrix is presented in **Table 9 -85**, enables the Occupational Health and Safety (OHS) team to prioritize workplace hazards by categorizing them as high, substantial, moderate, or low. Hazards classified as high require the most stringent controls and immediate attention. In some cases, this may necessitate canceling the associated activities from the project altogether. By implementing specific workplace controls, hazards can be managed more effectively, potentially shifting their risk classification to a more acceptable level. The matrix also emphasizes that the ultimate form of hazard control is elimination. If a hazard can be eliminated - whether by removing the task that exposes workers to the hazard or by outsourcing the task to a specialized contractor - the hazard no longer exists. This approach allows the hazard to be fully removed from the project's control process, achieving the highest standard of safety management.

Table 9-85: Risk Matrix

Likelihood / Severity	Remote (1)	Possible (2)	Occasional (3)	Likely (4)	Frequent (5)
Incidental (1)	Low (1)	Low (2)	Low (3)	Low (4)	Low (5)
Minor (2)	Low (2)	Low (4)	Low (6)	Moderate (8)	Moderate (10)
Moderate (3)	Low (3)	Low (6)	Moderate (9)	Substantial (12)	Substantial (15)
Serious (4)	Low (4)	Moderate (8)	Substantial (12)	High (16)	High (20)
Catastrophic (5)	Low (5)	Moderate (10)	Substantial (15)	High (20)	High (25)

9.4.4 Summary of Assessed Risks

The Project's potential risks and their significance have been assessed using the methodology described above. The Contractor will prepare a risk register using the likelihoods and consequences presented in Table 9 -83 and Table 9 -84. The risk register will present a summary of these risks and their significance along with the control measures. Risk register will be revisited by the Contractor once construction details are available. The following are some of the anticipated risks assessed for the Project:

- Work at Height

- Operation of mobile equipment on site and on community roads including passenger vehicles, truck dumpers, excavators, graders, loaders etc.;
- Electrical Systems
- Hazardous Materials
- Material Haulage (Loading and Unloading)
- Traffic and Pedestrian Interface Planning
- Severe Weather
- Lifting and Hoisting
- Scaffold Erection
- Working Near or Over Water
- Poor illumination
- Excavation Operation and associated risk to community members.
- Management of Security Forces
- Fire
- Plant Construction and Operation (batching and asphalt missing)

9.5 Management System Processes

The Management System Processes are a critical component of the Contractor's OCHSMP, serving as the second-tier documents following the overarching policies. These processes provide the detailed guidelines and operational frameworks necessary to effectively implement and maintain the OCHSMP. The Contractor will need to develop the following health and safety Management System Processes based on the project and site requirements:

PR01: Induction Process PR02: Risk Assessment (Job Hazard Analysis, Critical Risk Protocols, and Personal Risk Assessment) PR03: Meetings PR04: Personnel Competency and Training PR05: Short Service Worker Program (with tools for assessment) PR06: Reward and Recognition PR07: Disciplinary Process PR08: Permit to Work Process		PR09: Work Observation Process PR10: Personal Protective Equipment (PPE) PR11: Incident Investigation PR12: Measurement - Leading and Lagging Indicators PR13: OHS Compliance Audit PR14: Inspections PR15: Communications PR16: Document Control PR19: Risk Management

9.6 Standard Operating Procedures (SOP), Work Instructions and Forms

Standard Operating Procedures (SOPs) and Work Instructions are predominantly technical in nature and serve as third-tier documents within the overall risk management framework. These documents provide detailed, step-by-step guidance for executing specific tasks safely and efficiently.

Supporting tools such as forms and checklists play a crucial role in ensuring the effective implementation of the controls outlined in the SOPs.

The Contractor should develop the following SOPs as part of the Health and Safety Plan, based on a project-specific risk assessment. This list is non-exhaustive, and additional SOPs may be required depending on the specific needs and risks of the Project:

SOP 01: Work at Height		SOP 13: Electrical Systems
SOP 02: Mobile Equipment		SOP 14: Hazardous Material Management
SOP 03: Barricading and signs		SOP 15: Equipment Inspection and Maintenance
SOP 04: Cell Phone Use		SOP 16: First Aid
SOP 05: Safe Driving		SOP 17: Project Worker Welfare Facilities
SOP 06: Material Haulage (Loading and Unloading)		SOP 18: Camp Management
SOP 7: Traffic and Pedestrian Interface Planning		SOP 19: Emergency Response Plan
SOP 8: Severe Weather		SOP 20: Management of Security Forces
SOP 9: Lifting and Hoisting		SOP21: Fire
SOP 10: Scaffold Erection		SOP22: Plant Construction and Operation (batching and asphalt missing)
SOP 11: Working Near or Over Water		Others ….
SOP 12: Illumination		

9.7 Project Organization

9.7.1 Contractor Organogram

A typical Contractor's organogram is presented in **Figure 9 -23.** And efforts should be made to maintain an organogram like this, especially to make direct link between health and safety and Project Manager (senior leadership).

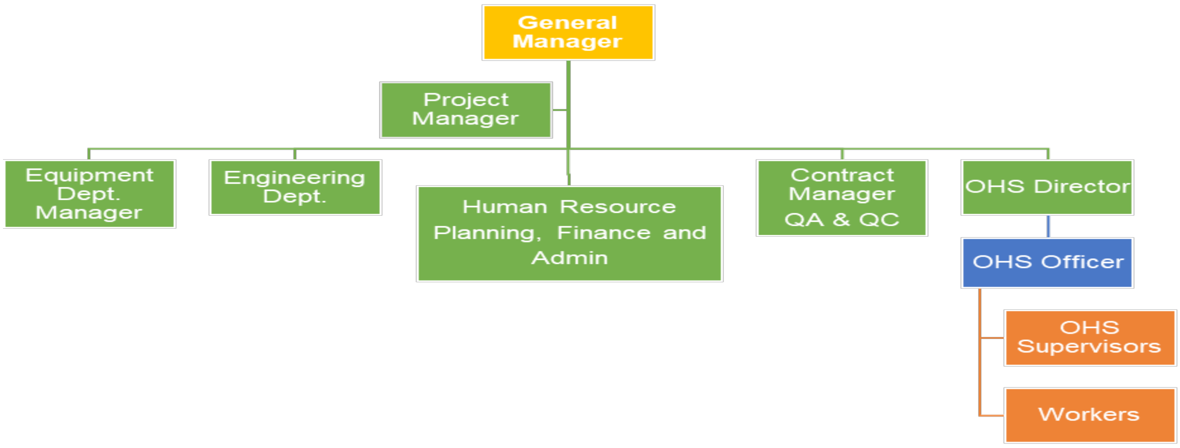

Figure 9-23: Contractor Organogram

9.7.2 OHS Organogram

The Contractor's typical health and safety organization should look like as presented in **Figure 9 -24.**

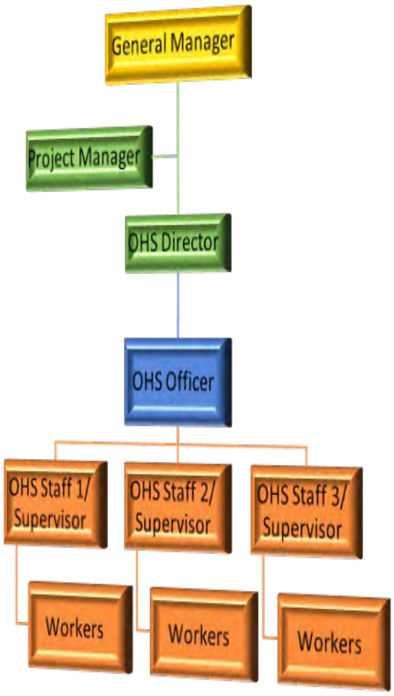

Figure 9-24: Contractor's OHS Organization

9.7.3 Roles and responsibilities

These typical roles and responsibilities give a holistic understanding pertaining to implementation of the OHS and CHS Plans which comprises multiple processes and SOPs. However, each process and SOP may also have additional specific requirements pertaining to a specific role.

General Project Manager

- Overall accountability for the development, implementation and maintenance of the Health and Safety Plan.
- Accountable for allocation of sufficient resources for the execution of the plan.
- Ensure that empowered and competent personnel are available for the execution of the plan
- Make sure that senior leadership (all directors, Construction Managers and other line management personnel) are fully aware of their responsibilities as per the Processes and SOPs of the Health and Safety Plan.
- Discourage achievement of operational results at the cost of safety violations
- Develop a culture where it is safe to speak up and provide the time, people and resources to respond to OHS concerns identified by their workers
- Review Executive Summary of incidents, ensure that Root Causes are being identified and resources are provided for the closure of Preventive and Corrective Actions

Project Manager

- Overall accountability for the development, implementation and maintenance of the Health and Safety Plan.
- Accountable for allocation of sufficient resources for the execution of the plan.
- Ensure that empowered and competent personnel are available for the execution of this plan
- Make sure that Sr. Leadership (all directors, Construction Managers and other line management personnel) are fully aware of their responsibilities as per the Processes and SOPs of the Health and Safety Plan.
- Demonstrate visible leadership, walk to talk behavior to reinforce the implementation of the Health and Safety Plan
- Attend monthly Health and Safety Committee/Progress Review Meeting and monitor the performance through leading and lagging indicators.
- Discourage achievement of operational results at the cost of safety violations
- Develop a conducive culture where Personnel are authorized to STOP[16] unsafe work without fear of retribution
- Develop a culture where it is safe to speak up and provide the time, people and resources to respond to Health and Safety concerns identified by their workers.
- Ensure that Work Observation program is utilized, and all incidents are fully investigated
- Review Executive Summary of incidents, ensure that Root Causes are being identified and resources are provided for the closure of Preventive and Corrective Actions
- Encourage reward and recognition where personnel demonstrate safe behavior or identify hazards and fairly apply disciplinary process when personnel cut short.

OHS Director

- Be a Subject Matter Expert of the Health and Safety Plan. Provide training and awareness regarding the implementation of the Health and Safety Plan that includes multiple Processes and SOPs
- Convene monthly Health and Safety Committee/Progress Review meeting and share implementation progress, points of concern
- Be familiar with all local, national, and international laws that are applicable to the operations.
- Establish and maintain a professional relationship with Company /Contractor and subcontractor representatives.
- Establish an audit system that measures the effectiveness of the Health and Safety Plan

OHS Officer

16 ILO COP 2.2.12. Where there is an imminent danger to the safety of workers, the employer should take immediate steps to stop the operation.

- Be a Subject Matter Expert of the Health and Safety Plan. Provide training and awareness regarding the implementation of the Health and Safety Plan that includes multiple Processes and SOPs
- To be familiar with all local, national, and international laws that are applicable to Operations.
- Raise concern in the monthly Health and Safety Committee/Progress Review meeting regarding implementation of controls stipulated in the Health and Safety Plan.
- Provide training to staffs on the Health and Safety Plan. Conduct regular sessions for all project team members to inculcate the requirements of the Health and Safety Plan.
- To report to the Contractor’s Management Team on implementation progress, monthly KPIs.
- To ensure that sufficient training and induction of all personnel is being provided and maintained.
- To ensure that visit induction is given to all visitors before they are allowed to visit the site.
- To develop the Health and Safety awareness of all personnel employed on the project and ensures their participation in all aspects of the health and Health and Safety program
- Provide guidance for the purchase of personal protective equipment
- Regular inspection of construction safety and security as per PR09: Work Observation Process
- Provide guidance to employees regarding their emergency response responsibilities.
- Decide whether a potential rescue service or team is adequately trained and equipped to perform permit space rescues of the kind needed at the facility and whether such rescuers can respond in a timely manner, and organize drills
- Review of Health and Safety management plan annually.

OHS Staff/ Supervisor

- Perform the assigned inspections and discuss the findings with OHS Officer
- Ensure communication procedure and system to communicate emergency events to site technical supervisor and emergency authorities (e.g., Incident Response Center (IRC) and/or Police, health centers)
- Communicate with construction site personnel to help them understand the hazards of the site and understand the demands of the operating personnel about Health and Safety matters.

Site Technical Supervisors (part of the technical team)

- They allocate tasks and check that the project workers are implementing Health and Safety requirements to standard. They provide feedback and guidance on Health and Safety implementation.
- Ensure that the controls stipulated in Permit to Work (if needed) are implemented and STOP the work when critical controls are missing or compromised
- Discuss Job Hazard Analysis (JHA) and conduct effective Tool Box Talk with all project workers. Ask questions to ensure that they have a good understanding.

- Ensure that all new employees receive training as per PR01: Induction Process and PR05: Short Service Worker Process
- Conduct worksite observations, discuss safety concerns with project workers
- Develop a culture where it is safe to speak up and provide the time, people and resources to respond to Health and Safety concerns identified by their workers. They are also responsible for escalating issues that can't be resolved by the project workers or at the supervision level to Health and Safety Team or senior management.
- Responsible for making an incident scene safe and secure and for ensuring that hazards, near misses and incidents are entered into the reporting system.
- Ensure all project workers use appropriate PPEs and train them how to use PPEs.

Workers

- Conduct Personal Risk Assessment Take 5 (Stop, Look, Assess, Control, and Monitor) and do not proceed to work if unsafe to do.
- Use authority to STOP work if observe an unsafe work by fellow worker or SSW.
- Report hazards and at-risk behavior as and help the Contractor management to develop a conducive safety culture.
- Use PPE as provided.
- Conduct a visual inspection of equipment in the beginning of the operation and ensure that equipment is de-energized before working on a piece of equipment.
- Ensuring that they wear appropriate PPE for the activity that they undertake.
- Be aware and mindful of hazards related to any work activity; do not undertake a job or task if physically or mentally not fit.
- Seek clarification for uncertainty relating to a task with the Supervisor.
- Do not undertake a job if not competent to do so.
- Raise improvement opportunities.
- Report near misses and actual incidents immediately to the supervisor.

10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This chapter describes how the identified impacts and risks (refer to Chapters 8 and 9) will be managed, with mitigation and enhancement measures as well as monitoring. Mitigation and enhancement measures are collated and expanded upon in the Environmental and Social Management Plan (ESMP). The ESMP is organized by management plans, institutional setup, capacity building and training, and presents key monitoring and performance indicators.

For each topic, this chapter identifies mitigation and enhancement measures. Where feasible, the mitigation hierarchy as per ESS1 are followed. The following sections present management measures and monitoring requirements for the impacts and risks.

10.1 Contractors' Qualification

It is recommended that all contractors procured under the Project be compliant with ISO 9001 Quality Management, ISO 14001 Environmental Management and ISO45001 Occupational Health and Safety Management or equivalent. These will be done by NHA imposing the requirements of ISO certifications during prequalification or technical evaluation of contractors. In addition, all subcontractors under the major contractors will also be subject to ISO 14001 and ISO45001 audit provisions by the main Contractor during the course of the project.

10.2 Various Mitigation and Control Measures

The ESMP includes different types of mitigation and control measures and subplans for significant impacts and risks: (i) general and non-site-specific measures in the form of Environmental and Social Codes of Practices (ECPs) presented in Annex 10-1 to address general construction and operation matters identified as moderate and low in significance prior to mitigation and prevention in **Table 8-2** and Annex 9-1; (ii) project specific and to the extent possible, site-specific mitigation measures for substantial and higher impacts and risks are presented in Chapter 8; (iii) C-ESMP with site-specific and contract-specific management plans to be prepared by the Contractor; (iv) OCHS Management System Processes and Standard Operating Procedures to be prepared by the Contractors; and (v) proposed plans in this ESMP to address significant and cumulative impacts.

10.3 Environmental and Social Code of Practices for Construction

The environmental and social codes of practice (ECPs) are generic, non-site-specific guidelines for the construction phase. The ECPs consist of environmental and social management guidelines and OHS practices to be followed by the contractors for sustainable management of all environmental, social, health and safety issues. The ECPs are listed below and details are presented in Annex 10-1.

- ECP 1: Waste Management
- ECP 2: Fuels and Hazardous Goods Management
- ECP 3: Water Resources Management

- ECP 4: Drainage Management
- ECP 5: Soil Quality Management
- ECP 6: Erosion and Sediment Control
- ECP 7: Topsoil Management
- ECP 8: Topography and Landscaping
- ECP 9: Borrow Areas Development & Operation
- ECP 10: Air Quality Management
- ECP 11: Noise and Vibration Management
- ECP 12: Protection of Flora
- ECP 13: Protection of Fauna
- ECP 14: Road Transport and Road Traffic Management
- ECP 15: Construction Camp Management
- ECP 16: Cultural and Religious Issues
- ECP 17: Construction and Operation Phase Security

10.4 Contractor's Environmental and Social Action Plan

The Contractor will prepare a 'Contractor's Environment and Social Management Plan' (C-ESMP) demonstrating the manner in which they will comply with the requirements of Site-Specific Management Plans, ECPs and the mitigation measures proposed in this ESIA Report. The C-ESMP will be submitted before the start of any construction activities (maximum of 90 days) of Contractor's mobilization and be approved by the Engineer. The C-ESMP will form the part of the contract documents and will be used as monitoring tool for compliance. Violation of the compliance requirements will be treated as non-compliance leading to the corrections or otherwise imposing penalty on the contractor.

10.5 Occupational and Community Health and Safety Plan

The Contractor will also prepare an occupational and community health and safety Management (OCHSM) plan devising the general guidelines for the identified hazards and control measures along with the OHS Management Processes and Standard Operating Procedures presented in Chapter 9 of this ESIA. The OHS shall comply with ESS1, World Bank Group General Environmental Health and Safety Guidelines, Chapter 2: Occupational Health and Safety, 2007; Sindh, KP and Punjab Labour and OHS Acts; and ILO Code of Practices 1992, Safety and Health in Construction Industry; and Safety and Health in Building and Civil Engineering Work, ILO Codes of Practices. If the guidelines stated before cannot address a specific OCHS management in the project, Good International Industry Practices will be applied, as for example, OSHA and ISO45000.

Review and update of the OCHSM plan will be done,

a) when there is a change in the scope of the project,
b) there is a change in construction methodology/technique based on site condition,
c) following significant OHS hazard or a major accident, and
d) at the end of the Project (to allow for improvements in subsequent projects).

OCHS Plan should contain general guidance for all identified risks under each work activities. It also contains management system processes and standard operating practices.

Processes and SOPs should be presented in three discrete headings, (a) Contractor's Standards on the identified risk management, (b) Expected Site specific OCHS hazard and risks during construction, and (c) Control Measures proposed by the Contractor.

10.6 Risk Assessment and Management

Risk assessment (RA) will be done by Contractor for each construction task focusing on job tasks as a way to identify risk before they occur, based on the guidance provided in Chapter 9. The outcome of the RA will be the risk register, which will focus on the relationship between the worker, the task, the tools, and the work environment. Ideally, after identifying uncontrolled hazards, steps should be taken to utilize hierarchy of control: elimination, substitution, engineering controls, administrative controls and personal protective equipment, to minimize them to an acceptable risk level. Many workers are injured and killed at the worksite every day. The RA should be one of the major components of the larger commitment of the Contractor's health and safety management system.

The RA should be conducted on many jobs in the worksite. Priority should be given to the following types of jobs:

- Jobs with the highest injury or illness rates;
- Jobs with the potential to cause severe or disabling injuries or illness, even if there is no history of previous accidents;
- Jobs in which one simple human error could lead to a severe accident or injury;
- Jobs that are new or complex to the construction or have undergone changes in construction processes and procedures; and
- Jobs complex enough to require written instructions.

10.6.1 EHS in Method Statement

The Contractor will include an EHS Chapter in each Method Statement. This EHS section will be based on the RA and other provisions of OCHS Plan and environmental issues of the site and specific to construction methods to be followed by the Contractor. This section will be reviewed by the EHS Specialists of the Engineer/Construction Supervision Consultant (CSC) and confer approval along with other technical parameters to be reviewed by the engineering team of the CSC. Each revision of the method statement shall also be reviewed by the EHS Specialists and their concurrence will be required to get the method statements approved.

10.6.2 Field Engineer's EHS Oversight

There will be limited supervision staffs available in EHS to cover all work sites and project shifts in the project. Therefore, it will become impossible to supervise and monitor EHS parameters in every site in a continuous basis. Hence, site engineers can be delegated certain EHS oversight. Engineers monitoring forms including available for inspection (AFI) and Daily Monitoring Forms (DMF) and checklists will be designed to include EHS aspects. EHS should be made also a key responsibility of site engineers.

Training program will be devised by CSC on engineers' oversight in EHS and will be offered by EHS specialists of the Contractor and CSC to address EHS immediately when identified and raise it to EHS specialists if further action is required. The training on engineers' oversight should convey the following messages:

- Engineers would assume greater responsibility for overseeing the EHS as part of their daily routine work,
- Engineers would review and approve each site's readiness to commence the work as per the design specifications, certifying whether Contractors are meeting the requirements of the Method Statements, and withholding funds from them that are not complied with.
- Engineers would impose financial penalties on the Contractor with nonexistent or non-compliant EHS matters; and
- Engineers will assist workers in recognizing environment friendly and safe work measures and procedures necessary to protect the natural environment and occupational health and safety of workers and prevent illnesses, injuries and fatalities during construction.

10.6.3 Request for Inspection

Poor temporary structures such as scaffold, access walkways, stairs, and ladders are some of the major causes of the accidents in construction industry. For technical verifications of the temporary structures, specifications in the bidding documents define the material, stability, strength and deflections of each temporary structure. However, this clause is often ignored in construction industry as the main focus is the permanent structures. Therefore, Request for Inspection (RFI) or Availability for Inspection (AFI) for temporary structures will be required, as a pre-requisite for the readiness of site. Along with the technical requirements (e.g., complete drawings, calculations relating to stability, strength, and deflections), health and safety parameters will also be inspected for all temporary structures. During these RFI/AFI, both technical and EHS personnel of the CSC will inspect the requirements and certify the technical quality and the readiness of the site to commence the permanent work.

10.7 Inclusion of Relevant Components of ESMP in Contract Documents

The ESMP of the Project along with the ECPs and occupational hazards and risks will be included in the contractors' bid documents. The technical specifications of the bid documents will clearly state that contractor will need to comply with the mitigation and control measures provided in the ESMP, ECPs, OCHSMP, World Bank Group EHS General Guidelines and NEQS.

10.7.1 BOQs in Bidding Documents

The following items will be included in the bills of quantities (BOQs) of bidding documents

- After the award of the contract and before mobilization, the Contractor will prepare and submit two separate plans, C-ESMP and OCHSMP in compliance with this ESIA, ESS2, WBG EHS Guidelines, ILO COPs, and NEQS. The preparation and their revisions and updates will also be quantified and presented as line items in the Contract.

- Quantities of personal protective equipment (PPE), first-aid boxes, ambulance, health care facility with Pakistan Medical and Dental Council licensed doctors and nurses.
- Provision of Environmental and OHS Staffs for the entire construction period. Detail staff requirements are presented later in the Chapter.
- Providing and maintenance of Dust Measurement Meters for spot measurements (2 number).
- Quarterly 24-hour Ambient Air Quality Monitoring of PM10, PM2.4, NO2, SO2, and CO.
- 15 minutes continuous noise monitoring at 4 sites for each Section of the highway close proximity of settlements during the construction work.

10.7.2 Payment Mile Stones

Payments to contractors will be linked to environmental, health and safety performance, measured by completion of the prescribed environmental and social mitigation measures in the C-ESMP and control measures described in the OCHS plan. In addition, for any non-compliance causing damages or material harm to the natural environment, workers, public or private property or resources, the Contractor will be required to either remediate / rectify any such damages in a timeframe specified by and agreed with the engineer (CSC), or pay implementation agency (IA) for the cost (as assessed by IA) of contracting a third party to carry out the remediation work. For repeated non-compliance the Contractor will be penalized. The penalty of non-compliance of the requirements of the C-ESMP and OCHS Plan will be 3% of the total Civil Works in the Instruction of Payment Certificate (IPC). The penalty will be imposed after all contractual instruments are applied and a Non-compliance Report (NCR) is issued by the Engineer.

10.8 Institutional Arrangements

10.8.1 Existing Environmental and Social Arrangements in NHA

NHA operates an Environment, Afforestation and Land Section (EALS), which is currently overseen by the Member (Administration). The organizational structure of this section is illustrated in Figure 10 -25. Despite its critical mandate, EALS is currently overextended, bearing the responsibility of managing a wide array of projects. These include those financed by the Government of Pakistan as well as numerous initiatives supported by International Financial Institutions (IFIs) such as the Asian Development Bank (ADB), Asian Infrastructure Investment Bank (AIIB), the World Bank, CPEC, and others. Furthermore, EALS also serves as the Focal Point for Climate Change within NHA, adding to its already substantial workload.

Given the increasing complexity and volume of development activities, the current capacity of EALS is insufficient to meet operational demands effectively. To ensure timely and effective project implementation, there is an urgent need to strengthen the institutional capacity of EALS through both structural reforms and resource augmentation. This concern has also been formally recognized by AIIB in their Project Note, where the limited institutional capacity of EALS was flagged as a significant risk that could lead to delays in project implementation.

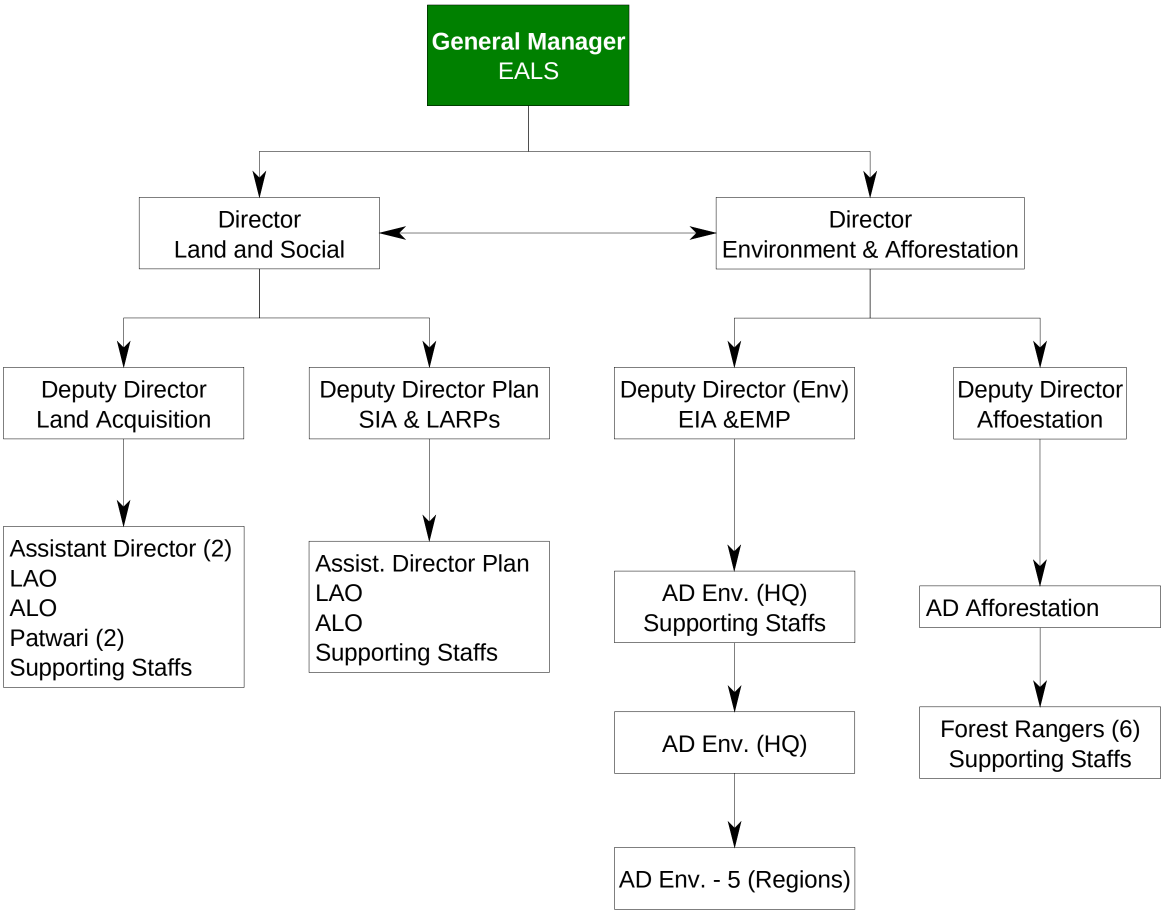

Figure 10-25: Environment, Afforestation and Land Section (EALS) of NHA-HQ

10.8.2 Project Implementation Unit – Headquarter (PIU-HQ)

A Project Implementation Unit (PIU) in NHA-HQ has been established to manage projects including the proposed project funded by AIIB. The PIU will administer the Project during the pre-construction/design phase and oversee the construction of the Project as well. PIU-HQ will be headed by the General Manager (Engineer) and will take overall responsibility for the design and preconstruction aspects of the Project.

10.8.3 Institutional Arrangements for Implementation of E&S Instruments during Construction Phase

The key players involved during construction phase of the proposed Project are the PIU-HQ-NHA as employer / proponent and RIU(s) at each Section, concerned EPAs, the Construction Supervision Consultants (CSC), Third Party Validation Consultant and the Contractor(s). The roles and responsibilities of these organizations are outlined below.

The following staff will be involved in the implementation of E&S Instruments:

- PIU-HQ (General Manager (Engineer) NHA-HQ) / Proponent / Employer;
- PIU-HQ EALS;
- RIU(s) at each Section (Project Director(s) and its E&S Staff);
- CSC;
- Third-party Validation Consultant; and
- Contractor’s Staff.

The PIU-HQ NHA will make Contractors bound through contract documents to implement the E&S instruments and other terms and conditions of the relevant Permits including NOCs from Concerned EPAs and concerned agencies. The E&S instruments will be included as a clause of the contract documents. Construction camps will be established after necessary approvals and submission of Site-Specific E&S instruments (where required) to be developed in the light of AIIB’s and the relevant agencies requirements, before commencement of new works. The detailed roles and responsibilities of the above staff of these institutional arrangements are provided in ESMPF whereas the organizational setup for implementation of E&S instruments during construction phase is provided in **Figure 10.1**.

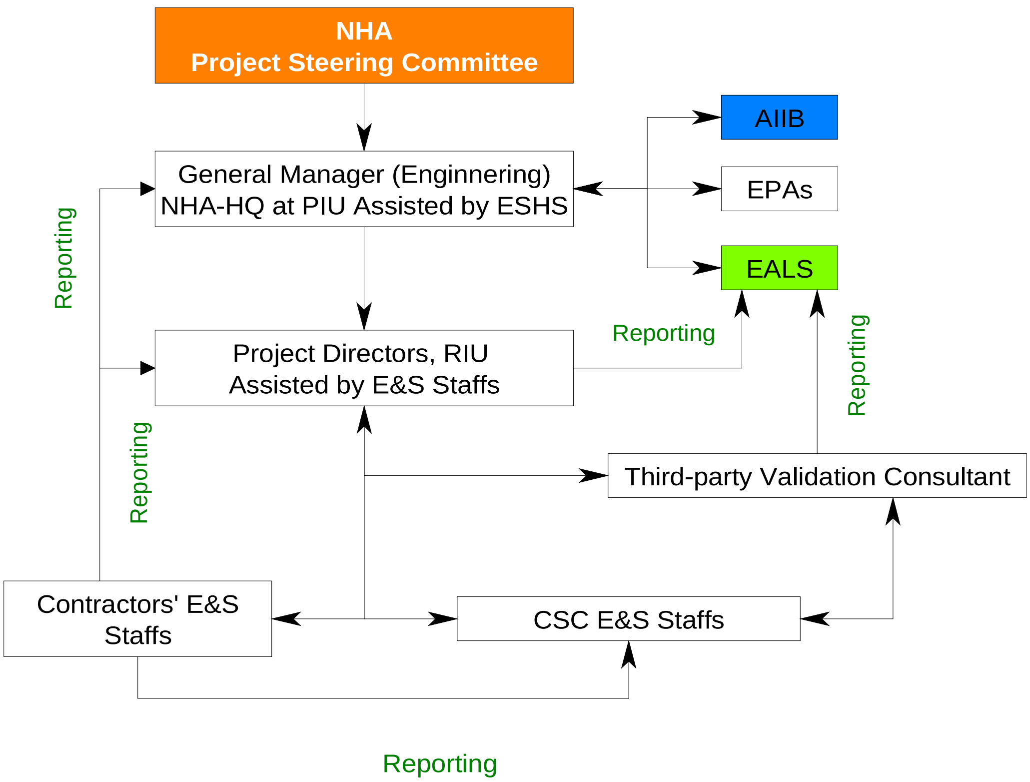

Figure 10-26: Organizational Setup for Implementation of E&S Instruments during Construction

10.8.4 Regional Implementation Unit (RIU)

The RIUs will be established at regional level offices, which will be headed by the Project Director (PD), an executive head of the concerned Project Section. He will be responsible for necessary administrative and financial decisions and actions for effective and timely implementation of the project as per the approved framework and implementation schedules. The PD will be responsible for overall implementation of the project including environmental and social management aspects at site. The PD-RIU will be assisted by E&S Staffs of the concerned project Section for the onsite administration and other matters with close coordination with ESHS of PIU-HQ. The following E&S staffs of RIU are proposed and will be at site during project implementation stage:

- Social and Resettlement Specialists (3 nos)
- Gender Specialist,
- Labor Specialist,
- Communication Specialist,
- OHS Specialists (4 nos, two for Section 2 and one each for Section 7 and 8)
- Environment Specialists (3 nos).

The E&S Staff at RIU will be responsible to monitor the compliance of E&S instruments during construction phase. The compliance will require monitoring of environmental, OHS, and social parameters and observations at the construction sites to evaluate compliance.

Furthermore, E&S Staff at RIU shall be responsible for:

- Regular site visits of the construction sites to review the environmental and social performance of the Contractor(s);
- Make sure that the Contractor is implementing the additional measures suggested by the CSC in environmental and social monitoring reports;
- Assist ESHS Section-PIU-HQ in the assessment of the livelihood loss and negotiation with the affectees for fixation of compensation to be paid for temporary impacts;
- Assist in checking genuine ownerships of the claimants, in consultation with the Revenue staff for prompt payment to the affectees;
- Assist the Contractor for the timely payments of negotiated prices;
- Assist Contractor(s) for obtaining necessary approvals from the concerned departments;
- Ensuring that the required environmental and social training is provided to the concerned site staff;
- Review contractor(s) monthly and quarterly monitoring and CSC progress reports of environment and social related activities;
- Report immediately within 24 hrs to PIU-HQ when environmental and social incidents (fatal and high potential) are occurred, while record of other incident and report will be the part of ES monitoring & Compliance; and
- Maintaining interface with the other lined departments/stakeholders in coordination with PIU-HQ.

10.8.5 Construction Supervision Consultant (CSC)

CSC will be responsible for the following tasks:

- Responsible for the supervision of RAP implementation;
- Supervise civil works, ensuring compliance with C-ESMP, OCHS Management Plan (OCHSMP), LMP, and all design parameters including quality requirements,

- Ensure Contractors include an EHS section in all Method Statements by addressing relevant EHS issues for each construction task,
- Supervise contractors implementation of C-ESMP and OCHSMP and address noncompliance through work observation, inspection, and audits,
- Conduct EHS trainings for Contractors, the Employer and CSC staffs,
- Provide input, advice and approve method statements relating to ESHS issues,
- Prepare monthly and quarterly reports and submit to RIU and PIU-HQ.

The EHS staffs of CSC along with the person-month proposed for each position are presented in **Table 10 -86**.

Table 10-86: Positions and proposed person-month of CSC

Sl.	Expertise	No. of Positions	Input (PM)	Total (PM)
A	**International Consultants**			
1	Int'l Environment, Health and Safety Specialist	1	30	30
	Subtotal (A)			*30*
B	**National Consultants**			
1	Environmental Specialists	3	30	90
2	Occupational Health and Safety Specialists	4	30	120
4	Social Specialists (including LAR, LMP and SEA/SH)	3	30	90
5	Communication Specialist	3	30	90
6	EHS Supervisors	12	30	360
8	Social Surveyors	4	30	120
	Subtotal (B)			0
	Total (A+B)			**900**

10.8.6 Contractor

Contractors will be responsible for the following:

- Preparation of C-ESMP with site specific mitigation plans for approval of CSC before mobilization.
- Preparation of Occupational and Community Health and Safety Management Plan based on construction methods, site specific hazards and guidance presented in Chapter 9.
- Implementation of C-ESMP and OCHSMP as well as mitigation, monitoring, and control measures proposed in the ESMP and OCHS Guidance.
- Prepare separate monthly reports for addressing environmental and social impacts and OCHS issues.

The following personnel are required in the contractor's environmental and social team:

- International EHS Manager
- Environmental Specialist (3 numbers)
- Social Specialist (SEA/SH, 3 numbers)
- OHS Specialists (7 numbers, 3 for Section 2 and 2 each for Sections 7 and 8)
- Community Liaison/Communication Officer (2 numbers)
- EHS Supervisors (14 numbers, 6 for Section 2 and 4 each for Sections 7 and 8)
- Flagman (9 numbers, 5 for Section 2 and 2 each for Sections 7 and 8)

- Medical Doctors (3 numbers with PMDC Licensed and all medical facilities including ambulance)
- Medical Technicians (4 numbers, 2 for Section 2 and 1 each for Sections 7 and 8)

The Contractor shall appoint one EHS Manager who shall be responsible for ensuring that the environment, health and Safety Management is adhered to the approved C-ESMP and OCHSMP. The EHS Manager shall be a graduate with at least a Bachelor Degree in OHS/engineering/ environmental management and have experiences of more than 15 years in environment, health and safety works in infrastructure construction. They will be suitably qualified and experienced persons acceptably fluent in the English language. They shall have obtained a vocational certification issued by NEBOSH (National Examination Board in Occupational Safety and Health), or Board of Canadian Registered Safety Professional or an equivalent certification. The EHS Manager or his designates (equally qualified) shall be available at Site on a 24h/day basis and their deputies shall carry out regular and random checks of all parts of the Site where work is taking place.

10.8.7 Third-party Validation (TPV) Consultant

The TPV will be carried out through independent E&S Specialists / Consultants (TOR are attached as **Annex 2 of ESMPF**). They will monitor the environmental and social parameters and conduct field surveys at the construction sites to evaluate compliance level. They will be engaged to conduct the external and independent monitoring of the implementation of the E&S instruments. This external monitoring agency is to conduct biannual and final evaluation of the E&S Instruments implementation and recommend changes if and when necessary to the ESHS Section.

Roles and responsibilities of TPV Consultant will be the following:

- Carry out independent monitoring at critical locations during construction phase and monitoring the implementation of E&S instrument at project area;
- Monitor GRM and resolution of complaints;
- Inform ESHS Section, NHA and AIIB of any significant impacts arising during construction; and
- Observe and amend/prepare (if required) of corrective action plans.

The TPV Consultant will carry out external monitoring on implementation of C-ESMP, LMP, OCHSMP, and will consist of the following team members on intermittent basis:

- Environmental, Health and Safety Specialist
- Social Specialist
- OHS Specialist
- EHS Supervisors - 2 numbers
- Social Surveyors - 2 numbers

10.9 Environmental and Social Management

10.9.1 Construction Stage Site Specific Management Plans

Contractor will be required to prepare site specific management plans and include in the C-ESMP along with the ECPs, prior to his mobilization and commencement of construction works, for approval of PIU-HQ and CSC. The key sub-plans are described below:

- **Material Transportation Plan** will be prepared by the contractor to prevent accidents during transportation by using motor-vehicles to the project sites and using other means. The plan should address specific details on the site conditions, the exact route to be followed and the conditions of the road. It is recommended that Contractor propose alternative routes for review and approval by the Engineer. A commitment must be made by the Contractor to repair the road to its original condition, if any local road is damaged due to the heavy loaded traffic of the Project.
- **Pollution Prevention Plan** will be prepared as part of C-ESMP and implemented by the contractors on the basis of the ECPs and WBG EHS Guidelines that will be part of the bidding documents. The Plan will be submitted to the CSC for their review and approval before contractor mobilization.
- **Construction Camp Management Plan** will be prepared as part of C-ESMP by the contractor based on ECP 14. The Plan will include the camp layout, details of various facilities including supplies, storage, and disposal. The Plan will be submitted to the CSC for their review and approval before camp establishment.
- **Emergency Preparedness Plan** will be prepared by the contractor after assessing potential risks and hazards that could be encountered during construction.
- **Communication Plan** to deal with the interaction of the community, complaints management, workers recruitment, notice of works and workers conduct with locals.

10.9.2 Mitigation Plan

The mitigation, safety inspections, and audit plans are the key element of ESMP to be prepared on the basis of impact and risk assessment described in Chapter 8. The Plan describes the potentially negative impacts and risk during construction and operation, lists mitigation and prevention measures to address the negative impacts and risks, and assigns responsibilities for implementation, prevention and monitoring and inspecting of these measures. The Mitigation and prevention Plan is given in **Table 10 -87**. Contractor will make sure they present the implementation status of mitigation and preventive measures identified in this Table in every monthly report, with quantifiable information.

Table 10-87: Mitigation, compensation, enhancement, and prevention plan

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
ESS1: Assessment and Management of Environmental and Social Risks and Impacts				
Cumulative impacts	• Mitigation measures include coordination between construction and local traffic under the monitoring of NHA to avoid major consequence.	Pre-bidding		PIU-HQ
Lack of appropriate E&S personnel with CSC, Contractors and the Borrower	• ESMP defines the education, qualification, training and experience requirements. • Recruit all personnel listed in the ESMP as per the requirements.	Pre-bidding process	Evaluation as per the requirements of ESMP	PIU-HQ
Inadequate implementation of C-ESMP, LMP, OCHSMP.	• Recruit qualified contractors who maintains environmental sustainability in corporate strategy. • Avoid contractors with poor environmental, health, and safety management. • Contractor's qualifications stated in the ESMP are included as the pre-qualification criteria in the short-listing process. • Ensure that the conditions of the ESMP is correctly reflected in	Planning prior to construction, implementation throughout. System review and re-planned for operations.	C-ESMP, LMP, OCHSMP.	Contractor, CSC, PIU-HQ, RIU

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	the contractor's bidding documents and the supervision consultant's TOR. • EHS bills of quantities are included in the specifications. • Education, qualification and training requirements of personnel are included in the bidding documents and considered by the supervision consultant when they give approval to the contractor. • Prepare Contractor's Environmental and Social Management Plan (C-ESMP), OCHSMP based on the ESIA. • Recruit qualified staffs to implement the C-ESMP and OCHSMP.			
ESS1: Labor and Working Conditions				
Labor management,	• Implement Labor Management Procedure (LMP)	Planning prior to construction, implementation throughout. System review and	LMP; Stakeholder engagement with workers Worker representation committees Supply chain analysis and	PIU-HQ, RIU, CSC, Contractor

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
		re-planned for operations.	due diligence procedure	
Working condition	• Mitigation measures include skill development, local employment, RIU-supervision for labor standards, worker training on GRM, a complaint box for reporting issues, and effective LMP compliance.	Throughout project lifecycle	LMP	CSC, RIU Contractor
Worker accommodations	• ECP 14: Construction Camp Management • ensure that the Contractors are following the labor standards, training for the workers on the existing GRM so they know their rights and responsibilities, and availability of complaint box allowing for workers to report any wrongdoings. • dedicated cleaning staff, routine checks of the conditions of the accommodations, penalties (to act as deterrent rather than with the intention for punishment) for workers are careless and	Throughout project lifecycle	Workers' accommodation plan and LMP	CSC, RIU Contractor

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	intentionally do not uphold the safety and hygiene standards. • Mitigation measures provided in LMP			
Child and forced labor	• Adding legal requirements in Contractor contracts that they must not employ underage workers, and positive identification before hiring. • The contractor will comply with the labor laws of the Country. • When souring for primary suppliers, the project will require such suppliers to identify the risk of child labor/forced labor and serious safety risks. The PIU-HQ and the consultants will review and approve the purchase of primary supplies from the suppliers following such risk identification/assessment. Where appropriate, the Project will be required to include specific requirements on child labor/forced labor and work safety issues in all purchase	Throughout project lifecycle	LMP	CSC, RIU, Contractor

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	orders and contracts with primary suppliers. In particular, NHA will require bidders to provide two declarations: a Forced Labor Performance Declaration (which covers past performance), and a Forced Labor Declaration (which covers future commitments to prevent, monitor and report on any forced labor, cascading the requirements to their own sub-contractors and suppliers).			
Risk of falling in water or drowning during bridge construction and maintenance over water	• Contractors will implement an OHS management plan with SOPs, job hazard analysis, method statements, training, and incident reporting. Work should be subcontracted to experienced firms, minimizing manual overwater tasks using mechanical equipment. Safety provisions include passive systems (fencing, guardrails, safety nets),	Construction	OCHSMP	CSC, RIU Contractor

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	worker rescue measures, safe transport, and mandatory life jackets.			
Occupational Health and safety	• Contractors will prepare and implement OHS management plan that would include standard operating procedures (SOPs) for all works, requirement of conducting Job Hazard Analysis and preparing Method Statements containing OHS aspects, traffic interface planning, working at height and hot work permit, barricading, OHS training requirements, incident recording and reporting protocols. • NHA will prepare a similar Plan/System for the operation phase.	Throughout project lifecycle	OCHSMP	CSC, RIU, Contractor
Safeguarding personnel, property and the risks from presence of a security force	• ECP 17: Construction and Operation Phase Security	Planning prior to construction, implementation throughout.	Security management plan	RIU in collaboration as deemed relevant with a security service provider and Contractor

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
ESS1: Resource Efficiency and Pollution Prevention and Management				
Land use change	• Mitigation measures would include proper land clearance planning, spoil management measures, vegetation clearance and erosion management, sediment management, design of storm water drainage in construction areas as well as design and implementation of site erosion control.	Design and procurement period	Comply with design requirements	CSC, RIU, Contractor
Landscape aesthetic	• Mitigation measures would involve careful siting of project components and improve landscape through plantations.	Design and procurement period	Comply with design requirements	RIU, CSC, Contractor
Air pollution	• Emissions management from construction vehicles, frequent spray of water on unpaved roads, and preventing the release of emission from burning waste materials. • Dust control measures would consist of proper construction materials planning, dust management planning, and water spraying where needed. • Prevent release of dust	Throughout construction and operation	Air quality management plan	CSC, Contractor, RIU

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	and emissions from burning waste materials, construction vehicles, and generators, and their management • ECP 1: Waste Management • ECP 2: Fuels and Hazardous Goods Management • ECP 7: Topsoil Management • ECP 9: Air Quality Management • ECP 13: Road Transport and Road Traffic Management			
Noise and vibration	• Noise and vibration management, organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise on the work site, use lower wattage flat lens fixtures that direct light down and reduce glare during the night, thus reducing light pollution. • Using noise control mechanisms (eg, noise canopy over generators and compressors) • Avoiding/minimizing	Throughout construction and operation	Noise and vibration management plan Air quality management plan	CSC, RIU, Contractor

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	noisy works during the night time as far as possible • Maintaining community liaison • Using light diffusers where necessary • ECP 10: Noise and Vibration Management			
Potential hazards caused by bitumen and other toxic chemicals	• Spills and leaks will be contained through appropriate means such as bunding. Chemicals and oils will be stored on cemented platform and in a covered area with spill containment arrangements. • A waste management plan will be developed to deal with the wastewater produced from construction sites and camps as well as a design for spillage control and wastewater treatment. • ECP 2: Fuels and Hazardous Goods Management	Throughout construction and operation	OCHSMP	CSC, Contractor, RIU
Spoil management measures	• ECP 1: Waste Management • ECP 7: Topsoil Management	Prior to construction	Spoil management plan	CSC,Contractor
Pollution associated with borrow	• Obtain and verify permits for borrow pits, regulate excavation	Throughout construction	Borrow material management	contractor RIU

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
pits	depth (1:4 slope), control soil erosion, prevent mosquito breeding, preserve topsoil for vegetation, use pits for waste disposal, and ensure safety with fencing and access restrictions. • ECP 9: Borrow Areas Development & Operation			
Wastewater from construction camps and other site facilities	• Avoid storing liquids where there is a high risk of water pollution or land contamination (e.g., on bare ground or unsealed surfaces, next to drains, creeks etc.). • Proper waste disposal system is to be implemented to minimize pollution • All fuel, oils, chemicals, hydraulic fluids, on-site toilets etc. must be stored in the construction site compound which shall be bunded • Optimize use of resources (oil, water, etc.) to minimize the amount needed • Make incidence reporting a priority in case of spills and leaks	Prior to construction; During construction	Design Waste management plan	RIU, contractor and designers

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	• Train staff to recognize spills and the appropriate measures to take • Keep continuous inspection for leaks prior to each construction activity (e.g., concrete pouring) • All pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents, etc. for outfalls must be completed in dry weather • Locations where concrete or other wet materials are to be used, bunded steel decks must be used to capture any spilled concrete, alkaline water displaced from inside tubular steel piles or spilled sealants or other materials • The fueling equipment should be equipped with breakaway" hose connections that provide emergency shutdown of flow in case of failure of connection.			

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	• Absorbents should be present at places of refueling. • All camps and other facilities will have appropriate effluent treatment and disposal mechanism • Regular monitoring of water quality near Project Area • ECP 1: Waste Management • ECP 3: Water Resources Management • ECP 14: Construction Camp Management			
Stormwater in construction areas	• ECP 1: Waste Management • ECP 4: Drainage Management • ECP 3: Water Resources Management • ECP 14: Construction Camp Management	Prior to construction	Design	RIU, contractor and designers
Site erosion	• ECP 5: Soil Quality Management • ECP 6: Erosion and Sediment Control • ECP 7: Topsoil Management	Prior to construction Throughout construction period	Design Sedimentation and erosion control plan	RIU, contractor and designers
Leaks and spills	• ECP 1: Waste Management • ECP 2: Fuels and Hazardous Goods	Design prior to construction .	Design Spill management plan	RIU, contractor and designers

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	Management • ECP 3: Water Resources Management	Throughout construction period.	Traffic management plan Water resources management plan Construction traffic management plan	
Safe drinking water	• ECP 3: Water Resources Management	Throughout project	Water resources management plan	contractor; RIU
Stockpiling arrangements and pollution prevention	• ECP 1: Waste Management • ECP 2: Fuels and Hazardous Goods Management • ECP 3: Water Resources Management • ECP 7: Topsoil Management	Construction	Ecological management plan within the ESMMP spill management plan water resources management plan waste management plan	contractor
Solid waste management	• Implement waste management system to avoid, minimize, reduce and reuse waste including defining material ordering, use and handling measures. Moreover, waste	Throughout construction and operations	Waste management plan	contractor

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	material storage areas, borrow pits and materials laydown areas should be carefully designed and sited. Appropriate measures should also be introduced for materials storage, handling and use. • Introduce measures for waste segregation where applicable • Define storage and transportation requirements for various types of wastes • Define final disposal arrangement/location for various types of wastes • ECP 1: Waste Management • ECP 2: Fuels and Hazardous Goods Management			
Measures for materials storage, handling and use	• ECP 1: Waste Management • ECP 2: Fuels and Hazardous Goods Management	Throughout construction and operations	Materials management plan	contractor
Re-use construction material	• ECP 1: Waste Management	During design and construction	Materials management plan	contractor
Traffic managemen	• Mitigation measures include road condition	Construction	Traffic management	contractor

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
t including Speed restrictions; Vehicle monitoring; Trained drivers and licensed contractors, road maintenance; Designated crossing points; on site traffic management; Minimize vehicle journeys and fuel consumptions; and accident action planning	surveys, controlling vehicle movement, final road routing, and ensuring proper road maintenance. • The contractor will prepare and implement a traffic management plan that would include drivers' training in defensive driving techniques, speed control, placement of flagmen where needed (eg, along the populated areas and markets), placement of sign boards, liaison with the community and increasing community awareness regarding project related traffic. • ECP 13: Road Transport and Road Traffic Management		plan	
Operational phase traffic management	• ECP 13: Road Transport and Road Traffic Management	Operations	Traffic management plan	RIU
Structural adaptation measures - Adding flexibility and low regret climate adaptation	• Locate camp on higher and stable ground • Design access roads with consideration of flood and drought risks • Provide shading, insulation and ventilation at work sites	Detailed design	Design	RIU and contractor

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
measures for dealing with floods, droughts, heatwave events	• Locate transmission line towers and their foundations out of known flood zones and avoiding steep slopes if possible • For transmission towers and their foundations, increase concrete mix/strength to be more resilient to flood, drought, heat and lightning strikes • Insulate and protect critical service infrastructure • Adapt traditional construction materials to withstand higher temperatures • Include debris screens for drainage systems, additional construction joints to allow for more thermal expansion, slope protection / stabilization measures and monitoring			
Climate resilience decision making	• Use an adaptive management and systems approach with regards to operating regime • Include monitoring, evaluation and reporting requirements in this plan or through other	Construction	Climate risk management plan (with guidance from IHA Hydropower Sector Climate Resilience	RIU

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	management plans.		Guide 2019)	
Temporary flood reduction measures	• Store temporary flood barriers for deploying in a storm/heavy precipitation event. • Prepare temporary additional drainage and temporary debris screens • Plan for increased road drainage, and road surfacing on temporary/ unsurfaced roads • Revise construction schedule during extreme flood event	During construction	Climate risk management plan (following IHA Hydropower Sector Climate Resilience Guide 2019)	contractor
ESS1: Community Health and Safety				
Community Health and Safety Risks in the Communities close Proximity of the Project; labor influx; SEA/SH risks	• Mitigation measures would include performing medical screening and requiring proof of vaccination prior to any employment. Moreover, the contractor should conduct induction training or workshops to introduce the basics of health and hygiene and the necessary preventive measures against them. • Vaccination programs can also be organized in the camp and any positive cases of COVID-19 should be	Throughout project lifecycle	Community health and safety plan	RIU Contactors

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	dealt with diligently. • Establish workers' camps separated from local communities with strict protocols for interaction with local communities in order to avoid project impacts from labor influx. • Contractor will develop a Code of Conduct (CoC) for all site personnel. All site personnel will sign this CoC and will abide by it. • Project staff will receive training on the prevention of SEA/SH. Engagement of skilled trainers to raise awareness among project workers of the risks, expected behaviors, and consequences of violations, communicated through training, and publicized codes of conduct. It may also be important to raise awareness of the risks among community members and local health authorities and inform them about available grievance mechanisms.			

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	• Arrange and support local organizations and/ or government initiatives on community STD education, prevention, and treatment programs. • Extensive training for awareness raising strategy which describes how workers and local communities will be sensitized to SEA and SH risks, and the worker's responsibilities under the CoC • The routes/places used by the women will be avoided as far as possible. If unavoidable, alternate routes will be identified for the communities, if required, especially along routes frequented by women folk, such as route to the local well or water source. • Construction crew will avoid entering villages and settlements. • Communities will be informed and consulted before commencing works inside or near the communities.			

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	• Provision related to SEA/SH will be incorporated in the bidding document, • Identification and mapping of the service providers.			
Management of project-induced influx and local community effects from availability of short-term salaries	• Compile influx management strategies incorporated across the employment and procurement policy, stakeholder engagement plan, community health and safety plan, community investment plan and security plan into this plan. • Identify additional actions as required, for instance ring fence community investment funds for spatial planning or support for local initiatives to address greater demand for community and infrastructure, hold influx forum every year during construction, support counselling services in response to known anti-social behavior (including gender-based violence), and support financial	Planning prior to construction, implementation throughout. Plan updated for operations if risk assessment indicates ongoing influx.	Influx management plan	RIU Contractor

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	management awareness services.			
Traffic Management; Traffic and Road Safety	• Mitigation measures include road condition surveys, controlling vehicle movement, final road routing, and ensuring proper road maintenance. • The Contractor will prepare and implement a traffic management plan based on the recommendations made by the road safety study (separately carried out for N5) that would include drivers' training in defensive driving techniques, speed control, placement of flagmen where needed (e.g., along the populated areas and markets), placement of sign boards, liaison with the community and increasing community awareness regarding project related traffic. • ECP 13: Road Transport and Road Traffic Management	Construction	Traffic management plan	contractor
Training on human rights	• Train managers and key staff in anticipated interactions between the project and human	All phases	ESMP; LMP	RIU

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	rights issues to embed the project's commitments on delivering on human rights policies and procedures			
Emergency Preparedness and Response	• Preparing an emergency preparedness and response plan (EPRP) by the Contractor at site level as part of the OCHSMP and by NHA at the Project level to contain larger emergencies. • NHA will work with the local authorities to coordinate with the national emergency response network in the areas of influence and to ensure implementation of the project specific emergencies and make arrangements with external emergency services (Fire, ambulance, etc.), if the resources available with the Contractor is not sufficient to contain an emergency.	Design, pre-construction, construction, and throughout project lifecycle	Emergency Preparedness and Response Plan	RIU Contractor
ESS 1: Biodiversity, Conservation, and Sustainable Management of Living Natural Resources				
Losses of	• Mitigation measures	Operation	ESMP	RIU and

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
trees and terrestrial habitat due to land clearance	include minimizing land clearance, restricting activities to designated areas, and properly planning camps, machinery movement, and temporary roads to protect vegetation. • Construction camps should be established in areas with little to no vegetation, and alternate routes for access and diversion road should be chosen to avoid environmental impact. • Camp locations will be selected to minimize environmental effects, reduce costs, and limit land use. • Compensate each tree with 10 trees planted with a total of 83,900 saplings, through a plantation enhancement program. • ECP 5: Soil Quality Management • ECP 6: Erosion and Sediment Control • ECP 7: Topsoil Management • ECP 8: Topography and Landscaping • ECP 11: Protection of			Contractors

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
	Flora • ECP 12: Protection of Fauna			
Habitat rehabilitation and restoration	• Include habitat rehabilitation and restoration on the sites affected temporarily by construction (these are unknown at this stage). The nature and areas of habitats to be restored on these sites will be determined following stakeholder consultation led by the RIU.	Implement immediately after construction	Ecological management plan within the ESMMP (Vegetation removal and restoration plan within this)	Led by RIU with contractor implementation support
Killing or injury of species	• introducing and enforcing speed limits for vehicles. • A hunting ban imposed on Project staff alongside other standard mitigation for road safety and habitat clearance. • ECP 11: Protection of Flora • ECP 12: Protection of Fauna	Throughout project lifecycle	Ecological management plan within the ESMP (Wildlife rescue and relocation plan within this)	contractor
ESS1: Stakeholder Engagement and Information Disclosure				
Stakeholder engagement carried out in a meaningful and inclusive way, providing	• Detailed measures available in Stakeholder Engagement Plan	Stakeholder engagement plan (current version developed as part of this ESIA)	Stakeholder engagement framework in ESMS Stakeholder Engagement Plan	RIU, possibly with support of a communications

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
access to remedy		Implementation prior to construction, during construction and operations		company
Data security policy	• Prepare and implement a data security policy to ensure secure handling of personal data by the project	All phases	Data security policy	RIU
ESS 2: Land Acquisition and Involuntary Resettlement				
Resettlement of affected people	• Fair and timely compensation will be provided, through stakeholder engagement and livelihood restoration. The RAP will include a recovery plan with ongoing monitoring. Income loss assessments will be updated as needed. Awareness programs will inform affected individuals about project benefits, land acquisition, and compensation. • Implement Resettlement Action Plan	Project preparation and implement stage	RAP	RIU
Temporary Land	• Construction camps will be on acquired land; if	Prior to the mobilization	RAP	RIU

Impacts and Risks	Details of mitigation/enhancement measure	Implementation timing	Implementation method	Responsibility
Acquisition	not feasible, leased through direct agreements without LAA, 1894 applicability. Camps will be 500m from settlements and cultural sites, with an approved management plan. Waste or barren land at higher elevations will be prioritized to reduce environmental impact.	of main Contractor		

10.10 Plans to Address Project Impacts and Risks

Five ESMP Subplans have been proposed to address direct project and cumulative impacts, to guide environmental and social management procedures and the implementation of prescribed mitigation and enhancement measures during the construction and operational phases of the Project. This section will be further updated when engineering design is finalized. The following sub-plans have been proposed under the Project to be implemented by the Contractor and RIU:

10.10.1 Tree Plantation / Reforestation Plan

The basic purpose of afforestation/plantation of suitable species in the Project area is to reduce the risk been made due to different construction activities for the proposed Project. The expected risk made will be compensated by planting of saplings to enhance green cover and improve the overall environment of the area. Afforestation will not only reduce the risk been made but will also increase the green cover, carrying capacity and aesthetics of the area along with many positive aspects and impacts.

Plantation will be done after the construction work immediately. Plantation of indigenous trees species is highly important to maintain the biodiversity and ecological balance. It is also important to prevent global warming, soil erosion and pollution. Afforestation purifies the environment and helps in reducing the carbon dioxide level. Along with the importance of construction, the afforestation activity will further help in enhancing the socio-economic condition of the area and Project sustainability.

The Forest Department KP, Sindh, Punjab and Capital Development Authority Islamabad may be engaged for carrying out the proposed activates. The details are attached as Annex 10-2. Maintenance of the plantation will be responsibility of NHA Afforestation Department.

10.10.2 Project Induced Labor Influx Management Plan

The plan is to recruit one Contractor for the entire project and they may develop four or more construction facilities – two for Section 2, one each for Section 7 and 8 of and the second one for Site 2. The project expects to involve direct workers, contracted workers and primary supply workers. It is estimated that approximately 2,500 direct jobs are expected to be created during the construction phase (625 skilled and 1,875 unskilled or low skilled), and 50 in the operations phase (35 skilled and 15 unskilled). Most unskilled positions are likely to be sourced from the local districts and neighboring communities, thereby sharing project benefits with communities. Many of the workers are expected to be employed from the existing highway reconstruction projects, therefore, reducing new workers coming into the area.

The construction work, with the promise for more development in the project locations – particularly in selected central places/markets, may further attract diverse groups of in-migrants, namely, families/followers, traders/entrepreneur, small business/shop owners, suppliers of construction-related materials and various other service providers will move into the area to benefit from the project construction for more than two years period. This may lead to potential negative socio-cultural impacts, including a wide range of concerns such as gender-based violence, sexual exploitation and abuse of women/children, generating tensions between the local residents of the remote and isolated and rather conservative communities and the in-migrant groups.

The Contractor will prepare a labor influx management plan in line with AIIB's guidelines, covering measures or strategies to (i) raise awareness and engage all stakeholders (e.g., project management, contractors, consultants, community groups/leaders, local NGOs) in responding to the social and cultural risks to local communities; (ii) inter-cultural understanding with a view to minimize the risks; (iii) better management of construction and labor camps; (iv) development and implementation of code of conduct for locals and in-migrant workers (for instance, respect to local values and cultures; workers strictly forbidden to establish contacts and relationship with local women; workers must not leave camps without prior permission from the supervisors; and workers or local resident must report any suspicious contact or activities to the camp officers); and (v) improvement in local law and order to ensure positive environment and build a community of mutual trust and respect for project construction.

10.10.3 Chance Find Procedure

The purpose of these guidelines is to address the possibility of archaeological deposits, finds and features becoming exposed during earth removing and ground altering activities associated with the construction and to provide procedures to follow in the event of a chance archaeological find. The chance find procedure of archaeological deposits is attached as Annex 1 of the ESMPF.

10.10.4 Skill Development Plan for Employment with the Contractor

Due to the high unemployment rate in the country, communities who are affected by the Project due to the resettlement for project implementation will come to the Contractors and implementing agency with the demand to be employed in the Project, this was echoed during community consultation as well. Most of them are unskilled and has no experience in infrastructure project. Therefore, Contractor will be reluctant to employ them at the beginning in the construction activities. This can cause protest and agitations in the project area and often lead to Contractors' work stoppages and extreme delay in project implementation. It is recommended that one-week job specific skill development training should be provided with pay to the community members prior to their employment. Some training can be outsourced to the recognized national or provincial institutions. Certificates should be provided to the participants after completion of the training. The training should be hands-on and specific to the job, e.g., Truck and car driver, Catering staff, Cement finisher, Scaffolder, Security staff, Electrician, asphalt sprayer, etc. This will bring two prong benefits, one in the development of skills in the country and the second one in quick project implementation. The skill development will cost about $150,000 and will be included in the Contractor's contract.

In addition to the job specific training, the Contractor will provide training in the following areas:

(a) Communication Skills

Communication forms the backbone of almost any construction project. Whether it is to present an idea to the supervisor or foreman, discuss an alternate plan when construction hits a snag, or even just request new supplies, communication is important to making sure the project stays on track. The Contractor will always prefer construction workers who already have this soft skill; therefore, a good communicator will pay off the construction site by this skill.

(b) Teamwork Skills

Construction workers have to work in teams. Teamwork skills help get the job done. Much like good communication skills keep everyone on the same page, good teamwork skills allow everyone to work together in a harmonious way. The job stays on track and will likely be finished sooner if everyone works together.

(c) Time Management Skills

Time management skills are incredibly important for construction workers in any number of roles. Construction work has deadlines to meet. Some tasks are time-sensitive (e.g., concrete creeping). Delays are very common on the sites of construction projects. Contractor needs workers who can manage their time effectively. Contractor needs workers who know how to prioritize and reorganize their schedules when faced with unexpected delays.

(d) Technical Skills

Specific construction skills include manual and mechanical excavation, stone-laying, pouring cement, erecting and installing specific types of equipment. Contractors typically appreciate versatile workers who can take on additional tasks as needed. Construction tasks may include:

(i) Electrical
(ii) Framing
(iii) Concrete
(iv) Panel assembly work
(v) Environmental codes
(vi) Reading and interpreting drawings
(vii) OSHA safety requirements
(viii) Erecting
(ix) Crane and Rigging
(x) Operation of Construction equipment
(xi) Use of Power tools

(e) Occupational Health and Safety at Worksite

Construction industry comes next to agriculture and cotton industry in providing jobs in Pakistan; though it is the third largest source of livelihood, it is highly informal and unorganized, with unskilled and semi-skilled workers. These workers, mostly migrants, fall into the trap of contractors and middlemen and lose their jobs and a decent life. The only way to reconstruct their lives is by training them in functional skills and equipping them with safety and health information at the earliest. In fact, such intervention can be effectively carried out on the construction premises itself with bare minimum infrastructure.

The classroom training apart from technical aspects also has soft skill trainings focusing on the social and behavioral habits of the trainees, including health, sanitation and safety to bring significant improvements in their worldview and way of life. Such skill trainings will help construction worker to gain self-confidence. Once they undergo the trainings, raw/unskilled workers look forward to handling semi-skilled jobs and semi-skilled workers to jobs requiring skilled manpower. As a result, Wage Enhancement is almost assured for all of those undergoing such trainings. These trained workers can then pursue semi-skilled jobs in the middle-east.

10.11 Environmental and Social Monitoring

Environmental and Social monitoring provides timely and useful information to the Project management and implementation agencies. Conceptually, "monitoring" means to check and balance, on a regular basis, the status of the Project activities and realization of various developmental targets during E&S preparation, pre-construction, construction and O&M. It helps in timely identification / analysis and removal of the bottlenecks and expedites actions. Certain environmental parameters (physical, ecological and social) are selected and quantitative analysis is carried out. The results of analysis will be compared with the guidelines; standards and pre-Project condition to investigate whether the ESIA/ESMP and its implementation are effective for the mitigation of impacts or not. The objectives of environmental and social monitoring plan during the pre-construction, construction and O&M phases will be as follows:

- Monitor the actual Project impacts on physical, ecological and socio-economic receptors;
- Recommend mitigation measures for any unforeseen impact or where the impact level exceeds the anticipated level in the ESIA/ESMP;
- Ensure compliance with legal and community obligations including safety during construction and O&M phases;
- Ensure the safe disposal of excess construction materials, solid waste, water and wastewater and gaseous emissions;
- Appraise the adequacy of the ESIA/ESMP with respect to the Project's predicted long-term impacts on the area's physical, ecological and socio-economic environment;
- Evaluate the effectiveness of the mitigation measures proposed in the ESIA/ESMP and recommend improvements in ESIA/ESMP, if required; and
- Compile periodic incidents / accidents data to support analyses that will help to minimize future risks.

PIU-HQ and RIU of NHA will be responsible for all the monitoring activities (compliance monitoring and effect monitoring). All the findings and results in the form of monitoring report will be finally shared with respective EPA as well as AIIB as per the reporting mechanism.

10.11.1 Compliance Monitoring

The compliance monitoring of the proposed Project activities is principally a tool to ensure that the environmental and social control measures identified are strictly adhered to during the Project execution. The compliance monitoring will be conducted by the E&S Staff of SC. Various aspects of the ESIA/ESMP compliance monitoring will be to:

- Systematically observe the activities undertaken by the contractor(s) or any other persons associated with the proposed Project;
- Verify that the activities are undertaken in compliance with the ESIA/ESMP;
- Document and communicate the observations to the CSC and E&S staff of RIUs, so that any corrective measures, if required, can be taken in a timely manner;
- Maintain a record of all incidents of environmental and social significance and related actions and corrective measures;
- Maintain contact with the communities, solicit their views and concerns, and discuss them during the monthly meetings; and
- Prepare periodic reports of the environmental and social performance of proposed Project.

10.11.2 Effect Monitoring Strategy

The ESIA/ESMP anticipates the impacts of the proposed Project on the basis of information available at the time of conducting the assessment and the natural processes that link various environmental and social parameters. Based on assessment, mitigation measures are introduced such that the predicted residual effects do not exceed acceptable levels. Consequently, it is possible that even if the mitigation measures are implemented fully, the negative impacts of the Project could exceed predicted levels or acceptable limits. In order to address the above concerns, effects monitoring will be undertaken during the Project activities, with the overall objective of proper management of environmental and social risks and uncertainties. Broadly, effects monitoring has the following objectives:

- To verify that the impacts of the proposed Project are within acceptable limits, thus establishing credibility (public assurance);
- To immediately warn the PIU-HQ and RIU of unanticipated adverse impact or sudden changes in impact trends so that corrective actions can be undertaken, which may include modifications in the proposed activities, or the inclusion of modified or additional mitigation measures;
- To provide information to plan and control the timing, location, and level of certain Project activities so that the effects are minimized; and
- To facilitate research and development by documenting the effects of the proposed Project that can be used to validate impact-prediction techniques and provide a basis for more accurate predictions of future projects.

The contractor(s) is mainly responsible for effect monitoring, which is being supervises by the CSC and monitor by RIUs at each site, and for the entire Project. The effect monitoring program has been designed carefully considering the identified impacts and some additions or deletions probably in frequency may be taken up in this program after learning lessons from one-year operation of the Project through Change Record Register. Table 10 -88 provides environmental and social effect monitoring schedule for pre-construction, construction and operations stages of the proposed Project.

Table 10-88: Monitoring Plan as per ESSs

Sl.	Parameters / Receptor	Monitoring Parameters / Performance Indicator	Location[17]	Monitoring Mechanism	Monitoring and Reporting Frequency	Responsibility	
						Implementation	Monitoring
1.	Water Resources/ Water Quality	Monitoring of all parameters of effluent from construction sites as per stringent environmental quality standards.	Proposed Project routes. • Major receptor, i.e., residential areas etc. within the RoW/ AoI. However, estimated sampling points will be verified at construction stage. Other proposed effluent discharge points are: • Contractors camps • Concrete preparation plants • Fuel (Petrol. Oil and Grease) products storages. • Vehicle and machines repairing and	Visual checks of laboratory activities Discrete grab sampling and laboratory testing of water samples by Concerned EPA approved Laboratory for monitoring.	• Once before the start of construction by activity monitors and reported; and • On quarterly basis during the construction. • Bi annual during O&M Phase	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase

17 Locations will be refined during ESIA stage.

Sl.	Parameters / Receptor	Monitoring Parameters /	Location	Monitoring Mechanism	Monitoring and Reporting	Responsibility	
						Implementation	Monitoring
			servicing yards.				
2.	Drinking Water	Monitoring of all parameters of drinking water as per stringent environmental quality standards.	Proposed Project routes. • Major receptor i.e. construction site, camps area and nearby residential areas within the RoW/AoI. However, estimated sampling points will be verified at construction stage.	Visual checks and monitoring of laboratory activities Discrete grab sampling and laboratory testing of drinking water samples by Concerned EPA approved Laboratory for monitoring.	• Once before the start of construction by activity monitors and reported; and • On quarterly basis during the construction. • Bi annual during O&M Phase	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
3.	Soil Contamination	Soil contamination, uncontrolled solid waste disposal activities at sites.	Proposed Project routes. • Sites with severe contamination. Other proposed sampling sites are: • Construction Camp. • Equipment washing yards. • Spillage points of fuel, chemicals and lubricants.	Visual observations and checks of laboratory activities Sampling and laboratory testing for soil samples.	• Once before the start of construction by activity monitors and reported; and • On quarterly basis during the construction. • Bi annual during O&M Phase	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
4.	Land	Land use	Proposed Project	Random visits	• Once before	• Contractor	• Compliance

Sl.	Parameters / Receptor	Monitoring Parameters /	Location	Monitoring Mechanism	Monitoring and Reporting	Responsibility	
						Implementation	Monitoring
	Resources	change.	routes. • Sites with significant land use change.	and visual observations of land use change.	the start of construction by activity monitors and reported; and • On quarterly basis during the construction. • Bi annual during O&M Phase	during Pre-Construction and Construction Phase • NHA during O&M Phase	monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
5.	Dust Emissions	Monitoring of PM_{10} $PM_{2.5}$ as per stringent environmental quality standards	Proposed Project routes. • Sensitive receptors within the RoW/AoI, construction site, camps area. Estimated sampling points will be verified during construction stage.	Visual checks and monitoring of laboratory activities Onsite Ambient Air Monitoring equipment	• Once before the start of construction by activity monitors and reported; and • On quarterly basis during the construction. • Bi annual during O&M Phase	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
6.	Noise Pollution	Day and night time noise monitoring in dBA Leq. as per stringent environmental	Proposed Project routes. • Sensitive receptors within the RoW/AoI. Estimated	Visual checks and monitoring of laboratory activities Monitoring of	• Once before the start of construction by activity monitors and reported; and	• Contractor during Pre-Construction and Construction Phase	• Compliance monitoring lies with CSC and RIU during Construction

Sl.	Parameters / Receptor	Monitoring Parameters /	Location	Monitoring Mechanism	Monitoring and Reporting	Responsibility	
						Implementation	Monitoring
		quality standards	sampling points will be verified during construction stage. Other proposed sampling sites are: • Construction camps. • Equipment yards.	noise level at site.	• On Monthly basis during the construction (spot measurement regular daily basis keeping in view the day to day application of different heavy noise causing equipment by the contractor). • Bi annual during O&M Phase	• NHA during O&M Phase	Phase • NHA during O&M Phase
7.	Fumes and gases	Monitoring of CO, CO_2, SOx, NO_x, HC and $PM_{2.5}$ PM_{10} and compliance with stringent environmental quality standards Vehicular emissions as per stringent environmental quality standards.	Proposed Project routes. • Major receptors within the RoW/ AoI. Estimated sampling points will be verified during construction stage. • Emissions from the silencers of heavy machinery, trucks and other	Visual checks and monitoring of laboratory activities Onsite monitoring of ambient air quality will be preferred.	• Once before the start of construction by activity monitors and reported; and • On quarterly basis during the construction. • Bi annual during O&M Phase	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase

Sl.	Parameters / Receptor	Monitoring Parameters /	Location	Monitoring Mechanism	Monitoring and Reporting	Responsibility	
						Implementation	Monitoring
			vehicles.				
8.	Ecological Resources	Disturbance to natural habitat and fauna, uncontrolled floral cutting which can be avoidable.	Proposed Project routes along the RoW/AoI.	Visual checks to ensure that only marked trees are cut within the Project corridor. Monitoring of Wildlife / birds hunting. Inventory of existing trees, cut trees, and planted trees.	• Once before the start of construction by activity monitors and reported; and • On quarterly basis during the construction. • Bi annual during O&M Phase	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
9.	Public Infrastructure	Disturbance or damage to public infrastructure	Proposed Project routes. • Public infrastructures within the RoW/ AoI. These structures will be verified prior to the start of construction.	Random visits and consultations with vulnerable.	Prior to the start of construction. Reporting will be done on the basis of RAP recommendation.	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
10.	Community around the Project corridor	Use of common resources. Hindrance to mobility. CHS	• Communities within the RoW/ AoI.	Community consultations.	Prior to the start of construction and during the construction stage. Reporting will be done on the basis of RAP recommendation.	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
11.	Waste	Inspection of	• Main Project	Visual	• Review the	• Contractor	• Compliance

Sl.	Parameters / Receptor	Monitoring Parameters /	Location	Monitoring Mechanism	Monitoring and Reporting	Responsibility	
						Implementation	Monitoring
	Management	waste and spoil disposal in accordance with Waste Management Plan	area (RoW) • Construction camps and Offices. • Equipment yards. • Other Project allied facilities	Observations, Monitoring and Audits	waste management stream before start of the Project; • Monitoring and reporting on monthly basis during the construction stage; • Bi annual during O&M Phase	during Pre-Construction and Construction Phase • NHA during O&M Phase	monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
12.	Labor Management and Working Conditions	As per the LMP of which include but not limited to OHS, hygiene facilities, appropriate camps area, etc.	• Main Project area (RoW) • Construction camps and Offices. • Equipment yards. • Other Project allied facilities	Visual Observations, Incident/accident register Monitoring and Audits ,	• Monitoring and reporting on monthly basis during the construction stage; • Bi annual during O&M Phase	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
13.	Traffic Safety and Management	As per the TMP of ESIA / ESMP which include but not limited to the observation of traffic congestion at bottleneck areas,	• Main Project area (RoW and AoI) • Construction camps and Offices. • Equipment yards.	Visual Observations, Vehicle Log Books, Monitoring and Audits	• Monitoring and reporting on monthly basis during the construction stage. • Bi annual during O&M	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during

Sl.	Parameters / Receptor	Monitoring Parameters /	Location	Monitoring Mechanism	Monitoring and Reporting	Responsibility	
						Implementation	Monitoring
		provision of signs and signal, vehicular inspection, driving safety protocols, etc.	• Other Project allied facilities		Phase		O&M Phase
14.	Social aspects including GBV and other Grievances	Social and cultural conflicts, SEA/SH complaints, grievances related to livelihood impacts, child abuse, etc.	• Main Project area (RoW and AoI) • Construction camps and Offices. • Equipment yards. • Other Project allied facilities	Visual Observations and consultations, Grievance Redress/Social Complaint Register, Monitoring and Audits	• Monitoring and reporting on monthly basis during the construction stage; • Bi annual during O&M Phase	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
15.	OHS, CHS, accidents and incidents	As per Chapter 9 OCHS which include but not limited to the unsafe acts and conditions, work permits, provision and availability of mandatory PPEs, Community complaints on OCHS, incidents and injuries, illnesses, trainings, TBTs,	• Main Project area (RoW and AoI) • Construction camps and Offices. • Equipment yards. • Other Project allied facilities	Visual Observations and consultations, Grievance Redress/Social Complaint Register, Incident/accident register, Monitoring and Audits	• Monitoring and reporting on monthly basis during the construction stage • Bi annual during O&M Phase	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase

Sl.	Parameters / Receptor	Monitoring Parameters /	Location	Monitoring Mechanism	Monitoring and Reporting	Responsibility	
						Implementation	Monitoring
		walk-through-inspections, etc.					
16.	Chemical Storage and Handling	Safety Data Sheets, Leakage and spills, Segregated handling and storage of chemicals, availability of fire extinguishers.	• Main Project area (RoW and AoI) • Construction camps • Equipment yards. • Other Project allied facilities	Visual Observations, Chemical Storage inventory, Incident/accident register, Monitoring and Audits	• Monitoring and reporting on monthly basis during the construction stage • Bi annual during O&M Phase	• Contractor during Pre-Construction and Construction Phase • NHA during O&M Phase	• Compliance monitoring lies with CSC and RIU during Construction Phase • NHA during O&M Phase
17.	Land Acquisition and Resettlement	As per Entitlement Matrix of RPF and RAP	• Within the proposed project construction limits	As per RAP	• As defined in RAP	• NHA	• TPV (External Monitor)

10.12 Grievance Redress Mechanism

NHA will establish a Grievance Redress Mechanism (GRM) to effectively address community complaints and grievances. The GRM for this project will follow a three-tiered structure:

- Community/Local Level Grievance Redress Committee (GRC)
- Project Implementation Unit (PIU) Level GRC
- Project Management Unit (PIU-HQ-NHA) Level GRC

In addition to these GRCs, Gender-Based Violence (GBV) Committees will be established and formally notified within the PIU-HQ/RIU to handle issues related to GBV, Sexual Exploitation and Abuse, and Sexual Harassment (SEA&SH). These committees will be gender-sensitive, ensuring that women can safely register grievances related to compensation, movement restrictions during construction, privacy concerns, GBV, or other project-related issues. The committee will facilitate and support affected women in lodging complaints and ensuring resolution.

For project workers, the PIU-HQ-NHA, supervision consultants, and contractors will establish a separate GRM (or integrate provisions into the overall GRM) to address labor and workplace-related concerns in compliance with national and provincial laws and Asian Infrastructure Investment Bank (AIIB) Environmental and Social Framework (ESF) requirements before the project becomes effective.

Detailed functions and responsibilities of each GRC, GBV Committee, and Worker GRM are outlined in the Stakeholder Engagement Plan (SEP) of this project.

10.13 ESMP Trainings

It is proposed that training programs be implemented during the Project life cycle to ensure all staff receive the required training in both general and job-specific issues. Trainings should be provided to all new recruits and continual refresher courses should be established for the existing staff. The implementation of the E&S training would help ensure that the requirements of the ESIA and ESMP are transparent to all project personnel and they are followed accordingly throughout the project lifespan. Moreover, the training programs would also ensure that all site personnel are well aware of their work responsibilities for instance, the environmental and social requirements of the Project and how they will be implemented and monitored on site. They will also be introduced to the potential impacts and risks of the Project, including the mitigation and control measures that have adopted to address those impacts and risks as well as where to implement the appropriate measures. Additionally, the trainings would lead the staffs to be well aware about the roles of NHA, the Engineer and the Contractor when it comes to environmental and social issues. Each organization will be responsible to provide training to their own staffs before the start of the Project and also during the execution of the Project. Training will cover all staff levels, including management, supervisory personnel as well as both skilled and unskilled workforces. A budget of USD 250,000 is allocated for capacity building and training.

Training program will consist of the following:

- General E&S awareness or toolbox talks, induction, and community interaction.
- Discussion regarding the ESMP, E&S sensitivity of the project area and key findings of the ESIA.
- Awareness of transmissible diseases and will be scheduled before the start of any field activities.
- The trainings conducted by the Contractor for the construction staff would educate them about the ESMP and waste disposal and would similarly start before any construction activities.
- The drivers would be trained prior to and during the field operations regarding road safety, defensive driving, waste disposal and cultural values and social sensitivity.
- All site personnel would be educated about camp operation, waste disposal, natural resource conservation and housekeeping through trainings and they would commence prior to any field operations and would be continued throughout.
- Special training will be organized for the Contractors' staff on near and over water construction.
- Contractor staffs will be trained on job-specific work prior to commence the task, proper use of personal protective equipment.
- Employees working under the Contractor would be trained about restoration requirements and waste disposal and the training program would commence before any restoration activities.
- PIU-HQ will engage a third party to train NHA operation staff on how to clean the panels.

10.14 Reporting and Documentation

Contractor will prepare two separate monthly reports, one for Environmental and Social Management and the second one for OHS Management. The ESHS Section with assistance from CSC and contractors will also produce quarterly reports.

Incident Report: Contractors should present all incident information in the monthly report including property and environmental damages. For fatal and high potential incidents, a flash report must be submitted within 24 hours to the PIU-HQ and a detail investigation report within 7 days of the incident. All fatal incidents and high potential incidents require a root-cause analysis.

Contractor and CSC Monthly Report: Implementation schedule of the mitigation plans and safety inspections and preventive controls suggested in the ESMP (**Table 10 -87**) should be reported in all monthly reports. The outcome of the field inspections and audits should be reported in all monthly report. Contractors should present the implementation schedule of mitigation measures and preventive actions in all monthly report along with monitoring and auditing and CSC should confirm the status of mitigation and preventive measures claimed by the Contractor.

Quarterly Progress Reports on Environment, Health and Safety: The environmental, Social, Health and Safety monitoring reports will include environmental and social mitigation measures and preventive actions undertaken, environmental and social monitoring activities conducted, details of monitoring data collected, analysis of monitoring results particularly the non-compliances, recommended mitigation and corrective measures, GRM data, ESHS training conducted, and environmental and OHS regulatory violations observed. The monitoring reports will be prepared by CSC and submitted quarterly during the construction period and annually for three years after completion of construction to EPA by ESHS Section/PIU-HQ.

Project Completion Environmental, Health and Safety Monitoring Report: One year after completion of construction, the ESHS Section will submit a Project Completion Environmental Monitoring Report which will summarize the overall environmental and social impacts and risks from the project.

10.15 ESMP Implementation Costs

Detailed cost estimates for implementation of mitigation measures, preventive actions, and monitoring are is presented in Table 10 -89. Total cost of ESMP implementation is $ 18,701,211. The budget for Civil Works with the Contractor is $ 5,982,300 and the PIU-HQ cost is $ 12,718,911.

Table 10-89: ESMP Implementation Cost

Sl.	Items	Unit	Site	Quantity	Unit Rate ($)	Amount ($)
1	**Civil Works (will be part of Contract)**					
(a)	Camp Construction and Management	year	4	1	100,000.00	400,000
(b)	Preparation and Submission of C-ESMP	No	3	1	20,000.00	60,000
(c)	Revision of C-ESMP	No	3	2	3,250.00	19,500
(d)	Preparation and Submission of OCHS Management Plan	No	3	1	30,000.00	90,000
(e)	Revision of OCHS Management Plan	No	3	2	5,000.00	30,000
(f)	Preparation and Submission of LMP	No	1	1	20,000.00	20,000
(g)	Revision of LMP	No	1	2	3,250.00	6,500
(h)	Dust management by Water Spraying	veh-d	3	360	200.00	216,000
(i)	Top Soil Stripping, Storage and Reuse	m3	4	399000	1.00	1,596,000
(j)	EHS Staffs of Contractors	No				2,799,500
(k)	Environmental Quality Monitoring	No	3	8	10,200.00	244,800
(l)	Periodic Maintenance of Access Road	No	2	4	125,000.00	500,000
					Subtotal	*5,982,300*
2	**PIU Cost**					
(a)	NOC of ESIA by KP, Sindh, and Punjab EPAs	No		3		6,589
(b)	RAP Implementation Cost					8,030,000
(c)	Construction Supervision Consultant (E&S)					3,060,000
(d)	Third-party Validation Consultant					240,000
(e)	Capacity Building and Training of NHA					250,000
(f)	Skill Development Training for Community	No	1	3	45,000.00	135,000
(g)	Plantation Program					647,321
(h)	Stakeholder Engagement Plan					100,000
(i)	Project Level Emergency Response					150,000
(j)	Additional Studies					100,000
					Subtotal	*12,718,911*
					Total	**18,701,211**

VOLUME 2: ESIA – ANNEXES

ANNEX 1 - CHECKLIST FOR PHYSICAL BASELINE CONDITIONS

PHYSICAL ENVIRONMENT

a. Type of area

- Mountainous
- Arid
- Semi-arid
- Forest
- Dense forest
- Populated
- Densely populated

Any other ________________________________specify)

b. Landuse of area

- Agriculture
- Barren
- Built-up
- Desert
- Access road
- Wetland

Any other ________________________________(specify)

c. Geological conditions

- is the geology of the area rocky ______________________
- is the origin of rocks sedimentary/igneous/metamorphic
- any other _________________________________ (specify)

d. Seismology

- is there any record of earthquakes in the past 50 years
- presence of faults/fractures
- any other details ___________________________ (specify)

e. Topography & soils

- are the soils mixtures of sand /silt/clay/gravel/rock/clayey silt_________
- any other ____________________________________ (specify)

Proposed site	Soil description

Other features

- Drains
- Hills
- Plain Areas
- Any other ___________________________ (specify)

f. Climate historical data from nearest weather station ( )

Temperature	Wind	Relative humidity	precipitation	Evapotranspiration

g. Surface and Ground water

Source of surface water

- Rivers
- Hill Torrents
- Surface Ponds
- Any other______________________________ (Specify)
- Surface water quality visual? __________________________

Sources of ground water

- Wells
- Hand Pumps
- Tube wells
- Any other______________________________ (Specify)
- Quality and Approx. depth ____________________________

g. Air Quality

- Is the area visually pollution free ______________________
- Identification of point sources (Industries Refineries, power plants) or any other _______________ (specify)
- Identification of non- point sources (cars, trucks, tractors) or any other ____________________ (specify)

h. Liquid effluents

- liquid effluents sources (industries/household/commercial)
- if any other _________________________________ (specify)
- Identification of any disposal source for waste water from plant ______ _______________________________________

Describe Details

i. Solid Waste

- Types of waste (Municipal, commercial, institutional, agriculture industrial, biomedical) any other ___________________________ (Specify)
- Waste Disposal facility (Landfill, dumping stations)
- Approx. waste generated (tons/day)____________________
- Responsible solid waste management authority? _______________

- Waste management (Good or Poor)____________________if poor, specify the reasons (lack of awareness among people, authority is not responsible enough)

j. Noise

- Sources of noise (traffic/industry or other _____________(Specify)
- Areas under high noise pollution? _____________________

k. Natural Hazards

- Does the project area has any previous records of flooding ______
- Are there any records of drought ______________________________
- Any other_______________________________(Specify)

l. Nearby Infrastructures in Study Area

Sr. No.	Infrastructure	Details
1.	Transmission Line Crossing	
2.	Surface Water Body	
3.	Water Supply Line	
4.	Roads	
5.	Quarry Area	
6.	Developmental Project	
7.	Sensitive Receptor	
8.	Other (Specify)	

Sr. No.	Significant Impacts	Details

ECOLOGICAL CHECKLIST FOR ESIA/ESMP

	Data Sheet No.			**Date**	/ /	**Expert Name**			
	Location/Village				**District**	Rawalpindi	**RD/KMs.**		
	BIODIVERSITY FEATURES								
(i)	**Vegetation Description**								
	Forests (Trees, Herbs, Shrubs)	Yes/No	**Ecological Zone/Forest Type**			**Legal Status**			
	Species Composition	ROW			**No of Trees (Possibly Affected)**				
	Diameter Class	0-15 cm	16-30 cm	31-45 cm	46-50 cm	51-65 cm	66-80 cm	81-95cm	Above 95 cm
	Rangeland	Yes/No	**Agricultural Land**	Yes/No		**Crop Type**			
(ii)	**Wildlife/ Fauna Description**								
	Wildlife Protected Areas (Notified or Sensitive)								
	Mammals	Yes/No							
	Reptiles	Yes/No							
	Amphibians	Yes/No							
	Aquatic Habitat	Yes/No							
	Avifauna/Birds	Yes/No							
	Natural Wetland	Yes/No							
	Endangered Species	Yes/No							
	Other Biodiversity Features								
	Remarks/Comments:								

QUESTIONNAIRE FOR SOCIOECONOMIC BASELINE SURVEY

Date. --------------- Photo No. --------------- ID No. ----------------------

1. IDENTIFICATION

1.1 Name of Respondent_______________________________________

1.2 Father's Name_________________________ **1.3 Cell. No:** ________________________

1.3 Permanent Address of the Respondent:

Village: _______________Town ______________ Tehsil ________________ District: ____________

1.5 Located _______________________________**Caste**__________________________________

1.6 Demographic Profile of Respondent (Children up to 10 yrs (#): M______, F ______ T______)

Sr. No.	(a) Relationship with Respondent (See codes)	(b) Sex (See Codes)	Age (Yrs.)	(c) Education (See Codes)	(d) Name of Business/ Occupation (See Codes)		Income from Business/ Occupation (Rs. / Annum)		(e) Health Condition
					Main	Secondary	Main	Secondary	
1	Self								
2									
3									
4									
5									
6									
7									
8									
9									
10									

Demographic Codes:

a) Relationship: 1=Self, 2=Wife, 3=Son, 4=Daughter, 5=Father, 6=Mother, 7=Brother, 8=Sister, 9=Grand Father, 10=Grand Mother, 11=Sister in Law, 12=Nephew, 13=Father-in-Law, 14=Mother-in-Law, 15=Niece, 16=Uncle,17=Aunty, 18= Son-in-law, 19= Daughter, 20= S. in Law,21=D. in Law, 22= Other__________

b). Sex: 1=Male, 2=Female, 3= Transgender

c). Education: 1= Primary 2= Middle 3= Metric, 4= Intermediate, 5= Graduate, 6= Post Graduate, 7=Law, 8=Engineer, 9=MBBS, 10=Technical Diploma, 11=Dars-e-Nizami, 12=Can Read Quran, 13= Can Insert Signatures, 14= Illiterate

d). Occupations:1=Agriculturist, 2=Shopkeeper, 3=Hotel, 4=Mechanic, 5=Barber, 6=Butcher, 7=Cobbler, 8= Business, 9= Govt. Servant,10=Private Servant, 11=Labor, 12=Student, 13=House-Maid, 14=Housewife, 15=Advocate, 16=Livestock/Dairy, 17=Fishing, 18=Driver, 19=Health Related, 20=Teaching, 21=Entertainer, 22=Gone Abroad, 23=Retired/Old, 24=Other______________

e). Health: 1= Good, 2= Average, 3= Poor

1.8) Language Spoken _______________________**Religion**_________________

1.9) Type of family system: 1.Joint: __________ 2.Nuclear_______________

2. AVERAGE MONTHLY EXPENDITURE ON FOOD AND NON- FOOD ITEMS (Rs.)

Items	Expenses
Food	
Non-food	
Utilities	
Health	
Education Care	
Other	

3. HOUSING CONDITIONS

3.1 Personal_______ Rented___________ Other_________

3.2 Type of Structure

(i) Katcha______ (ii) Semi Pacca______ (iii) Pacca_____

4. ACCESS TO SOCIAL AMENITIES *(TICK)*

Social Amenities	Available (Yes-No)	Satisfactory (Yes-No)	Reasons for Not Satisfaction
Electricity			
Gas			
Water Supply			
Water Filtration plant			
Telephone			
Sewerage/Drainage			
Hospital			
School (Boys-Girls)			
College (Boys-Girls)			
University (Boys-Girls)			
Religious Institution			
Road			
Source of Cooking if Sui Gas is not available			

5. CREDIT UTILIZATION

5.1 Have you obtained credit during last year? Yes___ No_____ if yes, source of credit:

a) Formal b) Informal

5.2 Please write the name of relevant source

Formal source (s) ____

Informal source (s) _______________________________________

Purpose of Loan ____

6. WOMEN'S PARTICIPATION AND ROLE IN DIFFERENT HOUSEHOLD ACTIVITIES

6.1 Participation and Decision Making (Tick)

Activities	Participation Extent (%)	Decision Making Extent (%)
Household activities		
Child caring		
Farm/Crop activities		
Livestock rearing		
Sale & Purchase of properties		
Social obligations (marriage, birthday & other functions)		
Local representation (councilor/political gathering)		

7. SOURCE OF DRINKING WATER:

1. Public Water Supply 2.Hand Pumps 3. Borehole 4. Any other __

7.1 Quality of water: Good__________ Poor: __________

If Poor (Reason) ______________________________________

8. DOES ANY NGO EXIST IN YOUR AREA?

Yes_______________ No______________________

If yes, Name of NGO -: ____

8.1 Are you member of NGO? yes----------- No----------------- if yes,

Role in NGO-:____

9. PERCEPTION OF RESPONDENTS FOR ACTION ASSOCIATED WITH THE PROJECT:

Possible impacts/effects of the Project	Increase	Decrease
Employment opportunities		
Industrial Development Opportunities		
Living standard		
Unemployment		
Income generating activities		
Improvement in transport		
Mobility (Access to Resources)		
Physical Displacement		
Other specify		

10. ANY OTHER HISTORICAL /ARCHEOLOGICAL MONUMENT IN OR NEARBY THE PROPOSED PROJECT AREA?

1. Yes_____ 2. No______ If yes, please specify

Name ____________________ Type___________ Distance from the proposed project ____

11. MAJOR DISEASES COMMON IN THE PROPOSED PROJECT AREA

____

____

____

12. IN YOUR OPINION, WHAT ARE SOME PRESSING NEEDS OF THIS AREA?

____

____

____

____

13. GENERAL REMARKS OF THE RESPONDENT

____

____

____

____

14. GENERAL OBSERVATIONS OF INTERVIEWER

____

____

____

____

Name of Interviewer: ______________________ Date: _______________

GENDER SURVEY

1. **Location:**

Settlement: ____

UC: ____________Tehsil: _______________________ District: __________________

2. **Identification**

2.1: Name:___________________ 2.2:Father's / Husband Name: ____________________

2.3: Permanent Address:

____

2.4: Contact No.______________________________________

2.5: What is your age?

Age (year) 18 – 25_________ 26 – 35 _________

36 – 45_________ 46 and above _________

2.6: Marital status? I. Married ______________ II.Unmarried ______________

2.7: What is your family size? I. Male_________________II. Female____________________

2.8: What is your caste /ethnic group?___________________________________

2.9: What is your language? ___________________________________

2.10: What is your qualification?

I. Illiterate ____________ II. Primary______________ III. Middle ______________

IV. Metric ____________ V. Intermediate _________ VI. Above Inter __________

3. **What are the main roles and responsibilities of women?**

Roles	Involvement(%age)
Household Activities	
Income Generation Activities	
Others	

Decision Making:

Who decides the following household matters?

Men = 1, Women = 2, Both = 3.	
	Decision maker
Education where to send, whom to send	
Health facilities (from where to avail)	
Number of children to have	
Children Marriages	
What HH assets to buy and sell	
Women to work outside home	

4. Access to Social/Financial Services and Mobility

4.1 Access to Education and Skills

Are there any constraints for girls accessing education? What are the main constraints?

____

4.2 Gender preferences for sending children to school?

____

4.3 Are there any vocational centers/schools for girls/women? What kinds of training courses are available with these vocational centers?

____

5. Access to Health

5.1 What kinds of health facilities are available in the area? Do women seek pre and post-natal health consultations and care? If not, what are the main constraints?____________________

____

____

5.2 Distance from the nearest health facility in KMs? __________________________________

5.3 What are the main health issues for men and women? Any common water borne diseases in the area?

____

6. Access to Drinking Water

6.1 What are the main sources of drinking water?

____

6.2 What are the key drinking water specific issues in the area?

____

6.3 Do women fetch water in the area from outside? Distance travelled by women ________?

6.4 Time used in fetching water? _______________________

7. Access to Finance

7.1 What kind of financial services (such as banking, micro-finance, and savings) are available to women?

____

7.2 What kind of challenges/constraints women face in accessing financial services?

____

8. Access and Control over Resources

8.1 What are the common trends of women ownership of land and assets?

____

8.2 What kind of issues, women face in access and control over resources/assets/property?

____

9 Access to Income Earning Opportunities

9.1 Are you involved in Income generating activities?

i) Yes ____________________ ii) No____________________

If yes, what are common activities?

i) Stitching/Embroidery___________ ii) Livestock________ iii) Job _______ iv) other________

9.2 What is opinion of male about the job of female, whether they like and encourage the female in jobs?

____

9.3 Are women allowed to work outside home? What are the main constraints for women in accessing economic opportunities?

____

9.4 Do you satisfied with the private wage/salary?

Yes _____ No ______ if No, how much it should be per day or per month (Rs.) ______________

9.5 Did you allow saving your salary/income independently in a separate bank account?

yes _______ No ________________, If No, why explain the reason. _________________

9.6 In which area, the female employees spend their salaries or earnings on?

House construction:____________ Marriage of her children:___________ Education:_____________

Kitchen:______________ Livestock: __________ Other:________________

9.7 What are the key potentials in the area for increasing women's participation in economic activities?

____

10 What is the attitude of the husband/ in laws family in case of more girl baby births against the willing of boy baby?

____

11 Women's Participation in Local Forums/Training Programs

11.1 What kind of local forums (formal, informal) exist in the area where women can participate?

____

11.2 Are there any cultural norms and social constraints refraining women to participate in the local forums?

____

11.3 What are the key potentials for engaging women in the local area development?

____

11.4 Do women participate in training programs offered by development partners (NGOs/CSOs)? What kind of training programs has been imparted?

____

12 Vulnerabilities (Poor, Elderly, Disabled and Widows)

12.1 What are the key vulnerabilities for women in the area?

____

12.2 What kind of social protection mechanisms/programs for the vulnerable women?

____

13 Have you ever faced violence from male members of the household?

Yes________________________ No ____________________If Yes, Type

Physical___________________ Mental___________________ On what type of Issues?

i) Domestic_______ ii) Economic _______________ iii) Others______________________

14. Any complaint or voice rose against violence to NGO or Police?

Yes________ No __________, if yes where ____________________

14.1 Was compensated to the affected woman? yes ______________No __________________

If yes, what result and consequences of that complaint? ____________________________

If Not. Why..____

15. Project Benefits for Women

15.1 What protective measures do you suggest regarding the project implementation?

____

____

15.2 How women's participation could be ensured in the project implementation? How project interventions will benefit women?

____

____

15.3 What are the key recommendations for maximizing project benefits for women?

____

____

15.4 What kind of negative impacts do this project has on women?

____

____

15.5 What are the pressing needs of women of the Project Area?

____

____

16. Existence of other development partners:

16.1 Are there any other development partners (funding agencies, CSOs/NGOs) working in this area for the socio-economic development of the communities? List down the names of the development partners.

____

____

16.2 What kind of development support is provided by other development partners for the socio-economic uplift of the communities in this area?

____

____

17. Any other concerns/comments

____

____

Interviewer’s Signature _________________________

Assets Inventory and Census Questionnaire

(With this Questionnaire Socio-Economic Questionnaire will be used)

Date: -------------------- ID No: --------- Coordinates ____________________Side (ROW) _____

1. LOCATION

1.1 Name of Setlement_________________________**1.2: RD No:** ____________

1.3 Tehsil: ___________ **1.4 District:** _____________________________

2. IDENTIFICATION

2.1 Name of Affected Person: ___________________________**2.2 Father's Name:** _________________

2.3 NIC No: ____________________________**2.4 Permanent Address of the Respondent:** ____________

____ **3.5:** Contact No.________________

3. CATEGORY OF RESPONDENT: (TICK RELEVANT)

4. DETAIL OF AFFECTED PROPERTY/ASSETS

4.**1** **If land, provide following details:**

Type of Land	**Total Land (Acre/Kanal /Marla) Guntha**	**Affected Land Acre/ Kanal/Marla Guntha**	**Ownership Status of affected/acquired land (Tick the relevant**		
			Titled land	**Leased (state/private) land**	**Encroached ROW**
a) Agriculture					
b)Residential					
C) Commercial					
d) Forest/Orchard Land					
e) Wasteland					
Total Area					

4.2 identification/details of joint owners of affected/acquired land and land parcels.

Sr. No.	Name	Type of Business	% Share	Documents Available (Yes/No)
1.				
2.				
3.				

4.3 **For arable agricultural land, provide following details:**

Type of Land	Total cultivated area AH owns (Acre/Kanal/ Marla)	Affected Crop Area (Kanal)	Ownership Status	Production and Income		
				Production	Expenses	Net income
a) Crop area (Rabi)						
b) Crop Area (Khrif)						
c) Orchards Area						

4.4 Details of affected Residential Structure, Specify Category of Structure

1. Single Storey 2. Double Storey 3. Triple Storey

Structure	Type of Construction *	Nos. and size of Structure			% of affected Structures
		Nos	Type Roof	Size (sft rft)	
Room					
Veranda					
Kitchen					
Bathroom/ Latrine					
Boundary Wall (rft)					
Hand Pump/Electric Motor					
Electric Meter					
Any other					

* 1- Kacha. 2- Semi-Pacca 3- Pacca 4-Straw

4.5 Commercial Structures:

1. Single Storey 2. Double Storey 3. Triple Storey

Structure	Type and size of Structure		% Affected
	Type of Construction	Size (sft)	
Shop			
Shed			
Kiosk			
Other			

* 1- Kacha. 2- Semi-Pacca 3- Pacca 4-Straw 5- Type of Roof

4.6 Community/Public and Religious Structures Under Project Impact

1. Single Storey 2. Double Storey 3. Triple Storey

Structure	Type and size of Structure			% Affected
	Type of Construction	Type of Roof	Size (sft)	

4.7 Cattle, Structure, Specify Category of Structure

Structure	Type of Construction *	Nos. and size of Structure			% Affected
		Nos	Type of Roof	Size (sft- rft)	
Room					
Shed					
Boundary Wall					
Hand Pump/Electric Motor					
Electric Meter					
Any other					

* 1- Kacha. 2- Semi-Pacca 3- Pacca 4-Straw

4.8 Water Supply assets/ fixture affected:

Type of Asset	No.	Size (sft- rft)	Value (Rs.)	When Purchased / Installed (No. of Yrs.)	Type of Roof	% Affected
Room						
Tube well bore hole						
Bore hole of Electric water pump						
Well						
Water Box						
Other (specify)						

4.9 Details about Shareholder/Tenant, if any: ______________________________

Sr. No.	Name	Relationship with Respondent	Type of business	Share in % age	Document Available (Yes/No)
1.					
2.					
3.					
4.					
5.					

4.10 Private Owned Trees Under Project Impact

Sr. No.	Type	Numbers	Size/age		
			Mature	Girth	Sapling
1	**Non-Fruit Trees**				
2	**Fruit Trees**				
3	**Other**				

4.11 Details of Govt. Affected Trees:

			Size/age

Sr. No.	Type	Numbers	Mature	Girth	Sapling
1	Non-Fruit Trees				
2	Fruit Trees				
3	Other				

4.12 Employee Description: How many employees do you have? Nos.-------------

Sr. No.	Name of Employee	Nature of Employment	Average Monthly Wage (Rs.)
1			
2			
3			

5. RELOCATION OPTION

5.1 Do you have some other place to move? (Yes)________ (No) ________

5.2 In case of Yes:

a) How far away from this place? ________(km) (b) Do you own this place? (Yes) ___ (No)____

if Yes (Where) ____

6. COMMENTS / OBSERVATIONS

6.1 General Remarks of the Respondents:

____

6.2 Pressing Needs of the Respondent:

____

6.3 General Observations of Interviewers:

____

Conducted by: ____________________________________ **Date:** ____________________

COMMUNITY/PUBLIC CONSULTATION

1- Identification:

Date______________________

Settlement:

____

UC:________________ Tehsil:_____________________District: ____________________

Location of Meeting________________________

Resource Person ___________________________ Contact No.______________________

2. What types of impacts do you expect due to implementation of project in the area?

____
____
____
____
____
____
____
____

3. Questions& Response

Question	**Response**

4. General Remarks and suggestions of the participants:

____
____
____
____
____
____

5. General Observations of Interviewer:

____
____
____
____
____
____
____

List of Participants

Sr. No.	Name	Occupation	Signature/ Thumb (NIC)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

ANNEX 5-2: LIST OF SENSITIVE RECEPTORS

Section 2			
Sl.	**Sensitive Receptor**	**Latitude**	**Longitude**
1.	Imam Bargah Qasim Shareef	27°16'9.76"N	68°29'47.25"E
2.	City Medical Centre	27°16'54.80" N	68°30'20.66"E
3.	Rural Health Center Ranipur	27°16'55.54" N	68°30'22.57"E
4.	Bhatti Public School	27°16'56.36" N	68°30'28.88"E
5.	Ahlul Bait Public School	27°17'4.29"N	68°30'15.31"E
6.	Ranipur Civil Hospital	27°16'57.35" N	68°30'24.06"E
7.	Al Hajj Pir Syed Abdul Qadir Shah Jillani Public Park	27°17'15.98" N	68°30'21.38"E
8.	Hajna Shah Bodla Mazar	27°17'21.24" N	68°30'23.30"E
9.	Batool Medical Center	27°17'4.82"N	68°30'34.18"E
10.	Surhan Elementary Public School Ranipur	27°17'10.51" N	68°30'40.13"E
11.	New Iqra Computer and Coaching	27°17'18.31" N	68°30'45.22"E
12.	Ever Shine Public School	27°17'20.17" N	68°30'33.08"E
13.	Yasir Public School	27°17'19.73" N	68°30'28.51"E
14.	Government Sachal Sarmast Degree College, Ranipur	27°17'29.38" N	68°30'45.08"E
15.	Pir Syed Abdul Qadir Shah Jeelani Cricket Stadium Ranipur	27°17'31.06" N	68°30'43.03"E
16.	Rohri Canal	27°17'29.62" N	68°30'57.12"E
17.	Madni Masjid Soumra	27°19'13.74" N	68°31'16.59"E
18.	Step School Gambat Campus	27°20'35.28" N	68°32'1.20"E
19.	Dargah Ali Shah	27°20'48.93" N	68°31'52.39"E
20.	Agha Khan Hospital Laboratory	27°20'52.25" N	68°31'56.20"E
21.	Abu Zar Ghaffari Masjid	27°21'33.26" N	68°31'56.27"E
22.	Mohammadi Public School and College Gambat	27°21'49.26" N	68°32'1.04"E
23.	Dargah Aalia Ghausia Miskeenpur Shareef	27°23'20.85" N	68°33'24.75"E
24.	Baitussalam School and Masjid - Gambat	27°23'20.28"	68°33'52.86"E

Section 2			
Sl.	**Sensitive Receptor**	**Latitude**	**Longitude**
		N	
25.	Jamia Masjad and Madarsa Syed Ashique Ali Shah jelani	27°24'27.15" N	68°34'43.65"E
26.	Indus Schools of Knowledge, Moosani	27°24'46.44" N	68°36'3.49"E
27.	Jamia Masjid Ali ul Murtaza RA	27°26'30.26" N	68°37'48.32"E
28.	Government High School Khairpur	27°26'46.46" N	68°38'22.06"E
29.	Government Boys Primary School Buto Khan Chandio	27°27'0.71"N	68°38'20.30"E
30.	Government Boys High School Kouro Goth	27°30'17.76" N	68°41'39.48"E
31.	Government Boys Primary School sanghroo juneja	27°31'12.11" N	68°42'19.29"E
32.	Masjid Baba-e-Rehmat	27°31'59.86" N	68°42'42.04"E
33.	Government Dispensary Khanpur	27°31'25.76" N	68°42'29.70"E
34.	Shah Hussain Dargah Khairpur	27°32'6.71"N	68°42'53.89"E
35.	Maddie School	27°34'18.13" N	68°44'45.89"E
36.	Govt High school Wisrio Wahan	27°36'17.12" N	68°47'17.56"E
37.	Jamia Masjid Wisrio Wahan	27°36'19.13" N	68°47'20.36"E
38.	Government Primary School Qazi Khooh	27°36'36.45" N	68°47'31.59"E
39.	Haji Muhammad Kamail u Jan School	27°37'12.42" N	68°47'39.60"E
40.	Jamia Masjid Karamabad	27°37'15.80" N	68°47'47.28"E
41.	Basic Health Unit Gagri	27°38'7.46"N	68°48'43.64"E
42.	Bilal masjid Baberloi	27°39'2.20"N	68°50'12.50"E
43.	Govet Girls High School Babarloi	27°38'58.48" N	68°50'10.71"E
44.	Jamia Masjid Doonhon Ibrahim Shah Doonhon Babarloi	27°38'55.34" N	68°49'56.36"E
45.	Markazi Imam Bargah Doonhon Ibrahim Shah Babarloi	27°38'57.33" N	68°50'2.89"E
46.	The Smart School Baberloi Campus	27°39'9.05"N	68°50'20.84"E
47.	Basic Health Unit Babarloi Sukkur	27°39'20.52" N	68°50'19.75"E
48.	SIUT Hospital Sukkur	27°39'40.21" N	68°50'58.05"E
49.	Mirwah Canal	27°39'40.18"	68°51'11.51"E

Section 2			
Sl.	Sensitive Receptor	Latitude	Longitude
		N	
50.	Masjid Ali Ul Murtaza	27°39'46.09" N	68°51'19.75"E
51.	Government Boys Primary School Tando Mir Muhammad	27°40'0.73"N	68°51'25.59"E
52.	Basic Health Unit Tando Thatti Sukkur	27°39'50.12" N	68°51'36.94"E
53.	Masjid Bab Al Hawaij	27°40'1.62"N	68°51'31.80"E
54.	Government Ata Hussain ShahDegree College	27°40'3.65"N	68°51'54.51"E
55.	Noor Pur Masjid Dargah Rohri	27°39'54.91" N	68°52'29.17"E
56.	Dargah Shah Khair Wand	27°40'2.28"N	68°52'56.71"E
57.	Government Girls Primary School Nandhi Patni	27°39'39.24" N	68°53'9.97"E
58.	The Aror University Of Art, Architecture, Design & Heritage Rohri	27°39'40.44" N	68°54'2.75"E
59.	Jamia Masjid Aror	27°39'31.75" N	68°54'1.47"E
60.	Jamia Masjid	27°39'47.41" N	68°54'7.89"E
61.	Muhammadi Masjid	27°39'53.78" N	68°54'44.64"E
62.	Allama Iqbal Open University Regional Center Sukkur	27°39'58.94" N	68°55'24.21"E
63.	Local Masjid	27°40'5.24"N	68°55'39.53"E
64.	Government Boys Elementary School Mevo Khan Sahib Khan Jiskani	27°40'24.36" N	68°55'58.75"E

Section 7			
Sl.	Name Sensitive Receptors	Longitude	Latitude
1	Harvard College of Commerce and Science	72.998594	33.612931
2	Government College of Commerce	72.995231	33.61258
3	Ujala School System	72.985984	33.617552
4	Kohinoor Textile Mills Mosque	72.979744	33.617484
5	Punjab College of Commerce	72.975686	33.623002
6	University of Wah	72.790459	33.741755
7	Nasheman Institute of Special Education	72.788962	33.743046
8	Froebel's International School Peshawar Road	72.974239	33.623763
9	Quaid-e-Azam International Hospital	72.973104	33.624688
10	SKANS International Islamic School	72.965755	33.623598
11	NUST College of Electrical and Mechanical Engineering	72.960163	33.622366
12	Army Public School Golra	72.95496	33.626279
13	Masjid Jafria	72.943377	33.626482
14	Jamia Masjid Farooq-e- Azam	72.91467	33.646632
15	Jamia Majid Ghousia Tarnol	72.91282	33.652145
16	Grace International Hospital	72.887988	33.663503
17	Health Aid College of Nursing	72.887428	33.663611
18	Alfalah Hospital	72.852926	33.676441
19	National Excellenec Institute	72.840105	33.686088
20	Government Associate College for Women Taxila	72.824736	33.7054
21	Taxila Bypass Masjid	72.814607	33.712415
22	Jamia Masjid Ghosia	72.804393	33.721422
23	Wahdat Colony Playground	72.804039	33.722368
24	New Lasani Medical Complex	72.804257	33.728758
25	Wah International Hospital	72.804808	33.732987
26	Haider Mosque	72.800006	33.73505
27	Mashal Degree College for Women	72.791333	33.740965
28	Jamia Masjid Al-Habib	72.788795	33.739893
29	COMSATS University Islamabad	72.7868	33.74371
30	Iqbal Memorial Hospital & Diagnostic Center	72.781635	33.743321
31	PWCT01-Virtual University	72.781962	33.744039
32	Rawal Surgical Hospital Wah Cantt	72.782569	33.743854
33	Graveyard Wah Cantt	72.770035	33.7467
34	Alain Hospital	72.762804	33.75192
35	Al-Moeed Hospital	72.753734	33.755341
36	Government boys High School Losar Sharfoo Taxila	72.749467	33.75372
37	Wise Montessori Campus	72.738276	33.759297
38	Froebel's International School	72.728224	33.761722
39	Dar-ul-Madina. Girls Primay & Secondary school	72.726351	33.76224
40	PWCT04- Virtual University Wah Model Town Campus, Wah Cantt	72.724469	33.76782
41	Jamia Masjoid-e-Ibrahim	72.718134	33.77259
42	Lalarukh Graveyard	72.720835	33.776126
43	Bilal Masjid	72.719111	33.778364
44	Imambargah Qasr-e-Shabbir, Wah Cantt	72.71818	33.77875
45	Umer Masjid	72.718916	33.78085

Section 7			
Sl .	Name Sensitive Receptors	Longitude	Latitude
46	Saint Paul High School Girls Campus	72.720587	33.781076
47	Sharif Hospital	72.718538	33.782562
48	CB Public Boys School & College, Lalarukh Wah Cantt	72.720491	33.785501
49	Superior College Wah Cantt	72.719833	33.787599
50	Ayesha Mosque	72.720942	33.789616
51	Federal Science Degree College	72.721593	33.788559
52	CB Play gROUND	72.720948	33.791407
53	Noor Hospital Wah Cantt	72.720642	33.79295
54	Punjab Group of Colleges, GT Road, Wah Cantt	72.707004	33.803654
55	Qadir Town Graveyard	72.703041	33.807509
56	Mualij Homeopathic Hospital Hassanabdal	72.698068	33.807708
57	Presentation convent High school	72.696961	33.809255
58	Fud International School	72.691781	33.810988
59	Jamia Masjid Fatima (RA)	72.691208	33.811045
60	The Educator Abdalian Campus	72.691805	33.813111
61	Hassan Medical and Surgical Complex	72.689101	33.81403
62	Government Girls Elementary Model School	72.680824	33.82225
63	Cadet College Hassanabdal	72.676758	33.819331
64	NADRA Registration Centre	72.67707	33.822159
65	Majid Hanfia	72.668234	33.822356
66	Dar-ul Uloom Muhammadia Ghousia Gulzare Madina	72.667995	33.821795
67	Minhas Masjid	72.658871	33.824071
68	Government Associate College Hassanabdal	72.652767	33.825059
69	Masjid Qaba Madni	72.636998	33.824098
70	Graveyard Burhan	72.633331	33.825325
71	Jamia Masjid Dhoke Molian	72.610673	33.819639
72	Mosque Anwar-e-Madina	72.620305	33.820439
73	Al Abbas Hospital	72.79482	33.738528
74	Swedish College of Engineering And Technology, Wah Cantt	72.72058	33.770795
75	Islamabad Model College	72.913693	33.650088
76	Noor Hospital	72.908828	33.649018
77	Tariq Dawakhana	72.850962	33.674475
78	Darbar Shah Jhani Sarkar	72.851263	33.673708
79	B-17 Lake	72.832997	33.694964
80	Jamia Masjid Sddiq-e-Akbar	72.808645	33.715815
81	POF Institute of Technology	72.783831	33.74508
82	Health Care Lab	72.772594	33.746886
83	IDC Lab and Diagnostic Center	72.770658	33.746652
84	Masjid Jamia Usman	72.764435	33.748986
85	Noorani Masjid	72.746927	33.756518
86	Wah OInstitute of Safety and Technology-WIST	72.719603	33.791587
87	Madni Masjid	72.713876	33.796003
88	Jamia Masjid Shan-e-Sahaba	72.708895	33.798287
89	Jamia Masjid Qadir Town	72.704401	33.805057
90	Punjab Academy of Sciences	72.680791	33.817918
91	Benchmark School	72.997215	33.614283

Section 7			
Sl.	Name Sensitive Receptors	Longitude	Latitude
92	East West Law College Hassanabdal	72.62314	33.821399

	Section 8		
Sl.	Name Sensitive Receptors	Longitude	Latitude
1.	Name Sensitive Receptors	Longitude	Latitude
2.	Masjid Khadija tul Qubra	72.028263	34.010709
3.	Government High School Wattar	72.073893	34.005695
4.	Graveyard Wattar	72.073383	34.006394
5.	LB School	72.072984	34.005056
6.	Hira Public School Wattar	72.069485	34.006323
7.	Beaconhouse Nowshera Campus	72.059193	34.00855
8.	Jamia Usmania	72.057478	34.005994
9.	Kabul River	72.051522	34.009512
10.	JR.PFC Football Ground	72.050756	34.007343
11.	EI-8The Peace School & College	72.048639	34.008179
12.	Jamia Darul Huda	72.048666	34.007432
13.	Roots Millennium Schools River Tree Campus	72.045949	34.008267
14.	Piece College GT Road Hakeemabad Nowshera	72.046413	34.010177
15.	Nowshera College of Nursing & Health Sciences	72.043092	34.009942
16.	Ripha International College Nowshera	72.040836	34.007217
17.	Masjid Peer Sabaq	72.041606	34.007521
18.	City Degree College and School Nowshera	72.039817	34.008633
19.	Jamia Tehseen-ul-Quran	72.035254	34.009032
20.	Sarhad University Center Hakeeemabad	72.031872	34.006759
21.	School of Armour	72.022505	34.010379
22.	Zia-ul-Haq Stadium	72.019275	34.006995
23.	Polo Ground	72.016011	34.006386
24.	Cantt Children Park	72.016079	34.010685
25.	Local Masjid	72.0136	34.009
26.	N.C.B Mosque	72.011604	34.008508
27.	Cantonment Board PRAK	72.012759	34.00856
28.	Cantt Rose Garden	72.009567	34.009842
29.	Army Public School and College	72.008669	34.008057
30.	Madni Masjid	72.008154	34.005516
31.	Polo Ground	72.005083	34.010794
32.	Jinnah Park (Comapny Bagh)	72.00278	34.011533
33.	Government High School Shame ky Bhattian	72.000716	34.008507
34.	F.G Degree College	72.000176	34.006996
35.	Masjid Ameer Muavia	71.999723	34.00564
36.	School of Artillary Pakistan	72.000898	34.004548
37.	Haroon Medical Hall Nowshera Cantt	72.004782	34.003718
38.	School of Artillery Mosque	71.998756	34.002821
39.	Mediks International Hospital	71.995548	34.006653
40.	Nowhsera Combined Millitary Hospital	71.993241	34.003549
41.	Government Post Graduate College Nowshera	71.989267	34.005911

	Section 8		
Sl.	**Name Sensitive Receptors**	**Longitude**	**Latitude**
1.	Name Sensitive Receptors	Longitude	Latitude
42.	Eid Gah Nowshera	71.98843	34.008047
43.	Government High School Number Two for Boys	71.986356	34.005734
44.	Hockey Football Ground	71.984746	34.003832
45.	Masjid-e-Usmania	71.984158	34.003078
46.	Doctor Mamoona Riffat's Clinic	71.980682	34.005303
47.	Daffodil's Schooling System (Girls-Senior)	71.979682	34.003835
48.	Daffodil's Schooling System (Boys Senior)	71.979723	34.003206
49.	FG Degree College for Boys Nowshera Cantt	71.976407	34.002384
50.	Muhammad Islam Surgical Hospital Urologist & Laparoscopic Surgeon	71.967481	34.006117
51.	Jamia Masjid	71.961717	34.010816
52.	Government High School Khat Kali	71.957563	34.011019
53.	The peace School and College Nowshera	71.953364	34.012563
54.	Ali Surgical Center	71.954023	34.011019
55.	Zakir Eye Center	71.953588	34.010956
56.	Amanullah Khan Medical and Nursing Institute Nowshera	71.950512	34.011543
57.	Masjid TMA Nowshera	71.94851	34.011571
58.	Jamia Masjid Railway	71.939497	34.009607
59.	Pakistan Public School and College	71.933474	34.009107
60.	Al-Noor Masjid	71.931285	34.012722
61.	The Little Angels Model School Amangarh Nowshera	71.930977	34.008612
62.	Doctor Abdul Ali Clinic	71.929774	34.008022
63.	Darbar Sheikh Abdul Ghafoor	71.926866	34.010969
64.	Sheikh Abdul Ghafoor Graveyard	71.925972	34.010599
65.	Masjid Zafar Ali Khan	71.898534	34.007967
66.	Doctor Sadaf Sarwar Maternity Home	71.895289	34.008792
67.	Government Higher Secondary School Pir Pia	71.891411	34.010937
68.	Doctor Shehzad Clinic	71.890687	34.009433
69.	Masjid Umar Bin Abdul Aziz	71.869279	34.008788
70.	Muslim College Azakhel Campus	71.853011	34.010907
71.	IRM Center Azakhel	71.850271	34.008109
72.	NADRA Office Azakhel	71.823236	34.009675
73.	Al-Rabiah Orphan School and College	71.819076	34.007813
74.	Sabawoon Education Academy	71.817036	34.008511
75.	The Educatos Pabbi Campus	71.812991	34.008899
76.	Neelub School	71.81267	34.010622
77.	Masjid Khan Jomat	71.812403	34.010225
78.	Darwesh diabetes research institute	71.809689	34.008929
79.	Darbar Sheikh Shahbaz Baba (RA)	71.802242	34.007018
80.	Pabbi Janazgah	71.79811	34.007593
81.	Mian Rashid Hussain Shaheed Memorial Hospital	71.798212	34.009133
82.	Masjid Zuraab Baba	71.795793	34.006674
83.	Makki Masjid	71.793165	34.01003
84.	Masjid Molana Muhammad Asif Sahab	71.787238	34.008204
85.	Allied School Pabbi	71.788933	34.009235
86.	The Institute CENNA	71.786774	34.010806

	Section 8		
Sl.	**Name Sensitive Receptors**	**Longitude**	**Latitude**
1.	Name Sensitive Receptors	Longitude	Latitude
87.	Masjid Bilal Khudrezai	71.784763	34.012831
88.	My School Pabbi	71.782653	34.010458
89.	Doctor haseena imdad gyne and obs clinic	71.774292	34.012974
90.	NADRA Office Pabbi	71.769641	34.01279
91.	Jamia Islamia Pabbi Peshawar	71.765799	34.013329
92.	Doctor Nighat Health Care	71.765687	34.012419
93.	Masjid Maaz Ibn-e-Jabbar	71.763759	34.011451
94.	Government Degree College Pabbi	71.760488	34.013026
95.	Maternity Clinic	71.75854	34.013059
96.	Makkah Mdecical Center & Laboratory Services	71.758181	34.01422
97.	Frontier Public School	71.757363	34.013433
98.	Jamia Masjid Nasir Kale	71.756682	34.012418
99.	Eidhi Center Pabbi	71.754688	34.013767
100.	Masjid Azkhail	71.753813	34.015628
101.	Aurangzerbabad Cemetery	71.752138	34.015703
102.	Irham Model School and Taleem-ul-Quran Academy	71.736075	34.017578
103.	Masjid Tahiri	71.736958	34.017938
104.	Masjid Abbu Bakar Siddique (RA)	71.738328	34.017665
105.	Government High School Tarru Jabba	71.729027	34.01646
106.	Clinic Doctor Muhammad Jahangir Khan	71.729547	34.015068
107.	Mercy Educational Complex	71.683608	34.019391
108.	Al-Haram Green Masjid	71.66984	34.015431
109.	Crescent Model School	71.665652	34.021037
110.	Masjid-e-Rehmatulil Alamin	71.665442	34.022446
111.	Peshawar Garden Mosque	71.661282	34.015622
112.	Masjid-e-Mustafa	71.660162	34.021147
113.	Masjid-e-Umar (RA)	71.656943	34.017741
114.	Jamia Masjid Madina	71.896134	34.009517
115.	Government Girls Degree College, Pirpai	71.8883	34.010224
116.	Ghazi Model School & College Pabbi New Branch	71.821212	34.009713
117.	Darbar Hazrat Abdul Shakoor Malang Bab (RA)	71.662229	34.0184
118.	The City School Nowshera Campus	72.043533	34.008614
119.	Garison Ground Nowshera Cantt	72.009523	34.006368
120.	Government Degree College	71.997585	34.007443
121.	CMH Mosque	71.994296	34.003122
122.	Catholic Church	71.994566	34.002254
123.	Graveyard	71.96622	34.004674
124.	Jamia Masjid Akramabad	71.965352	34.005652
125.	Graveyard Khatkalay	71.961549	34.006856
126.	Masjid Allah-u-Akbar	71.961358	34.008019
127.	Lady Doctor Asma Arif Maternity Home	71.948779	34.011245
128.	Learning Tree School	71.936437	34.010292
129.	Masjid Sheikh Abdul Ghafoor	71.927441	34.010084
130.	Masjid Gandher Baba	71.917165	34.008676
131.	Local Masjid	71.913926	34.010044
132.	Jamia Riyaz-ul-Jannah	71.906027	34.008209

	Section 8		
Sl.	**Name Sensitive Receptors**	**Longitude**	**Latitude**
1.	Name Sensitive Receptors	Longitude	Latitude
133.	Masjid Bilal	71.905101	34.010344
134.	Masjid Ayesha	71.903696	34.010158
135.	Masjid Siddiqu-e-Akbar	71.892247	34.011858
136.	Masjid Umar-e-Farooq	71.888549	34.008725
137.	Azakhel Park	71.875733	34.00741
138.	IBM Computer Academy	71.85644	34.006542
139.	Majid Ameer Muavia (RA)	71.846167	34.006742
140.	Masjid Abu Hurraira (RA)	71.831043	34.012023
141.	Jamia Siddiqia	71.811656	34.007133
142.	Zahoor Eye Hospital	71.786537	34.011231
143.	Shaheenabad Masjid	71.767172	34.009703
144.	Jamal English Education Academy	71.76272	34.012593
145.	Muhammadi Masjid	71.739937	34.013945
146.	Masjid Madina	71.727956	34.012964
147.	Railway Station Taru Jabba	71.72815	34.01673
148.	Jamia Masjid Sanan Bin Salma	71.697812	34.01668
149.	Governmnet High School Number one	71.985161	34.005877
150.	Cantt Hospital	71.991089	34.004204
151.	Dream College of Nursing Nowshera	71.888547	34.00945
152.	Masjid Rehman	71.721285	34.018831
153.	Masjid Tarnab CNG Filling Station	71.71522	34.0168
154.	Mercy Pak School College & Vocational Training Institute	71.683837	34.01818
155.	STEP School Khyber Campus	71.678588	34.018605
156.	Nasirpur Railway Station	71.677706	34.018685
157.	Quaid-e-Azam Institute of Legal Studies, Nowshera	72.039065	34.008339

Annex 7-1: List of other interested parties and minutes of their consultations.

	Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
	Islamabad Capital Territory				
1.		23-10-2024	Islamabad Wildlife Management Board (IWMB)	Ms. Ume Habiba, Director Wildlife	• The NESPAK team visited the subject office to brief the officials regarding the Project and share details. • The official told that N-5 road is passing nearby Margalla national park. Therefore, care should be taken while designing and construction of road to protect the wildlife. • The official requested NESPAK team to submit the Project details along with the RoW of the road. The IWMB official will then physically verify the site. • The official told that NoC will be required from IWMB before the start of construction activities.
2.		23-10-2024	CDA Environment	Mr. Rana Kashif, Horticulture (west)	• The NESPAK team visited the subject office to brief the officials regarding the Project and share details. • The official appreciated the proposed Project due to the traffic congestion situation on N5 road. • The E&S team was requested to coordinate with CDA throughout the Project. The official also told that the EIA/IEE matters are dealt by Federal EPA.
3.		22-10-2024	Archaeology Department	Mr. Arshad Ullah-Deputy Director	• The official told that no cultural notified site is present near the N-5 in Islamabad Capital Territory. However, on site verification will still be required to confirm once the detailed design will be finalized and unground demarcation will be completed (as required).. • The official recommended to incorporate the chance find procedure to NESPAK team.
4.		22-10-2024	Federal Environment Protection Agency	Mr. Bin Yamin, Assistant Director	The NESPAK's relevant environment and social team briefed the official regarding the proposed Project. The official provided following suggestions: • All stakeholders should be taken on board and consultation should be carried out at each stage. • Measures should be taken to minimize cutting of trees. Following points must be considered while preparing Environmental Impact Assessment report: • Identification of location for construction camps alternate

Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
				routes for traffic flow during construction • Arrangements for material storage and transport • Alternate routes shall be provided in consultation with Traffic Police to the residents and commuters. • Dust control mitigations shall be recommended to the contractor • Demolition waste shall be properly disposed if it cannot be reused.
5.	September – October 2024	NHA Environment, Afforestation and Land Section (EALS)	Mr. Farid Khan Ms. Nosheen Butt	Team is in close coordination with the EALS section of NHA for the land ownership. EALS Section wrote the letters to concerned regional maintenance offices and Road Asset Management Department (RAMD) for the provision of available ROW data, land ownership status/record and record of encroachment and lease within the ROW. Based on these letters, consultants visited the concerned maintenance offices to obtain the respective data.
Khyber Pakhtunkhwa Province				
6.	03-10-2024	Environmental Protection Agency- Khyber Pakhtunkhwa	Mr. Sami Ullah, Director General Mr. Mumtaz Ali Wazir, Deputy Director Legal	• Overall, EPA was in favor of the proposed Project. The official briefed about advantages of the proposed Project as its implementation will benefit all the neighborhood along the route. Traffic congestions in the Project Area will be reduced. • E&S Consultant must fill and submit Schedule-I form provided in Khyber Pakhtunkhwa Environmental assessment rules, 2021 to agency through NHA and specified study must be submitted to EPA for obtaining NOC prior to start of work. • Collection of environmental, social and ecological baseline data must be ensured through primary means using field visit checklists and socio-economic tools; • Alternate routes shall be provided in consultation with Traffic Police to the residents, educational institutions and road users for their movement and to avoid the chaotic situation of traffic at this bottleneck;
7.	03-10-2024	Forest Department	Mr. Kifayatullah Baloch, Chief Conservator Forest Department	• No specific reserve forest and important area exist in the vicinity of the Project ROW however; the proponent will request cutting of trees from Forest department via letter.

Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
				The concerned Divisional Forest Officers will visit the site with the NHA and E&S officials to verify the trees. • Tree cutting should be avoided up to maximum level; and • A feasible provision of budget for tree plantation plan should be included in the Project cost
8.	03-10-2024	Wildlife Department	Iftikhar uz Zaman, Conservator Wildlife department Mr. Ali Gohar, GIS Expert/ Range Officer	• The official appreciated that the E&S team is conducting meaningful consultations with the department prior to the start of the Project • The official told that no as such impact is envisaged on wildlife. The concerned District Forest Officer (DFO) will be directed to verify and provide the No objection certificate if required.
9.	03-10-2024	Directorate of Archaeology and Museums Government of Khyber Pakhtunkhwa	Mr. Faheem Shahzad, Section Officer	• The official told that no archeological site exists near the proposed section (Peshawar to Nowshera). However, he suggested to incorporate the procedure of any accidental and chance of finding any historical / archeological site during the execution of work.
10.	14-10-2024	Social Welfare & Women Development Complex Peshawar Division	Mr. Qayum Khan- Deputy Director	The official provided following suggestions: • Facilities of rest by areas and public toilets for the passengers should be provided. • At Bus Stop, waiting room for passengers should be constructed. • Prayer area must be provided for passengers. • Maximum skilled & unskilled labor should be hired from the local community during the Project construction activities so that local people can take maximum benefit of the Project. • Occupational health and safety should be taken care with respect during construction of the road. • Physical and livelihood disturbance should be avoided/minimized. • During the construction period safe movement of the pedestrian should be ensured and proper Traffic Management Plan (TMP) should be devised. • Awareness among the students should be created about the Project. Traffic should be managed properly in school hours during the construction work. • Awareness among the population about the risks associated

Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
				the Project activities and mitigation measures should be adopted. • The environment of the most part of Project Area is friendly, but due to construction activities dust & air pollution may lead to respiratory diseases. Medical camp should be established in the area during the period of construction. • The official briefed about advantages of the proposed Project as its implementation will benefit all the neighborhood along the route; • Traffic congestions in the Project Area will be reduced.
11.	18-11-2024	KP Social Welfare Department (Child Protection Unit - CPO) KP Directorate of Social Welfare	Mr. Akhtar Muneer – Child Protection Officer Mr. Nayyab Ali - Social Case worker Mr. Haris Khan, Social Case worker	The official provided following suggestions/recommendations: • Build waiting rooms for commuters to provide shelter from harsh weather conditions. • Construct underground pedestrian crossings as they are more feasible and can also serve commercial purposes (e.g., shops). • Recommend underground passes in nearby and adjacent crowded areas. • Install visible signboards with clear instructions and emergency contact numbers. • Develop a green belt adjacent to the road with small forested areas and a playground for children. • Remove billboards in the area to reduce distractions for drivers. • Road Divider Installation: Install road dividers to prevent glare from opposite traffic
12.	19-11-2024	KP Social Welfare Department (Women Empowerment) KP Directorate of Social Welfare	Mr. Noor Muhammad, District Social welfare Officer Mr. Sardar Ali, District Social welfare Officer (NGO) Mr. Sahib, auxiliary works Musa Khan, Junior Clerk	The official provided following suggestions/recommendations • Passenger waiting rooms • Zebra crossing provision for the local population • Schools are located adjacent to the road; special precautions need to be considered • Road blockage during construction may cause traffic congestion and traffic Jam, careful planning is required

Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
				• Overhead bridges and flyover need to be designed
13.	19-11-2024	Labour Department Government of Khyber Pakhtunkhwa KP Directorate of labour	Mr. Irfan, Director Labour Mr. Zaheer, PA to Director labour Mr. Azhar, Assistant Director Administration	The official provided following suggestions: • Compliance with Minimum wages and local labour laws to be ensured • Discourage child labour and forced labour • Implementation of CSR activities to support local people • Development of robust Environmental and Social Management plan to minimize the negative impacts on the community
14.	19-11-2024	Secours Islamique France (Islamic Relief France) **Non-Governmental Organization**	Mr. Asif Anwar, livelihood Officer Mr. Mansoor Ahmed, Meal Officer KP Ms. Sanam – Distribution Assistant, Ms. Azra, Meal Assitant, Ms. Beenish, Livelihood Assistant	The official provided following feedback: • Positive Impacts and Suggestions o Benefits of the Project, Reduction in accidents and traffic congestion. o Improved business opportunities and growth for local communities. • Potential Issues that may arise during construction, o the Project construction may lead to environmental impacts and social issues in the area. o Resettlement of local residents and disruption to livelihoods are potential negative outcomes. o Social disconnection between the two sides of the area could occur due to road division o Construct flyovers, overhead bridges, and fencing to prevent road accidents, especially involving children. o Address traffic congestion during construction and operational phases. • Mitigation Measures the stakeholder suggested are, o To coordinate with all stakeholders in and around the area. o Compensate affected individuals through proper resettlement packages. o Address livelihood disruptions by providing alternative means of income (e.g., skill development programs). o Tree plantation in affected areas to minimize

Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
				environmental impact. • Community Support Initiatives o Launch skill development programs such as mobile repair training, poultry farming, and indoor poultry farms. o Provide seeds to encourage kitchen gardening in the community.
15.	19-11-2024	Foundation for Rural Development- (FRD) Non-Governmental Organization	Ms. Shumaila Murtaza, Meal Manager Ms. Sana Ibraheem, HR	The official provided following suggestions: • Concerns: o Possible tree cutting for the Project. o Issues for local women during the construction phase (e.g., accessibility and safety). o Issues related to Parda (Religious sensitivity) in the local Area o Gender Based Violence (GBV) o Transportation issues in the area • Recommendations during construction Phase: o Focus on greenery and reforestation efforts post-construction. o Design separate transport stops for men and women for cultural sensitivity. o Initiatives for the protection of women like Ababeel force etc. o Construct waiting rooms, zebra crossings, and flyovers to enhance pedestrian safety. o Ensure school road accessibility to avoid blockages that inconvenience residents. o Prioritize safety measures such as fencing, flyovers, and pedestrian crossings o Initiate compensation and community programs to reduce social and economic disruption. • Operational Phase Recommendations

Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
				o Capacity Building, Conduct training programs on gender-based violence (GBV) and local demand-driven skills. o Form committees involving women for inclusive planning and execution. o Infrastructure Enhancements o Build underpasses and overhead bridges for safer pedestrian access. o Separate transport stops for men and women.
Punjab Province				
16.	10-10-2024	Environmental Protection & Climate Change Department	Mr. Waseem Ahsan (Director – EIA) Mr. Noor Ahmad (Deputy Director – EIA)	• Official direct to seek NOC and approval from EPA as per the regulatory requirement prior to initiate the work. • Dust control in the area should be ensured. Dust suppressors (salt / water) preferably $CaCl_2$ should be sprayed on roadside. • Ensure minimal impact to nearby cities and communities. • Construction camps and asphalt plants should be installed away from the population. • Asphalt plants should preferably have a built-in pollution control technology. • Construction material disposal and transportation should be done properly as per existing laws.
17.	10-10-2024	Tourism, Archaeology and Museums Department	Ms. Sadaf Zafar (Additional Secretary) Mr. Iqbal Khan Manj (Deputy Director – Admin)	• The official recommended that access roads to nearby tourist/ archeological sites should also be planned. • Archaeological sites within 200 – 300 ft. of distance from the Project area of impact should be avoided as much as possible. • Concerns were shown regarding the safety of Nicholson Tower which is located at Tarnol Pass on main GT Road in Rawalpindi to Burhan package. • A list of important archaeological sites of Punjab was shared with the consultant for assistance. It was preliminary observed that no notified archeological site exists in nearby ROW of N5. • Further meetings will be arranged for future planning at ESIA stage once the design of each package will be finalized.

Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
18.	14-10-2024	Wildlife Department	Mr. Khurram Amin (Additional Secretary-Technical)	• It was suggested that wildlife corridors should be considered in the Project design and special measures must be considered for crossing of these wildlife if encountered. • Maps with marked species territory and protected areas will be provided by the wildlife department at later stage after finalization of ROW/ design to the consultants for assistance.
19.	14-10-2024	Forest Department	Mr. Sajid Mahmood (Deputy Director – Admin) Mr. Haroon Abdullah (Assistant Director – Admin)	• The official informed that the median and roadside/ canal side/ railway line side plantation in whole Punjab is a protected forest area. • He shared list of relevant Division Forest Officers (DFOs) of Punjab who will provide relevant data to the consultant. • The official requested consultants to provide site plans and road maps to DFOs.
20.	10-10-2024	Social Welfare and Baitulmaal Department	Mr. Aslam Section Officer (Social Welfare) Mr. Shahid Iqbal Saroya – Section Officer – 0345-4042799 Mr. Muhammad Asif – PA to SS – 0333-4136827	• The official told that local people should be given employment opportunities in the proposed Project. • The official told that child labor should be strictly prohibited and due care and consideration should be given to the community health and safety
21.	21-11-2024	Child protection & Welfare Bureau Home Dept. Govt. of Punjab	Mr. Waseem Abbas – Media Officer Mr. Asif Nadeem – Social Protection Officer	The official discussed following points: • Provision for safe road crossing should be ensured, and overhead bridges should be constructed at suitable intervals to facilitate pedestrian movement. • Appropriate signage should be installed to indicate speed limits, particularly in areas near schools, to enhance safety for children. • Roads in the vicinity of schools should be fenced to prevent children from crossing haphazardly. • These measures are essential to minimize the risk of road accidents and ensure the safety of children and other pedestrians.
22.	21-11-2024	Women Development Department Govt. of Punjab	Ms. Naeem Afzal – Deputy Secretary Planning Mr. Shabbir Hussain – Admin Officer	The official discussed following points: • A dedicated pink lane should be established on the highway to ensure the safety and convenience of women commuters. • Road underpasses should be constructed to prevent dangerous crossings and ensure safe passage for women.

Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
				• Separate bus stops should be designated exclusively for women to reduce the risk of harassment and ensure their safety. • The design of the road should restrict public access to these specific stops, ensuring a secure environment for women. • Clear signboards should be placed along the road to indicate speed limits and provide other essential instructions for drivers. • Accessibility for women with disabilities should be incorporated, with proper indicators and instructions to cater to their specific needs.
23.	21-11-2024	Office of the DG Labour welfare Labour & Human resource Department Govt. of Punjab	Mr. Zubair Hassan Rajput	The official discussed following points: • Workers should receive their salaries on time, ensuring compliance with minimum wage standards. For example, with a minimum wage of 37,000 PKR, the daily wage should be calculated as 37,000 divided by 26, resulting in 1,423 PKR per day. • Compliance with daily working hours regulations must be ensured, and workers should be granted appropriate rest periods. • Personal protective equipment (PPE) such as long shoes, gloves, goggles, and helmets should be provided during construction activities, along with other necessary workplace safety precautions. • Overtime should be limited to a maximum of two hours per day. • Female employees should be entitled to maternity leave in accordance with labor laws. • Employers are required to sign contracts with employees, and an appointment letter should be provided to each worker. • Employees must be given relevant Standard Operating Procedures (SOPs) and Job Descriptions (JDs). • Signboards must be installed at construction sites to promote safety, and all activities should comply with the Occupational

Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
				Health and Safety Act of Punjab.
24.	21-11-2024	Punjab Rural Support Program (PRSP) Non-Governmental Organization	Nadeem Akram Siddiqui – Transport Officer – 0334-4201065	The official discussed following points: • Dividers should be installed along the highway with adequate width and height to prevent glare from oncoming traffic, ensuring better visibility and safety. • The socio-economic impact of the Project should be assessed, and compensation should be provided to local communities who are displaced or otherwise affected by the Project. • Workers and local residents may be impacted by dust and pollution during construction. Continuous water sprinkling should be implemented to minimize these environmental issues. • Tree plantation activities should be carried out promptly after the clearing of land, helping to restore the environment. • Upon Project completion, safety signs and toll-free emergency numbers should be displayed prominently, with specific attention to women's safety. Emergency contact numbers and rescue services should be easily accessible at suitable locations along the route. • Rest areas should be provided at 20-25-kilometer intervals, equipped with dispensaries, public washrooms, and law enforcement officers for added security. • Female staff should be employed in law enforcement agencies and ambulance services to ensure that women are catered to in a sensitive and appropriate manner during their travel. • Anti-fog measures should be implemented on the highway as per standard practices to improve visibility during low-visibility conditions.
25.	18-10-2024	NHA Maintenance Office	Mr. Iftekhar Sajid – GM Maintenance North Punjab (Regional Office Punjab) 0313-4319914	Team visited the regional office Punjab and met GM-Maintenance North Punjab. The official ensured to support the consultant in all aspects for the preparation of RAP documents and also provided the ROW data of Package 7. The office also facilities the team during the site reconnaissance and onsite briefing of available ROW.

Sr. No.	Date	Department/ Organization	Name/Designation	Concerns / Suggestions
				The team also requested to share the encroachment data and lease data on which the official responded that the encroachment data is not much reliable and updated however he assured to share the lease data with consultant for the priority packages.

Annex 8-1: Outline of Project Level Emergency Preparedness and Response Plan (EPRP)

1. BACKGROUND
2. POLICY AND GUIDELINES
    - 2.1 AIIB ESF - Emergency Preparedness Plan
    - 2.2 OSHA 3122
    - 2.3 OSHA 3990 and 29 CFR 1910.1030
3. SCOPE OF PLAN
4. MANAGEMENT OF EPRP
    - 4.1 Importance of the EPRP
    - 4.2 Purpose of the Plan
    - 4.3 Application of this EPRP
5. EPRP MANAGEMENT STRUCTURE
    - 5.1 Introduction
    - 5.2 The Emergency Response Team (ERT)
        - 5.2.1 Membership
        - 5.2.2 Meetings
        - 5.2.3 Meeting Place
        - 5.2.4 Function
    - 5.3 Incidence Response Center (IRT)
    - 5.4 The IRT
        - 5.4.1 Organization
        - 5.4.2 Resources
        - 5.4.3 Funding
        - 5.4.4 Emergency Contact List
        - 5.4.5 Reporting
    - 5.5 Training
6. PREVENTION
    - 6.1 Introduction
    - 6.2 Emergency Risk Management

Annex 10–1: Environmental Code of Practices (ECPs)

Introduction

The objective of the Environmental Code of Practices (ECPs) is to address all potential and general construction related impacts and risks during implementation of the Project. The ECPs consist of environmental and social management guidelines to be followed by the contractors for sustainable management of all environmental and social issues. These ECPs shall be annexed to the general conditions of all the contracts, including subcontracts, carried out under the Project.

The list of ECPs prepared for the Project is given below.

- ECP 1: Waste Management
- ECP 2: Fuels and Hazardous Goods Management
- ECP 3: Water Resources Management
- ECP 4: Drainage Management
- ECP 5: Soil Quality Management
- ECP 6: Erosion and Sediment Control
- ECP 7: Top Soil Management
- ECP 8: Topography and Landscaping
- ECP 9: Borrow Areas Development & Operation
- ECP 10: Air Quality Management
- ECP 11: Noise and Vibration Management
- ECP 12 Protection of Flora
- ECP 13: Protection of Fauna
- ECP 14: Road Transport and Road Traffic Management
- ECP 15: Construction Camp Management
- ECP 16: Cultural and Religious Issues
- ECP 17: Construction and Operation Phase Security

Contractors will prepare site specific management plans, namely Construction Environmental and Social Action Plan (CESAP) and Occupational Health and Safety Plan, in compliance with World Bank and Government Regulation and guidelines and based on the guidance given in the ECPs. The CESAP and OHS Plan will form the part of the contract documents and will be used as monitoring tool for compliance. It is mandatory for the main contractors procured directly by the project to include these ECPs in their subcontracts. Violation of the compliance requirements will be treated as non-compliance leading to the corrections or otherwise imposing penalty on the contractors.

ECP 1: Waste Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
General Waste	Soil and water pollution from the improper management of wastes and excess materials from the construction sites.	The Contractor shall • Develop site specific waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris, food waste etc.) prior to commencing of construction and submit to supervision consultant for approval. • Organize disposal of all wastes generated during construction in the designated disposal sites approved by the Project. • Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. • Segregate and reuse or recycle all the wastes, wherever practical. • Vehicles transporting solid waste shall be covered with tarps or nets to prevent spilling waste along the route. • Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. • Provide refuse containers at each worksite. • Request suppliers to minimize packaging where practicable. • Place a high emphasis on good housekeeping practices. • Maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal. • Potable water should be supplied in bulk containers to reduce the quantity of plastic waste (plastic bottles). Plastic bag use should be avoided.
Hazardous Waste	Health hazards and environmental impacts due to improper waste management practices	The Contractor shall • Collect chemical wastes in 200 liter drums (or similar sealed container), appropriately labeled for safe transport to an approved chemical waste depot. • Store, transport and handle all chemicals avoiding potential environmental pollution. • Store all hazardous wastes appropriately in bunded areas away from water courses. • Make available Material Safety Data Sheets (MSDS) for hazardous materials on-site during construction.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Collect hydrocarbon wastes, including lube oils, for safe transport off-site for reuse, recycling, treatment or disposal at approved locations. • Construct concrete or other impermeable flooring to prevent seepage in case of spills.

ECP 2: Fuels and Hazardous Goods Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Fuels and hazardous goods.	Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals and hazardous goods/materials on-site, and potential spills from these goods may harm the environment or health of construction workers.	The Contractor shall • Prepare spill control procedures and submit them for supervision consultant approval. • Train the relevant construction personnel in handling of fuels and spill control procedures. • Store dangerous goods in bunded areas on top of a sealed plastic sheet away from watercourses. • Refueling shall occur only within bunded areas. • Store and use fuels in accordance with material safety data sheets (MSDS). Make available MSDS for chemicals and dangerous goods on-site. • Transport waste of dangerous goods, which cannot be recycled, to a designated disposal site. • Provide absorbent and containment material (e.g., absorbent matting) where hazardous material are used and stored; and ensure personnel trained in the correct use. • Provide protective clothing, safety boots, helmets, masks, gloves, goggles, to the construction personnel, appropriate to materials in use. • Make sure all containers, drums, and tanks that are used for storage are in good condition and are labeled with expiry date. Any container, drum, or tank that is dented, cracked, or rusted might eventually leak. Check for leakage regularly to identify potential problems before they occur. • Store and use fuels in accordance with material safety data sheets (MSDSs).

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Store all liquid fuels in fully bunded storage containers, with appropriate volumes, a roof, a collection point and appropriate filling/decanting point. • Store hazardous materials above flood level considered for construction purposes • Put containers and drums in temporary storages in clearly marked areas, where they will not be run over by vehicles or heavy machinery. The area shall preferably slope or drain to a safe collection area in the event of a spill. • Take all precautionary measures when handling and storing fuels and lubricants, avoiding environmental pollution. • Avoid the use of material with greater potential for contamination by substituting them with more environmentally friendly materials.

ECP 3: Water Resources Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Hazardous material and Waste	Water pollution from the storage, handling and disposal of hazardous materials and general construction waste, and accidental spillage	The Contractor shall • Follow the management guidelines proposed in ECPs 1 and 2. • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways or storm water systems.
Discharge from construction sites	Construction activities, sewerages from construction sites and work camps may affect the surface water quality. The construction works will modify groundcover and topography changing the surface water drainage patterns of	The Contractor shall • Install temporary drainage works (channels and bunds) in areas required for sediment and erosion control and around storage areas for construction materials. • Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from site.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
	the area. These changes in hydrological regime lead to increased rate of runoff, increase in sediment and contaminant loading, increased flooding, and effect habitat of fish and other aquatic biology.	• Divert runoff from undisturbed areas around the construction site. • Stockpile materials away from drainage lines • Prevent all solid and liquid wastes entering waterways by collecting solid waste, oils, chemicals, bitumen spray waste and wastewaters from brick, concrete and asphalt cutting where possible and transport to an approved waste disposal site or recycling depot. • Wash out ready-mix concrete agitators and concrete handling equipment at washing facilities off site or into approved bunded areas on site. Ensure that tires of construction vehicles are cleaned in the washing bay (constructed at the entrance of the construction site) to remove the mud from the wheels. This should be done in every exit of each construction vehicle to ensure the local roads are kept clean.
Soil erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion. • Ensure that roads used by construction vehicles are swept regularly to remove dust and sediment. • Water the loose material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g., high winds).
Construction activities in water bodies	Construction works in the water bodies will increase sediment and contaminant loading, and effect habitat of fish and other aquatic biology.	The Contractor Shall • Dewater sites by pumping water to a sediment basin prior to release off site – do not pump directly off site. • Monitor the water quality in the runoff from the site or areas affected by dredge/excavation plumes, and improve work practices as necessary. • Protect water bodies from sediment loads by silt screen or other barriers. • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		chemical wastes). These substances must not enter waterways or storm water systems. • Do not discharge cement and water curing used for cement concrete directly into water courses and drainage inlets.
Drinking water	Untreated surface water is not suitable for drinking purposes due to presence of suspended solids and ecoli.	The Contractor Shall • Provide the drinking water that meets NEQS standards. Drinking water to be chlorinated at source, and ensure presence of residual chlorine 0.1 ~ 0.25 ppm as minimum after 30 minutes of chlorine contact time.

ECP 4: Drainage Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Excavation and earth works, and construction yards	Lack of proper drainage for rainwater/liquid waste or wastewater owing to the construction activities harms environment in terms of water and soil contamination, and mosquito growth.	The Contractor shall • Prepare drainage management procedures and submit them for supervision consultant approval. • Prepare a program to prevent/avoid standing waters, which supervision consultant will verify in advance and confirm during implementation. • Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line. • Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there. • Rehabilitate road drainage structures immediately if damaged by contractors' road transports. • Build new drainage lines as appropriate and required for wastewater from construction yards connecting to the available nearby recipient water bodies. Ensure wastewater quality conforms to NEQS, before it is being discharged into the recipient water bodies.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Ensure that there will be no water stagnation at the construction sites and camps. • Provide appropriate silt collector and silt screen at the inlet and manholes and periodically clean the drainage system to avoid drainage congestion. • Protect natural slopes of drainage channels to ensure adequate storm water drains. • Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem.
Ponding of water	Health hazards due to mosquito breeding	• Do not allow ponding of water especially near the waste storage areas and construction camps. • Discard all the storage containers that are capable of storing of water, after use or store them in inverted position.

ECP 5:Soil Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Storage of hazardous and toxic chemicals	Spillage of hazardous and toxic chemicals will contaminate the soils	The Contractor shall • Strictly manage the wastes management plans proposed in ECP1 and storage of materials in ECP2. • Construct appropriate spill contaminant facilities for all fuel storage areas. • Establish and maintain a hazardous material register detailing the location and quantities of hazardous substances including the storage, and their disposals. • Train personnel and implement safe work practices for minimizing the risk of spillage. • Identify the cause of contamination, if it is reported, and contain the area of contamination. The impact may be contained by isolating the source or implementing controls around the affected site.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Remediate the contaminated land using the most appropriate available method.
Construction material stock piles	Erosion from construction material stockpiles may contaminate the soils	The Contractor shall • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds.

ECP 6: Erosion and Sediment Control

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Clearing of construction sites	Cleared areas and slopes are susceptible for erosion of top soils, which affects the growth of vegetation and causes ecological imbalance.	The Contractor shall • Prepare site specific erosion and sediment control measures and submit them for supervision consultant approval. • Reinstate and protect cleared areas as soon as possible. • Cover unused area of disturbed or exposed surfaces immediately with mulch/grass turf/tree plantations.
Construction activities and material stockpiles	The impact of soil erosion are (i) Increased run off and sedimentation causing a greater flood hazard to the downstream, and (ii) destruction of aquatic environment by erosion and/or deposition of sediment damaging the spawning grounds of fish	The Contractor shall • Locate stockpiles away from drainage lines. • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds. • Remove debris from drainage paths and sediment control structures. • Cover the loose sediments of construction material and water them if required. • Divert natural runoff around construction areas prior to any site disturbance. • Install protective measures on site prior to construction, for example, sediment traps. • Install ‘cut off drains’ on large cut/fill batter slopes to control water runoff speed and hence erosion.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Observe the performance of drainage structures and erosion controls during rain and modify as required.
Soil erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion. • Ensure that roads used by construction vehicles are swept regularly to remove sediment. • Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds).

ECP 7: Top Soil Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth or agricultural development.	The Contractor shall • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m. • Remove unwanted materials from top soil like grass, roots of trees and similar others. • The stockpiles will be done in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil. • Locate topsoil stockpiles in areas outside drainage lines and protect from erosion. • Construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil. • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Prior to the re-spreading of topsoil, the ground surface will be ripped to assist the bunding of the soil layers, water penetration and revegetation
Transport	Vehicular movement outside ROW or temporary access roads will affect the soil fertility of the agricultural lands	• Limit equipment and vehicular movements to within the approved construction zone. • Plan construction access to make use, if possible, of the final road alignment.

ECP 8: Topography and Landscaping

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Construction activities especially earthworks will change topography and disturb the natural rainwater/flood water drainage as well as will change the local landscape.	The Contractor shall • Prepare landscaping and plantation plan and submit the plan for supervision consultant approval. • Ensure the topography of the final surface of all raised lands (construction yards, approach roads and rails, access roads, etc.) are conducive to enhance natural draining of rainwater/flood water. • Keep the final or finished surface of all the raised lands free from any kind of depression that causes water logging. • Undertake mitigation measures for erosion control/prevention by grass-turfing and tree plantation, where there is a possibility of rain-cut that will change the shape of topography. • Cover immediately the uncovered open surface that has no use of construction activities with grass-cover and tree plantation to prevent soil erosion and bring improved landscaping. • Reinstate the natural landscape of the ancillary construction sites after completion of works.

ECP 9: Borrow Areas Development & Operation

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Development and operation of borrow and quarry areas	Borrow and quarry areas will have impacts on local topography, landscaping and natural drainage.	The Contractor shall • Prepare borrow area management plan and submit the plan for supervision consultant approval. • Use only approved quarry and borrow sites • Identify new borrow and quarry areas in consultation with Project Director, if required. • Reuse excavated or disposed material available in the project to the maximum extent possible. • Store top soil for reinstatement and landscaping. • Develop surface water collection and drainage systems, anti-erosion measures (berms, revegetation etc.) and retaining walls and gabions where required. Implement mitigation measures in ECP 3: Water Resources Management, ECP 6: Erosion and Sediment Control • The use of explosive should be used in as much minimum quantity as possible to reduce noise, vibration and dust. • Control dust and air quality deterioration by application of watering and implementing mitigation measures proposed in ECP 10: Air Quality Management • Noise and vibration control by ECP 11: Noise and Vibration Management.

ECP 10: Air and Dust Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Air quality can be adversely affected by vehicle exhaust emissions and combustion of fuels.	The Contractor shall • Prepare air quality management plan (under the Pollution Prevention Plan) and submit the plan for supervision consultant approval. • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner. • Cover hauls vehicles carrying dusty materials moving outside the construction site. • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions. • Control the movement of construction traffic. • Water construction materials prior to loading and transport. • Service all vehicles regularly to minimize emissions. • Limit the idling time of vehicles not more than 2 minutes.
Construction machinery	Air quality can be adversely affected by emissions from machinery and combustion of fuels.	The Contractor shall • Fit machinery with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition in accordance with the specifications defined by their manufacturers to maximize combustion efficiency and minimize the contaminant emissions. Proof or maintenance register shall be required by the equipment suppliers and contractors/subcontractors. • Focus special attention on containing the emissions from generators. • Machinery causing excess pollution (e.g. visible smoke) will be banned from construction sites. • Service all equipment regularly to minimize emissions. • Provide filtering systems, duct collectors or humidification or other techniques (as applicable) to the concrete batching and mixing plant to control the particle

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		emissions in all its stages, including unloading, collection, aggregate handling, cement dumping, circulation of trucks and machinery inside the installations.
Construction activities	Dust generation from construction sites, material stockpiles and access roads is a nuisance in the environment and can be a health hazard, and also can affect the local crops;	The Contractor shall • Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. Increase the watering frequency during periods of high risk (e.g. high winds). Stored materials such as gravel and sand shall be covered and confined to avoid their being wind-drifted. • Minimize the extent and period of exposure of the bare surfaces. • Restore disturbed areas as soon as practicable by vegetation/grass-turfing. • Store the cement in silos and minimize the emissions from silos by equipping them with filters. • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations. • Not water as dust suppression on potentially contaminated areas so that a liquid waste stream will be generated. • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems. • Not permit the burning of solid waste.

ECP 11: Noise and Vibration Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Noise quality will be deteriorated due to vehicular traffic	The Contractor shall • Prepare a noise and vibration management plan (under the Pollution Prevention Plan) and submit the plan for supervision consultant approval. • Maintain all vehicles in order to keep it in good working order in accordance with manufactures maintenance procedures. • Make sure all drivers will comply with the traffic codes concerning maximum speed limit, driving hours, etc.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise on the work site.
Construction machinery	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Appropriately site all noise generating activities to avoid noise pollution to local residents. • Use the quietest available plant and equipment. • Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures. Equipment suppliers and contractors shall present proof of maintenance register of their equipment. • Install acoustic enclosures around generators to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment. • Avoid the unnecessary use of alarms, horns and sirens.
Construction activity	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Notify adjacent landholders prior any typical noise events outside of daylight hours. • Educate the operators of construction equipment on potential noise problems and the techniques to minimize noise emissions. • Employ best available work practices on-site to minimize occupational noise levels. • Install temporary noise control barriers where appropriate. • Notify affected people if major noisy activities will be undertaken, e.g. blasting. • Plan activities on site and deliveries to and from site to minimize impact. • Monitor and analyze noise and vibration results and adjust construction practices as required. • Avoid undertaking the noisiest activities, where possible, when working at night near the residential areas.

ECP 12: Protection of Flora

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Vegetation clearance	Local flora are important to provide shelters for the birds, offer fruits and/or timber/fire wood, protect soil erosion and overall keep the environment very friendly to human-living. As such damage to flora has wide range of adverse environmental impacts.	The Contractor shall • Prepare a plan for protection of flora and submit the plan for supervision consultant approval. • Minimize disturbance to surrounding vegetation. • Use appropriate type and minimum size of machine to avoid disturbance to adjacent vegetation. • Get approval from supervision consultant for clearance of vegetation. • Make selective and careful pruning of trees where possible to reduce need of tree removal. • Control noxious weeds by disposing of at designated dump site or burn on site. • Clear only the vegetation that needs to be cleared in accordance with the engineering plans and designs. These measures are applicable to both the construction areas as well as to any associated activities such as sites for stockpiles, disposal of fill a, etc. • Not burn off cleared vegetation – where feasible, chip or mulch and reuse it for the rehabilitation of affected areas, temporary access tracks or landscaping. Mulch provides a seed source, can limit embankment erosion, retains soil moisture and nutrients, and encourages re-growth and protection from weeds. • Return topsoil and mulched vegetation (in areas of native vegetation) to approximately the same area of the roadside it came from. • Avoid work within the drip-line of trees to prevent damage to the tree roots and compacting the soil. • Minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible. • Ensure excavation works occur progressively and re-vegetation done at the earliest • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Supply appropriate fuel in the work camps to prevent fuel wood collection.

ECP 13: Protection of Fauna

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities	The location of construction activities can result in the loss of wild life habitat and habitat quality,	The Contractor shall • Prepare a plan for protection of fauna and submit the plan for supervision consultant approval. • Limit the construction works within the designated sites allocated to the contractors. • Check the site for animals trapped in, or in danger from site works and use a qualified person to relocate the animal.
	Impact on migratory birds, its habitat and its active nests	The Contractor shall • Not be permitted to destruct active nests or eggs of migratory birds. • Minimize the tree removal during the bird breeding season. If works must be continued during the bird breeding season, a nest survey will be conducted by a qualified biologist prior to commence of works to identify and locate active nests. • If bird nests are located/ detected within the ledges and roadside embankments then those areas should be avoided. • Petroleum products should not come in contact with the natural and sensitive ecosystems. Contractor must minimize the release of oil, oil wastes or any other substances harmful to migratory birds' habitats, to any waters, wetlands or any areas frequented by migratory birds.
Vegetation clearance	Clearance of vegetation may impact shelter, feeding and/or breeding and/or physical destruction and severing of habitat areas	The Contractor shall • Restrict the tree removal to the minimum numbers required. • Relocate hollows, where appropriate. • Fell the hollow bearing trees in a manner which reduces the potential for fauna mortality. Felled trees will be inspected after felling for fauna and if

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		identified and readily accessible will be removed and relocated or rendered assistance if injured. After felling, hollow bearing trees will remain unmoved overnight to allow animals to move of their own volition.
Night time lighting	Lighting from construction sites and construction camps may affect the visibility of night time migratory birds that use the moon and stars for navigation during their migrations.	The Contractor shall • Use lower wattage flat lens fixtures that direct light down and reduce glare, thus reducing light pollution, • Avoid flood lights unless they are absolutely required. • Use motion sensitive lighting to minimize unneeded lighting. • Use, if possible, green lights that are considered as bird's friendly lighting instead of white or red colored lights. • Install light shades or plan the direction of lights to reduce light spilling outside the construction area.
Construction camps	Illegal poaching	The Contractor shall • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching. • Ensure that staff and Subcontractors are trained and empowered to identify, address and report potential environmental problems.

ECP 34: Road Transport and Road Traffic Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Increased traffic use of road by construction vehicles will affect the movement of normal road traffics and the safety of the road-users.	The Contractor shall • Prepare a traffic management plan and submit the plan for supervision consultant approval. • Strictly follow the Project's 'Traffic Management Plan' and work with close coordination with the Traffic Management Unit.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Prepare and submit additional traffic plan, if any of his traffic routes are not covered in the Project's Traffic Management Plan, and requires traffic diversion and management. • Include in the traffic plan to ensure uninterrupted traffic movement during construction: detailed drawings of traffic arrangements showing all detours, temporary road, temporary bridges temporary diversions, necessary barricades, warning signs / lights, road signs etc. • Provide signs at strategic locations of the roads complying with the schedules of signs contained in the National Traffic Regulations.
	Accidents and spillage of fuels and chemicals	The Contractor shall • Restrict truck deliveries, where practicable, to day time working hours. • Restrict the transport of oversize loads. • Operate vehicles, if possible, to non-peak periods to minimize traffic disruptions. • Enforce on-site speed limit. • Report any accident within 12-24 hours.

ECP 45: Construction Camp Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Siting and Location of construction camps	Campsites for construction workers are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.	The Contractor shall • Prepare a construction camp management plan ensuring labor influx management and submit the plan to NTDC, WB and supervision consultant for approval. • Locate the construction camps within the designed sites or at areas which are acceptable from environmental, cultural or social point of view.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Consider the location of construction camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • Submit to the supervision consultant for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters.
Construction Camp Facilities	Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	Contractor shall provide the following facilities in the campsites • Consider impacts of camps on local communities, keep distance and educate workers on code of conduct. • Adequate housing for all workers. • Safe and reliable water supply, which should meet NEQS. Drinking water to be chlorinated at source, and ensure presence of residual chlorine 0.1 ~ 0.25 ppm as minimum after 30 minutes of chlorine contact time (WHO guideline). • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. Provide separate latrines and bathing places for males and females with total isolation by location. The minimum number of toilet facilities required is one toilet for every ten persons. • Treatment facilities for sewerage of toilet and domestic wastes. • Storm water drainage facilities. • Paved internal roads.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Provide in-house community/common entertainment facilities. Dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Disposal of waste	Management of wastes is crucial to minimize impacts on the environment	The Contractor shall • Ensure proper collection and disposal of solid wastes within the construction camps. • Insist waste separation by source; organic wastes in one container and inorganic wastes in another container at household level. • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed. • Do not establish site specific landfill sites. All solid waste will be collected and removed from the work camps and disposed in approval waste disposal sites.
Fuel supplies for cooking purposes	Illegal sourcing of fuel wood by construction workers will impact the natural flora and fauna	The Contractor shall • Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Made available alternative fuels like natural gas or kerosene on ration to the workforce to prevent them using biomass for cooking. • Conduct awareness campaigns to educate workers on preserving the protecting the biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	Increased risk of communicable diseases and burden on local health services to be transmitted including malaria, exacerbated by inadequate health and safety practices.	The Contractor shall • Provide adequate health care facilities within construction sites. • Provide first aid facility round the clock. Maintain stock of medicines in the facility and appoint fulltime designated first aider or nurse.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas. • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work. • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellant sprays during rainy season in offices and construction camps and yards. • Not dispose food waste openly as that will attract rats and stray dogs. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. Place display boards at strategic locations within the camps containing messages on best hygienic practices.
Safety	In adequate safety facilities to the construction camps may create security problems and fire hazards	The Contractor shall • Provide appropriate security personnel (police or private security guards) and enclosures to prevent unauthorized entry in to the camp area. • Maintain register to keep a track on a head count of persons present in the camp at any given time. • Encourage use of flameproof material for the construction of labor housing / site office. Also, ensure that these houses/rooms are of sound construction and capable of withstanding wind storms/cyclones. • Provide appropriate type of firefighting equipment suitable for the construction camps • Display emergency contact numbers clearly and prominently at strategic places in camps. • Communicate the roles and responsibilities of laborers in case of emergency in the monthly meetings with contractors.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Social and cultural aspect for Camp setup	Labor Influx in the project area will have risk of social conflict, illicit behavior and crime, burden on and competition for public service provision	The Contractor will • The Contractor will schedule construction time particularly near the settlements, to cause least disturbance to the local population, particularly women. • Contractor will take due care of the local community and observe sanctity of local customs and traditions by his staff. Contractor will warn the staff strictly not to involve in any unethical activities and to obey the local norms and cultural restrictions. • The Contractor will carry out the construction activities in such a way that the open defecation timings by the local community should not be affected. The normal defecation timings are early in the morning and at late in the evening. So, the Contractor will have to take care of these timings. • During construction activities, if privacy of the nearby households is affected, the Contractor will inform the house owner to make some arrangements. Similarly, Contractor will take care as much as possible that the construction activities should not affect the privacy. • The Contractor will also ensure that noise and light pollution from the labor camp is kept at minimal levels especially at night. • Ensure an operational Grievance Mechanism, accessible to the public, is available.
Site Restoration	Restoration of the construction camps to original condition requires demolition of construction camps.	The Contractor shall • Dismantle and remove from the site all facilities established within the construction camp including the perimeter fence and lockable gates at the completion of the construction work. • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed. • Give prior notice to the laborers before demolishing their camps/units. • Maintain the noise levels within the national standards during demolition activities.

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		• Different contractors should be hired to demolish different structures to promote recycling or reuse of demolished material. • Reuse the demolition debris to a maximum extent. Dispose remaining debris at the designated waste disposal site. • Handover the construction camps with all built facilities as it is if agreement between both parties (contactor and land-owner) has been made so. • Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner.

ECP 56: Cultural and Religious Issues

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities near religious and cultural sites	Disturbance from construction works to the cultural and religious sites, and contractors lack of knowledge on cultural issues cause social disturbances.	The Contractor shall • Communicate to the public through community consultation regarding the scope and schedule of construction, as well as certain construction activities causing disruptions or access restriction. • Not block access to cultural and religious sites, wherever possible. • Restrict all construction activities within the foot prints of the construction sites. • Stop construction works that produce noise (particularly during prayer time) should there be any mosque/religious/educational institutions close to the construction sites and users make objections. • Take special care and use appropriate equipment when working next to a cultural/religious institution. • Stop work immediately and notify the site manager if, during construction, an archaeological or burial site is discovered. It is an

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
		offence to recommence work in the vicinity of the site until approval to continue is given. • Provide separate prayer facilities to the construction workers. • Show appropriate behavior with all construction workers especially women and elderly people. • Allow the workers to participate in praying during construction time. • Resolve cultural issues in consultation with local leaders and supervision consultants. • Establish a mechanism that allows local people to raise grievances arising from the construction process. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works so as to maintain effective surveillance over public health, social and security matters.

ECP 17: Construction and Operation Phase Security

Project Activity/ Impact Source	Impacts /Concerns	Mitigation Measures/ Management Guidelines
Construction Phase	Inadequate construction site security poses a significant risk to assets, construction materials and property. Theft/vandalism of assets, materials and property would increase construction costs and cause delays in project completion.	The Contractor shall: • Provide appropriate security personnel (i.e. security guards) to prevent unauthorized entry into the camp area. • Employ night watchman for periods of significant on-site storage or when the area necessitates. • Ensure all assets (i.e., tools, equipment, etc.) and construction materials at construction site are identified, inventoried and tracked as closely as possible. All assets should be clearly labeled and marked. Keep records of tool serial numbers and check inventory on a regular basis.

Project Activity/ Impact Source	Impacts /Concerns	Mitigation Measures/ Management Guidelines
		• All tools and equipment should have a check out/in system, if not in use should be secured and stored in a proper place to prevent theft or loss. Provide storage sheds for the secure storage of equipment and tools when not in use. • Ensure there is proper fencing around construction site perimeter. Fencing should be chain-link at least 2.4 m high and secured with a steel chain and lock. If possible the entire site should be fenced; if this is not possible, make sure construction trailer and any equipment storage areas are fenced. • Ensure construction site has controlled access points (one or two entry points at most), allowing for close monitoring of comings and goings from the site. • Workers should be easily identified and have credentials that indicate site access. • No trespassing signs should be posted in conspicuous areas throughout the job site. • List of employees who have after hour access to the property should be available to the BWB and local authorities. • Ensure job site is properly lighted at night. Well-lit areas should include any office trailers and equipment storage trailers. Floodlights operated by sensors should also be installed where appropriate. • Pre-employment screening investigations should be used to verify the applicants relating to their employment, education and criminal history background.
	Improper security measures may pose security risk for construction workers and especially foreign staff on construction sites.	The Contractor shall: • Prepare site specific security plan. • Maintain register to keep track of number of persons present in the camp at any given time. • Provide appropriate security personnel at job sites as mentioned above.

Project Activity/ Impact Source	Impacts /Concerns	Mitigation Measures/ Management Guidelines
		• Ensure proper fencing as mentioned above. • Ensure controlled access points to job site as mentioned above. • Ensure works have easily identified credentials as mentioned above. • Ensure job sites are properly lighted at night, as mentioned above.
Operation Phase	Vandalism/damage (including use of explosives) and theft of infrastructure (i.e. metals and etc.).	• Ensure strategic infrastructure sites are secure and fenced with controlled access points. Fencing should be chain-link at least 2.4 m high and secured with a steel chain and lock.

Annex 10-2: Plantation Plan

The basic purpose of afforestation/plantation of suitable species in the project area is to reduce the risk been made due to different construction activities for the proposed project. The expected risk made will be compensated by planting of saplings to enhance green cover and improve the overall environment of the area. Afforestation will not only reduce the risk been made but will also increase the Green cover, carrying capacity and aesthetics of the area along with many positive aspects and impacts.

Plantation will be done after the construction work immediately. Plantation of indigenous trees species is highly important to maintain the biodiversity and ecological balance. It is also important to prevent global warming, soil erosion and pollution. Afforestation purifies the environment and helps in reducing the carbon dioxide level. Along with the importance of construction, the afforestation activity will further help in enhancing the socio-economic condition of the area and project sustainability.

Note: *The National Highway Authority and Forest Department may be engaged for carrying out the proposed activates.*

IMPORTANCE OF TREE PLANTATION

- Trees contribute to their environment by providing oxygen, improving air quality, climate amelioration, conserving water, preserving soil, and supporting wildlife.
- Trees control climate by moderating the effects of the sun, rain and wind. Leaves absorb and filter the sun's radiant energy, keeping things cool in summer.
- Trees also preserve warmth by providing a screen from harsh wind.
- Trees also lower the air temperature and reduce the heat intensity of the greenhouse effect by maintaining low levels of carbon dioxide.
- Both above and below ground, trees are essential to the eco-systems in which they reside.
- Trees absorb and store rainwater which reduce runoff and sediment deposit after storms. This helps the ground water supply recharge, prevents the transport of chemicals into streams and prevents flooding.
- Trees, shrubs and turf also filter air by removing dust and absorbing other pollutants like carbon monoxide, sulfur dioxide and nitrogen dioxide.

OBJECTIVES

- To Restore native species
- To improve the quality of air and reduce its pollution
- To add color to the landscape and enhances the beauty of the environment
- To uplift the quality of our living environment through active planting, proper maintenance and preservation of trees together with other vegetation.
- To Protect and conserve flora and fauna of the project area.
- To attract rain which is a positive impact on the project area at all.
- To reduce sedimentation by plantation in the project area which will act as protection wall against wind born dust particles.

AREA ENHANCEMENT PLAN

Plants will be raised along the nearby available project area or along roads, two on either side of the road. Distance from the outer boundary of the ROW and between two plants will be kept as 4 meters. Total number of plants to be planted is **25,500** Number for Section 2 , **23,420** for Section 7, and **34,980** Number for Section 8.

**The Forest Department or concerned authority may update the standards of planting and choice of species as per the requirements and suitability.*

Trees Recommended

Following trees are recommended for plantation, along this portion of the road on both sides.

Sr. No.	Local Name	*Scientific Name*
	Peshawar – Nowshera Section	
1.	Mulberry	*Morus alba*
2.	Chir Pine	*Pinus roxburghii*
3.	Bottle Brush	*Callistemon spp*
4.	Phulai	*Acacia Modesta*
	Rawalpindi –Burhan Section	
5.	Sukh Chain	*Pongamia pinnata*
6.	Bottle Brush	*Callistemon spp*
7.	Kikar & Phulai	*Acacia nilotica & Modesta*
8.	Sirris	*Acacia lebbek*
9.	Jacarnda	*Jacaranda moniosifolia*
10.	Silver Oak	*Grevillea robusta*
11.	*Shisham*	*Dalbergia sissoo*
12.	Jaman	*Eugenia jambolina*
13.	Kachnar	*Bauhinia variegate*
	Ranipur - Rohri Section	
14.	Babul	*Acacia nilotica*
15.	Neem	*Azadirachta indica*
16.	Shisham	*Dalbergia Sisso*
17.	Parkinsonia	*Parkinsonia aculeata*

Cost

Break-up of Expenditure per Avenue kilometer @ Rs. 1500/- per diem: Break-up of Expenditure per Avenue kilometer or 250 plants @ Rs. 1500/- per diem:

<u>FIRST YEAR</u>

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	Layout	1 Av.km	2 MD/Av.km	3000.00
2.	Digging of Pits 2.5 ft. each 2.5x250 = 625 cft.	625 cft.	5 MD/Av.km	7500.00
3.	Cost of Plants including	250 No.	Rs100/- plant	25,000.00
4.	Cost of planting of plants	250 No.	Rs. 25/- plant	6250.00
5.	Carriage of plants from private nursery to site including loading/unloading	250 No.	Rs. 10/- plant	2500.00
6.	Cost of Manure and Bhall (silt) including carriage	1 Av. Km		20,000.00
7.	H/watering 50 times 250x50 with water bowser, one driver and one coolie	12500 no.	5MD/per %0	100,000.00
8.	Weeding twice 250x2	500 no.	2 MD/per %	15,000.00
9.	Reopening of Pits twice (250x2)/cft/pit	500 cft.	2 MD/per %	15,000.00
10.	Unforeseen			5885.00
Total				200,135.00

SECOND YEAR

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	Cost of Plants 20% Restocking	50 No.	Rs.100/- plant	5,000.00
2.	Cost of planting	50 No.	Rs. 25/- plant	1250.00
3.	Carriage of plants	50 No.	Rs. 10/- plant	500.00
4.	H/watering 50 times with water bowser, one driver and one coolie	12500 no.	5MD/per %0	100,000.00
5.	Reopening of Pits twice (250x2)	500 cft.	2 MD/per %	1,5000.00
6.	Weeding twice 250x2	500 no.	2 MD/per %	1,5000.00
7.	Unforeseen			1250.00
Total				1,38,000.00

THIRD YEAR

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	Cost of Plants 10% Restocking 25 No.	25 No.	Rs.100/- plant	2500.00
2.	Cost of planting	25 No.	Rs. 25/- plant	625.00
3.	Carriage of plants	25 No.	Rs. 10/- plant	250.00
4.	H/watering 40 times x250 no.	10,000 no.	5MD/per %0	75000.00
5.	Reopening of Pits twice (250x2)	500	5MD/per %0	3850.00
6.	Unforeseen			2875.00
Total				85,100.00

FOURTH YEAR

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	H/watering 30 times	7500 no.	5MD/per %0	56350.00
5.	Pruning and cleaning of plants	250 no.	5MD/per %0	1875.00
6.	Unforeseen			1875.00
Total				60,100.00

FIFTH YEAR

Sr. No.	Item	Quantity	Rate	Amount (Rs.)
1.	H/watering 30 times	7500 no.	5MD/per %0	52350.00
5.	Pruning and cleaning of plants	250 no.	5MD/per %0	1875.00
6.	Unforeseen			1875.00
Total				56,100.00

Cost for raising 1 Av. Km and Maintenance or 250 plants in a single row: = Rs.539,435/- For 5 years

Peshawar Nowshera Section
Total cost for **35,000** plants and their maintenance for 5 years = **PKR. 75,520,900/-**

Rawalpindi Burhan Section
Total cost for **23,500** plants and their maintenance for 5 years = **PKR. 50,706,890/-**

Ranipur to Rohri Section
Total cost for **25,500** plants and their maintenance for 5 years = **PKR. 55,022,370/-**

***The above calculations and standards are approximate and tentative provided on the basis of available data which may be updated by the implementing agency as per actual, during implementation.*

VOLUME 3: CLIMATE CHANGE ASSESSMENT

NATIONAL HIGHWAY AUTHORITY
GOVERNMENT OF PAKISTAN

WIDENING & IMPROVEMENT OF PRIORITY SECTIONS OF N-5

RANIPUR - SUKKUR ROAD SECTION

CLIMATE CHANGE ASSESSMENT, HYDROLOGICAL AND HYDRAULIC STUDIES FOR CROSS DRAINAGE STRUCTURES REPORT

JANUARY 2025

Irfan

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
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CLIMATE CHANGE ASSESSMENT, HYDROLOGICAL AND HYDRAULIC STUDIES FOR CROSS DRAINAGE STRUCTURES REPORT RANIPUR – SUKKUR SECTION

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**WIDENING & IMPROVEMENT OF PRIORITY
SECTIONS OF N-5
RANIPUR – SUKKUR ROAD SECTION**

CLIMATE CHANGE STUDIES

1. INTRODUCTION

The N5 road, a critical transportation artery, is undergoing an expansion from 4 lanes to 6 lanes to accommodate increasing traffic demand and promote regional economic growth. As part of this expansion, it is essential to assess the potential risks associated with climate change to ensure the long-term resilience and sustainability of the infrastructure.

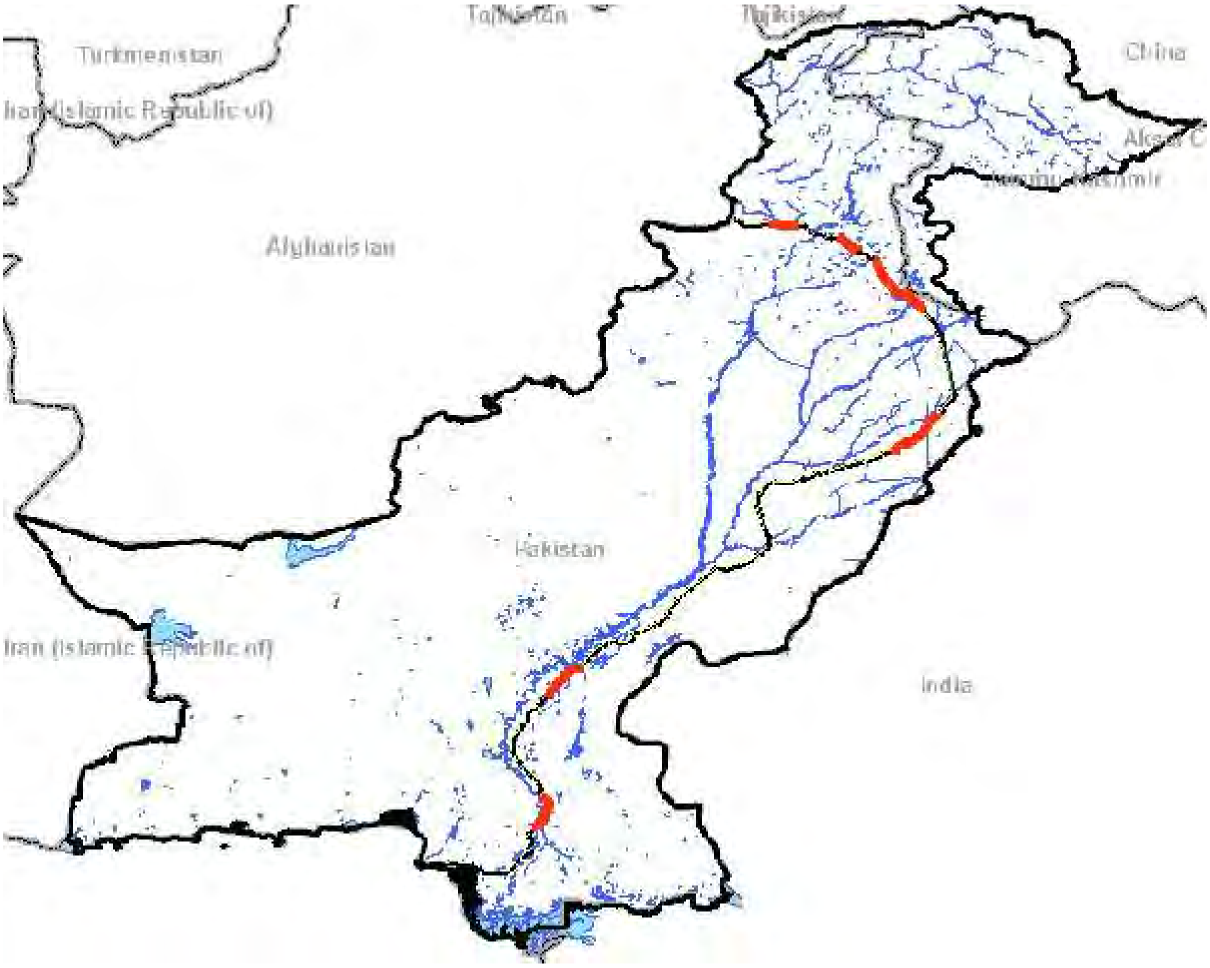


Figure 1.1: N5 Road Alignment with Dualization Sections
(Highlighted in Red Colour)

1.1 REVIEW OF CLIMATE CHANGE FOR PAKISTAN

Pakistan is influenced by different climate zones, particularly by Monsoon climate in the south and mountain climate in the north. The general climatic conditions are altered by Pakistan's diverse geography with the far north reaching into the Himalayas and the southern and western regions being lowland plains of the Indus River, contributing to the diversity in climatic conditions in different regions of the country. The climate is respectively characterized by diverse conditions. Average temperatures are strongly dependent on the topography, with coolest annual temperatures below zero in the far North (the Himalayan region), and higher average temperatures in the lower-lying south-east. Rainfall is low throughout the year in large parts of the country (20-30mm per month), but the northern regions, on the southern side of the Himalayan mountains, receive rainfall of up to 200mm per month as a result of the summer monsoon through July to September.

1.1.1 Current Climatology

Pakistan's climate context for the current climatology, 1991-2020, derived from observed, historical data (see, **Figure 1.2**, **Figure 1.3** and **Figure 1.4**). Information should be used to build a strong understanding of current climate conditions in order to appreciate future climate scenarios and projected change. Observed, historical data is produced by the Climatic Research Unit (CRU) of University of East Anglia. Data is presented at a 0.5º x 0.5º (50km x 50km) resolution.

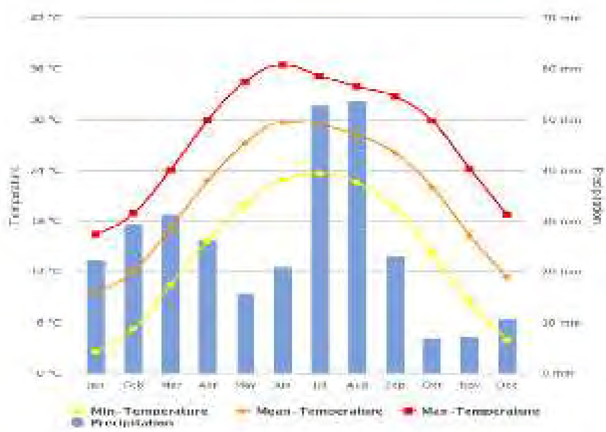


Figure 1.2: Monthly Climatology of Min, Max And Mean Temperature With Rainfall (1991-2020) (Source: World Bank)

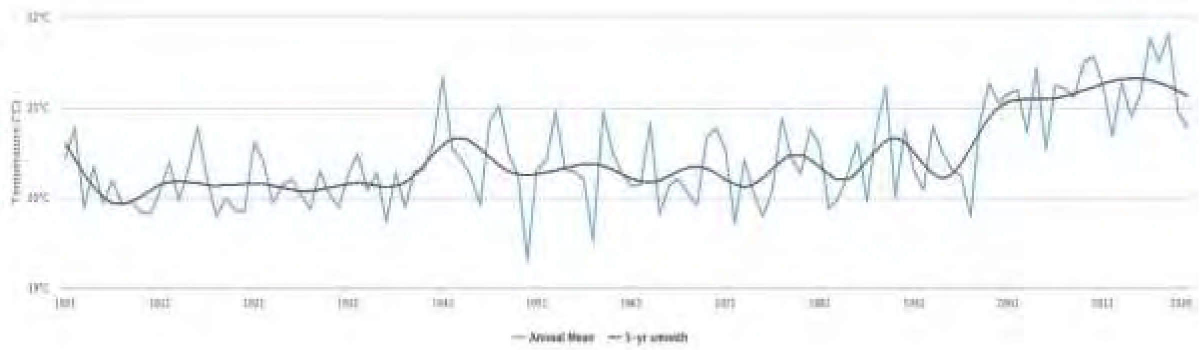


Figure 1.3: Observed Average Annual Mean- Temperature Of Pakistan For 1901-2020

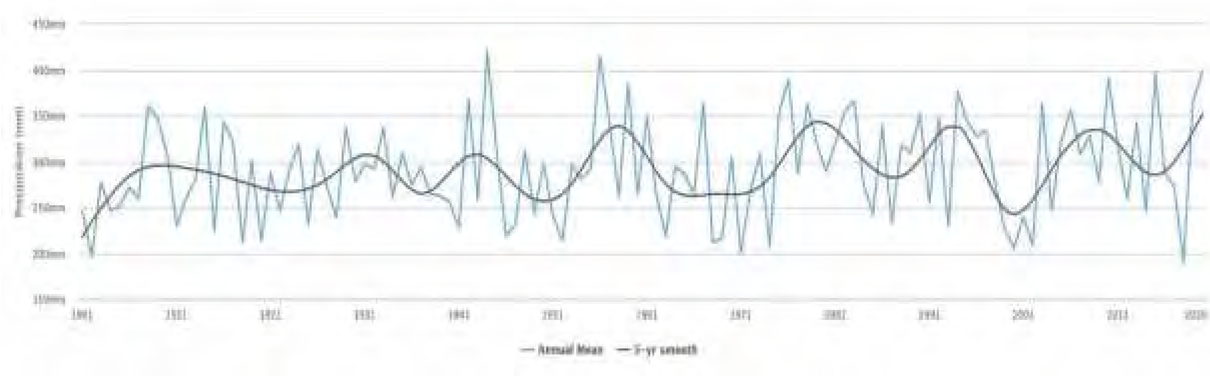


Figure 1.4: Observed Average Annual Rainfall of Pakistan for 1901-2020

<u>Temperature</u>

- Warming in Pakistan was estimated at 0.57°C over the 20th century, but has accelerated more recently, with 0.47°C of warming measured between 1961–2007.
- Increases in temperature is strongly biased towards the winter and post-monsoon months (November–February). On a sub-national level, warming is also strongly biased towards the more southerly regions, with Punjab, Sind, and Baluchistan all experiencing winter warming in the region of 0.91°C–1.12°C between 1961–2007, and Khyber Pakhtunkhwa in the north experiencing only 0.52°C.
- The rise in average daily maximum temperatures (0.87°C between 1961–2007) has been slightly stronger than the rise in average temperatures. A concurrent increase in the frequency of heat wave days has been documented, particularly in Sindh Province.

<u>Rainfall</u>

- Mean rainfall in the arid plains of Pakistan and the coastal belt has decreased by 10-15% since 1960. Most other regions have experienced a slight increase, seen both in the monsoon and dry seasons.
- The number of heavy rainfall events has increased since 1960, and the nine heaviest rains recorded in 24 hours were recorded in 2010.
- Recent evidence suggests that glaciers in the headwaters of the Indus Basin may be expanding due to increased winter rainfall over the Himalayan region in the last 40 years.

1.1.2 Projected Climatology

Climate projection data is modeled data from the global climate model compilations of the Coupled Model Inter-comparison Projects (CMIPs), overseen by the World Climate Research Program. Data presented is CMIP6, derived from the Sixth phase of the CMIPs. The CMIPs form the data foundation of the IPCC Assessment Reports. CMIP6 supports the IPCC's Sixth Assessment Report. Data is presented at a 0.25º x 0.25º (25km x 25km) resolution. Projected multi model mean temperature and rainfall trend for Pakistan is shown in **Figure 1.5** and **Figure 1.6** respectively.

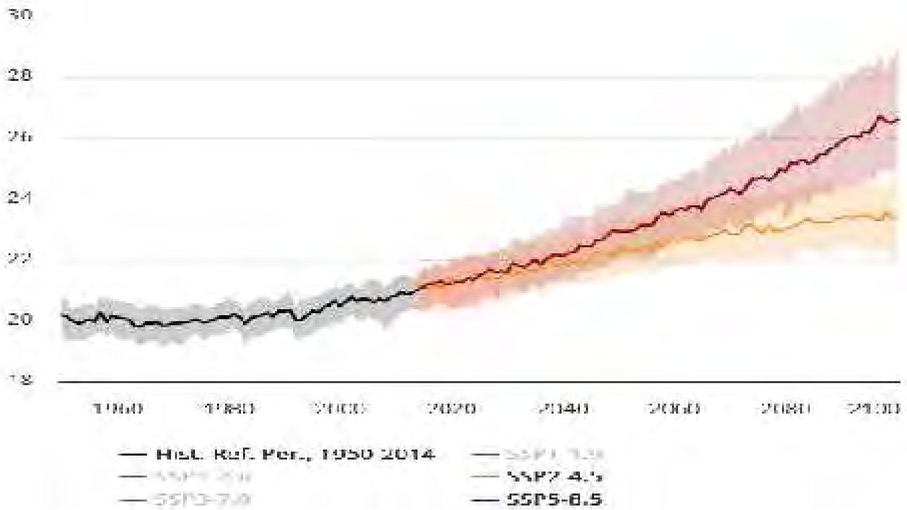


Figure 1.5: Projected Mean Temperature (Multi-Model Ensemble) Pakistan

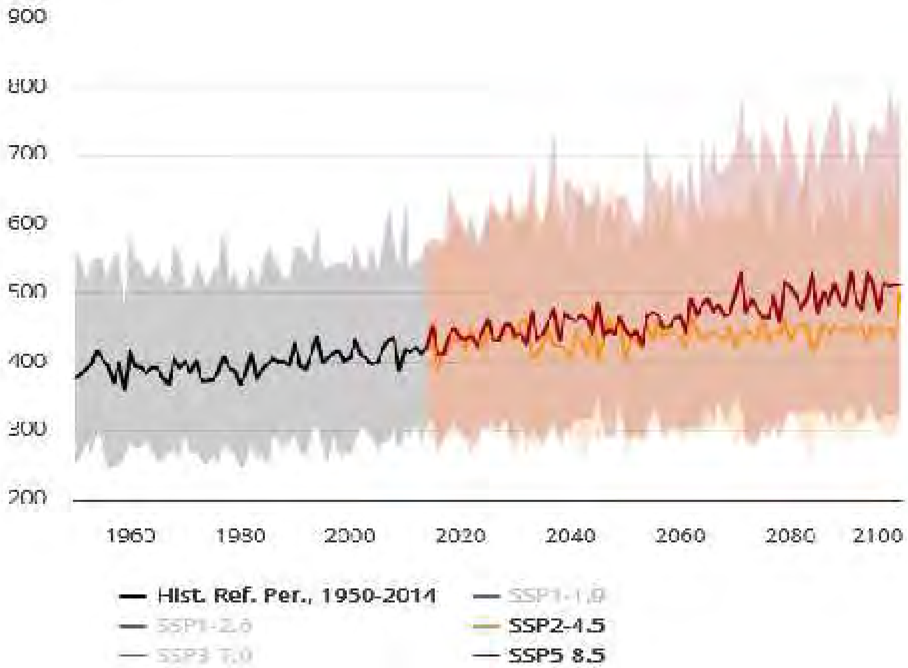


Figure 1.6: Projected Rainfall (Multi-Model Ensemble) Pakistan

1.2 CLIMATE DIAGNOSTIC

Consultants performed climate risk assessment as per International standard practice for climate change projects following the guidelines of Intergovernmental Panel for Climate Change.

1.2.1 Modelling framework

Climate change scenarios is retrieved and analysed at different spatial and temporal resolutions. Daily climate data (rainfall, maximum and minimum temperature) is retrieved from the NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP) dataset (Sheffield et al. 2006; Thrasher et al. 2022), which are available at a spatial resolution of 25 km. Daily climate data (rainfall, maximum and minimum temperature) is retrieved from the ERA5 dataset which is available at a spatial resolution up to 11 km. For both datasets, current and future climate conditions are retrieved and analysed (see **Table 1.1**).

Table 1.1: Available Climate Information for Climate Change Assessment

Dataset	Conditions	Resolution		Period	Description
		Spatial	Temporal		
ERA5	Historic	11 km	Daily	1985-2014	Mean temperature (ºC)
					Rainfall (mm)
NEX-GDDP-CMIP6	Current	25 km	Daily	1985-2014	Mean temperature (ºC)
					Rainfall (mm)
	Future	25 km	Daily	Until 2099	Mean temperature (ºC)
					Rainfall (mm)

Future conditions included the Intergovernmental Panel on Climate Change Sixth Assessment (IPCC6) climate projections from global climate models (GCMs) for different shared socio-economic pathways (SSPs). Different climate scenarios (SSP 2-4.5 and SSP 5-8.5) are used according to data availability of IPCC6.

SSP 2-4.5 is a scenario that represents the medium range of future forcing pathways and serves as an update to the RCP4.5 pathway. It is utilized as a reference experiment by several CMIP6-Endorsed MIPs. SSP 2-4.5 was chosen because its land use and aerosol pathways are not extreme compared to other SSPs, making it central to the concerns of Detection and Attribution MIP (DAMIP)1 and Decadal Climate Prediction Project (DCPP)2. Additionally, it is relevant to Integrated Assessment Modelling (IAM) and Impact, Adaptation, and Vulnerability (IAV) research as it represents a scenario that combines intermediate societal vulnerability with an intermediate forcing level.

SSP 5-8.5 represents the high end of future pathways in the IAM and serves as an update to the RCP8.5 pathway. This scenario is specifically chosen to address scientific questions across various CMIP6-Endorsed MIPs. SSP 5-8.5 is unique among the SSP scenarios because it exhibits emissions high enough to generate a radiative forcing of 8.5 Wm^{-2} in 2100. The selection of SSP 5-8.5 as the forcing pathway is significant due to its ability to capture the upper bounds of potential future climate conditions. This scenario is essential for understanding the potential outcomes and developing appropriate strategies to mitigate and adapt to the impacts of climate change.

1.2.2 ERA5

ERA5 is the fifth-generation reanalysis dataset produced by the European Centre for Medium-Range Weather Forecasts (ECMWF). It provides comprehensive and high-resolution data on various atmospheric, oceanic, and land-surface variables, including rainfall and temperature, from 1950 to the present. ERA5 provides consistent global data coverage, enabling analysis

1 Gillett, N. P., Shiogama, H., Funke, B., Hegerl, G., Knutti, R., Matthes, K., Santer, B. D., Stone, D., and Tebaldi, C.: The Detection and Attribution Model Intercomparison Project (DAMIP v1.0) contribution to CMIP6, Geosci. Model Dev., 9, 3685-3697, doi:10.5194/gmd-9-3685-2016, 2016

2 Boer, G. J., Smith, D. M., Cassou, C., Doblas-Reyes, F., Danabasoglu, G., Kirtman, B., Kushnir, Y., Kimoto, M., Meehl, G. A., Msadek, R., Mueller, W. A., Taylor, K. E., Zwiers, F., Rixen, M., Ruprich-Robert, Y., and Eade, R.: The Decadal Climate Prediction Project (DCPP) contribution to CMIP6, Geosci. Model Dev., 9, 3751-3777, doi:10.5194/gmd-9-3751-2016, 2016

across different geographic scales, from local to global levels. ERA5 rainfall and temperature data are extensively used in climate research, weather forecasting, hydrology, and environmental impact assessments. They are valuable for understanding historical climate trends, evaluating extreme weather conditions, and supporting adaptation and mitigation planning. The Consultant uses ERA5 data to evaluate and correct climate change data, considering catchments and its spatial coverage in N5.

1.2.3 NEX-GDDP-CMIP6

Climate change forecasts are estimates of the climate system's response to potential greenhouse gas and aerosol emissions over the next century. These projections are often based on climate model simulations. Ongoing climate change may impact on the dynamics of extreme events as well as the availability of water supplies. We may prepare the community and manage infrastructure based on scientific understanding of projected changes and situations, allowing us to take actions to adapt to the new conditions. The complexity of climate models varies; some include more procedures than others. This means that each model will produce distinct results. The magnitude of these fluctuations can be big or small, depending on the model, area, season, variable, etc. A model may perform well in one area/season/ variable but poorly in another, whereas another model excels in yet another.

To estimate the probable future climatic change in this region, a complete analysis of thirty-five (35) global climate models (GCMs) (**Table 1.2**) from the current set of the Coupled Model Intercomparison Project Phase 6 (CMIP-6) by the NEX-GDDP-CMIP63 was performed. The collection contains scenarios for all four "Tier 1" greenhouse gas emissions scenarios, known as Shared Socioeconomic Pathways (SSPs). The CMIP6 GCM simulations were produced to help the Intergovernmental Panel on Climate Change (IPCC AR6) prepare its Sixth Assessment Report. This dataset provides downscale predictions based on ScenarioMIP model runs. The predictions are daily scenarios developed and shared by the Earth System Grid Federation. The goal of this dataset is to provide a collection of reliable climate change projections on a worldwide scale, with high resolution and bias correction. These forecasts can be used to evaluate the impact of climate change on systems affected by more detailed climate variations, as well as the influence of local topography on climate conditions. For this investigation, 30-year baseline data (1985-2014) were employed. By adopting this dependable and well accepted methodology, the Consultants establish a solid foundation for their study and estimates of climate change consequences in this region.

Table 1.2: List of Available GCMs Used for Study Area

ACCESS-CM2	CanESM5	HadGEM3-GC31-MM	MPI-ESM1-2-HR
ACCESS-ESM1-5	EC-Earth3	IITM-ESM	MPI-ESM1-2-LR
BCC-CSM2-MR	EC-Earth3-Veg-LR	INM-CM4-8	MRI-ESM2-0
CESM2	FGOALS-g3	INM-CM5-0	NESM3
CESM2-WACCM	GFDL-CM4-1	IPSL-CM6A-LR	NorESM2-LM
CMCC-CM2-SR5	UKESM1-0-LL	KACE-1-0-G	NorESM2-MM
CMCC-ESM2	GFDL-ESM4	KIOST-ESM	TaiESM1
CNRM-CM6-1	GISS-E2-1-G	MIROC-ES2L	GFDL-CM4-2
CNRM-ESM2-1	HadGEM3-GC31-LL	MIROC6	

3Thrasher, B., Wang, W., Michaelis, A. et al. NASA Global Daily Downscaled Projections, CMIP6. Sci Data 9, 262 (2022). https://doi.org/10.1038/s41597-022-01393-4

To address this, bias correction through ground station data or satellite estimates will be necessary to improve the accuracy of future climate projections.

Data was downloaded for the period 2035-2064 (hereafter referred to as projections to 2050) for climate change assessments. Since the project roads mainly involve upgradation, projections to 2050 are suitable for the road project design life. However, for locations involving bridge construction, data was also downloaded for the period 2070-2099 (projections to 2085) to account for a longer design life suitable for the bridges.

1.3 IMPACT OF CLIMATIC CHANGE

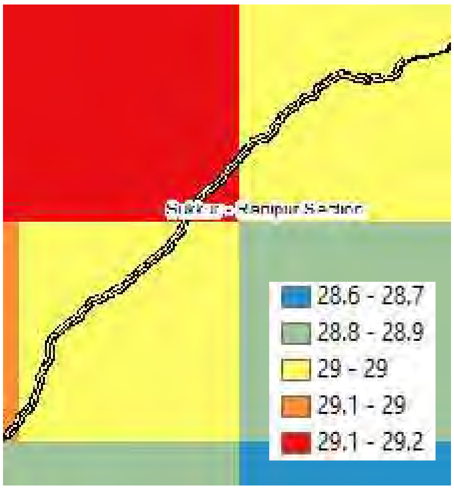
1.3.1 Climate change assessment over Sukkur – Ranipur Section

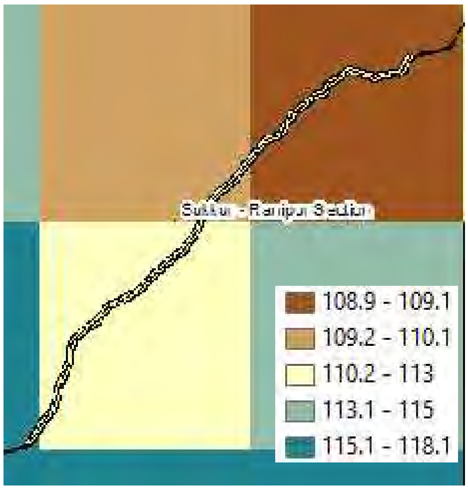
Specifically, temperature and rainfall variation over different timeframes and climate scenarios are considered for Sukkur and Ranipur road section (see **Figure 1.7**). Key highlights are:

- **Temperature Projections:**
  - Under SSP 2-4.5: Temperatures are expected to increase by 1.8°C by 2050 and 2.8°C by 2085.
  - Under SSP 5-8.5: Temperatures could increase by 2.4°C by 2050 and 4.9°C by 2085.
- **Rainfall Projections (Annual):**
  - Under SSP 2-4.5: Total annual rainfall is projected to increase by 28.8% by 2050 and 43.5% by 2085.
  - Under SSP 5-8.5: Rainfall could increase by 43% by 2050 and 76% by 2085.

Scenarios **Temperature (C)** **Rainfall (mm)**

SSP 2-4.5 (2035-2064)





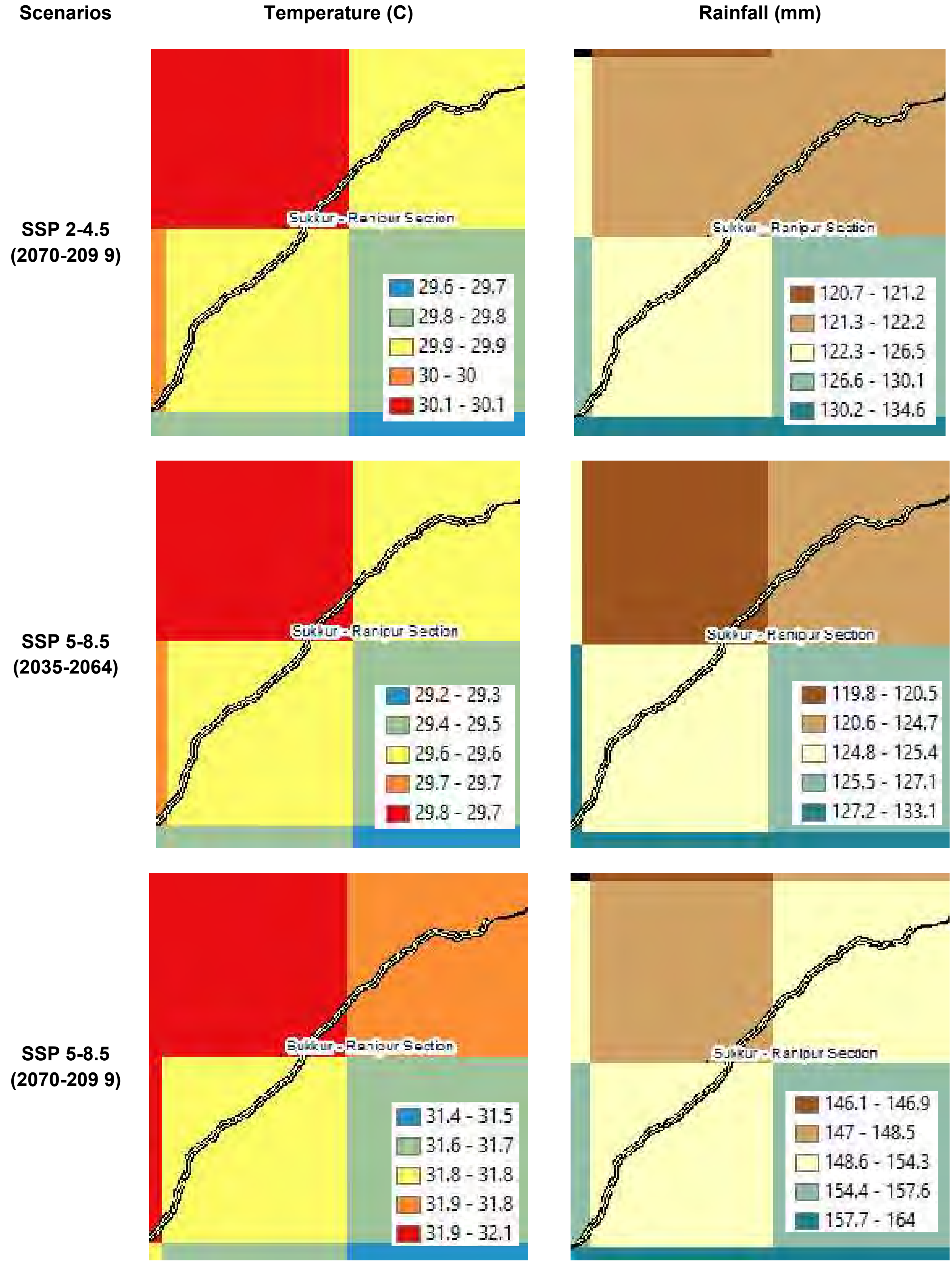


Figure 1.7: Temperature and Rainfalls Under Different Timeframes And Climate Scenarios Over Sukkur – Ranipur Section

1.3.2 Flood Assessment for Sukkur – Ranipur Section

The most important factors for climate-proofing the project infrastructure are the projected changes in the climatic extremes. The projections regarding changes in daily maximum rainfall

(RX1DAY) climate extreme was done based on the ERA5 gridded data. Consultants have employed a baseline period spanning from 1985 to 2014, which encompasses 30 years of data, to analyze rainfall data. Rainfalls have been estimated for both historic and future data (area can be seen in **Figure 1.8**. The impact of climate change is assessed on floods and these results (**Table 1.3**) will be used in Hydrological Modelling and Hydraulics study for climate resilient analysis.

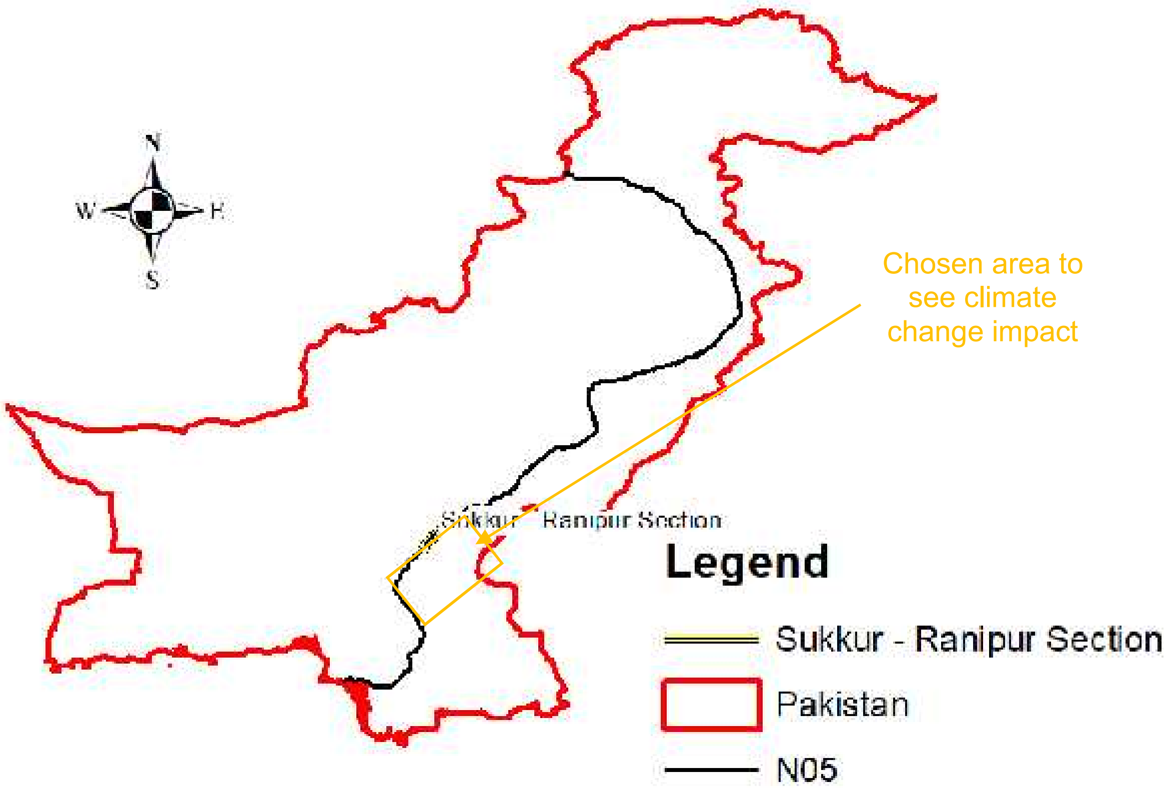


Figure 1.8: N5 Road Sections for Climate Change Analysis on Flooding (chosen area is highlighted in orange color)

1.3.2.1 <u>Selection of General Circulation Models (GCMs)</u>

As outlined in the previous section, to estimate the probable future climatic change in this area, a complete analysis of thirty-five (35) GCMs (**Table 1.2**) from the current set of the Coupled Model Intercomparison Project Phase 6 (CMIP-6) by the NEX-GDDP-CMIP6 was performed. **Figure 1.9** illustrates the overall process used for this climate change study. By adopting this dependable and well accepted methodology, the Consultants establish a solid foundation for their study and estimates of climate change consequences in this region.

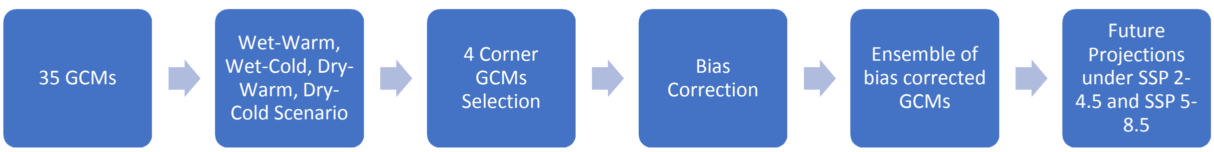


Figure 1.9: Overall Methodology Adopted for Climate Change Study

In the process of selecting GCMs for the study, a comparison is made between the maximum daily rainfall derived from the climate models and the data from historic ERA5 estimates (**Figure 1.10**). These findings indicate discrepancies in rainfall estimates among different models, with some underestimating and others overestimating maximum rainfall in the region. To address this, bias correction will be necessary to improve the accuracy of future climate projections.

Of the available scenarios SSP 2-4.5 (middle of the road) and SSP 5-8.5 (business as usual) (extreme) scenario are used for climate change inclusive hydrological impact assessment study.

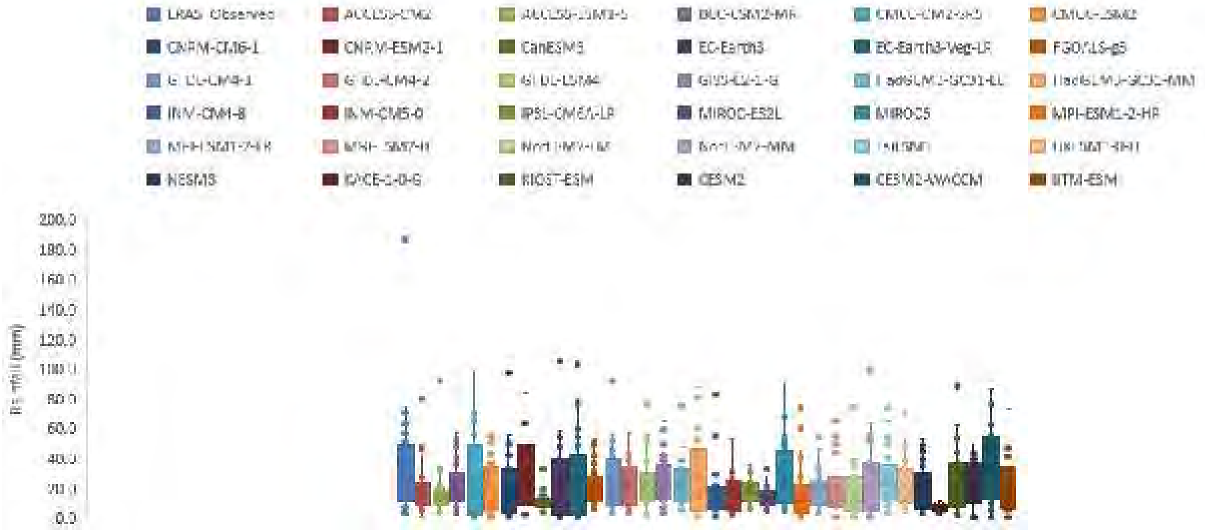


Figure 1.10: Raw GCMs Comparison with ERA5 Rainfall (Whisker Plot)

1.3.2.2 <u>Shortlisting of GCMs</u>

The selection of GCMs will be determined using the delta approach for rainfall and temperature. The base data utilized for this purpose will extend from 1985 to 2014, while the projected future data will encompass the time frame from 2015 to 2100 for the SSP 2-4.5 and SSP 5-8.5 scenarios. The median GCMs falling within the designated percentile range (10% and 90%) will be selected during the second stage. This strategy seeks to decrease the level of uncertainty surrounding anticipated future data. Consultant utilizes corner model approaches to check the possible rainfall variations in this region[4&5.]

Details of the different parts of the full spectrum considered during this study are as follows:

- the Dry-Cold corner, represented by the 10th percentile ΔP as well as 10th percentile value of ΔT
- the Dry-Warm corner, represented by the 10th percentile ΔP but the 90th percentile value of ΔT

4 NESPAK Project "Emergency flood assistance project, Khyber Pakhtunkhwa, Pakistan", ADB, 2023
5 NESPAK Project "Study and evaluation of the safety of existing dams in different regions of the Kingdom of Saudi Arabia" (2023-2026).

- the Wet-Cold corner, represented by the 90th percentile ΔP and the 10th percentile value of ΔT
- the Wet-Warm corner, represented by the 90th percentile values for both ΔP as well as ΔT

Four corner models under SSP 2-4.5 (CMCC-ESM2, GFDL-CM4-1, MIROC6 and NESM3) and SSP 5-8.5 (GFDL-CM4-2, MIROC-ES2L, NorESM2-MM and NESM3) have been selected for bias correction application in this area. Average results have been adopted for analysis with variation range.

1.3.2.3 Bias Correction

Climate models often include inherent biases when simulating variables. To guarantee accurate applications in contexts with nonlinear sensitivities to biases, these biases must be addressed and eliminated beforehand. Bias correction strategies are important in climate change impact studies because they have the potential to influence model-projected mean changes. Consultant chose statistical downscaling[6] because dynamic downscaling is too time-consuming and computationally intensive. To develop relationships using statistical methods, observational records are required; long-term records from 1985 to 2014 are available as baseline data. Consequently, a comprehensive review of the most employed and latest bias correction techniques has been conducted to identify the most suitable method. Considering the analysis, Consultants adopted Quantile Delta Mapping (QDM)[7,8] for bias correction of rainfall data.

The bias correction procedures mentioned above, while chosen as the best possible alternative given the availability of time, resources, and data, are not without limits. These bias correction approaches increase the agreement of climate model output with observations, reducing the uncertainty range of forecasts and simulations; but they do so without a solid physical basis. This bias corrected GCM will allow us to provide average forecasts for future forecasted data.

1.3.2.4 Frequency Analysis

To estimate the return period of maximum daily rainfall, generalized extreme value (GEV) distribution is used. The GEV distribution is widely used for estimating the magnitude and occurrence probability of hydrological extreme events. The results indicate that extremes of more intense rainfall are expected. The ensemble of bias corrected GCMs for this region showed that there will no increase in rainfall under SSP 2-4.5 (low confidence of increase) while there will be increase in rainfall of about 6.8%, 4.3% and 2.2% for return period of 25, 50 and 100 years respectively under SSP 5-8.5 with medium confidence (see **Table 1.3**) which are used in the project's engineering design. However, it is important to note that there will always be some residual risk associated with the performance of individual GCMs. There

6 Flaounas, E., P. Drobinski, M. Vrac, S. Bastin, C. Lebeaupin-Brossier, M. Stefanon, M. Borga, and J.-C. Calvet (2013), Precipitation and temperature space-time variability and extremes in the Mediterranean region: Evaluation of dynamical and statistical downscaling methods, *Clim. Dyn.*, 40(11-12), 2687–2705, doi:10.1007/s00382-012-1558-y.
7 Xavier, A. C. F., Martins, L. L., Rudke, A. P., de Morais, M. V. B., Martins, J. A., & Blain, G. C. (2022). Evaluation of Quantile Delta Mapping as a bias-correction method in maximum rainfall dataset from downscaled models in São Paulo state (Brazil). International Journal of Climatology, 42(1), 175-190.
8 Project "Emergency flood assistance project, Khyber Pakhtunkhwa, Pakistan", ADB, 2023

climatic change increase factors be used to increase the rainfall depths for inclusion in flood studies.

Table 1.3: Estimated increase in rainfall under SSP 2-4.5 and SSP 5-8.5

Return Periods	SSP 2-4.5	SSP 5-8.5
25	Nil	6.8%
50	Nil	4.3%
100	Nil	2.2%

1.4 CONCLUSION

This report initiates a detailed **climate change assessment** for the **N5 road expansion**, specifically focusing on the Sukkur and Ranipur areas. By addressing climate-related risks upfront, it aims to ensure long-term sustainability and resilience of critical infrastructure in the face of future climate changes.

In the road project area, **average monthly temperatures** are projected to rise significantly by 2085, with increases as high as 4°C. Under the **SSP 2-4.5** scenario, temperatures are expected to increase by **1.8°C by 2050** and **2.8°C by 2085**, whereas under **SSP 5-8.5**, the rise could reach **2.4°C by 2050** and **4.9°C by 2085**. Additionally, **annual rainfall** is anticipated to rise by **28.8% by 2050** and **43.5% by 2085** under SSP 2-4.5, while under SSP 5-8.5, rainfall could increase by **43% by 2050** and **76% by 2085**.

Floods and **extreme temperatures** are identified as key climate-related hazards that the road projects will face in the future. The analysis shows that extreme rainfall is expected to intensify. An ensemble of bias-corrected GCMs predicts no rise in rainfall under SSP 2-4.5 (low confidence of increase). Under SSP 5-8.5, the projected increases are **6.8%**, **4.3%**, and **2.2%**, respectively with medium confidence, all of which have been incorporated into the project's engineering design. It is recommended to adopt SSP 5-8.5 results in the design.

2. HYDROLOGICAL STUDIES

2.1 GENERAL

National Highway 5 (N-5), spanning over 1,800 kilometers, is Pakistan's longest and most critical transportation corridor. It connects Karachi, the nation's economic hub in the south, to Peshawar, a historic and administrative center in the north, forming an indispensable part of the country's infrastructure. Serving as a modern adaptation of the legendary Grand Trunk Road, N-5 is a cornerstone of Pakistan's trade and logistics network. It ensures seamless connectivity across key metropolitan areas, industrial hubs, and agricultural regions, facilitating the efficient movement of goods, services, and people. This strategic artery underpins national development, fostering economic growth and enhancing regional integration.

The Ranipur-Sukkur section is an essential segment of National Highway 5 (N-5) which extends approximately 70 kilometers, linking Sukkur, a major commercial and logistical hub, with Ranipur, a town of significant agricultural importance in Sindh. This critical stretch plays a fundamental role in facilitating both regional and national economic activities. It efficiently manages substantial freight traffic, including agricultural produce, industrial goods, and raw materials destined for key markets and industrial centers.

Beyond freight transport, this segment is instrumental in facilitating the mobility of daily commuters and intercity travelers, bolstering connectivity between rural and urban areas. The Ranipur-Sukkur section enhances regional integration and sustains critical transportation flows. Its significance extends beyond local connectivity, serving as an essential link in Pakistan's broader economic framework.

2.2 LOCATION of PROJECT AREA

Sukkur, situated on the banks of the Indus River in Sindh province, is a dynamic city renowned for its strategic importance in Pakistan's trade and transportation networks. As a key commercial hub, Sukkur plays a pivotal role in connecting northern and southern regions of the country. Its well-established logistical infrastructure, including its proximity to National Highway 5 (N-5) and the Sukkur Barrage, supports the efficient movement of goods, particularly agricultural produce and industrial materials. The city is also known for its historical landmarks, such as the Lansdowne Bridge and Sadh Belo Temple, which reflect its cultural and historical significance.

Ranipur, a town located in the heart of Sindh, is renowned for its agricultural productivity and cultural heritage. It is positioned along National Highway 5 (N-5) and serves as a vital link in the region's transportation network, facilitating the movement of goods and people. The town is known for its lush fields, producing a variety of crops that contribute significantly to the local and national economy. Ranipur is also home to cultural landmarks such as the shrine of Sachal Sarmast, a symbol of the town's rich spiritual and literary legacy.

Considering the economic significance of Sukkur and Ranipur, the client, National Highway Authority (NHA), plans to widen and upgrade the existing metaled road connecting these two key locations. This section of National Highway 5 (N-5) plays a pivotal role in facilitating trade, transportation, and daily commuting, linking Sukkur's commercial and logistical hubs with

Ranipur's agricultural and cultural centers. The proposed enhancements aim to expand road capacity, alleviate traffic congestion, and ensure the efficient movement of freight and passenger vehicles. Upgrading this essential corridor will not only support the growing economic activities in Sukkur and Ranipur but also improve regional connectivity, fostering greater economic productivity. The length of the road under consideration is approximately 70 kilometers. The location map is given in **Figure 2.1**.

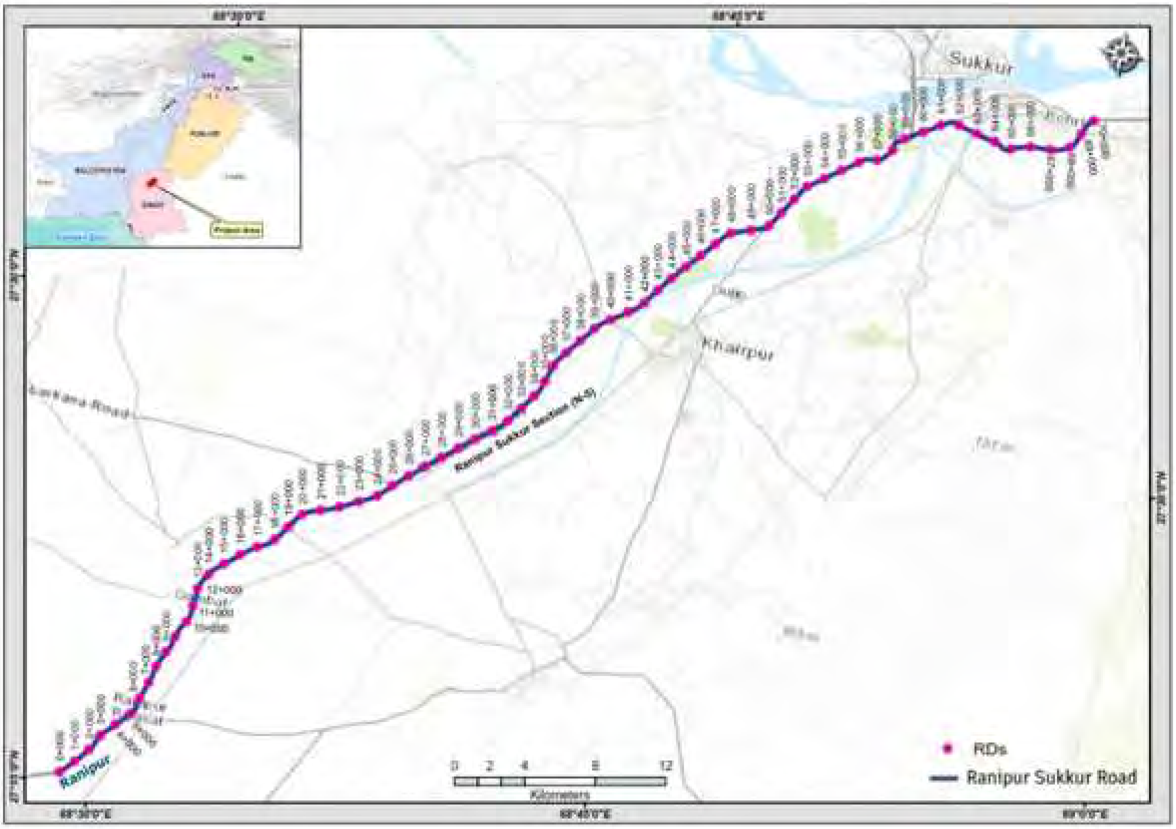


Figure 2.1: Location Map of Project Area

2.3 SCOPE OF HYDROLOGICAL STUDIES

The Ranipur-Sukkur section of National Highway 5 (N-5) traverses through a region characterized by its predominantly flat terrain, interspersed with agricultural fields and date farms that are a hallmark of the area. Despite its dry climate, the region thrives agriculturally due to the presence of the Indus River and the Rohri Canal, which run parallel to this segment of the highway. These critical water resources provide essential irrigation, transforming the arid landscape into a fertile zone capable of producing staple crops like wheat, rice, sugarcane, and high-quality dates.

As per the Term of Reference (ToR) of the project, the scope of hydrological studies includes locating the streams and nullahs etc., crossing the road and estimation of discharges of these streams and nullahs against various return periods considering the effect of climate change.

2.4 CLIMATIC STATIONS IN VICINITY OF PROJECT AREA

There is no discharge gauging for any stream/nullah crossing the road. In the vicinity of the project area, there exists t rain gauge station, which is being operated and maintained by

Pakistan Meteorological Department (PMD). The location of this station is shown in **Figure 2.2**.

Selection of a suitable climatic station involves careful considerations to ensure accurate and reliable data available for analysis. Keeping into consideration the appropriate length of data available and its minimum distance from the project area, Sukkur gauging station has been selected. This station gives a fair representation of the climate of the project area.

Figure 2.2: Rainfall Gauging Station in Vicinity of Road Section

2.4.1 Climate of Sukkur

Sukkur, located in the Sindh province of Pakistan, has an arid to semi-arid climate, marked by hot summers and mild winters. The region experiences extreme temperature fluctuations, with summer temperatures often exceeding 40°C, particularly from May to September. During this time, heatwaves are common, making the climate harsh and dry. Winters, on the other hand, are relatively mild, with temperatures ranging between 8°C to 25°C from December to February.

Precipitation in Sukkur is limited, with annual rainfall averaging between 150 mm and 200 mm, mostly occurring during the monsoon season from June to September. However, rainfall is often unpredictable and sparse, contributing to periods of drought and water scarcity. The Indus River, flowing near Sukkur, plays a significant role in moderating temperatures and supporting irrigation.

2.4.1.1 <u>Precipitation</u>

Mean monthly rainfall data and the number of rainy days recorded at Sukkur Station are given in **Table *2.1.*** The annual rainfall of the area is about 103 mm (Ref.1). While on average the maximum monthly rainfall is 23.5 mm during the month of August and a minimum of 3.6 mm in October. The maximum rainfall occurs during the months of July to September, which is about 52% of the annual rainfall. Winter rains generally occur during the month of February and March, whereas October is normally the month with the least precipitation. The distribution of average monthly rainfall and number of rainy days in Sukkur have been shown in **Figure 2.3** and **Figure 2.4** respectively**.**

Table 2.1: Mean Monthly Rainfall in Sukkur

Months	Precipitation (mm)	Rainy Days (No.)
January	3.7	0.4
February	8.1	0.8
March	7.7	1.1
April	6.1	0.5
May	4.5	0.5
June	5.0	0.6
July	17.7	1.1
August	23.5	1.0
September	13.3	0.3
October	3.6	0.1
November	4.2	0.3
December	5.8	0.3

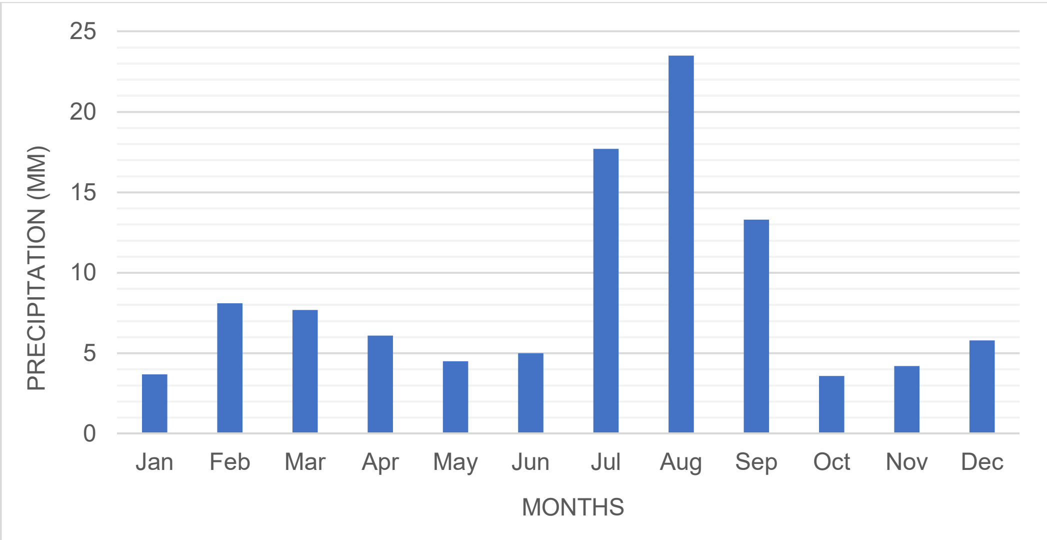


Figure 2.3: Mean Monthly Distribution of Rainfall in Sukkur

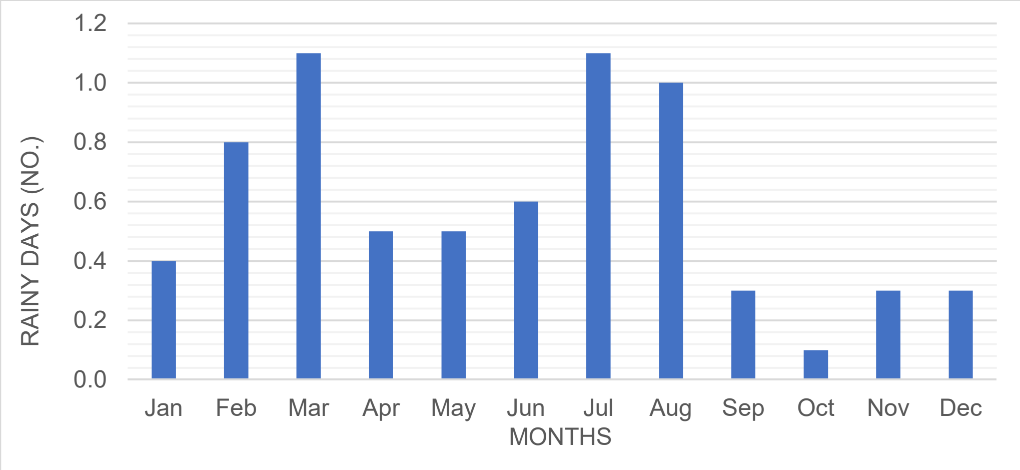


Figure 2.4: Number of Rainy Days in Sukkur

2.4.1.2 <u>Temperature</u>

The average daily temperature in Sukkur exhibits significant variation between the seasons. During the hot summer months from April to September, the mean daily temperature ranges from 30.4°C to 36°C, with May, June, and July being the hottest months. In contrast, the winter season, spanning from December to February, experiences relatively cooler temperatures, with the mean daily temperature ranging from 14.5°C to 18.2°C. December and January are typically the coldest months. The peak monthly temperature reaches 36°C in June, while the lowest temperature is recorded at 14.5°C in January. These seasonal temperature shifts underscore the stark difference between Sukkur's intense summers and its comparatively cooler winters. The monthly averages for minimum, maximum, and mean daily temperatures are detailed in **Table 2.2** and illustrated graphically in **Figure 2.5**.

Table 2.2: Mean Monthly Temperatures in Sukkur

Month	Min Temp (°C)	Max Temp (°C)	Mean Temp (°C)
January	7.1	22.6	14.5
February	10.3	26.1	18.2
March	15.5	32.1	23.8
April	21.5	39.1	30.4
May	26.2	43.4	34.8
June	28.7	43.5	36.0
July	28.8	41.3	35
August	27.6	39.4	33.1
September	25.4	38.2	31.9
October	20.3	35.9	28.1
November	13.8	30.3	22.1
December	8.4	24.7	16.5

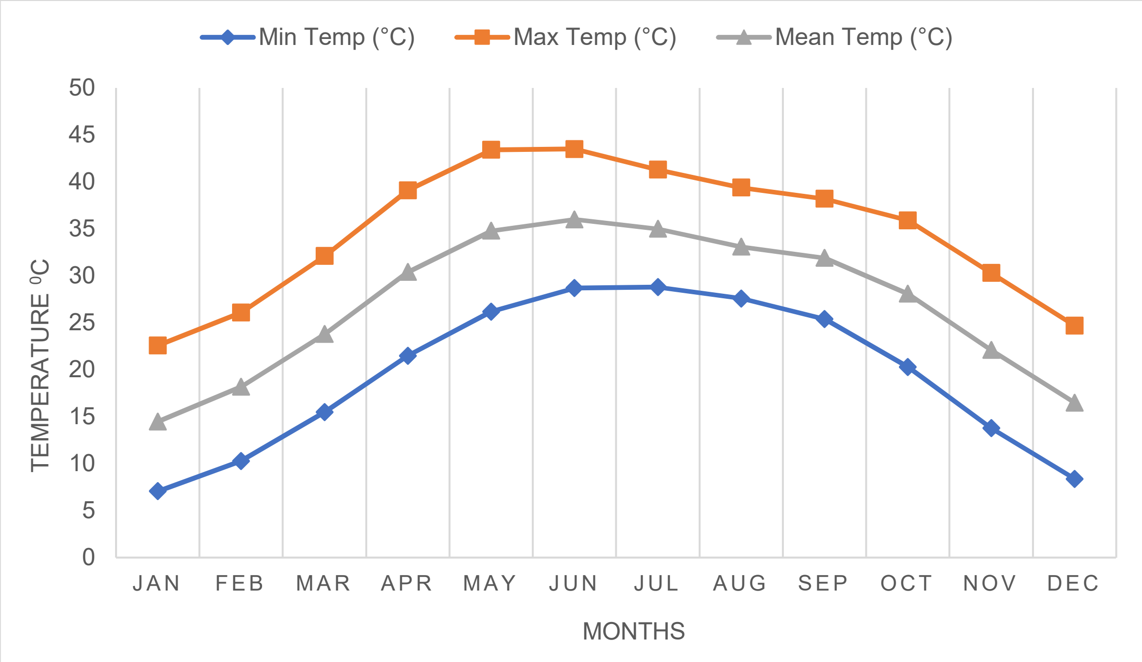


Figure 2.5: Mean Monthly Temperatures in Sukkur

2.4.1.3 Relative Humidity

The relative humidity data at 00:00, 03:00 and 12:00 hours has been collected from PMD. Mean monthly relative humidity is given in **Table 2.3** and shown graphically in **Figure 2.6**. At 00:00 hour the relative humidity varies from lowest value of 59% in May to highest value of 83.6% in December. At 12:00 hour the lowest value is 25% in April and highest value of 48.9% in July.

Table 2.3: Mean Monthly Relative Humidity in Sukkur

Month	Relative Humidity (%)		
	00 UTC	03 UTC	12 UTC
January	82.7	85.5	39.7
February	78.3	79.5	34.4
March	74.0	71.9	25.2
April	61.2	56.1	25.0
May	59	54.3	32.7
June	66.3	63.4	44.1
July	73.1	71.6	48.9
August	77.2	75.1	46.5
September	80.4	77.9	46.5
October	81.1	78.8	42.9
November	81.2	81.5	44.5
December	83.6	86.0	48.3

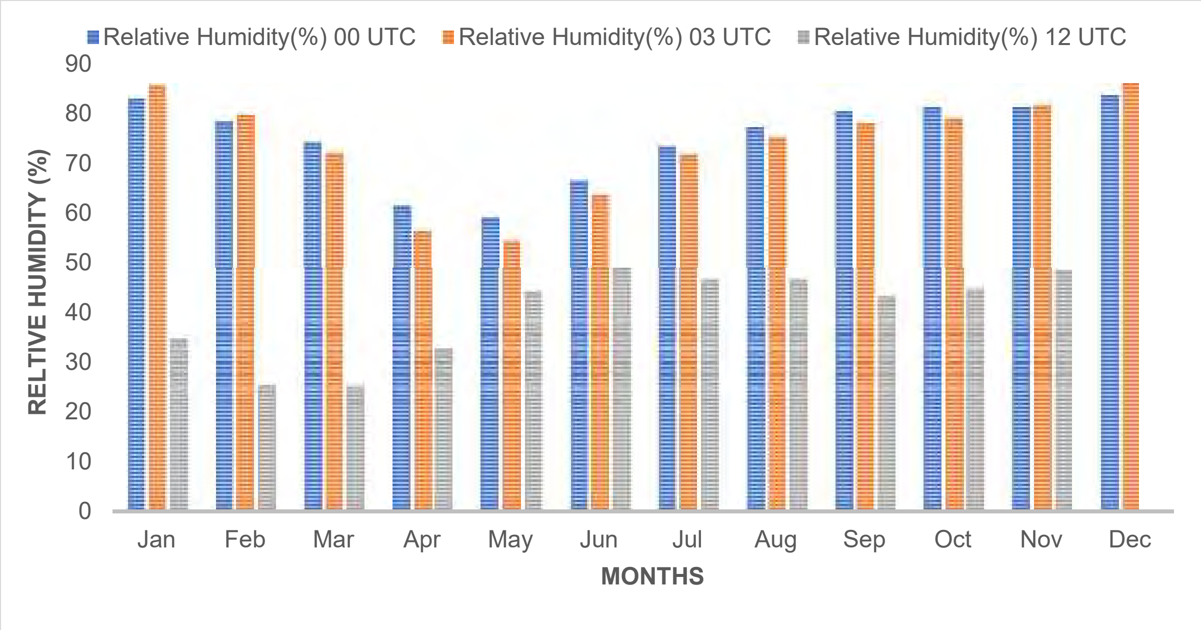


Figure 2.6: Mean Monthly Relative Humidity in Sukkur

2.4.1.4 Wind Speed

The mean monthly wind speed in knots is given in **Table 2.4** and shown graphically in **Figure 2.7**. The data reveals that at 12:00 hours wind speed is higher. During summers, wind speeds are generally higher than wind speeds in winters.

Table 2.4: Mean Monthly Wind Speed in Sukkur

Month	Mean Wind at Synoptic Hours (Knots)		
	0:00	3:00	12:00
January	1.2	1.9	2.6
February	1.7	2.7	3.5
March	2.4	3.3	3.9
April	2.9	4.0	4.8
May	3.9	5.3	5.7
June	5.3	6.8	7.0
July	4.8	5.6	6.1
August	3.8	4.9	4.7
September	2.9	3.8	3.9
October	1.2	1.9	2.1
November	1.1	1.8	1.2
December	0.6	1.3	1.4

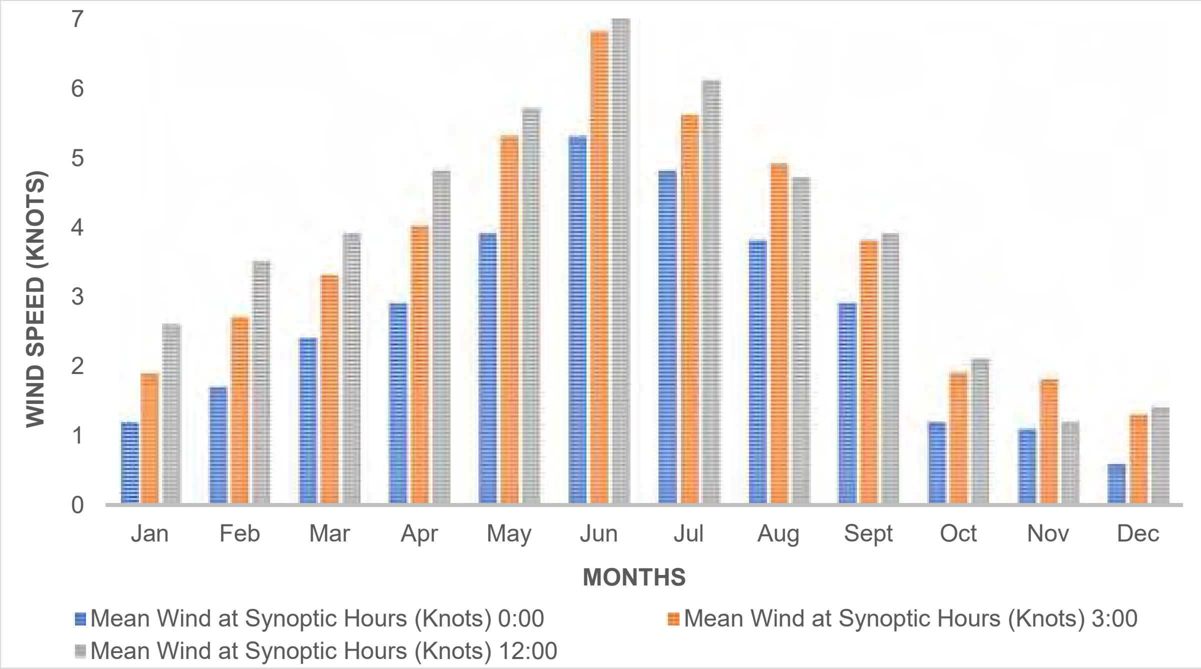


Figure 2.7: Mean Monthly Wind Speed in Sukkur

2.5 ISOHYETAL METHOD

The isohyetal method is a technique used to estimate precipitation over catchment based on observed rainfall data from multiple weather stations. The method involves drawing lines called isohyets which connect points of equal rainfall intensity relative to contour lines on a topographic map. Annual normal rainfall isohyetal map (1981-2010) has been collected from Pakistan Metrological Department (PMD) as shown in **Figure *2.8***.

The road section has been overlayed on the isohyetal map. According to this, isohyet of 100 to 150 mm rainfall traverses through the project area as shown in **Figure *2.9***.

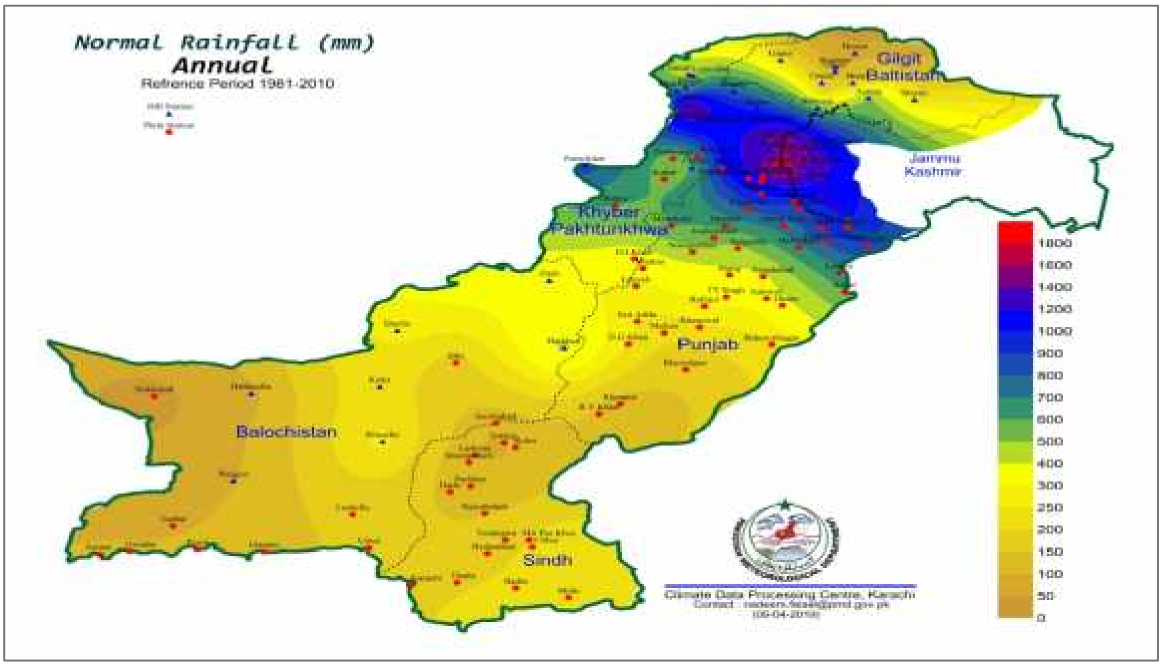


Figure 2.8: Annual Normal Rainfall Isohyetal Map of Pakistan

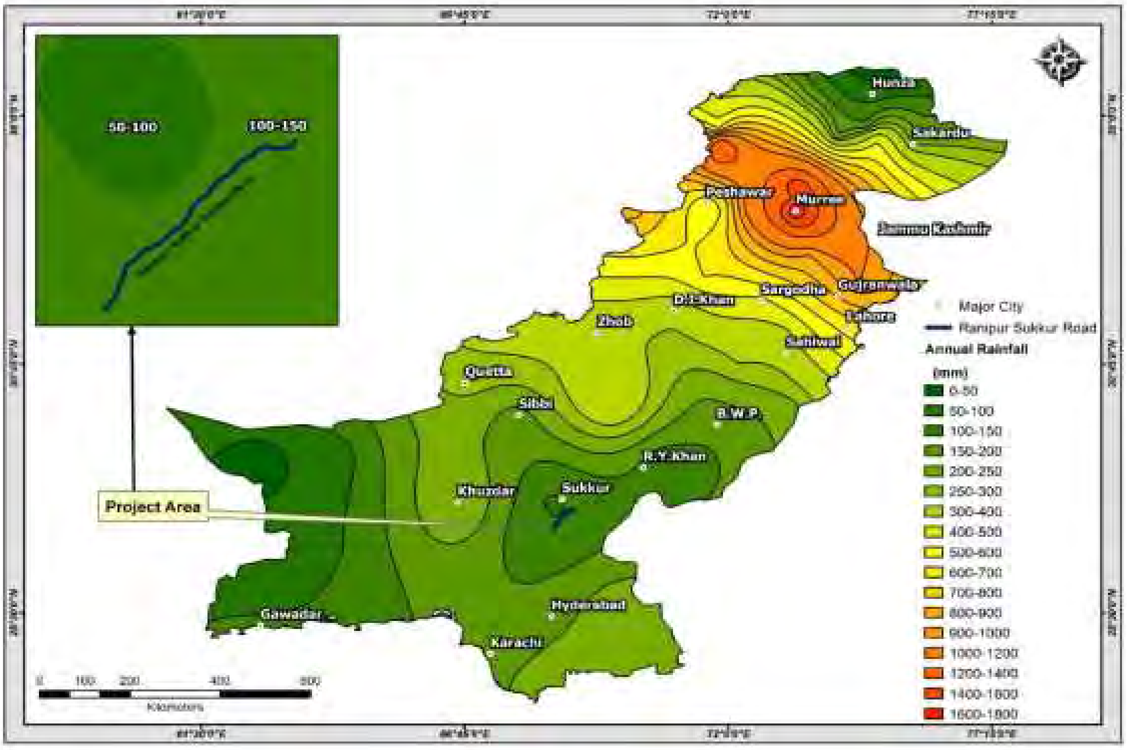


Figure 2.9: Road Section Overlayed on Annual Normal Isohyetal Map

2.6 SOIL PROPERTIES OF PROJECT AREA

Soil properties influence the relationship between rainfall and runoff by affecting the rate of infiltration. The soil type and land cover play a crucial role in the rainfall-runoff model and require comprehensive evaluation. Surface runoff is influenced by factors such as rainfall intensity and duration, weather conditions (including temperature), soil properties, vegetation cover, land use patterns, initial soil moisture content, entrapped air, and the depth of the groundwater table.

Vegetation cover serves to mitigate the impact of rain drops and enhances infiltration rates, whereas built-up areas and rocky surfaces tend to increase runoff. To accurately assess these factors, various sources of information are utilized, including maps of soil surveys from Pakistan, global land use datasets, field investigations, and satellite imagery.

Natural Resources Conservation Services (NRCS) divides soils into four hydrologic soil groups based on infiltration rates (Groups A-D).

Group A: Group A soils have a low runoff potential due to high infiltration rates even when saturated (0.30 in/hr. to 0.45 in/hr. or 7.6 mm/hr. to 11.4 mm/hr.). These soils primarily consist of deep sands, deep loess, and aggregated silts.

Group B: Group B soils have a moderately low runoff potential due to moderate infiltration rates when saturated (0.15 in/hr. to 0.30 in/hr. or 3.8 mm/hr. to 7.6 mm/hr.). These soils primarily consist of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures (shallow loess, sandy loam).

<u>Group C</u>: Group C soils have a moderately high runoff potential due to slow infiltration rates (0.05 in/hr. to 0.5 in/hr. or 1.3 mm/hr. to 3.8 mm/hr. if saturated). These soils primarily consist of soils in which a layer near the surface impedes the downward movement of water or soils with moderately fine to fine texture such as clay loams, shallow sandy loams, soils low in organic content, and soils usually high in clay.

<u>Group D</u>: Group D soils have a high runoff potential due to very slow infiltration rates (less than 0.05 in./hr. or 1.3 mm/hr. if saturated). These soils primarily consist of clays with high swelling potential, soils with permanently high-water tables, soils with a clay pan or clay layer at or near the surface, shallow soils over nearly impervious parent material such as soils that swell significantly when wet or heavy plastic clays or certain saline soils.

The soil properties of the project area are shown by **Figure 2.10**.

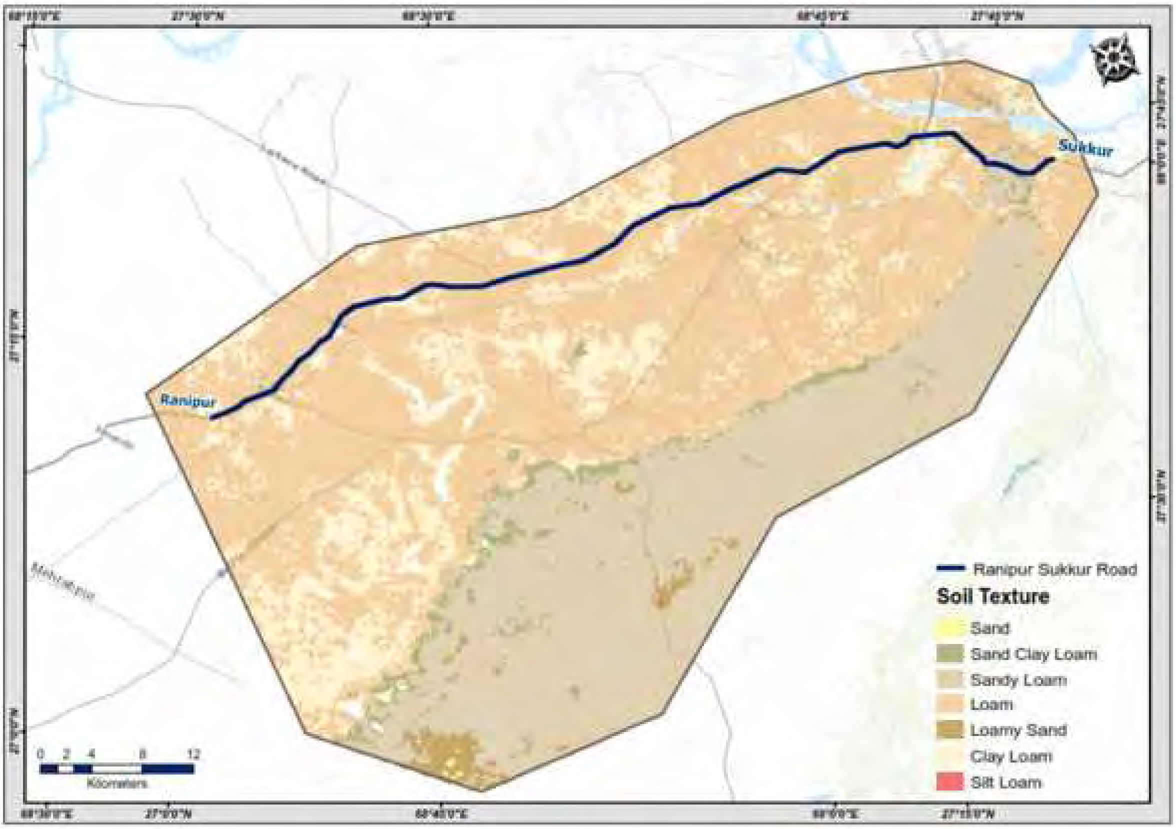


Figure 2.10: Soil Properties of Ranipur - Sukkur Road Section

2.7 LAND USE PROPERTIES OF PROJECT AREA

The land use is used for watershed delineation of project catchment. All the major categories are marked, and CN numbers are given accordingly. In addition to that, these maps illustrate the Hydraulic Soil Type within the project area, derived from remote sensing data, the Soil Survey Map of Pakistan, and on-site verification. These maps are instrumental in characterizing the soil properties critical for hydraulic modeling and infrastructure planning.

Land use maps provide critical input for modelling runoff and designing effective water management strategies. The Anderson Land use classification is given below:

- Bare Areas
- Built up Areas
- Waterbodies
- Cropland
- Grassland
- Shrubland
- Tree covers

The land use properties of the project area are shown in **Figure 2.11**.

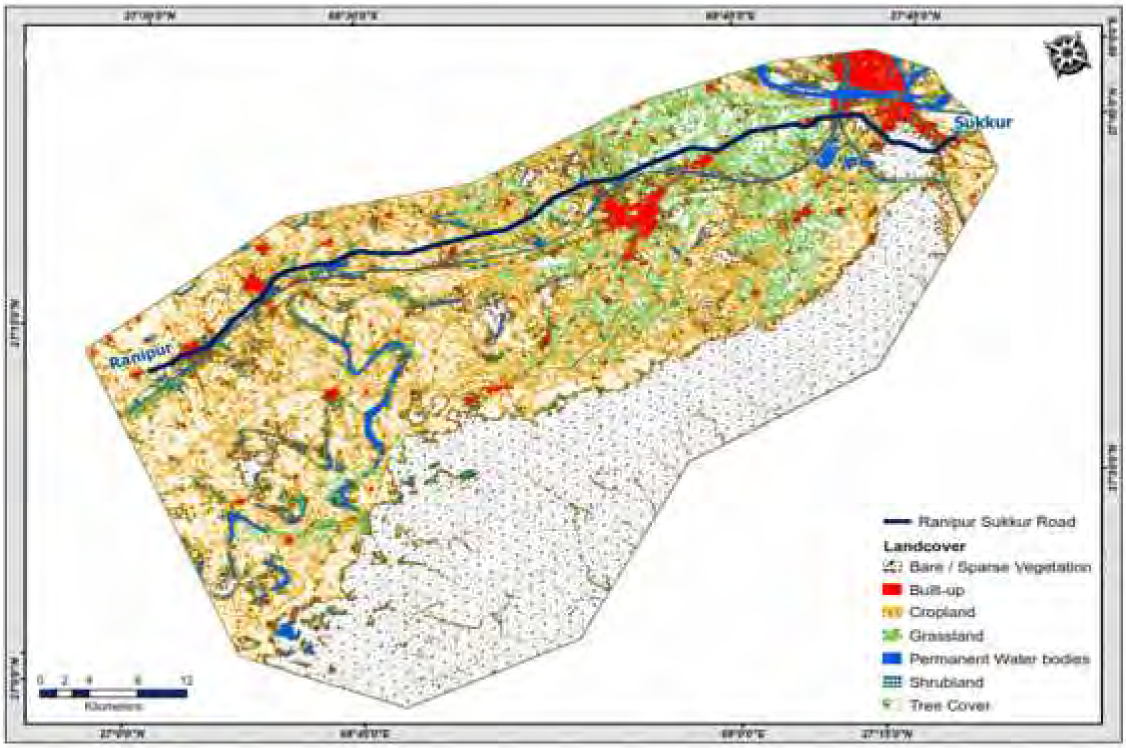


Figure 2.11: Land Use Properties of Ranipur - Sukkur Road Section

2.8 CATCHMENT AREA DELINEATION AND GENERATION OF STREAM NETWORK

Catchment characteristics can be sub-divided mainly into two categories i.e., physical characteristics and hydrological characteristics. Physical characteristics of the catchment include catchment area, length and weighted slope of the longest stream draining to the point of interest. These physical characteristics have been determined from the topographic maps of 1:50,000 scale and Digital Elevation Model (DEM) obtained from Shuttle Radar Topographic Mission (SRTM) and GLO-30. The catchment areas of all the desired points have been marked using DEM data and have been verified using topographic maps.

Stream network development using Digital Elevation Models (DEMs) is a foundational technique in hydrology for mapping and analyzing water flow paths across a landscape. DEMs provide a digital graphical representation of terrain, capture variations in land elevation, enabling detailed analysis of water movement and channel formation. Flow direction and flow accumulation has been identified by using this technique. For Ranipur-Sukkur Road section, Topaz and Arc-Hydro tools have been used for generating stream network by GLO-30 DEM.

Defining the catchment area of the generated stream network is known as watershed delineation. The longitudinal slopes and lengths of the natural streams/nullahs have been determined from the topographic maps, DEM data and by using tools i.e. WMS (Water Management System) and Arc-Hydro. The hydrologic characteristics of the catchments i.e., conditions of the area; soil cover, land use, soil type and extent, and other flow controlling parameters have been investigated through soil maps and satellite imagery. **Figure 2.12** and **Figure 2.13** represent the stream network by above mentioned techniques.

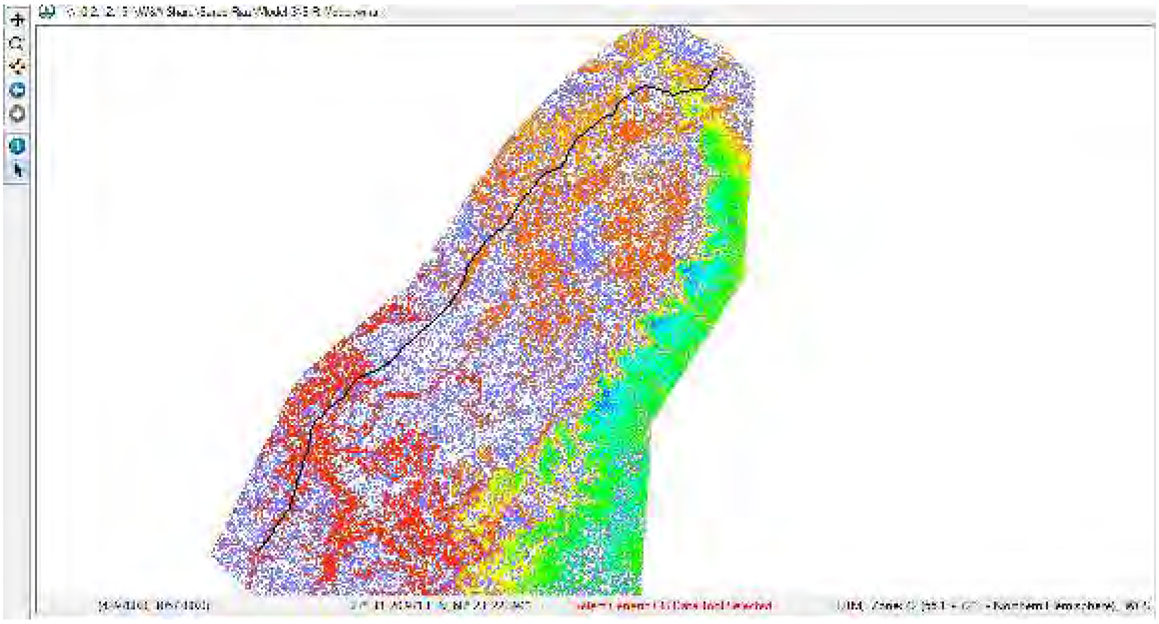


Figure 2.12:Stream Network Generation Using Topaz Tool

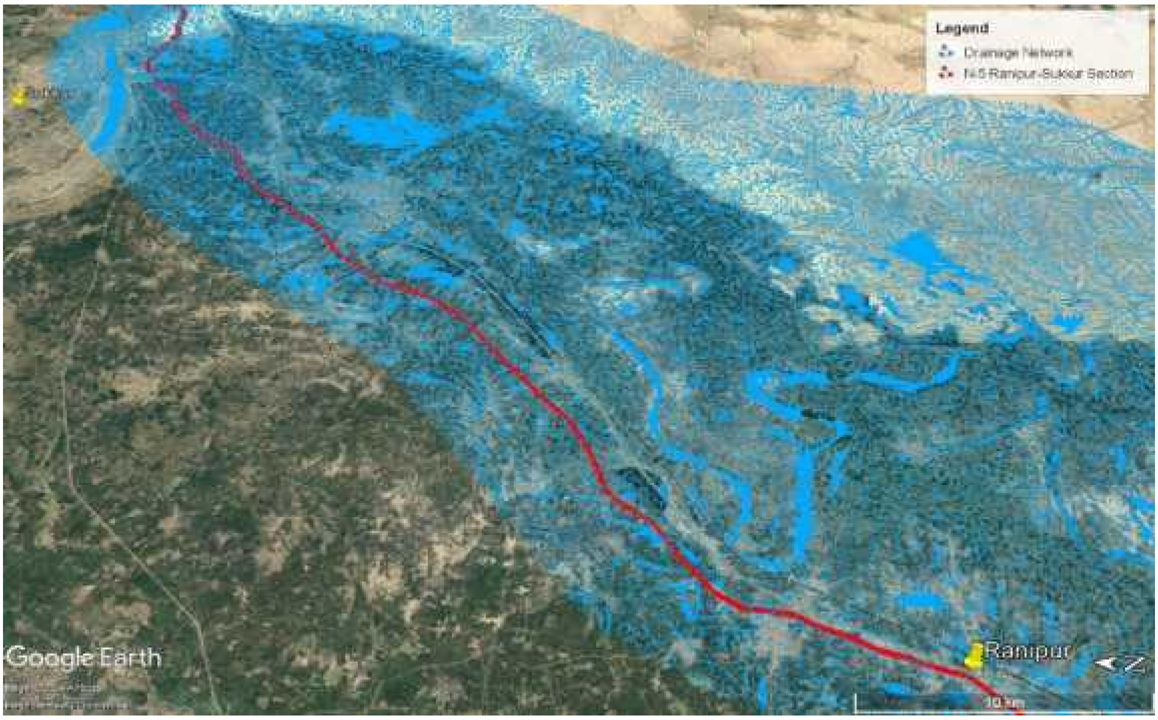


Figure 2.13: Stream Network Generation Using Arc-Hydro Tool

2.9 HYDRO-METROLOGICAL DATA USED

The flood study for a location depends upon the hydro-meteorological data of the location/area. For gauged locations, recorded data is used to estimate peak flood discharges, whereas, for ungauged locations synthetic storm is used which is estimated with recorded intense rainfall events in the area. In case of non-availability of rainfall data in the study area, the data of a station in the vicinity with similar climatic conditions is synthesized over study area.

The discharge data for the streams flowing in the proposed project area is not available. Thus, studies for the computation of the flood discharges have been carried out using rainfall data.

One-day annual maximum rainfall data of Sukkur station has been collected from Pakistan Metrological Department and its inventory is given in **Table 2.5**.

Table 2.5: Inventory of Gauging Stations

S. No.	Station	Data Type	Data Period (Years)	Agency
Rainfall Gauging Station				
1	Sukkur	One Day Annual Maximum Rainfall	1997-2023	PMD

2.9.1 Analysis of Rainfall Data

<u>Sukkur Station</u>

The one-day annual maximum rainfall data for Sukkur is available for the period 1997 - 2023 (27 years) and is provided in **Table 2.6**.

Table 2.6: 1-Day Annual Maximum Rainfall in Sukkur

Year	Rainfall (mm)	Year	Rainfall (mm)
1997	36.5	2011	37.5
1998	13.5	2012	164.2
1999	47.0	2013	59.0
2000	6.5	2014	8.0
2001	51.0	2015	64.0
2002	6.6	2016	42.0
2003	44.5	2017	16.0
2004	19.0	2018	31.0
2005	29.5	2019	71.0
2006	9.5	2020	30.0
2007	31.2	2021	20.0
2008	92.0	2022	82.0
2009	13.0	2023	90.0
2010	18.0		

Historic data since 1997 suggest an average value of 41.9 mm, the maximum magnitude of rainfall witnessed till date is 164.2 mm in year 2012. **Figure 2.14** shows the trends of annual maximum rainfalls observed at Peshawar station.

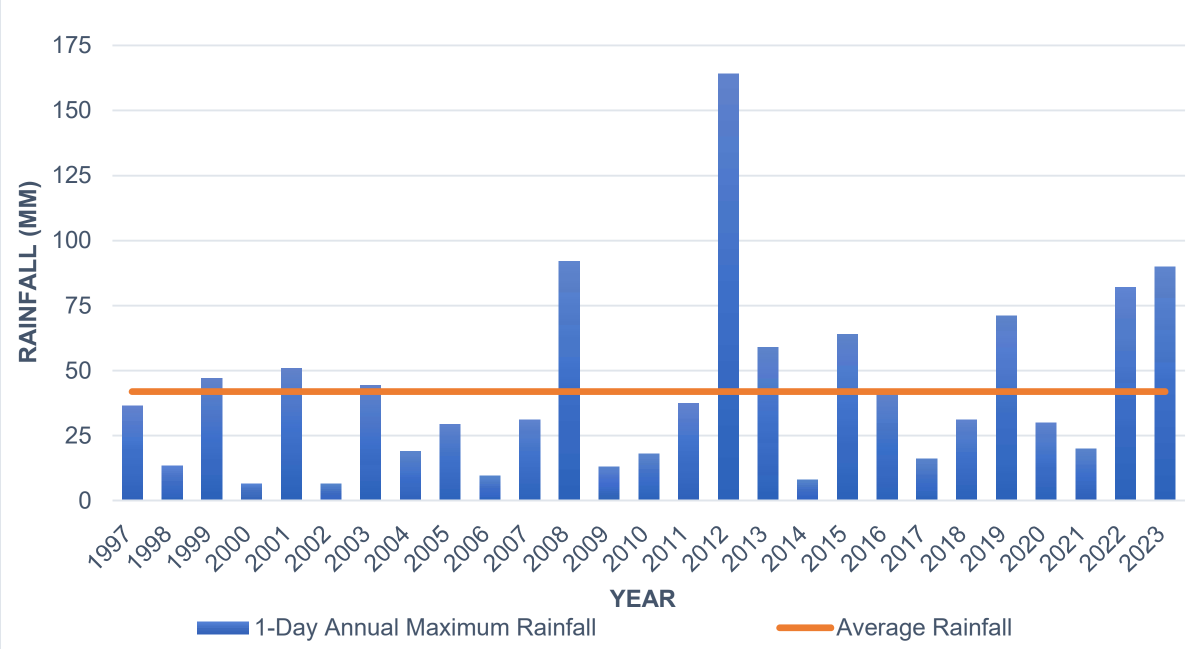


Figure 2.14: One-Day Annual Maximum Rainfall in Sukkur

2.9.2 Frequency Analysis of Rainfall Data

Frequency analysis for 1-day annual maximum rainfall data of Peshawar station has been carried out using Gumble's Extreme Value Type-1 Distribution. The plotting positions have been computed by Weibull's formula. Gumbel distribution is a member of family of extreme value distributions. It is a two-parameter distribution and is widely used in hydrology. Different return periods to be computed for frequency analysis have been approached using Weibull formula. For annual maximum series, Weibull formula has been adopted as the standard plotting position method by the U. S. Water Resources Council (1981).

Result of frequency analysis for Sukkur is given in **Table 2.7** and shown graphically by **Figure 2.15**.

Table 2.7: Results of Rainfall Frequency Analysis at Sukkur

Return Period (Years)	**Rainfall Depth** (mm)
2.33	46.2
5	73.5
10	95.7
25	123.8
50	144.6
100	165.3
500	213.1

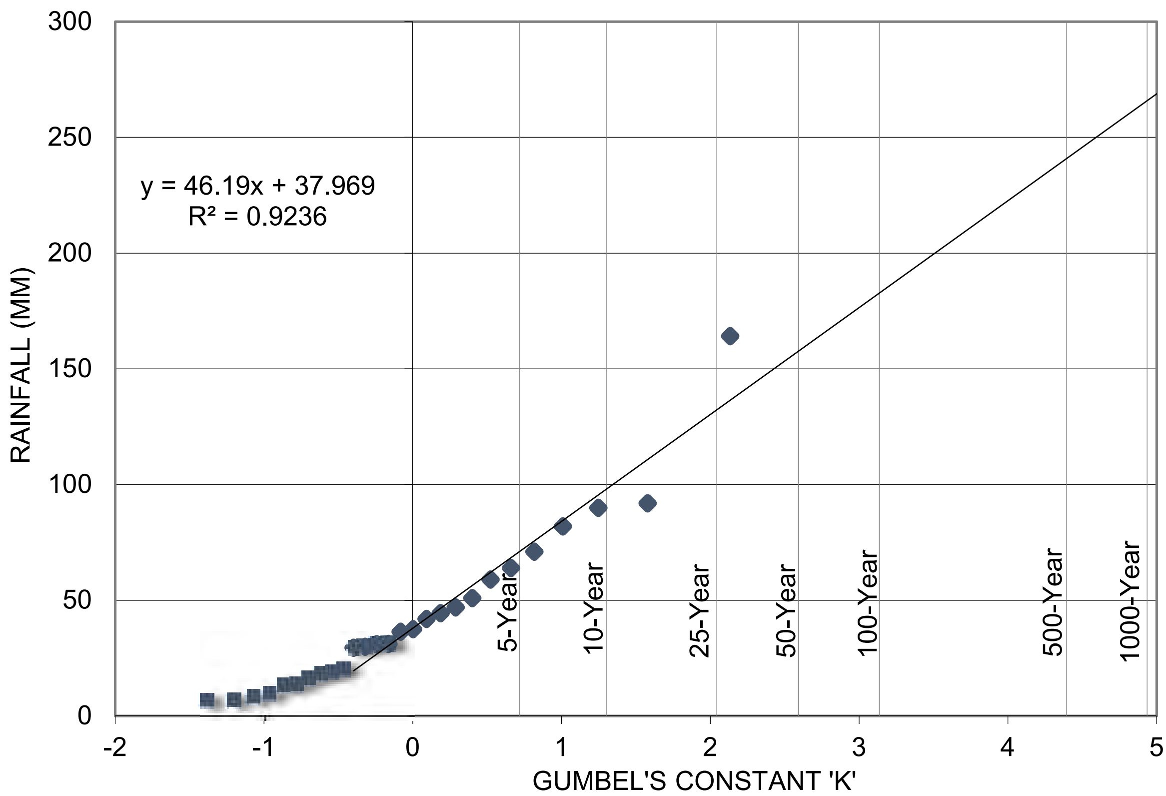


Figure 2.15: Frequency Fitting of 1-Day Annual Maximum Rainfall at Sukkur

2.10 DESIGN FLOOD ESTIMATION

All catchments of Ranipur-Sukkur Road section have area less than 1 km^2, hence design flood for the streams crossing the road has been estimated by using rational method.

2.10.1 Rational Method

As the catchments have area less than 1km^2 hence rational method has been used to compute the floods. Rational method technique is described as under:

$$Q = CIA$$

Where;

Q = Peak discharge (cusecs)
C= Coefficient of discharge
I = Intensity of rainfall (mm/hour)
A = Catchment area (acres)

Runoff Coefficient (C)

The catchment area of the crossings consists of settlements as well as agricultural land. Therefore, runoff coefficient for the catchments has been taken keeping in view its soil cover and future land use.

Rainfall Intensity

Rainfall intensity is defined as the ratio of the total amount of rain (rainfall depth) falling during a given period to the duration of the period. It is expressed in depth units per unit time, usually as mm/hour or inch/hour. The use of uniform rainfall intensity for duration equal to the time of concentration is a simplifying assumption since rainfall does not truly persist at a uniform intensity for even a short time like 5 min. Rainfall intensity has been calculated by the formula given below.

$$\text{Rainfall Intensity} = \frac{\text{Rainfall magnitude in a duration equal to time of concentration}}{T_c}$$

Intensity-Duration-Frequency curves have been developed for Peshawar rain gauging station and is shown in **Figure 2.16**. The rainfall distribution with time is then re-oriented to have a centrally loaded rainfall pattern.

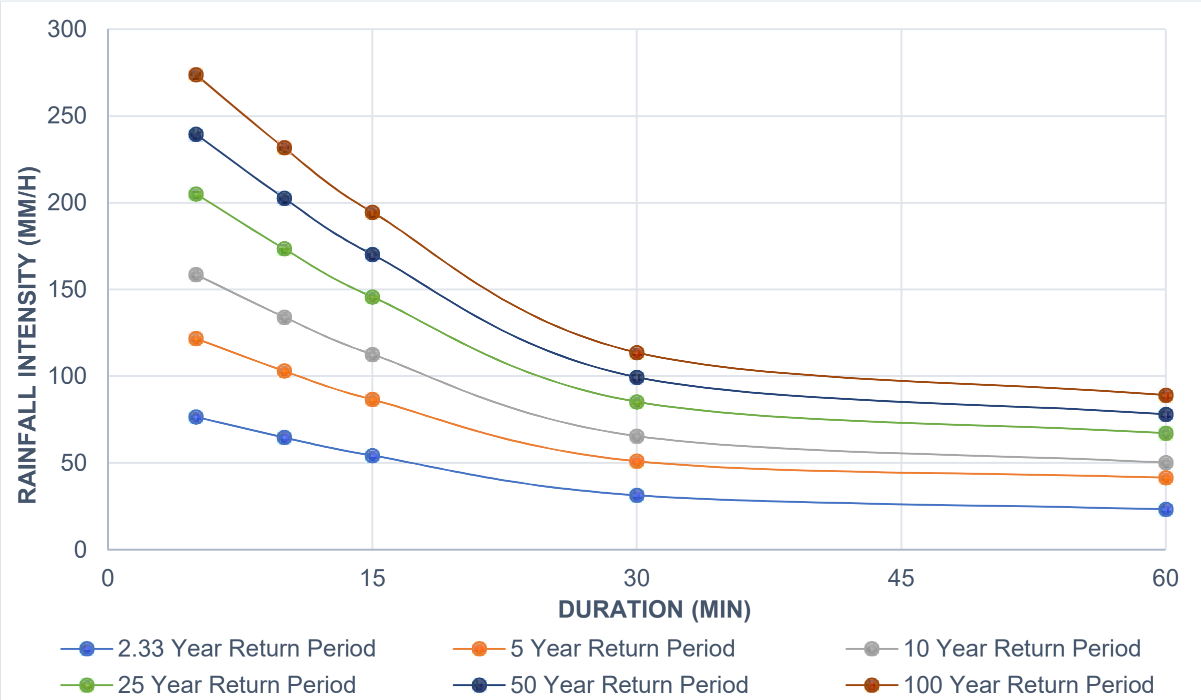


Figure 2.16: Intensity-Duration-Frequency Curve for Sukkur

2.11 ESTIMATED FLOOD DISCHARGES

The floods estimated against various return periods for the natural streams crossing the Ranipur - Sukkur Road Section are given in **Table *2.8***.

Table 2.8: Discharges against Various Return Periods

Sr. No	Structure RD's	Flow Direction	Catchment Area (km^2)	Peak Flood Discharges (m^3/sec) 25 yrs	50 yrs	100 yrs
1	2+210	Left	0.005	0.10	0.12	0.14
2	5+555	Right	0.084	1.03	1.20	1.37
3	7+585	Left	0.033	0.65	0.75	0.86
4	8+275	Left	0.056	1.00	1.16	1.33
5	9+421	Right	0.173	2.60	3.04	3.47

Sr. No	Structure RD's	Flow Direction	Catchment Area	Peak Flood Discharges		
				25 yrs	50 yrs	100 yrs
			(km^2)	(m^3/sec)		
6	13+200	Left	0.039	0.75	0.87	1.00
7	13+950	Right	0.049	0.97	1.13	1.29
8	14+410	Left	0.042	0.82	0.95	1.09
9	15+375	Right	0.031	0.61	0.72	0.82
10	15+650	Right	0.071	1.01	1.18	1.34
11	18+045	Right	0.009	0.17	0.20	0.23
12	18+361	Left	0.078	1.54	1.80	2.06
13	19+416	Left	0.021	0.41	0.47	0.54
14	25+519	Right	0.067	1.32	1.54	1.76
15	34+296	Right	0.046	0.91	1.07	1.22
16	35+229	Right	0.073	1.32	1.55	1.77
17	35+900	Right	0.011	0.22	0.26	0.29
18	37+067	Right	0.104	1.94	2.26	2.59
19	38+025	Right	0.017	0.33	0.39	0.44
20	38+058	Left	0.012	0.23	0.27	0.31
21	40+350	Left	0.006	0.12	0.14	0.16
22	41+160	Right	0.047	0.92	1.07	1.22
23	41+835	Right	0.018	0.36	0.42	0.48
24	45+720	Left	0.086	1.61	1.88	2.15
25	55+770	Right	0.346	5.14	6.00	6.86
26	58+160	Right	0.039	0.77	0.90	1.03
27	62+065	Left	0.575	4.36	5.09	5.81
28	64+104	Left	0.013	0.25	0.29	0.33
29	64+520	Left	0.235	4.61	5.39	6.16
30	64+820	Left	0.024	0.47	0.55	0.63
31	65+530	Left	0.222	3.96	4.62	5.29
32	65+810	Left	0.120	2.35	2.75	3.14
33	66+262	Right	0.398	6.05	7.07	8.08
34	66+610	Right	0.395	6.87	8.02	9.17

2.12 FLOOD DISCHARGES WITH CLIMATE IMPACT

The floods estimated against various return periods with climate change effect under SSP 585 for the streams crossing the road are given in **Table 2.9**.

Table 2.9: Discharges with Climate Impact SSP 585 against Various Return Periods

Sr. No	Structure RD's	Flow Direction	Catchment Area	Peak Flood Discharges		
				25 yrs	50 yrs	100 yrs
			(km^2)	(m^3/sec)		
1	2+210	Left	0.005	0.11	0.13	0.14
2	5+555	Right	0.084	1.08	1.25	1.39
3	7+585	Left	0.033	0.69	0.79	0.88
4	8+275	Left	0.056	1.06	1.21	1.36
5	9+421	Right	0.173	2.76	3.16	3.53
6	13+200	Left	0.039	0.80	0.91	1.02
7	13+950	Right	0.049	1.03	1.18	1.32
8	14+410	Left	0.042	0.87	0.99	1.11

Sr. No	Structure RD's	Flow Direction	Catchment Area	Peak Flood Discharges		
				25 yrs	50 yrs	100 yrs
			(km^2)	(m^3/sec)		
9	15+375	Right	0.031	0.65	0.75	0.83
10	15+650	Right	0.071	1.07	1.22	1.37
11	18+045	Right	0.009	0.19	0.21	0.24
12	18+361	Left	0.078	1.64	1.88	2.10
13	19+416	Left	0.021	0.43	0.49	0.55
14	25+519	Right	0.067	1.40	1.60	1.79
15	34+296	Right	0.046	0.97	1.11	1.24
16	35+229	Right	0.073	1.41	1.61	1.80
17	35+900	Right	0.011	0.23	0.27	0.30
18	37+067	Right	0.104	2.07	2.36	2.64
19	38+025	Right	0.017	0.35	0.40	0.45
20	38+058	Left	0.012	0.25	0.29	0.32
21	40+350	Left	0.006	0.13	0.14	0.16
22	41+160	Right	0.047	0.98	1.12	1.25
23	41+835	Right	0.018	0.38	0.44	0.49
24	45+720	Left	0.086	1.72	1.96	2.20
25	55+770	Right	0.346	5.46	6.25	6.98
26	58+160	Right	0.039	0.83	0.94	1.05
27	62+065	Left	0.575	4.43	5.23	5.68
28	64+104	Left	0.013	0.26	0.30	0.34
29	64+520	Left	0.235	4.92	5.62	6.28
30	64+820	Left	0.024	0.51	0.58	0.65
31	65+530	Left	0.222	4.22	4.82	5.39
32	65+810	Left	0.120	2.51	2.87	3.21
33	66+262	Right	0.398	6.43	7.36	8.21
34	66+610	Right	0.395	7.31	8.36	9.34

3. HYDRAULIC DESIGN OF CROSS DRAINAGE STRUCTURES

3.1 SCOPE OF HYDRAULIC STUDIES

The scope of hydraulics studies includes assessment of flow capacity and to check the adequacy of cross drainage structures present on this road i.e. Ranipur to Sukkur section for safely pass the design floods with climate change effect under SSP 5-8.5 for 6.8%, 4.3% and 2.2% increase on rainfall for 25-, 50- and 100-year return period floods respectively.

3.1.1 Design Approach of Proposed Culverts And Bridges

Culverts and bridges are provided as cross drainage structures on this roadway where irrigation channels, natural drains and nullahs cross the road. Here, in the reach from 0+000 to 70+000, cross drainage structures comprising culverts and bridges are provided at 127 locations in order to pass the irrigation and flood discharges.

Considering the floods estimated through hydrologic studies, hydraulic design review of existing twenty-four (24) box culverts, four (04) pipe culverts and one (01) bridge have been carried out by adopting comprehensive methodology which described in the subsequent sections. A schematic flow chart for hydraulic studies is shown in **Figure 3.1.**

3.1.2 Evaluation of Existing Bridges

3.1.2.1 HEC-RAS Model

HEC-RAS computer model developed by US Army Corps of Engineers has been used to compute the flow parameters and the water surface profile of nullah at bridge location along the reach under study. Following procedure has been adopted to conduct the hydraulic analysis of nullah to check the adequacy of the existing bridge.

River Geometry

Geometric data consists of the nullah schematic layout diagram, cross sectional survey data, hydraulic structure data (bridge) and cross section interpolation (where needed). Cross sections have been selected at suitable intervals along the nullah to determine the hydraulic design parameters at structure location. Model have been developed with and without hydraulic structure to carry out the hydraulic analysis of nullah. Number of cross sections obtained from topographic survey at upstream and downstream of hydraulic structure have been used to develop the model to compute the Highest Flood Level (HFL) along the stretch of the road under consideration.

Roughness Coefficient

The value of roughness coefficient 'n' depends upon the morphology, bed material, vegetation and manmade interventions in and along the flood plain of the nullah. The basic factors affect the 'n' value include surface roughness, the size and shape of the grains of the materials forming the wetted parameter, vegetation type and cover, channel alignment and obstructions. Keeping in view the above factors, roughness coefficient of 0.030 for main nullah and 0.035 for left and right over bank have been chosen for the structure.

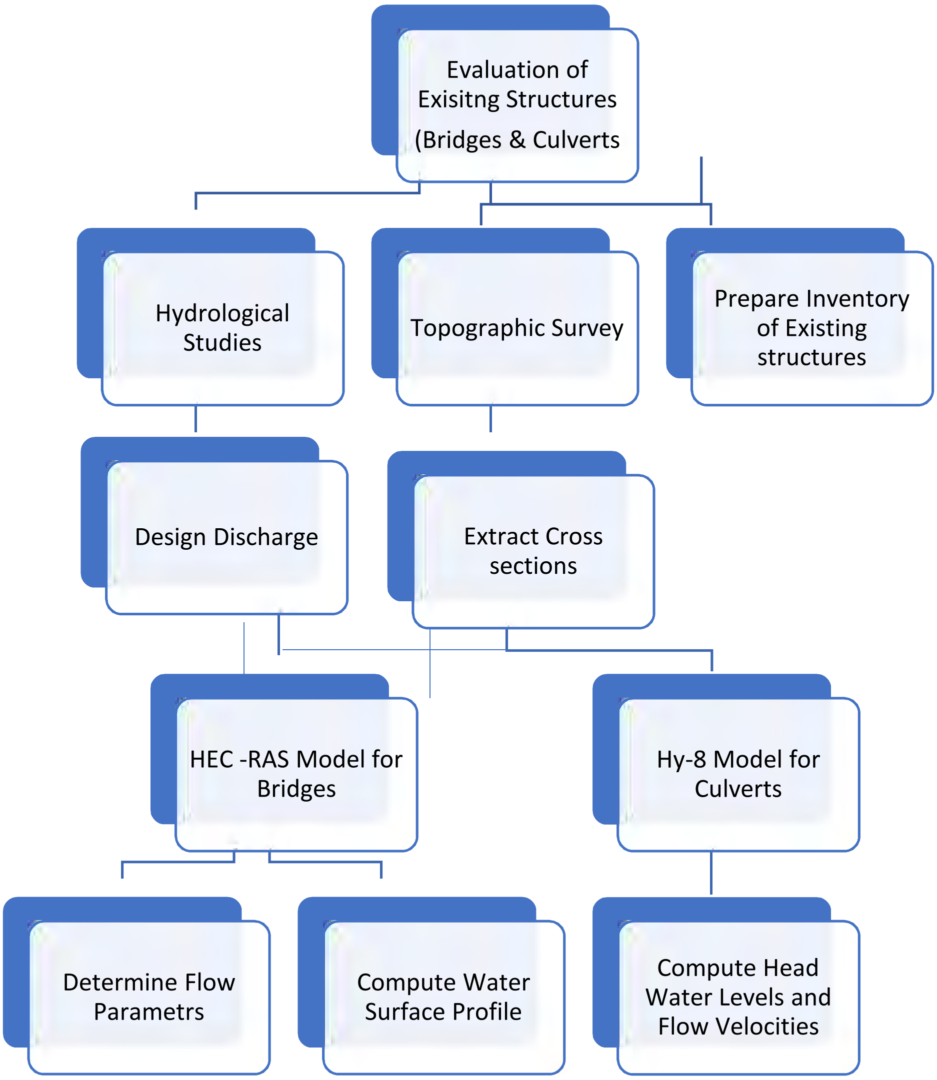


Figure 3.1: Schematic Flow Chart Showing Hydraulic Analysis of Bridge and Culverts

<u>Boundary Condition</u>

The model is run under steady state flow condition for subcritical or supercritical flow regimes and normal depth at downstream or upstream ends of the study reach has been taken as boundary condition depending on the prevalent regime of the nullah.

<u>Hydraulic Design Parameters</u>

The hydraulic design parameters like flow depth and flow velocity have been determined by using the cross-sectional data along with hydrological data as input in the HEC-RAS computer model.

Typical cross section and longitudinal profile of bridge in HEC-RAS model is given in **Figure 3.2** and **Figure 3.3**.

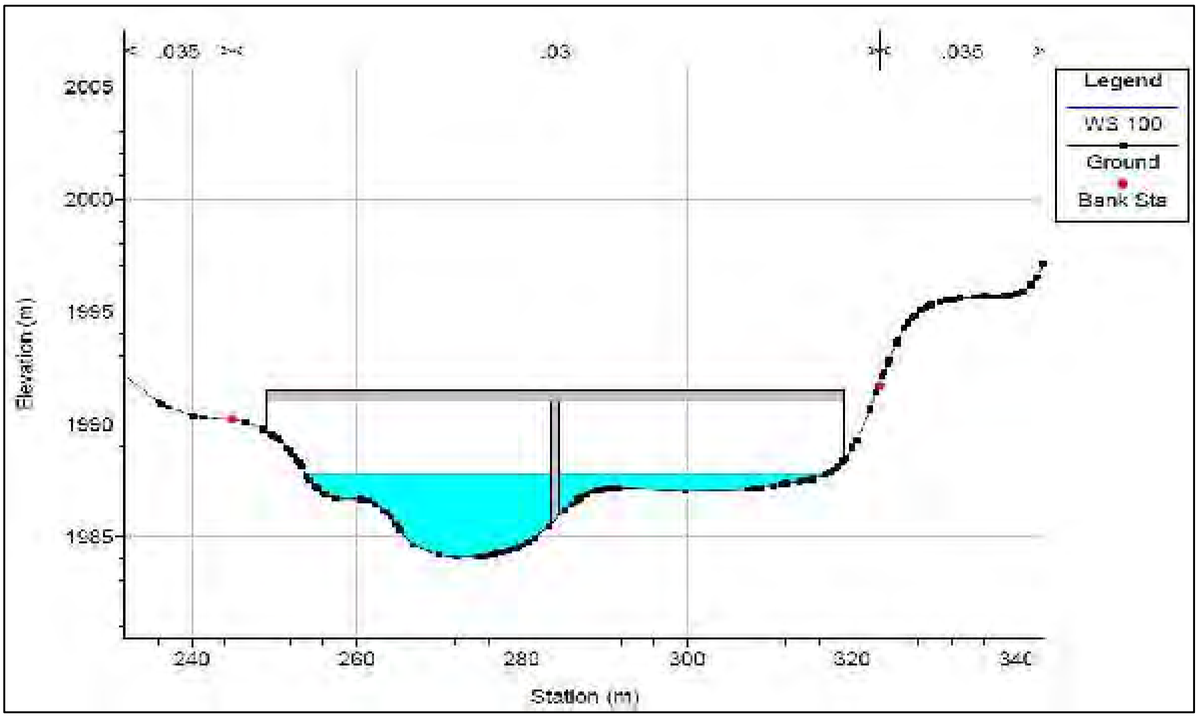


Figure 3.2: Typical Cross Section of Bridge in HEC-RAS Model

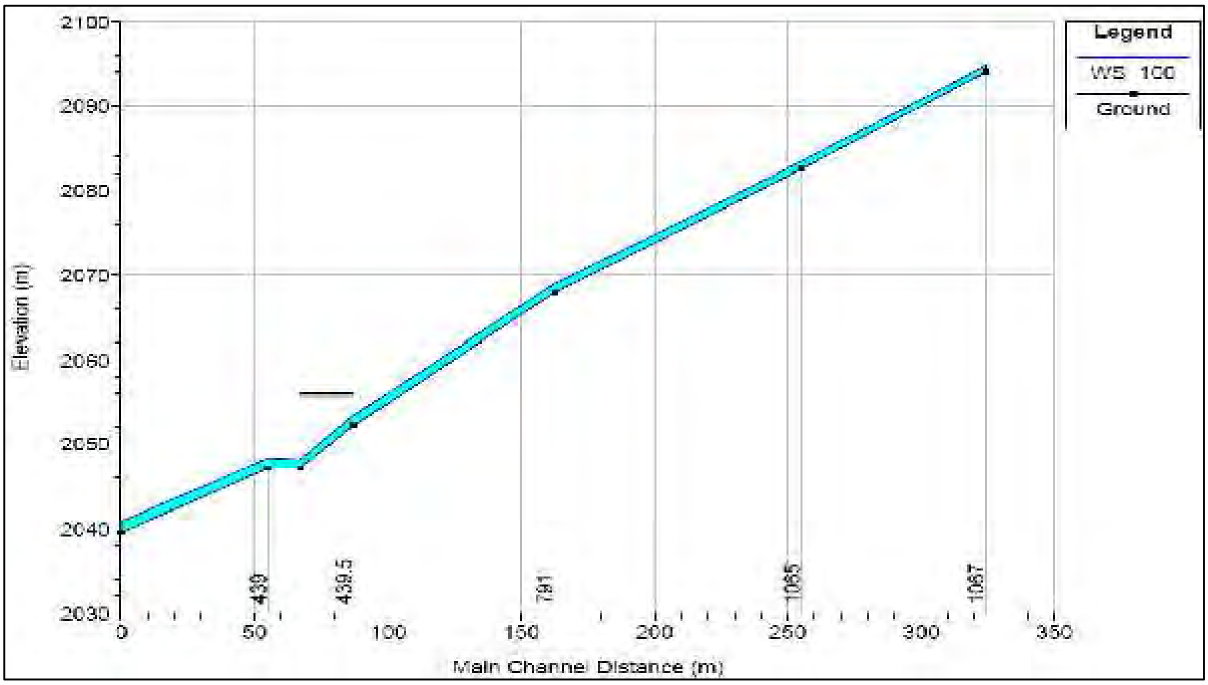


Figure 3.3: Typical Longitudinal Profile of nullah with Bridge in HEC-RAS Model

3.1.2.2 <u>Freeboard</u>

The freeboard for the bridge is adopted as 1m here in case of nullah.

3.1.3 Evaluation of Existing Culverts

The Culvert structures have been analysed on HY-8 software to confirm the existing conveyance capacity against the design discharge i.e., 25-year return period. Followings are the input parameters for the Hy-8 model:

3.1.3.1 Design Discharge

The existing culverts have been analysed on design discharge of 25 years return period flood, whereas minimum discharge is assumed as nil, and the maximum discharge is taken as 50 years return period flood.

3.1.3.2 Tail Water Data

The model requires manning's roughness coefficient (n), average bed slope and one cross section on the downstream, for the computation of tail water level. The average bed slope of the nullah on the downstream side of culvert is taken from the topographic survey data.

3.1.3.3 Roadway Data

The roadway data is required as input in the model, which comprises width of widened roads, road crown elevation and total carriage width. The size of each culvert has been checked for safe capacity under conditions that the head water level will not approach the roadway.

3.1.3.4 Culvert Data

Concrete box and pipe culverts are analysed with manning's roughness coefficient of 0.016. The data required for the model comprised of type, invert levels, culvert length, shape and size of culvert barrels along with inlet and outlet wing wall configurations.

Typical longitudinal profile of a culvert in HY-8 computer model is given as **Figure 3.4.**

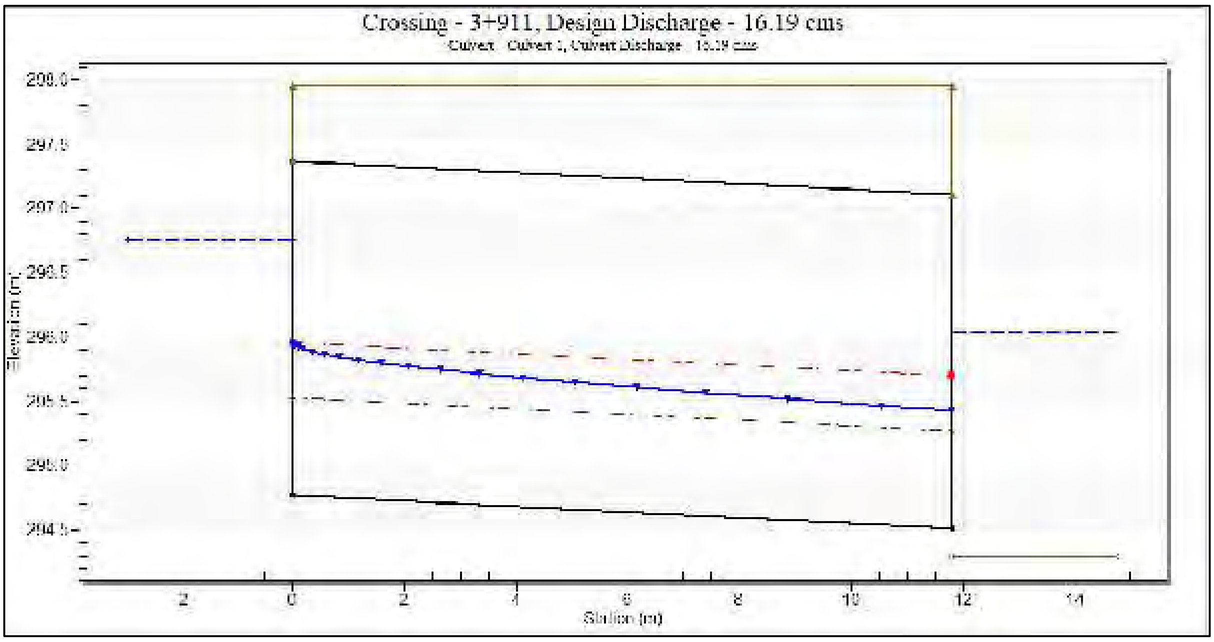


Figure 3.4: Typical Longitudinal Profile of Culvert in HY-8 Model

A typical summary table of culvert in HY-8 Computer Model is given as **Table 3.1**.

Table 3.1: Hydraulic Parameters of Culvert

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth(m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	294.77	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
2.33	2.33	295.32	**0.55**	0.36	1-JS1t	0.20	0.33	0.62	0.84	0.94	0.80
4.67	4.67	295.64	**0.87**	0.63	1-JS1t	0.32	0.52	0.87	1.09	1.34	0.96
7.00	7.00	295.91	**1.14**	0.83	1-JS1t	0.42	0.68	1.05	1.27	1.65	1.06
9.33	9.33	296.15	**1.38**	1.00	1-JS1t	0.51	0.82	1.20	1.42	1.95	1.14
11.67	11.67	296.37	**1.60**	1.17	1-JS1t	0.60	0.95	1.32	1.54	2.20	1.21
14.00	14.00	296.57	**1.80**	1.33	1-S2n	0.69	1.08	0.82	1.66	4.25	1.27
15.19	16.19	296.75	**1.98**	1.47	1-S2n	0.76	1.19	0.92	1.75	4.41	1.31
18.66	18.66	296.95	**2.18**	1.63	1-S2n	0.84	1.30	1.02	1.85	4.57	1.36
21.00	21.00	297.13	**2.36**	1.79	1-S2n	0.92	1.41	1.12	1.93	4.70	1.40
23.33	23.33	297.31	**2.54**	1.95	1-S2n	1.00	1.5	1.21	2.0	4.83	1.44

3.1.4 Analysis and Results

The hydraulic design review parameters of the existing culverts and bridge along with suggested remarks to be adopted for each structure for the project are shown in **Table 3.2**.

3.2 CONCLUSION AND RECOMMENDATIONS

Hydraulic design review of the culverts and bridge have been carried, by extracting required input parameters from available road layout plans, condition survey, natural topographic and google earth maps to check the adequacy for safely pass the design floods with climate change effect under SSP 5-8.5. It is observed that existing box culverts are present on small drain/ nullahs, and bridge exist on some bigger nullah at Ranipur-Sukkur section. Considering the topography of the project area, some development and huge agricultural land on the sides of the road at different locations the hydraulic analyses for the cross-drainage structures have been taken up. Here, in this reach the structures with individual design discharge have been reviewed as individual for capacity check as shown in Table-1 and some briefed below.

- The results of the hydraulic analyses show that culverts at RD. 45+772 and 55+770 (both sides) are not capable of passing design floods. Hence, these culverts required to increase number of cells/barrels to achieve adequate capacity as shown in summary table.
- Some culverts are moderately choked, minor damaged and filled with mud. Hence, required cleaning, repair and periodic maintenance for the proper drainage of the design floods. Some culverts with poor conditions are also suggested to replace with new box culverts as mentioned in remarks.
- In this reach of road only one bridge existed at RD. 68+275 with a capacity of about 600 m^3/s as indicated in the summary table. Here, one side (R-S) of bridge is filled with mud that require cleaning.

Table 3.2: Hydraulic Design Review Parameters of Existing Culverts and Bridge

Sr. No.	Structure Code	RD	Structure Type	Roadside	Estimated SSP 5-8.5 Discharge	No. of Span	Span / Dia.	Span Height	Estimated Capacity (m^3/sec)		Capacity Check	Remarks
					(m^3/sec)		(m)	(m)	Individual	Combined		
1	-	0+175	-	-	-	-	-	-	-	-	-	Irrigation Channel
2	-	0+900	-	-	-	-	-	-	-	-	-	Irrigation Channel
3	-	1+500	-	-	-	-	-	-	-	-	-	Irrigation Channel
4	PC-1	2+210	Pipe Culvert	-	0.11	1	0.9	-	1.32	1.32	Capacity OK	-
5	BC-1	7+585	Box Culvert	-	0.69	1	1	0.8	2.51	2.51	-	Poor Condition . Replace by 1x1.5 box culvert.
6	BC-2	8+275	Box Culvert	-	1.06	1	1	1	2.63	2.63	Capacity OK	-
7	BC-3	13+200	Box Culvert	-	0.8	1	1	1	3.89	3.89	Capacity OK	-
8	BC-4	13+950	Box Culvert	-	1.03	1	0.9	0.7	-	-	-	Choked & Poor Condition . Replace by 1x1.5 box culvert.
9	BC-5	14+410	Box Culvert	-	0.87	-	-	-	-	-	-	Choked . Replace by 1x1.5 box culvert.
10	-	15+125	-	-	-	-	-	-	-	-	-	Irrigation Channel
11	-	15+280	-	-	-	-	-	-	-	-	-	Irrigation Channel
12	-	15+375	-	-	-	-	-	-	-	-	-	Irrigation Channel
13	-	16+500	-	-	-	-	-	-	-	-	-	Irrigation Channel
14	BC-6	16+700	Box Culvert	-	-	1	0.95	0.95	2.79	2.79	-	Local Flow
15	-	17+200	-	-	-	-	-	-	-	-	-	Irrigation Channel
16	-	17+970	-	-	-	-	-	-	-	-	-	Irrigation Channel
17	-	18+750	-	-	-	-	-	-	-	-	-	Irrigation Channel
18	-	19+800	-	-	-	-	-	-	-	-	-	Irrigation Channel
19	-	20+115	-	-	-	-	-	-	-	-	-	Irrigation Channel
20	-	20+855	-	-	-	-	-	-	-	-	-	Irrigation Channel
21	-	21+325	-	-	-	-	-	-	-	-	-	Irrigation Channel
22	-	21+680	-	-	-	-	-	-	-	-	-	Irrigation Channel
23	-	21+920	-	-	-	-	-	-	-	-	-	Irrigation Channel
24	PC-2	22+225	Pipe Culvert	-	-	1	0.6	-	0.69	0.69	-	Poor Condition. Replace by 1x1.5 box culvert.
25	-	22+345	-	-	-	-	-	-	-	-	-	Irrigation Channel
26	-	22+935	-	-	-	-	-	-	-	-	-	Irrigation Channel
27	-	23+500	-	-	-	-	-	-	-	-	-	Irrigation Channel
28	-	23+800	-	-	-	-	-	-	-	-	-	Irrigation Channel
29	-	24+650	-	-	-	-	-	-	-	-	-	Irrigation Channel
30	-	24+940	-	-	-	-	-	-	-	-	-	Irrigation Channel
31	-	25+135	-	-	-	-	-	-	-	-	-	Irrigation Channel

Sr. No.	Structure Code	RD	Structure Type	Roadside	Estimated SSP 5-8.5 Discharge	No. of Span	Span / Dia.	Span Height	Estimated Capacity (m^3/sec)		Capacity Check	Remarks
					(m^3/sec)		(m)	(m)	Individual	Combined		
32	BC-7	25+520	Box Culvert	-	1.4	1	1	1	3.03	3.03	Capacity OK	-
33	-	25+780	-	-	-	-	-	-	-	-	-	Irrigation Channel
34	-	26+080	-	-	-	-	-	-	-	-	-	Irrigation Channel
35	-	26+280	-	-	-	-	-	-	-	-	-	Irrigation Channel
36	-	26+450	-	-	-	-	-	-	-	-	-	Irrigation Channel
37	-	26+920	-	-	-	-	-	-	-	-	-	Irrigation Channel
38	-	27+600	-	-	-	-	-	-	-	-	-	Irrigation Channel
39	-	27+990	-	-	-	-	-	-	-	-	-	Irrigation Channel
40	-	28+435	-	-	-	-	-	-	-	-	-	Irrigation Channel
41	-	28+600	-	-	-	-	-	-	-	-	-	Irrigation Channel
42	-	28+925	-	-	-	-	-	-	-	-	-	Irrigation Channel
43	-	29+650	-	-	-	-	-	-	-	-	-	Irrigation Channel
44	-	30+060	-	-	-	-	-	-	-	-	-	Irrigation Channel
45	-	30+480	-	-	-	-	-	-	-	-	-	Irrigation Channel
46	-	30+775	-	-	-	-	-	-	-	-	-	Irrigation Channel
47	-	30+800	-	-	-	-	-	-	-	-	-	Irrigation Channel
48	-	31+000	-	-	-	-	-	-	-	-	-	Irrigation Channel
49	-	31+625	-	-	-	-	-	-	-	-	-	Irrigation Channel
50	-	32+045	-	-	-	-	-	-	-	-	-	Irrigation Channel
51	-	32+080	-	-	-	-	-	-	-	-	-	Irrigation Channel
52	-	32+460	-	-	-	-	-	-	-	-	-	Irrigation Channel
53	-	32+860	-	-	-	-	-	-	-	-	-	Irrigation Channel
54	-	33+040	-	-	-	-	-	-	-	-	-	Irrigation Channel
55	-	33+175	-	-	-	-	-	-	-	-	-	Irrigation Channel
56	-	33+445	-	-	-	-	-	-	-	-	-	Irrigation Channel
57	-	34+550	-	-	-	-	-	-	-	-	-	Irrigation Channel
58	-	34+720	-	-	-	-	-	-	-	-	-	Irrigation Channel
59	-	35+545	-	-	-	-	-	-	-	-	-	Irrigation Channel
60	-	35+690	-	-	-	-	-	-	-	-	-	Irrigation Channel
61	BC-8	35+900	Box Culvert	-	0.23	1	1	1	3.15	3.15	Capacity OK	-
62	-	36+480	-	-	-	-	-	-	-	-	-	Irrigation Channel
63	-	36+690	-	-	-	-	-	-	-	-	-	Irrigation Channel
64	-	37+165	-	-	-	-	-	-	-	-	-	Irrigation Channel
65	-	37+810	-	-	-	-	-	-	-	-	-	Irrigation Channel
66	BC-9	38+025	Box Culvert	-	0.35	1	1	1	2.89	2.89	Capacity OK	-
67	BC-10	38+285	Box Culvert	-	-	1	1	1	2.95	2.95	-	Local Flow
68	-	38+545	-	-	-	-	-	-	-	-	-	Irrigation Channel

Sr. No.	Structure Code	RD	Structure Type	Roadside	Estimated SSP 5-8.5 Discharge	No. of Span	Span / Dia.	Span Height	Estimated Capacity (m^3/sec)		Capacity Check	Remarks
					(m^3/sec)		(m)	(m)	Individual	Combined		
69	-	38+750	-	-	-	-	-	-	-	-	-	Irrigation Channel
70	-	39+615	-	-	-	-	-	-	-	-	-	Irrigation Channel
71	-	40+270	-	-	-	-	-	-	-	-	-	Irrigation Channel
72	BC-11	40+350	Box Culvert	*R-S*	0.13	1	1	1	1.34	1.34	-	Poor Condition, Replace by 1x1.5 Box Culvert
			Pipe Culvert	*S-R*		1	0.9	-				
73	-	40+800	-	-	-	-	-	-	-	-	-	Irrigation Channel
74	PC-3	41+160	Pipe Culvert	-	0.98	1	0.9	-	1.37	1.37	Capacity OK	Choked, Cleaning & Maintenance Required
75	-	41+415	-	-	-	-	-	-	-	-	-	Irrigation Channel
76	BC-12	41+835	Box Culvert	-	0.38	1	0.8	0.5	1.36	1.36	Capacity OK	Choked, Cleaning & Maintenance Required
77	-	42+480	-	-	-	-	-	-	-	-	-	Irrigation Channel
78	-	42+990	-	-	-	-	-	-	-	-	-	Irrigation Channel
79	-	43+250	-	-	-	-	-	-	-	-	-	Irrigation Channel
80	-	43+490	-	-	-	-	-	-	-	-	-	Irrigation Channel
81	-	43+810	-	-	-	-	-	-	-	-	-	Irrigation Channel
82	-	44+260	-	-	-	-	-	-	-	-	-	Irrigation Channel
83	BC-13	45+010	Box Culvert	-	-	1	1	1	3.11	3.11	-	Local Flow
84	-	45+290	-	-	-	-	-	-	-	-	-	Irrigation Channel
85	-	45+575	-	-	-	-	-	-	-	-	-	Irrigation Channel
86	PC-4	45+720	Pipe Culvert	-	1.72	1	0.9	-	1.35	1.35	Less Capacity	Replace by 1x1.5 Box Culvert
87	-	45+985	-	-	-	-	-	-	-	-	-	Irrigation Channel
88	-	46+545	-	-	-	-	-	-	-	-	-	Irrigation Channel
89	-	47+045	-	-	-	-	-	-	-	-	-	Irrigation Channel
90	-	47+700	-	-	-	-	-	-	-	-	-	Irrigation Channel
91	-	48+135	-	-	-	-	-	-	-	-	-	Irrigation Channel
92	-	48+250	-	-	-	-	-	-	-	-	-	Irrigation Channel
93	-	48+655	-	-	-	-	-	-	-	-	-	Irrigation Channel
94	-	48+820	-	-	-	-	-	-	-	-	-	Irrigation Channel
95	-	49+110	-	-	-	-	-	-	-	-	-	Irrigation Channel
96	-	49+565	-	-	-	-	-	-	-	-	-	Irrigation Channel
97	BC-14	50+080	Box Culvert	-	-	1	1	1	3.21	3.21	-	Local Flow
98	BC-15	50+430	Box Culvert	-	-	1	1	1	3.05	3.05	-	Local Flow
99	-	51+285	-	-	-	-	-	-	-	-	-	Irrigation Channel
100	-	51+620	-	-	-	-	-	-	-	-	-	Irrigation Channel
101	-	52+330	-	-	-	-	-	-	-	-	-	Irrigation Channel
102	-	54+350	-	-	-	-	-	-	-	-	-	Irrigation Channel

Sr. No.	Structure Code	RD	Structure Type	Roadside	Estimated SSP 5-8.5 Discharge (m³/sec)	No. of Span	Span / Dia. (m)	Span Height (m)	Estimated Capacity (m^3/sec) Individual	Combined	Capacity Check	Remarks
103	-	55+485	-	-	-	-	-	-	-	-	-	Irrigation Channel
104	BC-16	55+770	Box Culvert	-	5.46	1	1	1	2.98	2.98	Less Capacity	Increase 1 barrel of 1x1 to cater the Climate Resilience flood
105	-	56+080	-	-	-	-	-	-	-	-	-	Irrigation Channel
106	-	56+580	-	-	-	-	-	-	-	-	-	Irrigation Channel
107	-	57+050	-	-	-	-	-	-	-	-	-	Irrigation Channel
108	-	57+320	-	-	-	-	-	-	-	-	-	Irrigation Channel
109	-	57+570	-	-	-	-	-	-	-	-	-	Irrigation Channel
110	-	57+970	-	-	-	-	-	-	-	-	-	Irrigation Channel
111	BC-17	58+160	Box Culvert	-	0.83	1	1	1	2.95	2.95	-	Choked, Cleaning & Maintenance Required
112	-	58+535	-	-	-	-	-	-	-	-	-	Irrigation Channel
113	-	58+800	-	-	-	-	-	-	-	-	-	Irrigation Channel
114	-	59+850	-	-	-	-	-	-	-	-	-	Irrigation Channel
115	-	59+975	-	-	-	-	-	-	-	-	-	Irrigation Channel
116	-	60+020	-	-	-	-	-	-	-	-	-	Irrigation Channel
117	-	60+100	-	-	-	-	-	-	-	-	-	Irrigation Channel
118	BC-18	60+235	Box Culvert	-	-	1	1.2	1	3.45	3.45	-	Local Flow
119	BC-19	62+065	Box Culvert	-	4.43	2	1.5	0.8	8.28	8.28	Capacity OK	-
120	-	63+135	-	-	-	-	-	-	-	-	-	Irrigation Channel
121	-	63+305	-	-	-	-	-	-	-	-	-	Irrigation Channel
122	BC-20	64+520	Box Culvert	-	4.92	1	2.2	1	-	-	-	Choked & Poor Condition, Replace by 2x1.5 Box Culvert
123	BC-21	64+820	Box Culvert	-	0.51	1	1.5	1	4.82	4.82	Capacity OK	-
124	BC-22	65+530	Box Culvert	-	4.22	1	1.5	1	4.78	4.78	Capacity OK	-
125	BC-23	65+810	Box Culvert	-	2.51	1	1.5	1	4.85	4.85	Capacity OK	-
126	BC-24	66+610	Box Culvert	-	7.31	2	2.5	2.5	21.47	21.47	Capacity OK	-
127	BR-1	68+275	Bridge	-	-	3	22	4.5	600	600	-	One side (R-S) filled with mud. Required Cleaning.

Note- PC = Pipe Culvert

BC = Box Culvert

BR = Bridge

R-S = Ranipur to Sukkur Side

S-R = Sukkur to Ranipur Side

Capacity of structure is estimated of smaller one in case of difference in size of structures on same RD of P-N & N-P roadways

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NATIONAL HIGHWAY AUTHORITY
GOVERNMENT OF PAKISTAN

WIDENING & IMPROVEMENT OF PRIORITY SECTIONS OF N-5

RAWALPINDI - HASSANABDAL ROAD SECTION

CLIMATE CHANGE ASSESSMENT, HYDROLOGICAL AND HYDRAULIC STUDIES FOR CROSS DRAINAGE STRUCTURES REPORT

DECEMBER 2024

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
HEAD OFFICE: NESPAK HOUSE, 1-C, BLOCK-N, MODEL TOWN EXTENSION LAHORE, PAKISTAN

CLIMATE CHANGE ASSESSMENT,
HYDROLOGICAL AND HYDRAULIC STUDIES
FOR CROSS DRAINAGE STRUCTURES REPORT
TARNOL-HASSANABDAL SECTION

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DETAILED DESIGN FOR WIDENING & IMPROVEMENT OF PRIORITY SECTIONS OF N-5 - 456 KM
TARNOL – HASSANABDAL ROAD SECTION

1. CLIMATE CHANGE STUDIES

1.1 INTRODUCTION

The N5 road, a critical transportation artery, is undergoing an expansion from 4 lanes to 6 lanes to accommodate increasing traffic demand and promote regional economic growth. As part of this expansion, it is essential to assess the potential risks associated with climate change to ensure the long-term resilience and sustainability of the infrastructure.

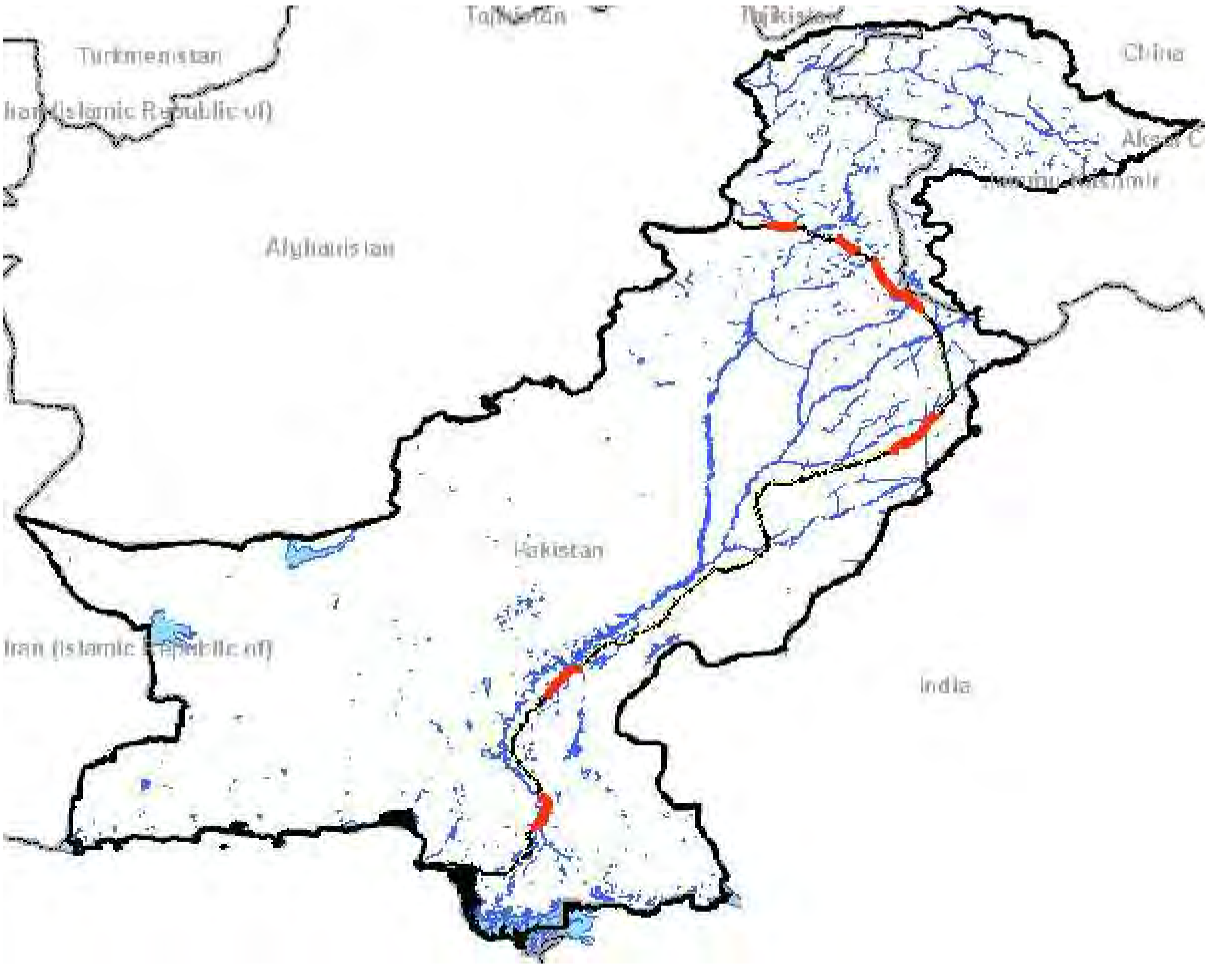

Figure 1.1: N5 Road Alignment with Dualization Sections (highlighted in red color)

1.2 REVIEW OF CLIMATE CHANGE FOR PAKISTAN

Pakistan is influenced by different climate zones, particularly by Monsoon climate in the south and mountain climate in the north. The general climatic conditions are altered by Pakistan’s diverse geography with the far north reaching into the Himalayas and the southern and western regions being lowland plains of the Indus River, contributing to the diversity in climatic conditions in different regions of the country. The climate is respectively characterized by diverse conditions. Average temperatures are strongly dependent on the topography, with coolest annual temperatures below zero in the far North (the Himalayan region), and higher average temperatures in the lower-lying south-east. Rainfall is low throughout the year in large parts of the country (20-30mm per month), but the northern regions, on the southern side of the Himalayan mountains, receive rainfall of up to 200mm per month as a result of the summer monsoon through July to September.

1.3 CURRENT CLIMATOLOGY

Pakistan's climate context for the current climatology, 1991-2020, derived from observed, historical data (see, **Figure 1.2**, **Figure 1.3** and **Figure 1.4**). Information should be used to build a strong understanding of current climate conditions in order to appreciate future climate scenarios and projected change. Observed, historical data is produced by the Climatic Research Unit (CRU) of University of East Anglia. Data is presented at a 0.5º x 0.5º (50km x 50km) resolution.

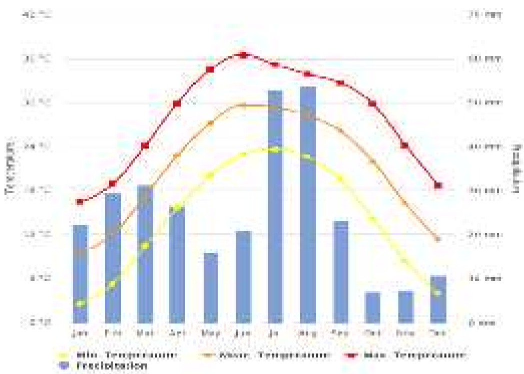

Figure 1.2: Monthly Climatology of Min, Max and Mean Temperature with Rainfall (1991-2020) (Source: World Bank)

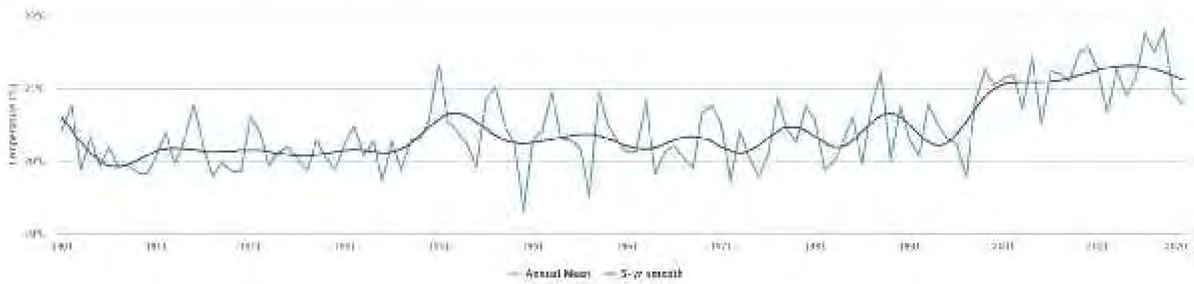

Figure 1.3: Observed Average Annual Mean- Temperature of Pakistan for 1901-2020

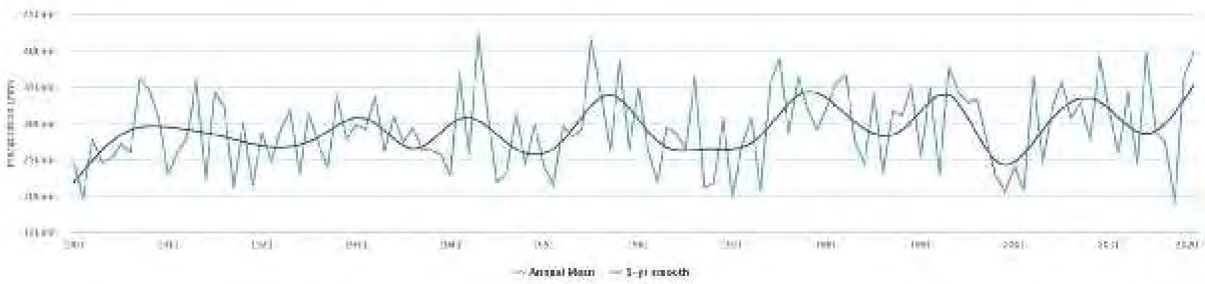

Figure 1.4: Observed Average Annual Rainfall of Pakistan for 1901-2020

<u>Temperature</u>

- Warming in Pakistan was estimated at 0.57°C over the 20th century, but has accelerated more recently, with 0.47°C of warming measured between 1961–2007.
- Increases in temperature is strongly biased towards the winter and post-monsoon months (November–February). On a sub-national level, warming is also strongly biased towards the more southerly regions, with Punjab, Sind, and Baluchistan all experiencing winter warming in the region of 0.91°C–1.12°C between 1961–2007, and Khyber Pakhtunkhwa in the north experiencing only 0.52°C.
- The rise in average daily maximum temperatures (0.87°C between 1961–2007) has been slightly stronger than the rise in average temperatures. A concurrent increase in the frequency of heat wave days has been documented, particularly in Sindh Province.

<u>Rainfall</u>

- Mean rainfall in the arid plains of Pakistan and the coastal belt has decreased by 10-15% since 1960. Most other regions have experienced a slight increase, seen both in the monsoon and dry seasons.
- The number of heavy rainfall events has increased since 1960, and the nine heaviest rains recorded in 24 hours were recorded in 2010.
- Recent evidence suggests that glaciers in the headwaters of the Indus Basin may be expanding due to increased winter rainfall over the Himalayan region in the last 40 years.

1.4 PROJECTED CLIMATOLOGY

Climate projection data is modeled data from the global climate model compilations of the Coupled Model Inter-comparison Projects (CMIPs), overseen by the World Climate Research Program. Data presented is CMIP6, derived from the Sixth phase of the CMIPs. The CMIPs form the data foundation of the IPCC Assessment Reports. CMIP6 supports the IPCC's Sixth Assessment Report. Data is presented at a 0.25º x 0.25º (25km x 25km) resolution. Projected multi model mean temperature and rainfall trend for Pakistan is shown in **Figure 1.5** and **Figure 1.6** respectively.

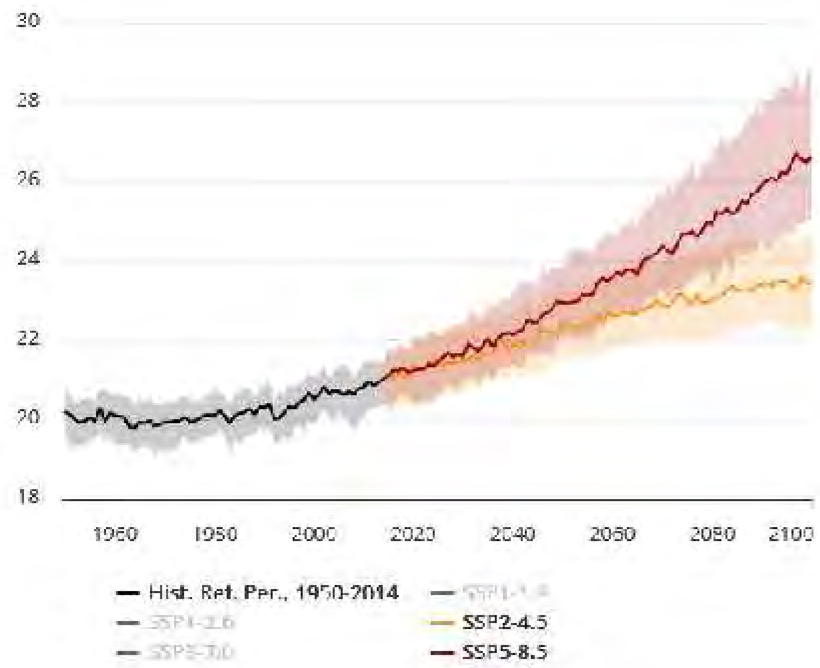

Figure 1.5: Projected Mean Temperature (Multi-Model Ensemble) Pakistan

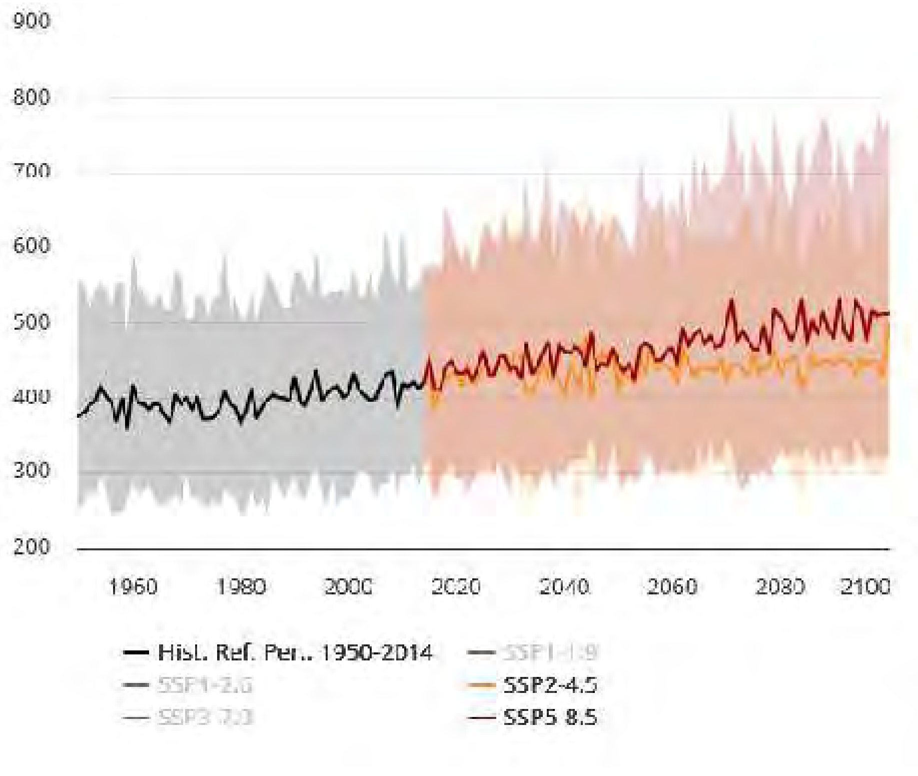

Figure 1.6: Projected Rainfall (Multi-Model Ensemble) Pakistan

1.5 CLIMATE DIAGONISTIC

Consultants performed climate risk assessment as per International standard practice for climate change projects following the guidelines of Intergovernmental Panel for Climate Change.

1.6 MODELLING FRAMEWORK

Climate change scenarios is retrieved and analyzed at different spatial and temporal resolutions. Daily climate data (rainfall, maximum and minimum temperature) is retrieved from the NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP) dataset (Sheffield et al. 2006; Thrasher et al. 2022), which are available at a spatial resolution of 25 km. Daily climate data (rainfall, maximum and minimum temperature) is retrieved from the ERA5 dataset which is available at a spatial resolution up to 11 km. For both datasets, current and future climate conditions are retrieved and analyzed (see **Table 1.1**).

Table 1.1: Available climate information for climate change assessment

Dataset	Conditions	Resolution		Period	Description
		Spatial	Temporal		
ERA5	Historic	11 km	Daily	1985-2014	Mean temperature (ºC)
					Rainfall (mm)
NEX-GDDP-CMIP6	Current	25 km	Daily	1985-2014	Mean temperature (ºC)
					Rainfall (mm)
	Future	25 km	Daily	Until 2099	Mean temperature (ºC)
					Rainfall (mm)

Future conditions included the Intergovernmental Panel on Climate Change Sixth Assessment (IPCC6) climate projections from global climate models (GCMs) for different shared socio-economic pathways (SSPs). Different climate scenarios (SSP 2-4.5 and SSP 5-8.5) are used according to data availability of IPCC6.

SSP 2-4.5 is a scenario that represents the medium range of future forcing pathways and serves as an update to the RCP4.5 pathway. It is utilized as a reference experiment by several CMIP6-Endorsed MIPs. SSP 2-4.5 was chosen because its land use and aerosol pathways are not extreme compared to other SSPs, making it central to the concerns of Detection and Attribution MIP (DAMIP)[1] and Decadal Climate Prediction Project (DCPP)[2]. Additionally, it is relevant to Integrated Assessment Modeling (IAM) and Impact, Adaptation, and Vulnerability (IAV) research as it represents a scenario that combines intermediate societal vulnerability with an intermediate forcing level.

SSP 5-8.5 represents the high end of future pathways in the IAM and serves as an update to the RCP8.5 pathway. This scenario is specifically chosen to address scientific questions across various CMIP6-Endorsed MIPs. SSP 5-8.5 is unique among the SSP scenarios

[1] Gillett, N. P., Shiogama, H., Funke, B., Hegerl, G., Knutti, R., Matthes, K., Santer, B. D., Stone, D., and Tebaldi, C.: The Detection and Attribution Model Intercomparison Project (DAMIP v1.0) contribution to CMIP6, Geosci. Model Dev., 9, 3685-3697, doi:10.5194/gmd-9-3685-2016, 2016

[2] Boer, G. J., Smith, D. M., Cassou, C., Doblas-Reyes, F., Danabasoglu, G., Kirtman, B., Kushnir, Y., Kimoto, M., Meehl, G. A., Msadek, R., Mueller, W. A., Taylor, K. E., Zwiers, F., Rixen, M., Ruprich-Robert, Y., and Eade, R.: The Decadal Climate Prediction Project (DCPP) contribution to CMIP6, Geosci. Model Dev., 9, 3751-3777, doi:10.5194/gmd-9-3751-2016, 2016

because it exhibits emissions high enough to generate a radiative forcing of 8.5 Wm^{-2} in 2100. The selection of SSP 5-8.5 as the forcing pathway is significant due to its ability to capture the upper bounds of potential future climate conditions. This scenario is essential for understanding the potential outcomes and developing appropriate strategies to mitigate and adapt to the impacts of climate change.

1.7 ERA5

ERA5 is the fifth-generation reanalysis dataset produced by the European Centre for Medium-Range Weather Forecasts (ECMWF). It provides comprehensive and high-resolution data on various atmospheric, oceanic, and land-surface variables, including rainfall and temperature, from 1950 to the present. ERA5 provides consistent global data coverage, enabling analysis across different geographic scales, from local to global levels. ERA5 rainfall and temperature data are extensively used in climate research, weather forecasting, hydrology, and environmental impact assessments. They are valuable for understanding historical climate trends, evaluating extreme weather conditions, and supporting adaptation and mitigation planning. The Consultant uses ERA5 data to evaluate and correct climate change data, considering catchments and its spatial coverage in N5.

1.8 NEX-GDDP-CMIP6

Climate change forecasts are estimates of the climate system's response to potential greenhouse gas and aerosol emissions over the next century. These projections are often based on climate model simulations. Ongoing climate change may impact on the dynamics of extreme events as well as the availability of water supplies. We may prepare the community and manage infrastructure based on scientific understanding of projected changes and situations, allowing us to take actions to adapt to the new conditions. The complexity of climate models varies; some include more procedures than others. This means that each model will produce distinct results. The magnitude of these fluctuations can be big or small, depending on the model, area, season, variable, etc. A model may perform well in one area/season/ variable but poorly in another, whereas another model excels in yet another.

To estimate the probable future climatic change in this region, a complete analysis of thirty-five (35) global climate models (GCMs) (**Table 1.2**) from the current set of the Coupled Model Intercomparison Project Phase 6 (CMIP-6) by the NEX-GDDP-CMIP6[3] was performed. The collection contains scenarios for all four "Tier 1" greenhouse gas emissions scenarios, known as Shared Socioeconomic Pathways (SSPs). The CMIP6 GCM simulations were produced to help the Intergovernmental Panel on Climate Change (IPCC AR6) prepare its Sixth Assessment Report. This dataset provides downscale predictions based on Scenario MIP model runs. The predictions are daily scenarios developed and shared by the Earth System Grid Federation. The goal of this dataset is to provide a collection of reliable climate change projections on a worldwide scale, with high resolution and bias correction. These forecasts can be used to evaluate the impact of climate change on systems affected by more detailed climate variations, as well as the influence of local topography on climate conditions. For this investigation, 30-year baseline data (1985-2014) were employed. By adopting this dependable

[3]Thrasher, B., Wang, W., Michaelis, A. et al. NASA Global Daily Downscaled Projections, CMIP6. Sci Data 9, 262 (2022). https://doi.org/10.1038/s41597-022-01393-4

and well accepted methodology, the Consultants establish a solid foundation for their study and estimates of climate change consequences in this region.

Table 1.2: List of Available GCMs used for Study Area

ACCESS-CM2	CanESM5	HadGEM3-GC31-MM	MPI-ESM1-2-HR
ACCESS-ESM1-5	EC-Earth3	IITM-ESM	MPI-ESM1-2-LR
BCC-CSM2-MR	EC-Earth3-Veg-LR	INM-CM4-8	MRI-ESM2-0
CESM2	FGOALS-g3	INM-CM5-0	NESM3
CESM2-WACCM	GFDL-CM4-1	IPSL-CM6A-LR	NorESM2-LM
CMCC-CM2-SR5	UKESM1-0-LL	KACE-1-0-G	NorESM2-MM
CMCC-ESM2	GFDL-ESM4	KIOST-ESM	TaiESM1
CNRM-CM6-1	GISS-E2-1-G	MIROC-ES2L	GFDL-CM4-2
CNRM-ESM2-1	HadGEM3-GC31-LL	MIROC6	

To address this, bias correction through ground station data or satellite estimates will be necessary to improve the accuracy of future climate projections.

Data was downloaded for the period 2035-2064 (hereafter referred to as projections to 2050) for climate change assessments. Since the project roads mainly involve upgradation, projections to 2050 are suitable for the road project design life. However, for locations involving bridge construction, data was also downloaded for the period 2070-2099 (projections to 2085) to account for a longer design life suitable for the bridges.

1.9 IMPACT OF CLIMATIC CHANGE

1.9.1 Climate Change Assessment Over Tarnol – Hassanabdal Section

Specifically, temperature and rainfall variation over different timeframes and climate scenarios are considered for Tarnol and Hassanabdal road section (see **Figure 1.7**). Key highlights are:

- **Temperature Projections:**
  - Under SSP 2-4.5: Temperatures are expected to increase by 1.8°C by 2050 and 2.5°C by 2085.
  - Under SSP 5-8.5: Temperatures could increase by 2.9°C by 2050 and 4.9°C by 2085.
- **Rainfall Projections (Annual):**
  - Under SSP 2-4.5: Total annual rainfall is projected to increase by 8.2% by 2050 and 7.5% by 2085.
  - Under SSP 5-8.5: Rainfall could increase by 11% by 2050 and 21% by 2085.

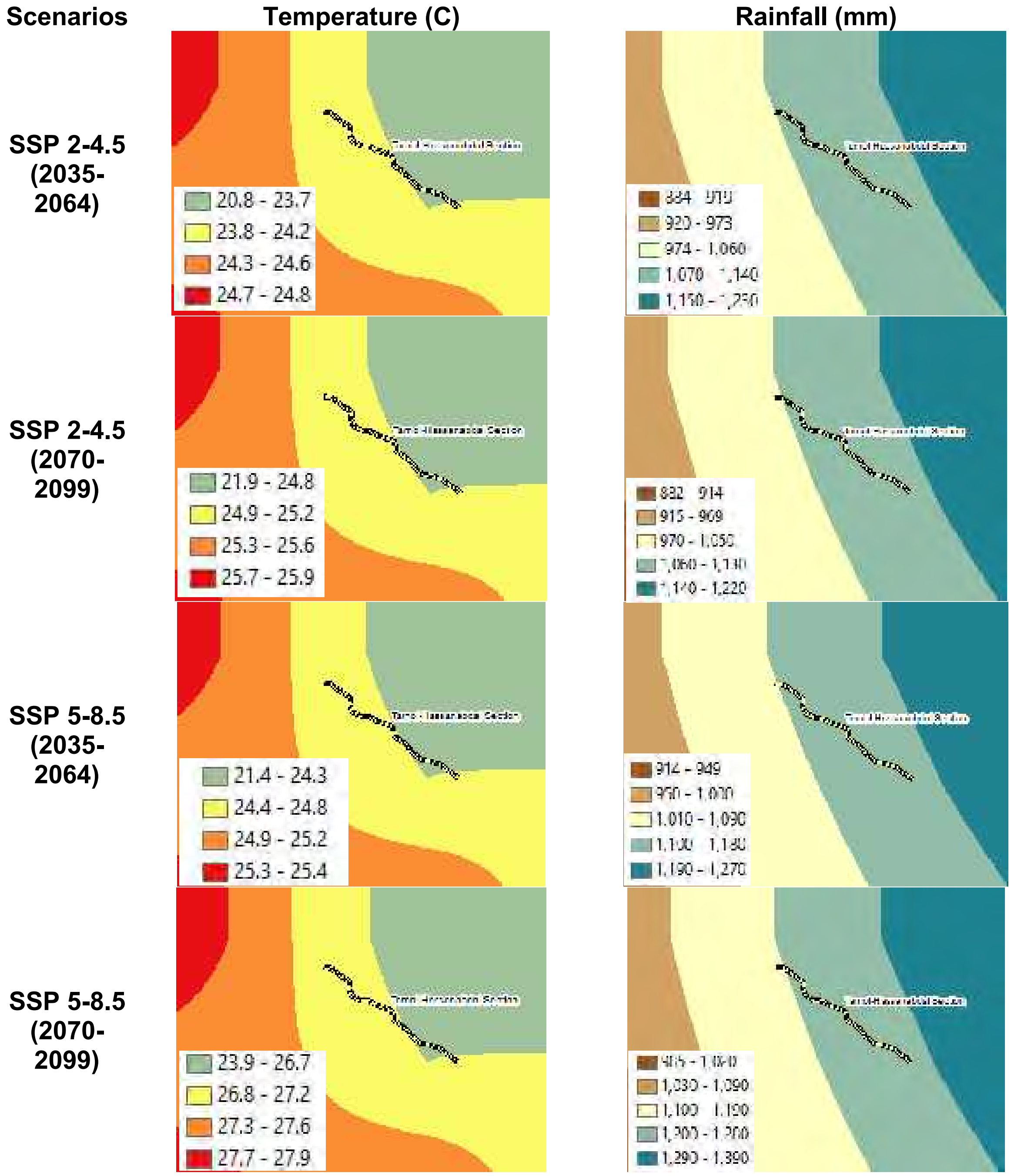

Figure 1.7: Temperature and Rainfalls under Different Timeframes and Climate scenarios over Tarnol – Hassanabdal Section

1.9.2 Flood assessment for Tarnol – Hassanabdal Section

The most important factors for climate-proofing the project infrastructure are the projected changes in the climatic extremes. The projections regarding changes in daily maximum rainfall (RX1DAY) climate extreme was done based on the ERA5 gridded data. Consultants have employed a baseline period spanning from 1985 to 2014, which encompasses 30 years of data, to analyze rainfall data. Rainfalls have been estimated for both historic and future data (area can be seen in **Figure 1.8**. The impact of climate change is assessed on floods and these results (Table 7) will be used in Hydrological Modeling and hydraulics study for climate resilient analysis.

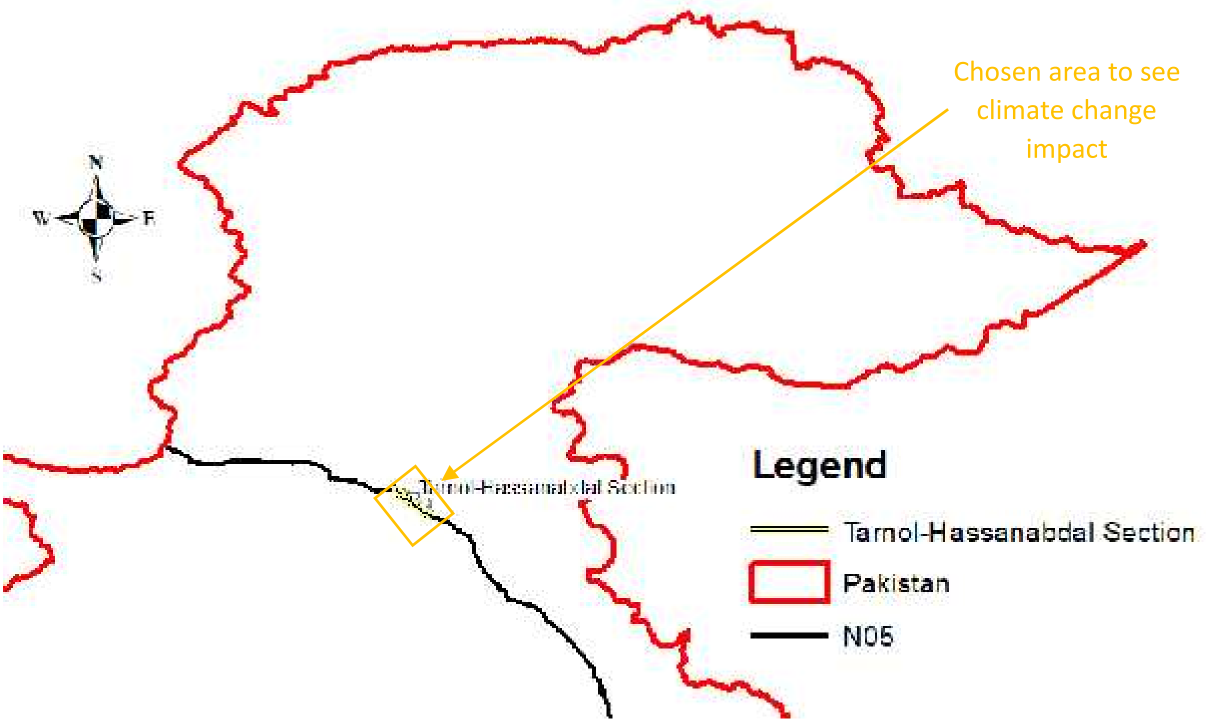

Figure 1.8: N5 road Sections for Climate Change Analysis on Flooding (chosen area is highlighted in orange color)

A. Selection of General Circulation Models (GCMs)

As outlined in the previous section, to estimate the probable future climatic change in this area, a complete analysis of thirty-five (35) GCMs (**Table 1.3**) from the current set of the Coupled Model Intercomparison Project Phase 6 (CMIP-6) by the NEX-GDDP-CMIP6 was performed. **Figure 1.9** illustrates the overall process used for this climate change study. By adopting this dependable and well accepted methodology, the Consultants establish a solid foundation for their study and estimates of climate change consequences in this region.

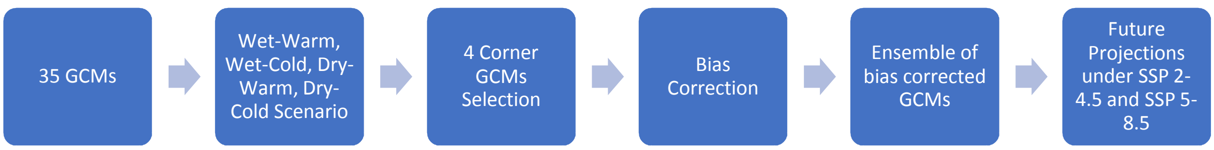

Figure 1.9: Overall Methodology Adopted for Climate Change Study

In the process of selecting GCMs for the study, a comparison is made between the maximum daily rainfall derived from the climate models and the data from historic ERA5 estimates (**Figure 1.10**). These findings indicate discrepancies in rainfall estimates among different models, with some underestimating and others overestimating maximum rainfall in the region. To address this, bias correction will be necessary to improve the accuracy of future climate projections.

Of the available scenarios SSP 2-4.5 (middle of the road) and SSP 5-8.5 (business as usual) (extreme) scenario are used for climate change inclusive hydrological impact assessment study.

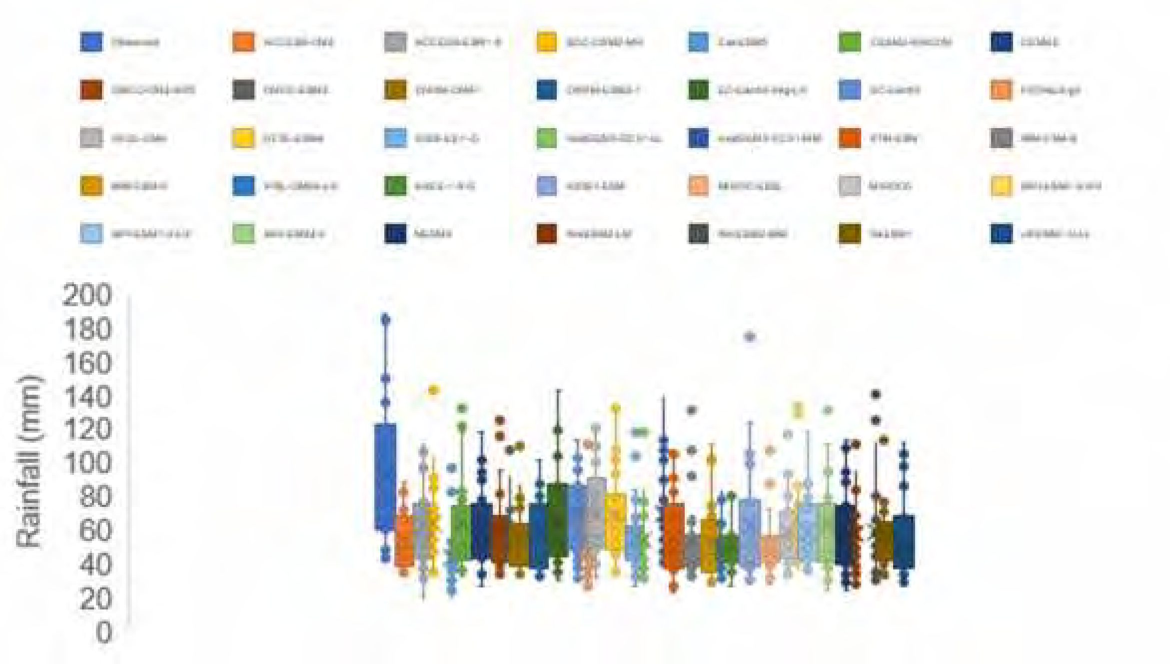

Figure 1.10: Raw GCMs Comparison with ERA5 Rainfall (Whisker Plot)

B. Shortlisting of GCMs

The selection of GCMs will be determined using the delta approach for rainfall and temperature. The base data utilized for this purpose will extend from 1985 to 2014, while the projected future data will encompass the time frame from 2015 to 2100 for the SSP 2-4.5 and SSP 5-8.5 scenarios. The median GCMs falling within the designated percentile range (10% and 90%) will be selected during the second stage. This strategy seeks to decrease the level of uncertainty surrounding anticipated future data. Consultant utilizes corner model approaches to check the possible rainfall variations in this region[4&5].

Details of the different parts of the full spectrum considered during this study are as follows:

- the Dry-Cold corner, represented by the 10th percentile ΔP as well as 10th percentile value of ΔT;
- the Dry-Warm corner, represented by the 10th percentile ΔP but the 90th percentile value of ΔT;
- the Wet-Cold corner, represented by the 90th percentile ΔP and the 10th percentile value of ΔT;
- the Wet-Warm corner, represented by the 90th percentile values for both ΔP as well as ΔT;

[4] NESPAK Project “Emergency flood assistance project, Khyber Pakhtunkhwa, Pakistan”, ADB, 2023

[5] NESPAK Project “Study and evaluation of the safety of existing dams in different regions of the Kingdom of Saudi Arabia” (2023-2026).

Four corner models under SSP 2-4.5 (HadGEM3-GC31-LL, MIROC-ES2L, CESM2 and CESM2-WACCM) and SSP 5-8.5 (EC-Earth3-Veg-LR, FGOALS-g3, GFDL-CM4-1, TaiESM1) have been selected for bias correction application in this area. Average results have been adopted for analysis with variation range.

C. Bias Correction

Climate models often include inherent biases when simulating variables. To guarantee accurate applications in contexts with nonlinear sensitivities to biases, these biases must be addressed and eliminated beforehand. Bias correction strategies are important in climate change impact studies because they have the potential to influence model-projected mean changes. Consultant chose statistical downscaling[6] because dynamic downscaling is too time-consuming and computationally intensive. To develop relationships using statistical methods, observational records are required; long-term records from 1985 to 2014 are available as baseline data. Consequently, a comprehensive review of the most employed and latest bias correction techniques has been conducted to identify the most suitable method. Considering the analysis, Consultants adopted Quantile Delta Mapping (QDM)[7,8] for bias correction of rainfall data.

The bias correction procedures mentioned above, while chosen as the best possible alternative given the availability of time, resources, and data, are not without limits. These bias correction approaches increase the agreement of climate model output with observations, reducing the uncertainty range of forecasts and simulations; but they do so without a solid physical basis. This bias corrected GCM will allow us to provide average forecasts for future forecasted data.

D. Frequency Analysis

To estimate the return period of maximum daily rainfall, generalized extreme value (GEV) distribution is used. The GEV distribution is widely used for estimating the magnitude and occurrence probability of hydrological extreme events. The results indicate that extremes of more intense rainfall are expected. The ensemble of bias corrected GCMs for this region showed that there will be average increase in rainfall of about 2.5%, 2.3% and 2.1% for return period of 25, 50 and 100 years, respectively under SSP 2-4.5 while there will be increase in rainfall of about 3.9%, 4.1% and 4.3% for return period of 25, 50 and 100 years respectively under SSP 5-8.5 (see **Table 1.3**) which are used in the project's engineering design. However, it is important to note that there will always be some residual risk associated with the performance of individual GCMs. There climatic change increase factors be used to increase the rainfall depths for inclusion in flood studies.

[6] Flaounas, E., P. Drobinski, M. Vrac, S. Bastin, C. Lebeaupin-Brossier, M. Stefanon, M. Borga, and J.-C. Calvet (2013), Precipitation and temperature space-time variability and extremes in the Mediterranean region: Evaluation of dynamical and statistical downscaling methods, *Clim. Dyn.*, 40(11-12), 2687–2705, doi:10.1007/s00382-012-1558-y.
[7] Xavier, A. C. F., Martins, L. L., Rudke, A. P., de Morais, M. V. B., Martins, J. A., & Blain, G. C. (2022). Evaluation of Quantile Delta Mapping as a bias-correction method in maximum rainfall dataset from downscaled models in São Paulo state (Brazil). International Journal of Climatology, 42(1), 175-190.
[8] Project "Emergency flood assistance project, Khyber Pakhtunkhwa, Pakistan", ADB, 2023

Table 1.3: Estimated increase in rainfall under SSP 2-4.5 and SSP 5-8.5

Return Periods	SSP 2-4.5	SSP 5-8.5
25	2.5%	3.9%
50	2.3%	4.1%
100	2.1%	4.3%

1.10 CONCLUSION

This report initiates a detailed **climate change assessment** for the **N5 road expansion**, specifically focusing on the Tarnol and Hassanabdal areas. By addressing climate-related risks upfront, it aims to ensure long-term sustainability and resilience of critical infrastructure in the face of future climate changes.

In the road project area, **average monthly temperatures** are projected to rise significantly by 2085, with increases as high as 4°C. Under the **SSP 2-4.5** scenario, temperatures are expected to increase by **1.8°C by 2050** and **2.5°C by 2085**, whereas under **SSP 5-8.5**, the rise could reach **2.9°C by 2050** and **4.9°C by 2085**. Additionally, **annual rainfall** is anticipated to rise by **8.2% by 2050** and **7.4% by 2085** under SSP 2-4.5, while under SSP 5-8.5, rainfall could increase by **11% by 2050** and **21% by 2085**.

Floods and **extreme temperatures** are identified as key climate-related hazards that the road projects will face in the future. The analysis shows that extreme rainfall is expected to intensify. An ensemble of bias-corrected GCMs predicts a rise in rainfall by **2.5% for a 25-year return period**, **2.3% for a 50-year return period**, and **2.1% for a 100-year return period** under SSP 2-4.5. Under SSP 5-8.5, the projected increases are **3.9%**, **4.1%**, and **4.3%**, respectively, all of which have been incorporated into the project's engineering design. It is recommended to adopt SSP 5-8.5 results in the design.

2. HYDROLOGICAL STUDIES

2.1 GENERAL

National Highway 5 (N-5), Pakistan's longest and most pivotal highway, spans over 1,800 kilometers, linking Karachi in the south and to Peshawar in the north. As an integral part of the historic Grand Trunk Road, N-5 serves as a critical conduit for trade, transportation, and communication, connecting major urban and industrial centers across the country.

The Tarnol-Hassanabdal section, approximately 35 kilometers long, is one of the key stretches of National Highway 5 (N-5). It connects Tarnol, a significant suburban area of Islamabad, with Hassanabdal, a historically and economically important town. This corridor plays a crucial role in supporting regional and national economic activity, handling significant freight traffic that moves raw materials and finished goods between major industrial and commercial centers. Additionally, it facilitates daily commuters and intercity travelers, enhancing connectivity across the region. The strategic importance of this section underscores its role as a vital link in Pakistan’s transportation network.

2.2 LOCATION of PROJECT AREA

Tarnol, a prominent suburban locality near Islamabad, Pakistan's capital, is strategically positioned along National Highway 5 (N-5). It acts as a key junction linking Islamabad with neighboring cities like Rawalpindi and northern regions of the country. Tarnol’s terrain, characterized by the flat to gently rolling features of the Potohar Plateau, includes scattered agricultural fields and small industrial zones. It is known for its vibrant markets, commercial activities, and efficient transport links. Tarnol is blend of residential and industrial developments. Due to its strategic location, it makes an essential hub for freight transport and logistical operations.

Hassanabdal, a town of historical importance in Punjab, is also located along National Highway 5 (N-5) at the foothills of the Margalla and Hazara ranges. The town’s diverse landscape of flat plains and rolling hills adds to its scenic appeal. It is renowned for its cultural heritage. Hassanabdal hosts significant landmarks, including the sacred Sikh pilgrimage site Gurdwara Panja Sahib and Mughal-era monuments. Serving as a critical junction between the Potohar Plateau and northern Pakistan, it facilitates trade, travel, and connectivity.

Considering the economic significance of Tarnol and Hassanabdal, the client, National Highway Authority (NHA), intends to widen and upgrade the existing metaled road connecting the two locations. This section of National Highway 5 (N-5) plays a crucial role in facilitating trade, transportation, and daily commuting, linking Islamabad and surrounding urban hubs to northern Pakistan. The proposed improvements aim to enhance road capacity, reduce congestion, and ensure a smoother flow of freight and passenger traffic. Upgrading this critical corridor will not only support the growing economic activities in Tarnol and Hassanabdal but also strengthen regional connectivity, boosting overall economic efficiency. The approximate length of the road under study is about 35 kilometers. The location map is shown in **Figure 2.1**.

Figure 2.1: Location Map of Project Area

2.3 SCOPE OF HYDROLOGICAL STUDIES

Tarnol-Hassanabdal section of National Highway 5 (N-5) is characterized by a varied landscape, blending flat plains with gently rolling hills. The route traverses the Potohar Plateau, which is known for its undulating terrain. As the highway progresses towards Hassanabdal, the terrain begins to gently ascend towards the foothills of the Margalla and Hazara mountain ranges. The road passes through agricultural land, with patches of industrial development along the way.

As per the Term of Reference (ToR) of the project, the scope of hydrological studies includes locating the streams and nullahs etc., crossing the road and estimation of discharges of these streams and nullahs against various return periods.

2.4 CLIMATIC STATIONS IN VICINITY OF PROJECT AREA

There is no discharge gauging for any stream/nullah crossing the road. In the vicinity of the project area there exists one rain gauge station, which is being operated and maintained by Pakistan Meteorological Department (PMD). The location of this station is shown in **Figure 2.2**. Selection of suitable climatic station involves careful considerations to ensure accurate and reliable data available for analysis. Keeping into consideration the appropriate length of data available and its minimum distance from the project area, Islamabad (Zero Point) station has been selected. This station gives a fair representation of the climate of the project area.

Figure 2.2: Rainfall Gauging Station in Vicinity of Road Section

2.5 CLIMATE OF ISLAMABAD

Islamabad, the capital of Pakistan, is known for its moderate climate, characterized by four distinct seasons: summer, monsoon, autumn, and winter. It is located at the foothills of the Margalla Hills and enjoys a humid subtropical climate with continental influences.

In summer from April to June, temperatures can rise to around 40°C but the evening cools off due to the city's elevation. The monsoon season from July to September brings relief with heavy rains and high humidity, reducing daytime heat, with temperatures ranging from 30°C to 35°C. Autumn from October to November is marked by pleasant, dry weather with clear skies and moderate temperatures between 20°C and 30°C. Winter are from December to February and ranges from cool to mild. The temperature ranges from 3°C to 20°C and nights are occasionally chilly. Snowfall is rare but can occur in the nearby hills.

2.5.1 Precipitation

Mean monthly rainfall data and the number of rainy days recorded at Islamabad Station are given in **Table 2.1.** The average annual rainfall of the area is about 1320.7 mm (Ref.1). While on average the maximum monthly rainfall is 332.0 mm during the month of August and a minimum of 16.4 mm in November. The maximum rainfall occurs during the months of July to September, which is about 61% of the annual rainfall. Winter rains generally occur during the months of January to March, whereas December is normally the month with the least precipitation. The distribution of average monthly rainfall and number of rainy days in Islamabad have been shown in **Figure 2.3** and **Figure 2.4** respectively**.**

Table 2.1: Mean Monthly Rainfall in Islamabad

Months	Precipitation (mm)	Rainy Days (No.)
January	62.2	5.5
February	96.0	7.5
March	95.7	9.0
April	63.7	9.0
May	40.0	7.7
June	78.4	7.9
July	329.6	15.4
August	332.0	14.9
September	144.4	8.6
October	33.4	3.8
November	16.4	2.7
December	28.7	3.3

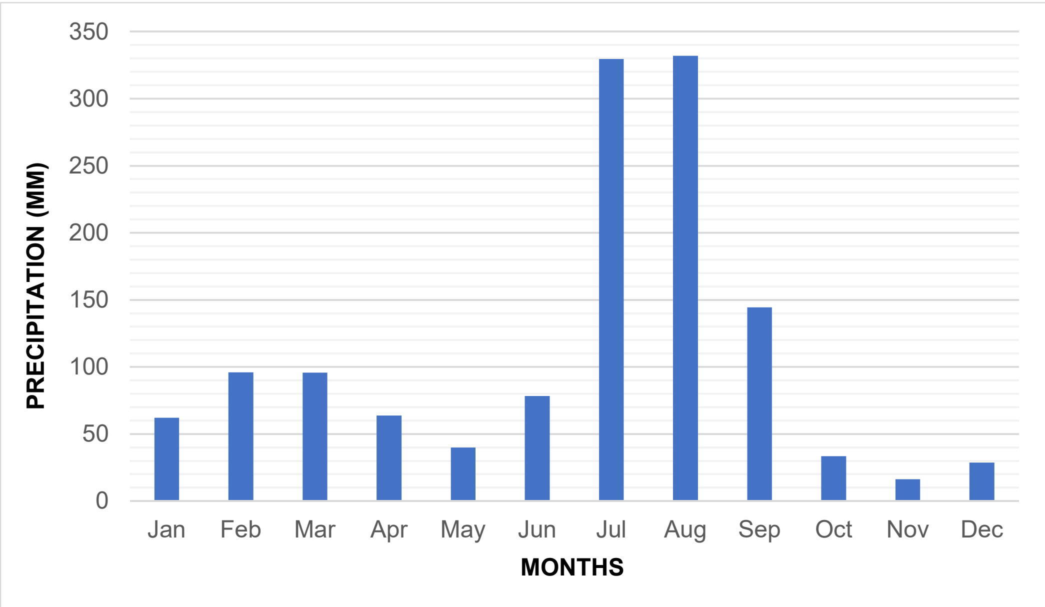

Figure 2.3: Mean Monthly Distribution of Rainfall in Islamabad

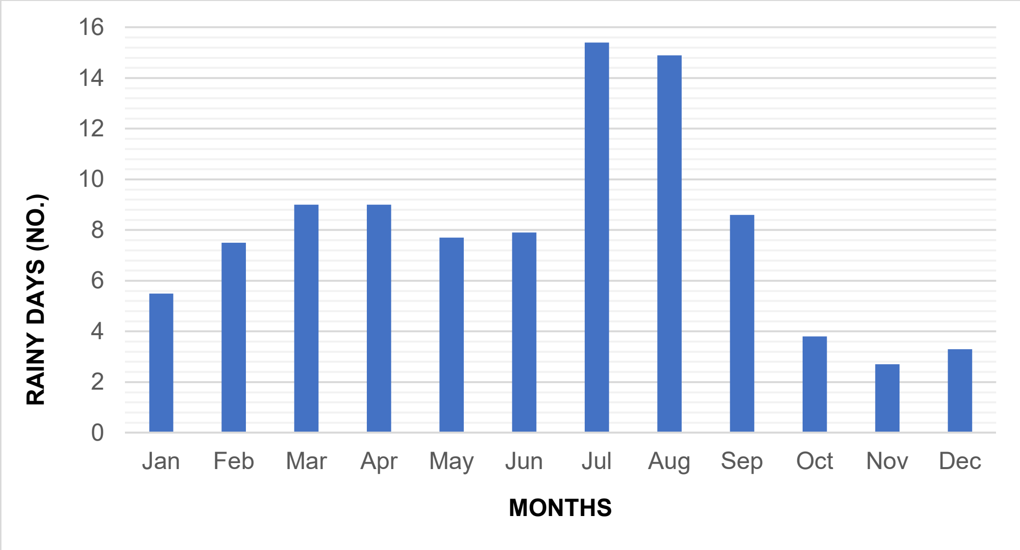

Figure 2.4: Number of Rainy Days in Islamabad

2.5.2 Temperature

The mean daily temperature ranges from (June and July being the hottest month) 26.8ºC to 30.3ºC in the summer season (May to September) and 10.2ºC to 13.3ºC in winter season (December to February). Mean monthly temperature in June and July rises to a highest value of 30.3ºC and falls to the lowest value of 10.2ºC in January. June, July and August are the hottest months in the summer season. December, January and February are the coldest months in the winter season. The monthly averages of minimum, maximum and mean daily temperatures are given in **Table 2.2** and shown graphically in **Figure 2.5**.

Table 2.2: Mean Monthly Temperatures in Islamabad

Month	Min Temp (°C)	Max Temp (°C)	Mean Temp (°C)
January	2.5	18.0	10.2
February	5.7	20.1	13.3
March	10.0	24.8	17.4
April	14.6	30.4	22.5
May	18.9	35.8	27.4
June	22.6	37.9	30.3
July	24.0	35.1	29.4
August	23.5	33.5	28.6
September	20.5	33.0	26.8
October	13.8	30.5	22.2
November	7.6	25.4	16.5
December	3.2	20.6	12.0

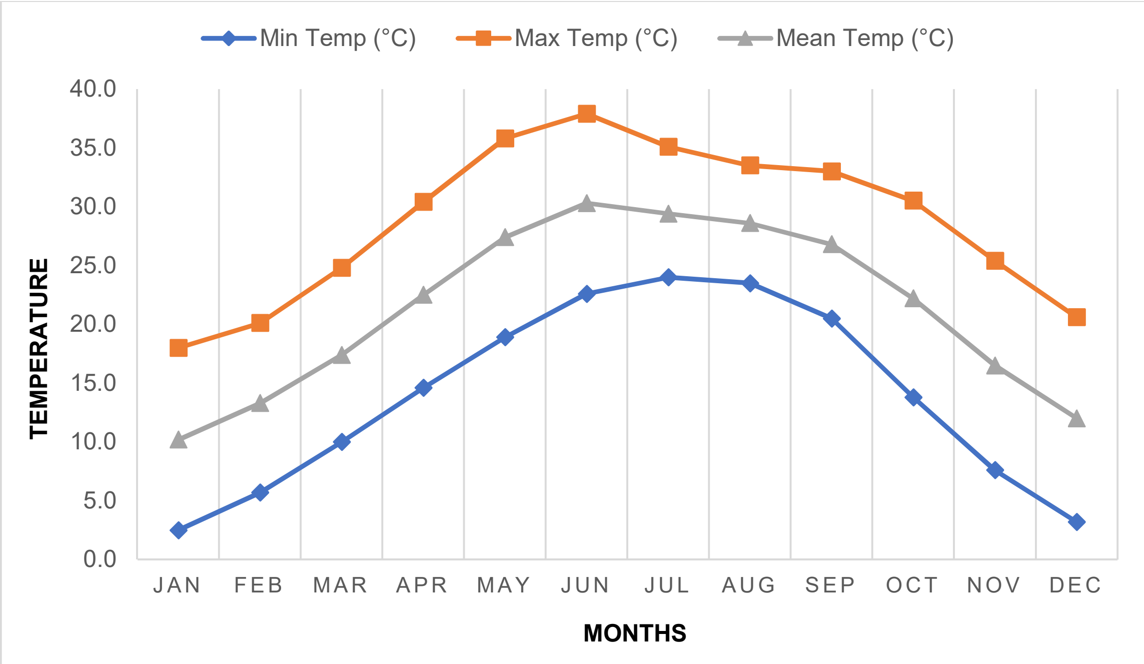

Figure 2.5: Mean Monthly Temperatures in Islamabad

2.5.3 Relative Humidity

The relative humidity data at 00:00, 03:00 and 12:00 hours has been collected from PMD. Mean monthly relative humidity is given in **Table 2.3** and shown graphically in **Figure 2.6**. At 00:00 hour the relative humidity varies from lowest value of 71.8% in May to highest value of 92.7% in November. At 12:00 hour the lowest value is 30.9% in May and highest value of 64.5% in August.

Table 2.3: Mean Monthly Relative Humidity in Islamabad

Month	Relative Humidity (%)		
	00 UTC	03 UTC	12 UTC
January	91.5	90.8	52.7
February	88.6	86.7	48.4
March	86.9	80.7	43.3
April	83.1	69	38.3
May	71.8	54.3	30.9
June	72.7	56.1	34.3
July	86.7	77.3	56.2
August	92.1	84.6	64.5
September	91.5	82.9	58.4
October	91.4	84.8	53.2
November	92.7	89.8	56.4
December	92.6	92.1	55.3

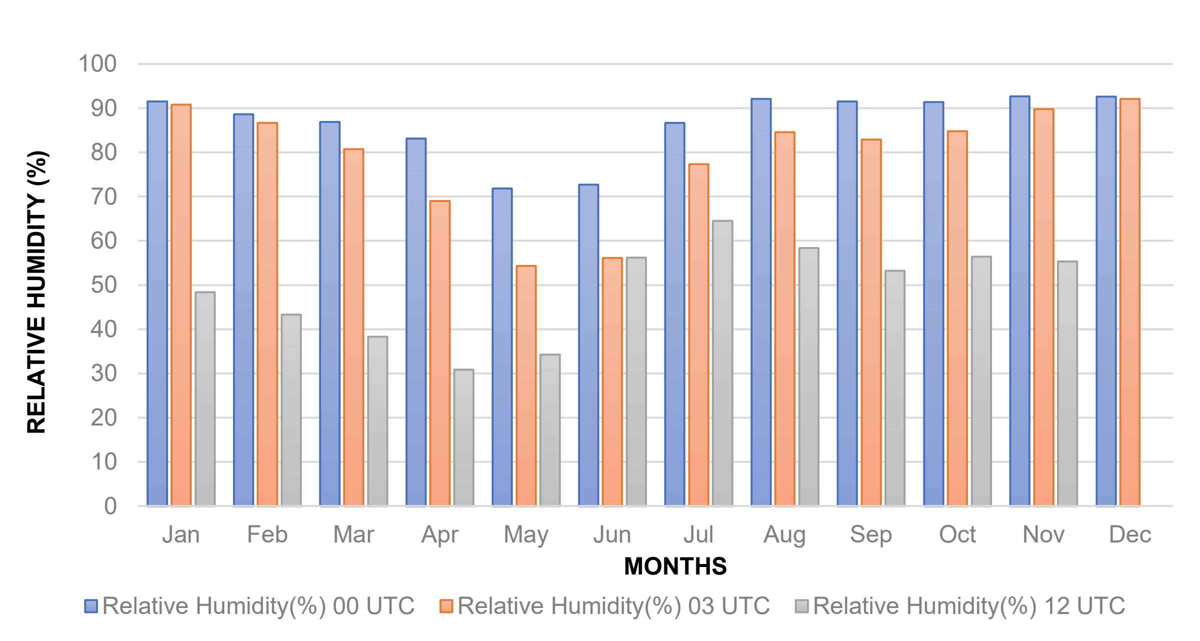

Figure 2.6: Monthly Relative Humidity in Islamabad

2.5.4 Wind Speed

The mean monthly wind speed in knots is given in **Table 2.4** and shown graphically in **Figure 2.7**. The data reveals that at 12:00 hours wind speed is higher. During summers, wind speeds are generally higher than wind speeds in winters.

Table 2.4: Mean Monthly Wind Speed in Islamabad

Month	Mean Wind at Synoptic Hours (Knots)		
	0:00	3:00	12:00
January	0.2	0.2	1.4
February	0.3	0.3	2.4
March	0.5	0.4	2.9
April	0.5	0.6	2.5
May	0.6	0.5	2.5
June	0.4	0.6	2.8
July	0.7	0.6	2.1
August	0.5	0.5	1.3
September	0.2	0.2	0.9
October	0.2	0.1	0.7
November	0.1	0.1	0.4
December	0.1	0.1	0.7

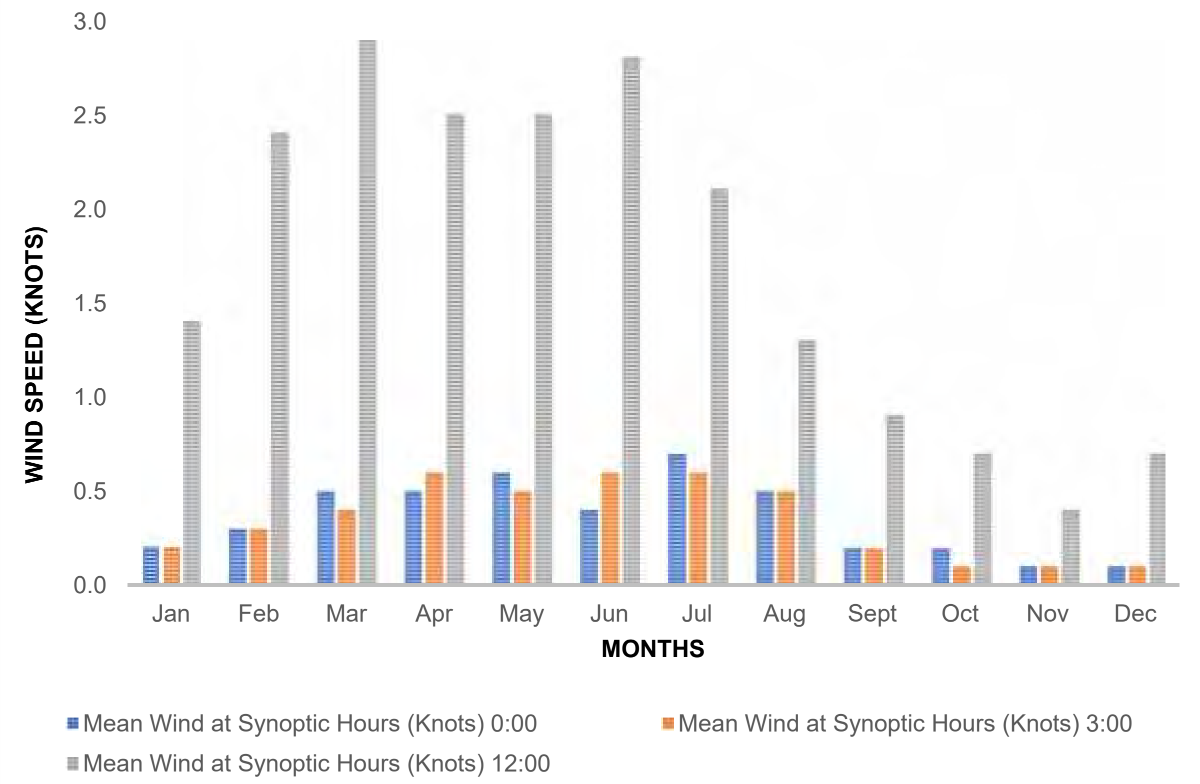

Figure 2.7: Mean Monthly Wind Speed in Islamabad

2.6 ISOHYETAL METHOD

The isohyetal method is a technique used to estimate precipitation over catchment based on observed rainfall data from multiple weather stations. The method involves drawing lines called isohyets which connect points of equal rainfall intensity similar to contour lines on a topographic map. Annual normal rainfall Isohyetal map (1981-2010) has been collected from Pakistan Metrological Department (PMD) as shown in **Figure 2.8.**

The road section has been overlayed on the isohyetal map. According to this, isohyet of 1000 to 1400 mm rainfall traverses through the project area as shown in **Figure 2.9**.

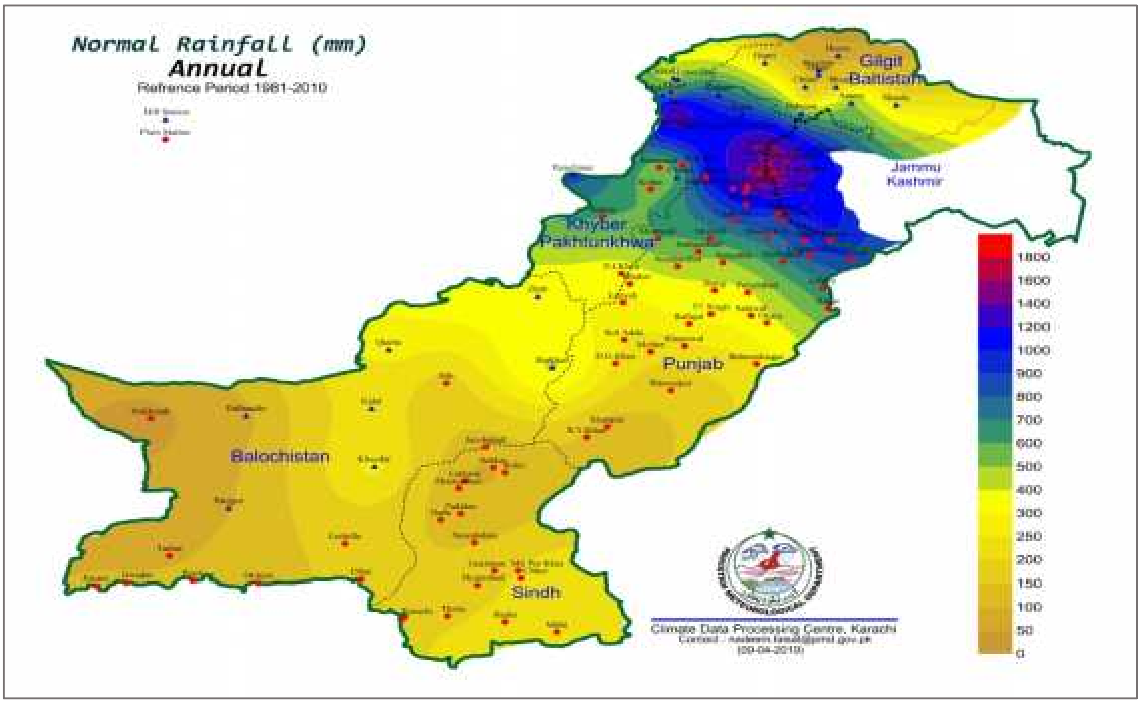

Figure 2.8: Annual Normal Rainfall Isohyetal Map of Pakistan

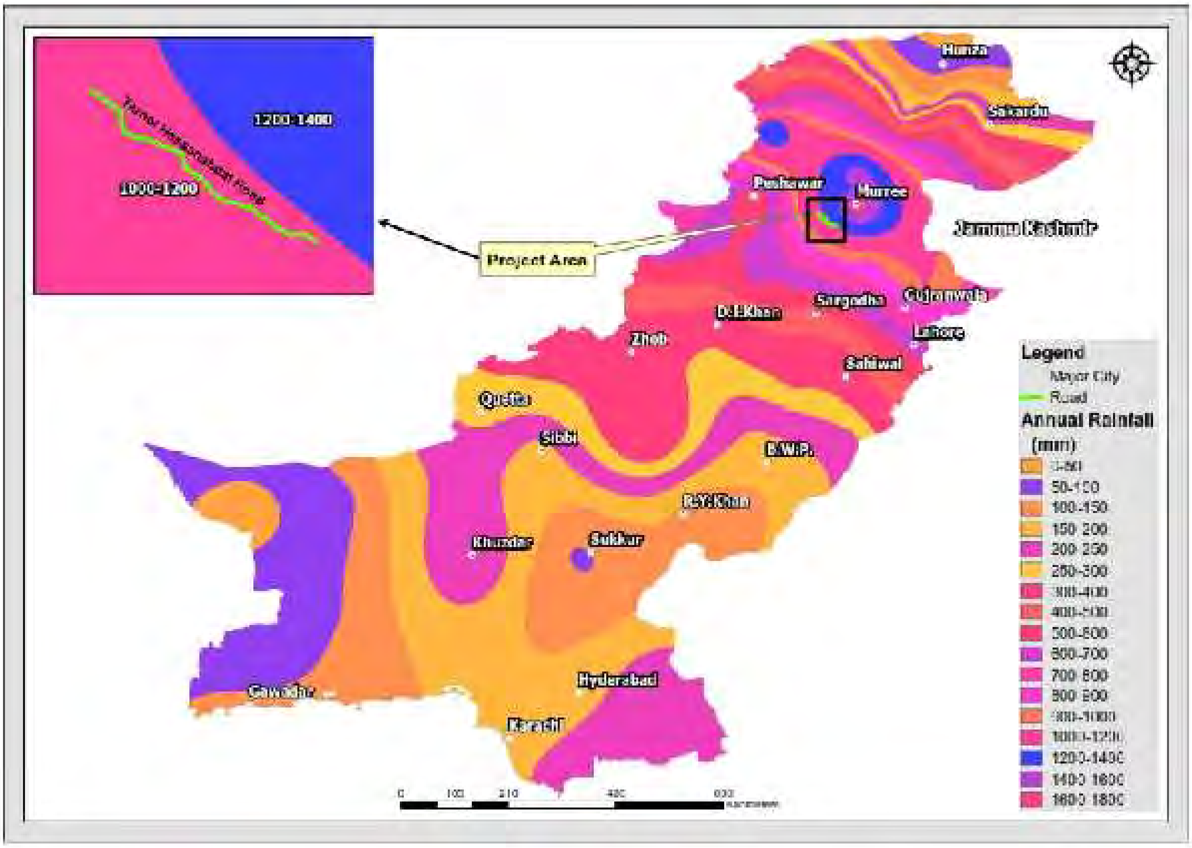

Figure 2.9: Road Section Overlayed on Annual Normal Isohyetal Map

2.7 SOIL PROPERTIES OF PROJECT AREA

Soil properties influence the relationship between rainfall and runoff by affecting the rate of infiltration. The soil type and land cover play a crucial role in the rainfall-runoff model and require comprehensive evaluation. Surface runoff is influenced by factors such as rainfall intensity and duration, weather conditions (including temperature), soil properties, vegetation cover, land use patterns, initial soil moisture content, entrapped air, and the depth of the groundwater table.

Vegetation cover serves to mitigate the impact of rain drops and enhances infiltration rates, whereas built-up areas and rocky surfaces tend to increase runoff. To accurately assess these factors, various sources of information are utilized, including maps of soil surveys from Pakistan, global land use datasets, field investigations, and satellite imagery.

Natural Resources Conservation Services (NRCS) divides soils into four hydrologic soil groups based on infiltration rates (Groups A-D).

Group A: Group A soils have a low runoff potential due to high infiltration rates even when saturated (0.30 in/hr. to 0.45 in/hr. or 7.6 mm/hr. to 11.4 mm/hr.). These soils primarily consist of deep sands, deep loess, and aggregated silts.

Group B: Group B soils have a moderately low runoff potential due to moderate infiltration rates when saturated (0.15 in/hr. to 0.30 in/hr. or 3.8 mm/hr. to 7.6 mm/hr.). These soils primarily consist of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures (shallow loess, sandy loam).

Group C: Group C soils have a moderately high runoff potential due to slow infiltration rates (0.05 in/hr. to 0.5 in/hr. or 1.3 mm/hr. to 3.8 mm/hr. if saturated). These soils primarily consist of soils in which a layer near the surface impedes the downward movement of water or soils with moderately fine to fine texture such as clay loams, shallow sandy loams, soils low in organic content, and soils usually high in clay.

Group D: Group D soils have a high runoff potential due to very slow infiltration rates (less than 0.05 in./hr. or 1.3 mm/hr. if saturated). These soils primarily consist of clays with high swelling potential, soils with permanently high-water tables, soils with a clay pan or clay layer at or near the surface, shallow soils over nearly impervious parent material such as soils that swell significantly when wet or heavy plastic clays or certain saline soils.

The soil properties of the project area are shown by **Figure 2.10**.

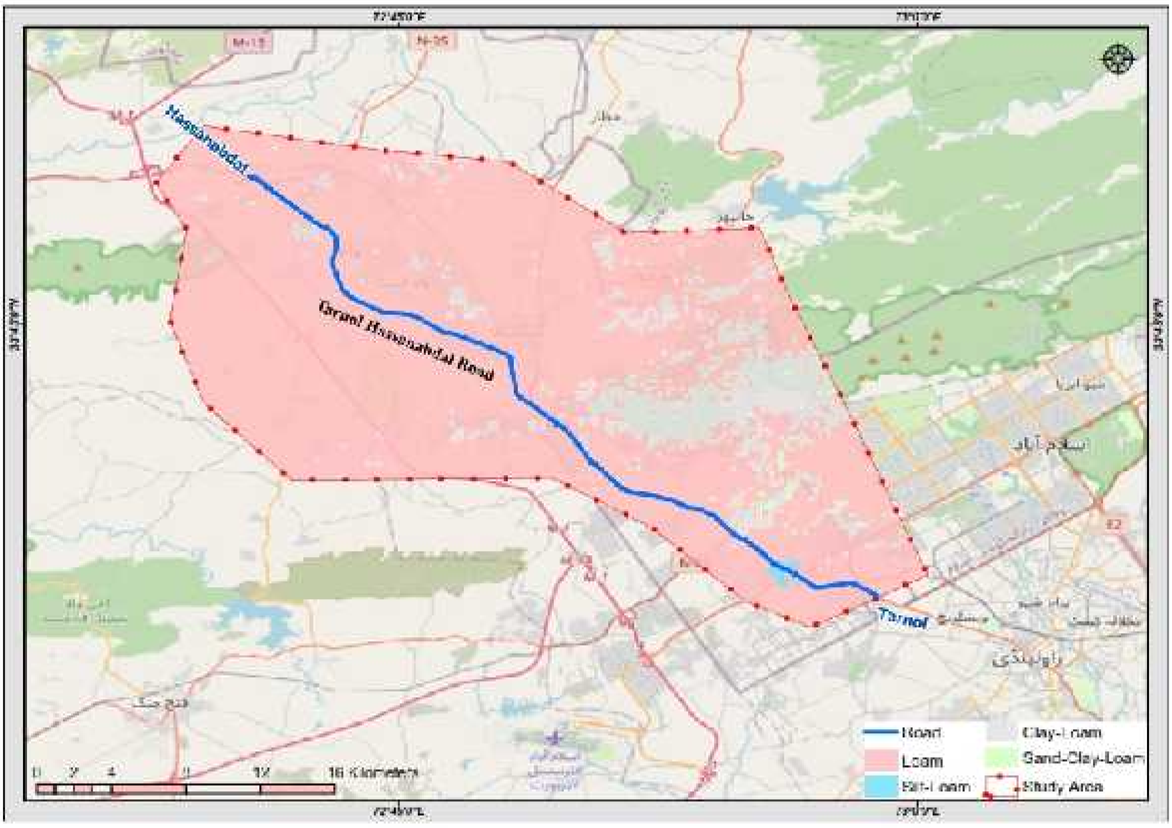

Figure 2.10: Soil Properties of Tarnol - Hassanabdal Road Section

2.8 LAND USE PROPERTIES OF PROJECT AREA

The land use is used for watershed delineation of project catchment. All the major categories are marked, and CN numbers are given accordingly. In addition to that, these maps illustrate the Hydraulic Soil Type within the project area, derived from remote sensing data, the Soil Survey Map of Pakistan, and on-site verification. These maps are instrumental in characterizing the soil properties critical for hydraulic modeling and infrastructure planning.

Land use maps provide critical input for modelling runoff and designing effective water management strategies. The Anderson Land use classification is given below:

- Bare Areas
- Built up Areas
- Waterbodies
- Cropland
- Grassland
- Shrubland
- Tree covers

The land use properties of the project area are shown in **Figure 2.11**.

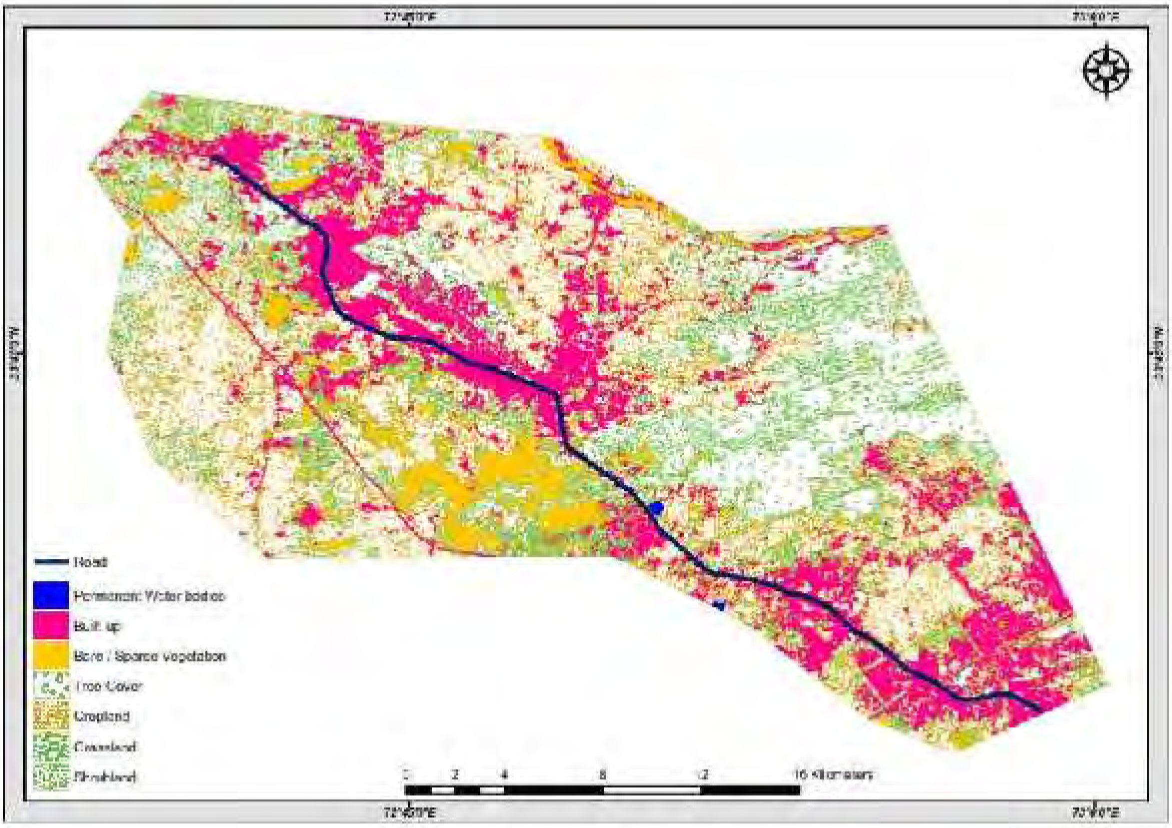

Figure 2.11: Land Use Properties of Tarnol - Hassanabdal Road Section

2.9 CATCHMENT AREA DELINEATION AND GENERATION OF STREAM NETWORK

Catchment characteristics can be sub-divided mainly into two categories i.e., physical characteristics and hydrological characteristics. Physical characteristics of the catchment include catchment area, length and weighted slope of the longest stream draining to the point of interest. These physical characteristics have been determined from the topographic maps of 1:50,000 scale and Digital Elevation Model (DEM) obtained from Shuttle Radar Topographic Mission (SRTM) and GLO-30. The catchment areas of all the desired points have been marked using DEM data and have been verified using topographic maps.

Stream network development using Digital Elevation Models (DEMs) is a foundational technique in hydrology for mapping and analyzing water flow paths across a landscape. DEMs provide a digital graphical representation of terrain, capture variations in land elevation, enabling detailed analysis of water movement and channel formation. Flow direction and flow accumulation has been identified by using this technique. For Tarnol Hassanabdal road section, Arc-Hydro and Topaz tools have been used for generating stream network by GLO-30 Dem.

Defining the catchment area of the generated stream network is known as watershed delineation. The longitudinal slopes and lengths of the natural streams/nullahs have been determined from the topographic maps, DEM data and by using tools i.e. WMS (Water Management System) and Arc-Hydro. The hydrologic characteristics of the catchments i.e., conditions of the area; soil cover, land use, soil type and extent, and other flow controlling parameters have been investigated through soil maps and satellite imagery. **Figure 2.12**, **Figure 2.13** represent the stream network and catchment area delineation respectively by above mentioned techniques.

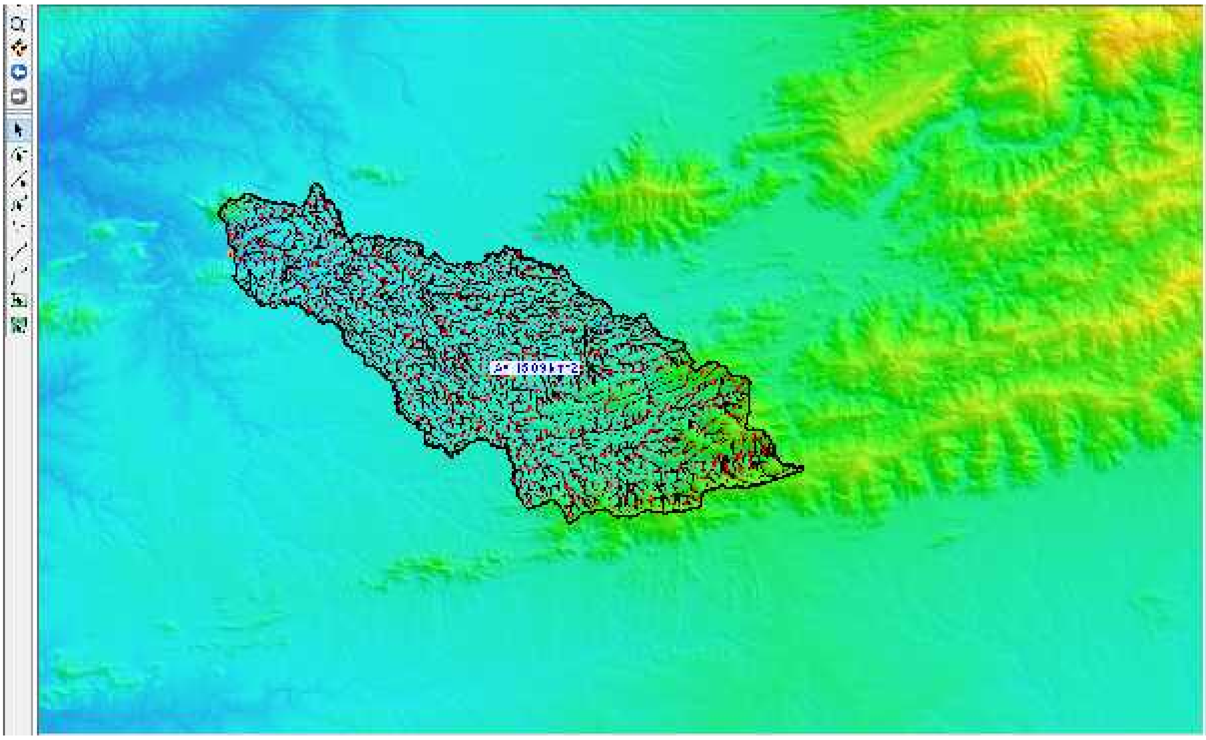

Figure 2.12:Stream Network Generation and Watershed Delineation using Topaz Tool

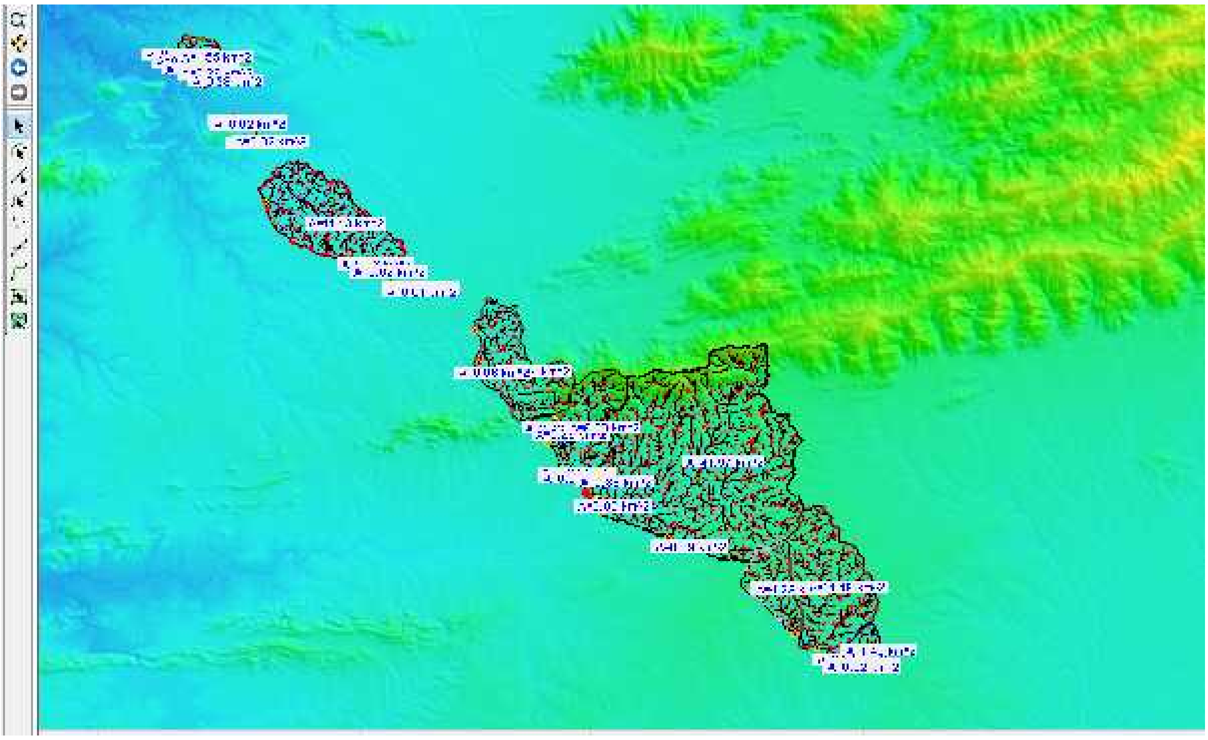

Figure 2.13: Stream Network Generation and Watershed Delineation using Topaz Tool

2.10 HYDRO-METROLOGICAL DATA USED

The flood study for a location depends upon the hydro-meteorological data of the location/area. For gauged locations, recorded data is used to estimate peak flood discharges, whereas, for ungauged locations synthetic storm is used which is estimated with recorded intense rainfall events in the area. In case of non-availability of rainfall data in the study area, the data of a station in the vicinity with similar climatic conditions is synthesized over study area.

The discharge data for the streams flowing in the proposed project area is not available. Thus, studies for the computation of the flood discharges have been carried out using rainfall data.

One-day annual maximum rainfall data of Islamabad stations have been collected from Pakistan Metrological Department and their inventory is given in **Table 2.4**.

Table 2.5: Inventory of Rainfall Gauging Stations

Sr. No.	Station	Data Type	Data Period (Years)	Agency
Rainfall Gauging Stations				
1	Islamabad Zero Point	One Day Annual Maximum Rainfall	1994-2023	PMD

2.11 ANALYSIS OF RAINFALL DATA

<u>Islamabad (Zero Point)</u>

One-day annual maximum rainfall data of Islamabad is available for 1994-2023 (30 years) as given in **Table 2.6**.

Table 2.6: 1-Day Annual Rainfall in Islamabad

Year	Rainfall (mm)	Year	Rainfall (mm)
1994	170.0	2009	82.0
1995	149.4	2010	120.0
1996	163.0	2011	126.0
1997	200.0	2012	127.0
1998	95.0	2013	124.0
1999	94.0	2014	298.0
2000	82.0	2015	132.0
2001	200.0	2016	69.0
2002	70.0	2017	72.0
2003	80.0	2018	163.4
2004	135.0	2019	83.1
2005	50.0	2020	97.1
2006	138.0	2021	169.0
2007	158.0	2022	85.0
2008	82.0	2023	110.0

Historic data since 1994 suggest an average value of 124.1 mm, the maximum magnitude of rainfall witnessed till date is 298.0 mm in year 2014. **Figure 2.14** shows the trends of annual maximum rainfalls observed at Islamabad Zero Point station.

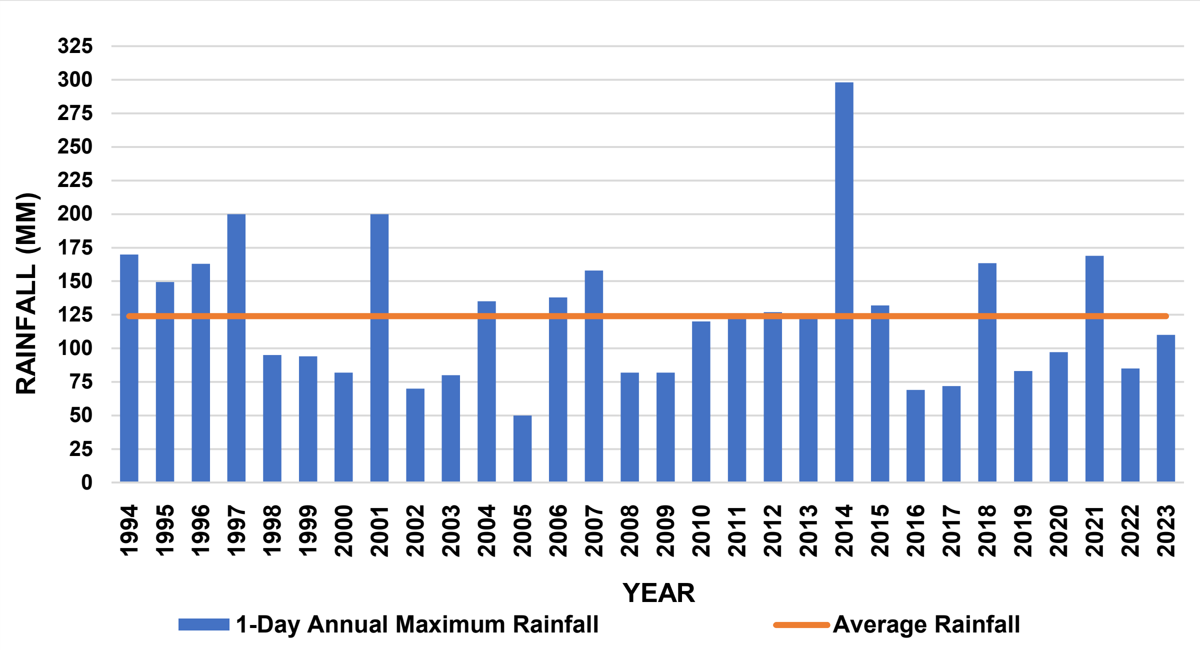

Figure 2.14: One-Day Annual Maximum Rainfall in Islamabad

2.12 FREQUENCY ANALYSIS OF RAINFALL DATA

Frequency analysis for the 1-day annual maximum rainfall data of Islamabad Zero Point station has been carried out using Log-Person-III distribution.

The **Log-Pearson Type III (LP-III)** distribution is a three-parameter probability model commonly used in hydrology for frequency analysis of extreme events such as floods and rainfall. It is particularly suitable for datasets with significant skewness, as it incorporates a logarithmic transformation that stabilizes variability and enhances the representation of positively skewed data. The three parameters of the LP-III distribution; location, scale, and shape, offer flexibility in modeling a wide range of hydrological scenarios, including rare and extreme events. This distribution is especially favored in applications where conservative estimates are required, as it provides robust predictions for average conditions while effectively capturing the influence of high values in the data. Widely adopted for designing water resource infrastructure, LP-III has been endorsed by the U.S. Water Resources Council as a standard for flood frequency analysis. Its ability to model both central tendencies and extremes makes it a cornerstone of hydrological statistical methods.

Result of frequency analysis for Islamabad is given in **Table 2.7** and shown graphically by **Figure 2.15**.

Table 2.7: Results of Rainfall Frequency Analysis at Islamabad

Return Period (years)	**Rainfall Depth** (mm)
2.33	113.9
5	159.3
10	191.2
25	224.0
50	271.9
100	313.7
500	441.0

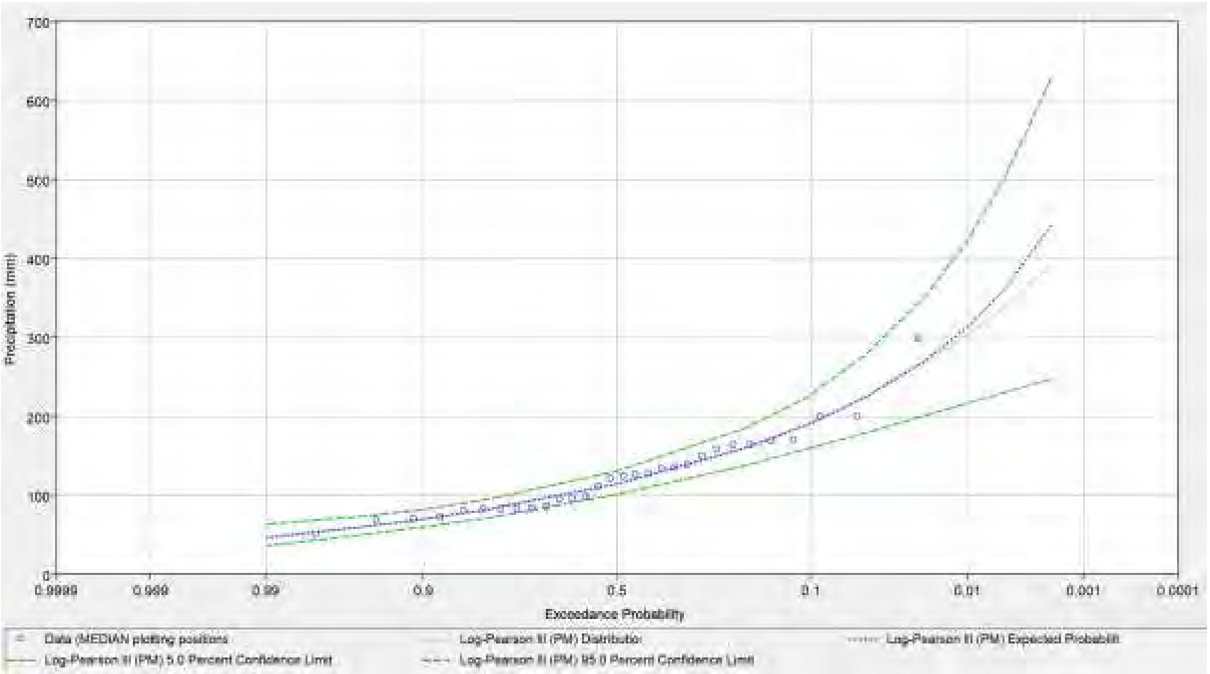

Figure 2.15: Frequency Fitting of 1-Day Annual Maximum Rainfall at Islamabad

2.13 DESIGN FLOOD ESTIMATION

Design flood for the streams crossing the road has been estimated by using three methods:

- Synthetic Hydrograph Method
- Rational Method

2.14 SYNTHETIC HYDROGRAPH METHOD

For catchments having area greater than 1km^2, US Soil Conservation Services Unit Hydrograph Method (SCS-UH) has been used to estimate peak discharges. This method requires the following information about the catchment.

- Maximum 24-hour rainfall for the design return period

- Length of stream measured along the longest path travelled by storm water from head to the site
- Slope of stream from head to site
- Catchment area
- Antecedent soil moisture condition
- Soil group

Maximum discharge is calculated from the following formulae:

$$S = \frac{1000}{CN - 10}$$

$$Q = \frac{(P-0.2S)^2}{P + 0.8S}$$

$$t_c = 0.00013 \times \frac{L^{0.77}}{m^{0.385}}$$

$$D = 0.133 \times t_c$$

$$t_p = \frac{D}{2} + (0.6 \times t_c)$$

$$Q_p = \frac{484 \times A \times Q}{t_p}$$

Where;

S	=	Potential maximum retention
CN	=	Curve number
Q	=	Volume of runoff in inches
P	=	Maximum 24 hours rainfall in inches of the required return period
L	=	Length of longest stream in feet
m	=	Slope of the stream
t_c	=	Time of concentration in hours
t_p	=	Time to peak in hours
D	=	Unit storm duration in hours
Q_p	=	Peak rate of flow in cusecs
A	=	Catchment area in sq. miles.

Time of Concentration

Time of concentration (Tc) is the time required for runoff to travel from the hydraulically most distant point in the watershed to the outlet. Kirpich formula has been used for computation of time of concentration which is given below:

$$Tc = \frac{(L)^{1.15}}{7700 * (H)^{0.385}}$$

Where;

T_c	=	Time of Concentration (hours)
L	=	Length of the longest stream (feet)
H	=	Fall in length L (feet)

<u>Selection of Curve Number</u>

The runoff curve number (also called a curve number or simply CN) is an empirical parameter used in hydrology for estimation of initial abstraction. It is widely used and is an efficient method for determining the approximate amount of direct runoff from a rainfall event in a particular area. The runoff curve number is based on the area's hydrologic soil group, land-use, treatment and hydrologic condition. The USNRCS equation for conversion of rainfall into runoff is given hereunder:

$$\text{Runoff} = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

Where;

P = Daily rainfall (inches)

S = Potential maximum retention after runoff begins $\left(\frac{1}{C \quad -1}\right)$

<u>Time Distribution of Rainfall Storm</u>

Total storm rainfall determines the magnitude of flood, while its pattern gives the shape of hydrograph. The storm pattern of rainfall is used as a relationship between time and rainfall which is as stated below:

$$P_t = \left(\frac{t}{24}\right)^n$$

Where P_t is ratio of rainfall at time 't' with 24-hr rainfall, t is time in hours and n is an exponent depending on hourly rainfall pattern.

2.15 RATIONAL METHOD

For the catchments having area less than 1km^2 rational method has been used to compute the floods. Rational method technique is described as under:

$$Q = CIA$$

Where;

Q = Peak discharge (cusecs)
C= Coefficient of discharge
I = Intensity of rainfall (mm/hour)
A = Catchment area (acres)

Runoff Coefficient (C)

The catchment area of the crossings consists of settlements as well as agricultural land. Therefore, runoff coefficient for the catchments has been taken keeping in view its soil cover and future land use.

Rainfall Intensity

Rainfall intensity is defined as the ratio of the total amount of rain (rainfall depth) falling during a given period to the duration of the period. It is expressed in depth units per unit time, usually as mm/hour or inch/hour. The use of uniform rainfall intensity for duration equal to the time of concentration is a simplifying assumption since rainfall does not truly persist at a uniform intensity for even a short time like 5 min. Rainfall intensity has been calculated by the formula given below.

$$\text{Rainfall Intensity} = \frac{\text{Rainfall magnitude in a duration equal to time of concentration}}{T_c}$$

Intensity-Duration-Frequency curves have been developed for Islamabad rain gauging station and shown in **Figure 2.16**. The rainfall distribution with time is then re-oriented to have a centrally loaded rainfall pattern.

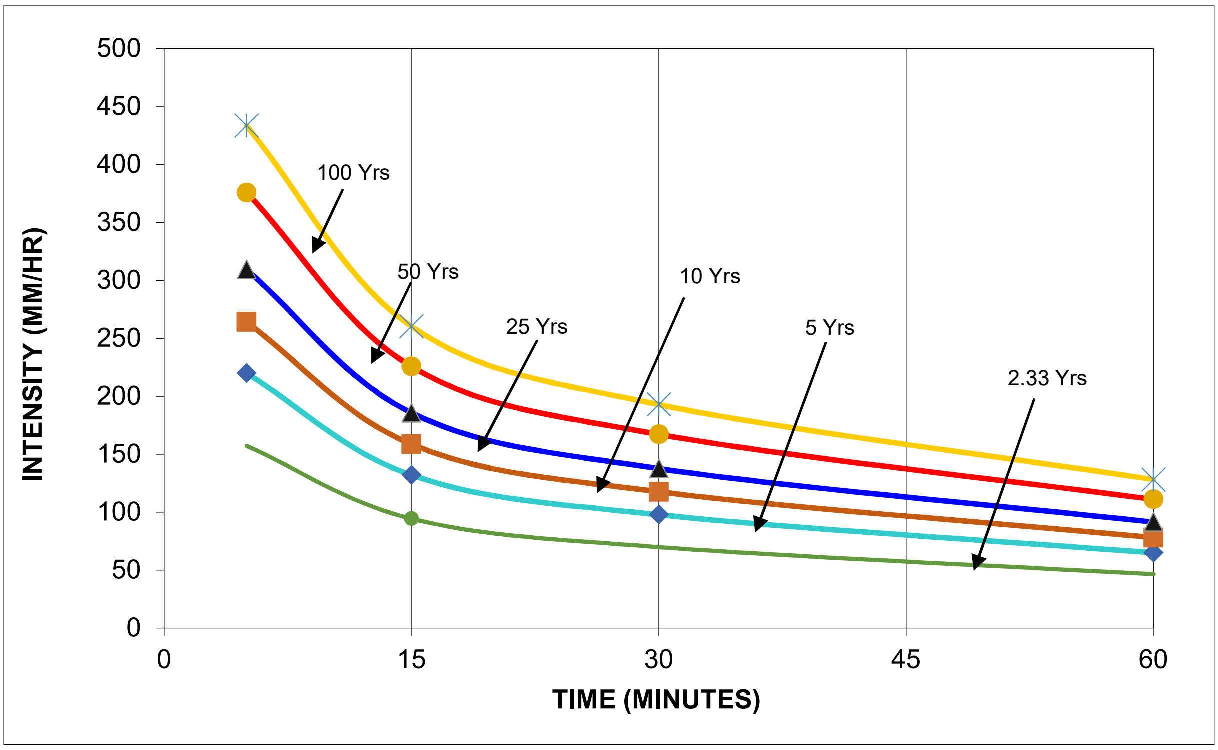

Figure 2.16: Intensity-Duration-Frequency Curve for Islamabad

2.16 FLOOD DISCHARGES

The floods estimated against various return periods for the streams crossing the Tarnol – Hassanabdal road section are given in **Table 1.1.**

Table 2.8: Discharges against Various Return Periods

Sr. No	Catchment RD's	Existing Structure	Catchment Area	Peak Flood Discharges			Remarks
				25 yrs	50 yrs	100 yrs	
			(km^2)	cumecs			
1		1545+780					Local Flow
2	1548+000 to 1549+600	1549+160	1.790	12	15	17	
3	1549+600 to 1550+500	1550+225	0.420	13	16	18	
4		1550+655					Local Flow
5	1550+655 to 1551+400	1550+735	10.80	110	145	177	
6	1551+400 to 1554+500	1551+715	4.230	52	69	85	
7		1551+977					Local Flow
8		1552+845					Local Flow
9		1555+520					Local Flow
10		1556+475					Local Flow
11		1556+575					Local Flow
12		1557+620					Local Flow
13		1558+435					Local Flow
14		1558+638					Local Flow
15	1554+500 to 1560+500	1560+300	42.300	394	523	637	
16	1560+400 to 1560+700		0.100	4	4	5	
17	1560+700 to 1560+800		0.004	0.14	0.17	0.20	
18	1560+800 to 1561+200	1560+970	0.910	13	15	18	
19	1561+200 to 1561+400		0.002	0.07	0.09	0.10	
20	1561+200 to 1561+300 (Left Side)		0.001	0.04	0.04	0.05	
21	1561+300 to 1561+400 (Left Side)		0.002	0.07	0.09	0.10	

Sr. No	Catchment RD's	Existing Structure	Catchment Area	Peak Flood Discharges			Remarks
				25 yrs	50 yrs	100 yrs	
			(km^2)	cumecs			
22	1561+500 to 1563+400	1561+855	6.870	92	124	153	
23		1562+170					Local Flow
24	1563+400 to 1563+650	1563+520	0.250	8	10	12	
25	1563+650 to 1564+450	1563+690	0.470	17	20	23	
26		1564+050					Local Flow
27		1564+130					Local Flow
28	1564+450 to 1564+700		0.010	0.36	0.43	0.50	
29	1564+700 to 1564+800		0.010	0.36	0.43	0.50	
30	1564+600 to 1564+800 (Left Side)		0.010	0.36	0.43	0.50	
31	1564+800 to 1564+900 (Left Side)		0.022	0.8	0.9	1.1	
32	1564+900 to 1565+100 (Left Side)		0.110	4	5	5	
33	1564+800 to 1565+100		0.050	1.8	2.2	2.5	
34		1566+200					Local Flow
35		1566+965					Local Flow
36		1567+510					Local Flow
37	1565+200 to 1568+900	1568+690	8.100	104	136	164	
38	1567+200 to 1567+500 (Left Side)	1567+510	0.030	1.1	1.3	1.5	
39	1569+900		0.001	0.04	0.04	0.05	
40	1569+960		0.002	0.07	0.09	0.10	
41	1570+000		0.002	0.07	0.09	0.10	
42	1570+050		0.002	0.07	0.09	0.10	
43	1570+100		0.003	0.11	0.13	0.15	
44	1570+200		0.004	0.14	0.17	0.20	
45	1571+700 to 1571+820	1571+820	0.040	1.4	1.7	2.0	

Sr. No	Catchment RD's	Existing Structure	Catchment Area (km²)	Peak Flood Discharges			Remarks
				25 yrs	50 yrs	100 yrs	
				cumecs			
46		1573+200					Local Flow
47	1572+300 to 1578+600	1578+120	11.400	116	150	180	
48		1580+755					Local Flow
49	1579+700 to 1581+800	1581+745	116.000	510	648	770	
50	1580+800 to 1580+900 (Left Side)		0.040	1.4	1.7	2.0	
51	1581+000 to 1581+200 (Left Side)		0.040	1.4	1.7	2.0	
52	1581+200 to 1581+300 (Left Side)		0.050	1.8	2.2	2.5	
53	1581+350 to 1581+500 (Left Side)		0.150	5.3	6.5	7.5	
54	1581+500 to 1581+600 (Left Side)		0.100	3.6	4.3	5.0	
55	1581+600 to 1581+700 (Left Side)		0.040	1.4	1.7	2.0	
56	1583+300 to 1583+500	1583+460	0.380	14	16	19	
57	1583+600 to 1583+900	1583+960	0.350	12	15	17	
58	1583+900 TO 1584+300	1584+250	0.150	5	6	7	
59		1584+660					Local Flow
60		1584+685					Local Flow
61	1583+300 to 1584+730	1584+715	1.600	46	63	78	
62	1585+100 to 1585+300	1585+175	0.030	1.1	1.3	1.5	

2.17 FLOOD DISCHARGES WITH CLIMATE EFFECT

The floods estimated against various return periods with climate change effect under SSP 585 for the streams crossing the road are given in **Table 2.9.**

Table 2.9: Discharges with Climate Impact SSP 585 against Various Return Periods

Sr. No	Catchment RD's	Existing Structure	Catchment Area	Peak Flood Discharges			Remarks
				25 yrs	50 yrs	100 yrs	
			(km^2)	cumecs			
1		1545+780					Local Flow
2	1548+000 to 1549+600	1549+160	1.790	12	15	18	
3	1549+600 to 1550+500	1550+225	0.420	13	16	19	
4		1550+655					Local Flow
5	1550+655 to 1551+400	1550+735	10.80	116	154	188	
6	1551+400 to 1554+500	1551+715	4.230	55	74	90	
7		1551+977					Local Flow
8		1552+845					Local Flow
9		1555+520					Local Flow
10		1556+475					Local Flow
11		1556+575					Local Flow
12		1557+620					Local Flow
13		1558+435					Local Flow
14		1558+638					Local Flow
15	1554+500 to 1560+500	1560+300	42.300	417	554	675	
16	1560+400 to 1560+700		0.100	4	4	5	
17	1560+700 to 1560+800		0.004	0.15	0.18	0.21	

Sr. No	Catchment RD's	Existing Structure	Catchment Area (km²)	Peak Flood Discharges 25 yrs	50 yrs	100 yrs	Remarks
				cumecs			
18	1560+800 to 1561+200	1560+970	0.910	13	16	19	
19	1561+200 to 1561+400		0.002	0.07	0.09	0.10	
20	1561+200 to 1561+300 (Left Side)		0.001	0.04	0.04	0.05	
21	1561+300 to 1561+400 (Left Side)		0.002	0.07	0.09	0.10	
22	1561+500 to 1563+400	1561+855	6.870	98	132	162	
23		1562+170					Local Flow
24	1563+400 to 1563+650	1563+520	0.250	9	11	12	
25	1563+650 to 1564+450	1563+690	0.470	17	21	24	
26		1564+050					Local Flow
27		1564+130					Local Flow
28	1564+450 to 1564+700		0.010	0.37	0.45	1	
29	1564+700 to 1564+800		0.010	0.37	0.45	1	
30	1564+600 to 1564+800 (Left Side)		0.010	0.37	0.45	1	
31	1564+800 to 1564+900 (Left Side)		0.022	0.8	1.0	1.1	
32	1564+900 to 1565+100 (Left Side)		0.110	4	5	6	

Sr. No	Catchment RD's	Existing Structure	Catchment Area	Peak Flood Discharges			Remarks
				25 yrs	50 yrs	100 yrs	
			(km^2)	cumecs			
33	1564+800 to 1565+100		0.050	2	2	3	
34		1566+200					Local Flow
35		1566+965					Local Flow
36		1567+510					Local Flow
37	1565+200 to 1568+900	1568+690	8.100	110	143	173	
38	1567+200 to 1567+500 (Left Side)	1567+510	0.030	1.1	1.3	1.6	
39	1569+900		0.001	0.04	0.04	0.05	
40	1569+960		0.002	0.07	0.09	0.10	
41	1570+000		0.002	0.07	0.09	0.10	
42	1570+050		0.002	0.07	0.09	0.10	
43	1570+100		0.003	0.11	0.13	0.16	
44	1570+200		0.004	0.15	0.18	0.21	
45	1571+700 to 1571+820	1571+820	0.040	1.5	1.8	2.1	
46		1573+200					Local Flow
47	1572+300 to 1578+600	1578+120	11.400	122	158	189	
48		1580+755					Local Flow
49	1579+700 to 1581+800	1581+745	116.000	535	681	809	
50	1580+800 to 1580+900 (Left Side)		0.040	1.5	1.8	2.1	
51	1581+000 to 1581+200 (Left Side)		0.040	1.5	1.8	2.1	

Sr. No	Catchment RD's	Existing Structure	Catchment Area	Peak Flood Discharges			Remarks
				25 yrs	50 yrs	100 yrs	
			(km^2)	cumecs			
52	1581+200 to 1581+300 (Left Side)		0.050	1.8	2.2	2.6	
53	1581+350 to 1581+500 (Left Side)		0.150	5.5	6.7	7.8	
54	1581+500 to 1581+600 (Left Side)		0.100	3.7	4.5	5.2	
55	1581+600 to 1581+700 (Left Side)		0.040	1.5	1.8	2.1	
56	1583+300 to 1583+500	1583+460	0.380	14	17	20	
57	1583+600 to 1583+900	1583+960	0.350	13	16	18	
58	1583+900 TO 1584+300	1584+250	0.150	6	7	8	
59		1584+660					Local Flow
60		1584+685					Local Flow
61	1583+300 to 1584+730	1584+715	1.600	48	66	82	
62	1585+100 to 1585+300	1585+175	0.030	1.1	1.3	1.6	

3. HYDRAULIC DESIGN OF CROSS DRAINAGE STRUCTURES

3.1 SCOPE OF HYDRAULIC STUDIES

Culverts and bridges are normally provided as cross drainage structures where natural drain i.e. river, stream or nullah crosses the roadway. Here in the reach of this project road total 36 structures are provided comprising box culverts and bridges in order to pass natural streams and storm water nullahs.

Considering the estimated discharges concluded by hydrologic studies, hydraulic analyses for storm-water drainage through the existing seventeen (17) box culverts, twelve (12) pipe culverts and eight (8) bridges have been carried out by adopting comprehensive methodology for each structure which described in the subsequent sections.

3.2 DESIGN APPROACH FOR THE CULVERTS AND BRIDGES

Keeping in view the site requirements and the compatibility of the terrains of the project area, hydraulic design review of the storm-water drainage structures comprising existing box culverts, pipe culverts and bridges have been carried out using manning's approach by extracting required input parameters from available road layout plans, natural topographic, google earth maps and previous design report[1] provided by the Client. All the existing culverts along the road have been analyzed considering the provided condition survey of the structures, wherein, fair conditioned box culverts with required flow capacity have been retained while with insufficient capacity box culverts have been proposed to add specified barrel with the culverts. The eight bridges are also analyzed based on manning's approach due to non-availability of nullahs cross sectional survey.

Summary of cross drainage structures including retained and proposed culverts and bridges along with suggested remarks to be adopted for each structure for the project, based on of hydraulic analyses are given in the **Table 3.1** as follows:

Table 3.1: Summary of Existing Cross Drainage Structures

Sr. No.	Structure I.D	Road Chainage	Estimated SSP 5-8.5 Discharge (m^3/sec)	Existing Structure				Estimated Capacity (m^3/sec)		Capacity Check	Remarks
				Roadside	No. of Cell / Span	Span / width (m)	Height (m)	Individual	Combined		
1	PC-1	1545+780	-	-	1	0.8	-	1.33	1.33	-	Local Flow
2	BC-1	1549+160	12	-	1	3.35	2.3	16.49	16.49	Capacity OK	Cleaning and Maintenance Required
3	BC-1	1550+225	13	-	1	2	1.5	14.54	14.54	Capacity OK	-
4	PC-2	1550+655	-	-	1	0.3	-	0.14	0.14	-	Local Flow
3	BR-01	1550+735	188	-	3	6+10.35+6	3.35	271	271	Capacity OK	Cleaning and Maintenance Required
4	BR-02	1551+715	90	-	1	10	9	156.32	156.32	Capacity OK	Cleaning and Maintenance Required
5	BC-2	1551+977	-	-	1	1.5	1	4.16	4.16	-	Local Flow
6	BC-3	1552+845	-	-	1	1	1	2.22	2.22	-	Local Flow
7	BC-4	1555+520	-	-	1	1.5	1	3.93	3.93	-	Local Flow
8	PC-3	1556+475	-	-	1	0.61	-	0.45	0.45	-	Local Flow
9	PC-4	1556+575	-	-	1	0.61	-	0.46	0.46	-	Local Flow
10	PC-5	1557+620	-	-	1	0.61	-	0.51	0.51	-	Local Flow
11	PC-6	1558+435	-	-	1	0.85	-	1.19	1.19	-	Local Flow
12	BC-5	1558+638	-	-	1	2.5	2.5	22.17	22.17	-	Local Flow
13	BR-03	1560+300	675	-	3	13	7	736.32	736.32	Capacity OK	Cleaning and Maintenance Required
14	BC-6	1560+970	13	-	1	5	1.9	31.36	31.36	Capacity OK	-

Sr. No.	Structure I.D	Road Chainage	Estimated SSP 5-8.5 Discharge (m^3/sec)	Existing Structure				Estimated Capacity (m^3/sec)		Capacity Check	Remarks
				Roadside	No. of Cell / Span	Span / width (m)	Height (m)	Individual	Combined		
15	BR-04	1561+855	162	-	1	9.1	8.2	216.64	216.64	Capacity OK	Some Maintenance Required
16	BC-7	1562+170	-	-	1	1	5	15.26	15.26	-	Local Flow
17	PC-7	1563+520	9	-	1	0.91	-	1.49	1.49	*Less Capacity*	Increase 1 barrel of 1.5x1.5 to catter the Climate Resilience flood
18	PC-8	1563+690	17	-	2	0.91	-	2.94	2.94	*Less Capacity*	Increase 1 barrel of 2.0x2.0 to catter the Climate Resilience flood
19	PC-9	1564+050	-	-	1	0.91	-	1.51	1.51	-	Local Flow
20	PC-10	1564+130	-	-	2	0.91	-	2.86	2.86	-	Local Flow
21	BC-8	1566+200	-	-	1	2	1.5	10.46	10.46	-	Local Flow
22	BC-9	1566+965	-	-	1	1.5	1.5	7.00	7	-	Local Flow
23	BC-10	1567+510	1	-	1	1.5	1.5	7.26	7.26	Capacity OK	Desilting/Cleaning and Maintenance Required
24	BR-05	1568+690	173	-	3	23.4	13	717	716.88	Capacity OK	-
25	BC-11	1571+820	1	-	1	1.5	1	4.34	4.34	Capacity OK	Cleaning Required
26	BC-12	1573+200	-	-	1	1.2	0.65	1.67	1.67	-	Local Flow
27	BR-06	1578+120	189	P-H	1	23.8	10	883.68	883.68	Capacity OK	Cleaning and Maintenance Required
				H-P	1	13.5	10				

Sr. No.	Structure I.D	Road Chainage	Estimated SSP 5-8.5 Discharge (m^3/sec)	Existing Structure				Estimated Capacity (m^3/sec)		Capacity Check	Remarks
				Roadside	No. of Cell / Span	Span / width (m)	Height (m)	Individual	Combined		
28	BC-13	1580+755	-	-	1	3	2.4	15.28	15.28	-	Local Flow
29	BR-07	1581+745	809	P-H	6	20.5	4	847.48	847.48	Capacity OK	-
				H-P	12	10.3	3				
30	BC-14	1583+460	14	-	1	1.7	1.6	10.52	10.52	*Less Capacity*	Increase 1 barrel of 1.5x1.5 to catter the Climate Resilience flood
31	BC-15	1583+960	13	-	1	2	2.4	15.55	15.55	Capacity OK	-
32	BC-16	1584+250	6	-	1	2.5	1	9.19	9.19	Capacity OK	Full of Mud, Cleaning Required.
33	PC-11	1584+660	-	-	1	0.65	-	0.62	0.62	-	Local Flow
34	BC-17	1584+685	-	-	1	1.7	2	10.77	10.77	-	Local Flow
35	BR-08	1584+715	82	P-H	3	6+12+6	3	123.88	123.88	Capcity OK	Cleaning and Maintenance Required
				H-P	1	12	3				
36	PC-12	1585+175	1	-	1	0.91	-	1.95	1.95	Capacity OK	Cleaning Required

Note- PC = Pipe Culvert

BC = BOX Culvert

P-H = Pindi to Hassanabdal Side

H-P = Hassanabdal to Pindi Side

Capacity of structure, in case of difference on P-H & H-P, is estimated of smaller one

3.3 CONCLUSIONS OF HYDRAULIC ANALYSES

Hydraulic design review of the existing culverts and bridges, being used for storm-water drainage, have been carried to check the adequacy to safely pass the design floods with climate change effect under SSP 5-8.5. It is observed that existing box culverts, pipe culverts are present on small drain/ nullahs and bridges exist on some bigger nullahs at Tarnol – Hassanabdal section.

Considering the slopes, topography of the project area and development on the sides of the road at some locations the hydraulic analyses for the cross drainage structures have been taken up. As per hydraulic design guidelines the hydraulic design and review have been carried for the culverts against 25 year return period flood and checked to pass 50 year return period flood, while, 100 year return period flood is used for the bridges

. Here, in this reach the structures with individual estimated discharge have been reviewed for capacity check and proposed additional barrel where required as shown in Table-1.

Some structures are moderately choked and filled with mud. At some locations as mentioned in the summary at remarks, the existing cross drainage structures with mud blockage and minor damages are required cleaning, repair and periodic maintenance for the proper drainage of the design floods. Culvert at three (03) locations are required an additional barrel for each of the size mentioned above for safely pass the flood discharge with climate change effect.

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NATIONAL HIGHWAY AUTHORITY
GOVERNMENT OF PAKISTAN

WIDENING & IMPROVEMENT OF PRIORITY SECTIONS OF N-5

NOWSHERA- PESHAWAR ROAD SECTION

CLIMATE CHANGE ASSESSMENT, HYDROLOGICAL AND HYDRAULIC STUDIES FOR CROSS DRAINAGE STRUCTURES REPORT

DECEMBER 2024

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD.
HEAD OFFICE: NESPAK HOUSE, 1-C, BLOCK-N, MODEL TOWN EXTENSION LAHORE, PAKISTAN

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1. CLIMATE CHANGE FLOOD REPORT

1.1 INTRODUCTION

The N5 road, a critical transportation artery, is undergoing an expansion from 4 lanes to 6 lanes to accommodate increasing traffic demand and promote regional economic growth. As part of this expansion, it is essential to assess the potential risks associated with climate change to ensure the long-term resilience and sustainability of the infrastructure.

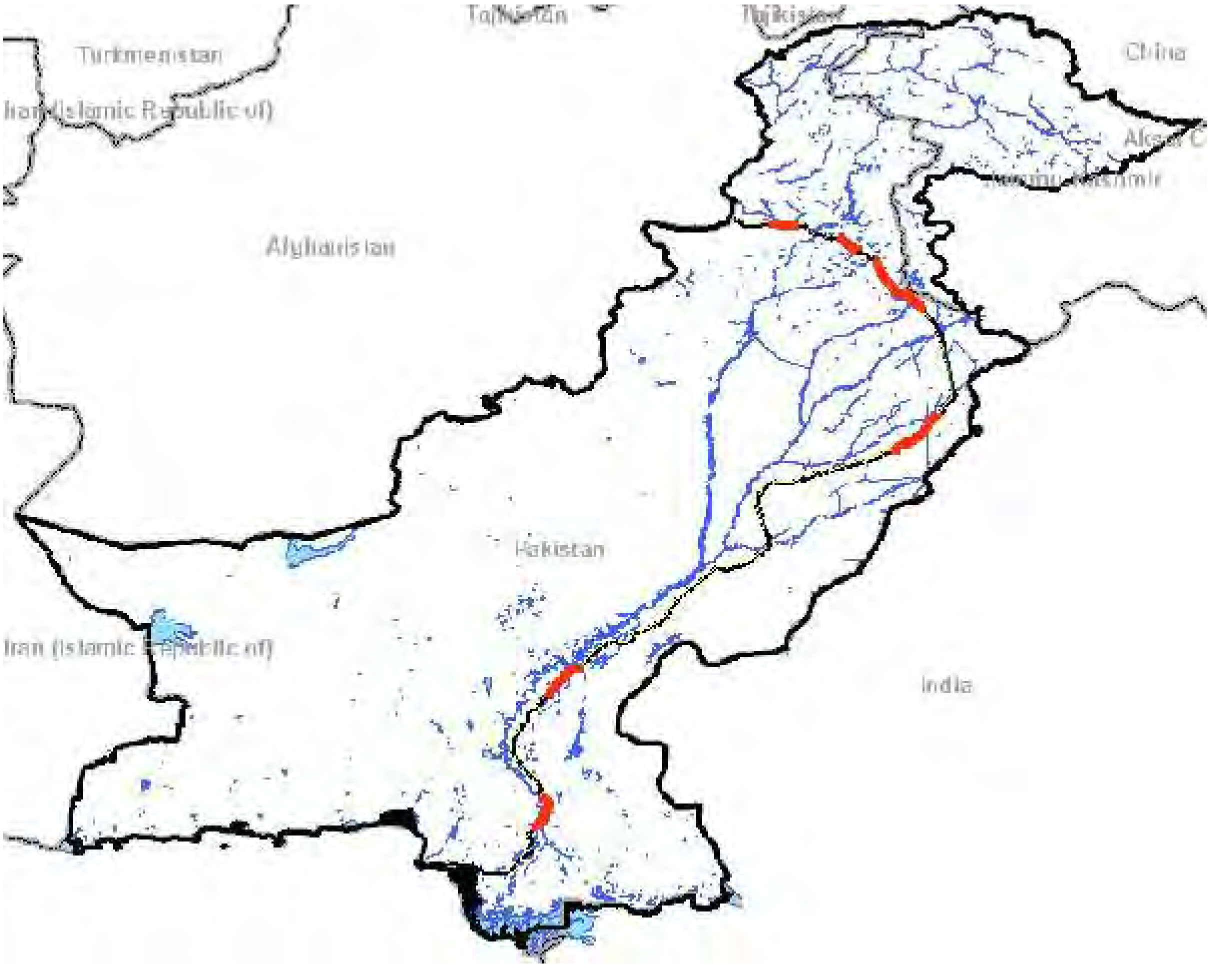

Figure 1.1: N5 Road Alignment with Dualization Sections (highlighted in red color)

1.2 REVIEW OF CLIMATE CHANGE FOR PAKISTAN

Pakistan is influenced by different climate zones, particularly by Monsoon climate in the south and mountain climate in the north. The general climatic conditions are altered by Pakistan's diverse geography with the far north reaching into the Himalayas and the southern and western regions being lowland plains of the Indus River, contributing to the diversity in climatic conditions in different regions of the country. The climate is respectively characterized by diverse conditions. Average temperatures are strongly dependent on the topography, with coolest annual temperatures below zero in the far North (the Himalayan region), and higher average temperatures in the lower-lying south-east. Rainfall is low throughout the year in large parts of the country (20-30mm per month), but the northern regions, on the southern side of the Himalayan mountains, receive rainfall of up to 200mm per month as a result of the summer monsoon through July to September.

1.3 CURRENT CLIMATOLOGY

Pakistan's climate context for the current climatology, 1991-2020, derived from observed, historical data (see, **Figure 1.2**, **Figure 1.3** and **Figure 1.4**). Information should be used to build a strong understanding of current climate conditions in order to appreciate future climate scenarios and projected change. Observed, historical data is produced by the Climatic Research Unit (CRU) of University of East Anglia. Data is presented at a 0.5º x 0.5º (50km x 50km) resolution.

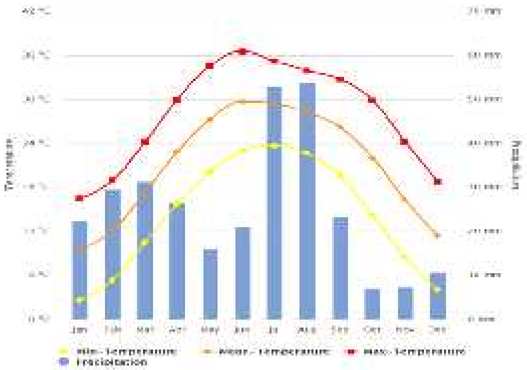

Figure 1.2 Monthly Climatology of Min, Max and Mean Temperature with Rainfall (1991-2020) (Source: World Bank)

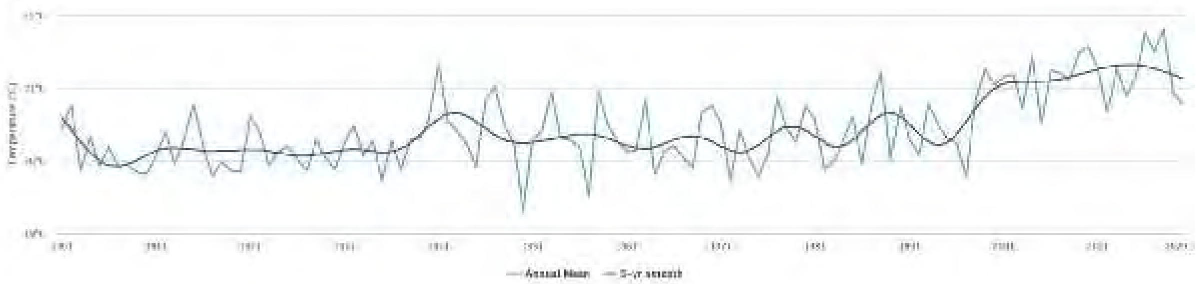

Figure 1.3 Observed Average Annual Mean- Temperature of Pakistan for 1901-2020

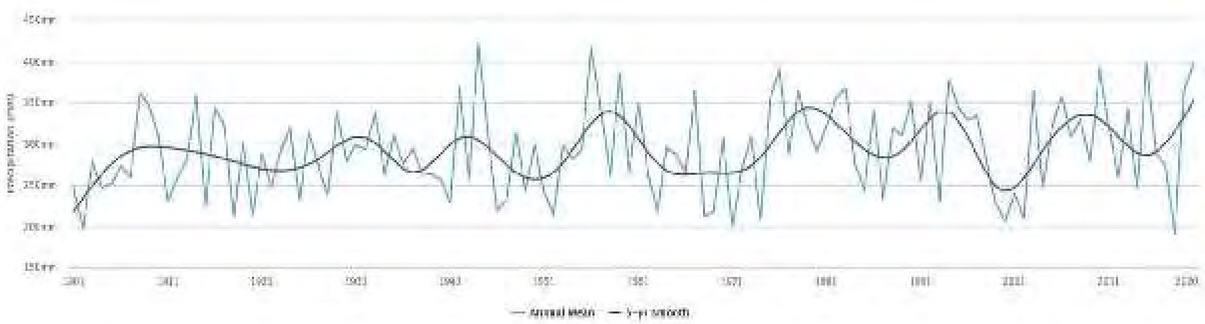

Figure 1.4 Observed Average Annual Rainfall of Pakistan for 1901-2020

Temperature

- Warming in Pakistan was estimated at 0.57°Cover the 20th century, but has accelerated more recently, with 0.47°C of warming measured between 1961–2007.
- Increases in temperature is strongly biased towards the winter and post-monsoon months (November–February). On a sub-national level, warming is also strongly biased towards the more southerly regions, with Punjab, Sind, and Baluchistan all experiencing winter warming in the region of 0.91°C–1.12°C between 1961–2007, and Khyber Pakhtunkhwa in the north experiencing only 0.52°C.
- The rise in average daily maximum temperatures (0.87°C between 1961–2007) has been slightly stronger than the rise in average temperatures. A concurrent increase in the frequency of heat wave days has been documented, particularly in Sindh Province.

Rainfall

- Mean rainfall in the arid plains of Pakistan and the coastal belt has decreased by 10-15% since 1960. Most other regions have experienced a slight increase, seen both in the monsoon and dry seasons.
- The number of heavy rainfall events has increased since 1960, and the nine heaviest rains recorded in 24 hours were recorded in 2010.
- Recent evidence suggests that glaciers in the headwaters of the Indus Basin may be expanding due to increased winter rainfall over the Himalayan region in the last 40 years.

1.4 PROJECTED CLIMATOLOGY

Climate projection data is modeled data from the global climate model compilations of the Coupled Model Inter-comparison Projects (CMIPs), overseen by the World Climate Research Program. Data presented is CMIP6, derived from the Sixth phase of the CMIPs. The CMIPs form the data foundation of the IPCC Assessment Reports. CMIP6 supports the IPCC's Sixth Assessment Report. Data is presented at a 0.25º x 0.25º (25km x 25km) resolution. Projected multi model mean temperature and rainfall trend for Pakistan is shown in **Figure 1.5** and **Figure 1.6** respectively.

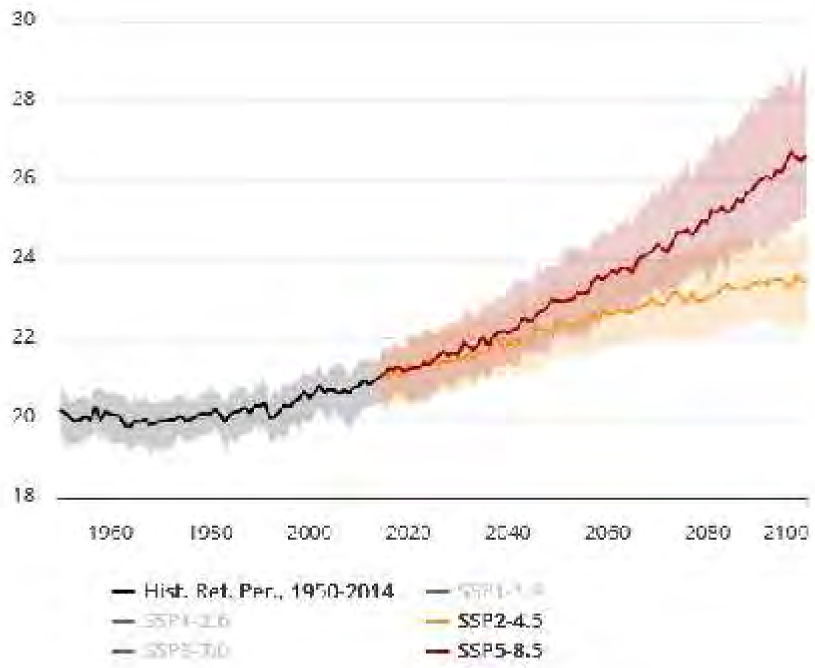

Figure 1.5 Projected Mean Temperature (Multi-Model Ensemble) Pakistan

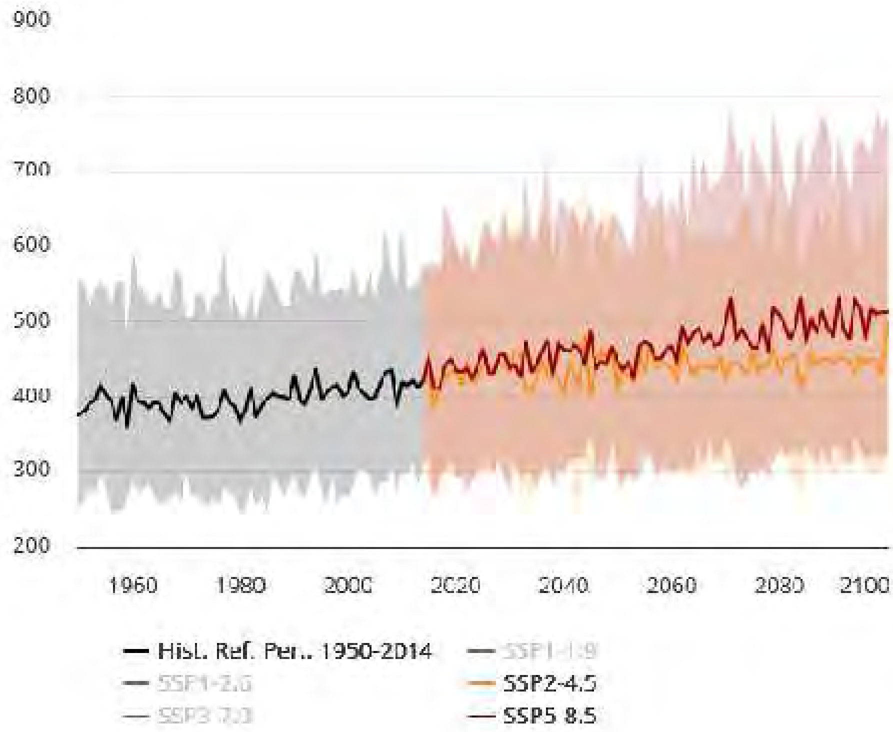

Figure 1.6 Projected Rainfall (Multi-Model Ensemble) Pakistan

1.5 CLIMATE DIAGONISTIC

Consultants performed climate risk assessment as per International standard practice for climate change projects following the guidelines of Intergovernmental Panel for Climate Change.

1.6 IMPACT OF CLIMATIC CHANGE

1.6.1 Climate Change Assessment Over Peshawar – Nowshera Section

Specifically, temperature and rainfall variation over different timeframes and climate scenarios are considered for Peshawar and Nowshera road section (see **Figure 1.7**) using NEX-GDDP-CMIP6. Key highlights are:

- **Temperature Projections:**
  - Under SSP 2-4.5: Temperatures are expected to increase by 1.9°C by 2050 and 3.0°C by 2085.
  - Under SSP 5-8.5: Temperatures could increase by 2.5°C by 2050 and 5.3°C by 2085.

- **Rainfall Projections (Annual):**
  - Under SSP 2-4.5: Total annual rainfall is projected to increase by 6.0% by 2050 and 5.0% by 2085.
  - Under SSP 5-8.5: Rainfall could increase by 8.4% by 2050 and 15.4% by 2085.

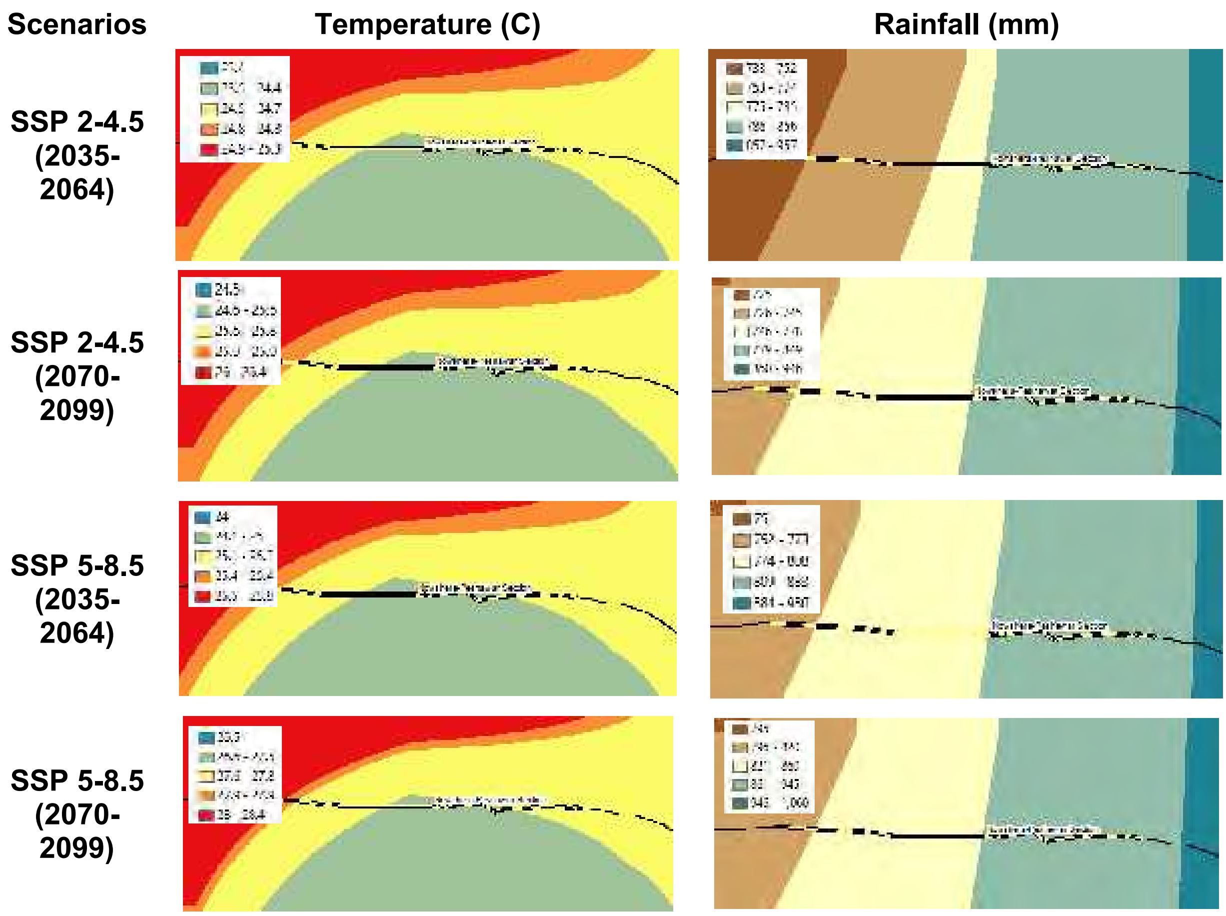

Figure 1.7 Temperature and Rainfalls under Different Timeframes and Climate Scenarios over Peshawar – Nowshera Section

1.7 FLOOD ASSESSMENT FOR PESHAWAR – NOWSHERA SECTION

Under the project titled "Emergency Flood Assistance Project, Khyber Pakhtunkhwa, Pakistan," funded by ADB in 2023, the Consultants have already conducted and estimated the impact of climate change for this region. The ensemble of bias corrected GCMs for this region showed that there will be average increase in rainfall of about 3.6%, 3.7% and 3.7% for return period of 25, 50 and 100 years, respectively under SSP 2-4.5 while there will be increase in rainfall of about 11.0%, 12.0% and 13.4% for return period of 25, 50 and 100 years respectively under SSP 5-8.5 (**Error! Reference source not found.**) which are used in the project's engineering design. However, it is important to note that there will always be some residual risk associated with the performance of individual GCMs. There climatic change increase factors be used to increase the rainfall depths for inclusion in flood studies.

Table 1.1: Estimated Increase in Rainfall under SSP 2-4.5 and SSP 5-8.5

Return Periods	SSP 2-4.5	SSP 5-8.5
25	3.6%	11.0%
50	3.7%	12.0%
100	3.7%	13.4%

1.8 CONCLUSION

This report initiates a detailed **climate change assessment** for the **N5 road expansion**, specifically focusing on the Peshawar and Nowshera areas. By addressing climate-related risks upfront, it aims to ensure long-term sustainability and resilience of critical infrastructure in the face of future climate changes.

In the road project area, **average monthly temperatures** are projected to rise significantly by 2085, with increases as high as 4°C. Under the **SSP 2-4.5** scenario, temperatures are expected to increase by **1.9°C by 2050** and **3.0°C by 2085**, whereas under **SSP 5-8.5**, the rise could reach **2.5°C by 2050** and **5.3°C by 2085**. Additionally, **annual rainfall** is anticipated to rise by **6.0% by 2050** and **5.0% by 2085** under SSP 2-4.5, while under SSP 5-8.5, rainfall could increase by **8.4% by 2050** and **15.4% by 2085**.

Floods and **extreme temperatures** are identified as key climate-related hazards that the road projects will face in the future. The analysis shows that extreme rainfall is expected to intensify. An ensemble of bias-corrected GCMs predicts a rise in rainfall by **3.6% for a 25-year return period**, **3.7% for a 50-year return period**, and **3.7% for a 100-year return period** under SSP 2-4.5. Under SSP 5-8.5, the projected increases are **11.0%**, **12.0%**, and **13.4%**, respectively, all of which have been incorporated into the project's engineering design. It is recommended to adopt SSP 5-8.5 results in the design.

2. HYDROLOGICAL STUDIES

2.1 GENERAL

National Highway 5 (N-5), Pakistan's longest and most strategically important highway, stretches over 1,800 kilometers, connecting the bustling port city of Karachi in the south to the historic city of Peshawar in the north. As a vital artery of the legendary Grand Trunk Road, N-5 serves as a cornerstone for national trade, transportation, and communication, seamlessly linking major urban centers and industrial hubs across the country.

The Nowshera-Peshawar section, a critical segment of National Highway 5 (N-5), spans approximately 30 kilometers, connecting Nowshera, a prominent industrial and agricultural hub, with Peshawar, the provincial capital of Khyber Pakhtunkhwa. This stretch plays a pivotal role in facilitating regional and national economic activity, efficiently handling significant freight traffic that includes raw materials and finished goods bound for major industrial and commercial centers. Additionally, it accommodates daily commuters and intercity travelers, significantly enhancing regional connectivity and mobility. The strategic importance of this section highlights its vital contribution to Pakistan's transportation network and economic integration.

2.2 LOCATION of PROJECT AREA

Nowshera, a vibrant city in Pakistan's Khyber Pakhtunkhwa province, is strategically located along the banks of the Kabul River. Renowned for its historical significance and cultural heritage, Nowshera serves as a vital link between major cities in the region. It is a hub for trade and industry, with a strong agricultural base and flourishing local markets. The city's proximity to key transportation routes, including the National Highway 5 (N-5), underscores its importance in regional connectivity and economic activity. Historically, Nowshera has played a significant role as a center of education and military training, housing institutions such as the Pakistan Air Force Academy. The blend of modern development and traditional values is reflected in its bustling bazaars, educational institutions, and diverse communities.

Peshawar, the capital of Khyber Pakhtunkhwa province, is one of Pakistan's oldest and most culturally rich cities. With a history spanning thousands of years, it has been a gateway for trade and cultural exchange, connecting South Asia with Central Asia. Peshawar's strategic location along the historic Grand Trunk Road and its proximity to the Khyber Pass have cemented its status as a key economic and geopolitical hub. The city is renowned for its vibrant bazaars, such as Qissa Khwani, and its historical landmarks, including the Bala Hisar Fort and Mahabat Khan Mosque, which reflect its rich heritage. Peshawar is also a center of education, housing prestigious institutions like the University of Peshawar. Its economy thrives on trade, agriculture, and services, with a growing focus on industrial development.

Considering the economic importance of Nowshera and Peshawar, the client, National Highway Authority (NHA), intends to widen and upgrade the existing metaled road connecting these two key locations. This section of National Highway 5 (N-5) is vital for facilitating trade, transportation, and daily commuting, linking Nowshera's industrial and agricultural hubs with Peshawar's administrative and commercial centers. The proposed improvements aim to increase road capacity, reduce traffic congestion, and ensure a smoother flow of freight and passenger vehicles. Upgrading this critical corridor will not only support the growing economic activities in Nowshera and Peshawar but also enhance regional connectivity, contributing to greater economic efficiency. The approximate length of the road under consideration is about 30 kilometers. The location map is shown in **Figure 2.1.**

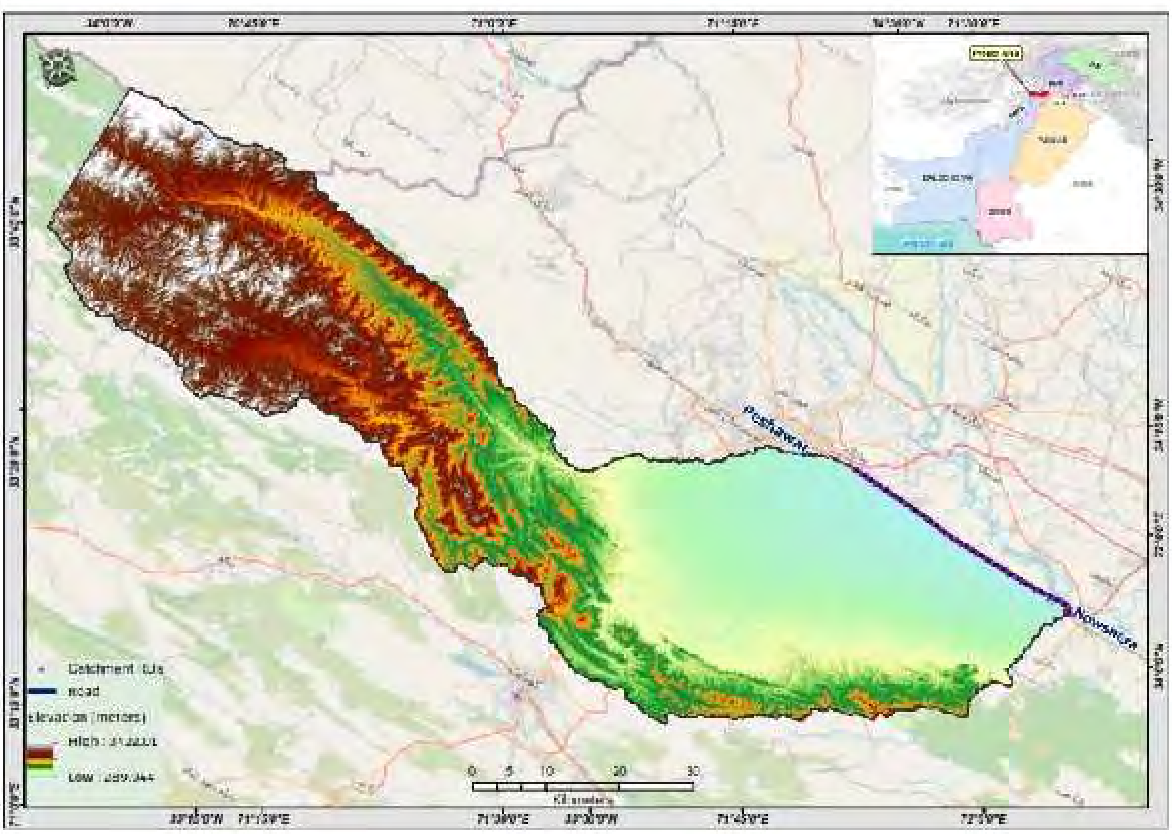

Figure 2.1: Location Map of Project Area

2.3 SCOPE OF HYDROLOGICAL STUDIES

The Nowshera-Peshawar section of National Highway 5 (N-5) traverses through a region characterized by diverse topographical features that significantly influence its design and functionality. The area primarily consists of flat to gently undulating plains, interspersed with patches of agricultural land, which dominate the landscape. The Kabul River runs parallel to parts of the highway, with its presence becoming particularly significant during the monsoon season when the river experiences increased water flow, impacting the surrounding areas.

As per the Term of Reference (ToR) of the project, the scope of hydrological studies includes locating the streams and nullahs etc., crossing the road and estimation of discharges of these streams and nullahs against various return periods considering the effect of climate change.

2.4 CLIMATIC STATIONS IN VICINITY OF PROJECT AREA

There is no discharge gauging for any stream/nullah crossing the road. In the vicinity of the project area, there exists two rain gauge stations, which are being operated and maintained by Pakistan Meteorological Department (PMD). The location of these stations is shown in **Figure 2.2**. Selection of suitable climatic station involves careful considerations to ensure accurate and reliable data available for analysis. Keeping into consideration the appropriate length of data available and its minimum distance from the project area, Peshawar gauging station has been selected. This station gives a fair representation of the climate of the project area.

Figure 2.2: Rainfall Gauging Stations in Vicinity of Road Section

2.5 CLIMATE OF PESHAWAR

Peshawar, the capital of Khyber Pakhtunkhwa, experiences a semi-arid climate characterized by distinct seasonal variations. The city has hot summers, mild winters, and a moderate amount of rainfall, influenced by its geographical location near the Khyber Pass and proximity to the Hindu Kush Mountain range.

Summer temperatures in Peshawar are typically high, with average daytime highs reaching around 40°C in June and July. Winters are mild, with average temperatures ranging from 5°C to 15°C, and occasional cold snaps, particularly in December and January. The monsoon season, which lasts from July to September, brings moderate to heavy rainfall, primarily influenced by the influx of moisture from the Indian Ocean.

2.5.1 Precipitation

Mean monthly rainfall data and the number of rainy days recorded at Peshawar Station are given in **Table 2.1.** The annual rainfall of the area is about 540.6 mm (Ref.1). While on average the maximum monthly rainfall is 78.2 mm during the month of March and a minimum of 16.8 mm in November. The maximum rainfall occurs during the months of February to April and July to August, which is about 65% of the annual rainfall. Winter rains generally occur during the month of January, whereas November is normally the month with the least precipitation.

The distribution of average monthly rainfall and number of rainy days in Peshawar have been shown in **Figure 2.3** and **Figure 2.4** respectively**.**

Table 2.1: Mean Monthly Rainfall in Peshawar

Months	Precipitation (mm)	Rainy Days (No.)
January	39.7	4.7
February	69.9	7.5
March	78.2	10.1
April	68.1	8.7
May	26.7	7.6
June	25.3	3.7
July	68.9	5.6
August	68.4	7.4
September	34.8	4.6
October	26.6	3.3
November	16.8	2.9
December	17.2	2.8

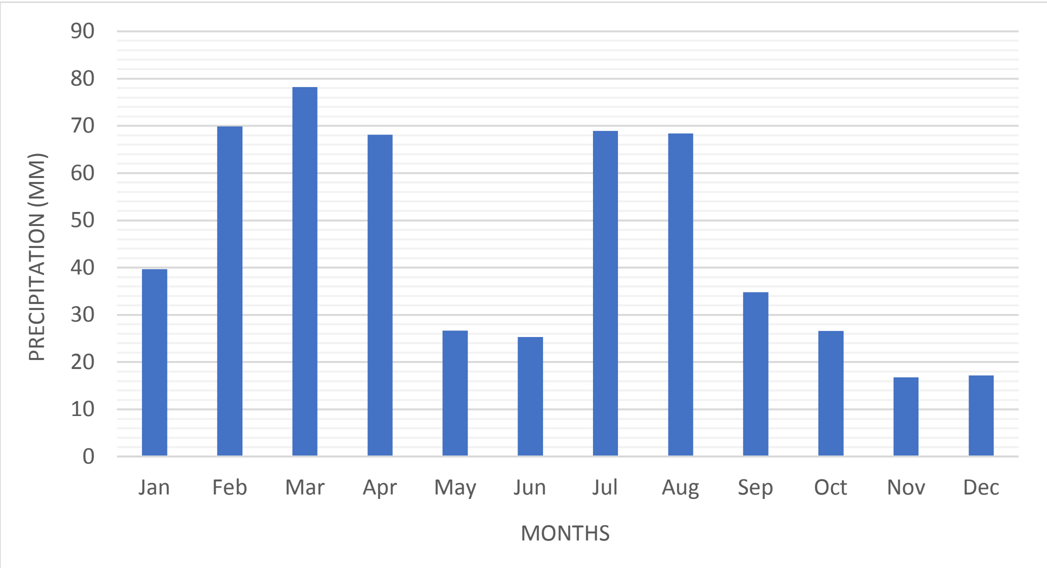

Figure 2.3: Mean Monthly Distribution of Rainfall in Peshawar

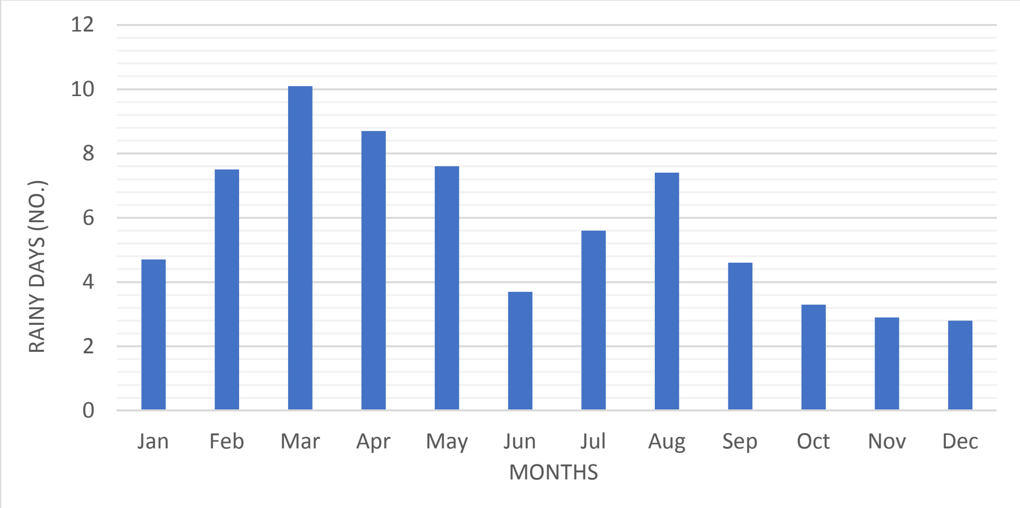

Figure 2.4: Number of Rainy Days in Peshawar

2.5.2 Temperature

The average daily temperature in Peshawar varies significantly between seasons. During the summer months of May through September, the mean daily temperature ranges from 29.0°C to 32.7°C, with June, July, and August being the hottest months. Conversely, the winter season, spanning December through February, has a mean daily temperature ranging from 11.3°C to 13.8°C, with December, January, and February being the coldest months. The mean monthly temperature peaks at 32.7°C during June and reaches its lowest value of 11.3°C in January. These seasonal variations highlight the contrast between Peshawar's hot summers and relatively mild winters. The monthly averages of minimum, maximum and mean daily temperatures are given in **Table 2.2** and shown graphically in **Figure 2.5**.

Table 2.2: Mean Monthly Temperatures in Peshawar

Month	Min Temp (°C)	Max Temp (°C)	Mean Temp (°C)
January	4.6	18.1	11.3
February	7.6	20.1	13.8
March	12.2	24.7	18.2
April	17.2	30.6	23.9
May	22.3	36.5	29.4
June	25.8	39.6	32.7
July	26.8	37.4	32.1
August	26.0	35.9	30.9
September	23.2	34.8	29.0
October	17.1	31.0	24.0
November	10.4	25.2	17.8
December	5.6	20.6	13.2

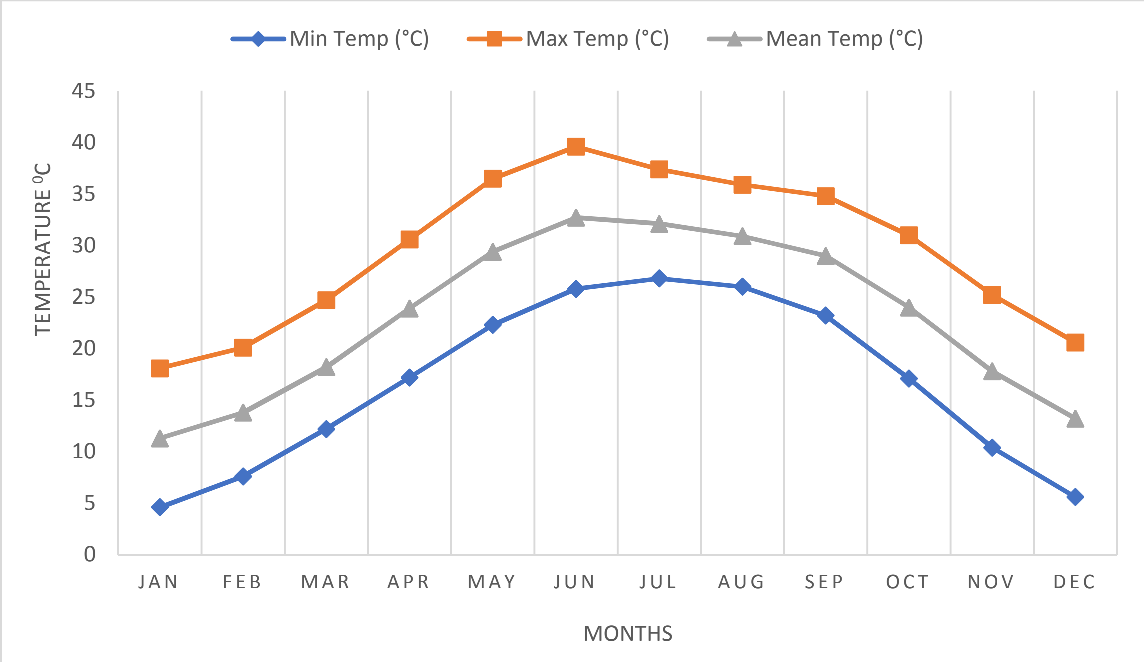

Figure 2.5: Mean Monthly Temperatures in Peshawar

2.5.3 Relative Humidity

The relative humidity data at 00:00, 03:00 and 12:00 hours has been collected from PMD. Mean monthly relative humidity is given in **Table 2.3** and shown graphically in **Figure 2.6**. At 00:00 hour the relative humidity varies from lowest value of 50.5% in June to highest value of 79.2% in January. At 12:00 hour the lowest value is 1.3% in October and highest value of 3.9% in August.

Table 2.3: Mean Monthly Relative Humidity in Peshawar

Month	Relative Humidity (%)		
	00 UTC	03 UTC	12 UTC
January	79.2	50.1	2.7
February	76.3	44.6	3.1
March	73.2	44.3	3.4
April	65.8	40.0	3.1
May	51.1	31.3	2.8
June	50.5	31.8	2.3
July	67.8	49.0	3.6
August	75.8	55.9	3.9
September	74.4	50.3	2.2
October	72.5	46.5	1.3
November	76.2	52.5	1.7
December	77.8	52.5	2.0

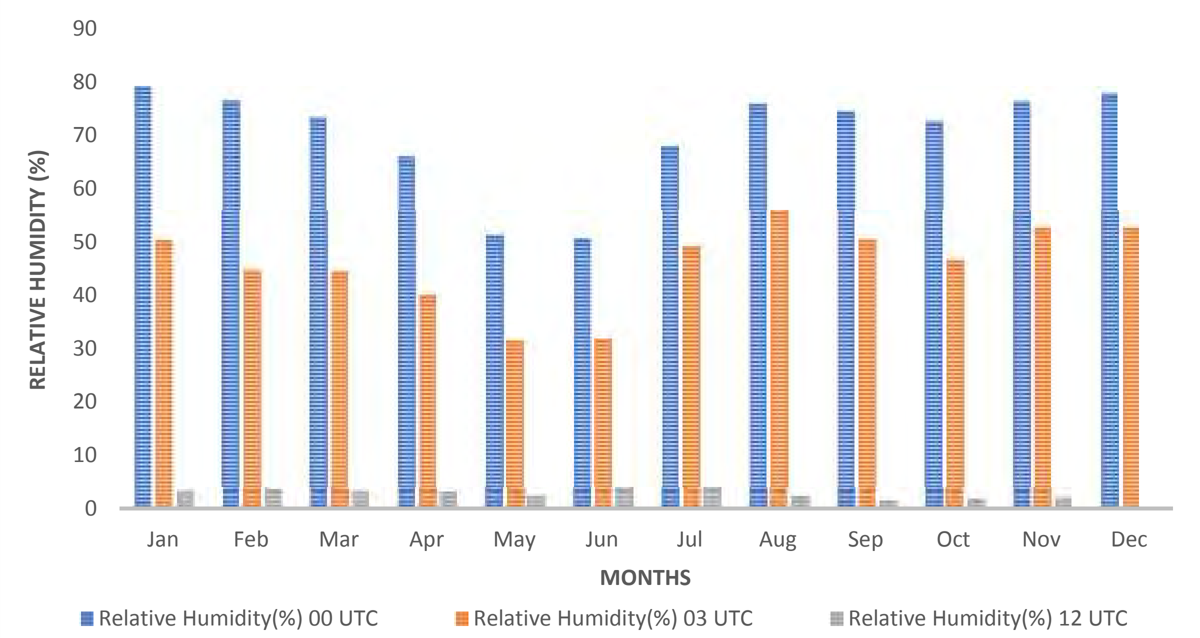

Figure 2.6: Monthly Relative Humidity in Peshawar

2.5.4 Wind Speed

The mean monthly wind speed in knots is given in **Table 2.4** and shown graphically in **Figure 2.7**. The data reveals that at 12:00 hours wind speed is higher. During summers, wind speeds are generally higher than wind speeds in winters.

Table 2.4: Mean Monthly Wind Speed in Peshawar

Month	Mean Wind at Synoptic Hours (Knots)		
	0:00	3:00	12:00
January	1.6	2.3	3.0
February	2.2	2.7	5.7
March	2.7	3.1	6.3
April	3.1	3.2	7.6
May	3.5	3.9	9.5
June	3.9	4.6	9.7
July	5.0	5.4	9.5
August	4.5	4.8	9.0
September	2.8	3.4	7.3
October	1.7	2.1	4.2
November	1.5	2.0	2.1
December	1.5	2.1	1.8

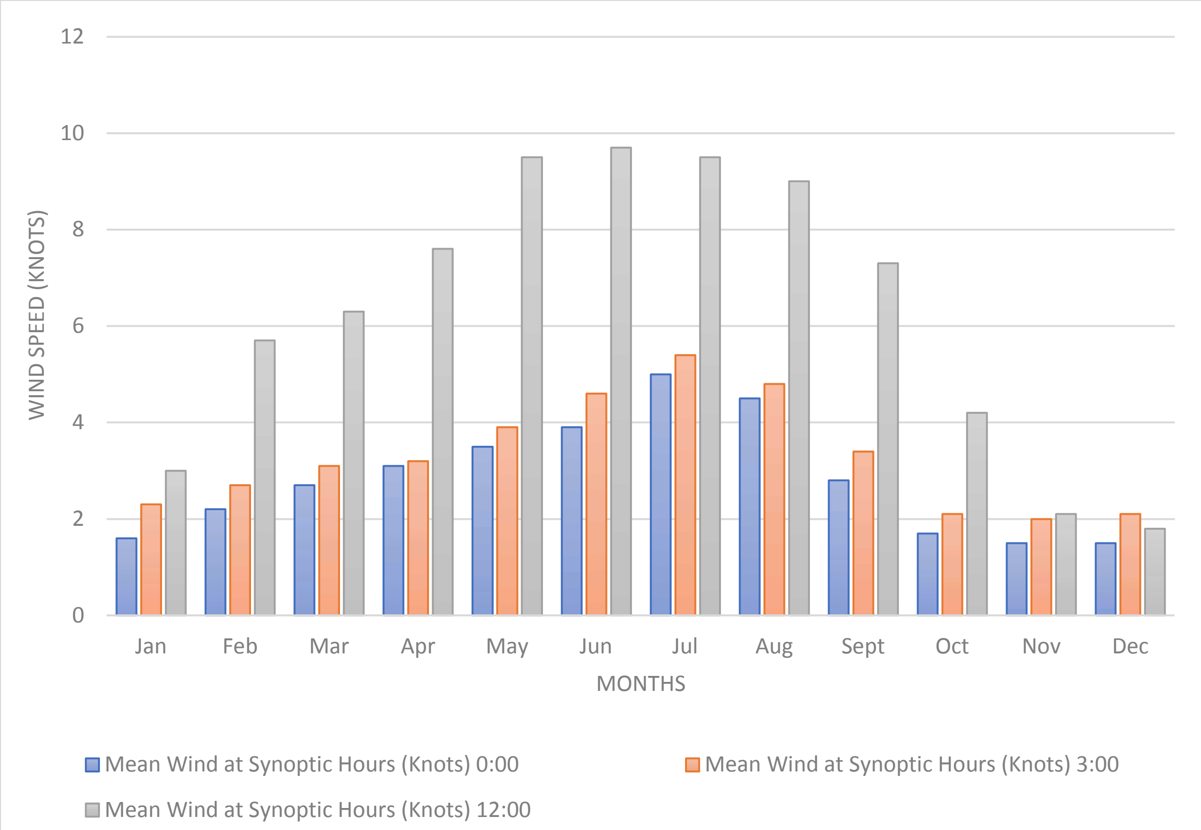

Figure 2.7: Mean Monthly Wind Speed in Peshawar

2.6 ISOHYETAL METHOD

The isohyetal method is a technique used to estimate precipitation over catchment based on observed rainfall data from multiple weather stations. The method involves drawing lines called isohyets which connect points of equal rainfall intensity relative to contour lines on a topographic map. Annual normal rainfall isohyetal map (1981-2010) has been collected from Pakistan Metrological Department (PMD) as shown in **Figure 2.8.**

The road section has been overlayed on the isohyetal map. According to this, isohyet of 500 to 700 mm rainfall traverses through the project area as shown in **Figure 2.9**

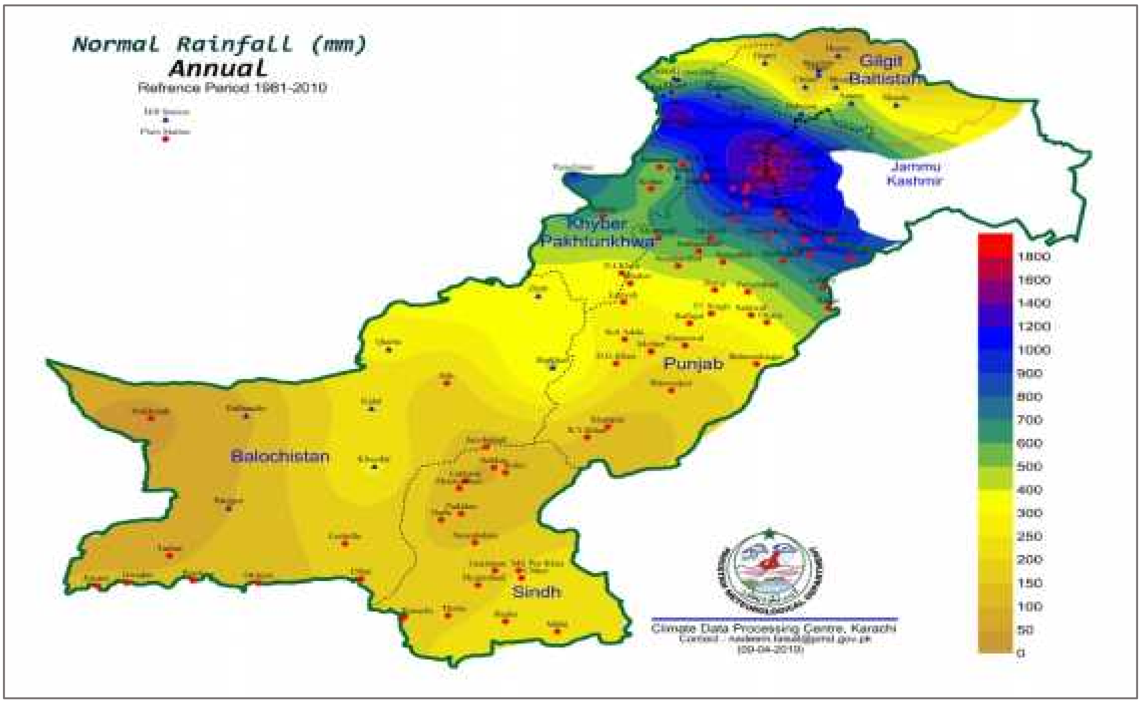

Figure 2.8: Annual Normal Rainfall Isohyetal Map of Pakistan

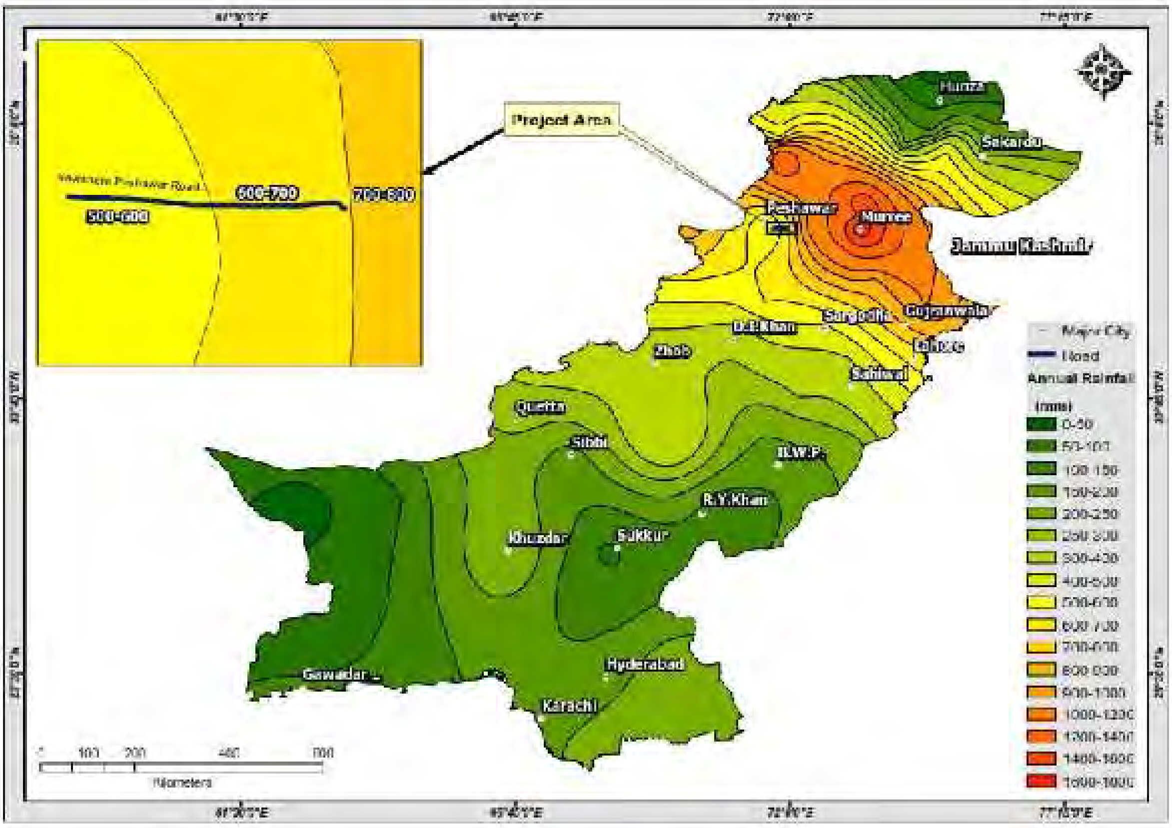

Figure 2.9: Road Section Overlayed on Annual Normal Isohyetal Map

2.7 SOIL PROPERTIES OF PROJECT AREA

Soil properties influence the relationship between rainfall and runoff by affecting the rate of infiltration. The soil type and land cover play a crucial role in the rainfall-runoff model and require comprehensive evaluation. Surface runoff is influenced by factors such as rainfall intensity and duration, weather conditions (including temperature), soil properties, vegetation cover, land use patterns, initial soil moisture content, entrapped air, and the depth of the groundwater table.

Vegetation cover serves to mitigate the impact of rain drops and enhances infiltration rates, whereas built-up areas and rocky surfaces tend to increase runoff. To accurately assess these factors, various sources of information are utilized, including maps of soil surveys from Pakistan, global land use datasets, field investigations, and satellite imagery.

Natural Resources Conservation Services (NRCS) divides soils into four hydrologic soil groups based on infiltration rates (Groups A-D).

Group A: Group A soils have a low runoff potential due to high infiltration rates even when saturated (0.30 in/hr. to 0.45 in/hr. or 7.6 mm/hr. to 11.4 mm/hr.). These soils primarily consist of deep sands, deep loess, and aggregated silts.

Group B: Group B soils have a moderately low runoff potential due to moderate infiltration rates when saturated (0.15 in/hr. to 0.30 in/hr. or 3.8 mm/hr. to 7.6 mm/hr.). These soils primarily consist of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures (shallow loess, sandy loam).

Group C: Group C soils have a moderately high runoff potential due to slow infiltration rates (0.05 in/hr. to 0.5 in/hr. or 1.3 mm/hr. to 3.8 mm/hr. if saturated). These soils primarily consist of soils in which a layer near the surface impedes the downward movement of water or soils with moderately fine to fine texture such as clay loams, shallow sandy loams, soils low in organic content, and soils usually high in clay.

Group D: Group D soils have a high runoff potential due to very slow infiltration rates (less than 0.05 in./hr. or 1.3 mm/hr. if saturated). These soils primarily consist of clays with high swelling potential, soils with permanently high-water tables, soils with a clay pan or clay layer at or near the surface, shallow soils over nearly impervious parent material such as soils that swell significantly when wet or heavy plastic clays or certain saline soils.

The soil properties of the project area are shown by **Figure 2.10**.

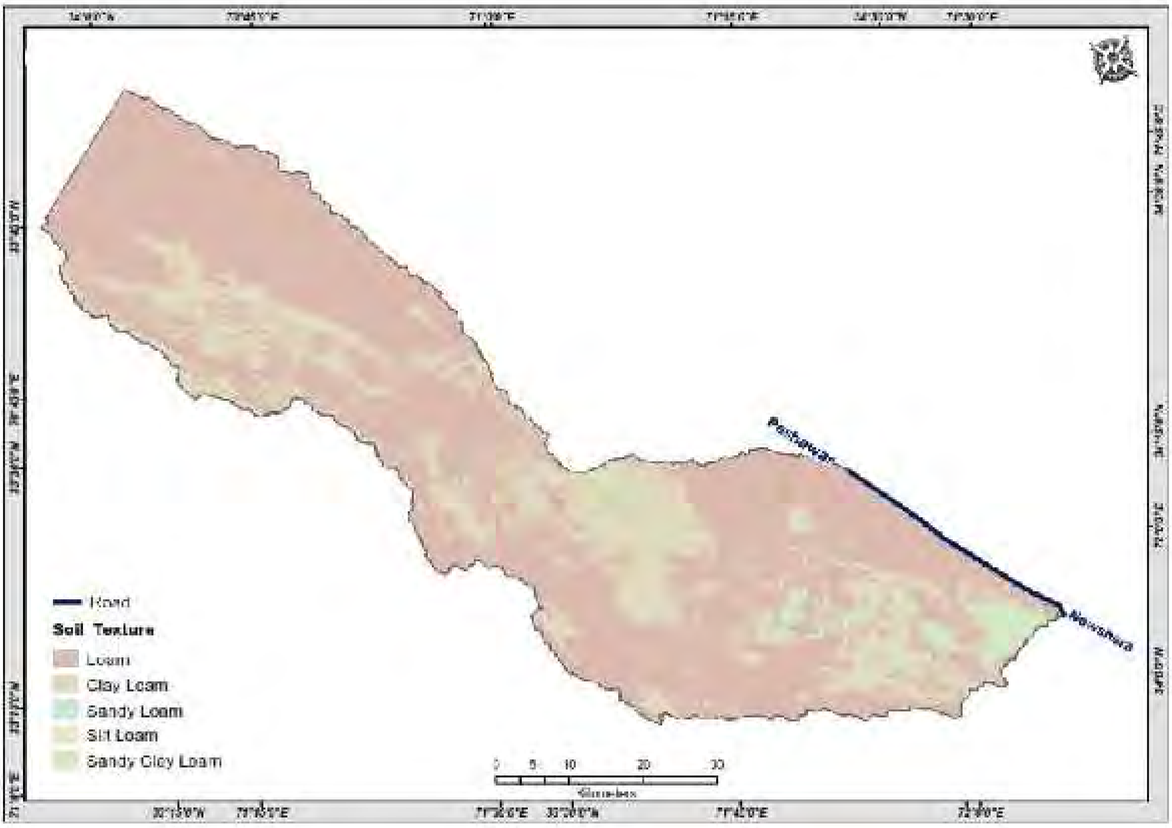

Figure 2.10: Soil Properties of Nowshera - Peshawar Road Section

2.8 LAND USE PROPERTIES OF PROJECT AREA

The land use is used for watershed delineation of project catchment. All the major categories are marked, and CN numbers are given accordingly. In addition to that, these maps illustrate the Hydraulic Soil Type within the project area, derived from remote sensing data, the Soil Survey Map of Pakistan, and on-site verification. These maps are instrumental in characterizing the soil properties critical for hydraulic modeling and infrastructure planning.

Land use maps provide critical input for modelling runoff and designing effective water management strategies. The Anderson Land use classification is given below:

- Bare Areas
- Built up Areas
- Waterbodies
- Cropland
- Grassland
- Shrubland
- Tree covers

The land use properties of the project area are shown in **Figure 2.11**.

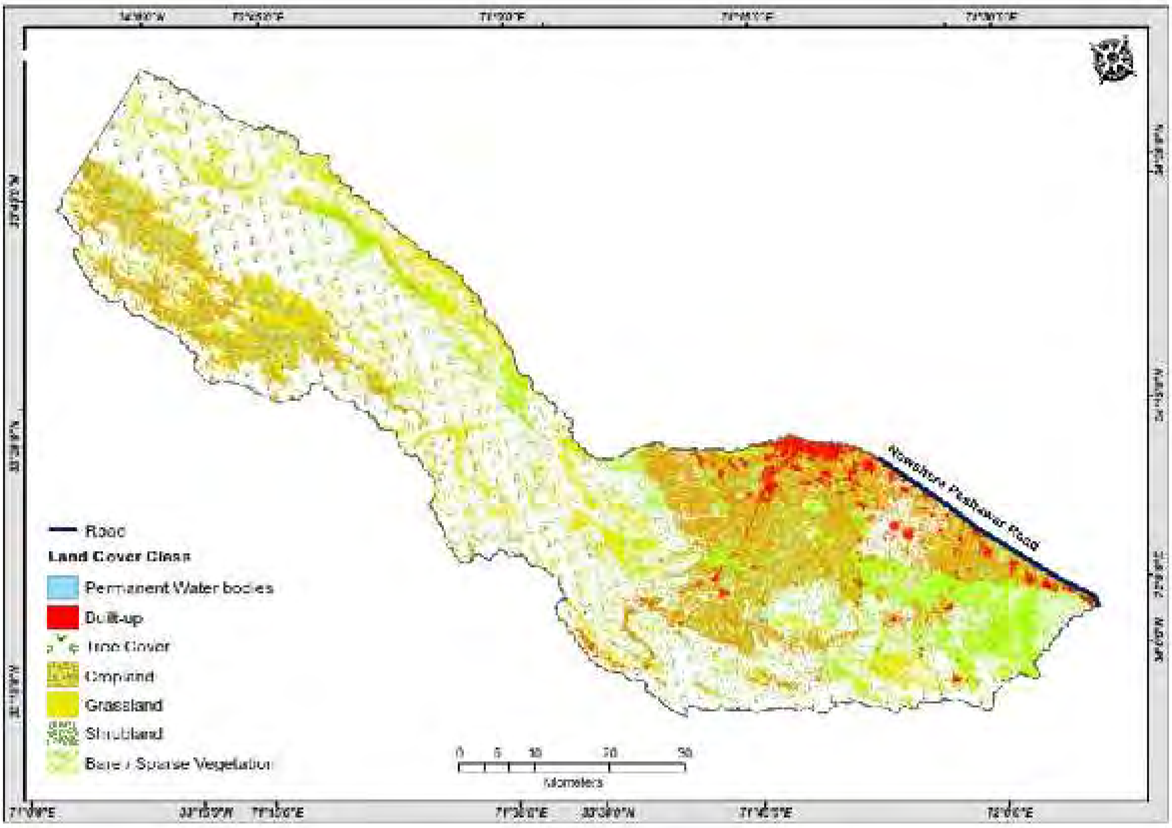

Figure 2.11: Land Use Properties of Nowshera - Peshawar Road Section

2.9 CATCHMENT AREA DELINEATION AND GENERATION OF STREAM NETWORK

Catchment characteristics can be sub-divided mainly into two categories i.e., physical characteristics and hydrological characteristics. Physical characteristics of the catchment include catchment area, length and weighted slope of the longest stream draining to the point of interest. These physical characteristics have been determined from the topographic maps of 1:50,000 scale and Digital Elevation Model (DEM) obtained from Shuttle Radar Topographic Mission (SRTM) and GLO-30. The catchment areas of all the desired points have been marked using DEM data and have been verified using topographic maps.

Stream network development using Digital Elevation Models (DEMs) is a foundational technique in hydrology for mapping and analyzing water flow paths across a landscape. DEMs provide a digital graphical representation of terrain, capture variations in land elevation, enabling detailed analysis of water movement and channel formation. Flow direction and flow accumulation has been identified by using this technique. For Nowshera - Peshawar Road section, Topaz and Arc-Hydro tools have been used for generating stream network by GLO-30 DEM.

Defining the catchment area of the generated stream network is known as watershed delineation. The longitudinal slopes and lengths of the natural streams/nullahs have been determined from the topographic maps, DEM data and by using tools i.e. WMS (Water Management System) and Arc-Hydro. The hydrologic characteristics of the catchments i.e., conditions of the area; soil cover, land use, soil type and extent, and other flow controlling parameters have been investigated through soil maps and satellite imagery. **Figure 2.12**,

Figure 2.13 represent the stream network and catchment area delineation respectively by above mentioned techniques.

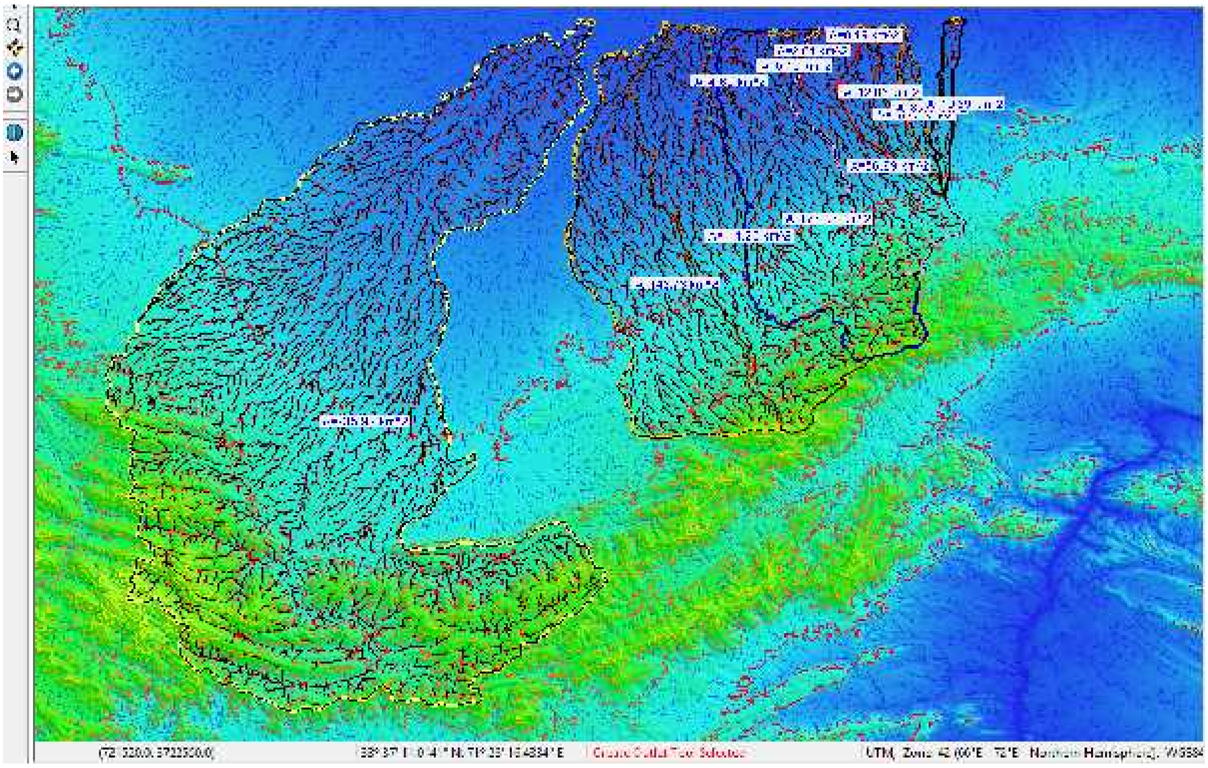

Figure 2.12:Stream Network Generation and Watershed Delineation using Topaz Tool

Figure 2.13: Watershed Delineation using Arc-Hydro Tool

2.10 HYDRO-METROLOGICAL DATA USED

The flood study for a location depends upon the hydro-meteorological data of the location/area. For gauged locations, recorded data is used to estimate peak flood discharges, whereas, for ungauged locations synthetic storm is used which is estimated with recorded intense rainfall events in the area. In case of non-availability of rainfall data in the study area, the data of a station in the vicinity with similar climatic conditions is synthesized over study area.

In the present study, discharge data is available only for the Bara River within the proposed project area. Consequently, flood discharge computations for other streams have been conducted by using rainfall data.

The maximum instantaneous discharge data for the Bara River and one-day annual maximum rainfall data for the Peshawar station have been obtained Pakistan Meteorological Department from Surface Water Hydrology (SWH), WAPDA, respectively. The details of these datasets are presented in **Table 2.5**.

Table 2.5: Inventory of Gauging Stations

Sr. No.	Station	Data Type	Data Period (Years)	Agency
Stream Gauge Station				
1	Bara River at Jhansi Post	Maximum Instantaneous Discharge	1961 - 2018	SWH, WAPDA
Rainfall Gauging Stations				
1	Peshawar	One Day Annual Maximum Rainfall	1960-2023	PMD

2.11 ANALYSIS OF RAINFALL DATA

Peshawar Station

The one-day annual maximum rainfall data for Peshawar is available for the period 1960 - 2023 (64 years), with some years missing are provided in **Table 2.6**.

Table 2.6: 1-Day Annual Maximum Rainfall in Peshawar

Year	Rainfall (mm)	Year	Rainfall (mm)
1960	49.5	1993	67.1
1961	40.6	1994	51.1
1962	44.2	1995	55.1
1963	38.1	1996	142.0
1964	52.3	1997	48.0
1965	54.1	1998	47.0
1966	55.1	1999	48.0
1967	164.1	2000	33.0
1968	29.5	2001	26.9
1970	54.6	2002	30.0

Year	Rainfall (mm)	Year	Rainfall (mm)
1971	84.6	2003	71.0
1972	45.0	2004	68.0
1973	45.7	2005	72.0
1974	19.3	2006	56.0
1975	53.3	2007	50.0
1976	102.1	2008	78.0
1977	113.5	2009	76.0
1978	68.3	2010	274.0
1979	54.4	2011	73.0
1980	46.0	2012	88.0
1981	55.9	2013	54.0
1982	40.6	2014	45.0
1983	84.6	2015	62.0
1984	86.9	2016	45.0
1985	62.0	2017	60.0
1986	47.5	2018	82.0
1987	62.5	2019	35.0
1988	44.2	2020	42.0
1989	35.1	2021	46.0
1990	55.1	2022	49.7
1991	62.0	2023	108.0
1192	55.9		

Historic data since 1960 suggest an average value of 63.3 mm, the maximum magnitude of rainfall witnessed till date is 274.0 mm in year 2010. **Figure 2.14** shows the trends of annual maximum rainfalls observed at Peshawar station.

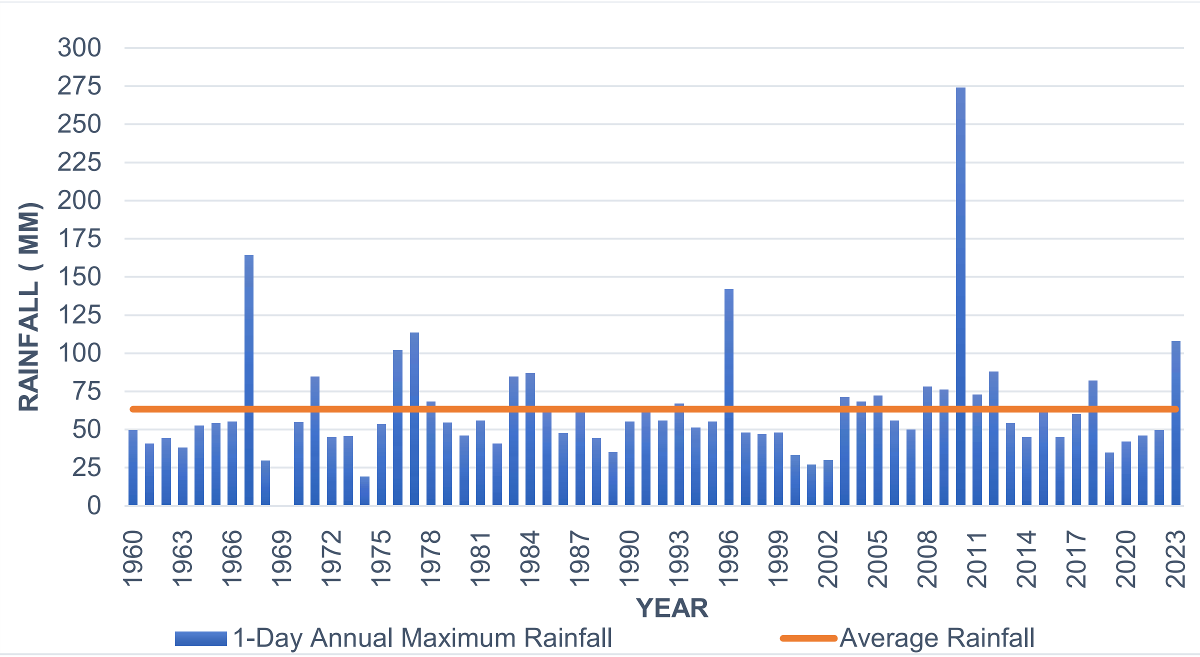

Figure 2.14: One-Day Annual Maximum Rainfall in Peshawar

2.11.1 Frequency Analysis of Rainfall Data

Frequency analysis for 1-day annual maximum rainfall data of Peshawar station has been carried out using Gumble's Extreme Value Type-1 Distribution. The plotting positions have been computed by Weibull's formula. Gumbel distribution is a member of family of extreme value distributions. It is a two-parameter distribution and is widely used in hydrology. Different return periods to be computed for frequency analysis have been approached using Weibull formula. For annual maximum series, Weibull formula has been adopted as the standard plotting position method by the U. S. Water Resources Council (1981).

Result of frequency analysis for Peshawar is given in **Table 2.7** and shown graphically by **Figure 2.15**.

Table 2.7: Results of Rainfall Frequency Analysis at Peshawar

Return Period (Years)	**Rainfall Depth** (mm)
2.33	48.4
5	79.2
10	104.2
25	135.9
50	159.4
100	182.7
500	236.5

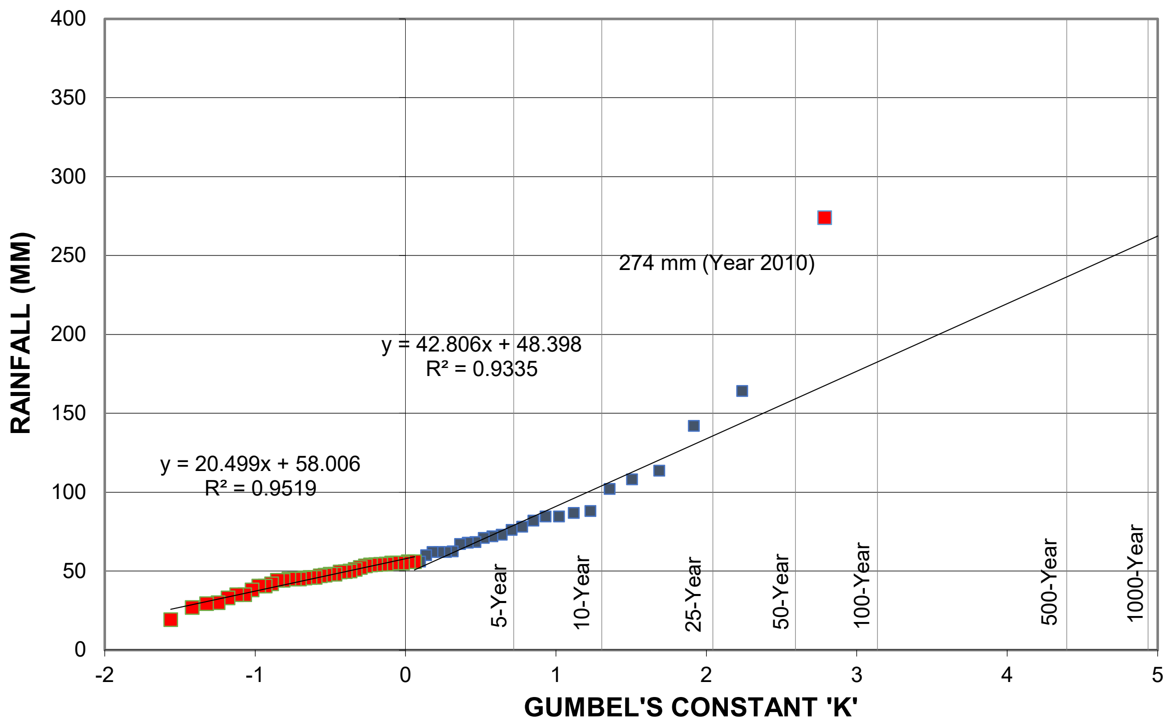

Figure 2.15: Frequency Fitting of 1-Day Annual Maximum Rainfall at Peshawar

2.11.2 Analysis of Stream Gauge Data

Bara River at Jhansi Post

The maximum instantaneous discharge data for Bara River at Jhansi Post is available for the period 1961 - 2018 (58 years), with some years missing is provided in **Table 2.8.**

Table 2.8: Instantaneous Maximum Discharge of Bara River at Jhansi Post

Year	Discharge (m^3/sec)	Year	Discharge (m^3/sec)
1961	118.4	1992	110.3
1962	182.6	1993	109.9
1963	272.7	1994	140.6
1965	152.9	1995	56.5
1966	159.7	1996	15.5
1967	317.1	1997	26.3
1968	82.1	1998	167.8
1969	160.3	1999	87.4
1970	61.4	2000	8.3
1971	34.5	2001	20.8
1972	232.2	2002	12.9
1973	586.2	2003	12.9
1975	866.5	2004	8.0
1977	75.6	2005	46.1
1978	136.2	2006	12.9
1980	66.5	2007	34.5
1981	228.0	2008	24.4
1982	149.5	2009	52.9
1983	569.2	2010	446.8
1984	957.1	2011	34.1
1985	28.9	2012	44.2
1986	116.7	2013	49.2
1987	46.7	2014	68.9
1988	57.2	2015	44.8
1989	10.4	2016	462.3
1990	150.0	2017	14
1991	39.1	2018	45

Historic stream gauge data since 1961 - 2018 suggest an average value of 148.4 cumecs. The maximum magnitude of discharge witnessed till date is 957.1 cumecs in year 1984. **Figure 2.16** shows the trends of annual maximum instantaneous discharge observed at Bara River stream gauge station.

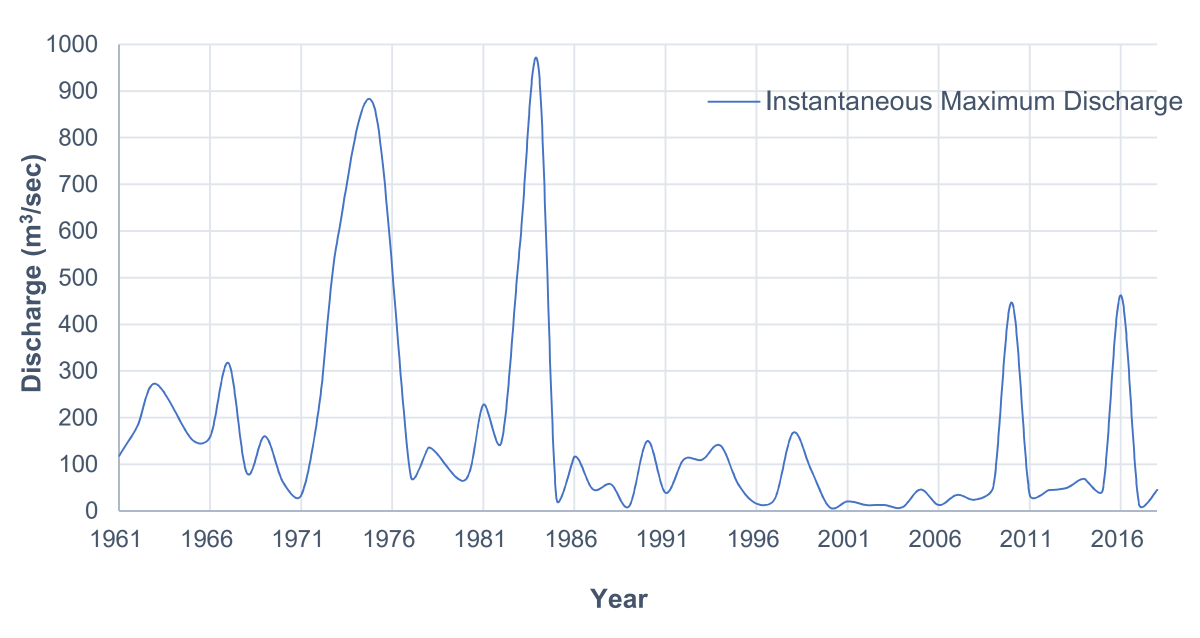

Figure 2.16: Maximum Instantaneous Discharge of Bara River at Jhansi Post

2.11.3 FREQUENCY ANALYSIS OF STREAM GAUGE DATA

Frequency analysis for the maximum instantaneous stream data of Bara River at Jhansi Post station has been carried out using Gumble's Extreme Value Type-1 Distribution. The plotting positions have been computed by Weibull's formula. Gumbel distribution is a member of family of extreme value distributions. It is a two-parameter distribution and is widely used in hydrology. Different return periods to be computed for frequency analysis have been approached using Weibull formula. For annual maximum series, Weibull formula has been adopted as the standard plotting position method by the U. S. Water Resources Council (1981). Result of frequency analysis is given in **Table 2.9** and shown graphically by **Figure 2.17**.

Table 2.9: Results of Rainfall Frequency Analysis of Bara River at Jhansi Post

Return Period (Years)	Discharge (m^3/sec)
2.33	101
5	421
10	667
25	979
50	1210
100	1439
500	2196

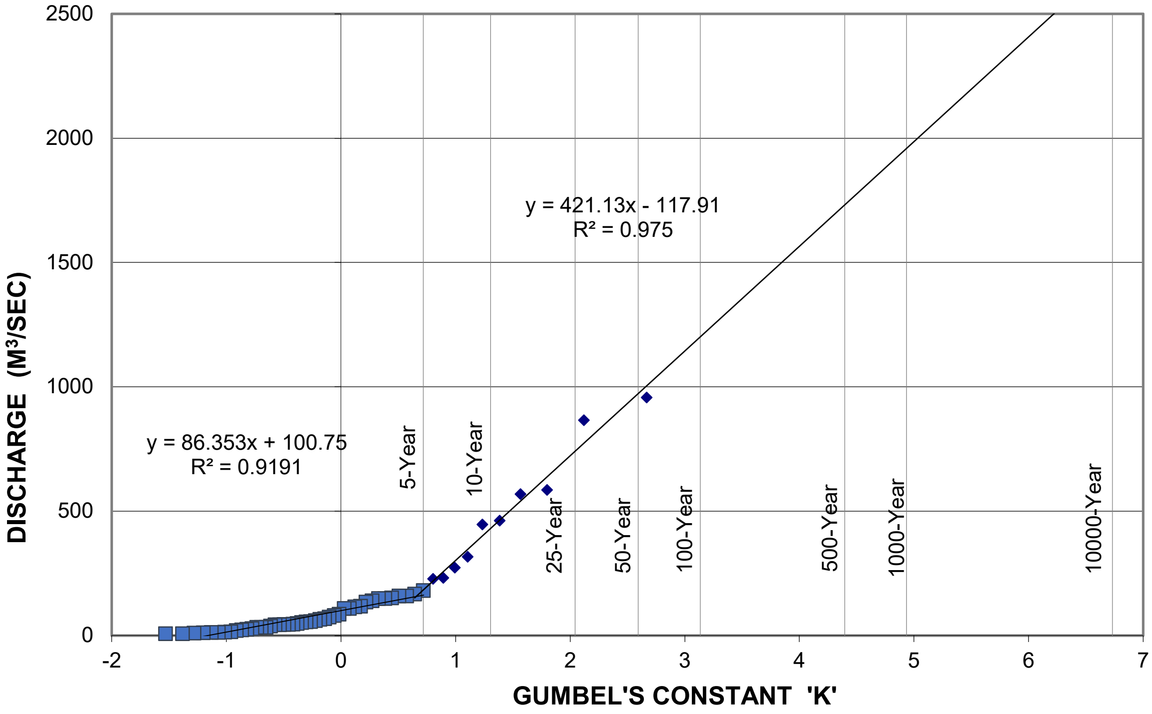

Figure 2.17: Frequency Fitting of Instantaneous Peaks of Bara River at Jhansi Post

2.12 DESIGN FLOOD ESTIMATION

Design flood for the streams crossing the road has been estimated by using two methods:

- Synthetic Hydrograph Method
- Rational Method

2.12.1 Synthetic Hydrograph Method

For catchments having area greater than 1km^2, US Soil Conservation Services Unit Hydrograph Method (SCS-UH) has been used to estimate peak discharges. This method requires the following information about the catchment.

- Maximum 24-hour rainfall for the design return period
- Length of stream measured along the longest path travelled by storm water from head to the site
- Slope of stream from head to site
- Catchment area
- Antecedent soil moisture condition
- Soil group

Maximum discharge is calculated from the following formulae:

$$S = \frac{1000}{CN - 10}$$

$$Q = \frac{(P-0.2S)^2}{P + 0.8S}$$

$$t_c = 0.00013 \times \frac{L^{0.77}}{m^{0.385}}$$

$$D = 0.133 \times t_c$$

$$t_p = \frac{D}{2} + (0.6 \times t_c)$$

$$Q_p = \frac{484 \times A \times Q}{t_p}$$

Where;

S	=	Potential maximum retention
CN	=	Curve number
Q	=	Volume of runoff in inches
P	=	Maximum 24 hours rainfall in inches of the required return period
L	=	Length of longest stream in feet
m	=	Slope of the stream
t_c	=	Time of concentration in hours
t_p	=	Time to peak in hours
D	=	Unit storm duration in hours
Q_p	=	Peak rate of flow in cusecs
A	=	Catchment area in sq. miles.

Time of Concentration

Time of concentration (Tc) is the time required for runoff to travel from the hydraulically most distant point in the watershed to the outlet. Kirpich formula has been used for computation of time of concentration which is given below:

$$\text{Tc} = \frac{(\text{L})^{1.15}}{7700 * (\text{H})^{0.385}}$$

Where;

T_c	=	Time of Concentration (hours)
L	=	Length of the longest stream (feet)
H	=	Fall in length L (feet)

Selection of Curve Number

The runoff curve number (also called a curve number or simply CN) is an empirical parameter used in hydrology for estimation of initial abstraction. It is widely used and is an efficient method for determining the approximate amount of direct runoff from a rainfall event in a particular area. The runoff curve number is based on the area's hydrologic soil group, land-use, treatment and hydrologic condition. The USNRCS equation for conversion of rainfall into runoff is given hereunder:

$$\text{Runoff} = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

Where;

P = Daily rainfall (inches)

S = Potential maximum retention after runoff begins $\left(\frac{1}{C \quad -1}\right)$

Time Distribution of Rainfall Storm

Total storm rainfall determines the magnitude of flood, while its pattern gives the shape of hydrograph. The storm pattern of rainfall is used as a relationship between time and rainfall which is as stated below:

$$P_t = \left(\frac{t}{24}\right)^n$$

Where P_t is ratio of rainfall at time 't' with 24-hr rainfall, t is time in hours and n is an exponent depending on hourly rainfall pattern.

2.12.2 Rational Method

For the catchments having area less than $1km^2$ rational method has been used to compute the floods. Rational method technique is described as under:

$$Q = CIA$$

Where;

Q = Peak discharge (cusecs)
C= Coefficient of discharge
I = Intensity of rainfall (mm/hour)
A = Catchment area (acres)

Runoff Coefficient (C)

The catchment area of the crossings consists of settlements as well as agricultural land. Therefore, runoff coefficient for the catchments has been taken keeping in view its soil cover and future land use.

Rainfall Intensity

Rainfall intensity is defined as the ratio of the total amount of rain (rainfall depth) falling during a given period to the duration of the period. It is expressed in depth units per unit time, usually as mm/hour or inch/hour. The use of uniform rainfall intensity for duration equal to the time of concentration is a simplifying assumption since rainfall does not truly persist at a uniform intensity for even a short time like 5 min. Rainfall intensity has been calculated by the formula given below.

$$\text{Rainfall Intensity} = \frac{\text{Rainfall magnitude in a duration equal to time of concentration}}{T_c}$$

Intensity-Duration-Frequency curves have been developed for Peshawar rain gauging station and shown in **Figure 2.18**. The rainfall distribution with time is then re-oriented to have a centrally loaded rainfall pattern.

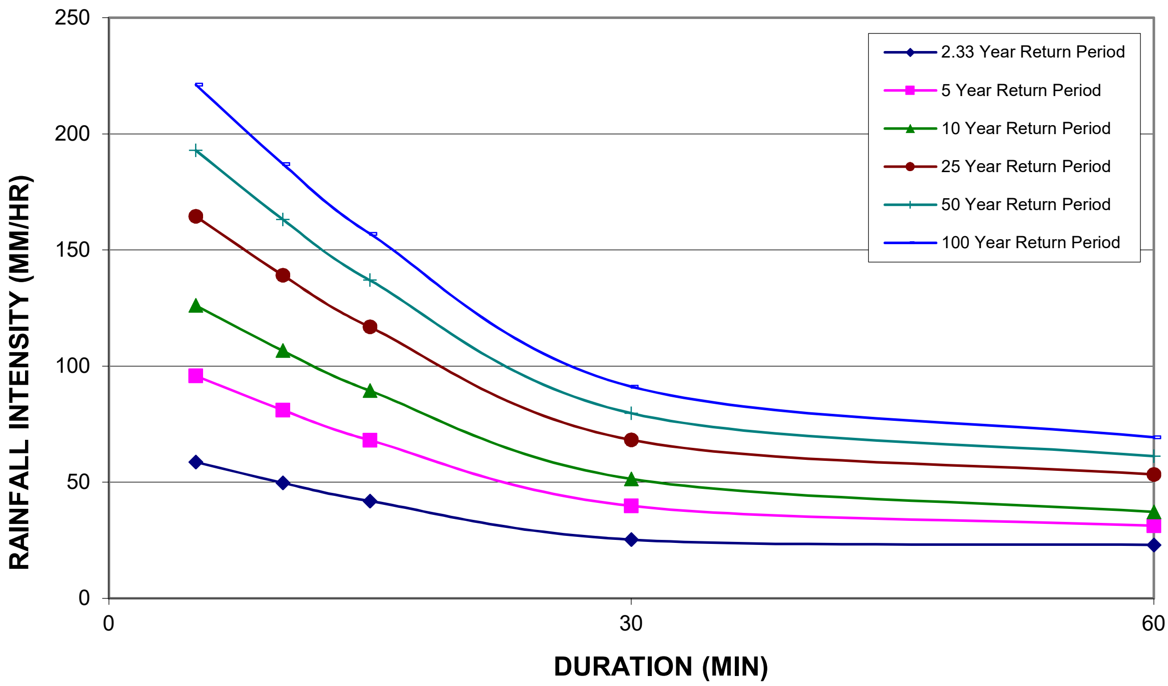

Figure 2.18: Intensity-Duration-Frequency Curve for Peshawar

2.13 CROSS DRAINAGE STRUCTURES ON WARSAK UPLIFT CANAL

The Warsak Uplift Canal, originating from the Warsak Dam, is a vital irrigation system that enhances water supply for agricultural and domestic use in the Peshawar region. It significantly contributes to improve agricultural productivity and supporting local livelihoods in its command area. The location map of the canal is shown in **Figure 2.19**.

Figure 2.19: Location Map of Warsak Uplift Canal

The canal impacts the hydrological conditions of the surrounding catchment, including the catchment areas of natural streams and local sheet flow, by altering the flow regime. The cross-drainage structures of the Warsak Uplift Canal play a crucial role. These structures include aqueducts, siphons and culverts, enabling the canal to traverse natural waterways without disrupting the flow of water in the canal. Detail of these cross-drainage structures are given in **Table 2.10**:

Table 2.10 Cross Drainage Structures on Warsak Uplift Canal

Sr. No.	Canal RD	Canal Cross-Drainage Structure Capacity (m^3/sec)	Type of Structure
1	86+181	50000	Aqueduct
2	104+093	14000	Aqueduct
3	112+200	42000	Siphon
4	130+838	22000	Siphon
5	135+745	9000	Aqueduct
6	147+320	7500	Aqueduct
7	150+272	5000	Aqueduct
8	157+000	300	Aqueduct
9	162+767	5525	Aqueduct
10	165+420	4450	Aqueduct
11	170+645	7150	Siphon

Sr. No.	Canal RD	Canal Cross-Drainage Structure Capacity (m^3/sec)	Type of Structure
12	173+689	7400	Siphon
13	177+103	80	Siphon
14	178+767	150	Siphon
15	180+403	3800	Siphon
16	181+924	75	Siphon
17	189+193	4075	Aqueduct
18	194+178	7450	Aqueduct
19	197+442	2225	Aqueduct
20	201+429	10	Siphon
21	203+759	2800	Aqueduct

During high flow periods, the flow in natural streams or nullahs can be significantly impacted by the canal cross drainage structures. These cross-drainage structures have been designed at a specified discharge capacity. Inadequate cross-drainage structures may lead to upstream water level increases, potentially resulting in flooding of nearby areas.

In the current study, the catchment areas of the natural streams intersected by the Warsak Uplift Canal have been categorized into two sub-catchments: upper side of the canal and lower side of the canal. A detailed list of these catchments is provided in **Table 2.11**.

Table 2.11: Natural Stream Catchments Traversed by the Canal

Sr. No.	Catchment RD	Canal Cross-Drainage Structure RD	Canal Cross-Drainage Structure Capacity (m^3/sec)
1	10+599	203+759	2800
		201+429	10
2	13+136	197+442	2225
		194+178	7450
		189+193	4075
3	17+497	181+924	75
		180+403	3800
4	18+573	147+320	7500
		150+262	5000
		157+000	300
		162+767	5525
		165+420	4450
		170+645	7150
		173+689	7400
		177+103	80
		178+767	150
5	20+468	130+838	22000
		135+745	9000
6	25+118	86+181	50000
		104+000	14000
		112+000	42000

It is concluded that the total estimated discharge from these natural streams reaching the road section includes the allowable discharge capacity of the canal's cross-drainage structures, along with the contributions from the intervening area between the Warsak Uplift Canal and the road. The estimated discharges reaching the road section have been detailed in the section ahead.

2.14 ESTIMATED FLOOD DISCHARGES

The floods estimated against various return periods for the natural streams or river crossing the Nowshera - Peshawar Road Section are given in **Table 2.12.**

Table 2.12: Discharges against Various Return Periods

Sr. No	Catchment RD's	Existing Structure	Catchment Area (km^2)	Peak Flood Discharges (m^3/sec) 25 yrs	50 yrs	100 yrs
1	0+140 – 0+470	0+465	0.042	2.4	2.8	3.2
2	0+470 – 0+960	0+900	0.089	2.8	3.3	3.8
3	0+960 –1+368	1+272 1+890	3.34	13	17	22
4	2+135 – 3+450	2+160 2+480 3+911	12	39	52	65
5	3+450 – 5+675	4+180 4+250 4+829 5+202 5+600	16.5	54	71	90
6	5+675 – 6+400	6+332	17.1	54	72	90
7	6+400 – 8+750	8+256	12.7	33	47	61
8	9+500 – 13+000	10+600	64.3	117	135	155
9	13+000 – 16+700	13+136 13+700 13+910 14+180 14+460	121	351	445	466

Sr. No	Catchment RD's	Existing Structure	Catchment Area	Peak Flood Discharges		
				25 yrs	50 yrs	100 yrs
			(km^2)	(m^3/sec)		
		14+950				
		15+250				
		15+500				
		15+540				
10	16+700 – 17+950	17+300 17+500	40.1	124	137	144
11	17+950 - 20+045	18+370 18+575 18+870 19+638 19+900	217	494	658	828
12	20+045 – 25+100	20+410 20+468 21+210 21+300 25+000	300	427	581	747
13	25+100 – 30-100 (Bara River)	25+118 25+205 25+405 25+940 26+630 27+040 27+660 28+000	2624	2306	2671	2945

It is to be noted that Rd 25+100 – 30-100 is Bara River crossing and its discharge has been estimated by using the stream gauge data of Bara River at Jhansi Post station.

2.14.1 Flood Discharges with Climate Impact

The floods estimated against various return periods with climate change effect under SSP 585 for the streams crossing the road are given in **Table 2.13.**

Table 2.13: Discharges with Climate Impact SSP 585 against Various Return Periods

Sr. No	Catchment RD's	Existing Structure	Catchment Area (km^2)	Peak Flood Discharges (m^3/sec) 25 yrs	50 yrs	100 yrs
1	0+140 – 0+470	0+465	0.042	2.6	3.1	3.6
2	0+470 – 0+960	0+900	0.089	3.1	3.7	4.3
3	0+960 –1+368	1+272 1+890	3.34	15	21	27
4	2+135 – 3+450	2+160 2+480 3+911	12	47	63	80
5	3+450 – 5+675	4+180 4+250 4+829 5+202 5+600	16.5	65	87	110
6	5+675 – 6+400	6+332	17.1	65	87	109
7	6+400 – 8+750	8+255	12.7	41	59	78
8	9+500 – 13+000	10+600	64.3	128	151	177
9	13+000 – 16+700	13+136 13+700 13+910 14+180 14+460 14+950 15+250 15+500 15+540	121	418	462	489

Sr. No	Catchment RD's	Existing Structure	Catchment Area (km^2)	Peak Flood Discharges (m^3/sec)		
				25 yrs	50 yrs	100 yrs
10	16+700 – 17+950	17+300	40.1	134	143	153
		17+500				
11	17+950 - 20+045	18+370	217	597	797	1014
		18+575				
		18+870				
		19+638				
		19+900				
12	20+045 – 25+100	20+410	300	523	716	929
		20+468				
		21+210				
		21+300				
		25+000				
13	25+100 – 30+100	25+118	2624	2593	2933	3019
		25+205				
		25+405				
		25+940				
		26+630				
		27+040				
		27+660				
		28+000				

2.15 INFLUENCE OF KABUL RIVER ON ROAD SECTION

Kabul River is a major watercourse originating in the Hindu Kush Mountains in Afghanistan and flowing through the Khyber Pakhtunkhwa province of Pakistan before joining the Indus River. As a perennial river, it serves as a critical water resource for irrigation, domestic use, and hydropower generation in the region. Its basin supports diverse agricultural activities and a significant portion of the local population's livelihood. It plays a prominent role in shaping the area's hydrology. The river's flow is influenced by seasonal variations and upstream hydrological activities, including snowmelt and monsoon rains. During high flow periods, the river can inundate low-lying areas, affecting local settlements and infrastructure.

The Kabul River significantly influences the N-5 Nowshera-Peshawar Road section, particularly in terms of flood risks. The road's proximity to the river near Nowshera (RD 0+000 to 1+250) increases its vulnerability to potential damage during high flood events, which can disrupt transportation and hinder economic activities. The location map of Kabul River near the project area is shown in **Figure 2.20**.

Figure 2.20: Location Map of Kabul River Near Nowshera Peshawar Road Section

M/s NESPAK recently has completed a project for the Irrigation Department of Khyber Pakhtunkhwa titled *"Emergency Flood Assistance Project for Reconstruction and Rehabilitation of Irrigation, Drainage, and Flood Protection Works."* The project also included flood protection measures along the right bank of the Kabul River.

Frequency analysis of the Kabul River at Nowshera Bridge has been conducted, and the results are summarized in **Table 2.14** and illustrated by a curve in **Figure 2.21**.

Table 2.14: Result of Frequency Analysis for Kabul River at Nowshera

Return Period (Years)	Estimated Peak Flood (m^3/sec)
2.33	3,258
5	4,507
10	5,596
25	6,838
50	8,775
100	10,500

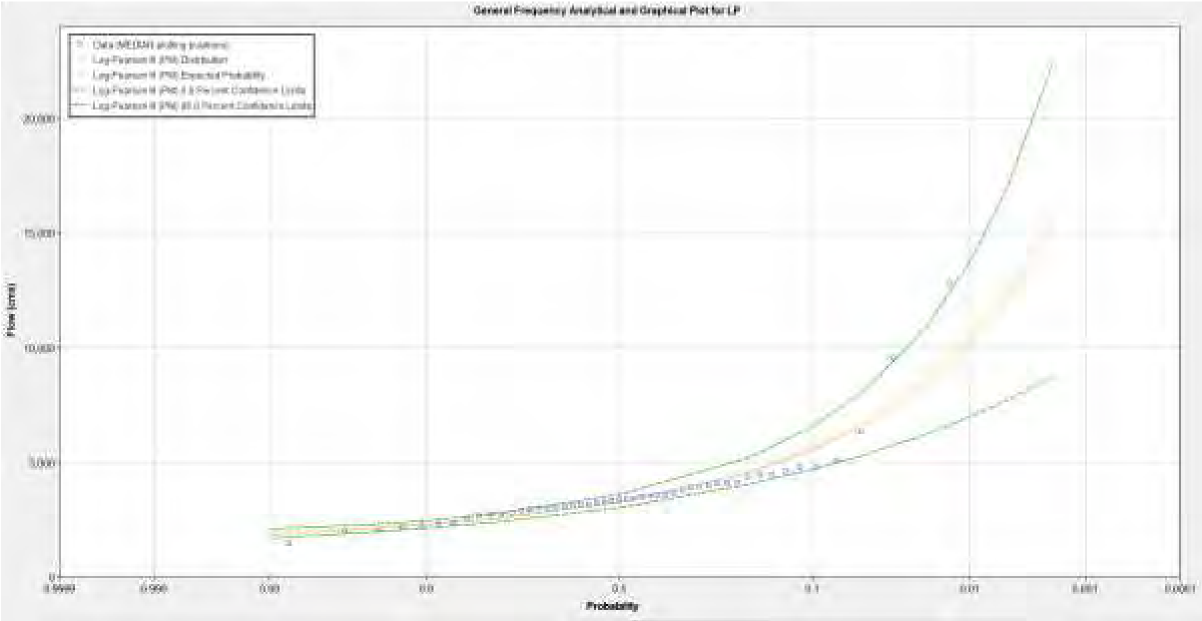

Figure 2.21: Flood Frequency Analysis of Kabul River at Nowshera

The climate impact under SSP-5 8.5 has been considered, and the peak flood is projected to 7,727 cumecs against 25-year return period. Flood protection works under EFAP have been illustrated in **Figure 2.22**. These works are currently under construction.

Figure 2.22: Proposed Flood Protection Works Along Right Bank of Kabul River

The proposed flood protection works, designed against 25-year return period flood event, offer a comprehensive and robust safeguard against potential flood risks along the N-5 Nowshera-Peshawar section. By mitigating the impact of floods, these measures are expected to preserve the structural integrity of the road and minimize disruptions to transportation and economic activities. Furthermore, the design accounts for climate change impacts under SSP-5 8.5, ensuring the road remains protected even during projected peak flood scenarios.

3. HYDRAULIC STUDIES

3.1 GENERAL

The existing Nowshera-Peshawar Road is situated in KPK Province. The approximate total length of the road is 30 kilometres. Alignment of this road, crosses several natural streams and storm water nullahs at different locations. The Client; National Highway Authority intents for Rehabilitation of existing deteriorated road sections, upgradation of existing road corridor into climate resilient infrastructure through additional cross drainage structures and conversion of 4-lane dual carriageway into 6-lane dual carriageway with addition of concrete lanes dedicatedly for heavy traffic road between Nowshera and Peshawar.

3.2 PROBLEM STATEMENT

The scope of hydraulics studies includes assessment of flow capacity and to check adequacy of each cross drainage structures present on this road for safely pass the design floods with climate change effect under SSP 5-8.5 for 11%, 12% and 13.4% increase on rainfall for 25, 50 and 100 year return period floods respectively.

3.3 DESIGN APPROACH OF PROPOSED BOX CULVERTS AND BRIDGES

Culverts and bridges are provided as cross drainage structures where natural drains and nullahs cross this roadway. Here, in the reach of this road from 0+000 to 30+000, cross drainage structures comprising box culverts and bridges are provided at 45 locations in order to pass the flood discharges.

Considering the floods estimated through hydrologic studies, hydraulic design review of thirty-two (32) existing box culverts, five (05) pipe culverts and eight (8) bridges have been carried out by adopting comprehensive methodology which described in the subsequent sections.

Location map of existing bridges and culverts is shown in **Figure 3.1**. A schematic flow chart for hydraulic studies is shown in **Figure 3.2.**

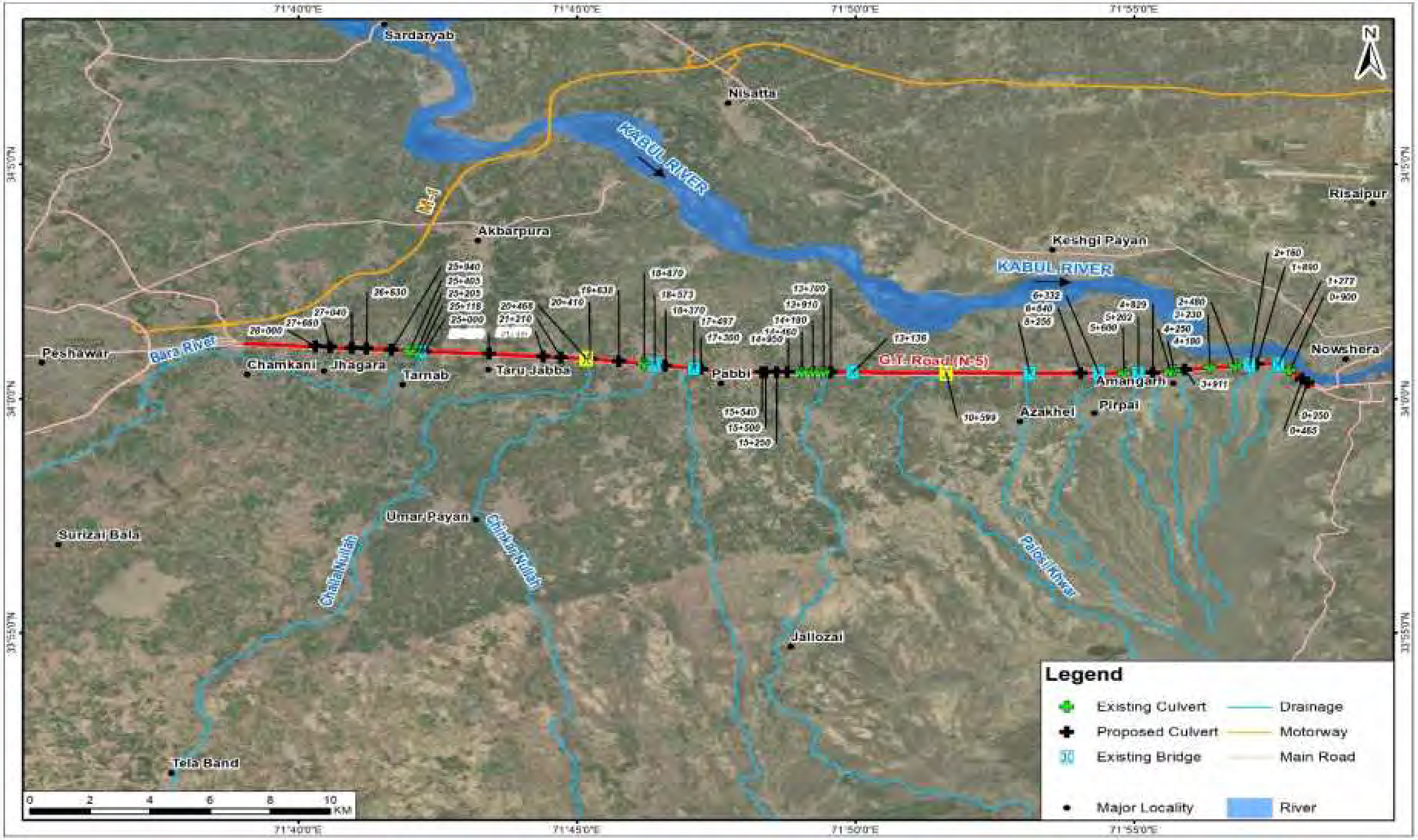

Figure 3.1: Location Map of Existing Bridges and Culverts

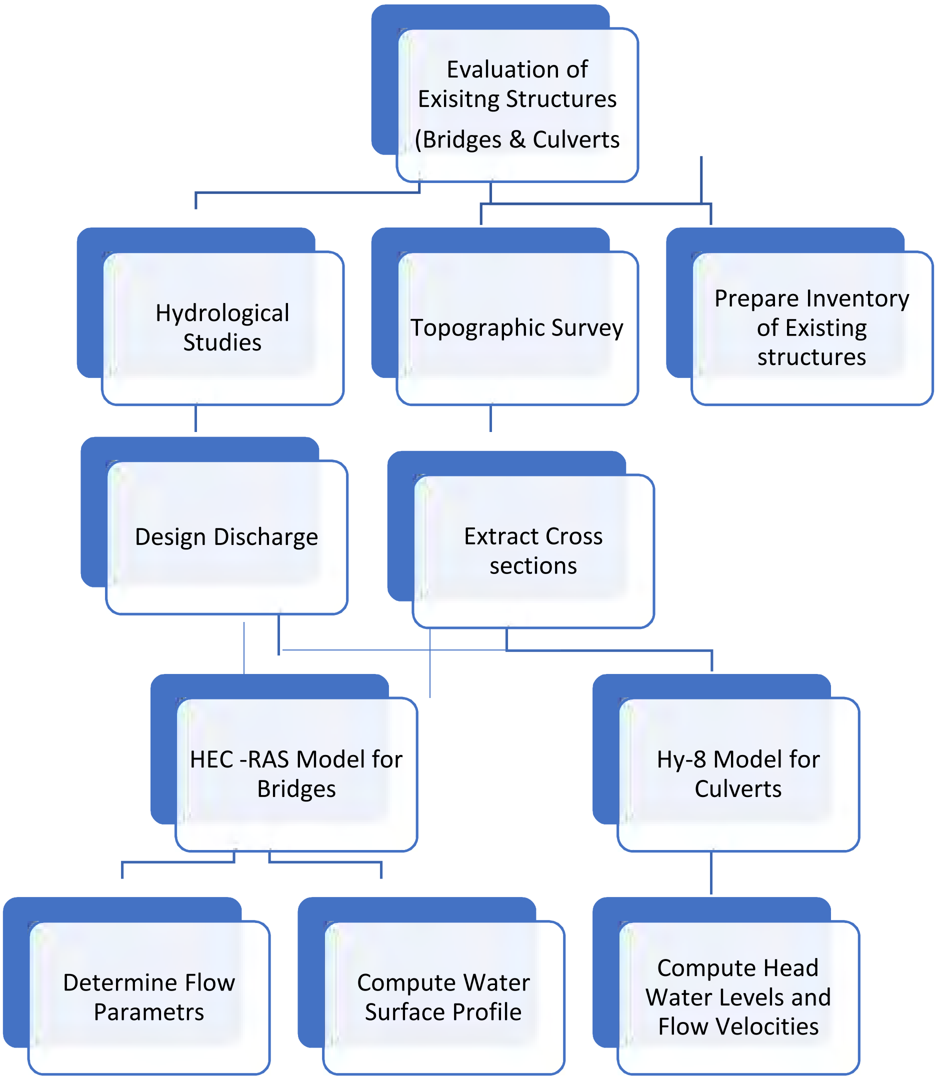

Figure 3.2: Schematic Flow Chart Showing Hydraulic Analysis of Bridges and Culverts

3.4 EVALUATION OF EXISTING BRIDGES

3.4.1 HEC-RAS Model

HEC-RAS computer model developed by US Army Corps of Engineers has been used to compute the flow parameters and the water surface profile of nullahs/river at bridge locations along the reach under study. Following procedure has been adopted to conduct the hydraulic analysis of nullahs/river to check the adequacy of the bridges;

3.4.1.1 <u>River Geometry</u>

Geometric data consists of the nullah/river schematic layout diagram, cross sectional survey data, hydraulic structure data (bridges) and cross section interpolation (where needed). Cross sections have been selected at suitable intervals along the nullah/river to determine the hydraulic design parameters at structure locations. Model have been developed with and without hydraulic structure to carry out the hydraulic analysis of nullah/river. Number of cross sections obtained from topographic survey at upstream and downstream of hydraulic structures have been used to develop the model to compute the Highest Flood Level (HFL) along the stretch of the road under consideration.

3.4.1.2 Design Discharge

Discharge data for 100 years computed with climate change effect from hydrological studies and boundary conditions employed to estimate the design flood levels at locations. HEC-RAS models are run for the estimation of hydraulic parameters of the structures across rivers.

3.4.1.3 Roughness Coefficient

The value of roughness coefficient ‘n’ depends upon the morphology, bed material, vegetation and manmade interventions in and along the flood plain of the rivers. The basic factors affect the ‘n’ value include surface roughness, the size and shape of the grains of the materials forming the wetted parameter, vegetation type and cover, channel alignment and obstructions. Keeping in view the above factors, roughness coefficient of 0.030 for main river and 0.035 for left and right over bank have been chosen for the structures.

3.4.1.4 Boundary Condition

The model is run under steady state flow condition for subcritical or supercritical flow regimes and normal depth at downstream or upstream ends of the study reach has been taken as boundary condition depending on the prevalent regime of river.

3.4.1.5 Hydraulic Design Parameters

The hydraulic design parameters like flow depth and flow velocity have been determined by using the cross-sectional data along with hydrological data as input in the HEC-RAS computer model.

Typical cross section and longitudinal profile of bridge in HEC-RAS model is given in **Figure 3.3 and Figure 3.4.**

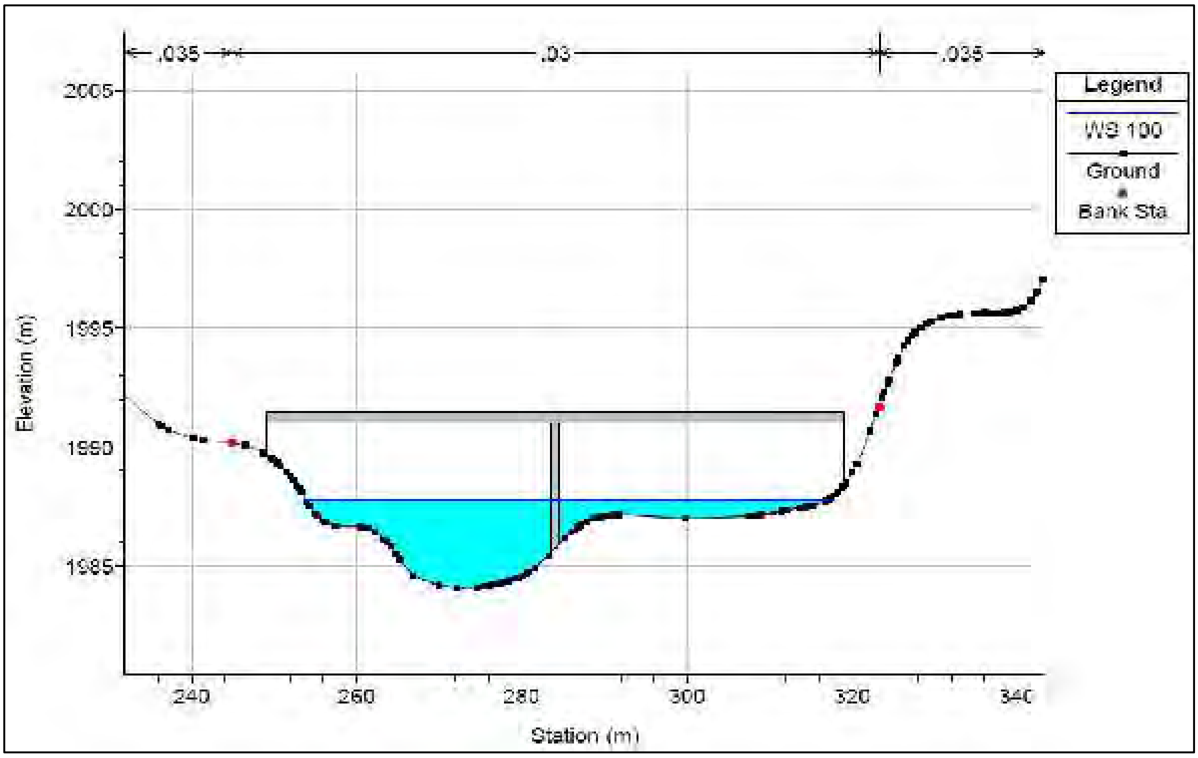

Figure 3.3: Typical Cross Section of Bridge in HEC-RAS Model

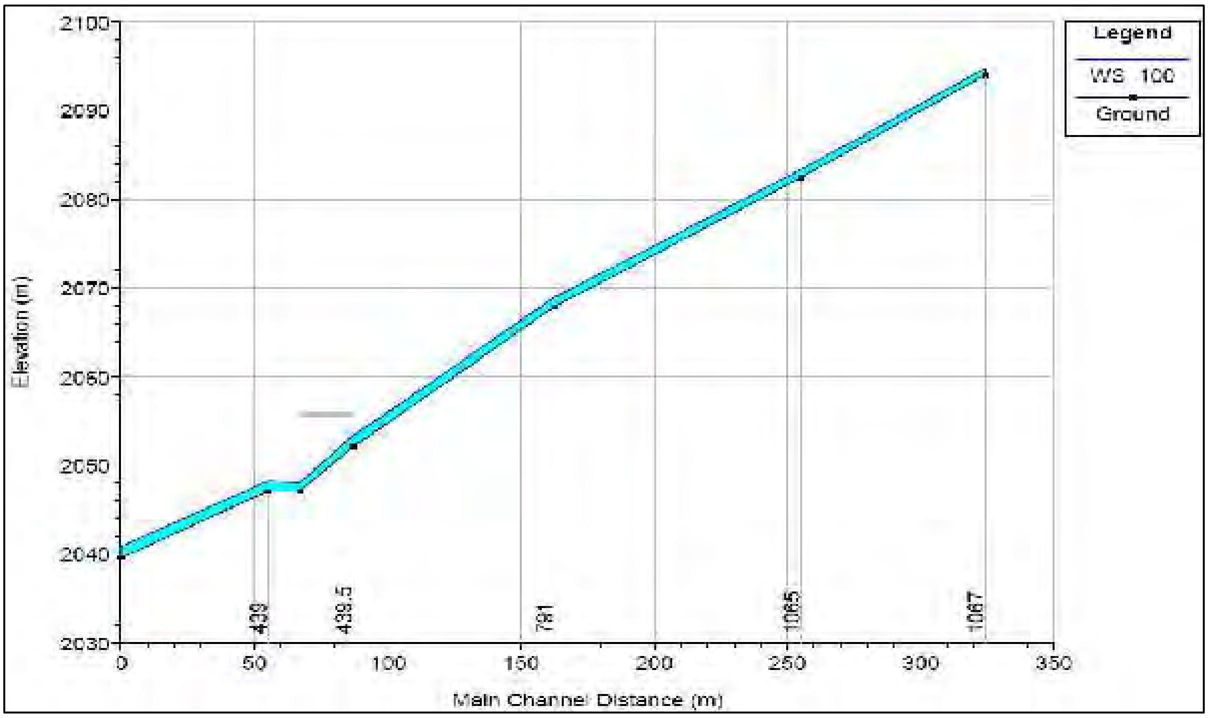

Figure 3.4: Typical Longitudinal Profile of nullah with Bridge in HEC-RAS Model

3.4.2 Freeboard

The freeboard for bridges is adopted as 1m for small streams/nullahs whereas, 2m freeboard is provided for larger streams/rivers.

3.5 EVALUATION OF EXISTING CULVERTS

The Culvert structures have been analysed on HY-8 software to confirm the existing conveyance capacity against the design discharge i.e., 25-year return period. Followings are the input parameters for the Hy-8 model:

3.5.1 Design Discharge

The existing culverts have been analysed on design discharge of 25 years return period flood, whereas minimum discharge is assumed as nil, and the maximum discharge is taken as 50 years return period flood.

3.5.2 Tail Water Data

The model requires manning's roughness coefficient (n), average bed slope and one cross section on the downstream, for the computation of tail water level. The average bed slope of the nullah on the downstream side of culvert is taken from the topographic survey data.

3.5.3 Roadway Data

The roadway data is required as input in the model, which comprises width of widened roads, road crown elevation and total carriage width. The size of each culvert has been checked for safe capacity under conditions that the head water level will not approach the roadway.

3.5.4 Culvert Data

Concrete box and pipe culverts are analysed with manning's roughness coefficient of 0.016. The data required for the model comprised of type, invert levels, culvert length, shape and size of culvert barrels along with inlet and outlet wing wall configurations.

Typical cross section and performance curve of culvert in HY-8 computer model is given as **Figure 3.5.**

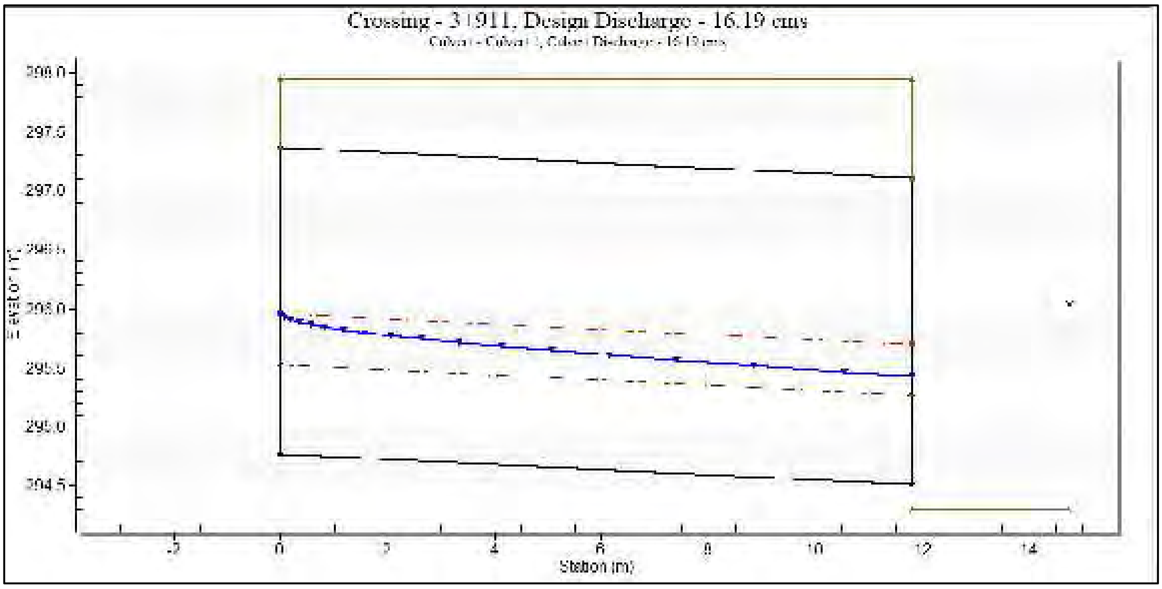

Figure 3.5: Typical Longitudinal Profile of Culvert in HY-8 Model

Summary table of culvert in HY-8 Computer Model is given as **Table 3.1.**

Table 3.1: Hydraulic Parameters of Culverts

Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
0.00	0.00	294.77	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
2.33	2.33	295.32	**0.55**	0.36	1-JS1t	0.20	0.33	0.62	0.84	0.94	0.80
4.67	4.67	295.64	**0.87**	0.63	1-JS1t	0.32	0.52	0.87	1.09	1.34	0.96
7.00	7.00	295.91	**1.14**	0.83	1-JS1t	0.42	0.68	1.05	1.27	1.66	1.06
9.33	9.33	296.15	**1.38**	1.00	1-JS1t	0.51	0.82	1.20	1.42	1.95	1.14
11.67	11.57	296.37	**1.60**	1.17	1-JS1t	0.60	0.95	1.32	1.54	2.20	1.21
14.00	14.00	296.57	**1.80**	1.33	1-S2n	0.69	1.08	0.82	1.66	4.25	1.27
16.19	15.19	296.75	**1.98**	1.47	1-S2n	0.76	1.19	0.92	1.75	4.41	1.31
18.66	18.56	296.95	**2.18**	1.63	1-S2n	0.84	1.30	1.02	1.85	4.57	1.36
21.00	21.00	297.13	**2.36**	1.79	1-S2n	0.92	1.41	1.12	1.93	4.70	1.40
23.33	23.33	297.31	**2.54**	1.95	1-S2n	1.00	1.51	1.21	2.01	4.83	1.44

3.6 ANALYSIS AND RESULTS

The hydraulic design review parameters of existing culverts and bridges along with suggested remarks to be adopted for each structure for the project are shown in **Table 3.2.**

Table 3.2: Hydraulic Design Review Parameters of Existing Culverts and Bridges

Sr. No.	Structure Code	RD	Structure Type	Roadside	Estimated SSP 5-8.5 Discharge (m³/sec)	No. of Span	Span / Dia (m)	Span Height (m)	Estimated Capacity (m^3/sec) Individual	Estimated Capacity (m^3/sec) Combined	Capacity Check	Remarks
1	BC-1	0+465	Box Culvert	-	*2.6*	1	1	1	1.66	1.66	Less Capacity	Increase 1 cell of Culvert of 1 x 1 on P-N & N-P both-ways.
2	BC-2	0+900	Box Culvert	*N-P*	*3.1*	2	4	2.2	73.93	73.93	Capacity Ok	-
				P-N		2	2.5	2.5				
3	BC-3	1+272	Box Culvert	*N-P*	*15*	3	3	3	91.54	93.04	Capacity Ok	-
			Bridge	*P-N*		1	21	4				
4	BC-4	1+890	Slab Culvert	-		1	1	1	1.5			
5	BR-01	2+160	Bridge	*N-P*	*80*	1	23	4	72	161.67	Capacity Ok	-
				P-N		1	21	4				
6	BC-5	2+480	Arch Culvert	*N-P*		1	3	1	9.82			
			Slab Culvert	*P-N*		2	1.5	1.85				
7	BC-6	3+230	Box Culvert	-		2	3	3	56.72			
8	BC-7	3+911	Box Culvert	-		2	3	2.6	23.13			
9	BC-8	4+180	Box Culvert	-	*110*	1	1	2	4.05	555.66	Capacity Ok	-
10	BC-9	4+250	Box Culvert	-		3	3.5	2	48.08			
11	BC-10	4+829	Culvert	-		-	-	-				

<table>
<tr><th rowspan="2">Sr. No.</th><th rowspan="2">Structure Code</th><th rowspan="2">RD</th><th rowspan="2">Structure Type</th><th rowspan="2">Roadside</th><th>Estimated SSP 5-8.5 Discharge</th><th rowspan="2">No. of Span</th><th>Span / Dia</th><th>Span Height</th><th colspan="2">Estimated Capacity (m^3/sec)</th><th rowspan="2">Capacity Check</th><th rowspan="2">Remarks</th></tr>
<tr><th>(m^3/sec)</th><th>(m)</th><th>(m)</th><th>Individual</th><th>Combined</th></tr>
<tr><td rowspan="2">12</td><td rowspan="2">BR-02</td><td rowspan="2">5+202</td><td rowspan="2">Bridge</td><td>N-P</td><td rowspan="3"></td><td>1</td><td>18</td><td>4</td><td rowspan="2">93</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>P-N</td><td>2</td><td>10</td><td>2</td></tr>
<tr><td>13</td><td>BC-11</td><td>5+600</td><td>Box Culvert</td><td>-</td><td>8</td><td>6</td><td>3</td><td>410.53</td></tr>
<tr><td rowspan="2">14</td><td rowspan="2">BR-03</td><td rowspan="2">6+332</td><td rowspan="2">Bridge</td><td>N-P</td><td rowspan="2">109</td><td>2</td><td>20</td><td>2.5</td><td rowspan="2">120</td><td rowspan="2">120</td><td rowspan="2">Capacity Ok</td><td rowspan="2">-</td></tr>
<tr><td>P-N</td><td>5</td><td>5</td><td>3</td></tr>
<tr><td rowspan="2">15</td><td rowspan="2">BR-04</td><td rowspan="2">8+256</td><td rowspan="2">Bridge</td><td>N-P</td><td rowspan="2">78</td><td>1</td><td>21</td><td>4</td><td rowspan="2">59</td><td rowspan="2">59</td><td rowspan="2">Less Capacity</td><td rowspan="2">Increase 1 span of Bridge on P-N side of 9x4.</td></tr>
<tr><td>P-N</td><td>2</td><td>15</td><td>4</td></tr>
<tr><td rowspan="2">16</td><td rowspan="2">BC-12</td><td rowspan="2">10+599</td><td>Culvert</td><td>N-P</td><td rowspan="2">128</td><td>5</td><td>6</td><td>3</td><td rowspan="2">105.35</td><td rowspan="2">105.35</td><td rowspan="2">Less Capacity</td><td rowspan="2">Increase1 cell of existing Culvert of 6x3 and Replace Bridge by same size of Culvert (6x3 with 6 cells).</td></tr>
<tr><td>Bridge</td><td>P-N</td><td>1</td><td>20</td><td>2.5</td></tr>
<tr><td>17</td><td>BR-05</td><td>13+136</td><td>Bridge</td><td>-</td><td rowspan="6">418</td><td>4</td><td>23.5</td><td>3.5</td><td>300</td><td rowspan="6">339.96</td><td rowspan="6">Less Capacity</td><td>Increase 1 span of each Bridge of 23.5x3.5 on P-N & N-P both-ways.</td></tr>
<tr><td>18</td><td>PC-1</td><td>13+700</td><td>Pipe Culvert</td><td>-</td><td>1</td><td>0.6</td><td>-</td><td>0.82</td><td>-</td></tr>
<tr><td>19</td><td>BC-13</td><td>13+910</td><td>Slab Culvert</td><td>-</td><td>2</td><td>1.5</td><td>1.5</td><td>8.89</td><td>-</td></tr>
<tr><td>20</td><td>BC-14</td><td>14+180</td><td>Slab Culvert</td><td>-</td><td>2</td><td>1.5</td><td>1.5</td><td>11.92</td><td>-</td></tr>
<tr><td>21</td><td>BC-15</td><td>14+460</td><td>Slab Culvert</td><td>-</td><td>1</td><td>2</td><td>1</td><td>5.15</td><td>-</td></tr>
<tr><td>22</td><td>BC-16</td><td>14+950</td><td>Slab Culvert</td><td>-</td><td>1</td><td>1</td><td>1</td><td>0.40</td><td>-</td></tr>
</table>

Sr. No.	Structure Code	RD	Structure Type	Roadside	Estimated SSP 5-8.5 Discharge	No. of Span	Span / Dia	Span Height	Estimated Capacity (m^3/sec)		Capacity Check	Remarks
					(m^3/sec)		(m)	(m)	Individual	Combined		
23	PC-2	15+250	Pipe Culvert	-		1	0.6	-	1.05			-
24	BC-17	15+500	Slab Culvert	*N-P*		1	6	1.5	9.01			-
				P-N		1	1.5	1.5				Increase 3 cell of Culvert of 1.5 x 1.5.
25	PC-3	15+540	Pipe Culvert	-		1	0.9	-	2.72			-
26	BC-18	17+300	Slab Culvert	-	*153*	1	1.5	1	3.92	213.92	Capacity Ok	-
27	BR-06	17+497	Bridge	-		2	14.5	2	210			
28	BC-19	18+370	Slab Culvert	-	*797*	1	1.5	1	3.92	912.56	Capacity Ok	-
29	BR-07	18+573	Bridge	*N-P*		2	18	3.5	660			
				P-N		2	20	3.5				
30	BC-20	18+870	Culvert	*N-P*		2	6.5	3	110.93			
				P-N		1	16.5	3				
31	BC-21	19+638	Culvert	-		1	1.5	1	2.46			
32	BC-22	19+900	Bridge	*N-P*		1	12.5	2	135.25			
			Slab Culvert	*P-N*		2	8	3				
33	PC-4	20+410	Pipe Culvert	-	*658*	1	0.6	-	0.82	493.17	Less Capacity	-
34	BC-23	20+468	Slab Culvert	*N-P*		7	4	3.5	364			Increase 3 cell of Culvert of 4 x 3.5.
			Bridge	*P-N*		2	20.5	3.5				-

Sr. No.	Structure Code	RD	Structure Type	Roadside	Estimated SSP 5-8.5 Discharge (m³/sec)	No. of Span	Span / Dia (m)	Span Height (m)	Estimated Capacity (m^3/sec) Individual	Estimated Capacity (m^3/sec) Combined	Capacity Check	Remarks
35	BC-24	21+210	Box Culvert	-		1	3.5	1	16.60			Increase 1 cell of each Culvert of 3.5 x 1 on P-N & N-P both-ways.
36	BC-25	21+335	Box Culvert	-		1	16.5	2.5	107.81			
37	PC-5	25+000	Pipe Culvert	*N-P*		2	0.8	-	3.94			-
			Slab Culvert	*P-N*		1	1.5	1				-
38	BR-08	25+118	Bridge	*N-P*	*3019*	3	23	4.5	1427	1490.42	Less Capacity	Increase 3 span of each Bridge of 22x4.5 on P-N & N-P both-ways.
				P-N		3	20.5	4.5				
39	BC-26	25+205	Box Culvert	*N-P*		1	4	3	18.63			Increase 2 cell of Culvert of 4 x 3.
				P-N		1	4	2				Increase 4 cell of Culvert of 4 x 2.
40	BC-27	25+405	Slab Culvert	-		1	3	3	25.43			Increase 2 cell of each Culvert of 3x3 on P-N & N-P both-ways.
41	BC-28	25+940	Slab Culvert	-		1	1.5	1	4.80			-
42	BC-29	26+630	Slab Culvert	-		1	1.5	1	3.72			-
43	BC-30	27+040	Slab Culvert	-		1	1.5	1	4.07			-
44	BC-31	27+660	Slab Culvert	-		1	1.5	1	4.25			-
45	BC-32	28+000	Slab Culvert	*N-P*		1	1.5	1	2.52			-

Sr. No.	Structure Code	RD	Structure Type	Roadside	Estimated SSP 5-8.5 Discharge	No. of Span	Span / Dia	Span Height	Estimated Capacity (m^3/sec)		Capacity Check	Remarks
					(m^3/sec)		(m)	(m)	Individual	Combined		
				P-N		1	1	1				-

Note- PC = Pipe Culvert
BC = Box Culvert
BR = Bridge
N-P = Nowshera to Peshawar Side
P-N = Peshawar to Nowshera Side
Capacity of structure is estimated of smaller one in case of difference in size of structures on same RD of P-N & N-P roadways

3.7 CONCLUSION AND RECOMMENDATIONS

Hydraulic design review of the culverts and bridges have been carried to check adequacy for safely pass the design floods with climate change effect under SSP 5-8.5. It is observed that existing box culverts are present on small drain/ nullahs and bridges exist on some bigger nullahs/river at Nowshera–Peshawar section. Considering the topography of the project area and development on the sides of the road at some locations the hydraulic analyses for the cross drainage structures have been taken up. Here, in this reach the structures with individual design discharge have been reviewed as individual, while remaining structures are checked for capacity in range of RDs as shown in Table-1 and some briefed below;

- The results of the hydraulic analyses show that bridges at RDs 1+272, 2+160, 5+202 and 6+332 are adequate for passing design floods. Whereas, bridges at RD 8+256, 10+599, 13+136, 17+497 and 25+118 are not capable of passing 100–yr. design flood.
- The bridges with insufficient capacity to pass design discharge are need to be increased number of bays as indicated in the summary table
- Culverts at RD. 0+465, 10+599, 21+210, 25+205,25+405 (both sides) and 15+500, 20+468 (one side) are not capable of passing design floods. Hence, these culverts required to increase number of cells/barrels to achieve adequate capacity as shown in summary table.
- Some cross drainage structures are moderately choked, minor damaged and filled with mud. Hence, required cleaning, repair and periodic maintenance for the proper drainage of the design floods.

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- Feasibility and Detailed Design for Peshawar (Chamkani) to Nowshera-Addition of Extra Lane on Each Side of N-5 (32Km) 0+000 TO KM 30+159 (NESPAK-2023)

VOLUME 4: ENVIRONMENTAL QUALITY BASELINE REPORT

ENVIRONMENTAL MONITORING REPORT APRIL - 2024

National Engineering Services Pakistan (Pvt.) Ltd (NESPAK)

Project: Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh

Prepared by: ENVI TECH AL

Email: info@envitechal.com

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ABBREVIATIONS

AA	Ambient Air
APHA	American Public Health Administration
CO_2	Carbon Dioxide
CO	Carbon Monoxide
EPA	Environmental Protection Agency
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
O_3	Ozone
SEQS	Sindh Environmental Quality Standards
DW-SEQS	Drinking Water-Sindh Environmental Quality Standards
NL	Noise Level
PEPA	Pakistan Environmental Protection Act 1997(Amended 2012)
SPM	Suspended Particulate Matter
PM	Particulate Matter
SO_2	Sulphur Dioxide
USEPA:	United states Environmental Protection Agency

UNITS

M:	Meter
°C:	Degree Celsius
Sec:	Seconds
Ppm:	Parts per Million
Mg/l:	Milligram per Litre
Mg/Nm^3:	Milligram per Normal cubic meter
µg/m^3:	Microgram per cubic meter
Mg.kg-1	Milligram per Kilogram

CHAPTER# 1. INTRODUCTION

1.1 Project Background

The proposed emergency flood assistance project (EFAP) was prepared in response to the Government of Pakistan's request to the Asian Development Bank (ADB) on 6 October 2022 for assistance in country floods response. The EFAP will contribute to the economic recovery of flood-ravaged provinces of Balochistan, Khyber Pakhtunkhwa, and Sindh, while building longer term resilience. It will finance the rehabilitation and reconstruction of high priority transport (roads and bridges), irrigation, drainage, flood risk management, and on-farm water management infrastructure that were damaged by the devastating floods. The EFAP will also support restoration of economic productivity and livelihoods of flood-affected rural population. The project is part of ADB's multitiered flood response to Pakistan and was designed in close coordination and cooperation with the World Bank.

The environmental monitoring is required for the constructional activities in accordance with EPA regulation and environmental management plan. Client Engaged M/s ENVI TECH AL for environmental monitoring of the following sites.

1.2 Objectives

The objective of this study is to:

- Comply with the regulatory requirements of the project;
- To Assess the current environmental conditions in surrounding areas
- Assessing the impact of plant operations on surrounding areas
- Monitor ambient air, noise level in study area/survey area;
- Analyze water quality.

1.3 Scope of Services

The environmental monitoring was conducted at advised locations for following environmental parameters.

- Ambient Air Quality Monitoring
- Noise Level Monitoring
- Surface Water

Sr. No.	Required Testing/ Parameters	Sampling Duration	Quantity
1.	Ambient Air Quality Monitoring	Averaging Period 24 Hours	02
2.	Noise Level Monitoring	24 Hours Continuous Monitoring	02

3.	Noise Level Monitoring	Spot	10
4.	Surface Water Analyses	Grab Sampling	02

1.4 Monitoring Duration

The environmental monitoring of project was carried out from 03/04/2024 to 06/04/2024 conducted through EPA Certified Environmental Laboratory; Envi Tech AL.

1.5 Monitoring Team

Sr. No.	Name	Designation	Qualification	Experience
1.	Irtaza Ahmed	Team Leader (Field)	B.s Environmental Sciences	02 Year

1.6 Project Locations

Locations for sampling and monitoring of required environmental parameters were identified by client.

Table 1-1: List of Ambient Air & Noise Level Monitoring Locations

Sr. No.	Monitoring Locations	Latitude	Longitude
I.	NH 5, Halani, Naushahro Feroze, Sindh	27.084707°N	68.318914°E
II.	AH2, Haji Rehmatullah Behan, Naushahro Feroze, Sindh	26.707917°N	68.041345°E

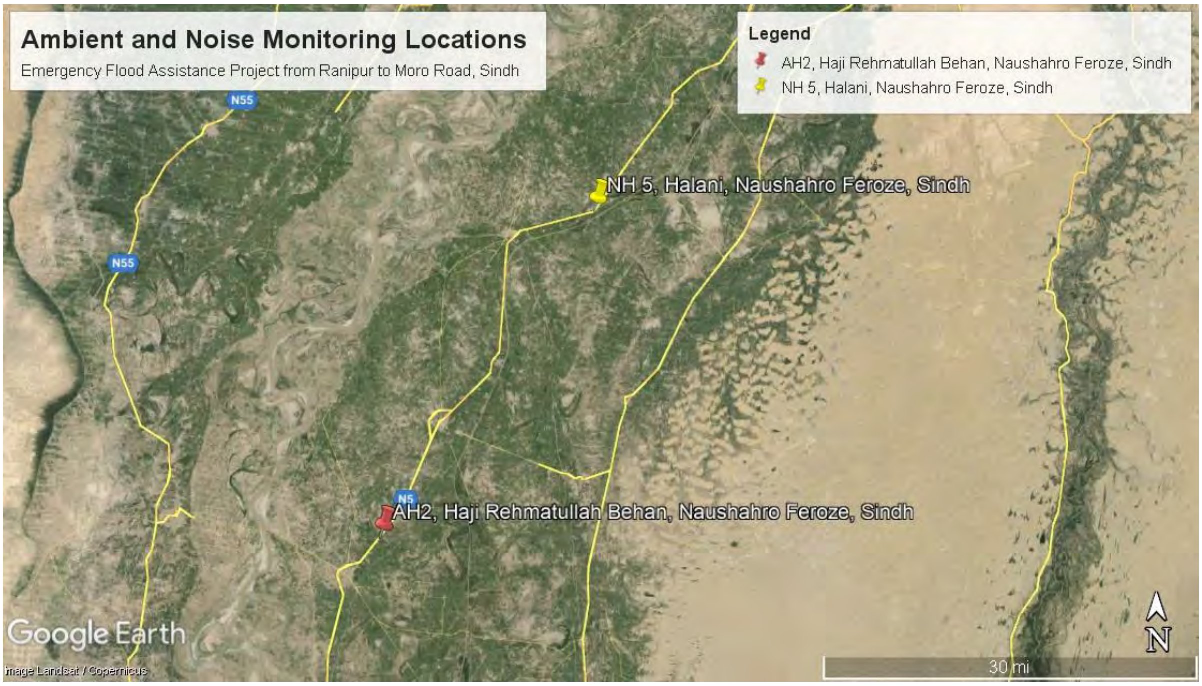


Figure 1-1: Ambient Air & Noise Level Monitoring Locations

Table 1-2: List of Spot Noise Level Monitoring Locations

Sr. No.	Monitoring Locations	Latitude	Longitude
I.	Near Ranipur Toll Plaza Lot-2	27.259329°N,	68.487656°E
II.	Halani Police Station Lot-2	27.085257°N	68.318893°E
III.	Mosque Lot-2	27.271315°N	68.354927°E
IV.	Dargah Allah Abad Sharif Kandiaro Lot-1	27.206278°N	68.418977°E

V.	Evergreen Public High School Hingorja Lot-2	27.25653°N	68.481304°E
VI.	Government High School Gadegi Lot-2	27.247099°N	68.456215°E
VII.	Government High School Khairpur Lot-2	27.247099°N	68.456259°E
VIII.	Basic Health Unit Bhellar Wada Lot-2	27.054384°N	68.215208°E
IX.	Ghulam Rabani Agro Govt Degree College Kandiaro Lot-1	27.04691°N	68.48765°E
X.	Basic Health Unit Plus Kundha Khahi Lot-1	27.868852°N	68.15158°E

Figure 1-2: Spot Noise Level Monitoring Locations

Table 1-3: List of Surface Water Sampling Locations

Sr. No.	Monitoring Locations	Latitude	Longitude
XI.	Surface Water from Canal at Lot-2	26.976807°N	68.203555°E
XII.	Surface Water from Pond at Lot-1	26.779265°N	68.089118°E

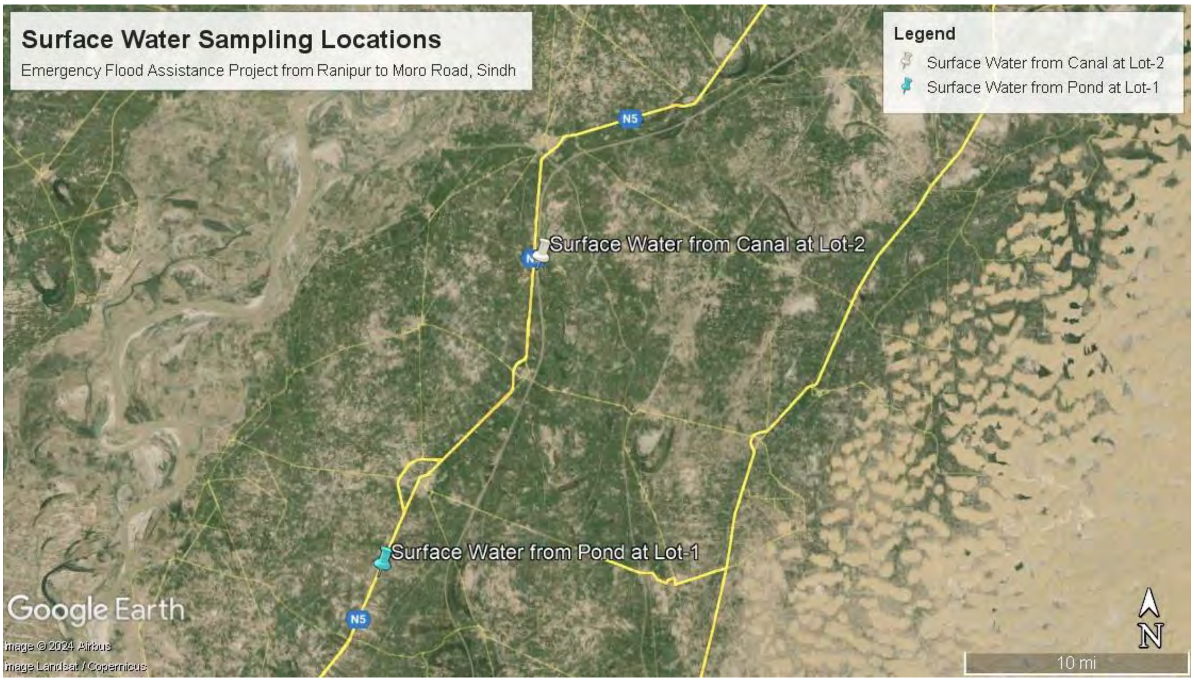


Figure 1-3: Surface Water Sampling Locations

CHAPTER# 2. METHODOLOGY

Following is the brief description of methodology adopted for this environmental monitoring:

2.1 Survey Planning

The project started with a planning of project activities with a management of the PICIIP.

2.1.1 Identification of Monitoring Locations

PICIIP provided location map of proposed project sites. Following criterion was used to finalize the sampling locations on the given site.

- Area where there will be project activities;
- Present environmental conditions at the site.

2.2 Sampling and Analysis Methods

The sampling and testing methods are given in following sections of the report.

2.3 Ambient Air Quality Monitoring

Ambient air quality monitoring was conducted at advised sampling locations to assess the concentration of pollutants (Carbon monoxide, Oxides of Nitrogen (NO, NO_2), Sulphur dioxide (SO_2), Ozone, $PM_{2.5}$ and PM_{10}, SPM). Selection of monitoring locations was based on the environmental factors including wind direction on the particular day and amount of turbulence in the air etc.

Reference method used for the measurements are included as Table 2.1 while the description is provided in subsequent sections.

Table 2-1: Methodology of Ambient Air Quality Monitoring

Air Pollutant	Monitoring Technique	Instrument Used	Reference Method	Sampling Duration
Carbon monoxide (CO)	Non-Dispersive Infrared Absorption (NDIR)	Environment S.A CO Analyzer	40 CFR Part 50, App. C (US-EPA)	8 hours
Sulfur Dioxide (SO_2)	UV fluorescence (UVF)	Environment S.A SO_2 Analyzer	EQSA-0197-114 (US-EPA)	24 hours

Oxides of Nitrogen	Reduced Pressure Chemiluminescence (CLD)	Environment S.A NO_x Analyzer	40 CFR Part 50, App F (US-EPA)	24 hours
Particulate Matter (PM_{10}, $PM_{2.5}$	Beta Ray Absorption Method	Metone BAM	40 CFR Part 50, App J (US-EPA)	24 hours
Particulate Matter (SPM)	Gravimetric Method	High Volume Air Sampler	40 CFR Part 50, App J (US-EPA)	24 Hours
Ozone O_3	Non-Dispersive UV Absorption (NDIR)	Environment S.A O_3 Analyzer	40 CFR Part 53	1 Hour

2.3.1 Carbon monoxide (CO)

Carbon monoxide (CO) was monitored using Environment S.A CO Analyzer. The Environment S.A CO Analyzer measures CO concentration using a non-dispersive infrared (NDIR) absorption method that is based on the nature of CO in that it absorbs special infrared light. Continuous data was recorded for 24 hr.

2.3.2 Oxides of Nitrogen

Oxides of Nitrogen (NOx) were monitored using Environment S.A NOx Analyzer. The analyzer measures NO, NO_2 and NO_x using chemiluminescence (CLD) method with the help of chemical reaction between NO_2 and O_3. Continuous data was recorded for 24 hr.

2.3.3 Sulphur Dioxide (SO_2)

SO_2Sulphur dioxide was monitored using Environment S.A SO_2 Analyzer. The Environment S.A SO_2 Analyzer measures SO_2 using UV fluorescence method that operates on the principle that when the SO_2 molecules contained in the sample gas are excited by ultraviolet radiation they emit a characteristic fluorescence in the range of 220- 240 nm. This fluorescence is measured and the SO_2 concentration is obtained from changes in the intensity of the fluorescence. Continuous data was recorded for 24 hr.

2.3.4 Particulate Matter (PM_{10} and $PM_{2.5}$)

Particulate matter concentration in terms of $PM_{10}$and $PM_{2.5}$ was monitored in the ambient air with the help of High-Volume Air Sampler. $PM_{10}$and $PM_{2.5}$sampling was conducted for period of 24 hour at identified sampling locations with the help of fiberglass filters. The filters were properly stored and placed in the vacuum zipper bag in order to avoid moisture and transported to ENVI TECH AL Laboratory for detection of PM_{10}.

Suspended Particulate Matter (SPM) was measured through gravimetric sampling method by using of high-volume air sampler. The sampling continues for 24 hours at identified sampling locations. For this purpose, fiber glass filters were used to collect the SPM. The filters were stored and transported to ENVI TECH AL Laboratory for further analysis.

2.3.5 Ozone (O_3)

Ozone was monitored using Environment S.A O_3 Analyzer. Sampling was conducted for period of 1 hour at identified sampling locations. The analyzer automatically measures and records ozone concentration levels (in milligrams or micrograms per cubic meter) using the industry-proven principle of non-dispersive UV absorption.

2.4 Noise Level

Noise level monitoring was conducted at identified locations using BENTECH Sound Meter. All noise monitoring was conducted in accordance with the guidance set out in BS 7445:2003. Measurements were made using 1/1 Octave in accordance with IEC61260-1:2014 and ANSI S1.11-2004. Meters were calibrated and checked before and after each measurement period by using sound level calibrator.

2.5 Water Sampling

Following methodology was adopted for water sampling and analysis:

2.5.1 Sample Collection

The water samples were collected from identified sampling points. The sampling was carried out in accordance to the Standard Operating Procedures (SOP) based on the recognized methods of United State Environmental Protection Agency (USEPA), World Health Organization (WHO) and American Public Health Administration (APHA) for water sampling and analysis.

2.5.2 Measurement of Field Parameters

Parameters that quickly degrade after they are sampled must be tested in the field. Following parameters were measured in field that can significantly change during storage and transportation. These includes: -

- ✓ pH (Measured at site)
- ✓ Temperature

2.5.3 Preservation

Preservation is important in order to minimize the changes in the sample. The collected water samples were preserved in appropriate containers as per APHA Guidelines.

2.5.4 Sample Identification and Chain of Custody

The collected samples were labeled and assigned a unique sample identification number, sampling date and time of collection to collected samples. All the relevant information (sample location, time of collection, sample identification, temperature, pH, collected by, preservation techniques etc.) was recorded immediately on the Chain of Custody form signed by ENVI TECH AL field Analyst.

2.5.5 Transportation

A shipping container (Ice box with eutectic cold packs instead of ice) with maintained temperature of 4° C ±5 °C was used for transporting the sample from the collection site to the environmental laboratory.

2.5.6 Parameters

Parameters provided in the scope of work for the testing include following:

- Surface Water

The samples of waste water were collected from identified sampling points. The collected samples were given to laboratory for analysis of parameters that are listed in table 2.2.

2.5.7 Methods of Analysis

Table 2-2: Parameters and Methods Used for Testing of Surface Water

S. No	Parameters	Method / Equipment Used	Reference
1	pH value (H^+) *	By pH meter	SMWW 4500H^+ B
2	Biochemical Oxygen Demand (BOD_5) at 20 ºC	Incubator, Titration	SMWW 5210 B
3	Chemical Oxygen Demand (COD)*	Digester & Photometer	SMWW 5220 D
4	Total Suspended Solids (TSS)*	Gravimetric method	SMWW 2540 D
5	Total Dissolved Solids (TDS)*	Gravimetric method	SMWW 2540 C
6	Phenolic Compounds (as Phenol)	4-Aminoantipyrine Method	SMWW 5530 C
7	Grease and Oil (as n-HEM)	Pyrex Glassware	U.S.EPA 1664 B
8	Chloride (as Cl^-) *	Argentometry Titration	SMWW 4500Cl^- -B
9	Fluoride (as F^-) *	Ion Selective Electrode	U.S. EPA 9214
10	Cyanide (as CN^-)	Ion Selective Electrode	SMWW 4500 CN- F
11	An-ionic detergents (as MBAS)	Spectrophotometer	SMWW 5540 C
12	Sulfate (SO_4^{2-}) *	Gravimetric method	SMWW 4500 - SO_4^{2-} C
13	Sulfide (S^{2-})	Titration Method	SMWW 4500 - S^{2-} F
14	Ammonia (NH_3)	Ion Selective Electrode & Meter	SMWW 4500-NH_3- D
15	Chlorine (Cl)	DPD Method	SMWW 4500-Cl B

16	Cadmium (Cd)	ICP-AES	U.S. EPA-200.7
17	Chromium (Trivalent and Hexavalent)	ICP-AES	U.S. EPA-200.7
18	Copper (Cu)	ICP-AES	U.S. EPA-200.7
19	Iron (Fe)	ICP-AES	U.S.EPA-200.7
20	Lead (Pb)	ICP-AES	U.S. EPA-200.7
21	Manganese (Mn)	ICP-AES	U.S. EPA-200.7
22	Mercury (Hg)	ICP-AES	U.S. EPA-200.7
23	Selenium (Se)	ICP-AES	U.S. EPA-200.7
24	Nickel (Ni)	ICP-AES	U.S. EPA-200.7
25	Silver (Ag)	ICP-AES	U.S. EPA-200.7
26	Zinc (Zn)	ICP-AES	U.S. EPA-200.7
27	Arsenic (As)	ICP-AES	U.S. EPA-200.7
28	Barium (Ba)	ICP-AES	U.S. EPA-200.7
29	Boron (B)	ICP-AES	U.S.EPA-200.7
30	Total Toxic Metals	---	Calculated Value
31	Pesticides	---	Screening Method
32	Temperature	Thermometer	SMWW-2550-B

Note: SMWW = Standard Method for the Examination of Water and Wastewater, 23rd Edition (2017)
USEPA: United States Environmental Protection Agency

CHAPTER# 3. RESULTS AND DISCUSSION

3.1 Ambient Air Results

This section of the report presents the testing results of Ambient Air {CO, NOx, SO_2, Ozone (O_3), PM_{10}, $PM_{2.5}$, SPM, Lead (Pb)} and Ambient Noise. Concentration of all the below mentioned parameters were measured at Identified sampling location to get an overview of the air quality. The detail results of measure concentration at each sampling location are given in annexures.

3.1.1 CO Measurements

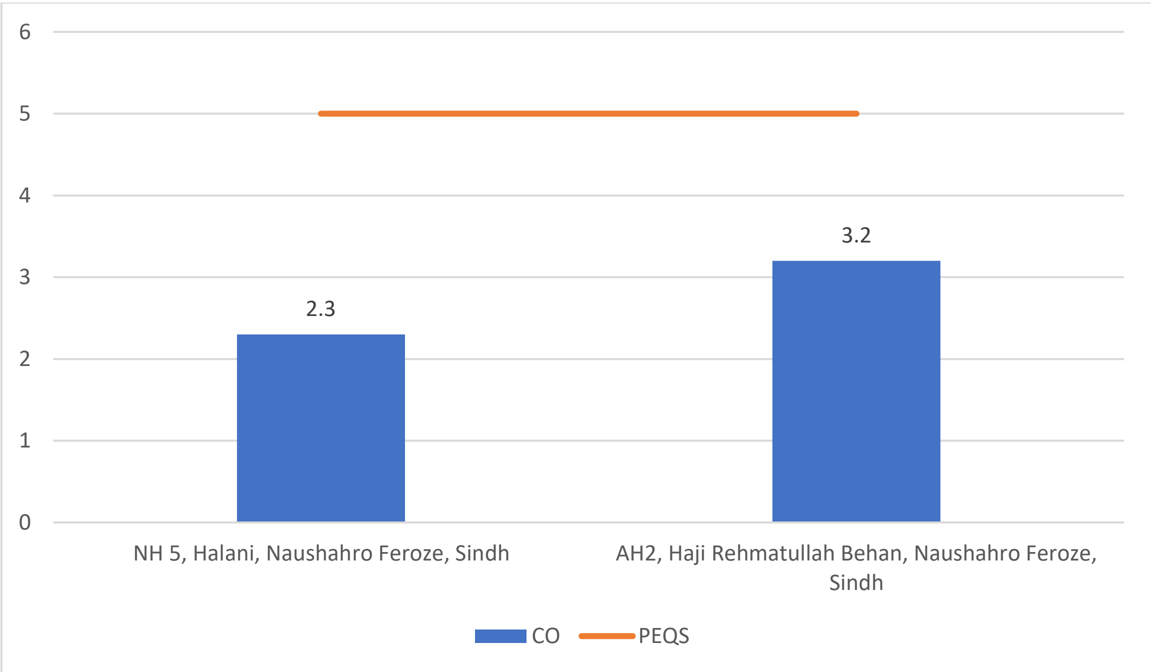


Figure 3-1: Comparison of Average CO Measurements with SEQS

<u>Discussion:</u>

Carbon monoxide was measured 8 hours at all sites, and the levels at all sites found under the NEQS-permissible limits (5.0 mg/m^3). Graphical representation of CO at all sites with comparison of SEQS limits are shown in above figure 3-1. Detailed monitoring reports are attached as Annexure-A.

<u>Mitigations:</u>

No specific mitigation measures required.

3.1.2 NO, NO_2 Measurements

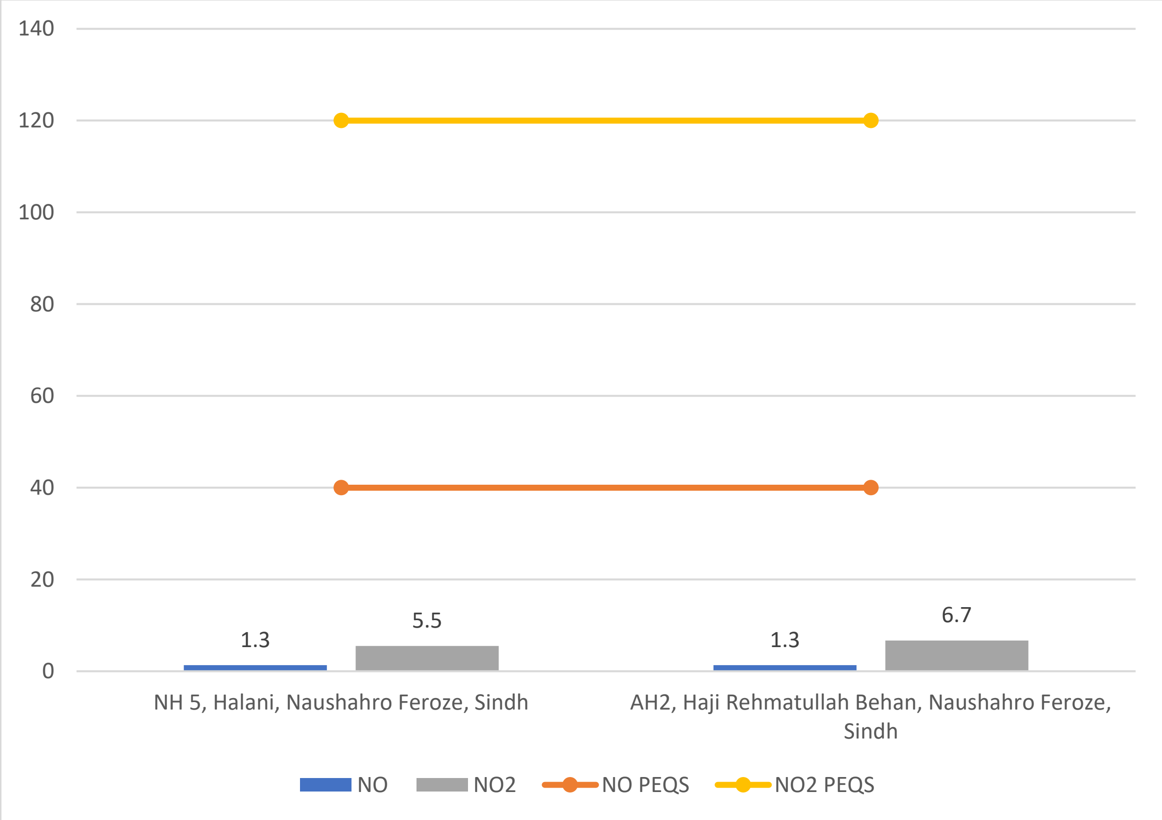


Figure 3-2: Comparison of Average NO and NO_2 Measurements with SEQS

Discussion:

Nitrogen Oxides and Nitrogen Dioxides was separately measured for 24 hours at all sites, and the concentration levels at all sites found under the SEQS-permissible limits (40 mg/m^3 and 80 mg/m^3 Respectively). Graphical representation of NO and NO_2 at all sites with comparison of SEQS limits are shown in above figure 3-2. Detailed monitoring reports are attached as annexure-A**.**

Mitigations:

No specific mitigation measures required.

3.1.3 SO_2 Measurements

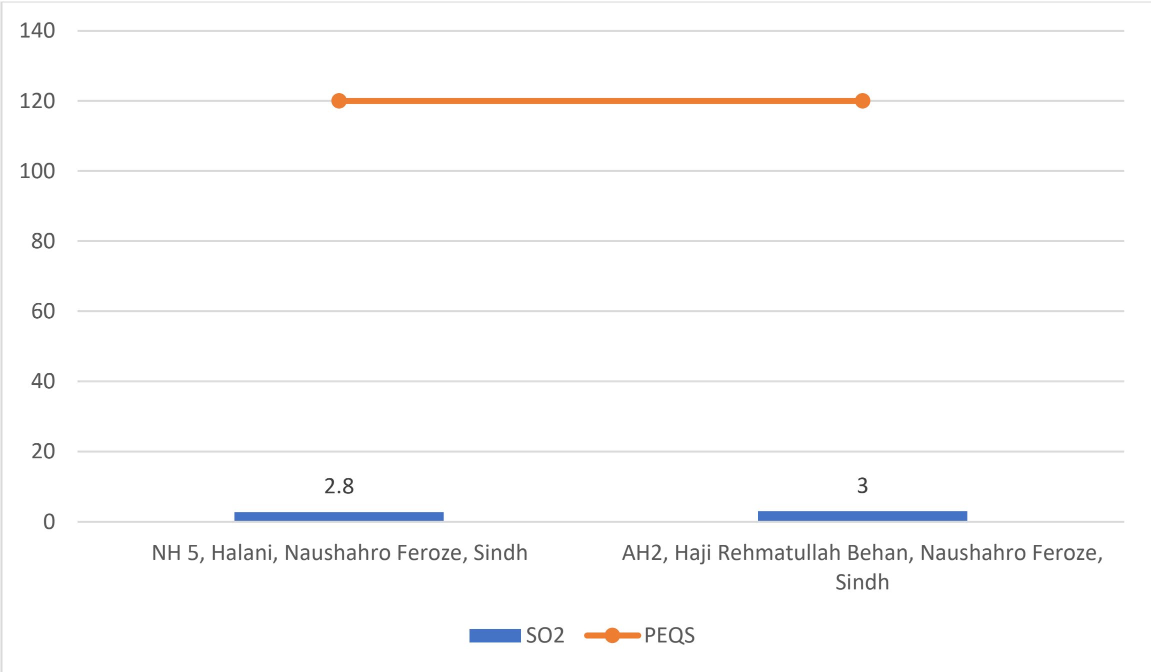


Figure 3-3: Comparison of Average SO_2 Measurements with SEQS

Discussion:

The concentration levels of Sulphur Dioxides (SO_2) were measured for 24 hours at all sites, and the concentration levels at all sites found under the SEQS-permissible limits (120 mg/m^3) as presented in above figure 3-3. Detailed monitoring reports are attached as annexure-A.

Mitigations:

No specific mitigation measures required.

3.1.4 O_3 Measurements

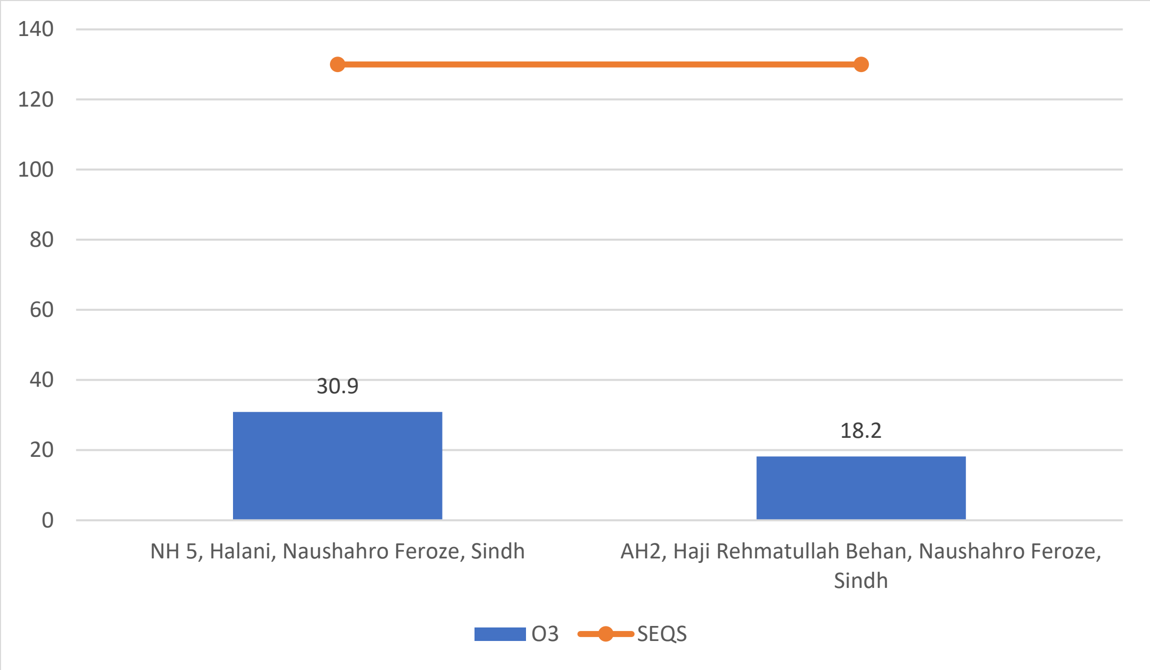


Figure 3-4: Comparison of Average O_3 Measurements with SEQS

Discussion:

The concentration levels of Ozone (O_3) were measured for the first 1 hour at all sites and the concentration levels at all sites found under the SEQS-permissible limits (130 mg/m^3). Graphical representation of concentration is presented in above figure 3-4. Detailed monitoring reports are attached as annexure-A.

Mitigations:

No specific mitigation measures required.

3.1.5 PM10, PM2.5 and SPM Measurements

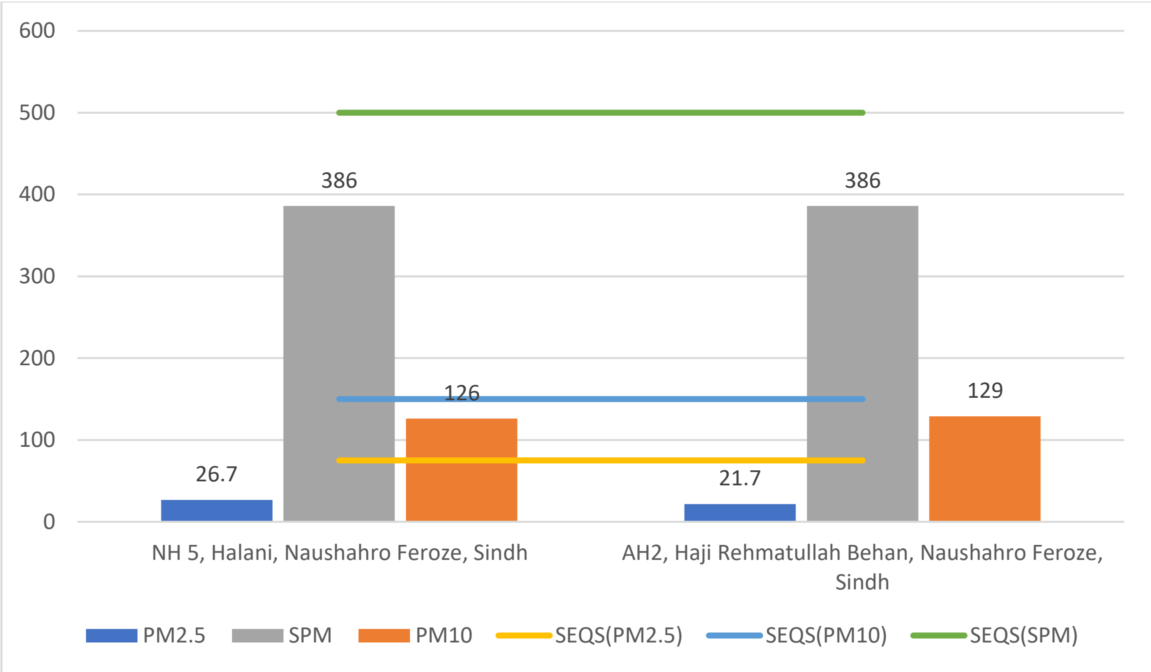


Figure 3-5: Comparison of Average PM_{10}, $PM_{2.5}$ and SPM Measurements with SEQS

Discussion:

Concentration levels of PM_{10}, $PM_{2.5}$ and SPM were monitored for 24 hours at all sites with a Met one BAM analyzer. Concentration levels of PM_{10}, $PM_{2.5}$ and SPM are incompliance with permissible limits of SEQS. A graphical representation of concentration is presented in Figure 3-5 above. Detailed monitoring reports are attached as annexure-A.

Mitigation Measure:

No specific mitigation measures required.

3.2 Noise Level Monitoring Results-24 Hours

Noise is an important environmental stressor and is essential part of environmental studies for projects. Noise has become a very important "stress factor" in the environment of human. The term "noise pollution" has been recently used to signify the hazard of sounds which are consequence of modern-day development, leading to health hazards of different type. Noise is described as an unwanted sound emitted from un-avoidable sources of anthropogenic activities.

The noise monitoring activity was carried out at the project site and the surrounding areas of project site for 24-hours. Detailed environmental monitoring reports are attached as **Annexure-B**

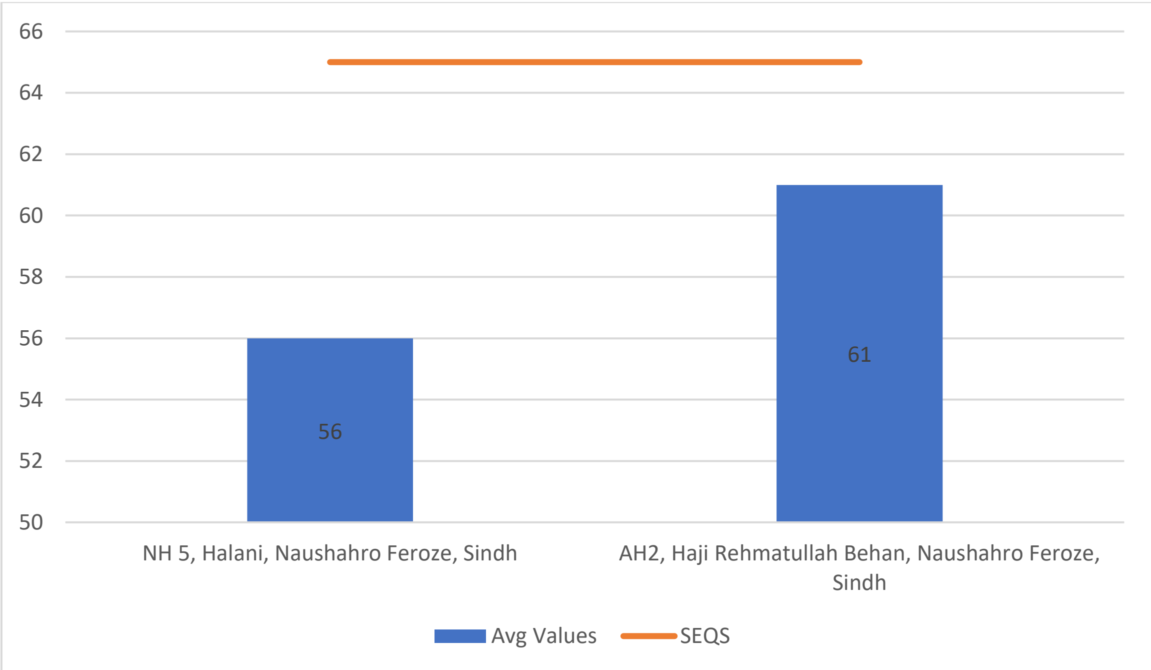


Figure 3-6: Comparison of Noise Levels with SEQS (Day Time)

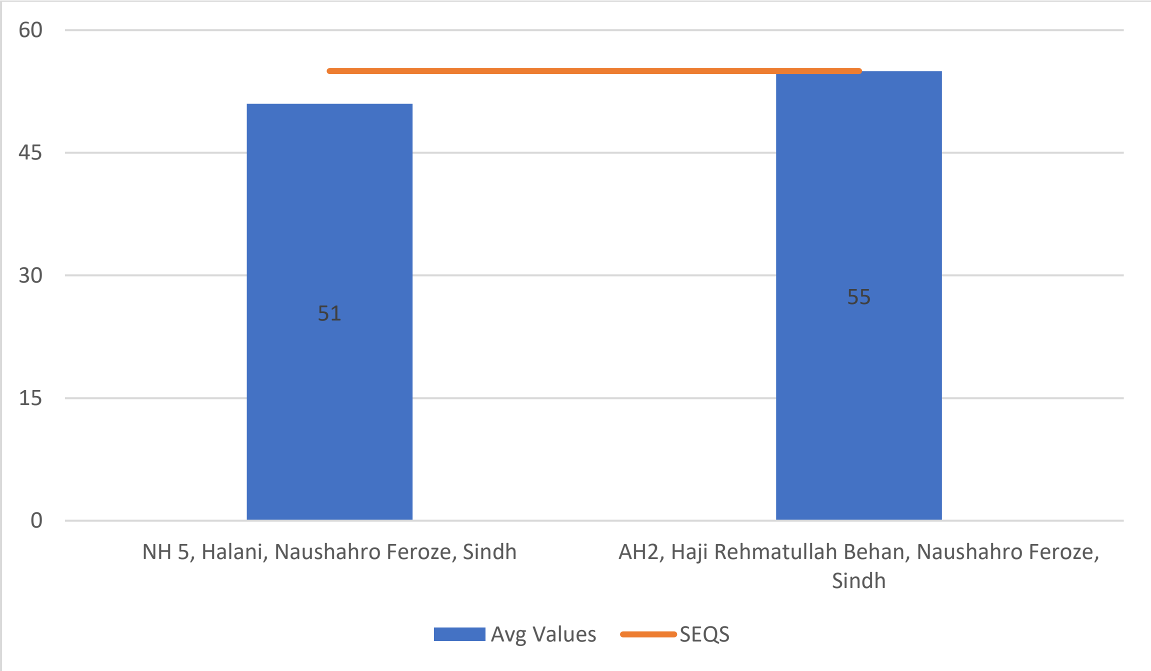


Figure 3-7: Comparison of Noise Levels with SEQS (Night Time)

Discussion:

Noise levels were monitored 24 hours a day at two sites using Bentech sound meter. According to the monitoring results, all sites have been found under the permissible limits (SEQS). Detailed monitoring reports are attached as annexure-B

Mitigation Measure:

No specific mitigation measures required.

3.3 Spot Noise Level Monitoring Results

The spot noise monitoring activity was carried out near the project site at 10 monitoring Locations. Detailed environmental monitoring reports are attached as **Annexure-B.**

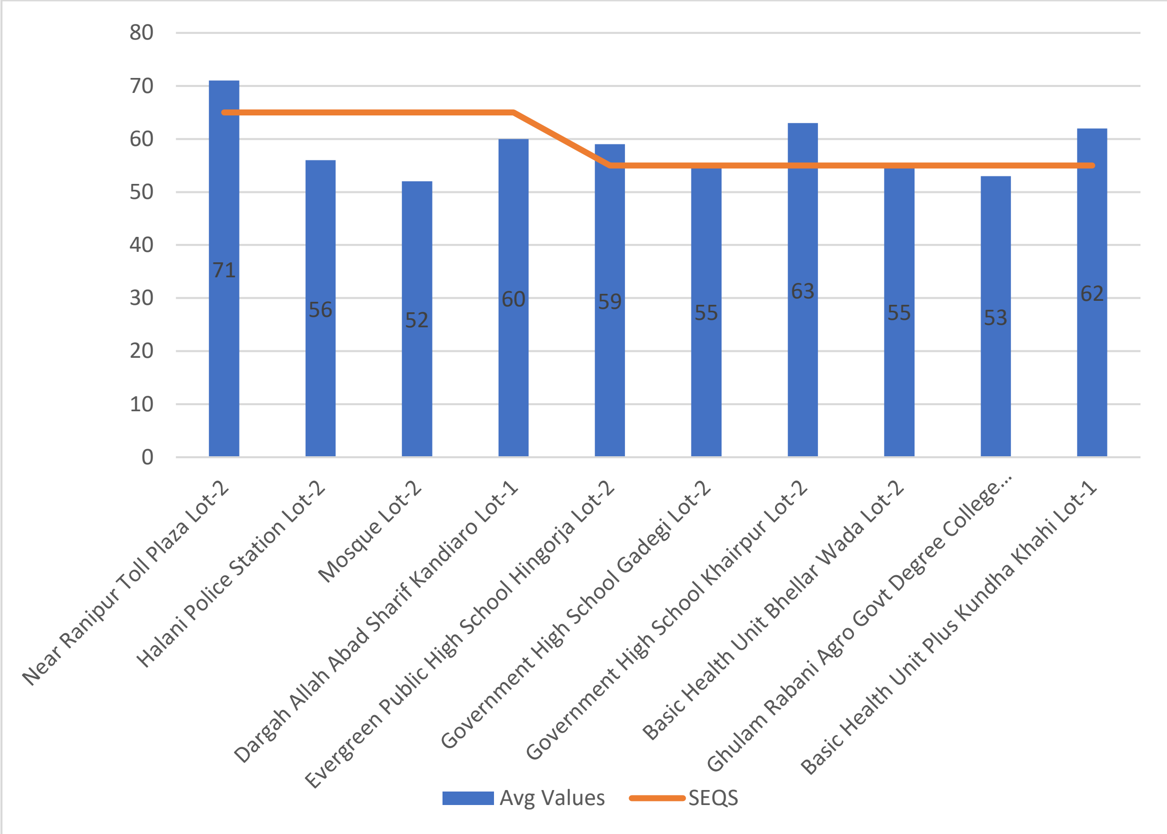


Figure 3-8: Comparison of Noise Levels with SEQS

<u>Discussion:</u>

Noise levels were monitored at ten sites using Bentech sound meter. According to the monitoring results, few sites are exceeding the permissible limits (SEQS). Detailed monitoring reports are attached as annexure-B

<u>Mitigation Measure:</u>

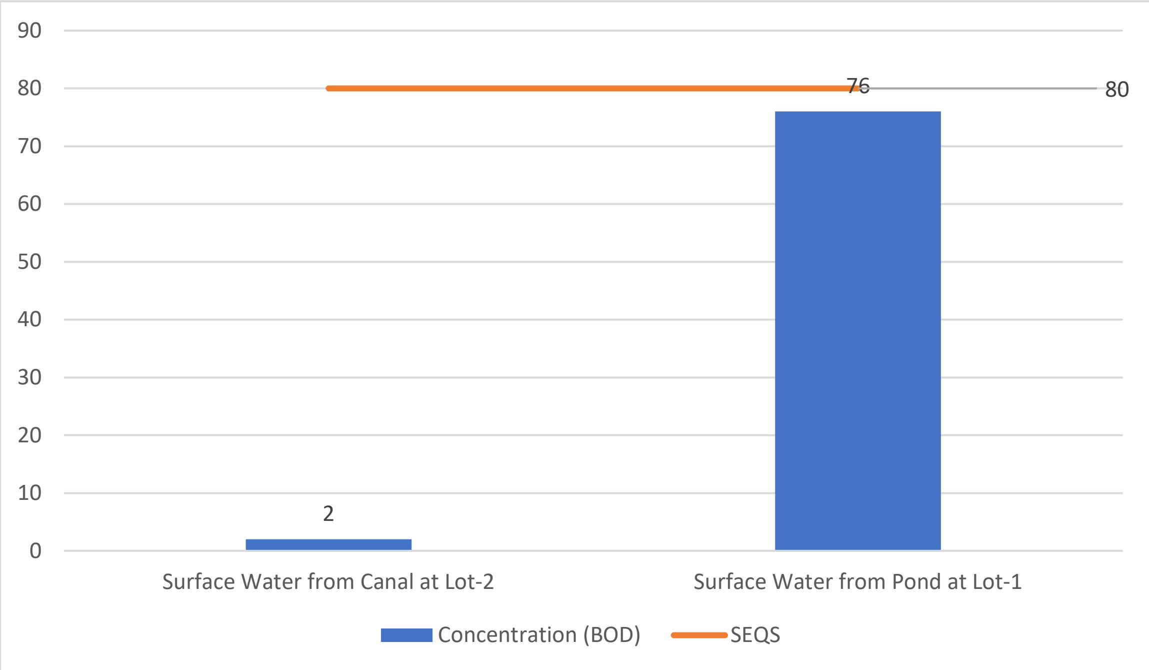
Avoid excessive horning on road.

3.4 Surface Water Analysis

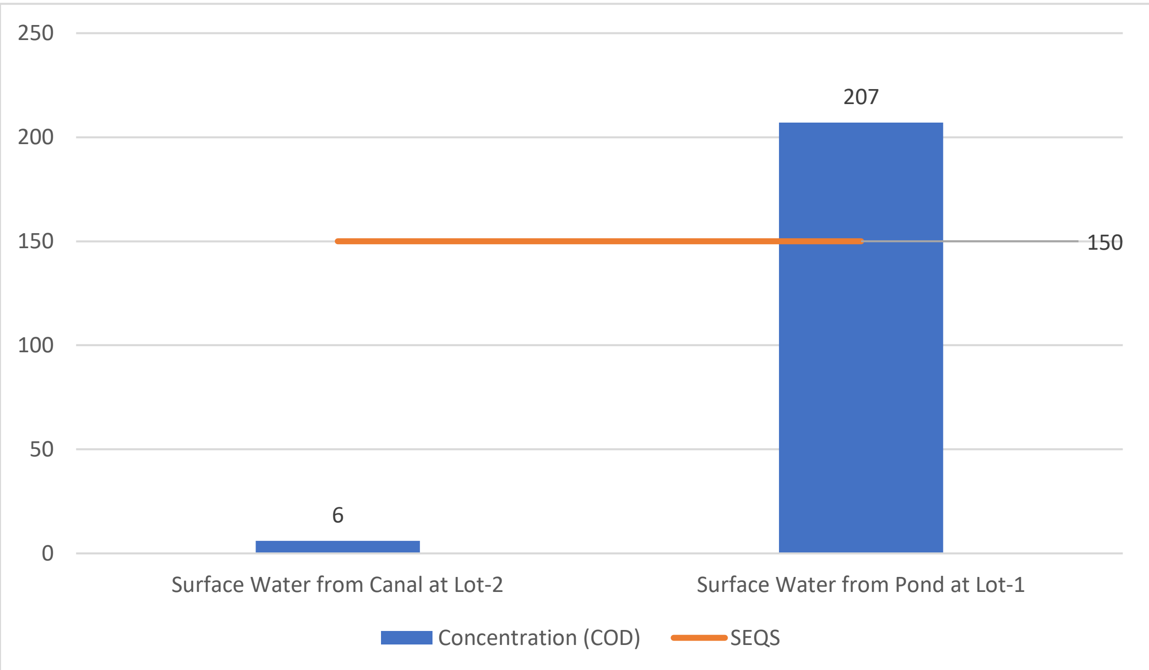
Surface waters are always exposed to atmospheric environment on the surface of earth in the form of mobile and immobile situation including snow masked mountains, Ice-caps, Glaciers, rivers, non-river streams, rain, sleet, wetlands, watersheds and oceans. These waters are potable or toxic would depend on environment of adjoining area. Surface Water are type of water which all the time exposed to the atmospheric environment and can be the target of any anthropogenic or non-anthropogenic activities at any moment of time. Surface resourced chemical and biological pollution and thus are not used for sensitive applications such as drinking directly, unless it is pretreated.

Graphical representation of major parameters for surface water samples described below and detailed reports are attached as annexure.

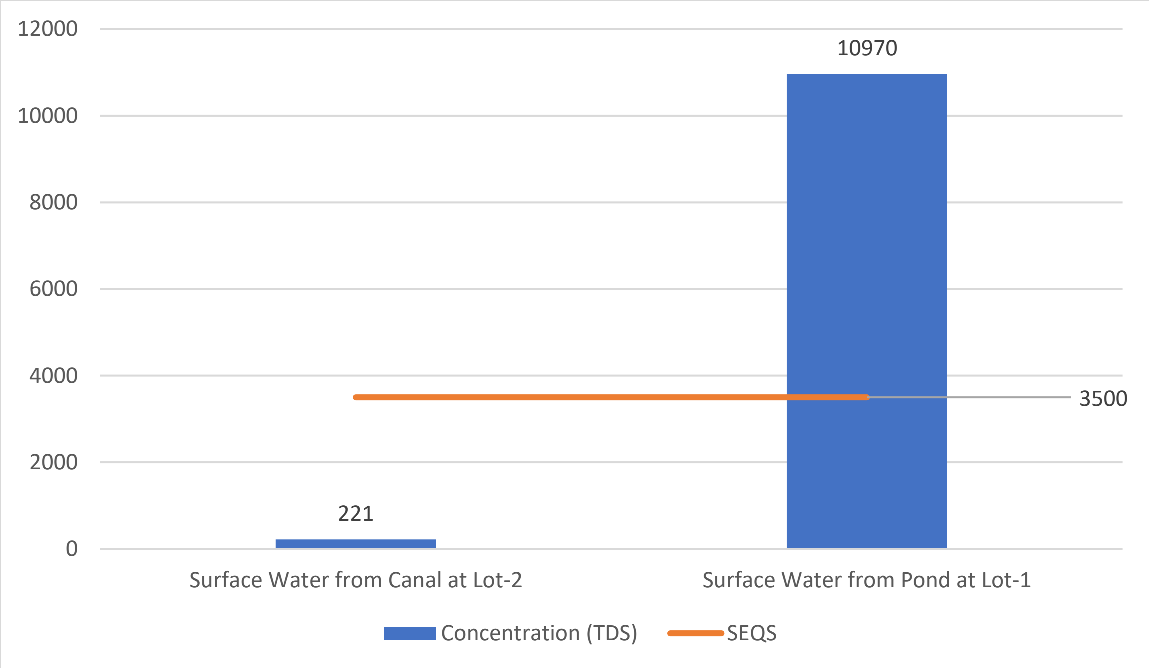
3.4.1 Biochemical Oxygen Deman (BOD_5)



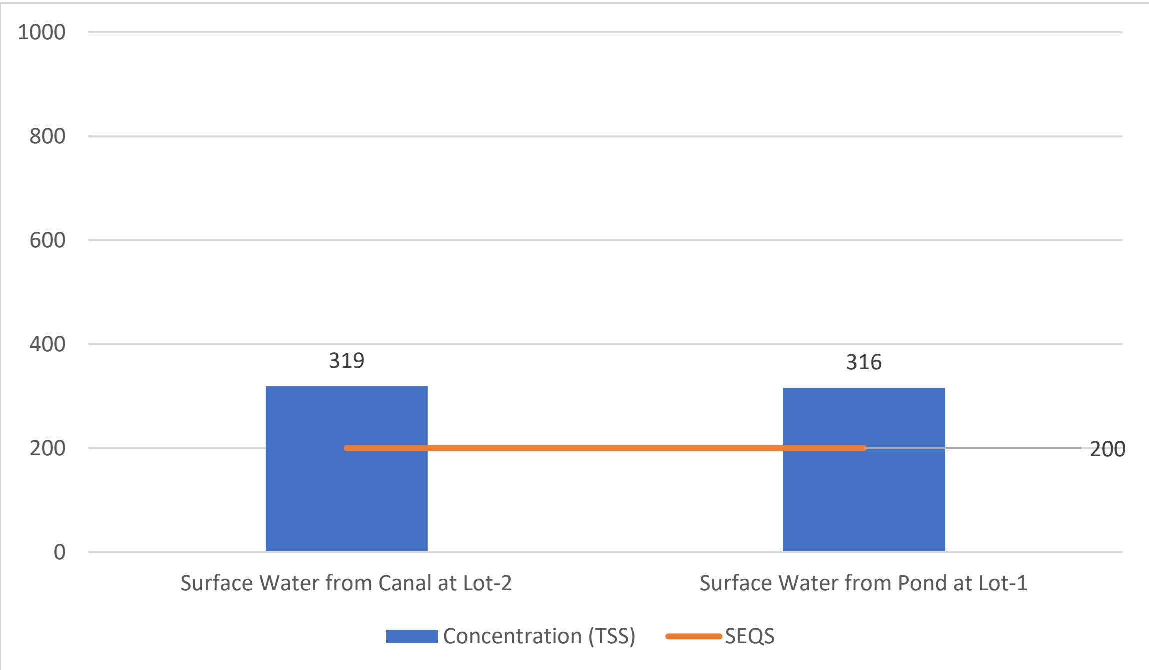
3.4.2 Chemical Oxygen Demand (COD)



3.4.3 Total Dissolved Solids (TDS)



3.4.4 Total Suspended Solids



<u>Discussion</u>

Two (2) samples of surface water were collected from identified sampling point according to sampling protocol defined in APHA 1060 B. These sample was preserved as per APHA 1060 C. According to laboratory results, maximum parameters e.g., TDS,TSS, COD, Sulfates, Zinc were found exceeded from permissible limits (SEQS). The trend of chemical analyzes on these water sources indicated that water samples showed high values of COD, BOD, TSS, Sulfates and Zinc, which are indicators of viable pollution in aquatic systems of these resource waters and are not used for sensitive applications such as drinking directly, unless treated.

Mitigations:

Wastewater should be treated before the discharge to final drain.

<u>ANNEXURE – A</u>

AMBIENT AIR RESULTS

Lab Report No. : 202404325-NESPAK-AAQ
Invoice Bill No. : INV-NESPAK-390

Page: 1 of 1
Reporting Date: 17-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Test ID:	**AAQ-202404325**
Project Name	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Monitoring Location	NH 5, Halani, Naushahro Feroze, Sindh, Pakistan (GPS: 27.084707°N, 68.318914°E)
Test Performed Date:	**03-April-2024 to 04-April-2024**
Test Type:	Ambient Air Quality- Continuous-24 Hours
Test Performed By:	Envi Tech AL
Test Description:	Ambient Air Quality as per SEQS-2016

Sr. #	Parameters / Analytes Description	Unit	Test Results	SEQS Limits
01	Carbon Monoxide (CO)	mg/m3	2.3	*5
02	Sulphur Dioxide (SO_2)	µg/m3	2.8	120
03	Ozone (O_3)	µg/m3	30.9	**130
04	Nitrogen Monoxide (NO)	µg/m3	1.3	40
05	Nitrogen Dioxide (NO_2)	µg/m3	5.5	80
06	Particulate matter ($PM_{(2.5)}$)	µg/m3	26.7	75
07	Particulate matter ($PM_{(10)}$)	µg/m3	126	150
08	Suspended Particulate matter (SPM)	µg/m3	386	500

Note: Measurement of uncertainty, statement of conformity, opinions & Interpretations will be provided on customer Demand.
*SEQs Limit for Carbon Monoxide (CO) to monitor for 8 hours (Reference: SEQS 2016).
** SEQs Limit for Ozone (O_3) to monitor for 1 hour (Reference: SEQS 2016).
SEQS Limits = Sindh Environmental Quality Standard (Reference: SEQS 2016)
N.D. = Not Detected

ENVI TECH AL

Analyzed By (Assistant analyst) **Reviewed By (Analyst)** **Approved By (Chief Analyst)**

Disclaimer:

- Report is Valid for current batch (sample).
- This report is not valid for any publication or judicial purposes.
- If sample is provided by the customer, Envi Tech AL is not responsible for the sample Identification and data shared by the client.
- The remaining portion of the sample shall be discarded after five working days unless otherwise instructed.

Lab Report No. : 202404326-NESPAK-AAQ
Invoice Bill No. : INV-NESPAK-390

Page: 1 of 1
Reporting Date: 17-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Test ID:	**AAQ-202404326**
Project Name	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Monitoring Location	AH2, Haji Rehmatullah Behan, Naushahro Feroze, Sindh, Pakistan (GPS: 26.707917° N, 68.041345°E)
Test Performed Date:	**05-April-2024 to 06-April-2024**
Test Type:	Ambient Air Quality- Continuous-24 Hours
Test Performed By:	Envi Tech AL
Test Description:	Ambient Air Quality as per SEQS-2016

Sr. #	Parameters / Analytes Description	Unit	Test Results	SEQS Limits
01	Carbon Monoxide (CO)	mg/m3	3.2	*5
02	Sulphur Dioxide (SO_2)	µg/m3	3.0	120
03	Ozone (O_3)	µg/m3	18.2	**130
04	Nitrogen Monoxide (NO)	µg/m3	1.3	40
05	Nitrogen Dioxide (NO_2)	µg/m3	6.7	80
06	Particulate matter ($PM_{(2.5)}$)	µg/m3	21.7	75
07	Particulate matter ($PM_{(10)}$)	µg/m3	129	150
08	Suspended Particulate matter (SPM)	µg/m3	386	500

Note: Measurement of uncertainty, statement of conformity, opinions & Interpretations will be provided on customer Demand.
*SEQs Limit for Carbon Monoxide (CO) to monitor for 8 hours (Reference: SEQS 2016).
** SEQs Limit for Ozone (O_3) to monitor for 1 hour (Reference: SEQS 2016).
SEQS Limits = Sindh Environmental Quality Standard (Reference: SEQS 2016)
N.D. = Not Detected

ENVI TECH AL

Analyzed By (Assistant analyst) | **Reviewed By (Analyst)** | **Approved By (Chief Analyst)**

Disclaimer:

- Report is Valid for current batch (sample).
- This report is not valid for any publication or judicial purposes.
- If sample is provided by the customer, Envi Tech AL is not responsible for the sample Identification and data shared by the client.
- The remaining portion of the sample shall be discarded after five working days unless otherwise instructed.

<u>ANNEXURE – B</u>

BACKGROUND NOISE LEVELS

Lab Report No. : 202404328-NESPAK-NA

Invoice Bill No. : INV-NESPAK-390

Page: 1 of 1

Reporting Date: 17-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Test ID:	**NA-202404328**
Project Name	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Test Performed Date:	**05-April-2024 to 06-April-2024**
Test Type:	**Noise Analysis-Continuous-24 Hours**
Test Performed By:	Envi Tech AL
Test Description:	Noise Analysis as per SEQS-2016

Sr. #	Parameters / Analytes Description	Method	Unit	Test Results	SEQS Limits
01	AH2, Haji Rehmatullah Behan, Naushahro Feroze, Sindh, Pakistan (GPS: 26.707917°N, 68.041345°E) - Day Time	ASTM E1686-16	dB	61	65
02	AH2, Haji Rehmatullah Behan, Naushahro Feroze, Sindh, Pakistan(GPS: 26.707917°N, 68.041345°E) - Night Time	ASTM E1686-16	dB	55	55

Measurement of uncertainty, statement of conformity, opinions & Interpretations will be provided on customer Demand.

SEQS Limits = Sindh Environmental Quality Standard (Reference: SEQS 2016)

N.D. = Not Detected.

Analyzed By (Assistant analyst)

Reviewed By (Analyst)

ENVI TECH AL

Approved By (Chief Analyst)

Disclaimer:

- Report is Valid for current batch (sample).
- This report is not valid for any publication or judicial purposes.
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(Certificate # 202101031) (Certificate # 202101032)

ENVI TECH AL

We strive for Pragmatic approach to achieve quality Excellence

Lab Report No. : 202404327-NESPAK-NA

Invoice Bill No. : INV-NESPAK-390

Reporting Date: 17-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Test ID:	**NA-202404327**
Project Name	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Test Performed Date:	**03-April-2024 to 04-April-2024**
Test Type:	**Noise Analysis-Continuous-24 Hours**
Test Performed By:	Envi Tech AL
Test Description:	Noise Analysis as per SEQS-2016

Sr. #	Parameters / Analytes Description	Method	Unit	Test Results	SEQS Limits
01	NH 5, Halani, Naushahro Feroze, Sindh, Pakistan(GPS: 27.084707°N, 68.318914°E) - Day Time	ASTM E1686-16	dB	56	65
02	NH 5, Halani, Naushahro Feroze, Sindh, Pakistan(GPS: 27.084707°N, 68.318914°E) - Night Time	ASTM E1686-16	dB	51	55

Measurement of uncertainty, statement of conformity, opinions & Interpretations will be provided on customer Demand.

SEQS Limits = Sindh Environmental Quality Standard (Reference: SEQS 2016)

N.D. = Not Detected.

Analyzed By (Assistant analyst)

Reviewed By (Analyst)

Approved By (Chief Analyst)

Disclaimer:

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Lab Report No. : 202404329-NESPAK-NA

Invoice Bill No. : INV-NESPAK-390

Page: 1 of 1

Reporting Date: 17-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Test ID:	**NA-202404329**
Project Name	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Test Performed Date:	**03-April-2024 to 06-April-2024**
Test Type:	**Noise Analysis-Spot Analysis**
Test Performed By:	Envi Tech AL
Test Description:	Noise Analysis as per SEQS-2016

Sr. #	Parameters / Analytes Description	Method	Unit	Test Results	SEQS Limits
01	Near Ranipur Toll Plaza Lot-2 (GPS: 27.259329°N, 68.487656°E)	ASTM E1686-16	dB (A)	71	65
02	Halani Police Station Lot-2 (GPS: 27.085257°N, 68.318893°E)	ASTM E1686-16	dB (A)	56	65
03	Mosque Lot-2 (GPS: 27.271315°N, 68.354927°E)	ASTM E1686-16	dB (A)	52	65
04	Evergreen Public High School Hingorja Lot-2 (GPS: 27.206278°N, 68.418977°E)	ASTM E1686-16	dB (A)	59	55
05	Government High School Gadegi Lot-2 (GPS: 27.25653°N, 68.481304°E)	ASTM E1686-16	dB (A)	55	55
06	Government High School Khairpur Lot-2 (GPS: 27.247099°N, 68.456215°E)	ASTM E1686-16	dB (A)	63	55
07	Basic Health Unit Bhellar Wada Lot-2 (GPS: 27.247099°N, 68.456259°E)	ASTM E1686-16	dB (A)	55	55
08	Dargah Allah Abad Sharif Kandiaro Lot-1 (GPS: 27.054384°N, 68.215208°E)	ASTM E1686-16	dB (A)	60	65
09	Ghulam Rabani Agro Govt Degree College Kandiaro Lot-1(GPS: 27.259329°N, 68.487656°E)	ASTM E1686-16	dB (A)	53	55
10	Basic Health Unit Plus Kundha Khahi Lot-1 (GPS: 27.868852°N, 68.15158°E)	ASTM E1686-16	dB (A)	62	55

Measurement of uncertainty, statement of conformity, opinions & Interpretations will be provided on customer Demand.

SEQS Limits = Sindh Environmental Quality Standard (Reference: SEQS 2016)

N.D. = Not Detected.

Analyzed By (Assistant analyst) **Reviewed By (Analyst)** **Approved By (Chief Analyst)**

Disclaimer:

- Report is Valid for current batch (sample).
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ANNEXURE – C

SURFACE WATER RESULTS

Lab Report No. : 202404331-NESPAK-WW

Invoice Bill No. : INV-NESPAK-390

Reporting Date: 20-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Sample ID:	**WW-202404331**
Project Name:	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Sample Collection Date:	**05-April-2024**
Sample Description:	**Surface Water from Pond at Lot-1** **(GPS: 26.779265°N, 68.089118°E)**
Sample Type:	Liquid – Grab Sample
Sample Collected / Submitted By:	Envi Tech AL
Date of Analysis:	07-April-2024 to 20-April-2024
Test Description:	Sindh Standards – Wastewater Quality (32– Parameters)

ANALYTICAL TEST REPORT

Sr. #	Parameters / Analytes Description	Methods	Unit	Test Results	SEQS Limits		
					1	2	3
01	Temperature 40 °C	*APHA 2550	°C	20.4	≤ 3°C	≤ 3°C	≤ 3°C
02	pH	*APHA 4500 H-B	-	8.0	6-9	6-9	6-9
03	Sulphide	*APHA 4500-S^{-2}-D	mg/L	N.D.	1.0	1.0	1.0
04	Biology Oxygen Demand $(BOD)_5$	***HACH 10099	mg/L	76	80	250	80
05	Chemical Oxygen Demand (COD)	***HACH 8000	mg/L	207	150	400	400
06	Total Dissolved Solids (TDS)	*APHA 2540-C	mg/L	10970	3500	3500	3500
07	Total Suspended Solids (TSS)	*APHA 2540-D	mg/L	316	200	400	200
08	Oil & Grease	ASTM D-3921	mg/L	N.D.	10	10	10
09	Cadmium	*APHA 3111-B	mg/L	N.D.	0.1	0.1	0.1
10	Selenium	*APHA 3114-B	mg/L	N.D.	0.5	0.5	0.5
11	Chromium	*APHA 3111-B	mg/L	0.4	1.0	1.0	1.0
12	Zinc	*APHA 3111-B	mg/L	7.7	5.0	5.0	5.0
13	Arsenic	*APHA 3114-B	mg/L	N.D.	1.0	1.0	1.0
14	Chloride	*APHA 4500 Cl-B	mg/L	2549	1000	1000	**SC
15	Residual Chlorine	***HACH 10069	mg/L	N.D.	1.0	1.0	1.0
16	Fluoride	***HACH 8029	mg/L	0.8	10	10	10

Lab Report No. : 202404331-NESPAK-WW
Invoice Bill No. : INV-NESPAK-390

Reporting Date: 20-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Sample ID:	**WW-202404331**
Project Name:	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Sample Collection Date:	**05-April-2024**
Sample Description:	**Surface Water from Pond at Lot-1 (GPS: 26.779265°N, 68.089118°E)**
Sample Type:	Liquid – Grab Sample
Sample Collected / Submitted By:	Envi Tech AL
Date of Analysis:	07-April-2024 to 20-April-2024
Test Description:	Sindh Standards – Wastewater Quality (32– Parameters)

ANALYTICAL TEST REPORT

Sr. #	Parameters / Analytes Description	Methods	Unit	Test Results	SEQS Limits		
					1	2	3
17	Cyanide (CN)	***HACH 8027	mg/L	N.D.	1.0	1.0	1.0
18	Silver	*APHA 3111-B	mg/L	N.D.	-	-	-
19	Total Toxic Metals	*APHA 3111	mg/L	N.D.	2.0	2.0	2.0
20	Sulphate	***HACH 8051	mg/L	3457	600	1000	**SC
21	An Ionic Detergent As MBAs	*APHA 5540 C	mg/L	N.D.	20	20	20
22	Boron (B)	***HACH 8015	mg/L	N.D.	6.0	6.0	6.0
23	Ammonia (NH_3)	***HACH 8038	mg/L	N.D.	40	40	40
24	Phenolic Compounds as Phenols	ASTM-D-1783	mg/L	N.D.	0.1	0.3	0.3
25	Barium (Ba)	***HACH 8014	mg/L	N.D.	1.5	1.5	1.5
26	Pesticide	USEPA-614.1	mg/L	N.D.	0.15	0.15	0.15
27	Copper	*APHA 3111-B	mg/L	N.D.	1.0	1.0	1.0
28	Iron	*APHA 3111-B	mg/L	3.0	8.0	8.0	8.0
29	Lead	*APHA 3111-B	mg/L	N.D.	0.5	0.5	0.5
30	Manganese	*APHA 3111-B	mg/L	0.7	1.5	1.5	1.5
31	Mercury	*APHA 3112-B	mg/L	N.D.	0.01	0.01	0.01
32	Nickel	*APHA 3111-B	mg/L	N.D.	1.0	1.0	1.0

Lab Report No. : 202404331-NESPAK-WW

Invoice Bill No. : INV-NESPAK-390

Page: 3 of 3

Reporting Date: 20-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Sample ID:	**WW-202404331**
Project Name:	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Sample Collection Date:	**05-April-2024**
Sample Description:	**Surface Water from Pond at Lot-1 (GPS: 26.779265°N, 68.089118°E)**
Sample Type:	Liquid – Grab Sample
Sample Collected / Submitted By:	Envi Tech AL
Date of Analysis:	07-April-2024 to 20-April-2024
Test Description:	Sindh Standards – Wastewater Quality (32– Parameters)

Note: Measurement of uncertainty, statement of conformity, opinions & Interpretations will be provided on customer Demand.
Environmental Conditions at the time of Testing; Temperature: 24.2 °C (± 1°C) & Humidity: 50 % (± 3%).

*APHA Standard Methods for Examination of water & wastewater 23rd Edition (2017).

***HACH Method 8000 (Edition 10-2019); HACH 8014(Edition 09-2014); HACH 8015(Edition 08-2014); HACH 8027(Edition 09-2014); HACH 8029 (Edition 10-2018); HACH Method 8038 (Edition 10-2015); HACH 8051(Edition 11-2019); HACH 10069(Edition 11-2014); HACH 10099 (Edition 8-2015).

SEQS Limits = Sindh Environmental Quality Standard (Reference: SEQS 2016).

1=*SEQS for Municipal & Liquid Industrial Effluent into inland waters.*

2= *SEQS for Municipal & Liquid Industrial Effluent into Sewage Treatment.*

3=*SEQS for Municipal & Liquid Industrial Effluent into Sea.*

** Discharge Concentration at or below Sea Concentration (SC).

N.D. = Not Detected.

Analyzed By (Assistant Analyst) | Reviewed By (Analyst) | Approved By (Chief Analyst)

Disclaimer:

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Lab Report No. : 202404330-NESPAK-WW
Invoice Bill No. : INV-NESPAK-390

Reporting Date: 20-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Sample ID:	**WW-202404330**
Project Name:	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Sample Collection Date:	**05-April-2024**
Sample Description:	**Surface Water from Canal at Lot-2** **(GPS: 26.976807°N, 68.203555°E)**
Sample Type:	Liquid – Grab Sample
Sample Collected / Submitted By:	Envi Tech AL
Date of Analysis:	07-April-2024 to 20-April-2024
Test Description:	Sindh Standards – Wastewater Quality (32– Parameters)

ANALYTICAL TEST REPORT

Sr. #	Parameters / Analytes Description	Methods	Unit	Test Results	SEQS Limits		
					1	2	3
01	Temperature 40 °C	*APHA 2550	°C	19.2	≤ 3°C	≤ 3°C	≤ 3°C
02	pH	*APHA 4500 H-B	-	7.9	6-9	6-9	6-9
03	Sulphide	*APHA 4500-S^{-2}-D	mg/L	N.D.	1.0	1.0	1.0
04	Biology Oxygen Demand $(BOD)_5$	***HACH 10099	mg/L	< 2	80	250	80
05	Chemical Oxygen Demand (COD)	***HACH 8000	mg/L	6	150	400	400
06	Total Dissolved Solids (TDS)	*APHA 2540-C	mg/L	221	3500	3500	3500
07	Total Suspended Solids (TSS)	*APHA 2540-D	mg/L	319	200	400	200
08	Oil & Grease	ASTM D-3921	mg/L	N.D.	10	10	10
09	Cadmium	*APHA 3111-B	mg/L	N.D.	0.1	0.1	0.1
10	Selenium	*APHA 3114-B	mg/L	N.D.	0.5	0.5	0.5
11	Chromium	*APHA 3111-B	mg/L	N.D.	1.0	1.0	1.0
12	Zinc	*APHA 3111-B	mg/L	0.2	5.0	5.0	5.0
13	Arsenic	*APHA 3114-B	mg/L	N.D.	1.0	1.0	1.0
14	Chloride	*APHA 4500 Cl-B	mg/L	17	1000	1000	**SC
15	Residual Chlorine	***HACH 10069	mg/L	N.D.	1.0	1.0	1.0
16	Fluoride	***HACH 8029	mg/L	0.2	10	10	10

Lab Report No. : 202404330-NESPAK-WW

Invoice Bill No. : INV-NESPAK-390

Reporting Date: 20-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Sample ID:	**WW-202404330**
Project Name:	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Sample Collection Date:	**05-April-2024**
Sample Description:	**Surface Water from Canal at Lot-2 (GPS: 26.976807°N, 68.203555°E)**
Sample Type:	Liquid – Grab Sample
Sample Collected / Submitted By:	Envi Tech AL
Date of Analysis:	07-April-2024 to 20-April-2024
Test Description:	Sindh Standards – Wastewater Quality (32– Parameters)

ANALYTICAL TEST REPORT

Sr. #	Parameters / Analytes Description	Methods	Unit	Test Results	SEQS Limits		
					1	2	3
17	Cyanide (CN)	***HACH 8027	mg/L	N.D.	1.0	1.0	1.0
18	Silver	*APHA 3111-B	mg/L	N.D.	-	-	-
19	Total Toxic Metals	*APHA 3111	mg/L	N.D.	2.0	2.0	2.0
20	Sulphate	***HACH 8051	mg/L	62	600	1000	**SC
21	An Ionic Detergent As MBAs	*APHA 5540 C	mg/L	N.D.	20	20	20
22	Boron (B)	***HACH 8015	mg/L	N.D.	6.0	6.0	6.0
23	Ammonia (NH_3)	***HACH 8038	mg/L	N.D.	40	40	40
24	Phenolic Compounds as Phenols	ASTM-D-1783	mg/L	N.D.	0.1	0.3	0.3
25	Barium (Ba)	***HACH 8014	mg/L	N.D.	1.5	1.5	1.5
26	Pesticide	USEPA-614.1	mg/L	N.D.	0.15	0.15	0.15
27	Copper	*APHA 3111-B	mg/L	N.D.	1.0	1.0	1.0
28	Iron	*APHA 3111-B	mg/L	0.1	8.0	8.0	8.0
29	Lead	*APHA 3111-B	mg/L	N.D.	0.5	0.5	0.5
30	Manganese	*APHA 3111-B	mg/L	N.D.	1.5	1.5	1.5
31	Mercury	*APHA 3112-B	mg/L	N.D.	0.01	0.01	0.01
32	Nickel	*APHA 3111-B	mg/L	N.D.	1.0	1.0	1.0

Lab Report No. : 202404330-NESPAK-WW **Page:** 3 of 3
Invoice Bill No. : INV-NESPAK-390 **Reporting Date:** 20-04-2024

Report to:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad
Attention:	M/s. National Engineering Services Pakistan (Pvt) Limited Address. NESPAK House, H&TE, 2nd Floor, Sector G-5/2, Islamabad

Sample ID:	**WW-202404330**
Project Name:	Emergency Flood Assistance Project from Ranipur to Moro Road, Sindh
Sample Collection Date:	**05-April-2024**
Sample Description:	**Surface Water from Canal at Lot-2** **(GPS: 26.976807°N, 68.203555°E)**
Sample Type:	Liquid – Grab Sample
Sample Collected / Submitted By:	Envi Tech AL
Date of Analysis:	07-April-2024 to 20-April-2024
Test Description:	Sindh Standards – Wastewater Quality (32– Parameters)

Note: Measurement of uncertainty, statement of conformity, opinions & Interpretations will be provided on customer Demand.
Environmental Conditions at the time of Testing; Temperature: 24.2 °C (± 1°C) & Humidity: 50 % (± 3%).

*APHA Standard Methods for Examination of water & wastewater 23rd Edition (2017).

***HACH Method 8000 (Edition 10-2019); HACH 8014(Edition 09-2014); HACH 8015(Edition 08-2014); HACH 8027(Edition 09-2014); HACH 8029 (Edition 10-2018); HACH Method 8038 (Edition 10-2015); HACH 8051(Edition 11-2019); HACH 10069(Edition 11-2014); HACH 10099 (Edition 8-2015).

SEQS Limits = Sindh Environmental Quality Standard (Reference: SEQS 2016).

1=*SEQS for Municipal & Liquid Industrial Effluent into inland waters.*

2= *SEQS for Municipal & Liquid Industrial Effluent into Sewage Treatment.*

3=*SEQS for Municipal & Liquid Industrial Effluent into Sea.*

** Discharge Concentration at or below Sea Concentration (SC).

N.D. = Not Detected.

Analyzed By (Assistant Analyst)	**Reviewed By (Analyst)**	**Approved By (Chief Analyst)**

Disclaimer:

- Report is Valid for current batch (sample).
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ANNEXURE – D

PHOTOLOG

Figure # 1. Ambient Air Monitoring at NH5

Figure # 2. Ambient Air Monitoring at AH-2

Figure # 3. Near Ranipur Toll Plaza Lot-2

Figure # 4. Halani Police Station Lot-2

Figure # 5. Mosque Lot-2

Figure # 6. Dargah Allah Abad Sharif Kandiaro Lot-1

Figure # 7. Evergreen Public High School Hingorja Lot-2

Figure # 8. Government High School Gadegi Lot-2

Figure # 9. Government High School Khairpur Lot-2

Figure # 10. Basic Health Unit Bhellar Wada Lot-2

Figure # 11. Ghulam Rabani Agro Govt Degree College Kandiaro Lot-1

Figure # 12. Basic Health Unit Plus Kundha Khahi Lot-1

Figure # 13. SW from Canal at Lot-2	Figure # 14. SW from Pond at Lot-1

ENVIRONMENTAL MONITORING & ANALYSIS REPORT

DETAILED DESIGN FOR WIDENNING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (487 KM) PACKAGES-7: RAWALPINDI TO HASSANABDAL (48 KMS)

- Ambient Air Monitoring
- Noise Monitoring
- Drinking Water Monitoring
- Surface Water Monitoring
- Wastewater Analysis

Report Reference No: AES-ENV-NP-07/2024 | Dated: 21 January, 2025

Customer Details	
Name of Contact Person	Mr. Kamran Yousuf
Designation	General Manager / Head
Contact No.	+92-42-99090000
Email	-
Address	Geotechnical and Geoenvironmental Engineering Division, National Engineering Services Pakistan (Pvt.) Limited 1-C, Block N, Model Town Ext, Lahore 54700, Pakistan

AES Details	
AES Director	Mr. Aleem Butt
Contact No.	0300-0303616
Email	info@asianenvirolab.com
Address	C-3, Jhelum Block, Green Forts-II, Lahore

Aleem Butt

Director Asian Environmental Services

Ambient Air Monitoring Location-01

POINT-01

Package-7: Rawalpindi to Hassanabdal (48 Kms)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-01	Monitoring Point	Point 01
Date of Monitoring	08-01-2025 to 09-01-2025	Monitoring Coordinates	33°49'19.1" N 72°37'23.3" E

Sr. No.	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)
1	11:00	3.12	35.00	17.30	52.30	65.41
2	12:00	2.87	36.86	17.96	54.82	73.21
3	13:00	2.55	37.87	17.81	55.68	60.44
4	14:00	2.01	39.02	18.16	57.18	62.18
5	15:00	3.03	39.90	18.88	58.78	58.44
6	16:00	2.88	39.52	18.55	58.07	55.10
7	17:00	2.10	40.48	18.01	58.49	77.43
8	18:00	1.88	38.60	17.70	56.30	81.22
9	19:00	1.82	38.02	17.29	55.31	52.31
10	20:00	1.73	36.97	17.07	54.04	55.10
11	21:00	1.44	36.18	16.53	52.71	51.77
12	22:00	1.03	35.86	15.95	51.81	56.10
13	23:00	0.98	35.39	15.49	50.88	45.31
14	00:00	0.83	35.28	12.91	48.19	42.00
15	01:00	0.88	25.85	12.63	38.48	45.06
16	02:00	0.94	25.30	11.92	37.22	35.11
17	03:00	0.53	24.83	11.44	36.27	39.32
18	04:00	0.72	24.20	10.87	35.07	28.31
19	05:00	1.22	23.31	11.56	34.87	32.55
20	06:00	1.31	31.73	19.27	51.00	44.08
21	07:00	1.27	32.54	19.69	52.23	55.10
22	08:00	1.52	33.36	21.21	54.57	56.39
23	09:00	1.67	34.13	19.14	53.27	54.87
24	10:00	1.20	34.02	20.01	54.03	54.01
Average Concentration		1.65	33.93	16.56	50.48	53.37

Monitored By

Reviewed By
(TM)

Approved By
(QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-01	Monitoring Point	Point 01
Date of Monitoring	08-01-2025 to 09-01-2025	Monitoring Coordinates	33°49'19.1" N 72°37'23.3" E

Parameters	Method of Measurement	Monitoring Duration	LDL	Average Obtained Concentration	PEQS	Remarks
Nitrogen Dioxide (NO_2) *	Gas Phase Chemiluminescence	24Hours	1.00	16.56	80.0 µg/m^3	Optimal
Nitrogen Oxide (NO)*	Gas Phase Chemiluminescence	24Hours	1.00	33.93	40.0 µg/m^3	Optimal
NO_x*	Gas Phase Chemiluminescence	24Hours	1.00	50.48	NGVS µg/m^3	-
Sulphur Dioxide (SO_2) *	Ultraviolet Fluorescence method	24Hours	1.00	53.37	120.0 µg/m^3	Optimal
Carbon Monoxide (CO)*	Non-Dispersive Infra-Red (NDIR)	24Hours	0.01	1.65	05.0 mg/m^3	Optimal
Ozone*	Non-Dispersive UV absorption Method	01 Hours	1.00	77	130 µg/m^3	Optimal
Lead*	ASS method after sampling using EPM 2000	24 Hours	0.07	1.2	1.5 µg/m^3	Optimal
Particulate Matter (PM_{10}) *	β Ray absorption method	24Hours	1.00	123	150.0 µg/m^3	Optimal
Particulate Matter ($PM_{2.5}$) *	β Ray absorption method	24Hours	1.00	43	35.0 µg/m^3	High
Total Particulate Matter (TSP)	Gravimetric Sampling	24Hours	1.00	186	500.0 µg/m^3	Optimal

*Parameters are approved from Punjab Environmental Protection Agency.

Abbreviations:
LDL= Lower Detection Limit
PEQS= Punjab Environmental Quality Standards
µg/m^3 = Micro Gram per Meter Cube
mg/m^3 = Milli Gram per Meter Cube

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-01	Monitoring Point	Point 01
Date of Monitoring	08-01-2025 to 09-01-2025	Monitoring Coordinates	33°49'19.1" N 72°37'23.3" E

Sr. No.	Time	Ambient Temperature ^{0}C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
1	11:00	8	SW	3.32	50	762.1
2	12:00	10	SW	3.22	47	762.5
3	13:00	13	SW	3.12	39	762.0
4	14:00	15	SW	3.82	42	762.4
5	15:00	17	SW	3.92	44	762.5
6	16:00	16	SW	3.22	48	761.0
7	17:00	14	SW	3.02	52	761.2
8	18:00	13	SW	3.32	59	761.4
9	19:00	12	SW	2.82	62	761.6
10	20:00	12	SW	2.72	62	761.8
11	21:00	11	SW	2.82	66	760.1
12	22:00	10	SW	2.42	65	760.3
13	23:00	10	SW	2.22	69	760.5
14	00:00	9	SW	2.82	72	760.7
15	01:00	9	SE	2.52	74	760.4
16	02:00	9	SE	2.32	74	760.2
17	03:00	8	N	2.12	78	760.3
18	04:00	8	N	2.92	78	761.6
19	05:00	8	N	2.72	79	761.1
20	06:00	9	N	3.22	78	762.0
21	07:00	10	N	3.42	72	762.8
22	08:00	10	N	3.62	67	762.2
23	09:00	11	N	3.32	59	762.3
24	10:00	12	N	3.92	55	762.7

Monitored By	Reviewed By (TM)	Approved By (QM)

NOISE MONITORING REPORT

Monitoring Details			
Report Reference No.	AES-ENV-NP-07-2025-AA-01	Monitoring Point	Point 01
Date of Monitoring	08-01-2025 to 09-01-2025	Monitoring Coordinates	33°49'19.1" N 72°37'23.3" E

Sr. No.	Time	Noise dB(A)	
1	11:00	83	Day Time
2	12:00	83	
3	13:00	82	
4	14:00	81	
5	15:00	80	
6	16:00	79	
7	17:00	82	
8	18:00	81	
9	19:00	79	
10	20:00	77	
11	21:00	76	
12	22:00	75	Night Time
13	23:00	74	
14	00:00	73	
15	01:00	69	
16	02:00	66	
17	03:00	64	
18	04:00	58	
19	05:00	59	
20	06:00	63	
21	07:00	70	Day Time
22	08:00	78	
23	09:00	81	
24	10:00	79	

	PEQS	Average Values	Remarks
Day Time	65	79	High
Night Time	55	67	High

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

Ambient Air Monitoring Location-02

POINT-02

Package-7: Rawalpindi to Hassanabdal (48 Kms)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-02	Monitoring Point	Point 02
Date of Monitoring	09-01-2025 to 10-01-2025	Monitoring Coordinates	33°40'27.9" N 72°51'13.4" E

Sr. No.	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)
1	11:00	1.44	32.86	17.22	50.08	49.32
2	12:00	1.78	33.78	16.13	49.91	50.60
3	13:00	1.94	34.77	18.10	52.87	63.21
4	14:00	2.37	36.05	21.59	57.64	60.43
5	15:00	3.11	37.06	22.25	59.31	55.17
6	16:00	3.45	36.84	22.10	58.94	54.86
7	17:00	3.46	37.36	31.01	68.37	55.59
8	18:00	4.03	38.47	33.44	71.91	57.13
9	19:00	3.81	37.97	29.87	67.84	56.42
10	20:00	2.67	37.14	25.63	62.77	55.27
11	21:00	2.91	36.67	21.99	58.66	54.62
12	22:00	2.90	36.03	21.58	57.61	53.73
13	23:00	1.43	35.69	21.36	57.05	53.26
14	00:00	1.01	34.87	20.82	55.69	52.11
15	01:00	1.78	33.98	20.24	54.22	50.89
16	02:00	0.87	33.27	19.78	53.05	49.89
17	03:00	0.65	32.39	19.20	51.59	39.22
18	04:00	1.33	31.96	18.92	50.88	48.06
19	05:00	1.01	30.87	18.21	49.08	46.55
20	06:00	1.61	30.14	17.73	47.87	45.53
21	07:00	1.82	29.25	17.16	46.41	44.30
22	08:00	1.08	30.32	17.85	48.17	58.11
23	09:00	2.60	31.41	22.43	53.84	60.20
24	10:00	1.04	32.05	23.03	55.08	66.81
Average Concentration		2.12	34.28	21.76	56.03	53.56

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-02	Monitoring Point	Point 02
Date of Monitoring	09-01-2025 to 10-01-2025	Monitoring Coordinates	33°40'27" N 72°51'13.4" E

Parameters	Method of Measurement	Monitoring Duration	LDL	Average Obtained Concentration	PEQS	Remarks
Nitrogen Dioxide (NO_2) *	Gas Phase Chemiluminescence	24Hours	1.00	21.76	80.0 µg/m³	Optimal
Nitrogen Oxide (NO)*	Gas Phase Chemiluminescence	24Hours	1.00	34.28	40.0 µg/m³	Optimal
NO_x*	Gas Phase Chemiluminescence	24Hours	1.00	56.03	NGVS µg/m³	-
Sulphur Dioxide (SO_2) *	Ultraviolet Fluorescence method	24Hours	1.00	53.56	120.0 µg/m³	Optimal
Carbon Monoxide (CO)*	Non-Dispersive Infra-Red (NDIR)	24Hours	0.01	2.28	05.0 mg/m³	Optimal
Ozone*	Non-Dispersive UV absorption Method	01 Hours	1.00	67	130 µg/m³	Optimal
Lead*	ASS method after sampling using EPM 2000	24 Hours	0.07	1.1	1.5 µg/m³	Optimal
Particulate Matter (PM_{10}) *	β Ray absorption method	24Hours	1.00	131	150.0 µg/m³	Optimal
Particulate Matter ($PM_{2.5}$) *	β Ray absorption method	24Hours	1.00	46	35.0 µg/m³	High
Total Particulate Matter (TSP)	Gravimetric Sampling	24Hours	1.00	196	500.0 µg/m³	Optimal

*Parameters are approved from Punjab Environmental Protection Agency.

Abbreviations:

LDL= Lower Detection Limit
PEQS= Punjab Environmental Quality Standards
µg/m³ = Micro Gram per Meter Cube
mg/m³ = Milli Gram per Meter Cube

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By
(TM)

Approved By
(QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-02	Monitoring Point	Point 02
Date of Monitoring	09-01-2025 to 10-01-2025	Monitoring Coordinates	33°40'27" N 72°51'13.4" E

Sr. No.	Time	Ambient Temperature ^0C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
1	11:00	8	SW	3.32	50	762.1
2	12:00	10	SW	3.22	47	762.5
3	13:00	13	SW	3.12	39	762.0
4	14:00	15	SW	3.82	42	762.4
5	15:00	17	SW	3.92	44	762.5
6	16:00	16	SW	3.22	48	761.0
7	17:00	14	SW	3.02	52	761.2
8	18:00	13	SW	3.32	59	761.4
9	19:00	12	SW	2.82	62	761.6
10	20:00	12	SW	2.72	62	761.8
11	21:00	11	SW	2.82	66	760.1
12	22:00	10	SW	2.42	65	760.3
13	23:00	10	SW	2.22	69	760.5
14	00:00	9	SW	2.82	72	760.7
15	01:00	9	SE	2.52	74	760.4
16	02:00	9	SE	2.32	74	760.2
17	03:00	8	N	2.12	78	760.3
18	04:00	8	N	2.92	78	761.6
19	05:00	8	N	2.72	79	761.1
20	06:00	9	N	3.22	78	762.0
21	07:00	10	N	3.42	72	762.8
22	08:00	10	N	3.62	67	762.2
23	09:00	11	N	3.32	59	762.3
24	10:00	12	N	3.92	55	762.7

Monitored By

Reviewed By
(TM)

Approved By
(QM)

NOISE MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-02	Monitoring Point	Point 02
Date of Monitoring	09-01-2025 to 10-01-2025	Monitoring Coordinates	33°40'27" N 72°51'13.4" E

Sr. No.	Time	Noise dB(A)	
1	11:00	78	Day Time
2	12:00	82	
3	13:00	81	
4	14:00	83	
5	15:00	84	
6	16:00	84	
7	17:00	81	
8	18:00	83	
9	19:00	77	
10	20:00	74	
11	21:00	72	
12	22:00	71	Night Time
13	23:00	70	
14	00:00	69	
15	01:00	69	
16	02:00	68	
17	03:00	66	
18	04:00	65	
19	05:00	66	
20	06:00	68	
21	07:00	70	Day Time
22	08:00	72	
23	09:00	73	
24	10:00	76	

	PEQS	Average Values	Remarks
Day Time	65	78	High
Night Time	55	68	High

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

Ambient Air Monitoring Location-03

POINT-03

Package-7: Rawalpindi to Hassanabdal (48 Kms)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-03	Monitoring Point	Point 03
Date of Monitoring	10-01-2025 to 11-01-2025	Monitoring Coordinates	33°45'17" N 72°45'17" E

Sr. No.	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)
1	11:00	1.99	29.77	24.98	54.75	57.67
2	12:00	2.02	27.87	26.88	54.75	57.88
3	13:00	2.08	34.87	30.88	65.75	59.15
4	14:00	1.67	45.12	28.65	73.77	57.61
5	15:00	1.60	44.87	26.76	71.63	56.67
6	16:00	1.53	39.39	25.67	65.06	54.56
7	17:00	1.47	42.11	27.12	69.23	54.01
8	18:00	1.43	32.86	25.76	58.62	52.62
9	19:00	1.35	31.81	22.11	53.92	51.21
10	20:00	1.30	31.02	22.25	53.27	49.52
11	21:00	1.23	33.96	18.56	52.52	48.26
12	22:00	1.16	34.11	19.43	53.54	45.86
13	23:00	1.11	30.12	16.42	46.54	45.44
14	00:00	1.08	29.68	15.77	45.45	44.84
15	01:00	1.05	29.14	18.09	47.23	44.11
16	02:00	1.09	27.87	19.22	47.09	43.19
17	03:00	1.15	22.66	14.45	37.11	46.25
18	04:00	1.20	27.15	20.44	47.59	47.58
19	05:00	1.25	26.57	21.11	47.68	48.50
20	06:00	1.36	27.38	23.87	51.25	49.99
21	07:00	1.49	32.98	20.19	53.17	50.98
22	08:00	1.62	35.09	24.98	60.07	52.42
23	09:00	1.80	34.71	32.07	66.78	54.22
24	10:00	1.89	35.66	23.04	58.70	57.67
Average Concentration		1.43	32.66	22.85	55.68	50.98

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-03	Monitoring Point	Point 03
Date of Monitoring	10-01-2025 to 11-01-2025	Monitoring Coordinates	33°45'17" N 72°45'17" E

Parameters	Method of Measurement	Monitoring Duration	LDL	Average Obtained Concentration	PEQS	Remarks
Nitrogen Dioxide (NO_2) *	Gas Phase Chemiluminescence	24Hours	1.00	22.85	80.0 µg/m³	Optimal
Nitrogen Oxide (NO)*	Gas Phase Chemiluminescence	24Hours	1.00	32.66	40.0 µg/m³	Optimal
NO_x*	Gas Phase Chemiluminescence	24Hours	1.00	55.68	NGVS µg/m³	-
Sulphur Dioxide (SO_2) *	Ultraviolet Fluorescence method	24Hours	1.00	50.98	120.0 µg/m³	Optimal
Carbon Monoxide (CO)*	Non-Dispersive Infra-Red (NDIR)	24Hours	0.01	1.43	05.0 mg/m³	Optimal
Ozone*	Non-Dispersive UV absorption Method	01 Hours	1.00	72	130 µg/m³	Optimal
Lead*	ASS method after sampling using EPM 2000	24 Hours	0.07	1.2	1.5 µg/m³	Optimal
Particulate Matter (PM_{10}) *	β Ray absorption method	24Hours	1.00	137	150.0 µg/m³	Optimal
Particulate Matter ($PM_{2.5}$) *	β Ray absorption method	24Hours	1.00	50	35.0 µg/m³	High
Total Particulate Matter (TSP)	Gravimetric Sampling	24Hours	1.00	211	500.0 µg/m³	Optimal

*Parameters are approved from Punjab Environmental Protection Agency.

Abbreviations:
LDL= Lower Detection Limit
PEQS= Punjab Environmental Quality Standards
µg/m³ = Micro Gram per Meter Cube
mg/m³ = Milli Gram per Meter Cube

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-03	Monitoring Point	Point 03
Date of Monitoring	10-01-2025 to 11-01-2025	Monitoring Coordinates	33°45'17" N 72°45'17" E

Sr. No.	Time	Ambient Temperature ^0C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
1	11:00	11	SE	4.18	55	762.9
2	12:00	13	SE	3.58	50	762.3
3	13:00	14	SE	3.48	47	762.7
4	14:00	16	SW	3.38	39	762.2
5	15:00	17	SW	4.08	42	762.6
6	16:00	17	SW	4.18	44	762.7
7	17:00	16	SW	3.48	48	761.2
8	18:00	15	SW	3.28	52	761.4
9	19:00	14	SW	3.58	59	761.6
10	20:00	13	SW	3.08	62	761.8
11	21:00	13	SW	2.98	62	762.0
12	22:00	12	SE	3.08	66	760.3
13	23:00	11	SE	2.68	65	760.5
14	00:00	10	E	2.48	69	760.7
15	01:00	10	E	3.08	72	760.9
16	02:00	10	E	2.78	74	760.6
17	03:00	9	E	2.58	74	760.4
18	04:00	9	SE	2.38	78	760.5
19	05:00	9	SE	3.18	78	761.8
20	06:00	8	SE	2.98	79	761.3
21	07:00	8	SE	3.48	72	762.2
22	08:00	9	SE	3.68	68	763.0
23	09:00	9	SE	3.88	67	762.4
24	10:00	10	SE	3.58	59	762.5

Monitored By

Reviewed By
(TM)

Approved By
(QM)

NOISE MONITORING REPORT

Monitoring Details			
Report Reference No.	AES-ENV-NP-07-2025-AA-03	Monitoring Point	Point 03
Date of Monitoring	10-01-2025 to 11-01-2025	Monitoring Coordinates	33°45'17" N 72°45'17" E

Sr. No.	Time	Noise dB(A)	
1	11:00	76	Day Time
2	12:00	80	
3	13:00	82	
4	14:00	83	
5	15:00	83	
6	16:00	80	
7	17:00	82	
8	18:00	76	
9	19:00	70	
10	20:00	66	
11	21:00	61	
12	22:00	60	Night Time
13	23:00	59	
14	00:00	59	
15	01:00	58	
16	02:00	56	
17	03:00	55	
18	04:00	56	
19	05:00	58	
20	06:00	60	
21	07:00	62	Day Time
22	08:00	66	
23	09:00	68	
24	10:00	72	

	PEQS	Average Values	Remarks
Day Time	65	73	High
Night Time	55	58	High

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

Ambient Air Monitoring Location-04

POINT-04

Package-7: Rawalpindi to Hassanabdal (48 Kms)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-04	Monitoring Point	Point 04
Date of Monitoring	11-01-2025 to 12-01-2025	Monitoring Coordinates	34°49'17" N 72°40'37" E

Sr. No.	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)
1	11:00	3.12	42.63	27.88	70.51	67.33
2	12:00	2.81	39.44	25.40	64.84	74.10
3	13:00	2.03	38.67	25.11	63.78	81.93
4	14:00	2.13	37.88	26.20	64.08	88.43
5	15:00	3.66	39.42	24.10	63.52	75.40
6	16:00	4.01	34.89	27.43	62.32	77.60
7	17:00	3.81	35.84	25.19	61.03	60.11
8	18:00	3.66	33.97	21.00	54.97	62.30
9	19:00	2.84	33.38	22.31	55.69	64.93
10	20:00	2.61	32.33	24.40	56.73	55.43
11	21:00	2.55	31.54	18.91	50.45	55.11
12	22:00	2.5	31.22	20.33	51.55	56.10
13	23:00	2.42	30.76	17.60	48.36	50.22
14	00:00	2.38	30.64	15.11	45.75	48.10
15	01:00	2.31	30.21	14.81	45.02	47.93
16	02:00	1.03	29.67	15.03	44.70	47.03
17	03:00	1.89	29.20	17.45	46.65	42.44
18	04:00	1.66	28.56	16.74	45.30	44.60
19	05:00	0.73	27.68	16.26	43.94	58.41
20	06:00	2.17	27.09	15.69	42.78	55.03
21	07:00	2.23	27.90	16.38	44.28	56.11
22	08:00	2.27	33.11	17.09	50.20	61.11
23	09:00	2.33	34.40	17.51	51.91	64.83
24	10:00	2.43	35.66	23.04	58.70	63.30
Average Concentration		2.45	32.76	20.13	52.89	60.46

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-04	Monitoring Point	Point 04
Date of Monitoring	11-01-2025 to 12-01-2025	Monitoring Coordinates	34°49'17" N 72°40'37" E

Parameters	Method of Measurement	Monitoring Duration	LDL	Average Obtained Concentration	PEQS	Remarks
Nitrogen Dioxide (NO_2) *	Gas Phase Chemiluminescence	24Hours	1.00	20.13	80.0 µg/m^3	Optimal
Nitrogen Oxide (NO)*	Gas Phase Chemiluminescence	24Hours	1.00	32.76	40.0 µg/m^3	Optimal
NO_x*	Gas Phase Chemiluminescence	24Hours	1.00	52.89	NGVS µg/m^3	-
Sulphur Dioxide (SO_2) *	Ultraviolet Fluorescence method	24Hours	1.00	60.46	120.0 µg/m^3	Optimal
Carbon Monoxide (CO)*	Non-Dispersive Infra-Red (NDIR)	24Hours	0.01	2.45	05.0 mg/m^3	Optimal
Ozone*	Non-Dispersive UV absorption Method	01 Hours	1.00	77	130 µg/m^3	Optimal
Lead*	ASS method after sampling using EPM 2000	24 Hours	0.07	0.9	1.5 µg/m^3	Optimal
Particulate Matter (PM_{10}) *	β Ray absorption method	24Hours	1.00	119	150.0 µg/m^3	Optimal
Particulate Matter ($PM_{2.5}$) *	β Ray absorption method	24Hours	1.00	39	35.0 µg/m^3	High
Total Particulate Matter (TSP)	Gravimetric Sampling	24Hours	1.00	179	500.0 µg/m^3	Optimal

*Parameters are approved from Punjab Environmental Protection Agency.

Abbreviations:
LDL= Lower Detection Limit
PEQS= Punjab Environmental Quality Standards
µg/m^3 = Micro Gram per Meter Cube
mg/m^3 = Milli Gram per Meter Cube

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-ENV-NP-07-2025-AA-04	Monitoring Point	Point 04
Date of Monitoring	11-01-2025 to 12-01-2025	Monitoring Coordinates	34°49'17" N 72°40'37" E

Sr. No.	Time	Ambient Temperature ^0C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
1	11:00	12	E	2.55	44	764.1
2	12:00	13	E	1.95	43	763.5
3	13:00	14	E	1.85	42	763.9
4	14:00	17	SE	1.75	41	763.4
5	15:00	18	SE	2.45	43	763.8
6	16:00	17	SE	2.55	43	763.9
7	17:00	16	SE	1.85	46	762.4
8	18:00	14	SE	1.65	46	762.6
9	19:00	14	SE	1.95	47	762.8
10	20:00	13	SE	1.45	47	763.0
11	21:00	13	E	1.35	52	763.2
12	22:00	12	E	1.45	52	761.5
13	23:00	12	E	1.05	57	761.7
14	00:00	11	E	0.85	59	761.9
15	01:00	10	E	1.45	63	762.1
16	02:00	10	E	1.15	66	761.8
17	03:00	9	SE	0.95	68	761.6
18	04:00	9	SE	0.75	69	761.7
19	05:00	9	SE	1.55	69	763.0
20	06:00	8	SE	1.35	71	762.5
21	07:00	8	SE	1.85	64	763.4
22	08:00	9	SE	2.05	61	764.2
23	09:00	11	E	2.25	56	763.6
24	10:00	12	E	1.95	48	763.7

Monitored By

Reviewed By
(TM)

Approved By
(QM)

NOISE MONITORING REPORT

Monitoring Details			
Report Reference No.	AES-ENV-NP-07-2025-AA-04	Monitoring Point	Point 04
Date of Monitoring	11-01-2025 to 12-01-2025	Monitoring Coordinates	34°49'17" N 72°40'37" E

Sr. No.	Time	Noise dB(A)	
1	11:00	76	Day Time
2	12:00	75	
3	13:00	77	
4	14:00	78	
5	15:00	78	
6	16:00	75	
7	17:00	73	
8	18:00	68	
9	19:00	64	
10	20:00	60	
11	21:00	59	
12	22:00	58	Night Time
13	23:00	58	
14	00:00	57	
15	01:00	56	
16	02:00	58	
17	03:00	59	
18	04:00	60	
19	05:00	62	
20	06:00	64	
21	07:00	66	Day Time
22	08:00	67	
23	09:00	70	
24	10:00	72	

	PEQS	Average Values	Remarks
Day Time	65	70	High
Night Time	55	59	High

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-FMO-NP-07/2025-DW-01	Report Issue Date	21-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-FMO-DW-01/2025	Sample Location/Co-ordinates	DW-01 (26 Number RWP) 33°49'36.1" N 72°37'57" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Drinking Water Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Laboratory Analysis					
Color*	SMWW 2120 C	≤ 15 TCU	0	N.A.	Optimal
Taste*	SMWW 2160 C	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Odor*	SMWW 2150 B	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Turbidity*	SMWW 2130 B	< 5 NTU	0	N.A.	Optimal
Total Hardness (as $CaCO_3$) **	SMWW 2340 C	< 500 mg/L	332	± 2.74	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	< 1000 mg/L	415	± 12.20	Optimal
pH**	SMWW 4500 H^+ B	6.5- 8.5	8.03	± 0.03	Optimal
Aluminum (Al)	SMWW 3111 B	≤ 0.2 mg/L	<0.005	N.A.	Optimal
Antimony (Sb)	SMWW 3114 B	≤ 0.005 mg/L	<0.005	N.A.	Optimal
Arsenic (As)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	0.7 mg/L	<0.0035	N.A.	Optimal
Boron (B)	SMWW 3113 B	0.3 mg/L	<0.02	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.01 mg/L	<0.006	N.A.	Optimal
Chloride (Cl^-) **	SMWW 4500-Cl^- B	< 250 mg/L	64	± 140	Optimal
Chromium (Cr)	SMWW 3113 B	≤ 0.05 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3111 B	2.0 mg/L	<0.164	N.A.	Optimal
Cyanide (CN^-)*	SMWW 4500-CN^- F	≤ 0.05 mg/L	0	N.A.	Optimal
Fluoride (F^-)**	SMWW 4500-F^- C	≤ 1.5 mg/L	0.39	± 0.06	Optimal
Lead (Pb)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Manganese (Mn)	SMWW 3113 B	≤ 0.5 mg/L	<0.015	N.A.	Optimal
Mercury (Hg)	SMWW 3114 B	≤ 0.001 mg/L	<0.001	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	≤0.02 mg/L	<0.02	N.A.	Optimal
Nitrate (NO_3^-) **	SMWW 4500-NO_3^- D	≤ 50 mg/L	82.6	± 0.06	Optimal
Nitrite (NO_2^-) *	SMWW 4500-NO_2^- B	≤ 3.0 mg/L	0	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.01 mg/L	<0.01	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500-Cl^- B	0.5 mg/L	0	N.A.	Optimal

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-FMO-NP-07/2025-DW-01	Report Issue Date	21-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-FMO-DW-01/2025	Sample Location/Co-ordinates	DW-01 (26 Number RWP) 33°49'36.1" N 72°37'57" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Drinking Water Analysis Results					
Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Phenolic Compounds (as Phenols) *	SMWW 5530 D	NGVS mg/L	0	N.A.	Optimal
Zinc (Zn)	SMWW 3113 B	5.0 mg/L	0.028	N.A.	Optimal
Microbiological Analysis					
Total Coliforms*	SMWW 9222 B	0 CFU / 100 mL	0	N.A.	Optimal
Fecal Coliforms *	SMWW 9222 D	0 CFU / 100 mL	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from Punjab EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

PEQS = Punjab Environmental Quality Standards
SMWW 24th Edition = Standard Methods for the examination of Water and Wastewater
TCU = True Color Unit
N.A. = Not Available
CFU = Colony Forming Unit
NTU = Nephelometric Turbidity Unit
MU = Measurement Uncertainty
NGVS = No Guideline Value Set

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

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Analyzed By	Reviewed By (TM)	Approved By (QM)

---------------End of Report---------------

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-DW-02	Report Issue Date	21-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-DW-02/2025	Sample Location/CO-ordinates	DW-02 (Pabbi Masjid) 33°49'7.4" N 72°40'59.2" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Drinking Water Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Laboratory Analysis					
Color*	SMWW 2120 C	≤ 15 TCU	0	N.A.	Optimal
Taste*	SMWW 2160 C	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Odor*	SMWW 2150 B	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Turbidity*	SMWW 2130 B	< 5 NTU	0	N.A.	Optimal
Total Hardness (as $CaCO_3$) **	SMWW 2340 C	< 500 mg/L	396	± 2.74	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	< 1000 mg/L	470	± 12.20	Optimal
pH**	SMWW 4500 H^+ B	6.5- 8.5	7.59	± 0.03	Optimal
Aluminum (Al)	SMWW 3111 B	≤ 0.2 mg/L	<0.005	N.A.	Optimal
Antimony (Sb)	SMWW 3114 B	≤ 0.005 mg/L	<0.005	N.A.	Optimal
Arsenic (As)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	0.7 mg/L	<0.0035	N.A.	Optimal
Boron (B)	SMWW 3113 B	0.3 mg/L	<0.02	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.01 mg/L	<0.006	N.A.	Optimal
Chloride (Cl^-) **	SMWW 4500-Cl^- B	< 250 mg/L	52	± 140	Optimal
Chromium (Cr)	SMWW 3113 B	≤ 0.05 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3111 B	2.0 mg/L	<0.164	N.A.	Optimal
Cyanide (CN^-)*	SMWW 4500-CN^- F	≤ 0.05 mg/L	0	N.A.	Optimal
Fluoride (F^-)**	SMWW 4500-F^- C	≤ 1.5 mg/L	0.35	± 0.06	Optimal
Lead (Pb)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Manganese (Mn)	SMWW 3113 B	≤ 0.5 mg/L	<0.015	N.A.	Optimal
Mercury (Hg)	SMWW 3114 B	≤ 0.001 mg/L	<0.001	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	≤0.02 mg/L	<0.02	N.A.	Optimal
Nitrate (NO_3^-) **	SMWW 4500-NO_3^- D	≤ 50 mg/L	111	± 0.06	High
Nitrite (NO_2^-) *	SMWW 4500-NO_2^- B	≤ 3.0 mg/L	0	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.01 mg/L	<0.01	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500-Cl^- B	0.5 mg/L	0	N.A.	Optimal

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-DW-02	Report Issue Date	21-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 $\pm$ 5) °C & (55 $\pm$ 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-DW-02/2025	Sample Location/CO-ordinates	DW-02 (Pabbi Masjid) 33°49'7.4" N 72°40'59.2" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Drinking Water Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Phenolic Compounds (as Phenols) *	SMWW 5530 D	NGVS mg/L	0	N.A.	Optimal
Zinc (Zn)	SMWW 3113 B	5.0 mg/L	0.032	N.A.	Optimal
Microbiological Analysis					
Total Coliforms*	SMWW 9222 B	0 CFU / 100 mL	0	N.A.	Optimal
Fecal Coliforms *	SMWW 9222 D	0 CFU / 100 mL	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from Punjab EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

PEQS = Punjab Environmental Quality Standards
SMWW 24th Edition = Standard Methods for the examination of Water and Wastewater
TCU = True Color Unit
N.A. = Not Available
CFU = Colony Forming Unit
NTU = Nephelometric Turbidity Unit
MU = Measurement Uncertainty
NGVS = No Guideline Value Set

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

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---------------End of Report---------------

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-DW-03	Report Issue Date	21-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-DW-03/2025	Sample Location/Co-ordinates	DW-03 (Masjid) 34°0'46.0" N 71°57'21.3" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Drinking Water Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Laboratory Analysis					
Color*	SMWW 2120 C	≤ 15 TCU	0	N.A.	Optimal
Taste*	SMWW 2160 C	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Odor*	SMWW 2150 B	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Turbidity*	SMWW 2130 B	< 5 NTU	0	N.A.	Optimal
Total Hardness (as $CaCO_3$) **	SMWW 2340 C	< 500 mg/L	368	± 2.74	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	< 1000 mg/L	377	± 12.20	Optimal
pH**	SMWW 4500 H^+ B	6.5- 8.5	7.63	± 0.03	Optimal
Aluminum (Al)	SMWW 3111 B	≤ 0.2 mg/L	<0.005	N.A.	Optimal
Antimony (Sb)	SMWW 3114 B	≤ 0.005 mg/L	<0.005	N.A.	Optimal
Arsenic (As)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	0.7 mg/L	<0.0035	N.A.	Optimal
Boron (B)	SMWW 3113 B	0.3 mg/L	<0.02	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.01 mg/L	<0.006	N.A.	Optimal
Chloride (Cl^-) **	SMWW 4500-Cl^- B	< 250 mg/L	25	± 140	Optimal
Chromium (Cr)	SMWW 3113 B	≤ 0.05 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3111 B	2.0 mg/L	<0.164	N.A.	Optimal
Cyanide (CN^-)*	SMWW 4500-CN^- F	≤ 0.05 mg/L	0	N.A.	Optimal
Fluoride (F^-)**	SMWW 4500-F^- C	≤ 1.5 mg/L	0.35	± 0.06	Optimal
Lead (Pb)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Manganese (Mn)	SMWW 3113 B	≤ 0.5 mg/L	<0.015	N.A.	Optimal
Mercury (Hg)	SMWW 3114 B	≤ 0.001 mg/L	<0.001	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	≤0.02 mg/L	<0.02	N.A.	Optimal
Nitrate (NO_3^-) **	SMWW 4500-NO_3^- D	≤ 50 mg/L	46.3	± 0.06	Optimal
Nitrite (NO_2^-) *	SMWW 4500-NO_2^- B	≤ 3.0 mg/L	0	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.01 mg/L	<0.01	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500-Cl^- B	0.5 mg/L	0	N.A.	Optimal

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-DW-03	Report Issue Date	21-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-DW-03/2025	Sample Location/Co-ordinates	DW-03 (Masjid) 34°0'46.0" N 71°57'21.3" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Drinking Water Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Phenolic Compounds (as Phenols) *	SMWW 5530 D	NGVS mg/L	0	N.A.	Optimal
Zinc (Zn)	SMWW 3113 B	5.0 mg/L	0.027	N.A.	Optimal
Microbiological Analysis					
Total Coliforms*	SMWW 9222 B	0 CFU / 100 mL	0	N.A.	Optimal
Fecal Coliforms *	SMWW 9222 D	0 CFU / 100 mL	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from Punjab EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

PEQS = Punjab Environmental Quality Standards
SMWW 24th Edition = Standard Methods for the examination of Water and Wastewater
TCU = True Color Unit
N.A. = Not Available
CFU = Colony Forming Unit
NTU = Nephelometric Turbidity Unit
MU = Measurement Uncertainty
NGVS = No Guideline Value Set

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

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Analyzed By

Reviewed By (TM)

Approved By (QM)

---------------End of Report---------------

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-DW-04	Report Issue Date	21-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-DW-04/2025	Sample Location/CO-ordinates	DW-04 33°40'28.6" N 72°51'12" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Drinking Water Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Laboratory Analysis					
Color*	SMWW 2120 C	≤ 15 TCU	0	N.A.	Optimal
Taste*	SMWW 2160 C	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Odor*	SMWW 2150 B	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Turbidity*	SMWW 2130 B	< 5 NTU	0	N.A.	Optimal
Total Hardness (as $CaCO_3$) **	SMWW 2340 C	< 500 mg/L	340	± 2.74	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	< 1000 mg/L	327	± 12.20	Optimal
pH**	SMWW 4500 H^+ B	6.5- 8.5	7.68	± 0.03	Optimal
Aluminum (Al)	SMWW 3111 B	≤ 0.2 mg/L	<0.005	N.A.	Optimal
Antimony (Sb)	SMWW 3114 B	≤ 0.005 mg/L	<0.005	N.A.	Optimal
Arsenic (As)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	0.7 mg/L	<0.0035	N.A.	Optimal
Boron (B)	SMWW 3113 B	0.3 mg/L	<0.02	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.01 mg/L	<0.006	N.A.	Optimal
Chloride (Cl^-) **	SMWW 4500-Cl^- B	< 250 mg/L	19	± 140	Optimal
Chromium (Cr)	SMWW 3113 B	≤ 0.05 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3111 B	2.0 mg/L	<0.164	N.A.	Optimal
Cyanide (CN^-)*	SMWW 4500-CN^- F	≤ 0.05 mg/L	0	N.A.	Optimal
Fluoride (F^-)**	SMWW 4500-F^- C	≤ 1.5 mg/L	0.22	± 0.06	Optimal
Lead (Pb)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Manganese (Mn)	SMWW 3113 B	≤ 0.5 mg/L	<0.015	N.A.	Optimal
Mercury (Hg)	SMWW 3114 B	≤ 0.001 mg/L	<0.001	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	≤0.02 mg/L	<0.02	N.A.	Optimal
Nitrate (NO_3^-) **	SMWW 4500-NO_3^- D	≤ 50 mg/L	20.3	± 0.06	Optimal
Nitrite (NO_2^-) *	SMWW 4500-NO_2^- B	≤ 3.0 mg/L	0.10	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.01 mg/L	<0.01	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500-Cl^- B	0.5 mg/L	0	N.A.	Optimal

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-DW-04	Report Issue Date	21-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-DW-04/2025	Sample Location/CO-ordinates	DW-04 33°40'28.6" N 72°51'12" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Drinking Water Analysis Results					
Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Phenolic Compounds (as Phenols) *	SMWW 5530 D	NGVS mg/L	0	N.A.	Optimal
Zinc (Zn)	SMWW 3113 B	5.0 mg/L	0.025	N.A.	Optimal
Microbiological Analysis					
Total Coliforms*	SMWW 9222 B	0 CFU / 100 mL	0	N.A.	Optimal
Fecal Coliforms *	SMWW 9222 D	0 CFU / 100 mL	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from Punjab EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

PEQS = Punjab Environmental Quality Standards
SMWW 24th Edition = Standard Methods for the examination of Water and Wastewater
TCU = True Color Unit
N.A. = Not Available
CFU = Colony Forming Unit
NTU = Nephelometric Turbidity Unit
MU = Measurement Uncertainty
NGVS = No Guideline Value Set

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Report Disclaimer

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Analyzed By

Reviewed By
(TM)

Approved By
(QM)

---------------End of Report---------------

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-DW-05	Report Issue Date	21-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-DW-05/2025	Sample Location/CO-ordinates	DW-05 33°40'28.6" N 72°51'12" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Drinking Water Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Laboratory Analysis					
Color*	SMWW 2120 C	≤ 15 TCU	0	N.A.	Optimal
Taste*	SMWW 2160 C	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Odor*	SMWW 2150 B	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Turbidity*	SMWW 2130 B	< 5 NTU	0	N.A.	Optimal
Total Hardness (as $CaCO_3$) **	SMWW 2340 C	< 500 mg/L	416	± 2.74	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	< 1000 mg/L	414	± 12.20	Optimal
pH**	SMWW 4500 H^+ B	6.5- 8.5	7.52	± 0.03	Optimal
Aluminum (Al)	SMWW 3111 B	≤ 0.2 mg/L	<0.005	N.A.	Optimal
Antimony (Sb)	SMWW 3114 B	≤ 0.005 mg/L	<0.005	N.A.	Optimal
Arsenic (As)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	0.7 mg/L	<0.0035	N.A.	Optimal
Boron (B)	SMWW 3113 B	0.3 mg/L	<0.02	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.01 mg/L	<0.006	N.A.	Optimal
Chloride (Cl^-) **	SMWW 4500-Cl^- B	< 250 mg/L	21	± 140	Optimal
Chromium (Cr)	SMWW 3113 B	≤ 0.05 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3111 B	2.0 mg/L	<0.164	N.A.	Optimal
Cyanide (CN^-)*	SMWW 4500-CN^- F	≤ 0.05 mg/L	0	N.A.	Optimal
Fluoride (F^-)**	SMWW 4500-F^- C	≤ 1.5 mg/L	0.17	± 0.06	Optimal
Lead (Pb)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Manganese (Mn)	SMWW 3113 B	≤ 0.5 mg/L	<0.015	N.A.	Optimal
Mercury (Hg)	SMWW 3114 B	≤ 0.001 mg/L	<0.001	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	≤0.02 mg/L	<0.02	N.A.	Optimal
Nitrate (NO_3^-) **	SMWW 4500-NO_3^- D	≤ 50 mg/L	46.9	± 0.06	Optimal
Nitrite (NO_2^-) *	SMWW 4500-NO_2^- B	≤ 3.0 mg/L	0	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.01 mg/L	<0.01	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500-Cl^- B	0.5 mg/L	0	N.A.	Optimal

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-DW-05	Report Issue Date	21-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-DW-05/2025	Sample Location/CO-ordinates	DW-05 33°40'28.6" N 72°51'12" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Drinking Water Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Phenolic Compounds (as Phenols) *	SMWW 5530 D	NGVS mg/L	0	N.A.	Optimal
Zinc (Zn)	SMWW 3113 B	5.0 mg/L	0.025	N.A.	Optimal
Microbiological Analysis					
Total Coliforms*	SMWW 9222 B	0 CFU / 100 mL	0	N.A.	Optimal
Fecal Coliforms *	SMWW 9222 D	0 CFU / 100 mL	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from Punjab EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

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CFU = Colony Forming Unit
NTU = Nephelometric Turbidity Unit
MU = Measurement Uncertainty
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Analyzed By

Reviewed By (TM)

Approved By (QM)

---------------End of Report---------------

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-01/2025-SW-01	Report Issue Date	21-01-2025
Nature of Sample	Surface Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-SW-01/2025	Sample Location/Co-ordinate	SW-01 (Sokha Kas) 33°46'21.4" N 72°43'13" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms).		

Surface Water Analysis Results					
Parameter	Analysis Method	FAO Guidelines	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6.0 - 8.5	7.62	± 0.04	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	-	95	N.A.	-
Chemical Oxygen Demand (COD)**	SMWW 5220 D	-	178	± 4.00	-
Total Suspended Solids (TSS)**	SMWW 2540 D	-	171	± 4.09	-
Total Dissolved Solids (TDS)**	SMWW 2540 C	0-2000	541	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	-	0	N.A.	-
Grease and Oil**	SMWW 5520 B	-	0.5	± 0.91	-
Chloride (Cl^-)**	SMWW 4500-Cl- B	0 - 1065	39	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	-	0.28	± 0.06	-
Cyanide (CN^-)*	SMWW 4500-CN-F	-	0	N.A.	-
An-ionic Detergents (as MBAs) *	SMWW 5540-C	-	0	N.A.	-
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	0-960	56	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	-	0	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-01/2025-SW-01	Report Issue Date	21-01-2025
Nature of Sample	Surface Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 $\pm$ 5) °C & (55 $\pm$ 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-SW-01/2025	Sample Location/Co-ordinate	SW-01 (Sokha Kas) 33°46'21.4" N 72°43'13" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms).		

Surface Water Analysis Results

Parameter	Analysis Method	FAO Guidelines	Result	MU (CL95%)	Remarks
Ammonia (NH_3) *	SMWW 4500-NH_3 C	-	0	N.A.	-
Cadmium (Cd)	SMWW 3113 B	-	<0.006	N.A.	-
Chromium (Cr)	SMWW 3113 B	-	<0.004	N.A.	-
Copper (Cu)	SMWW 3113 B	-	<0.164	N.A.	-
Lead (Pb)	SMWW 3113 B	-	<0.005	N.A.	-
Mercury (Hg)	SMWW 3112 B	-	<0.001	N.A.	-
Selenium (Se)	SMWW 3114 B	-	<0.01	N.A.	-
Nickel (Ni)	SMWW 3113 B	-	<0.02	N.A.	-
Silver (Ag)	SMWW 3113 B	-	<0.002	N.A.	-
Total Toxic Metals	Calculated Value	-	0.24	N.A.	-
Zinc (Zn)	SMWW 3111 B	-	0.027	N.A.	-
Arsenic (As)	SMWW 3114 B	-	<0.005	N.A.	-
Barium (Ba)	SMWW 3113 B	-	<0.0035	N.A.	-
Iron (Fe)	SMWW 3113 B	-	0.0750	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-01/2025-SW-01	Report Issue Date	21-01-2025
Nature of Sample	Surface Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-SW-01/2025	Sample Location/Co-ordinate	SW-01 (Sokha Kas) 33°46'21.4" N 72°43'13" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms).		

Surface Water Analysis Results

Parameter	Analysis Method	FAO Guidelines	Result	MU (CL95%)	Remarks
Manganese (Mn)	SMWW 3111 B	-	<0.015	N.A.	-
Boron (B)	SMWW 3113 B	0-2	<0.02	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	-	0	N.A.	-

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & Certified from Punjab EPA.

<u>The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.</u>

Abbreviations:

FAO = Food and Agriculture Organization
N.A. = Not Available
SMWW = Standard Methods for the examination of Water and Wastewater
MU = Measurement Uncertainty

Remarks:

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Analyzed By

Reviewed By (TM)

Approved By (QM)

---------------End of Report---------------

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-01/2025-SW-02	Report Issue Date	21-01-2025
Nature of Sample	Surface Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-SW-02/2025	Sample Location/Co-ordinate	SW-02 (Churewala Kas) 33°49'27.6" N 72°38'28" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms).		

Surface Water Analysis Results					
Parameter	Analysis Method	FAO Guidelines	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6.0 - 8.5	7.60	± 0.04	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	-	20	N.A.	-
Chemical Oxygen Demand (COD)**	SMWW 5220 D	-	44	± 4.00	-
Total Suspended Solids (TSS)**	SMWW 2540 D	-	65	± 4.09	-
Total Dissolved Solids (TDS)**	SMWW 2540 C	0-2000	416	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	-	0	N.A.	-
Grease and Oil**	SMWW 5520 B	-	0.8	± 0.91	-
Chloride (Cl^-)**	SMWW 4500-Cl- B	0 - 1065	22	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	-	0.34	± 0.06	-
Cyanide (CN^-)*	SMWW 4500-CN- F	-	0	N.A.	-
An-ionic Detergents (as MBAs) *	SMWW 5540-C	-	0	N.A.	-
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	0-960	48	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	-	0	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-01/2025-SW-02	Report Issue Date	21-01-2025
Nature of Sample	Surface Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-SW-02/2025	Sample Location/Co-ordinate	SW-02 (Churewala Kas) 33°49'27.6" N 72°38'28" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms).		

Surface Water Analysis Results					
Parameter	Analysis Method	FAO Guidelines	Result	MU (CL95%)	Remarks
Ammonia (NH_3) *	SMWW 4500-NH_3 C	-	0	N.A.	-
Cadmium (Cd)	SMWW 3113 B	-	<0.006	N.A.	-
Chromium (Cr)	SMWW 3113 B	-	<0.004	N.A.	-
Copper (Cu)	SMWW 3113 B	-	<0.164	N.A.	-
Lead (Pb)	SMWW 3113 B	-	<0.005	N.A.	-
Mercury (Hg)	SMWW 3112 B	-	<0.001	N.A.	-
Selenium (Se)	SMWW 3114 B	-	<0.01	N.A.	-
Nickel (Ni)	SMWW 3113 B	-	<0.02	N.A.	-
Silver (Ag)	SMWW 3113 B	-	<0.002	N.A.	-
Total Toxic Metals	Calculated Value	-	0.24	N.A.	-
Zinc (Zn)	SMWW 3111 B	-	0.027	N.A.	-
Arsenic (As)	SMWW 3114 B	-	<0.005	N.A.	-
Barium (Ba)	SMWW 3113 B	-	<0.0035	N.A.	-
Iron (Fe)	SMWW 3113 B	-	0.0740	N.A.	-
Manganese (Mn)	SMWW 3111 B	-	<0.015	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-01/2025-SW-02	Report Issue Date	21-01-2025
Nature of Sample	Surface Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-SW-02/2025	Sample Location/Co-ordinate	SW-02 (Churewala Kas) 33°49'27.6" N 72°38'28" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms).		

Parameter	Analysis Method	FAO Guidelines	Result	MU (CL95%)	Remarks
Boron (B)	SMWW 3113 B	0-2	<0.02	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	-	0	N.A.	-

Surface Water Analysis Results

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Analyzed By

Reviewed By (TM)

Approved By (QM)

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SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-SW-03	Report Issue Date	21-01-2025
Nature of Sample	Surface Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-SW-03/2025	Sample Location	SW-03 (Haro River) 33°40'21.8" N 72°51'19" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms).		

Parameter	Analysis Method	FAO Guidelines	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6.0 - 8.5	7.93	± 0.04	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	-	<5	N.A.	-
Chemical Oxygen Demand (COD)**	SMWW 5220 D	-	<5	± 4.00	-
Total Suspended Solids (TSS)**	SMWW 2540 D	-	7	± 4.09	-
Total Dissolved Solids (TDS)**	SMWW 2540 C	0-2000	357	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	-	0	N.A.	-
Grease and Oil**	SMWW 5520 B	-	0	± 0.91	-
Chloride (Cl^-)**	SMWW 4500-Cl- B	0 - 1065	20	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	-	0.21	± 0.06	-
Cyanide (CN^-)*	SMWW 4500-CN- F	-	0	N.A.	-
An-ionic Detergents (as MBAs) *	SMWW 5540-C	-	0	N.A.	-
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	0-960	73	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	-	0	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-SW-03	Report Issue Date	21-01-2025
Nature of Sample	Surface Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-SW-03/2025	Sample Location	SW-03 (Haro River) 33°40'21.8" N 72°51'19" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms).		

Surface Water Analysis Results					
Parameter	Analysis Method	FAO Guidelines	Result	MU (CL95%)	Remarks
Ammonia (NH_3) *	SMWW 4500-NH_3 C	-	0	N.A.	-
Cadmium (Cd)	SMWW 3113 B	-	<0.006	N.A.	-
Chromium (Cr)	SMWW 3113 B	-	<0.004	N.A.	-
Copper (Cu)	SMWW 3113 B	-	<0.164	N.A.	-
Lead (Pb)	SMWW 3113 B	-	<0.005	N.A.	-
Mercury (Hg)	SMWW 3112 B	-	<0.001	N.A.	-
Selenium (Se)	SMWW 3114 B	-	<0.01	N.A.	-
Nickel (Ni)	SMWW 3113 B	-	<0.02	N.A.	-
Silver (Ag)	SMWW 3113 B	-	<0.002	N.A.	-
Total Toxic Metals	Calculated Value	-	0.24	N.A.	-
Zinc (Zn)	SMWW 3111 B	-	0.027	N.A.	-
Arsenic (As)	SMWW 3114 B	-	<0.005	N.A.	-
Barium (Ba)	SMWW 3113 B	-	<0.0035	N.A.	-
Iron (Fe)	SMWW 3113 B	-	0.0740	N.A.	-
Manganese (Mn)	SMWW 3111 B	-	<0.015	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-SW-03	Report Issue Date	21-01-2025
Nature of Sample	Surface Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24 °C & 42 %
Sample ID	AES-ENV-SW-03/2025	Sample Location	SW-03 (Haro River) 33°40'21.8" N 72°51'19" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms).		

Surface Water Analysis Results					
Parameter	Analysis Method	FAO Guidelines	Result	MU (CL95%)	Remarks
Boron (B)	SMWW 3113 B	0-2	<0.02	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	-	0	N.A.	-

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from Punjab EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

FAO = Food and Agriculture Organization
N.A. = Not Available
SMWW = Standard Methods for the examination of Water and Wastewater
MU = Measurement Uncertainty

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

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Reviewed By (TM)

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WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-WW-05	Report Issue Date	21-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24°C & 42 %
Sample ID	AES-ENV-WW-05/2025	Sample Location/Co-ordinates	WW-01 (Pirwaddai Mor) 33°36'55" N 72°59'19" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Wastewater Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6 - 9	7.60	± 0.039	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	80 mg/L	240	N.A.	High
Chemical Oxygen Demand (COD)**	SMWW 5220 D	150 mg/L	459	± 18.82	High
Total Suspended Solids (TSS)**	SMWW 2540 D	200 mg/L	178	± 3.71	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	3500 mg/L	1220	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	0.1 mg/L	0	N.A.	Optimal
Grease and Oil**	SMWW 5520 B	10 mg/L	3.5	± 0.91	Optimal
Chloride (Cl^-)**	SMWW 4500-Cl^- B	1000 mg/L	149	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F^- D	10 mg/L	0.28	± 0.06	Optimal
Cyanide (CN^-)*	SMWW 4500-CN^- F	1.0 mg/L	0	N.A.	Optimal
An-ionic Detergents (as MBAs) *	SMWW 5540-C	20.0 mg/L	2.0	N.A.	Optimal
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	600 mg/L	58	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	1.0 mg/L	0	N.A.	Optimal
Ammonia (NH_3) *	SMWW 4500-NH_3 C	40 mg/L	0	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.1 mg/L	<0.006	N.A.	Optimal
Chromium (Cr)	SMWW 3113 B	1.0 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3113 B	1.0 mg/L	0.164	N.A.	Optimal
Lead (Pb)	SMWW 3113 B	0.5 mg/L	<0.005	N.A.	Optimal
Mercury (Hg)	SMWW 3112 B	0.01 mg/L	<0.001	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.5 mg/L	<0.01	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	1.0 mg/L	<0.02	N.A.	Optimal
Silver (Ag)	SMWW 3113 B	1.0 mg/L	<0.002	N.A.	Optimal
Total Toxic Metals	Calculated Value	2.0 mg/L	0.24	N.A.	Optimal
Zinc (Zn)	SMWW 3111 B	5.0 mg/L	0.033	N.A.	Optimal

WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-WW-05	Report Issue Date	21-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24°C & 42 %
Sample ID	AES-ENV-WW-05/2025	Sample Location/Co-ordinates	WW-01 (Pirwaddai Mor) 33°36'55" N 72°59'19" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Wastewater Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Arsenic (As)	SMWW 3114 B	1.0 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	1.5 mg/L	<0.0035	N.A.	Optimal
Iron (Fe)	SMWW 3113 B	8.0 mg/L	0.0856	N.A.	Optimal
Manganese (Mn)	SMWW 3111 B	1.5 mg/L	<0.015	N.A.	Optimal
Boron (B)	SMWW 3113 B	6.0 mg/L	0	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	1.0 mg/L	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).
**Parameters are accredited from Pakistan National Accreditation Council & approved from Punjab EPA.
The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:
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SMWW = Standard Methods for the examination of Water and Wastewater
N.A. = Not Available
MU = Measurement Uncertainty

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Document No. AES/LMS/FRM-111, Date of Issue 07 July, 2022, Revision No. 00

WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-WW-06	Report Issue Date	21-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24°C & 42 %
Sample ID	AES-ENV-WW-06/2025	Sample Location/Co-ordinate	WW-03 (Bahudra Kas) 33°47'23" N 72°43'12" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Wastewater Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6 - 9	7.67	± 0.039	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	80 mg/L	42	N.A.	Optimal
Chemical Oxygen Demand (COD)**	SMWW 5220 D	150 mg/L	83	± 18.82	Optimal
Total Suspended Solids (TSS)**	SMWW 2540 D	200 mg/L	76	± 3.71	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	3500 mg/L	664	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	0.1 mg/L	0	N.A.	Optimal
Grease and Oil**	SMWW 5520 B	10 mg/L	2.5	± 0.91	Optimal
Chloride (Cl^-)**	SMWW 4500-Cl- B	1000 mg/L	76	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	10 mg/L	0.24	± 0.06	Optimal
Cyanide (CN^-)*	SMWW 4500-CN- F	1.0 mg/L	0	N.A.	Optimal
An-ionic Detergents (as MBAs) *	SMWW 5540-C	20.0 mg/L	0.5	N.A.	Optimal
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	600 mg/L	47	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	1.0 mg/L	0	N.A.	Optimal
Ammonia (NH_3) *	SMWW 4500-NH_3 C	40 mg/L	0	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.1 mg/L	<0.006	N.A.	Optimal
Chromium (Cr)	SMWW 3113 B	1.0 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3113 B	1.0 mg/L	<0.164	N.A.	Optimal
Lead (Pb)	SMWW 3113 B	0.5 mg/L	<0.005	N.A.	Optimal
Mercury (Hg)	SMWW 3112 B	0.01 mg/L	<0.001	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.5 mg/L	<0.01	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	1.0 mg/L	<0.02	N.A.	Optimal
Silver (Ag)	SMWW 3113 B	1.0 mg/L	<0.002	N.A.	Optimal
Total Toxic Metals	Calculated Value	2.0 mg/L	0.24	N.A.	Optimal
Zinc (Zn)	SMWW 3111 B	5.0 mg/L	0.028	N.A.	Optimal

WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-ENV-NP-07/2025-WW-06	Report Issue Date	21-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24°C & 42 %
Sample ID	AES-ENV-WW-06/2025	Sample Location/Co-ordinate	WW-03 (Bahudra Kas) 33°47'23" N 72°43'12" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Wastewater Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Arsenic (As)	SMWW 3114 B	1.0 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	1.5 mg/L	<0.0035	N.A.	Optimal
Iron (Fe)	SMWW 3113 B	8.0 mg/L	0.0790	N.A.	Optimal
Manganese (Mn)	SMWW 3111 B	1.5 mg/L	<0.015	N.A.	Optimal
Boron (B)	SMWW 3113 B	6.0 mg/L	0	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	1.0 mg/L	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from Punjab EPA.

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WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-FMO-NP-07/2025-WW-07	Report Issue Date	21-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24°C & 42 %
Sample ID	AES-FMO-WW-07/2025	Sample Location	WW-02 (Wah)
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Wastewater Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6 - 9	7.67	± 0.039	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	80 mg/L	42	N.A.	Optimal
Chemical Oxygen Demand (COD)**	SMWW 5220 D	150 mg/L	83	± 18.82	Optimal
Total Suspended Solids (TSS)**	SMWW 2540 D	200 mg/L	76	± 3.71	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	3500 mg/L	664	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	0.1 mg/L	0	N.A.	Optimal
Grease and Oil**	SMWW 5520 B	10 mg/L	2.5	± 0.91	Optimal
Chloride (Cl^-)**	SMWW 4500-Cl^- B	1000 mg/L	76	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F^- D	10 mg/L	0.24	± 0.06	Optimal
Cyanide (CN^-)*	SMWW 4500-CN^- F	1.0 mg/L	0	N.A.	Optimal
An-ionic Detergents (as MBAs) *	SMWW 5540-C	20.0 mg/L	0.5	N.A.	Optimal
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	600 mg/L	47	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	1.0 mg/L	0	N.A.	Optimal
Ammonia (NH_3) *	SMWW 4500-NH_3 C	40 mg/L	0	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.1 mg/L	<0.006	N.A.	Optimal
Chromium (Cr)	SMWW 3113 B	1.0 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3113 B	1.0 mg/L	0.164	N.A.	Optimal
Lead (Pb)	SMWW 3113 B	0.5 mg/L	<0.005	N.A.	Optimal
Mercury (Hg)	SMWW 3112 B	0.01 mg/L	<0.001	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.5 mg/L	<0.01	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	1.0 mg/L	<0.02	N.A.	Optimal
Silver (Ag)	SMWW 3113 B	1.0 mg/L	<0.002	N.A.	Optimal
Total Toxic Metals	Calculated Value	2.0 mg/L	0.24	N.A.	Optimal
Zinc (Zn)	SMWW 3111 B	5.0 mg/L	0.035	N.A.	Optimal

WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-FMO-NP-07/2025-WW-07	Report Issue Date	21-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24°C & 42 %
Sample ID	AES-FMO-WW-07/2025	Sample Location	WW-02 (Wah)
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Wastewater Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Arsenic (As)	SMWW 3114 B	1.0 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	1.5 mg/L	<0.0035	N.A.	Optimal
Iron (Fe)	SMWW 3113 B	8.0 mg/L	0.0890	N.A.	Optimal
Manganese (Mn)	SMWW 3111 B	1.5 mg/L	<0.015	N.A.	Optimal
Boron (B)	SMWW 3113 B	6.0 mg/L	0	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	1.0 mg/L	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).
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N.A. = Not Available
SMWW = Standard Methods for the examination of Water and Wastewater
MU = Measurement Uncertainty

Remarks:
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WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-FMO-NP-07/2025-WW-08	Report Issue Date	21-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24°C & 42 %
Sample ID	AES-FMO-WW-08/2025	Sample Location	WW-04 (Mughal Gardens River)
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Wastewater Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6 - 9	7.63	± 0.039	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	80 mg/L	23	N.A.	Optimal
Chemical Oxygen Demand (COD)**	SMWW 5220 D	150 mg/L	45	± 18.82	Optimal
Total Suspended Solids (TSS)**	SMWW 2540 D	200 mg/L	31	± 3.71	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	3500 mg/L	414	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	0.1 mg/L	0	N.A.	Optimal
Grease and Oil**	SMWW 5520 B	10 mg/L	1.5	± 0.91	Optimal
Chloride (Cl^-)**	SMWW 4500-Cl^- B	1000 mg/L	22	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	10 mg/L	0.21	± 0.06	Optimal
Cyanide (CN^-)*	SMWW 4500-CN- F	1.0 mg/L	0	N.A.	Optimal
An-ionic Detergents (as MBAs) *	SMWW 5540-C	20.0 mg/L	0	N.A.	Optimal
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	600 mg/L	13	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	1.0 mg/L	0	N.A.	Optimal
Ammonia (NH_3) *	SMWW 4500-NH_3 C	40 mg/L	0	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.1 mg/L	<0.006	N.A.	Optimal
Chromium (Cr)	SMWW 3113 B	1.0 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3113 B	1.0 mg/L	0.164	N.A.	Optimal
Lead (Pb)	SMWW 3113 B	0.5 mg/L	<0.005	N.A.	Optimal
Mercury (Hg)	SMWW 3112 B	0.01 mg/L	<0.001	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.5 mg/L	<0.01	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	1.0 mg/L	<0.02	N.A.	Optimal
Silver (Ag)	SMWW 3113 B	1.0 mg/L	<0.002	N.A.	Optimal
Total Toxic Metals	Calculated Value	2.0 mg/L	0.24	N.A.	Optimal
Zinc (Zn)	SMWW 3111 B	5.0 mg/L	0.031	N.A.	Optimal

WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-FMO-NP-07/2025-WW-08	Report Issue Date	21-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	12-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	21-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			24°C & 42 %
Sample ID	AES-FMO-WW-08/2025	Sample Location	WW-04 (Mughal Gardens River)
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5 (487 Km) Packages-7: Rawalpindi to Hassanabdal (48 Kms)		

Wastewater Analysis Results

Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Arsenic (As)	SMWW 3114 B	1.0 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	1.5 mg/L	<0.0035	N.A.	Optimal
Iron (Fe)	SMWW 3113 B	8.0 mg/L	0.0780	N.A.	Optimal
Manganese (Mn)	SMWW 3111 B	1.5 mg/L	<0.015	N.A.	Optimal
Boron (B)	SMWW 3113 B	6.0 mg/L	0	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	1.0 mg/L	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from Punjab EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

PEQS = Punjab Environmental Quality Standards
N.A. = Not Available
SMWW = Standard Methods for the examination of Water and Wastewater
MU = Measurement Uncertainty

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Report Disclaimer

- If provided in the report, the statement of conformity is based on a binary decision rule of simple acceptance (shared risk).
- The decision rule will be provided upon request.
- The remaining portion of the sample (s) will be disposed off after 15 days after the issuance date of report from the laboratory unless otherwise instructed (Condition Apply).
- This report shall not be reproduced in part/parties.
- This report is not intended to be used legally.
- The provided results relate only to the sample provided/collected.
- Values reflect the testing results; decision for usage of report totally depends on Customer.

Analyzed By	Reviewed By (TM)	Approved By (QM)

---------------End of Report---------------

ENVIRONMENTAL MONITORING & ANALYSIS REPORT

DETAILED DESIGN FOR WIDENNING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5, PACKAGE-8: NOWSHERA TO PESHAWAR (40 KMS)

- Ambient Air Monitoring
- Noise Monitoring
- Drinking Water Analysis
- Surface Water Analysis
- Wastewater Analysis

Report Reference No.: AES-NP-01/2025

Dated: 16 January, 2025

Asian Environmental Services (Pvt.) Ltd.
has prepared this report as per prerequisites of Customer.
Any other individual using the content of this document shall do so at their own liability.
The customer is responsible for lawful usage of this reported data.

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Aleem Butt
Director Asian Environmental Services

AMBIENT AIR MONITORING LOCATION-01

POINT 1

Package-8: Nowshera to Peshawar (40 Kms)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-01	Monitoring Point	Point 01
Date of Monitoring	03-01-2025 to 04-01-2025	Monitoring Coordinates	34°1'10" N 71°39'12" E

Sr. No.	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)
1	10:00	2.49	24.26	16.49	40.75	47.91
2	11:00	2.63	25.14	16.35	41.49	49.81
3	12:00	2.75	26.12	16.69	42.81	50.02
4	13:00	2.94	27.13	17.41	44.54	51.30
5	14:00	3.03	28.28	17.08	45.36	49.76
6	15:00	3.12	29.16	16.54	45.70	48.82
7	16:00	3.15	28.78	16.24	45.02	46.71
8	17:00	3.21	29.74	15.82	45.56	46.16
9	18:00	2.80	27.86	15.60	43.46	44.77
10	19:00	2.53	27.28	15.06	42.34	43.36
11	20:00	2.17	26.23	14.49	40.72	41.66
12	21:00	1.81	25.44	14.02	39.46	40.41
13	22:00	1.08	25.12	13.45	38.57	38.01
14	23:00	1.90	24.65	13.16	37.82	37.59
15	00:00	1.63	24.54	12.45	36.99	36.99
16	01:00	1.46	24.11	11.98	36.08	36.26
17	02:00	0.38	23.51	11.40	34.91	35.34
18	03:00	0.57	23.09	12.10	35.19	38.40
19	04:00	0.63	22.46	12.81	35.26	39.73
20	05:00	0.42	21.57	13.22	34.80	40.65
21	06:00	0.23	20.99	13.75	34.74	42.13
22	07:00	1.29	21.80	14.35	36.15	43.13
23	08:00	1.33	22.63	15.00	37.63	44.56
24	09:00	2.44	23.39	15.83	39.23	46.37
Average Concentration		1.91	25.14	14.64	39.77	43.33

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-01	Monitoring Point	Point 01
Date of Monitoring	03-01-2025 to 04-01-2025	Monitoring Coordinates	34°1'10" N 71°39'12" E

Parameters	Method of Measurement	Monitoring Duration	LDL	Average Obtained Concentration	NEQS	Remarks
Nitrogen Dioxide (NO_2) *	Gas Phase Chemiluminescence	24Hours	1.00	14.64	80.0 µg/m³	Optimal
Nitrogen Oxide (NO)*	Gas Phase Chemiluminescence	24Hours	1.00	25.14	40.0 µg/m³	Optimal
NO_x*	Gas Phase Chemiluminescence	24Hours	1.00	39.77	NGVS µg/m³	-
Sulphur Dioxide (SO_2) *	Ultraviolet Fluorescence method	24Hours	1.00	43.33	120.0 µg/m³	Optimal
Carbon Monoxide (CO)*	Non-Dispersive Infra-Red (NDIR)	24Hours	0.01	1.91	05.0 mg/m³	Optimal
Ozone*	Non-Dispersive UV absorption Method	01 Hours	1.00	78	130 µg/m³	Optimal
Lead*	ASS method after sampling using EPM 2000	24 Hours	0.07	0.8	1.5 µg/m³	Optimal
Particulate Matter (PM_{10}) *	β Ray absorption method	24Hours	1.00	91	150.0 µg/m³	Optimal
Particulate Matter ($PM_{2.5}$) *	β Ray absorption method	24Hours	1.00	46	35.0 µg/m³	High
Total Particulate Matter (TSP)	Gravimetric Sampling	24Hours	1.00	203	500.0 µg/m³	Optimal

*Parameters are approved from KP Environmental Protection Agency.

Abbreviations:

LDL= Lower Detection Limit
NEQS= National Environmental Quality Standards
µg/m³ = Micro Gram per Meter Cube
mg/m³ = Milli Gram per Meter Cube

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-01	Monitoring Point	Point 01
Date of Monitoring	03-01-2025 to 04-01-2025	Monitoring Coordinates	34°1'10" N 71°39'12" E

Sr. No.	Time	Ambient Temperature ^0C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
1	10:00	18	NE	3.3	50	760.2
2	11:00	18	NE	3.0	41	760.3
3	12:00	19	NE	3.6	38	760.7
4	13:00	19	NE	3.0	35	760.1
5	14:00	20	NE	2.9	31	760.5
6	15:00	20	NE	2.8	41	760.0
7	16:00	19	NE	3.5	45	760.4
8	17:00	18	NE	3.6	50	760.5
9	18:00	16	NE	2.9	54	759.0
10	19:00	15	NE	2.7	55	759.2
11	20:00	15	E	3.0	59	759.4
12	21:00	14	E	2.5	61	759.6
13	22:00	13	E	2.4	66	759.8
14	23:00	12	SE	2.5	67	758.1
15	00:00	12	SE	2.1	71	758.3
16	01:00	11	SE	1.9	70	758.5
17	02:00	11	SE	2.5	73	758.7
18	03:00	10	SE	2.2	73	758.4
19	04:00	10	SE	2.0	74	758.2
20	05:00	10	SE	1.8	75	758.3
21	06:00	11	SE	2.6	75	759.6
22	07:00	13	SE	2.4	76	759.1
23	08:00	13	E	2.9	69	760.0
24	09:00	15	NE	3.1	55	760.8

Monitored By

Reviewed By
(TM)

Approved By
(QM)

NOISE MONITORING REPORT

Monitoring Details			
Report Reference No.	AES-NP-01-2025-AA-01	Monitoring Point	Point 01
Date of Monitoring	03-01-2025 to 04-01-2025	Monitoring Coordinates	34°1'10" N 71°39'12" E

Sr. No.	Time	Noise dB(A)	
1	10:00	73	Day Time
2	11:00	77	
3	12:00	76	
4	13:00	78	
5	14:00	79	
6	15:00	79	
7	16:00	76	
8	17:00	78	
9	18:00	72	
10	19:00	69	
11	20:00	67	
12	21:00	66	
13	22:00	65	Night Time
14	23:00	64	
15	00:00	64	
16	01:00	63	
17	02:00	61	
18	03:00	60	
19	04:00	61	
20	05:00	63	
21	06:00	65	
22	07:00	67	Day Time
23	08:00	68	
24	09:00	71	

	NEQS	Average Values	Remarks
Day Time	65	73	High
Night Time	55	63	High

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING LOCATION-02

POINT 2

Package-8: Nowshera to Peshawar (40 Kms)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-02	Monitoring Point	Point 02
Date of Monitoring	04-01-2025 to 05-01-2025	Monitoring Coordinates	34°0'58" N 71°42'58" E

Sr. No.	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)
1	11:00	2.73	31.44	29.25	60.69	60.08
2	12:00	2.82	35.61	30.14	65.75	64.11
3	13:00	2.86	37.04	21.11	58.15	68.73
4	14:00	3.11	22.41	22.61	45.02	70.03
5	15:00	2.50	25.61	23.41	49.02	67.85
6	16:00	2.43	31.18	21.61	52.79	64.03
7	17:00	3.37	19.41	20.41	39.82	58.51
8	18:00	2.31	22.40	19.11	41.51	57.96
9	19:00	2.26	16.24	26.10	42.34	56.58
10	20:00	2.18	27.11	22.11	49.22	55.17
11	21:00	2.14	29.40	23.43	52.83	53.47
12	22:00	1.44	27.07	27.12	54.19	52.22
13	23:00	1.61	27.61	15.15	42.76	44.88
14	00:00	1.94	26.30	16.01	42.31	42.61
15	01:00	1.11	24.77	17.42	42.19	46.70
16	02:00	0.73	24.03	18.04	42.07	48.06
17	03:00	0.41	13.61	14.16	27.77	47.15
18	04:00	0.09	12.73	22.78	35.51	50.21
19	05:00	1.03	13.45	23.60	37.05	51.54
20	06:00	1.09	13.86	24.37	38.23	52.45
21	07:00	1.19	14.39	25.23	39.62	53.94
22	08:00	1.33	31.61	26.12	57.73	54.93
23	09:00	2.46	34.93	17.42	52.35	63.11
24	10:00	2.64	34.43	19.07	53.50	64.05
Average Concentration		1.90	24.86	21.91	46.77	56.18

Monitored By	Reviewed By (TM)	Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-02	Monitoring Point	Point 02
Date of Monitoring	04-01-2025 to 05-01-2025	Monitoring Coordinates	34°0'58" N 71°42'58" E

Parameters	Method of Measurement	Monitoring Duration	LDL	Average Obtained Concentration	NEQS	Remarks
Nitrogen Dioxide (NO_2) *	Gas Phase Chemiluminescence	24Hours	1.00	21.91	80.0 µg/m³	Optimal
Nitrogen Oxide (NO)*	Gas Phase Chemiluminescence	24Hours	1.00	24.86	40.0 µg/m³	Optimal
NO_x*	Gas Phase Chemiluminescence	24Hours	1.00	46.77	NGVS µg/m³	-
Sulphur Dioxide (SO_2) *	Ultraviolet Fluorescence method	24Hours	1.00	56.18	120.0 µg/m³	Optimal
Carbon Monoxide (CO)*	Non-Dispersive Infra-Red (NDIR)	24Hours	0.01	1.90	05.0 mg/m³	Optimal
Ozone*	Non-Dispersive UV absorption Method	01 Hours	1.00	72	130 µg/m³	Optimal
Lead*	ASS method after sampling using EPM 2000	24 Hours	0.07	0.7	1.5 µg/m³	Optimal
Particulate Matter (PM_{10}) *	β Ray absorption method	24Hours	1.00	116	150.0 µg/m³	Optimal
Particulate Matter ($PM_{2.5}$) *	β Ray absorption method	24Hours	1.00	41	35.0 µg/m³	High
Total Particulate Matter (TSP)	Gravimetric Sampling	24Hours	1.00	191	500.0 µg/m³	Optimal

*Parameters are approved from KP Environmental Protection Agency.

Abbreviations:

LDL= Lower Detection Limit
NEQS= National Environmental Quality Standards
µg/m³ = Micro Gram per Meter Cube
mg/m³ = Milli Gram per Meter Cube

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-02	Monitoring Point	Point 02
Date of Monitoring	04-01-2025 to 05-01-2025	Monitoring Coordinates	34°0'58" N 71°42'58" E

Sr. No.	Time	Ambient Temperature ^0C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
1	11:00	19	E	3.3	33	762.5
2	12:00	19	E	3.2	43	762.0
3	13:00	20	E	3.9	47	762.4
4	14:00	20	SE	4.0	52	762.5
5	15:00	19	SE	3.3	56	761.0
6	16:00	18	SE	3.1	57	761.2
7	17:00	16	SE	3.4	61	761.4
8	18:00	15	SE	2.9	63	761.6
9	19:00	15	SE	2.8	68	761.8
10	20:00	14	SE	2.9	69	760.1
11	21:00	13	SE	2.5	73	760.3
12	22:00	12	SE	2.3	72	760.5
13	23:00	12	SE	2.9	75	760.7
14	00:00	11	SE	2.6	75	760.4
15	01:00	11	SE	2.4	76	760.2
16	02:00	10	SE	2.2	77	760.3
17	03:00	10	SE	3.0	77	761.6
18	04:00	10	SE	2.8	78	761.1
19	05:00	10	SE	3.3	71	762.0
20	06:00	11	SE	3.5	57	762.8
21	07:00	11	SE	3.7	52	762.2
22	08:00	12	SE	3.4	43	762.3
23	09:00	14	SE	4.0	40	762.7
24	10:00	14	SE	3.4	37	762.1

Monitored By

Reviewed By
(TM)

Approved By
(QM)

NOISE MONITORING REPORT

Monitoring Details			
Report Reference No.	AES-NP-01-2025-AA-02	Monitoring Point	Point 02
Date of Monitoring	04-01-2025 to 05-01-2025	Monitoring Coordinates	34°0'58" N 71°42'58" E

Sr. No.	Time	Noise dB(A)	
1	11:00	74	Day Time
2	12:00	74	
3	13:00	71	
4	14:00	73	
5	15:00	67	
6	16:00	68	
7	17:00	66	
8	18:00	65	
9	19:00	64	
10	20:00	63	
11	21:00	63	
12	22:00	62	Night Time
13	23:00	60	
14	00:00	59	
15	01:00	60	
16	02:00	62	
17	03:00	64	
18	04:00	66	
19	05:00	67	
20	06:00	70	
21	07:00	72	Day Time
22	08:00	76	
23	09:00	75	
24	10:00	77	

	NEQS	Average Values	Remarks
Day Time	65	70	High
Night Time	55	63	High

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING LOCATION-03

POINT 03

Package-8: Nowshera to Peshawar (40 Kms)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-03	Monitoring Point	Point 03
Date of Monitoring	05-01-2025 to 06-01-2025	Monitoring Coordinates	34°0'35" N 71°47'34" E

Sr. No.	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)
1	12:00	2.87	29.03	22.33	51.36	49.63
2	13:00	2.90	28.65	21.44	50.09	49.84
3	14:00	2.96	33.64	19.60	53.24	51.12
4	15:00	2.55	37.01	21.08	58.09	49.58
5	16:00	2.48	35.08	18.22	53.30	48.64
6	17:00	2.41	34.11	16.15	50.26	46.52
7	18:00	2.35	25.31	15.73	41.04	45.97
8	19:00	2.31	24.99	15.51	40.50	44.59
9	20:00	1.63	24.52	14.98	39.50	43.18
10	21:00	1.91	24.41	14.40	38.81	41.48
11	22:00	1.74	23.98	13.93	37.91	40.23
12	23:00	2.05	23.43	12.11	35.54	37.82
13	00:00	1.63	22.96	12.08	35.04	37.41
14	01:00	1.44	22.32	11.60	33.92	36.81
15	02:00	1.02	21.44	19.84	41.28	36.07
16	03:00	0.87	20.86	10.53	31.39	35.16
17	04:00	1.03	21.67	11.08	32.75	38.22
18	05:00	1.08	22.49	12.72	35.21	39.55
19	06:00	1.14	23.26	13.14	36.40	40.46
20	07:00	1.24	24.13	13.67	37.80	41.95
21	08:00	1.38	25.01	14.27	39.28	42.94
22	09:00	1.46	31.42	14.91	46.33	44.38
23	10:00	1.09	30.11	19.64	49.75	46.18
24	11:00	1.37	30.05	19.07	49.12	47.72
Average Concentration		1.79	26.66	15.75	42.41	43.14

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-03	Monitoring Point	Point 03
Date of Monitoring	05-01-2025 to 06-01-2025	Monitoring Coordinates	34°0'35" N 71°47'34" E

Parameters	Method of Measurement	Monitoring Duration	LDL	Average Obtained Concentration	NEQS	Remarks
Nitrogen Dioxide (NO_2) *	Gas Phase Chemiluminescence	24Hours	1.00	15.75	80.0 µg/m^3	Optimal
Nitrogen Oxide (NO)*	Gas Phase Chemiluminescence	24Hours	1.00	26.66	40.0 µg/m^3	Optimal
NO_x*	Gas Phase Chemiluminescence	24Hours	1.00	42.41	NGVS µg/m^3	-
Sulphur Dioxide (SO_2) *	Ultraviolet Fluorescence method	24Hours	1.00	43.14	120.0 µg/m^3	Optimal
Carbon Monoxide (CO)*	Non-Dispersive Infra-Red (NDIR)	24Hours	0.01	1.79	05.0 mg/m^3	Optimal
Ozone*	Non-Dispersive UV absorption Method	01 Hours	1.00	81	130 µg/m^3	Optimal
Lead*	ASS method after sampling using EPM 2000	24 Hours	0.07	0.9	1.5 µg/m^3	Optimal
Particulate Matter (PM_{10}) *	β Ray absorption method	24Hours	1.00	105	150.0 µg/m^3	Optimal
Particulate Matter ($PM_{2.5}$) *	β Ray absorption method	24Hours	1.00	40	35.0 µg/m^3	High
Total Particulate Matter (TSP)	Gravimetric Sampling	24Hours	1.00	189	500.0 µg/m^3	Optimal

*Parameters are approved from KP Environmental Protection Agency.

Abbreviations:

LDL= Lower Detection Limit
NEQS= National Environmental Quality Standards
µg/m^3 = Micro Gram per Meter Cube
mg/m^3 = Milli Gram per Meter Cube

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-03	Monitoring Point	Point 03
Date of Monitoring	05-01-2025 to 06-01-2025	Monitoring Coordinates	34°0'35" N 71°47'34" E

Sr. No.	Time	Ambient Temperature ^0C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
1	12:00	19	SE	2.8	41	760.0
2	13:00	19	W	3.5	45	760.4
3	14:00	20	W	3.6	50	760.5
4	15:00	20	W	2.9	54	759.0
5	16:00	21	W	2.7	55	759.2
6	17:00	21	W	3.0	59	759.4
7	18:00	20	W	2.5	61	759.6
8	19:00	18	SW	2.4	66	759.8
9	20:00	17	SW	2.5	67	758.1
10	21:00	15	SW	2.1	71	758.3
11	22:00	14	SW	1.9	70	758.5
12	23:00	14	SW	2.5	73	758.7
13	00:00	13	SW	2.2	73	758.4
14	01:00	13	SW	2.0	74	758.2
15	02:00	12	SW	1.8	75	758.3
16	03:00	12	SW	2.6	75	759.6
17	04:00	12	SW	2.4	76	759.1
18	05:00	11	SW	2.9	69	760.0
19	06:00	10	SW	3.1	55	760.8
20	07:00	10	SW	3.3	50	760.2
21	08:00	11	E	3.0	41	760.3
22	09:00	12	E	3.6	38	760.7
23	10:00	13	NE	3.0	35	760.1
24	11:00	15	NE	2.9	31	760.5

Monitored By

Reviewed By (TM)

Approved By (QM)

NOISE MONITORING REPORT

Monitoring Details			
Report Reference No.	AES-NP-01-2025-AA-03	Monitoring Point	Point 03
Date of Monitoring	05-01-2025 to 06-01-2025	Monitoring Coordinates	34°0'35" N 71°47'34" E

Sr. No.	Time	Noise dB(A)	
1	12:00	75	Day Time
2	13:00	72	
3	14:00	74	
4	15:00	73	
5	16:00	70	
6	17:00	71	
7	18:00	70	
8	19:00	69	
9	20:00	68	
10	21:00	68	
11	22:00	67	Night Time
12	23:00	65	
13	00:00	64	
14	01:00	65	
15	02:00	67	
16	03:00	69	
17	04:00	71	
18	05:00	72	
19	06:00	71	
20	07:00	73	Day Time
21	08:00	72	
22	09:00	77	
23	10:00	79	
24	11:00	80	

	NEQS	Average Values	Remarks
Day Time	65	72	High
Night Time	55	68	High

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING LOCATION-04

POINT 04

Package-8: Nowshera to Peshawar (40 Kms)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-04	Monitoring Point	Point 04
Date of Monitoring	06-01-2025 to 07-01-2025	Monitoring Coordinates	34°0'45" N 71°57'20" E

Sr. No.	Time	CO (mg/m³)	NO (µg/m³)	NO_2 (µg/m³)	NO_x (µg/m³)	SO_2 (µg/m³)
1	13:00	3.60	17.13	29.25	46.38	59.71
2	14:00	3.41	16.98	30.14	47.12	71.34
3	15:00	2.04	17.33	29.76	47.09	65.01
4	16:00	2.83	18.05	30.72	48.77	66.44
5	17:00	2.50	19.11	28.84	47.95	62.09
6	18:00	2.43	21.66	28.26	49.92	60.63
7	19:00	2.37	22.04	24.60	46.64	58.51
8	20:00	2.04	19.33	24.51	43.84	57.96
9	21:00	2.64	16.24	23.04	39.28	56.58
10	22:00	2.18	15.70	22.33	38.03	55.17
11	23:00	2.14	15.12	25.52	40.64	53.47
12	00:00	2.07	14.66	25.08	39.74	48.44
13	01:00	1.33	14.08	24.54	38.62	44.64
14	02:00	1.04	13.80	24.07	37.87	40.51
15	03:00	1.51	13.09	23.43	36.52	44.08
16	04:00	0.91	12.61	22.55	35.16	45.31
17	05:00	0.73	12.04	23.40	35.44	47.15
18	06:00	0.51	12.73	23.06	35.79	50.21
19	07:00	0.84	13.45	23.60	37.05	51.54
20	08:00	0.66	13.86	24.37	38.23	52.45
21	09:00	1.19	18.64	25.23	43.87	53.94
22	10:00	1.33	14.16	29.11	43.27	54.93
23	11:00	2.71	15.07	32.64	47.71	60.33
24	12:00	2.60	19.99	30.91	50.90	60.05
Average Concentration		1.90	16.12	26.21	42.33	55.02

Monitored By

Reviewed By (TM)

Approved By (QM)

AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-04	Monitoring Point	Point 04
Date of Monitoring	06-01-2025 to 07-01-2025	Monitoring Coordinates	34°0'45" N 71°57'20" E

Parameters	Method of Measurement	Monitoring Duration	LDL	Average Obtained Concentration	NEQS	Remarks
Nitrogen Dioxide (NO_2) *	Gas Phase Chemiluminescence	24Hours	1.00	26.21	80.0 µg/m³	Optimal
Nitrogen Oxide (NO)*	Gas Phase Chemiluminescence	24Hours	1.00	16.12	40.0 µg/m³	Optimal
NO_x*	Gas Phase Chemiluminescence	24Hours	1.00	42.33	NGVS µg/m³	-
Sulphur Dioxide (SO_2) *	Ultraviolet Fluorescence method	24Hours	1.00	55.02	120.0 µg/m³	Optimal
Carbon Monoxide (CO)*	Non-Dispersive Infra-Red (NDIR)	24Hours	0.01	1.90	05.0 mg/m³	Optimal
Ozone*	Non-Dispersive UV absorption Method	01 Hours	1.00	75	130 µg/m³	Optimal
Lead*	ASS method after sampling using EPM 2000	24 Hours	0.07	0.9	1.5 µg/m³	Optimal
Particulate Matter (PM_{10}) *	β Ray absorption method	24Hours	1.00	90	150.0 µg/m³	Optimal
Particulate Matter ($PM_{2.5}$) *	β Ray absorption method	24Hours	1.00	37	35.0 µg/m³	High
Total Particulate Matter (TSP)	Gravimetric Sampling	24Hours	1.00	175	500.0 µg/m³	Optimal

*Parameters are approved from KP Environmental Protection Agency.

Abbreviations:
LDL= Lower Detection Limit
NEQS= National Environmental Quality Standards
µg/m³ = Micro Gram per Meter Cube
mg/m³ = Milli Gram per Meter Cube

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

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AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-04	Monitoring Point	Point 04
Date of Monitoring	06-01-2025 to 07-01-2025	Monitoring Coordinates	34°0'45" N 71°57'20" E

Sr. No.	Time	Ambient Temperature ^0C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
1	13:00	17	NE	3.1	38	761.3
2	14:00	18	NE	3.8	42	761.7
3	15:00	18	N	3.9	47	761.8
4	16:00	19	N	3.2	51	760.3
5	17:00	19	N	3.0	52	760.5
6	18:00	18	N	3.3	56	760.7
7	19:00	17	N	2.8	58	760.9
8	20:00	16	N	2.7	63	761.1
9	21:00	16	N	2.8	64	759.4
10	22:00	15	N	2.4	68	759.6
11	23:00	15	N	2.2	67	759.8
12	00:00	14	N	2.8	70	760.0
13	01:00	13	N	2.5	70	759.7
14	02:00	13	N	2.3	71	759.5
15	03:00	12	N	2.1	72	759.6
16	04:00	12	N	2.9	72	760.9
17	05:00	11	N	2.7	73	760.4
18	06:00	10	N	3.2	66	761.3
19	07:00	10	N	3.4	52	762.1
20	08:00	10	N	3.6	47	761.5
21	09:00	11	N	3.3	38	761.6
22	10:00	12	NE	3.9	35	762.0
23	11:00	14	NE	3.3	35	761.4
24	12:00	15	NE	3.2	31	761.8

Monitored By

Reviewed By (TM)

Approved By (QM)

NOISE MONITORING REPORT

Monitoring Details

Report Reference No.	AES-NP-01-2025-AA-04	Monitoring Point	Point 04
Date of Monitoring	06-01-2025 to 07-01-2025	Monitoring Coordinates	34°0'45" N 71°57'20" E

Sr. No.	Time	Noise dB(A)	
1	13:00	75	Day Time
2	14:00	72	
3	15:00	74	
4	16:00	68	
5	17:00	65	
6	18:00	63	
7	19:00	62	
8	20:00	61	
9	21:00	60	
10	22:00	60	Night Time
11	23:00	59	
12	00:00	57	
13	01:00	56	
14	02:00	57	
15	03:00	59	
16	04:00	61	
17	05:00	63	
18	06:00	64	
19	07:00	67	Day Time
20	08:00	69	
21	09:00	73	
22	10:00	72	
23	11:00	74	
24	12:00	75	

	NEQS	Average Values	Remarks
Day Time	65	68	High
Night Time	55	60	High

Remarks:
Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Monitored By

Reviewed By
(TM)

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(QM)

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-DW-01	Report Issue Date	17-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-DW-01/2025	Sample Location/ Co-ordinate	DW-01 (New City Street 04) 34°1'8.31" N 71°39'52.2" E
Project Details	Detailed Design for Widenings and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40Kms).		

Drinking Water Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Laboratory Analysis					
Color*	SMWW 2120 C	≤ 15 TCU	0	N.A.	Optimal
Taste*	SMWW 2160 C	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Odor*	SMWW 2150 B	Non-Objectionable	Objectionable	N.A.	-
Turbidity*	SMWW 2130 B	< 5 NTU	0	N.A.	Optimal
Total Hardness (as $CaCO_3$) **	SMWW 2340 C	< 500 mg/L	476	± 2.74	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	< 1000 mg/L	590	± 12.20	Optimal
pH**	SMWW 4500 H^+ B	6.5- 8.5	7.71	± 0.03	Optimal
Aluminum (Al)	SMWW 3111 B	≤ 0.2 mg/L	<0.005	N.A.	Optimal
Antimony (Sb)	SMWW 3114 B	≤ 0.005 mg/L	<0.005	N.A.	Optimal
Arsenic (As)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	0.7 mg/L	<0.0035	N.A.	Optimal
Boron (B)	SMWW 3113 B	0.3 mg/L	<0.02	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.01 mg/L	<0.006	N.A.	Optimal
Chloride (Cl^-) **	SMWW 4500-Cl^- B	< 250 mg/L	39	± 140	Optimal
Chromium (Cr)	SMWW 3113 B	≤ 0.05 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3111 B	2.0 mg/L	<0.164	N.A.	Optimal
Cyanide (CN^-)*	SMWW 4500-CN^- F	≤ 0.05 mg/L	0	N.A.	Optimal
Fluoride (F^-)**	SMWW 4500-F^- C	≤ 1.5 mg/L	0.25	± 0.06	Optimal
Lead (Pb)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Manganese (Mn)	SMWW 3113 B	≤ 0.5 mg/L	<0.015	N.A.	Optimal
Mercury (Hg)	SMWW 3114 B	≤ 0.001 mg/L	<0.001	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	≤0.02 mg/L	<0.02	N.A.	Optimal
Nitrate (NO_3^-) **	SMWW 4500-NO_3^- D	≤ 50 mg/L	21.0	± 0.06	Optimal
Nitrite (NO_2^-) *	SMWW 4500-NO_2^- B	≤ 3.0 mg/L	0	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.01 mg/L	<0.01	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500-Cl^- B	0.5 mg/L	0	N.A.	Optimal

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-DW-01	Report Issue Date	17-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-DW-01/2025	Sample Location/ Co-ordinate	DW-01 (New City Street 04) 34°1'8.31" N 71°39'52.2" E
Project Details	Detailed Design for Widenings and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40Kms).		

Drinking Water Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Phenolic Compounds (as Phenols) *	SMWW 5530 D	NGVS mg/L	0	N.A.	Optimal
Zinc (Zn)	SMWW 3113 B	5.0 mg/L	0.028	N.A.	Optimal
Microbiological Analysis					
Total Coliforms*	SMWW 9222 B	0 CFU / 100 mL	0	N.A.	Optimal
Fecal Coliforms *	SMWW 9222 D	0 CFU / 100 mL	0	N.A.	Optimal

*Parameters are approved from KP Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from KP EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

NEQS = National Environmental Quality Standards
SMWW 24th Edition = Standard Methods for the examination of Water and Wastewater
TCU = True Color Unit
N.A. = Not Available
CFU = Colony Forming Unit
NTU = Nephelometric Turbidity Unit
MU = Measurement Uncertainty
NGVS = No Guideline Value Set

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Report Disclaimer

- If provided in the report, the statement of conformity is based on a binary decision rule of simple acceptance (shared risk).
- The decision rule will be provided upon request.
- The remaining portion of the sample (s) will be disposed off after *15* days after the issuance date of report from the laboratory unless otherwise instructed (Condition Apply).
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- This report is not intended to be used legally.
- The provided results relate only to the sample provided/collected.
- Values reflect the testing results; decision for usage of report totally depends on Customer.

Analyzed By

Reviewed By (TM)

Approved By (QM)

---------------End of Report---------------

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-DW-02	Report Issue Date	17-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-DW-02/2025	Sample Location/ Co-ordinate	DW-02 (Pabbi Masjid) 34°0'35.4" N 71°47'35.0" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Drinking Water Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Laboratory Analysis					
Color*	SMWW 2120 C	≤ 15 TCU	0	N.A.	Optimal
Taste*	SMWW 2160 C	Non-Objectionable	Objectionable	N.A.	-
Odor*	SMWW 2150 B	Non-Objectionable	Objectionable	N.A.	-
Turbidity*	SMWW 2130 B	< 5 NTU	0	N.A.	Optimal
Total Hardness (as $CaCO_3$) **	SMWW 2340 C	< 500 mg/L	416	± 2.74	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	< 1000 mg/L	735	± 12.20	Optimal
pH**	SMWW 4500 H^+ B	6.5- 8.5	7.89	± 0.03	Optimal
Aluminum (Al)	SMWW 3111 B	≤ 0.2 mg/L	<0.005	N.A.	Optimal
Antimony (Sb)	SMWW 3114 B	≤ 0.005 mg/L	<0.005	N.A.	Optimal
Arsenic (As)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	0.7 mg/L	<0.0035	N.A.	Optimal
Boron (B)	SMWW 3113 B	0.3 mg/L	<0.02	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.01 mg/L	<0.006	N.A.	Optimal
Chloride (Cl^-) **	SMWW 4500-Cl^- B	< 250 mg/L	51	± 140	Optimal
Chromium (Cr)	SMWW 3113 B	≤ 0.05 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3111 B	2.0 mg/L	<0.164	N.A.	Optimal
Cyanide (CN^-)*	SMWW 4500-CN^- F	≤ 0.05 mg/L	0	N.A.	Optimal
Fluoride (F^-)**	SMWW 4500-F^- C	≤ 1.5 mg/L	0.26	± 0.06	Optimal
Lead (Pb)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Manganese (Mn)	SMWW 3113 B	≤ 0.5 mg/L	<0.015	N.A.	Optimal
Mercury (Hg)	SMWW 3114 B	≤ 0.001 mg/L	<0.001	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	≤0.02 mg/L	<0.02	N.A.	Optimal
Nitrate (NO_3^-) **	SMWW 4500-NO_3^- D	≤ 50 mg/L	20.4	± 0.06	Optimal
Nitrite (NO_2^-) *	SMWW 4500-NO_2^- B	≤ 3.0 mg/L	0	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.01 mg/L	<0.01	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500-Cl^- B	0.5 mg/L	0	N.A.	Optimal

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-DW-02	Report Issue Date	17-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-DW-02/2025	Sample Location/ Co-ordinate	DW-02 (Pabbi Masjid) 34°0'35.4" N 71°47'35.0" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Drinking Water Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Phenolic Compounds (as Phenols) *	SMWW 5530 D	NGVS mg/L	0	N.A.	Optimal
Zinc (Zn)	SMWW 3113 B	5.0 mg/L	0.031	N.A.	Optimal
Microbiological Analysis					
Total Coliforms*	SMWW 9222 B	0 CFU / 100 mL	0	N.A.	Optimal
Fecal Coliforms *	SMWW 9222 D	0 CFU / 100 mL	0	N.A.	Optimal

*Parameters are approved from KP Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from KP EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

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SMWW 24th Edition = Standard Methods for the examination of Water and Wastewater
TCU = True Color Unit
N.A. = Not Available
CFU = Colony Forming Unit
NTU = Nephelometric Turbidity Unit
MU = Measurement Uncertainty
NGVS = No Guideline Value Set

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Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

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- Values reflect the testing results; decision for usage of report totally depends on Customer.

Analyzed By	Reviewed By (TM)	Approved By (QM)

---------------End of Report---------------

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-DW-03	Report Issue Date	17-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-DW-03/2025	Sample Location/ Co-ordinate	DW-03 (Masjid) 34°0'46.0" N 71°57'21.3" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Drinking Water Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Laboratory Analysis					
Color*	SMWW 2120 C	≤ 15 TCU	0	N.A.	Optimal
Taste*	SMWW 2160 C	Non-Objectionable	Objectionable	N.A.	-
Odor*	SMWW 2150 B	Non-Objectionable	Non-Objectionable	N.A.	-
Turbidity*	SMWW 2130 B	< 5 NTU	0	N.A.	Optimal
Total Hardness (as $CaCO_3$) **	SMWW 2340 C	< 500 mg/L	340	± 2.74	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	< 1000 mg/L	531	± 12.20	Optimal
pH**	SMWW 4500 H^+ B	6.5- 8.5	7.80	± 0.03	Optimal
Aluminum (Al)	SMWW 3111 B	≤ 0.2 mg/L	<0.005	N.A.	Optimal
Antimony (Sb)	SMWW 3114 B	≤ 0.005 mg/L	<0.005	N.A.	Optimal
Arsenic (As)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	0.7 mg/L	<0.0035	N.A.	Optimal
Boron (B)	SMWW 3113 B	0.3 mg/L	<0.02	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.01 mg/L	<0.006	N.A.	Optimal
Chloride (Cl^-) **	SMWW 4500-Cl^- B	< 250 mg/L	68	± 140	Optimal
Chromium (Cr)	SMWW 3113 B	≤ 0.05 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3111 B	2.0 mg/L	<0.164	N.A.	Optimal
Cyanide (CN^-)*	SMWW 4500-CN^- F	≤ 0.05 mg/L	0	N.A.	Optimal
Fluoride (F^-)**	SMWW 4500-F^- C	≤ 1.5 mg/L	0.18	± 0.06	Optimal
Lead (Pb)	SMWW 3114 B	≤ 0.05 mg/L	<0.005	N.A.	Optimal
Manganese (Mn)	SMWW 3113 B	≤ 0.5 mg/L	<0.015	N.A.	Optimal
Mercury (Hg)	SMWW 3114 B	≤ 0.001 mg/L	<0.001	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	≤0.02 mg/L	<0.02	N.A.	Optimal
Nitrate (NO_3^-) **	SMWW 4500-NO_3^- D	≤ 50 mg/L	35.8	± 0.06	Optimal
Nitrite (NO_2^-) *	SMWW 4500-NO_2^- B	≤ 3.0 mg/L	0	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.01 mg/L	<0.01	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500-Cl^- B	0.5 mg/L	0	N.A.	Optimal

DRINKING WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-DW-03	Report Issue Date	17-01-2025
Nature of Sample	Drinking Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-DW-03/2025	Sample Location/ Co-ordinate	DW-03 (Masjid) 34°0'46.0" N 71°57'21.3" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Drinking Water Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Phenolic Compounds (as Phenols) *	SMWW 5530 D	NGVS mg/L	0	N.A.	Optimal
Zinc (Zn)	SMWW 3113 B	5.0 mg/L	0.028	N.A.	Optimal
Microbiological Analysis					
Total Coliforms*	SMWW 9222 B	0 CFU / 100 mL	0	N.A.	Optimal
Fecal Coliforms *	SMWW 9222 D	0 CFU / 100 mL	0	N.A.	Optimal

*Parameters are approved from KP Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from KP EPA.

<u>The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.</u>

Abbreviations:

NEQS = National Environmental Quality Standards
SMWW 24th Edition = Standard Methods for the examination of Water and Wastewater
TCU = True Color Unit
N.A. = Not Available
CFU = Colony Forming Unit
NTU = Nephelometric Turbidity Unit
MU = Measurement Uncertainty
NGVS = No Guideline Value Set

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Report Disclaimer

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Analyzed By

Reviewed By (TM)

Approved By (QM)

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SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-01	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-01/2025	Sample Location/ Co-ordinate	SW-01 (Bara River) 34°1'1.53" N 71°42'12.1" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6.0 - 8.5	7.69	± 0.039	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	-	15	N.A.	-
Chemical Oxygen Demand (COD)**	SMWW 5220 D	-	32	± 18.82	-
Total Suspended Solids (TSS)**	SMWW 2540 D	-	40	± 3.71	-
Total Dissolved Solids (TDS)**	SMWW 2540 C	0-2000	502	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	-	0	N.A.	-
Grease and Oil**	SMWW 5520 B	-	0	± 0.91	-
Chloride (Cl^-)**	SMWW 4500-Cl- B	0 - 1065	37	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	-	0.22	± 0.06	-
Cyanide (CN^-)*	SMWW 4500-CN- F	-	0	N.A.	-
An-ionic Detergents (as MBAs) *	SMWW 5540-C	-	0	N.A.	-
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	0-960	86	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	-	0	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-01	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 $\pm$ 5) °C & (55 $\pm$ 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-01/2025	Sample Location/ Co-ordinate	SW-01 (Bara River) 34°1'1.53" N 71°42'12.1" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results					
Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Ammonia (NH_3) *	SMWW 4500-NH_3 C	-	0	N.A.	-
Cadmium (Cd)	SMWW 3113 B	-	<0.006	N.A.	-
Chromium (Cr)	SMWW 3113 B	-	<0.004	N.A.	-
Copper (Cu)	SMWW 3113 B	-	<0.164	N.A.	-
Lead (Pb)	SMWW 3113 B	-	<0.005	N.A.	-
Mercury (Hg)	SMWW 3112 B	-	<0.001	N.A.	-
Selenium (Se)	SMWW 3114 B	-	<0.01	N.A.	-
Nickel (Ni)	SMWW 3113 B	-	<0.02	N.A.	-
Silver (Ag)	SMWW 3113 B	-	<0.002	N.A.	-
Total Toxic Metals	Calculated Value	-	0.24	N.A.	-
Zinc (Zn)	SMWW 3111 B	-	0.027	N.A.	-
Arsenic (As)	SMWW 3114 B	-	<0.005	N.A.	-
Barium (Ba)	SMWW 3113 B	-	<0.0035	N.A.	-
Iron (Fe)	SMWW 3113 B	-	0.0750	N.A.	-
Manganese (Mn)	SMWW 3111 B	-	<0.015	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-01	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-01/2025	Sample Location/ Co-ordinate	SW-01 (Bara River) 34°1'1.53" N 71°42'12.1" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Boron (B)	SMWW 3113 B	0-2	<0.02	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	-	0	N.A.	-

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**Parameters are accredited from Pakistan National Accreditation Council & approved from KP EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

MU = Measurement Uncertainty
N.A. = Not Available
SMWW = Standard Methods for the examination of Water and Wastewater
FAO = Food and Agriculture Organization

Remarks:

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SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-02	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-02/2025	Sample Location	SW-02 (Aza Khel Khawar) 34°0'21.2" N 71°45'12.3" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6.0 - 8.5	7.87	± 0.03	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	-	6	N.A.	-
Chemical Oxygen Demand (COD)**	SMWW 5220 D	-	14	± 4.00	-
Total Suspended Solids (TSS)**	SMWW 2540 D	-	279	± 4.09	-
Total Dissolved Solids (TDS)**	SMWW 2540 C	0-2000	196	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	-	0	N.A.	-
Grease and Oil**	SMWW 5520 B	-	0	± 0.91	-
Chloride (Cl^-)**	SMWW 4500-Cl- B	0 - 1065	18	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	-	0.14	± 0.06	-
Cyanide (CN^-)*	SMWW 4500-CN- F	-	0	N.A.	-
An-ionic Detergents (as MBAs) *	SMWW 5540-C	-	0	N.A.	-
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	0-960	48	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	-	0	N.A.	-
Ammonia (NH_3) *	SMWW 4500-NH_3 C	-	0	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-02	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-02/2025	Sample Location	SW-02 (Aza Khel Khawar) 34°0'21.2" N 71°45'12.3" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results					
Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Cadmium (Cd)	SMWW 3113 B	-	<0.006	N.A.	-
Chromium (Cr)	SMWW 3113 B	-	<0.004	N.A.	-
Copper (Cu)	SMWW 3113 B	-	<0.164	N.A.	-
Lead (Pb)	SMWW 3113 B	-	<0.005	N.A.	-
Mercury (Hg)	SMWW 3112 B	-	<0.001	N.A.	-
Selenium (Se)	SMWW 3114 B	-	<0.01	N.A.	-
Nickel (Ni)	SMWW 3113 B	-	<0.02	N.A.	-
Silver (Ag)	SMWW 3113 B	-	<0.002	N.A.	-
Total Toxic Metals	Calculated Value	-	0.24	N.A.	-
Zinc (Zn)	SMWW 3111 B	-	0.025	N.A.	-
Arsenic (As)	SMWW 3114 B	-	<0.005	N.A.	-
Barium (Ba)	SMWW 3113 B	-	<0.0035	N.A.	-
Iron (Fe)	SMWW 3113 B	-	0.0750	N.A.	-
Manganese (Mn)	SMWW 3111 B	-	<0.015	N.A.	-
Boron (B)	SMWW 3113 B	0-2	<0.02	N.A.	Optimal

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-02	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-02/2025	Sample Location	SW-02 (Aza Khel Khawar) 34°0'21.2" N 71°45'12.3" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	-	0	N.A.	-

*Parameters are approved from KP Environmental Protection Agency (EPA).

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SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-03	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-03/2025	Sample Location/Co-ordinate	SW-03 (Khazam Khawar) 34°0'44.9" N 71°46'26.7" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6.0 - 8.5	7.84	± 0.03	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	-	6	N.A.	-
Chemical Oxygen Demand (COD)**	SMWW 5220 D	-	14	± 4.00	-
Total Suspended Solids (TSS)**	SMWW 2540 D	-	08	± 4.09	-
Total Dissolved Solids (TDS)**	SMWW 2540 C	0-2000	362	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	-	0	N.A.	-
Grease and Oil**	SMWW 5520 B	-	0	± 0.91	-
Chloride (Cl^-)**	SMWW 4500-Cl- B	0 - 1065	23	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	-	0.19	± 0.06	-
Cyanide (CN^-)*	SMWW 4500-CN-F	-	0	N.A.	-
An-ionic Detergents (as MBAs) *	SMWW 5540-C	-	0	N.A.	-
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	0-960	74	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	-	0	N.A.	-
Ammonia (NH_3) *	SMWW 4500-NH_3 C	-	0	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-03	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-03/2025	Sample Location/Co-ordinate	SW-03 (Khazam Khawar) 34°0'44.9" N 71°46'26.7" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results					
Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Cadmium (Cd)	SMWW 3113 B	-	<0.006	N.A.	-
Chromium (Cr)	SMWW 3113 B	-	<0.004	N.A.	-
Copper (Cu)	SMWW 3113 B	-	<0.164	N.A.	-
Lead (Pb)	SMWW 3113 B	-	<0.005	N.A.	-
Mercury (Hg)	SMWW 3112 B	-	<0.001	N.A.	-
Selenium (Se)	SMWW 3114 B	-	<0.01	N.A.	-
Nickel (Ni)	SMWW 3113 B	-	<0.02	N.A.	-
Silver (Ag)	SMWW 3113 B	-	<0.002	N.A.	-
Total Toxic Metals	Calculated Value	-	0.24	N.A.	-
Zinc (Zn)	SMWW 3111 B	-	0.027	N.A.	-
Arsenic (As)	SMWW 3114 B	-	<0.005	N.A.	-
Barium (Ba)	SMWW 3113 B	-	<0.0035	N.A.	-
Iron (Fe)	SMWW 3113 B	-	0.0720	N.A.	-
Manganese (Mn)	SMWW 3111 B	-	<0.015	N.A.	-
Boron (B)	SMWW 3113 B	0-2	<0.02	N.A.	Optimal

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-03	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 $\pm$ 5) °C & (55 $\pm$ 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-03/2025	Sample Location/Co-ordinate	SW-03 (Khazam Khawar) 34°0'44.9" N 71°46'26.7" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	-	0	N.A.	-

*Parameters are approved from KP Environmental Protection Agency (EPA).

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Abbreviations:

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Reviewed By (TM)

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SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-04	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 $\pm$ 5) °C & (55 $\pm$ 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-04/2025	Sample Location/ Co-ordinate	SW-04 (Khawar Banda) 34°0'34.1" N 71°46'26.7" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 KMS).		

Surface water Analysis Results

Parameter	Analysis Method	Result	FAO	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	7.61	6.0 - 8.5	± 0.03	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	10	-	N.A.	-
Chemical Oxygen Demand (COD)**	SMWW 5220 D	21	-	± 4.00	-
Total Suspended Solids (TSS)**	SMWW 2540 D	09	-	± 4.09	-
Total Dissolved Solids (TDS)**	SMWW 2540 C	253	0-2000	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	0	-	N.A.	-
Grease and Oil**	SMWW 5520 B	0	-	± 0.91	-
Chloride (Cl^-)**	SMWW 4500-Cl- B	23	0 - 1065	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	0.16	-	± 0.06	-
Cyanide (CN^-)*	SMWW 4500-CN- F	0	-	N.A.	-
An-ionic Detergents (as MBAs) *	SMWW 5540-C	0	-	N.A.	-
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	37	0-960	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	0	-	N.A.	-
Ammonia (NH_3) *	SMWW 4500-NH_3 C	0	-	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-04	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-04/2025	Sample Location/ Co-ordinate	SW-04 (Khawar Banda) 34°0'34.1" N 71°46'26.7" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 KMS).		

Surface water Analysis Results

Parameter	Analysis Method	Result	FAO	MU (CL95%)	Remarks
Cadmium (Cd)	SMWW 3113 B	<0.006	-	N.A.	-
Chromium (Cr)	SMWW 3113 B	<0.004	-	N.A.	-
Copper (Cu)	SMWW 3113 B	<0.164	-	N.A.	-
Lead (Pb)	SMWW 3113 B	<0.005	-	N.A.	-
Mercury (Hg)	SMWW 3112 B	<0.001	-	N.A.	-
Selenium (Se)	SMWW 3114 B	<0.01	-	N.A.	-
Nickel (Ni)	SMWW 3113 B	<0.02	-	N.A.	-
Silver (Ag)	SMWW 3113 B	<0.002	-	N.A.	-
Total Toxic Metals	Calculated Value	0.24	-	N.A.	-
Zinc (Zn)	SMWW 3111 B	0.025	-	N.A.	-
Arsenic (As)	SMWW 3114 B	<0.005	-	N.A.	-
Barium (Ba)	SMWW 3113 B	<0.0035	-	N.A.	-
Iron (Fe)	SMWW 3113 B	0.0620	-	N.A.	-
Manganese (Mn)	SMWW 3111 B	<0.015	-	N.A.	-
Boron (B)	SMWW 3113 B	<0.02	0-2	N.A.	Optimal

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SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-04	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-04/2025	Sample Location/ Co-ordinate	SW-04 (Khawar Banda) 34°0'34.1" N 71°46'26.7" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 KMS).		

Surface water Analysis Results

Parameter	Analysis Method	Result	FAO	MU (CL95%)	Remarks
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	0	-	N.A.	-

*Parameters are approved from KP Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from KP EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

MU = Measurement Uncertainty
N.A. = Not Available
SMWW = Standard Methods for the examination of Water and Wastewater
FAO = Food and Agriculture Organization

Remarks:

Optimal = Compliance with Permissible Range
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Report Disclaimer

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Analyzed By	Reviewed By (TM)	Approved By (QM)

---------------End of Report---------------

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-05	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-05/2025	Sample Location/ Co-ordinate	SW-05 (Kabul River) 34°0'21.2" N 71°58'14.3" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera To Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6.0 - 8.5	7.86	± 0.03	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	-	<5	N.A.	-
Chemical Oxygen Demand (COD)**	SMWW 5220 D	-	<5	± 4.00	-
Total Suspended Solids (TSS)**	SMWW 2540 D	-	40	± 4.09	-
Total Dissolved Solids (TDS)**	SMWW 2540 C	0-2000	259	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	-	0	N.A.	-
Grease and Oil**	SMWW 5520 B	-	0	± 0.91	-
Chloride (Cl^-)**	SMWW 4500-Cl- B	0 - 1065	16	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	-	0.16	± 0.06	-
Cyanide (CN^-)*	SMWW 4500-CN- F	-	0	N.A.	-
An-ionic Detergents (as MBAs) *	SMWW 5540-C	-	0	N.A.	-
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	0-960	65	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	-	0	N.A.	-
Ammonia (NH_3) *	SMWW 4500-NH_3 C	-	0	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-05	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-05/2025	Sample Location/ Co-ordinate	SW-05 (Kabul River) 34°0'21.2" N 71°58'14.3" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera To Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Cadmium (Cd)	SMWW 3113 B	-	<0.006	N.A.	-
Chromium (Cr)	SMWW 3113 B	-	<0.004	N.A.	-
Copper (Cu)	SMWW 3113 B	-	<0.164	N.A.	-
Lead (Pb)	SMWW 3113 B	-	<0.005	N.A.	-
Mercury (Hg)	SMWW 3112 B	-	<0.001	N.A.	-
Selenium (Se)	SMWW 3114 B	-	<0.01	N.A.	-
Nickel (Ni)	SMWW 3113 B	-	<0.02	N.A.	-
Silver (Ag)	SMWW 3113 B	-	<0.002	N.A.	-
Total Toxic Metals	Calculated Value	-	0.24	N.A.	-
Zinc (Zn)	SMWW 3111 B	-	0.025	N.A.	-
Arsenic (As)	SMWW 3114 B	-	<0.005	N.A.	-
Barium (Ba)	SMWW 3113 B	-	<0.0035	N.A.	-
Iron (Fe)	SMWW 3113 B	-	0.0650	N.A.	-
Manganese (Mn)	SMWW 3111 B	-	<0.015	N.A.	-
Boron (B)	SMWW 3113 B	0-2	<0.02	N.A.	Optimal

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-05	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-05/2025	Sample Location/ Co-ordinate	SW-05 (Kabul River) 34°0'21.2" N 71°58'14.3" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera To Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	FAO	Result	MU (CL95%)	Remarks
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	-	0	N.A.	-

*Parameters are approved from KP Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from KP EPA.

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Analyzed By	Reviewed By (TM)	Approved By (QM)

---------------End of Report---------------

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-06	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-06/2025	Sample Location/Co-ordinate	SW-06 (Azakhel Bala) 34°0'34.1" N 71°51'37.2" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	Result	FAO	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	7.54	7.69	± 0.03	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	<5	15	N.A.	-
Chemical Oxygen Demand (COD)**	SMWW 5220 D	12	32	± 4.00	-
Total Suspended Solids (TSS)**	SMWW 2540 D	10	40	± 4.09	-
Total Dissolved Solids (TDS)**	SMWW 2540 C	276	502	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	0	0	N.A.	-
Grease and Oil**	SMWW 5520 B	0	0	± 0.91	-
Chloride (Cl^-)**	SMWW 4500-Cl- B	22	37	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	0.15	0.22	± 0.06	-
Cyanide (CN^-)*	SMWW 4500-CN- F	0	0	N.A.	-
An-ionic Detergents (as MBAs) *	SMWW 5540-C	0	0	N.A.	-
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	63	86	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	0	0	N.A.	-
Ammonia (NH_3) *	SMWW 4500-NH_3 C	0	0	N.A.	-

SURFACE WATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-SW-06	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-06/2025	Sample Location/Co-ordinate	SW-06 (Azakhel Bala) 34°0'34.1" N 71°51'37.2" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results

Parameter	Analysis Method	Result	FAO	MU (CL95%)	Remarks
Cadmium (Cd)	SMWW 3113 B	<0.006	<0.006	N.A.	-
Chromium (Cr)	SMWW 3113 B	<0.004	<0.004	N.A.	-
Copper (Cu)	SMWW 3113 B	<0.164	<0.164	N.A.	-
Lead (Pb)	SMWW 3113 B	<0.005	<0.005	N.A.	-
Mercury (Hg)	SMWW 3112 B	<0.001	<0.001	N.A.	-
Selenium (Se)	SMWW 3114 B	<0.01	<0.01	N.A.	-
Nickel (Ni)	SMWW 3113 B	<0.02	<0.02	N.A.	-
Silver (Ag)	SMWW 3113 B	<0.002	<0.002	N.A.	-
Total Toxic Metals	Calculated Value	0.24	0.24	N.A.	-
Zinc (Zn)	SMWW 3111 B	0.026	0.027	N.A.	-
Arsenic (As)	SMWW 3114 B	<0.005	<0.005	N.A.	-
Barium (Ba)	SMWW 3113 B	<0.0035	<0.0035	N.A.	-
Iron (Fe)	SMWW 3113 B	0.0657	0.0750	N.A.	-
Manganese (Mn)	SMWW 3111 B	<0.015	<0.015	N.A.	-
Boron (B)	SMWW 3113 B	<0.02	<0.02	N.A.	Optimal

SURFACE WATER ANALYSIS REPORT

Sample Detail			
Report Reference No.	AES-NP-01/2025-SW-06	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-SW-06/2025	Sample Location/Co-ordinate	SW-06 (Azakhel Bala) 34°0'34.1" N 71°51'37.2" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Surface water Analysis Results					
Parameter	Analysis Method	Result	FAO	MU (CL95%)	Remarks
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	0	0	N.A.	-

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Abbreviations:

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N.A. = Not Available

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Analyzed By

Reviewed By (TM)

Approved By (QM)

---------------End of Report---------------

WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-WW-01	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-WW-01/2025	Sample Location/ Co-ordinate	WW-01 Pabbi Masjid 34°0'8.31" N 71°39'52.2" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Wastewater Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6 - 9	7.56	± 0.03	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	80 mg/L	11	N.A.	Optimal
Chemical Oxygen Demand (COD)**	SMWW 5220 D	150 mg/L	23	± 4.00	Optimal
Total Suspended Solids (TSS)**	SMWW 2540 D	200 mg/L	94	± 3.71	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	3500 mg/L	228	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	0.1 mg/L	0	N.A.	Optimal
Grease and Oil**	SMWW 5520 B	10 mg/L	0	± 0.91	Optimal
Chloride (Cl^-)**	SMWW 4500-Cl- B	1000 mg/L	16	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	10 mg/L	0.14	± 0.06	Optimal
Cyanide (CN^-)*	SMWW 4500-CN- F	1.0 mg/L	0	N.A.	Optimal
An-ionic Detergents (as MBAs) *	SMWW 5540-C	20.0 mg/L	0	N.A.	Optimal
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	600 mg/L	69	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	1.0 mg/L	0	N.A.	Optimal
Ammonia (NH_3) *	SMWW 4500-NH_3 C	40 mg/L	0	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.1 mg/L	<0.006	N.A.	Optimal
Chromium (Cr)	SMWW 3113 B	1.0 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3113 B	1.0 mg/L	<0.164	N.A.	Optimal
Lead (Pb)	SMWW 3113 B	0.5 mg/L	<0.005	N.A.	Optimal
Mercury (Hg)	SMWW 3112 B	0.01 mg/L	<0.001	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.5 mg/L	<0.01	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	1.0 mg/L	<0.02	N.A.	Optimal
Silver (Ag)	SMWW 3113 B	1.0 mg/L	<0.002	N.A.	Optimal
Total Toxic Metals	Calculated Value	2.0 mg/L	0.24	N.A.	Optimal
Zinc (Zn)	SMWW 3111 B	5.0 mg/L	0.026	N.A.	Optimal

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WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-WW-01	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 $\pm$ 5) °C & (55 $\pm$ 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-WW-01/2025	Sample Location/ Co-ordinate	WW-01 Pabbi Masjid 34°0'8.31" N 71°39'52.2" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Wastewater Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Arsenic (As)	SMWW 3114 B	1.0 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	1.5 mg/L	<0.0035	N.A.	Optimal
Iron (Fe)	SMWW 3113 B	8.0 mg/L	0.0776	N.A.	Optimal
Manganese (Mn)	SMWW 3111 B	1.5 mg/L	<0.015	N.A.	Optimal
Boron (B)	SMWW 3113 B	6.0 mg/L	<0.02	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	1.0 mg/L	0	N.A.	Optimal

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Abbreviations:

NEQS = National Environmental Quality Standards
N.A. = Not Available
SMWW = Standard Methods for the examination of Water and Wastewater
MU = Measurement Uncertainty

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Analyzed By	Reviewed By (TM)	Approved By (QM)

---------------End of Report---------------

WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-WW-02	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-WW-02/2025	Sample Location/Co-ordinate	WW-02 (New city) 34°1'7.76" N 71°40'3.79" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Wastewater Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6 - 9	7.56	± 0.03	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	80 mg/L	40	N.A.	Optimal
Chemical Oxygen Demand (COD)**	SMWW 5220 D	150 mg/L	83	± 4.00	Optimal
Total Suspended Solids (TSS)**	SMWW 2540 D	200 mg/L	19	± 3.71	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	3500 mg/L	284	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	0.1 mg/L	0	N.A.	Optimal
Grease and Oil**	SMWW 5520 B	10 mg/L	0	± 0.91	Optimal
Chloride (Cl^-)**	SMWW 4500-Cl- B	1000 mg/L	23	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	10 mg/L	0.15	± 0.06	Optimal
Cyanide (CN^-)*	SMWW 4500-CN- F	1.0 mg/L	0	N.A.	Optimal
An-ionic Detergents (as MBAs) *	SMWW 5540-C	20.0 mg/L	0	N.A.	Optimal
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	600 mg/L	64	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	1.0 mg/L	0	N.A.	Optimal
Ammonia (NH_3) *	SMWW 4500-NH_3 C	40 mg/L	0	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.1 mg/L	<0.006	N.A.	Optimal
Chromium (Cr)	SMWW 3113 B	1.0 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3113 B	1.0 mg/L	<0.164	N.A.	Optimal
Lead (Pb)	SMWW 3113 B	0.5 mg/L	<0.005	N.A.	Optimal
Mercury (Hg)	SMWW 3112 B	0.01 mg/L	<0.001	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.5 mg/L	<0.01	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	1.0 mg/L	<0.02	N.A.	Optimal
Silver (Ag)	SMWW 3113 B	1.0 mg/L	<0.002	N.A.	Optimal
Total Toxic Metals	Calculated Value	2.0 mg/L	0.24	N.A.	Optimal
Zinc (Zn)	SMWW 3111 B	5.0 mg/L	0.028	N.A.	Optimal

WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-WW-02	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 $\pm$ 5) °C & (55 $\pm$ 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-WW-02/2025	Sample Location/Co-ordinate	WW-02 (New city) 34°1'7.76" N 71°40'3.79" E
Project Details	Detailed Design for Widening and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Wastewater Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Arsenic (As)	SMWW 3114 B	1.0 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	1.5 mg/L	<0.0035	N.A.	Optimal
Iron (Fe)	SMWW 3113 B	8.0 mg/L	0.0790	N.A.	Optimal
Manganese (Mn)	SMWW 3111 B	1.5 mg/L	<0.015	N.A.	Optimal
Boron (B)	SMWW 3113 B	6.0 mg/L	<0.02	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	1.0 mg/L	0	N.A.	Optimal

*Parameters are approved from KP Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from KP EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

NEQS = National Environmental Quality Standards
N.A. = Not Available
SMWW = Standard Methods for the examination of Water and Wastewater
MU = Measurement Uncertainty

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
High = Exceeds from Permissible Range
Low = Less Than Permissible Range

Report Disclaimer

- If provided in the report, the statement of conformity is based on a binary decision rule of simple acceptance (shared risk).
- The decision rule will be provided upon request.
- The remaining portion of the sample (s) will be disposed off after 15 days after the issuance date of report from the laboratory unless otherwise instructed (Condition Apply).
- This report shall not be reproduced in part/parties.
- This report is not intended to be used legally.
- The provided results relate only to the sample provided/collected.
- Values reflect the testing results; decision for usage of report totally depends on Customer.

Analyzed By

Reviewed By
(TM)

Approved By
(QM)

---------------End of Report---------------

WASTEWATER ANALYSIS REPORT

Sample Detail

Report Reference No.	AES-NP-01/2025-WW-03	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-WW-03/2025	Sample Location /Co-ordinate	WW-03 (Aman garh) 34°0'38.2" N 71°55'56.6" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Wastewater Analysis Results

Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Lab Analysis					
pH**	SMWW 4500 H^+ B	6 - 9	7.54	± 0.03	Optimal
Biochemical Oxygen Demand (BOD_5) *	SMWW 5210-B	80 mg/L	150	N.A.	High
Chemical Oxygen Demand (COD)**	SMWW 5220 D	150 mg/L	282	± 4.00	High
Total Suspended Solids (TSS)**	SMWW 2540 D	200 mg/L	234	± 3.71	High
Total Dissolved Solids (TDS)**	SMWW 2540 C	3500 mg/L	534	± 12.20	Optimal
Phenolic Compounds (as Phenols) *	SMWW 5530 B, D	0.1 mg/L	0	N.A.	Optimal
Grease and Oil**	SMWW 5520 B	10 mg/L	0	± 0.91	Optimal
Chloride (Cl^-)**	SMWW 4500-Cl- B	1000 mg/L	63	± 1.40	Optimal
Fluoride (F^-)**	SMWW 4500-F- D	10 mg/L	0.18	± 0.06	Optimal
Cyanide (CN^-)*	SMWW 4500-CN- F	1.0 mg/L	0	N.A.	Optimal
An-ionic Detergents (as MBAs) *	SMWW 5540-C	20.0 mg/L	3.8	N.A.	Optimal
Sulfate (SO_4^{2-}) **	SMWW 4500-SO_4^{-2} E	600 mg/L	08	± 6.73	Optimal
Sulfide (S^{2-}) *	SMWW 4500-S^{-2} F	1.0 mg/L	0	N.A.	Optimal
Ammonia (NH_3) *	SMWW 4500-NH_3 C	40 mg/L	0	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.1 mg/L	<0.006	N.A.	Optimal
Chromium (Cr)	SMWW 3113 B	1.0 mg/L	<0.004	N.A.	Optimal
Copper (Cu)	SMWW 3113 B	1.0 mg/L	0.164	N.A.	Optimal
Lead (Pb)	SMWW 3113 B	0.5 mg/L	<0.005	N.A.	Optimal
Mercury (Hg)	SMWW 3112 B	0.01 mg/L	<0.001	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.5 mg/L	<0.01	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	1.0 mg/L	<0.02	N.A.	Optimal
Silver (Ag)	SMWW 3113 B	1.0 mg/L	<0.002	N.A.	Optimal
Total Toxic Metals	Calculated Value	2.0 mg/L	0.24	N.A.	Optimal
Zinc (Zn)	SMWW 3111 B	5.0 mg/L	0.035	N.A.	Optimal

WASTEWATER ANALYSIS REPORT

Sample Detail			
Report Reference No.	AES-NP-01/2025-WW-03	Report Issue Date	17-01-2025
Nature of Sample	Wastewater	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	07-01-2025	Sample Receiving Date	13-01-2025
Analysis Completion Date	16-01-2025	Laboratory Temperature & Humidity	(25 $\pm$ 5) °C & (55 $\pm$ 15) %
Ambient Temperature & Humidity at the Time of Sample collected			23 °C & 39 %
Sample ID	AES-WW-03/2025	Sample Location /Co-ordinate	WW-03 (Aman garh) 34°0'38.2" N 71°55'56.6" E
Project Details	Detailed Design for Widenning and Improvement of Priority Sections Of N-5, Package-8: Nowshera to Peshawar (40 Kms).		

Wastewater Analysis Results					
Parameter	Analysis Method	NEQS	Result	MU (CL95%)	Remarks
Arsenic (As)	SMWW 3114 B	1.0 mg/L	<0.005	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	1.5 mg/L	<0.0035	N.A.	Optimal
Iron (Fe)	SMWW 3113 B	8.0 mg/L	0.0895	N.A.	Optimal
Manganese (Mn)	SMWW 3111 B	1.5 mg/L	<0.015	N.A.	Optimal
Boron (B)	SMWW 3113 B	6.0 mg/L	<0.02	N.A.	Optimal
Residual Chlorine (Cl_2) *	SMWW 4500 Cl- B	1.0 mg/L	0	N.A.	Optimal

*Parameters are approved from KP Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from KP EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

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N.A. = Not Available
SMWW = Standard Methods for the examination of Water and Wastewater
MU = Measurement Uncertainty

Remarks:

Optimal = Compliance with Permissible Range
Marginal = Close to Extreme Edge
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Low = Less Than Permissible Range

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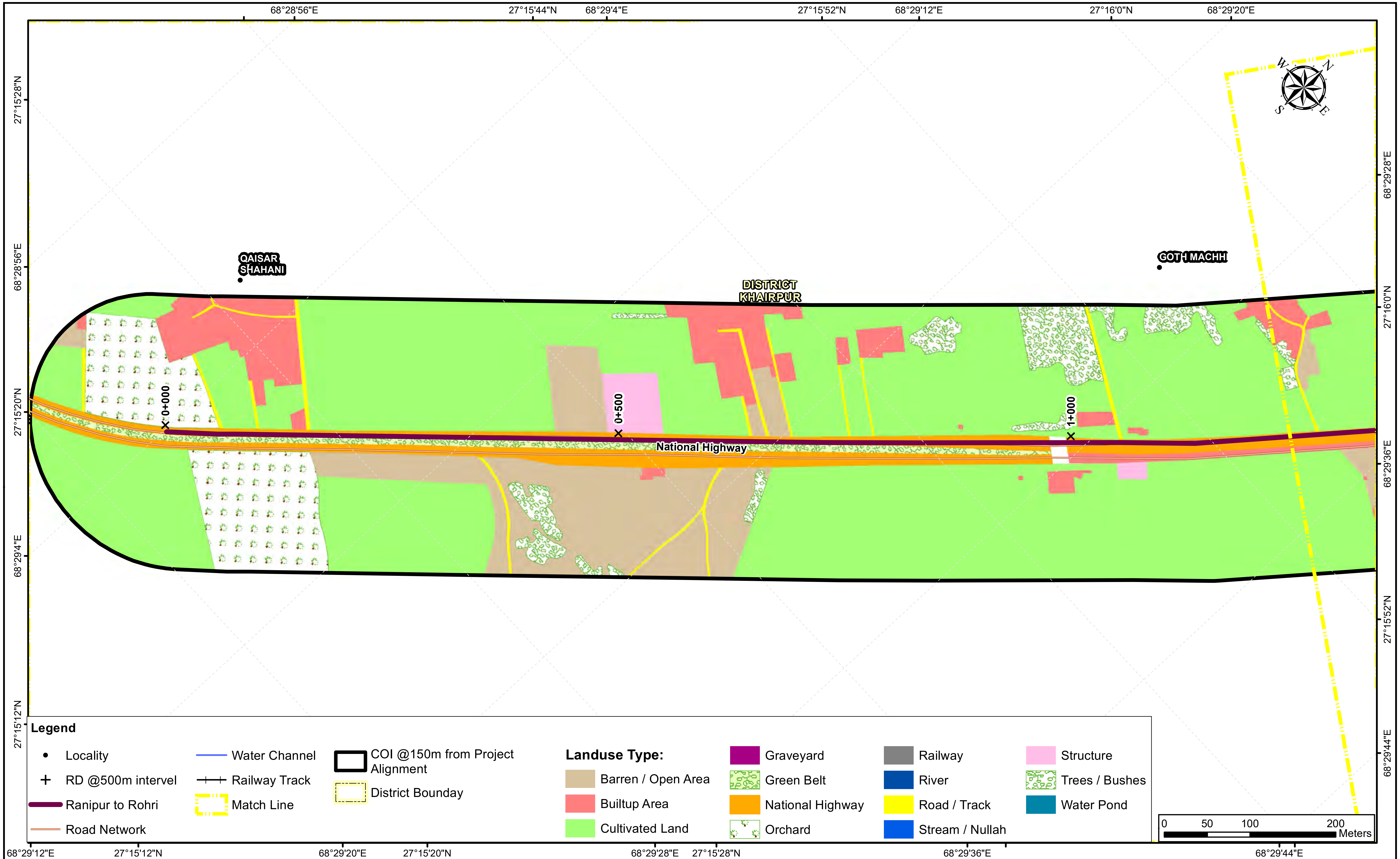
Analyzed By

Reviewed By
(TM)

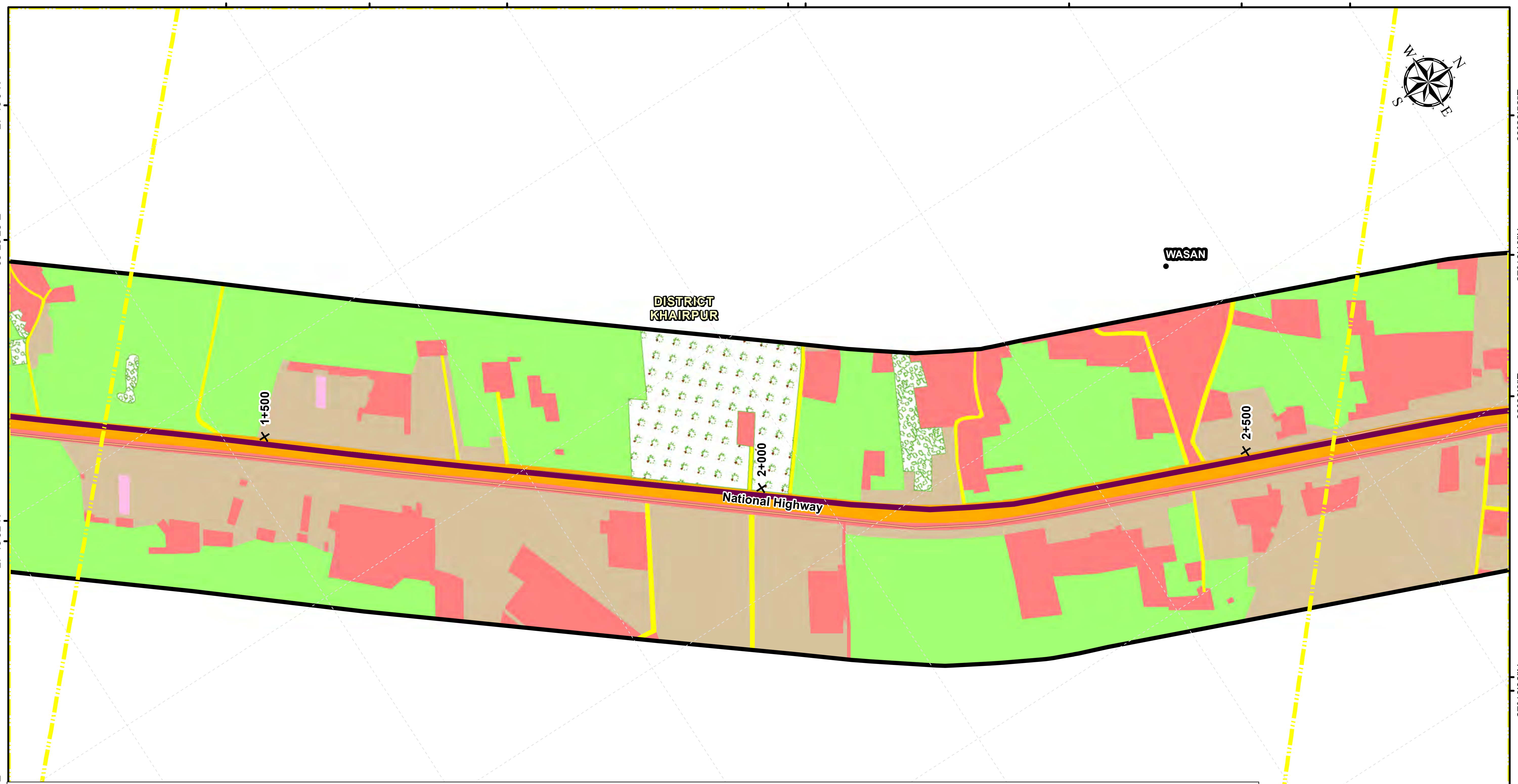
Approved By
(QM)

---------------End of Report---------------

VOLUME 5: LANDUSE MAPS



CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.		DATE: DECEMBER- 2024	FIG. NO.: Page 1 of 53
		02				RECOMMENDED				REV.: 0
		01				CHD/VER.				
						APPROVED				



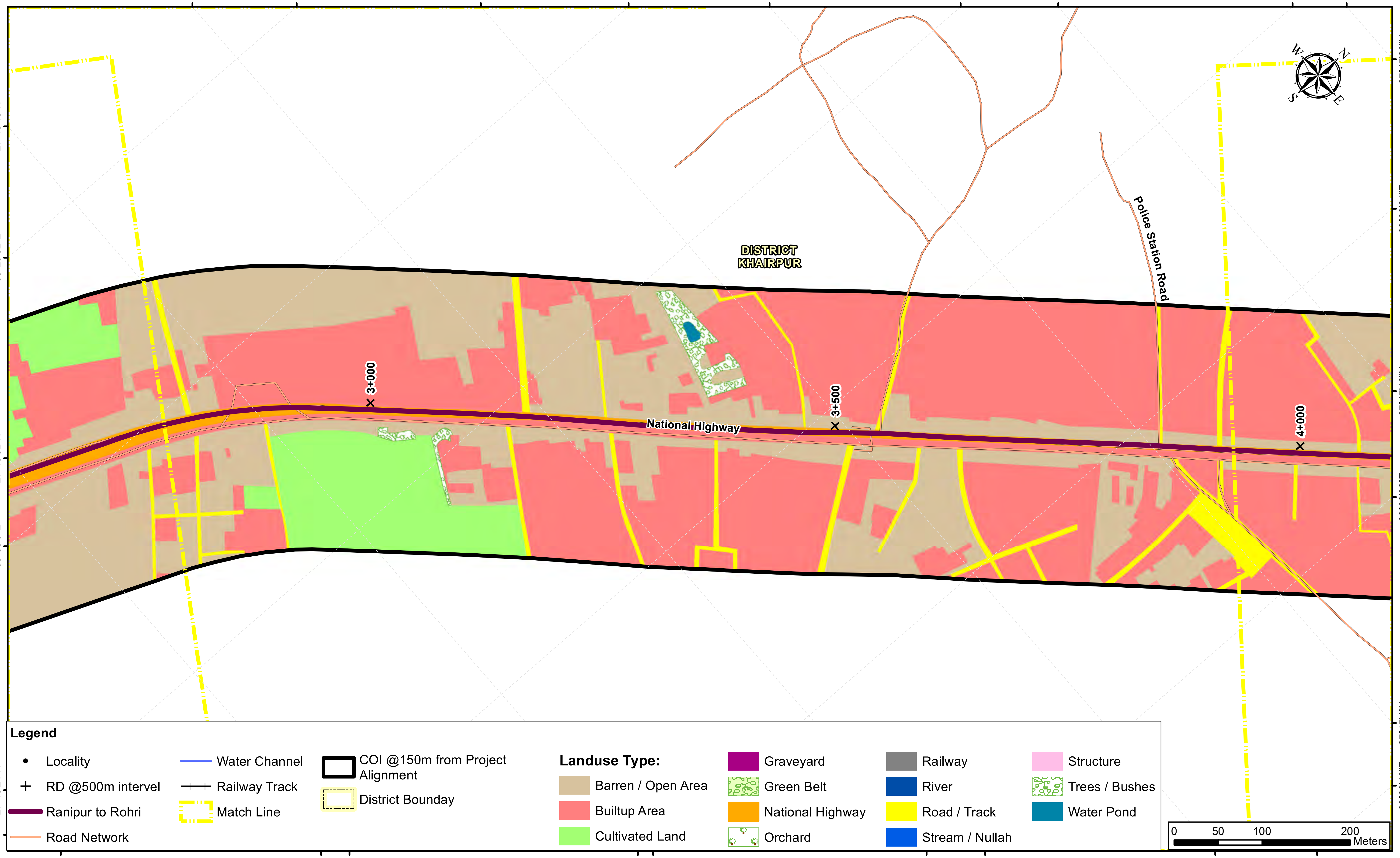
Legend

- Locality
- RD @500m intervel
- Ranipur to Rohri
- Road Network
- Water Channel
- Railway Track
- Match Line
- COI @150m from Project Alignment
- District Bounday

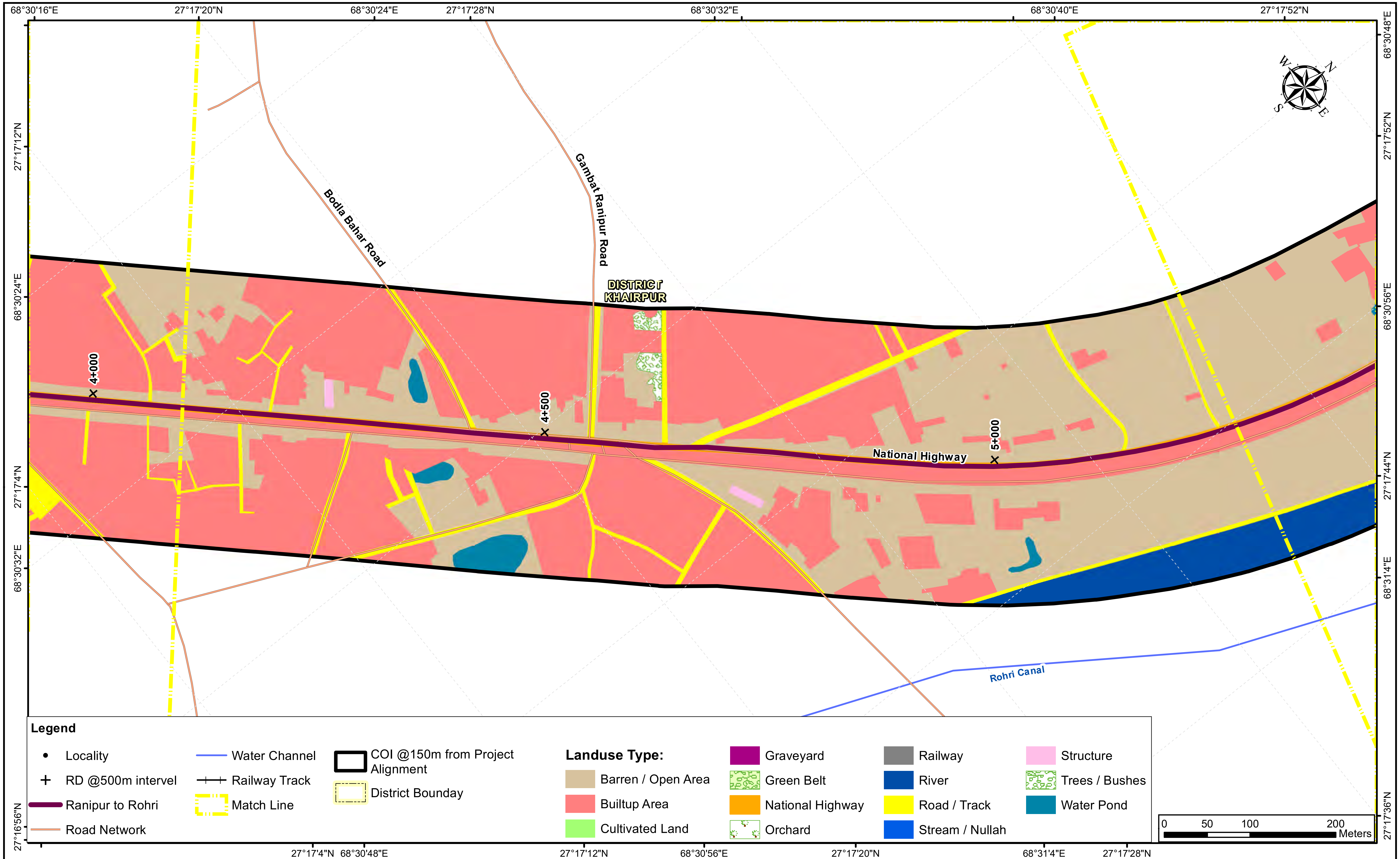
Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	02				RECOMMENDED			DATE: DECEMBER- 2024	FIG. NO. Page 2 of 53
		01				CHD/VER.				REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	**CONSULTANT** NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04 / 03 / 02 / 01	DRAWN: FARHEEN; SUBMITTED: FAHAD S.; RECOMMENDED; CHD/VER.; APPROVED	**PROJECT** DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		REV. / DATE / DESCRIPTION / APPROVED			DATE: DECEMBER- 2024; FIG. NO.: Page 3 of 53	REV. 0



CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		
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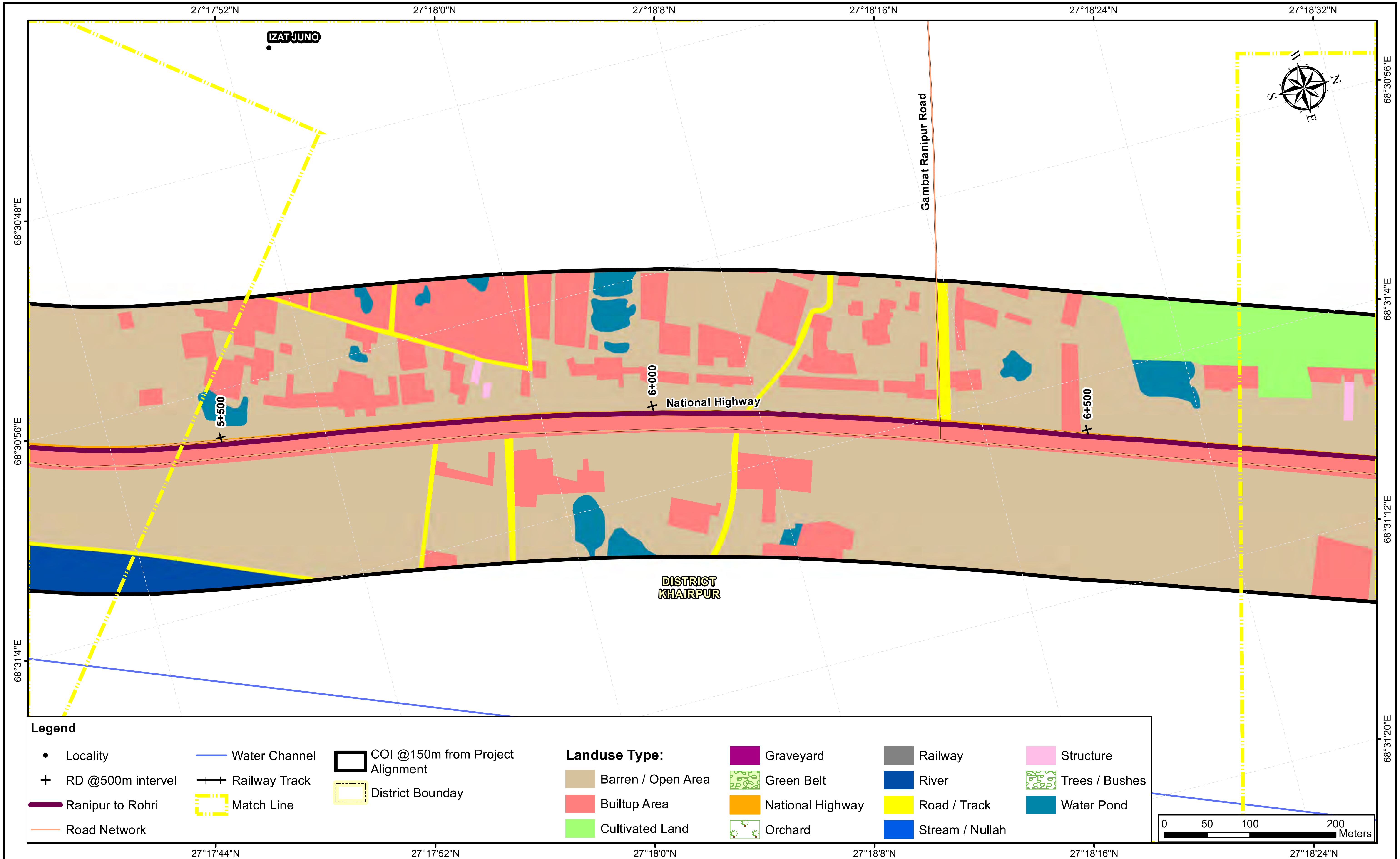
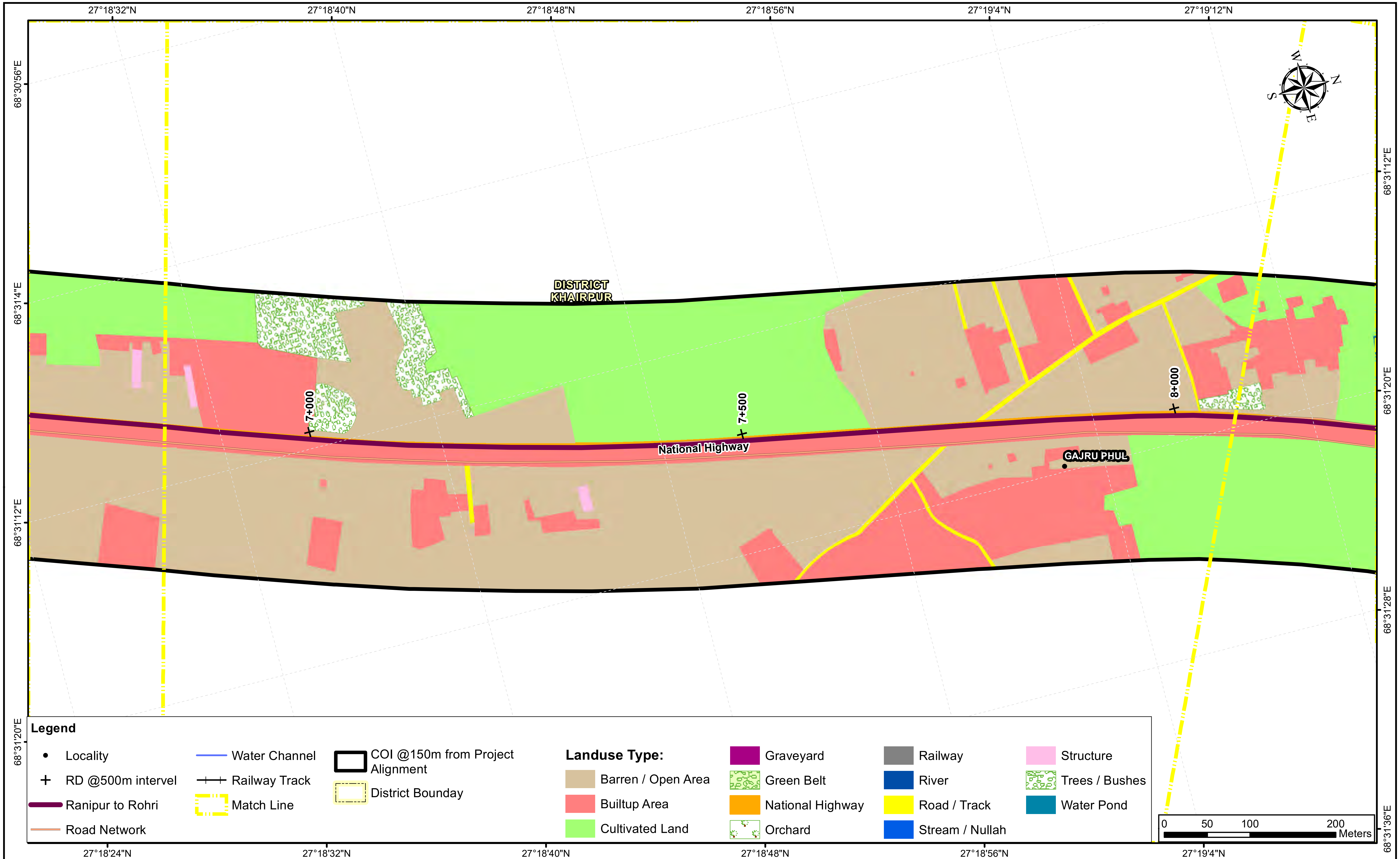
		03				SUBMITTED	FAHAD S.		DATE: DECEMBER- 2024	REV. 0
		02				RECOMMENDED			FIG. NO. Page 4 of 53	
		01				CHD/VER.				
						APPROVED				



CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	02				RECOMMENDED			DATE	FIG. NO.	REV.
		01				CHD/VER.			DECEMBER- 2024	Page 5 of 53	0
						APPROVED					



CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
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		03				SUBMITTED	FAHAD S.			
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	02				RECOMMENDED			DATE: DECEMBER- 2024	REV.
		01				CHD/VER.			FIG. NO.: Page 6 of 53	0
						APPROVED				

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.		DATE: DECEMBER- 2024	REV. 0
		02				RECOMMENDED			FIG. NO.: Page 7 of 53	
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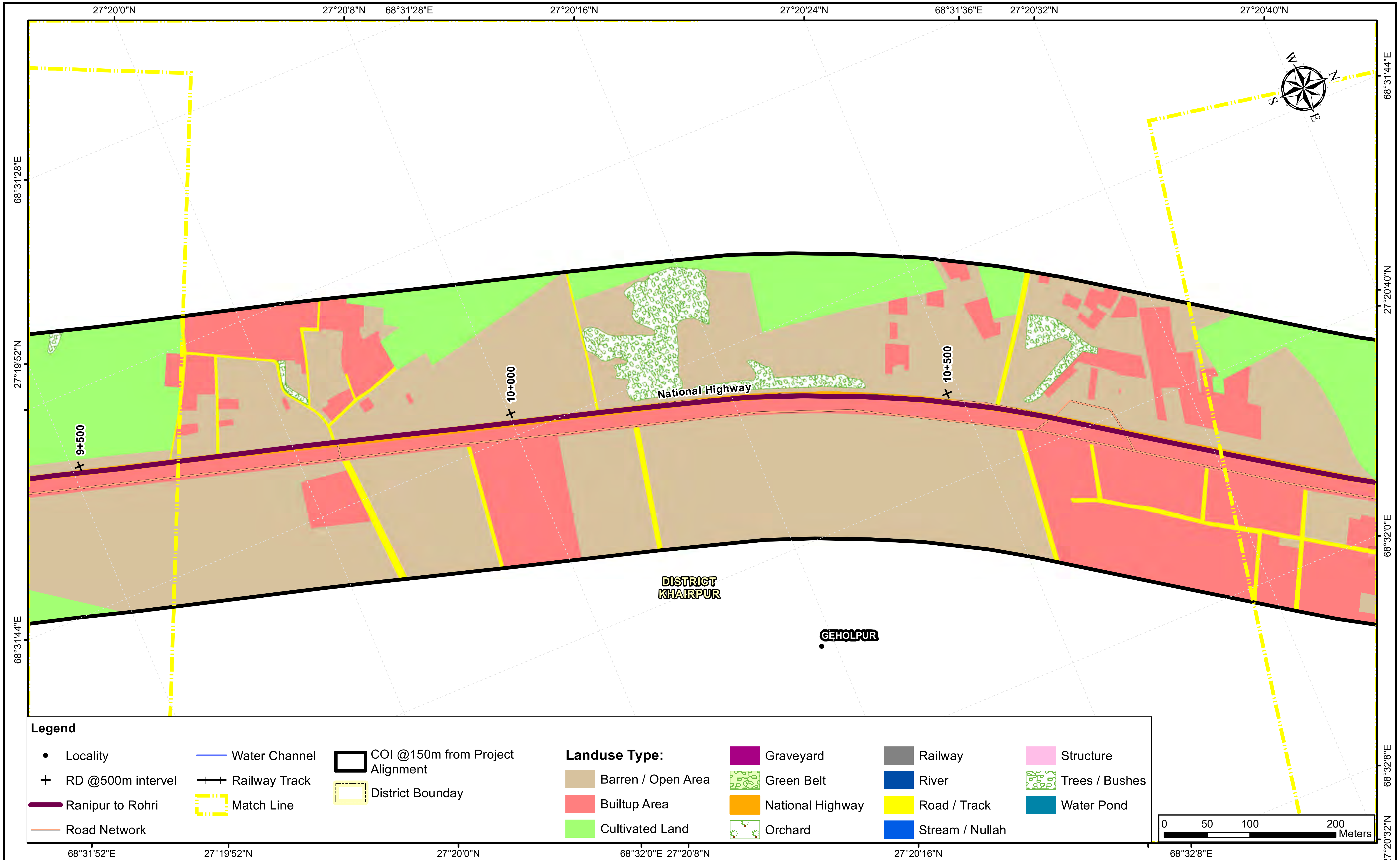
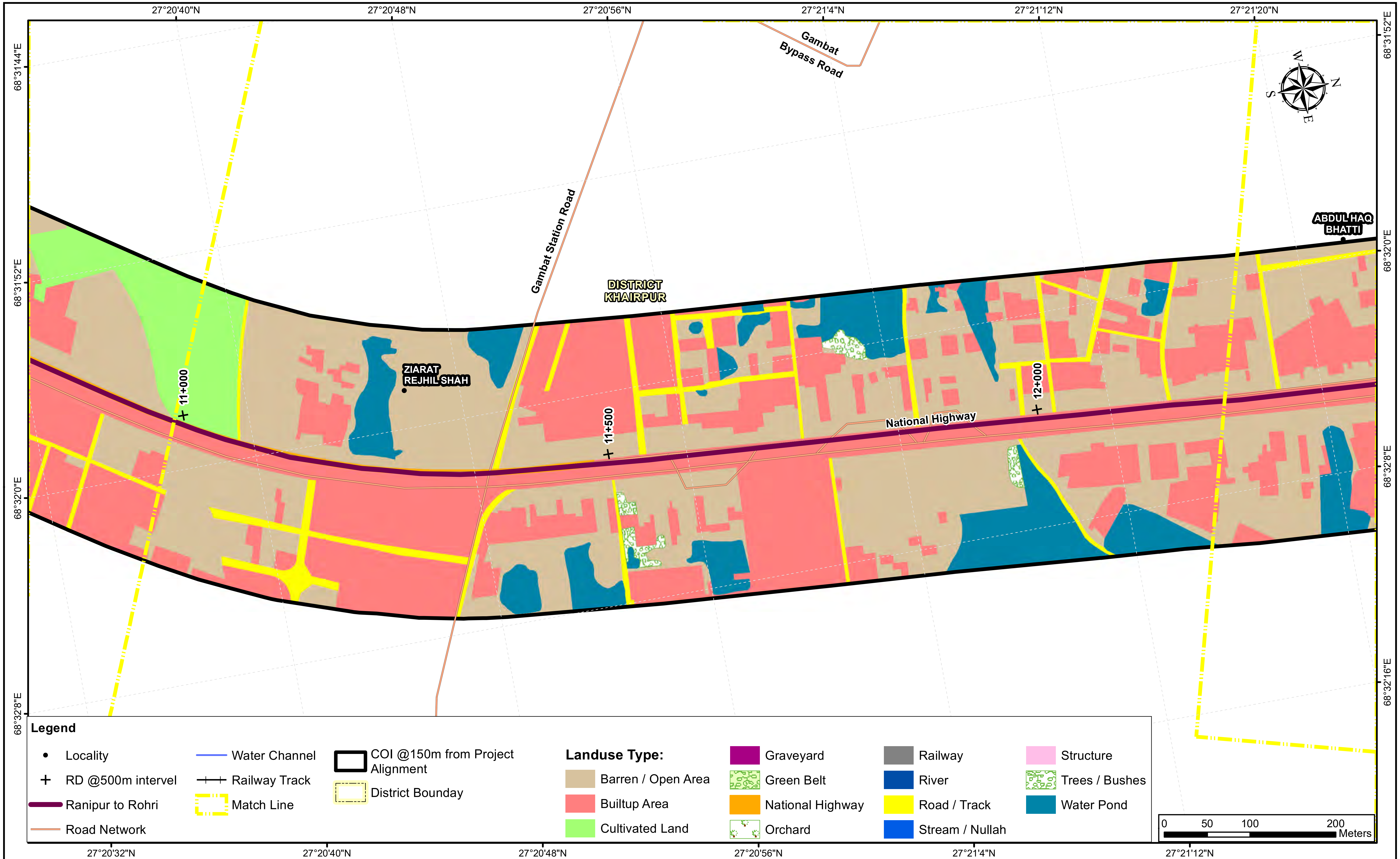
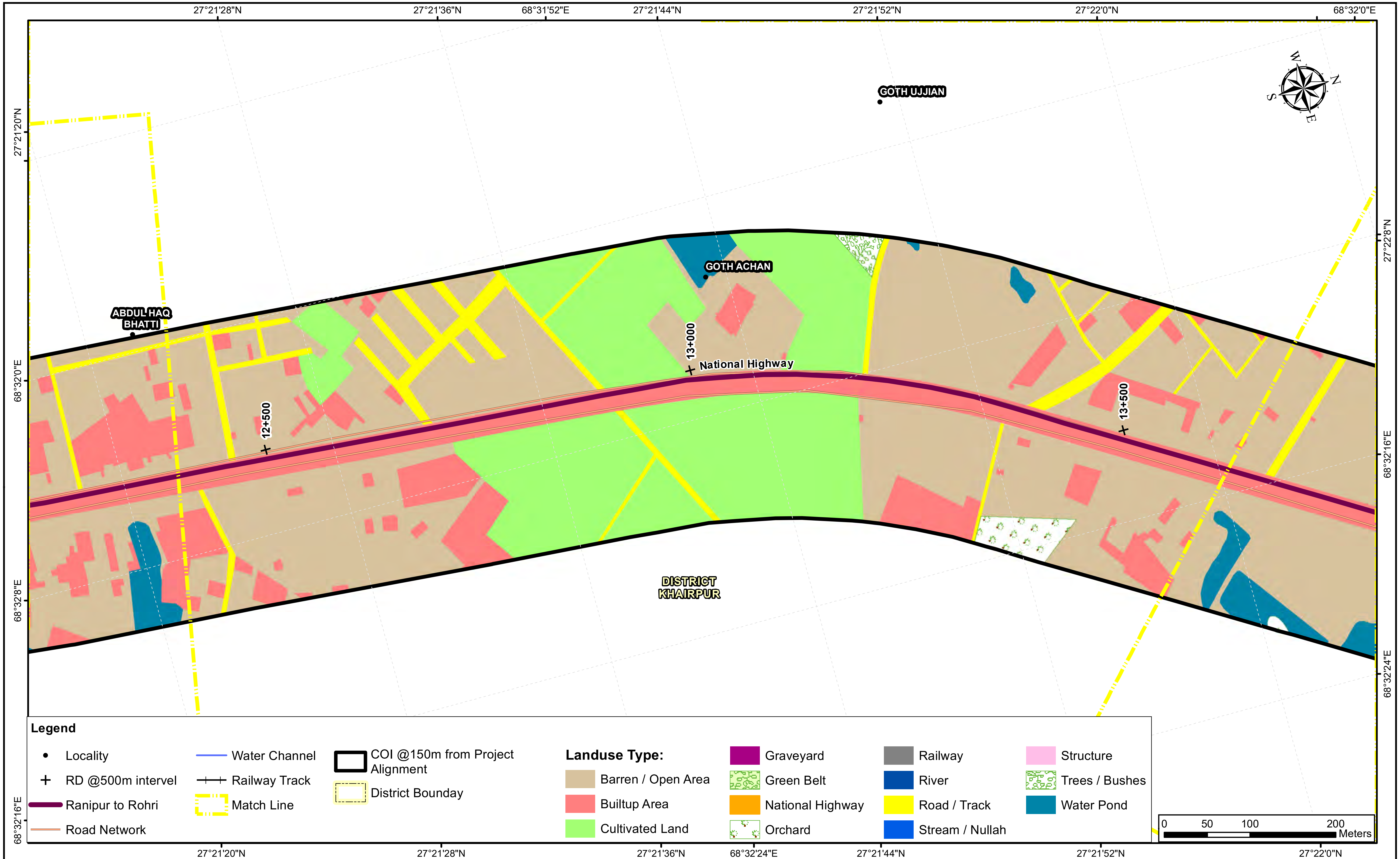
						APPROVED				



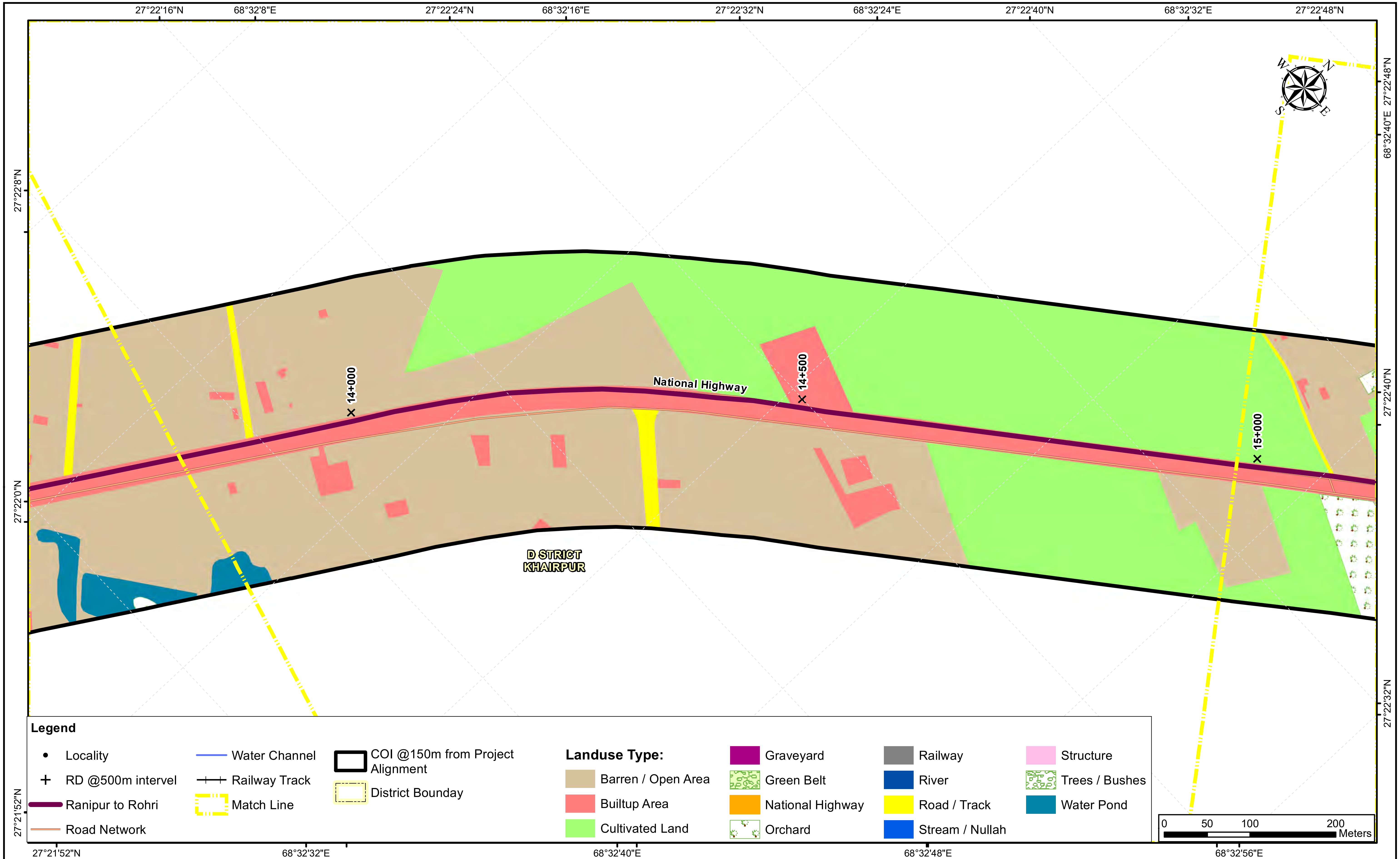
CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE DECEMBER- 2024 / FIG. NO. Page 8 of 53	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT						PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04			DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP		SCALE 1:4,000
		03			SUBMITTED	FAHAD S.				
		02			RECOMMENDED			DATE	FIG. NO.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01			CHD/VER.			DECEMBER- 2024	Page 9 of 53	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	02				RECOMMENDED			DATE DECEMBER- 2024	REV. 0
		01				CHD/VER.			FIG. NO. Page 10 of 53	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE DECEMBER- 2024	FIG. NO. Page 11 of 53
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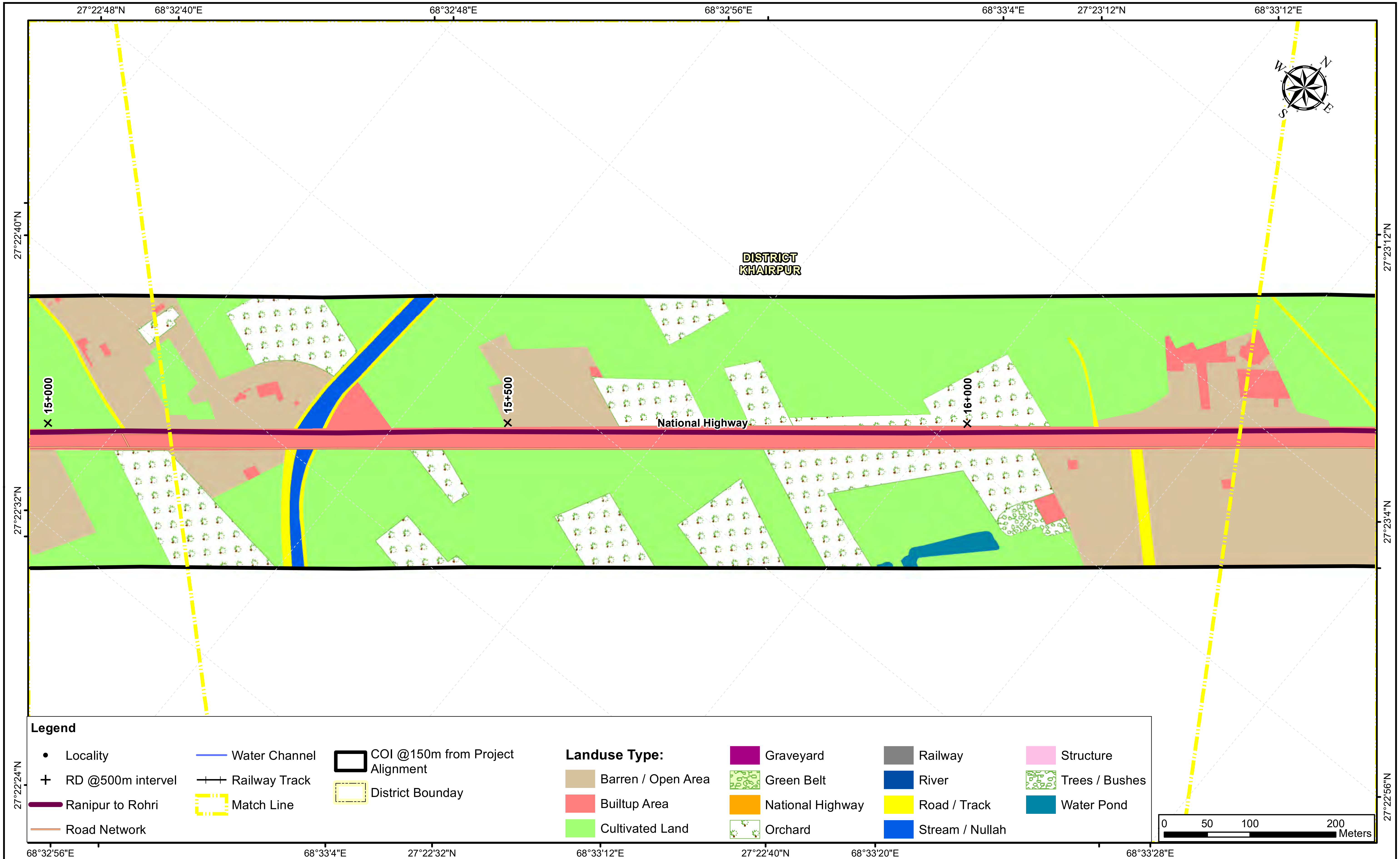

CLIENT	CONSULTANT							PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED			DATE	FIG. NO.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DECEMBER- 2024	Page 12 of 53	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					

CLIENT	CONSULTANT							PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED			DATE	FIG. NO.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DECEMBER- 2024	Page 13 of 53	0
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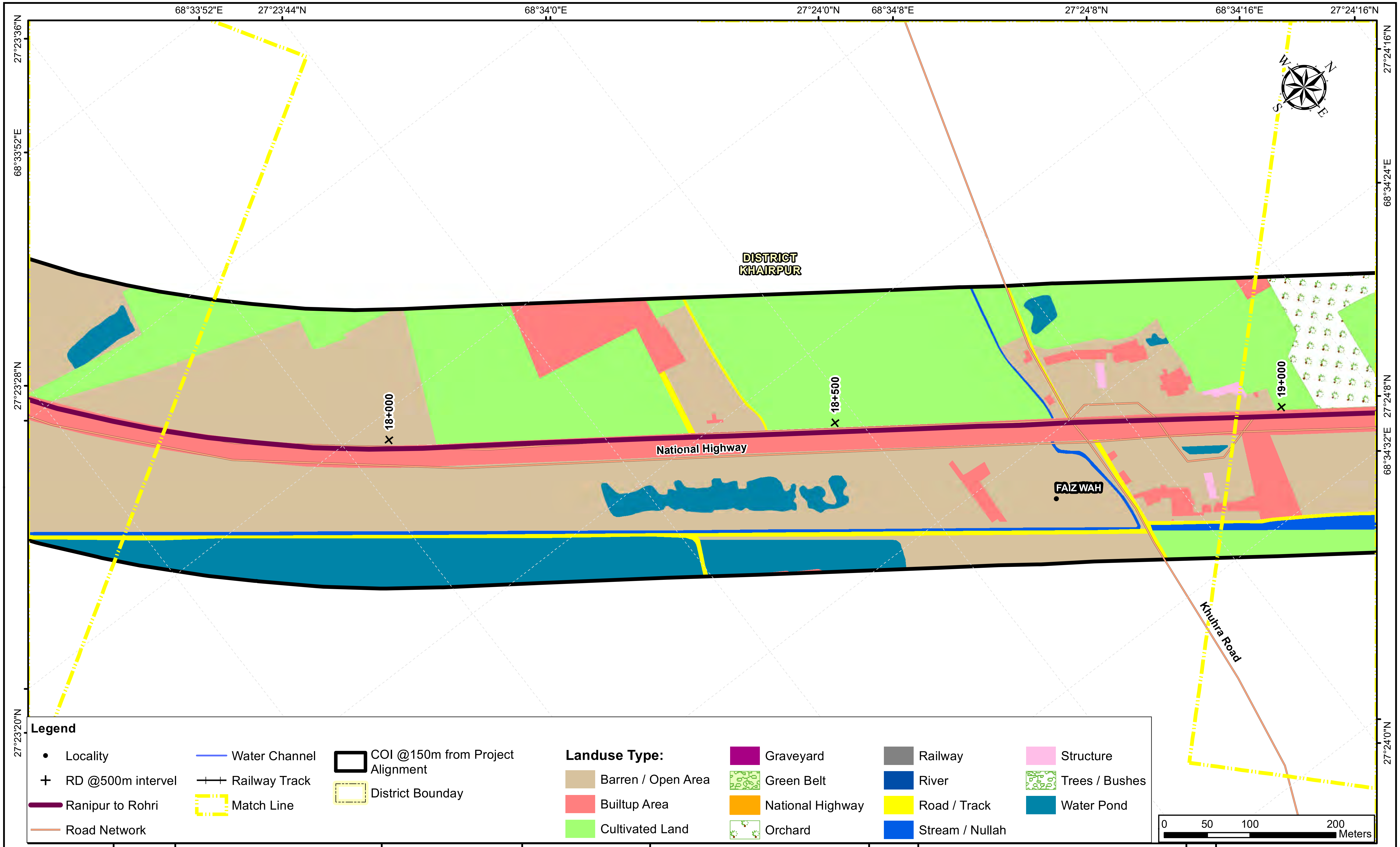
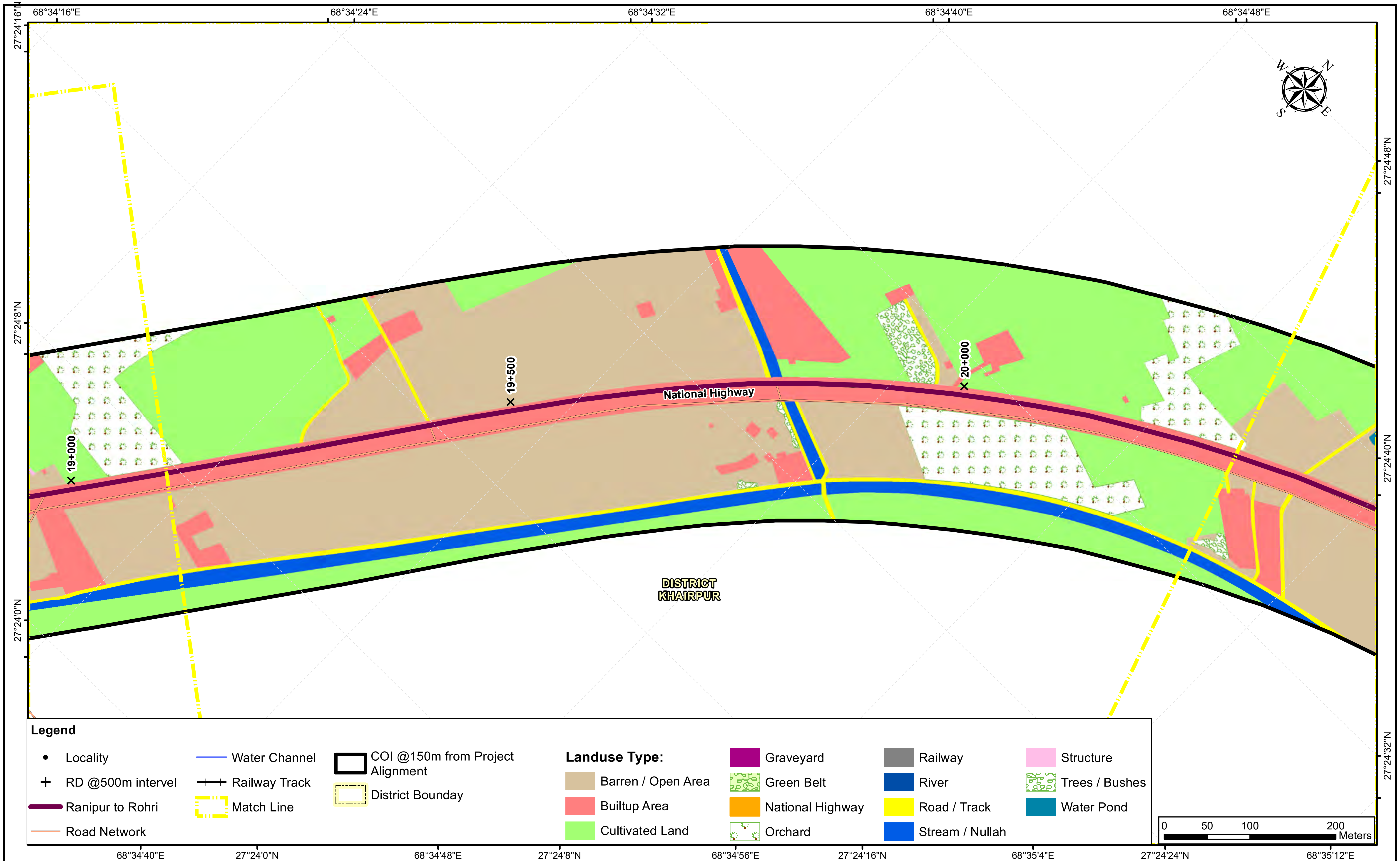
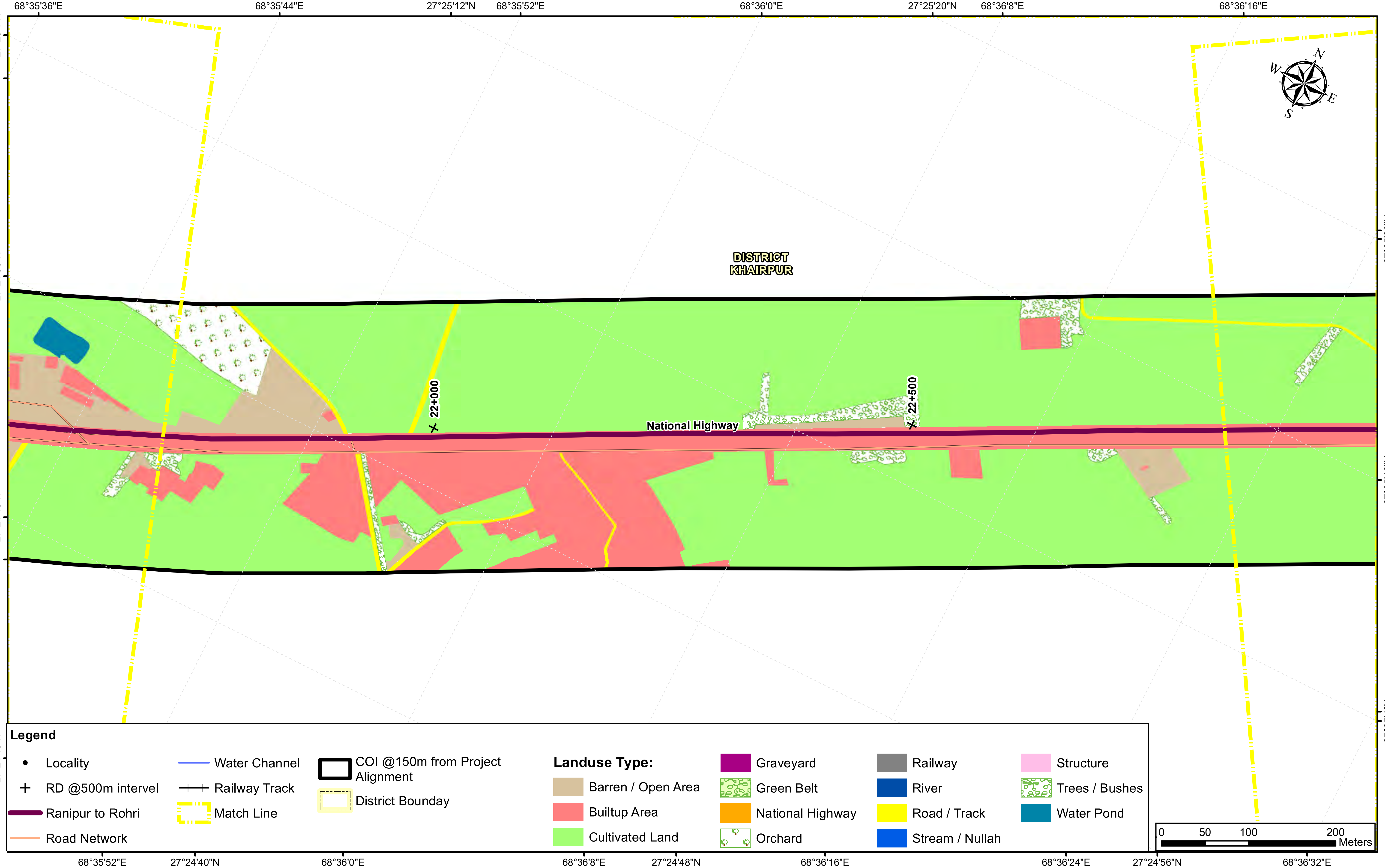


CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE DECEMBER- 2024	FIG. NO. Page 14 of 53	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				

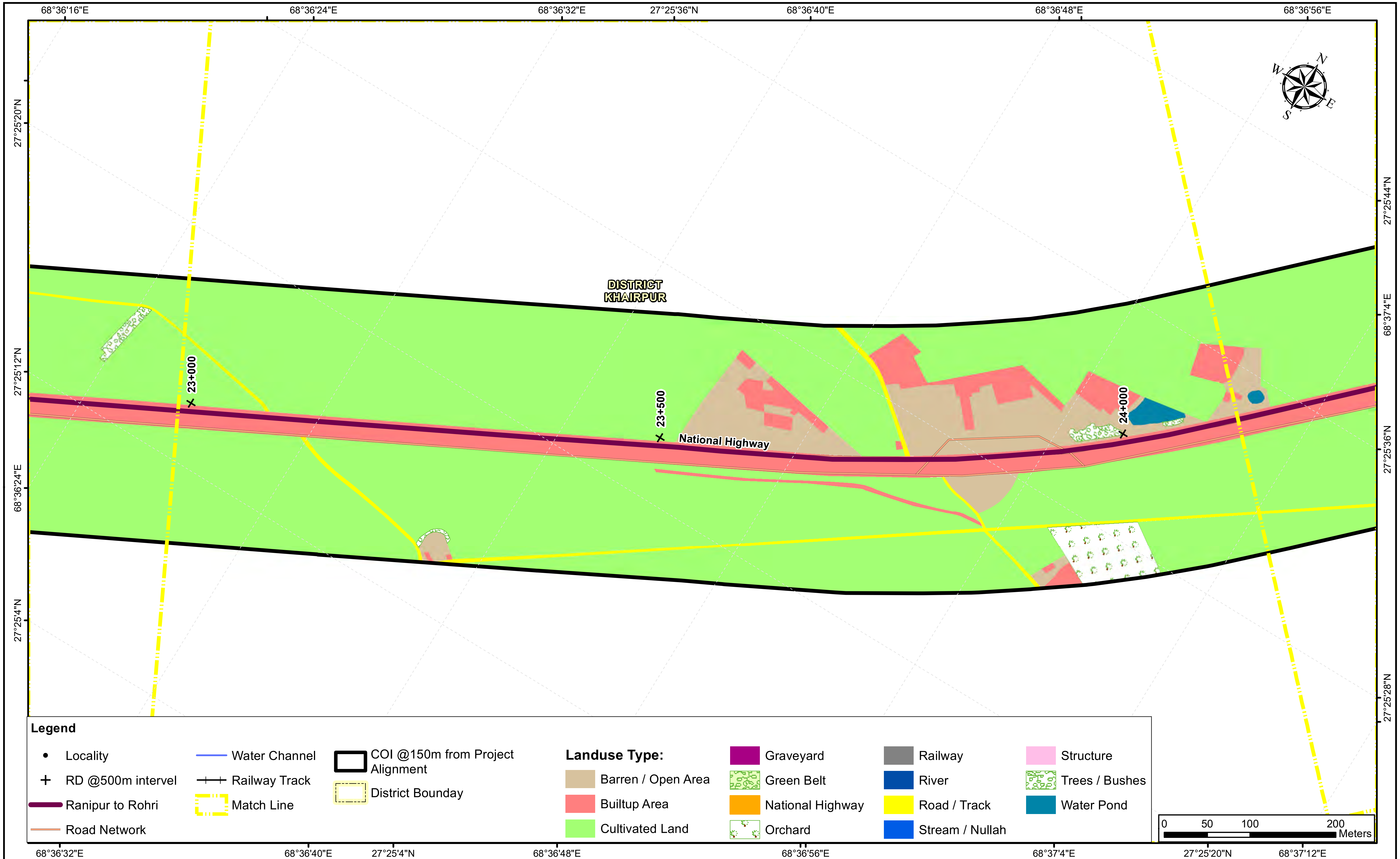


CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE DECEMBER- 2024	FIG. NO. Page 15 of 53
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.				REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: DECEMBER- 2024	REV. 0
		01				CHD/VER.			FIG. NO.: Page 16 of 53	
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: DECEMBER- 2024	REV. 0
		01				CHD/VER.			FIG. NO. Page 17 of 53	
						APPROVED				



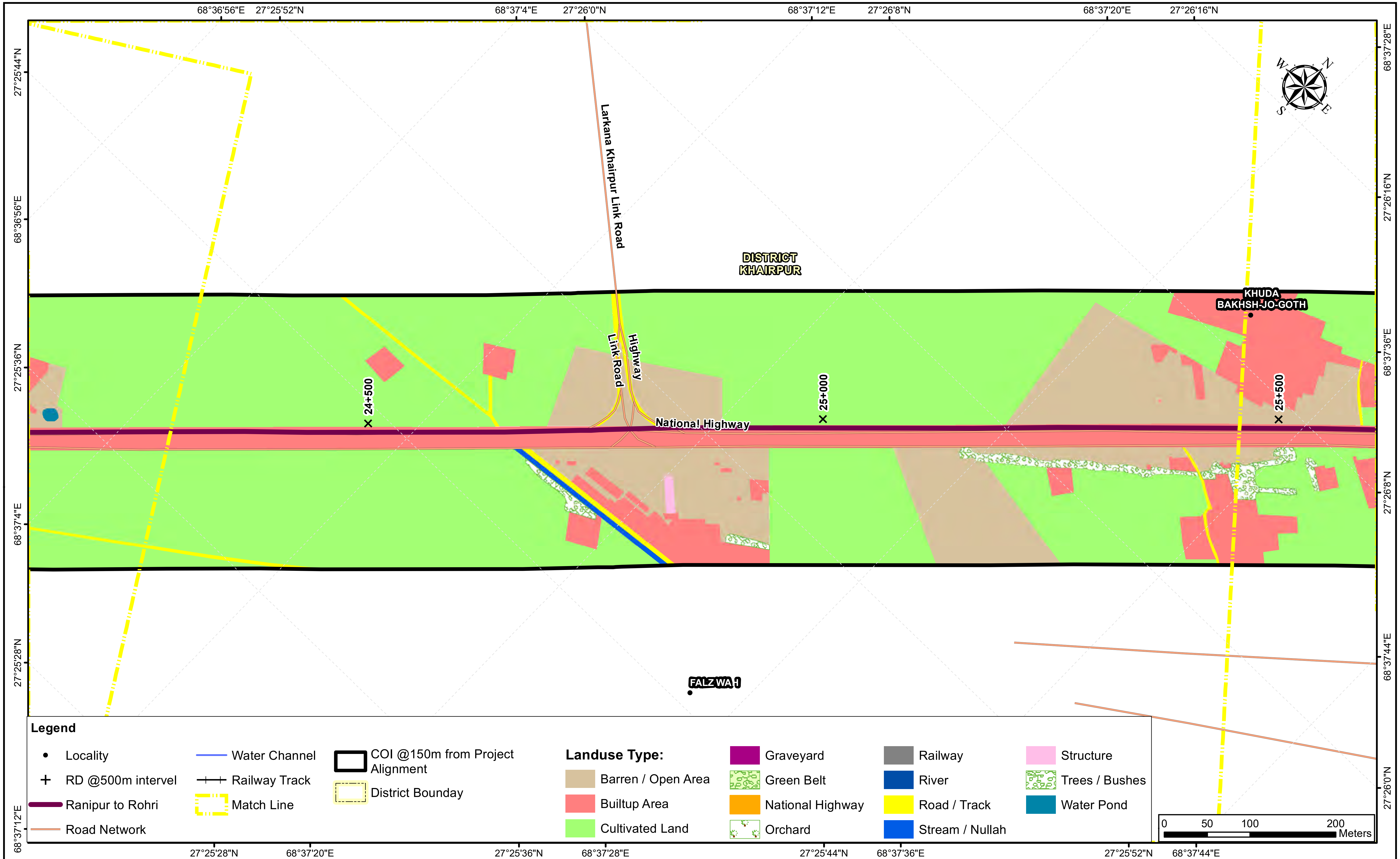
Legend

- Locality
- RD @500m intervel
- Ranipur to Rohri
- Road Network
- Water Channel
- Railway Track
- Match Line
- COI @150m from Project Alignment
- District Bounday

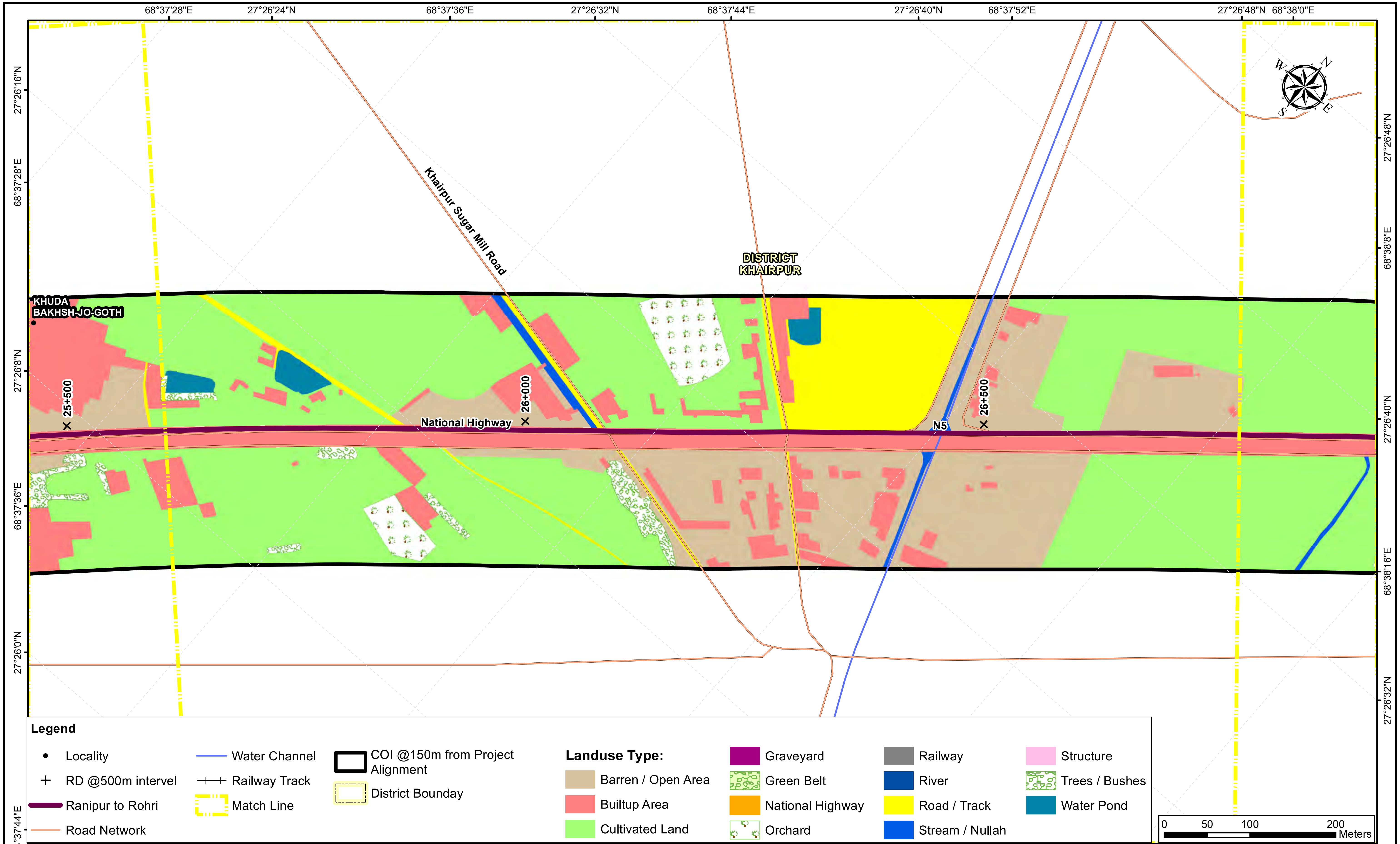
Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: DECEMBER- 2024	REV.
		01				CHD/VER.			FIG. NO.: Page 18 of 53	0
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE DECEMBER- 2024	REV. 0
		01				CHD/VER.			FIG. NO. Page 19 of 53	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



Legend

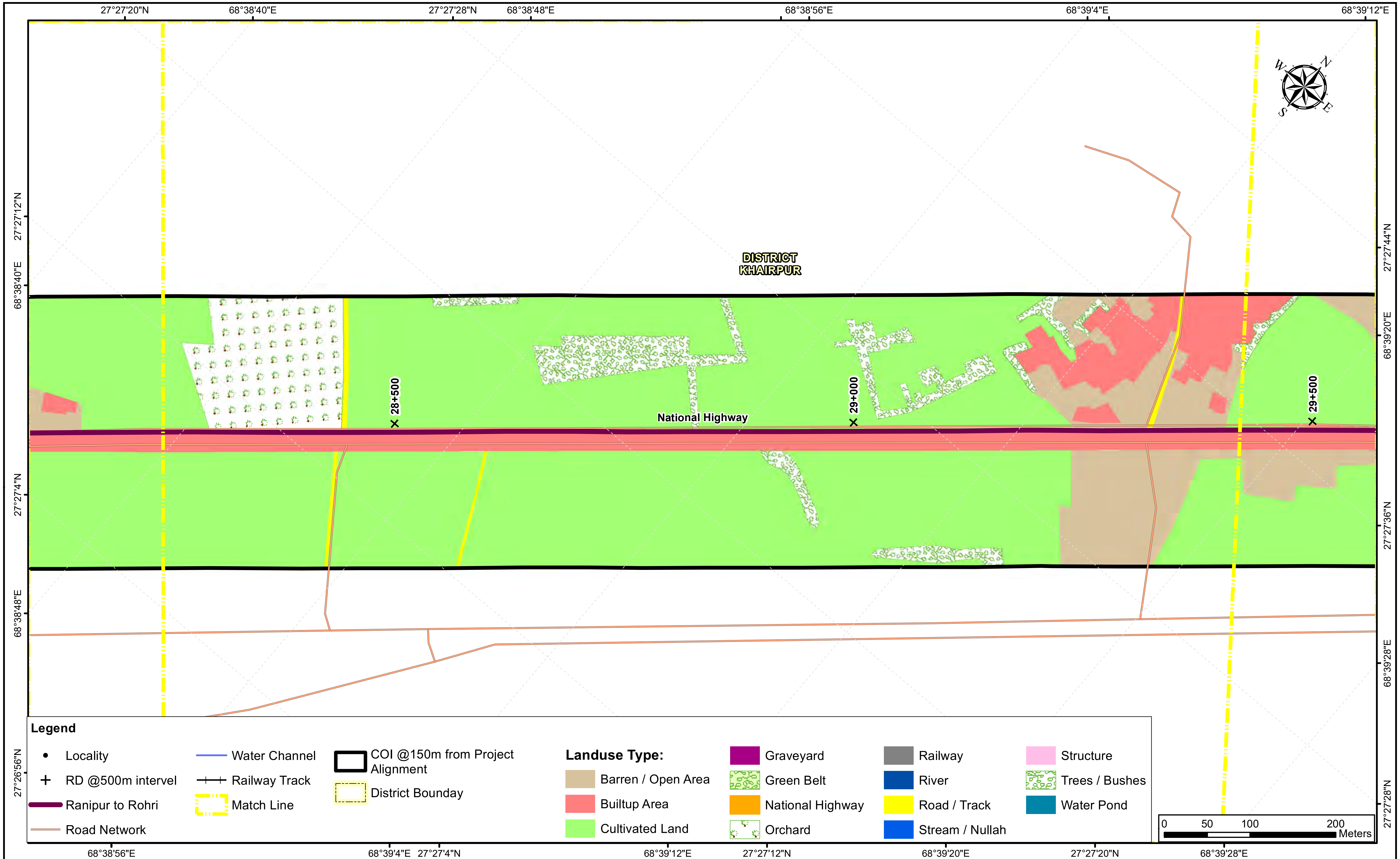
- Locality
- RD @500m intervel
- Ranipur to Rohri
- Road Network
- Water Channel
- Railway Track
- Match Line
- COI @150m from Project Alignment
- District Bounday

Landuse Type:

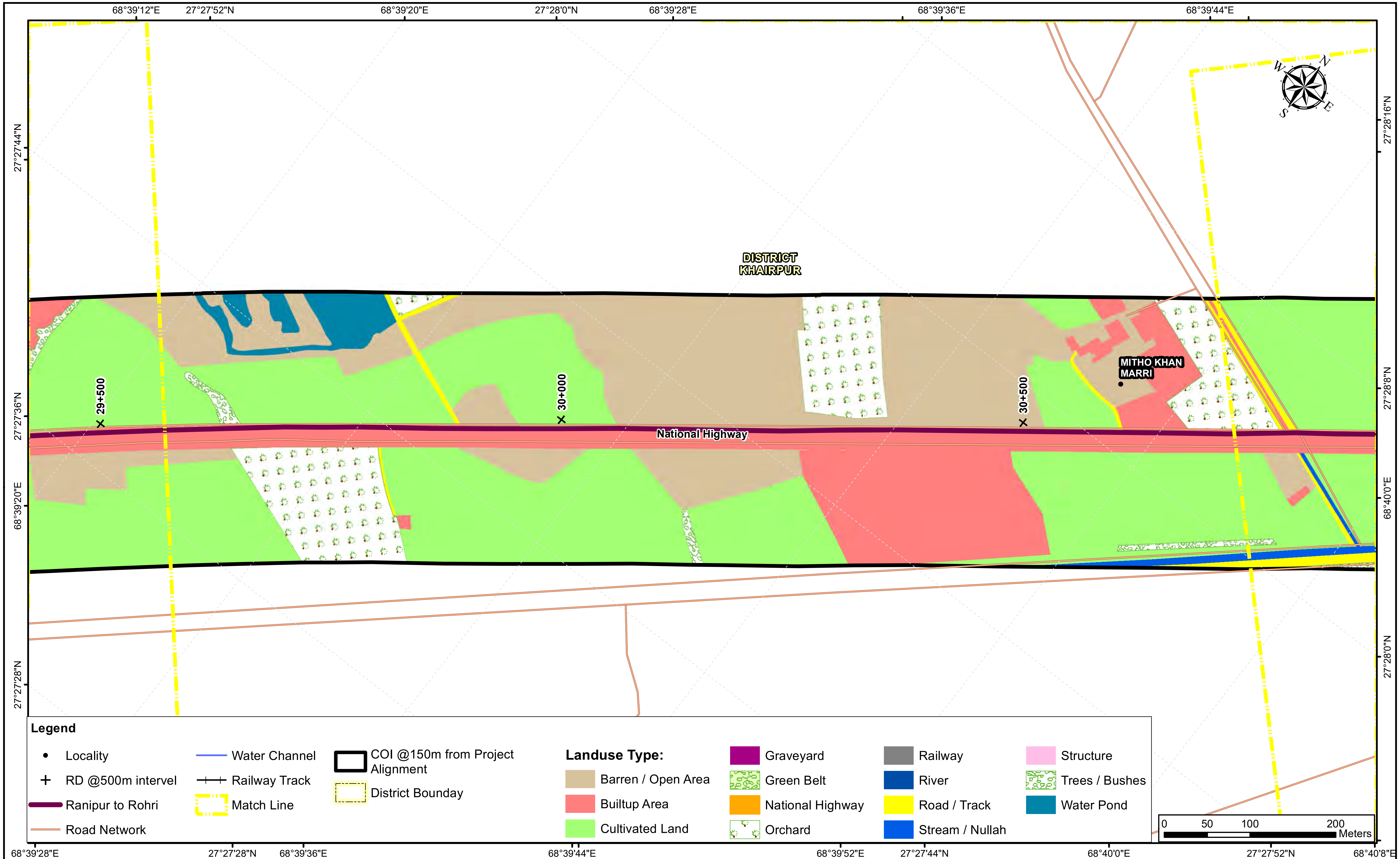
- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: DECEMBER- 2024	REV. 0
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			FIG. NO.: Page 20 of 53	
						APPROVED				

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE DECEMBER- 2024	FIG. NO. Page 21 of 53
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.				REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				

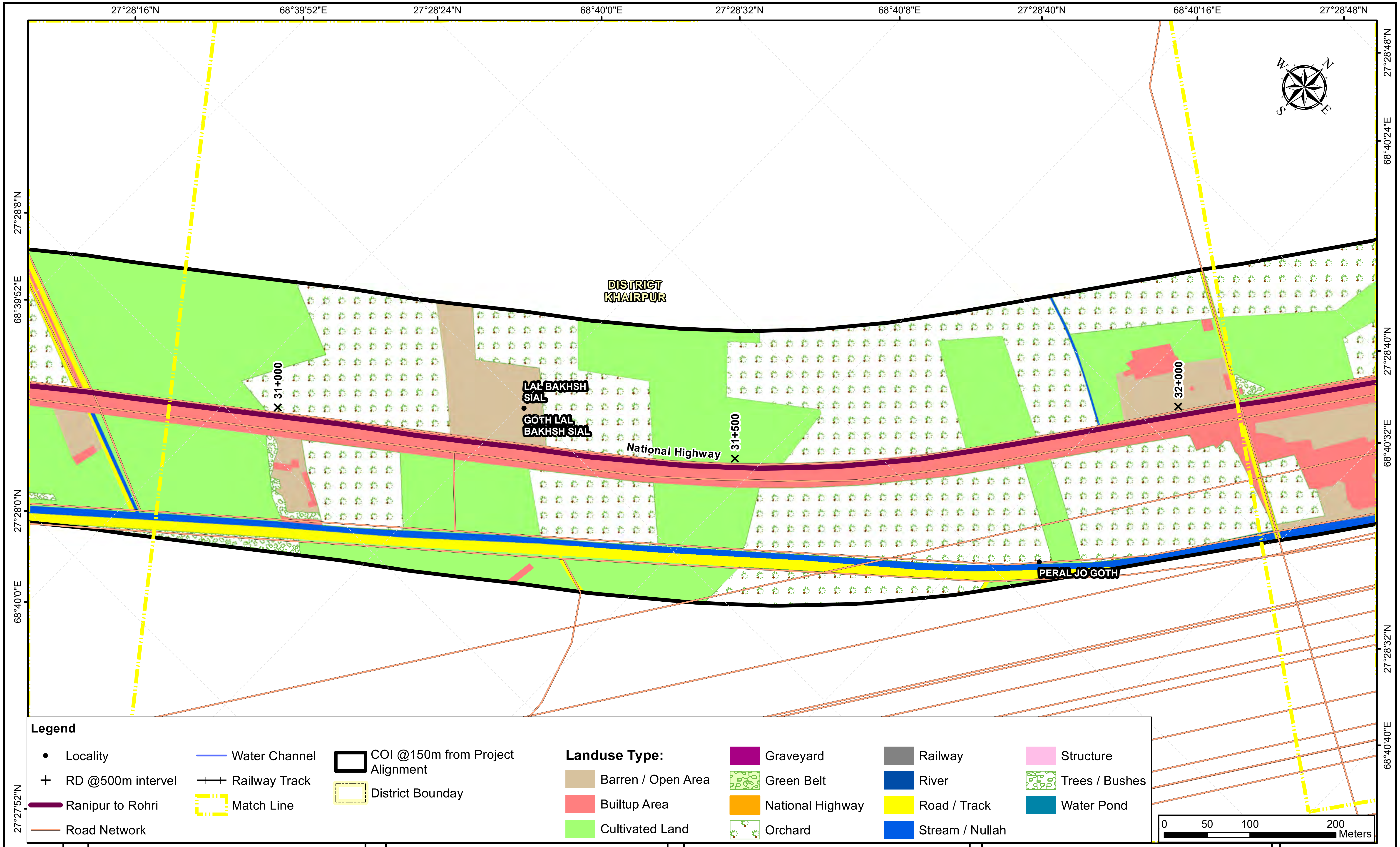


CLIENT	CONSULTANT							PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED					
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE	FIG. NO.	REV.
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			DECEMBER- 2024	Page 22 of 53	0

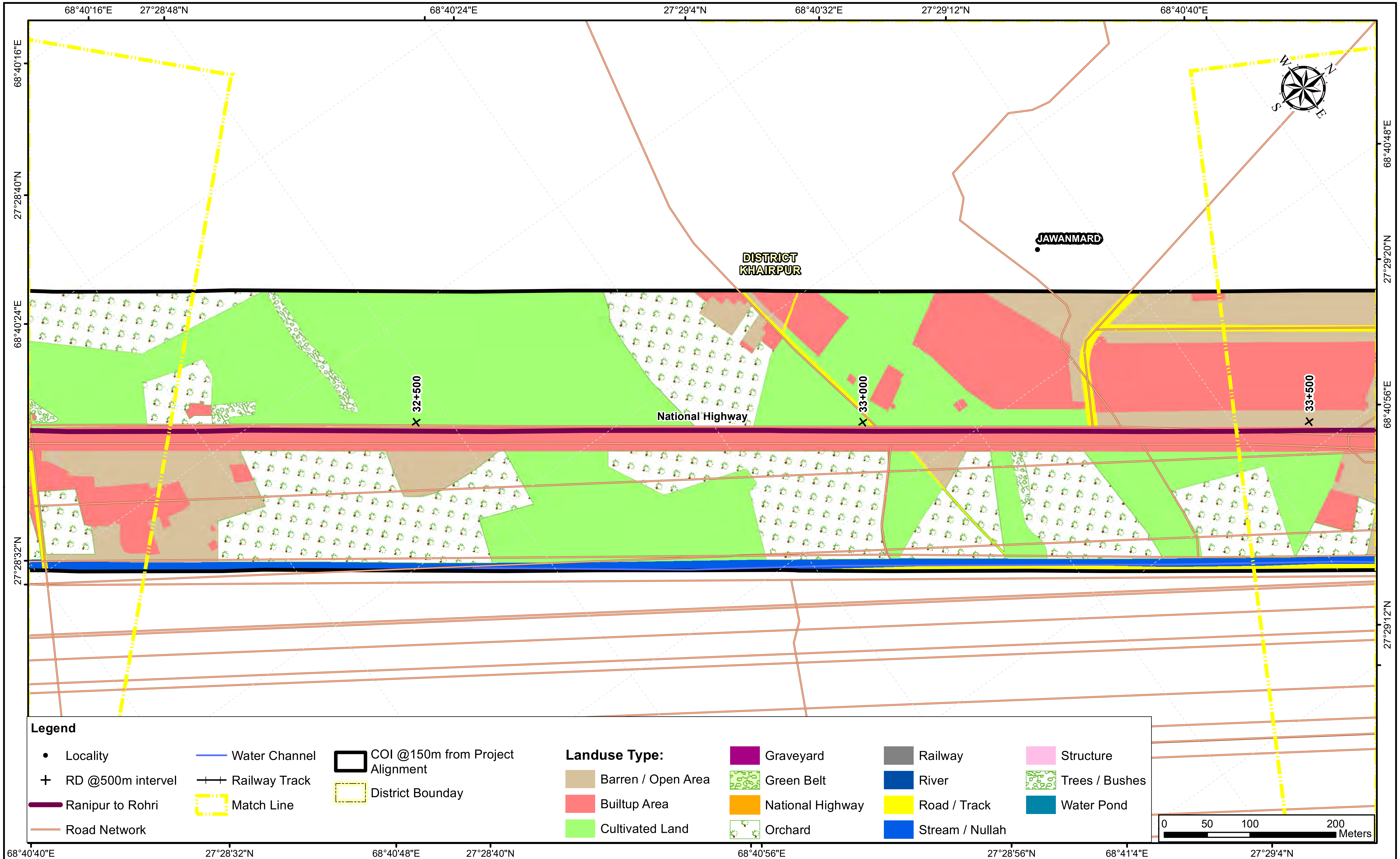


CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	FARHEEN	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)
		03				SUBMITTED	FAHAD S.	
		02				RECOMMENDED		
		01				CHD/VER.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

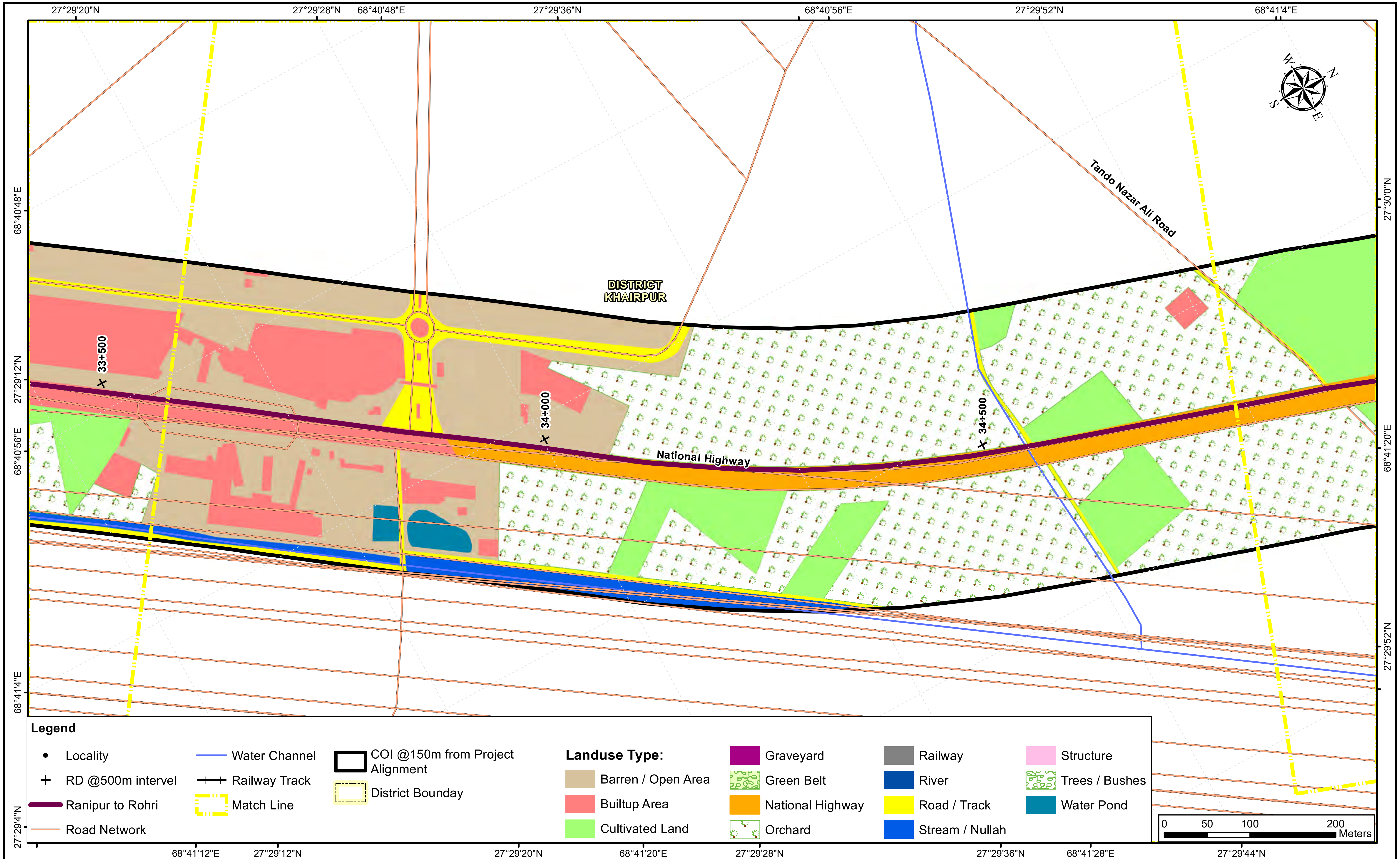
LAND USE MAP			SCALE 1:4,000
DATE DECEMBER- 2024	FIG. NO. Page 23 of 53		REV. 0



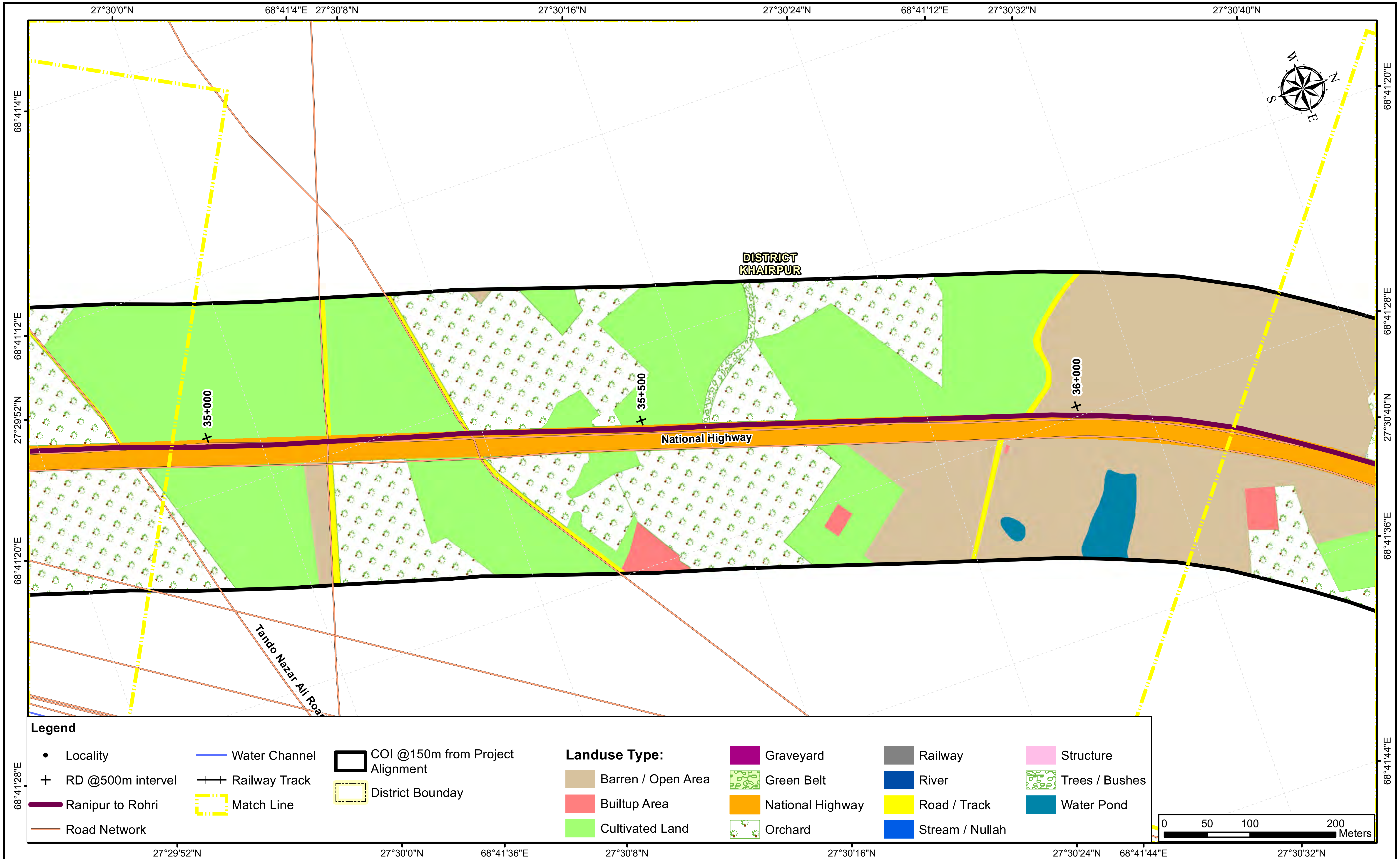
CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	02				RECOMMENDED			DATE: DECEMBER- 2024	REV.
		01				CHD/VER.			FIG. NO.: Page 24 of 53	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



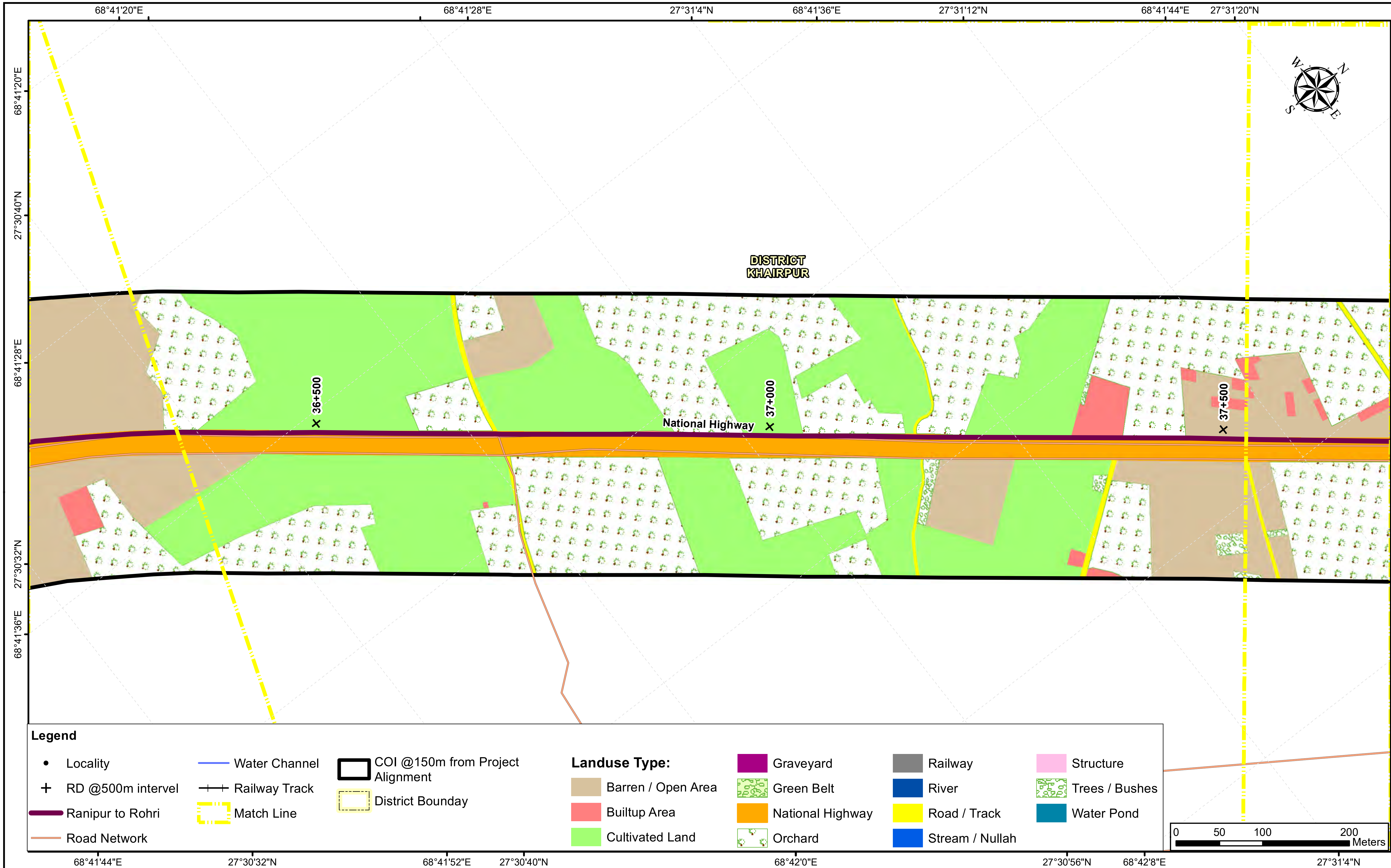
CLIENT	CONSULTANT								PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN		DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED					
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.				DATE DECEMBER- 2024	FIG. NO. Page 25 of 53	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



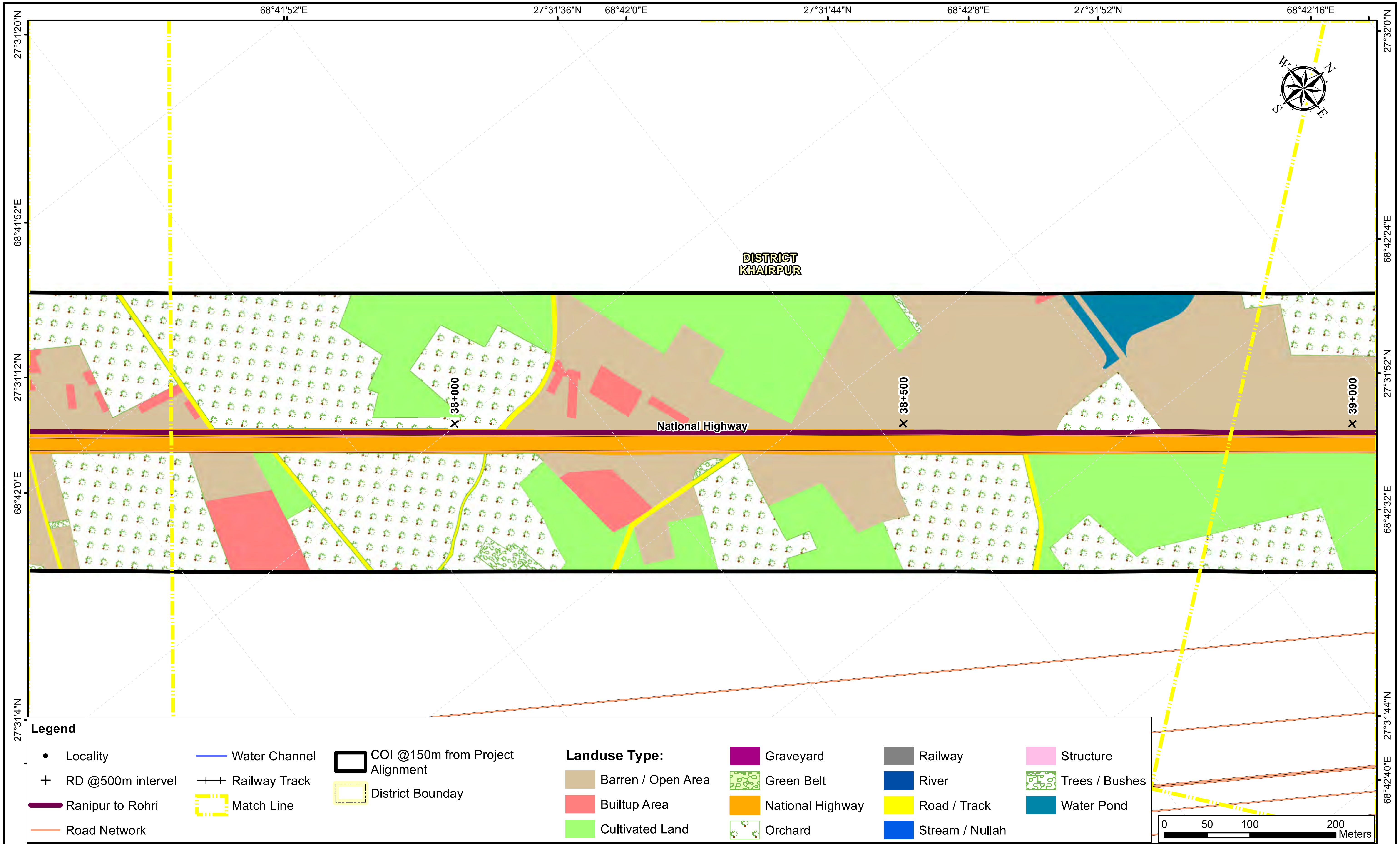
CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	FIG. NO.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DECEMBER- 2024	Page 26 of 53
						APPROVED			REV.	0



CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: DECEMBER- 2024	REV.
		01				CHD/VER.			FIG. NO.: Page 27 of 53	0
						APPROVED				



CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE DECEMBER- 2024	
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			FIG. NO. Page 28 of 53	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



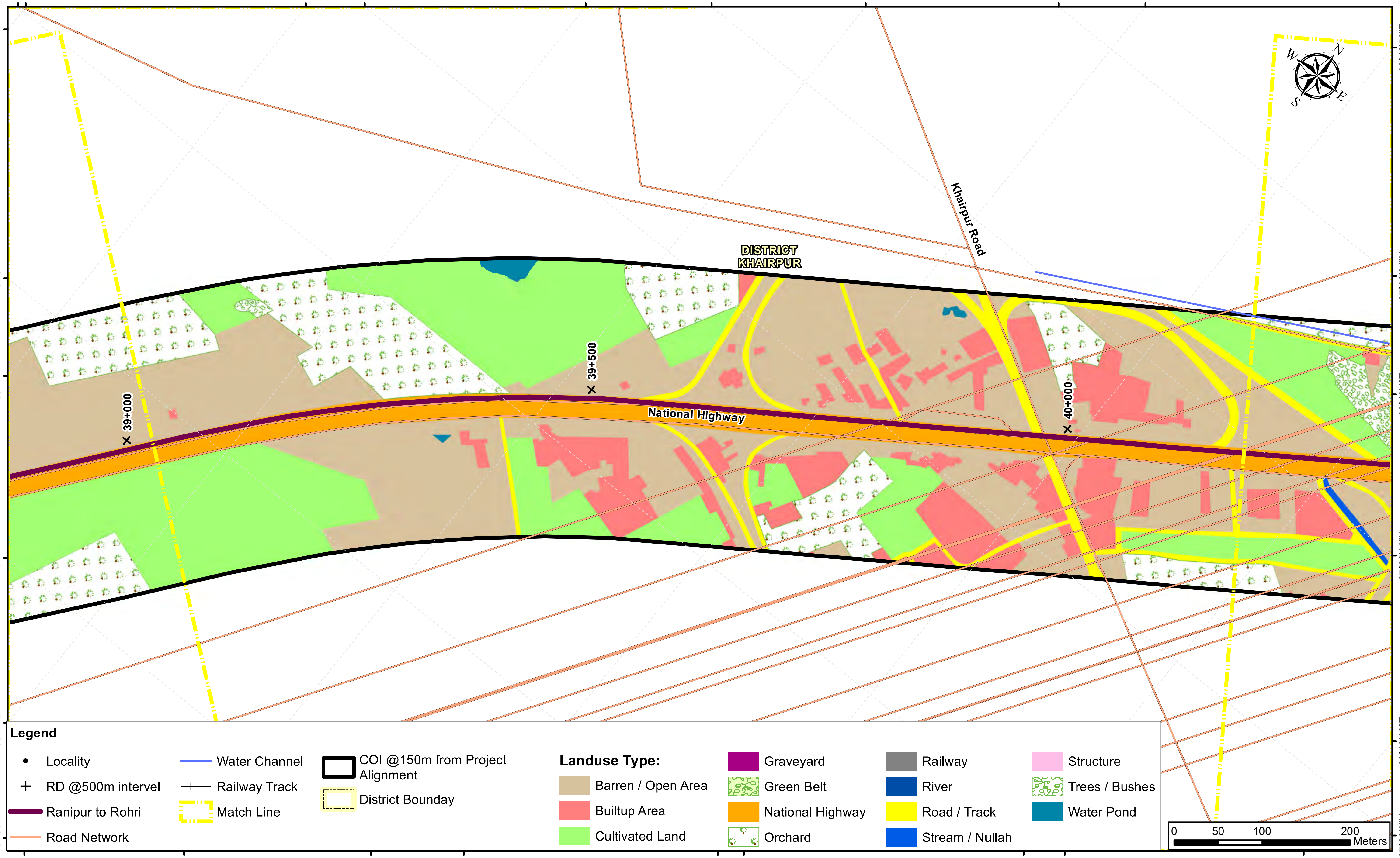
Legend

• Locality	Water Channel	COI @150m from Project Alignment
+ RD @500m intervel	Railway Track	District Bounday
Ranipur to Rohri	Match Line	
Road Network		

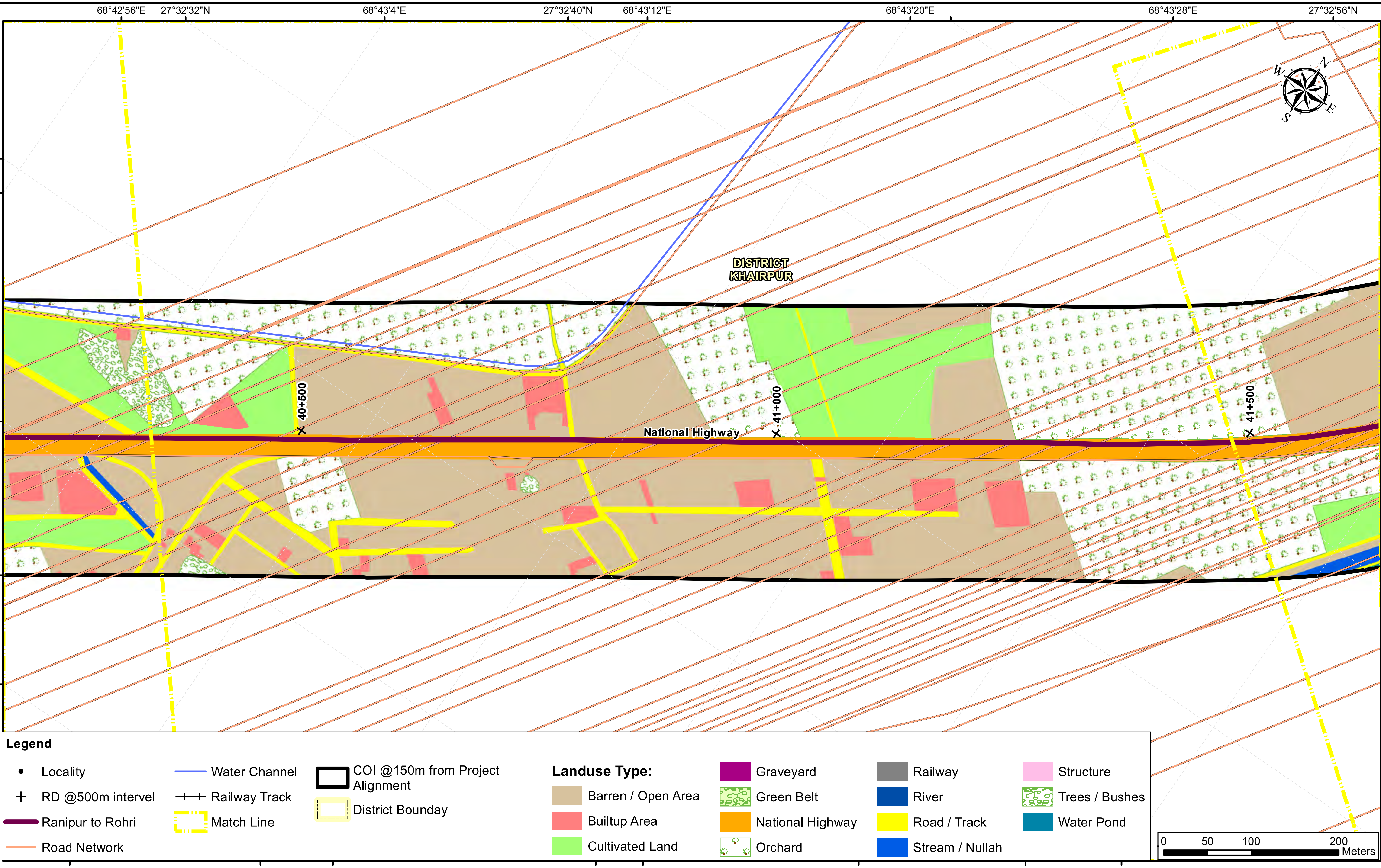
Landuse Type:

Barren / Open Area	Graveyard	Railway	Structure
Builtup Area	Green Belt	River	Trees / Bushes
Cultivated Land	National Highway	Road / Track	Water Pond
	Orchard	Stream / Nullah	

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	FARHEEN	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
		01				CHD/VER.			DATE DECEMBER- 2024	FIG. NO. Page 29 of 53
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				REV. 0



CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE DECEMBER- 2024	FIG. NO. Page 30 of 53
		01				CHD/VER.				REV. 0
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



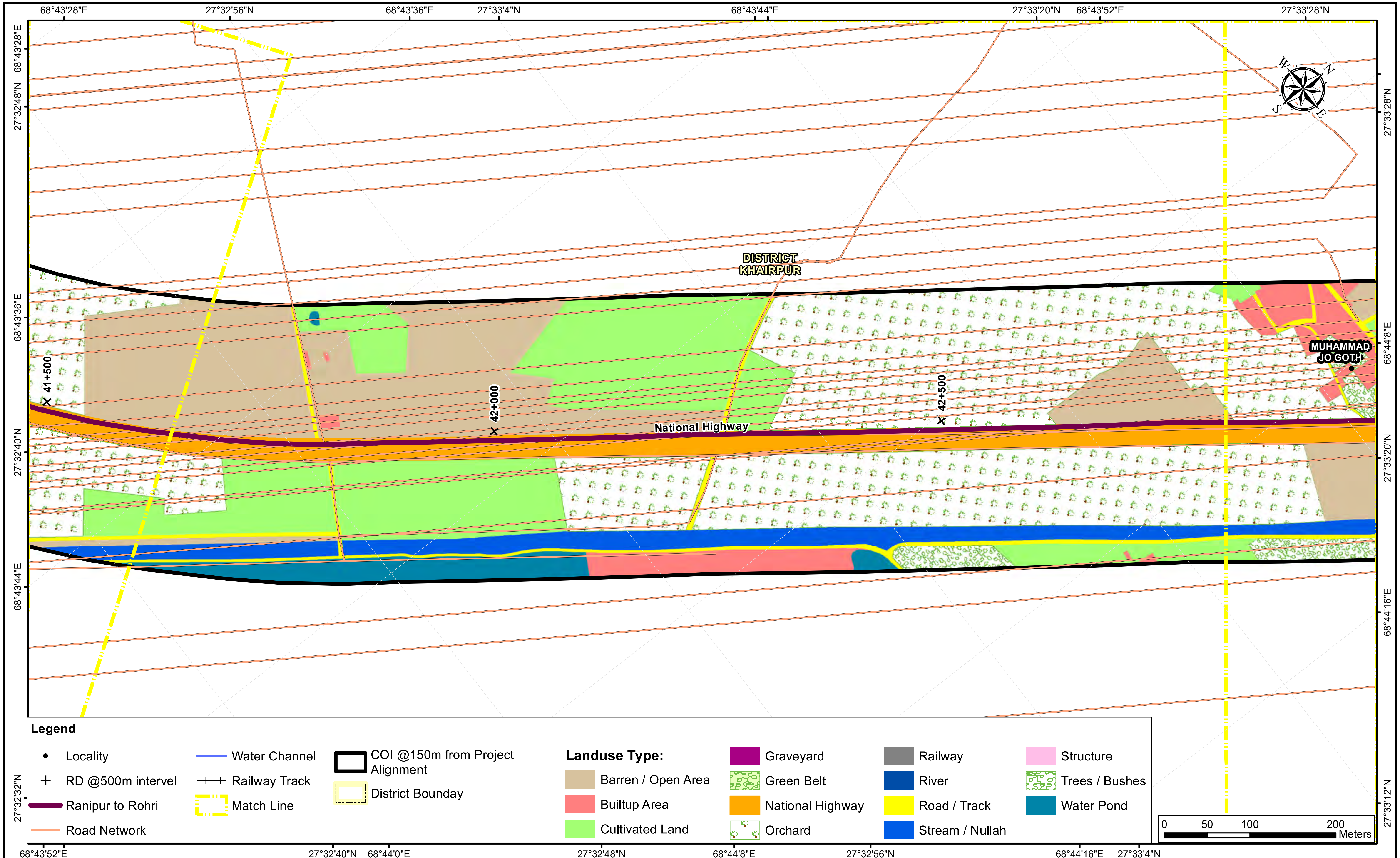
Legend

Locality
RD @500m interval
Ranipur to Rohri
Road Network
Water Channel
Railway Track
Match Line
COI @150m from Project Alignment
District Bounday

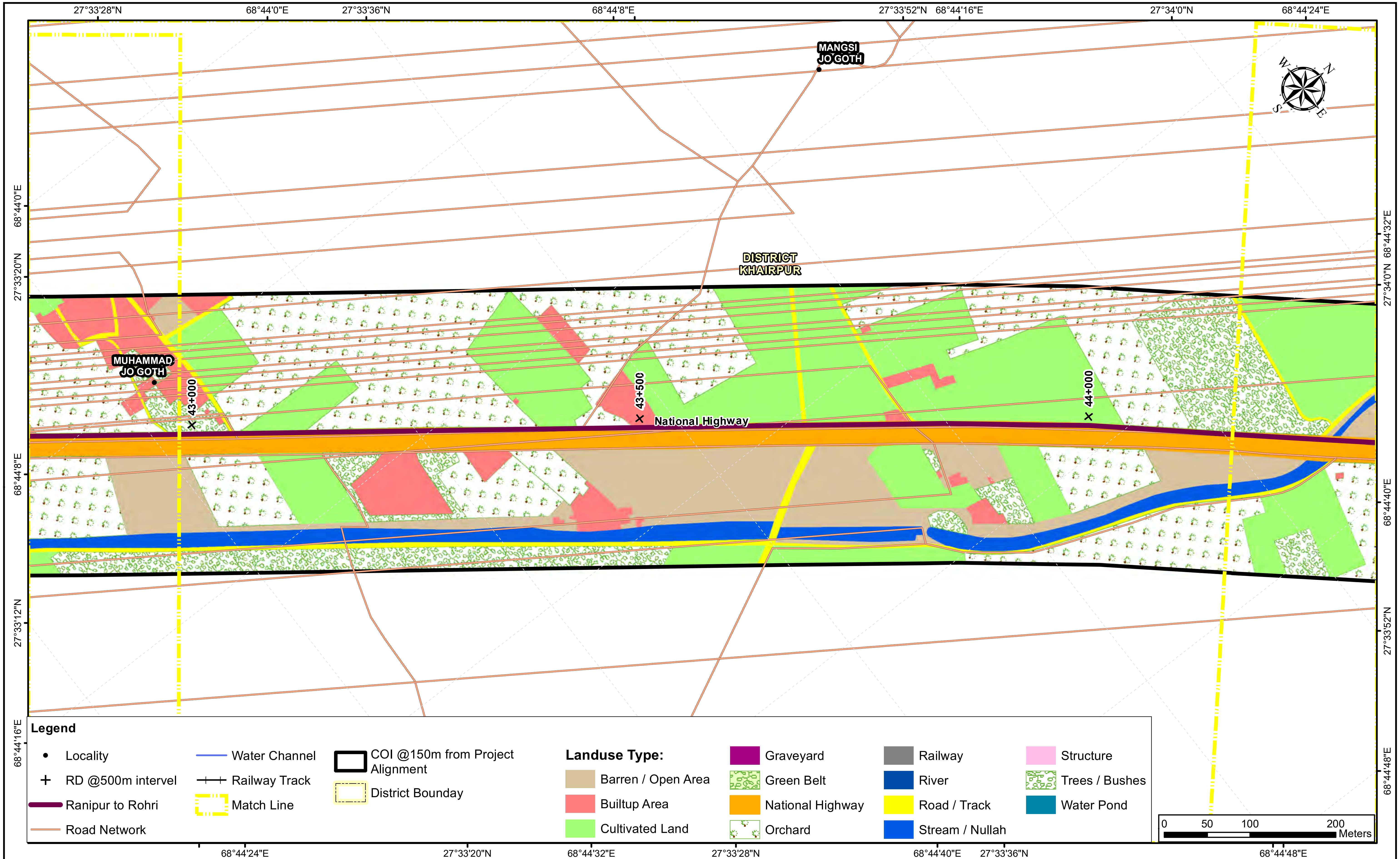
Landuse Type:

Barren / Open Area
Builtup Area
Cultivated Land
Graveyard
Green Belt
National Highway
Orchard
Railway
River
Road / Track
Stream / Nullah
Structure
Trees / Bushes
Water Pond

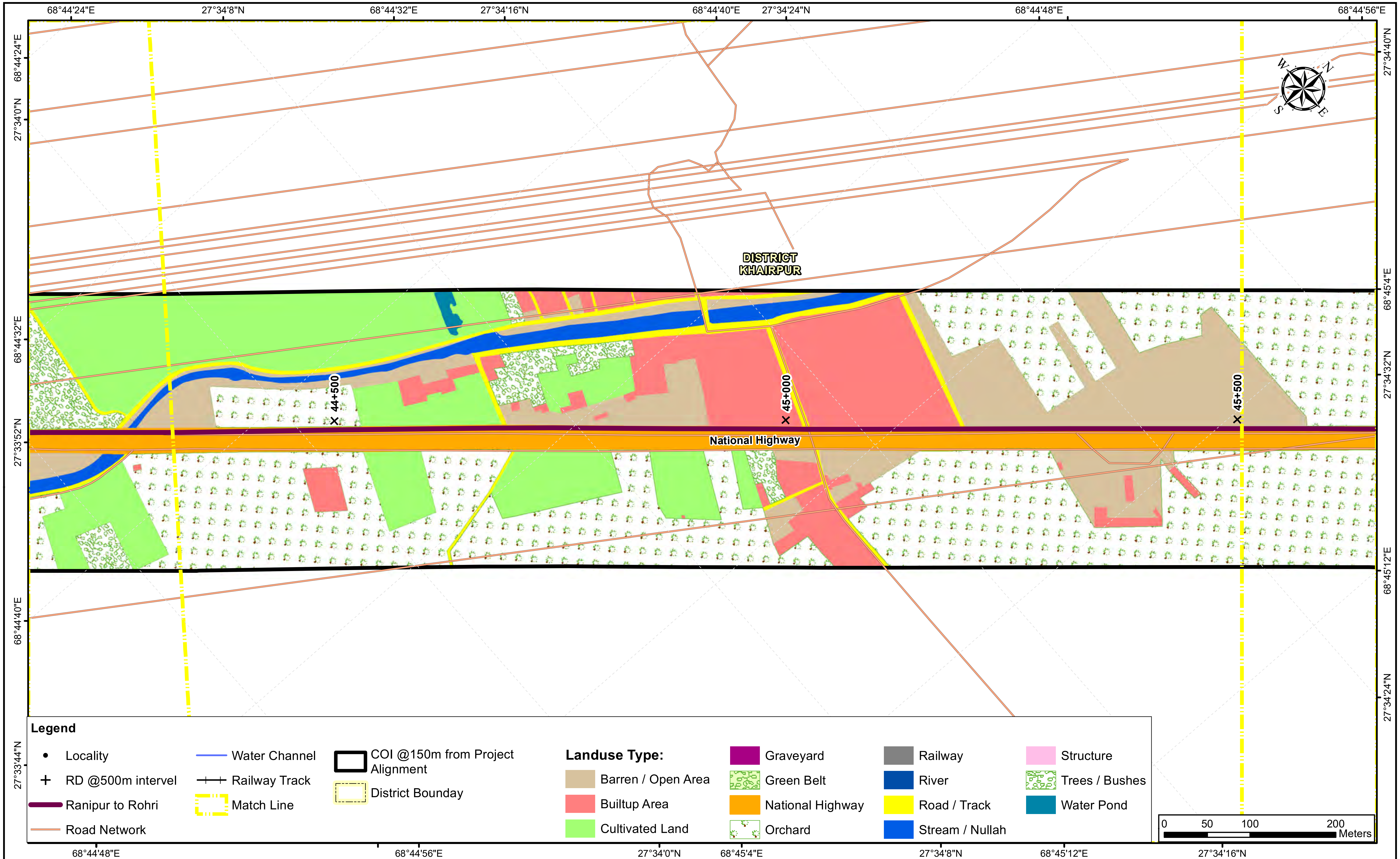
CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: DECEMBER- 2024	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			FIG. NO.: Page 31 of 53	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



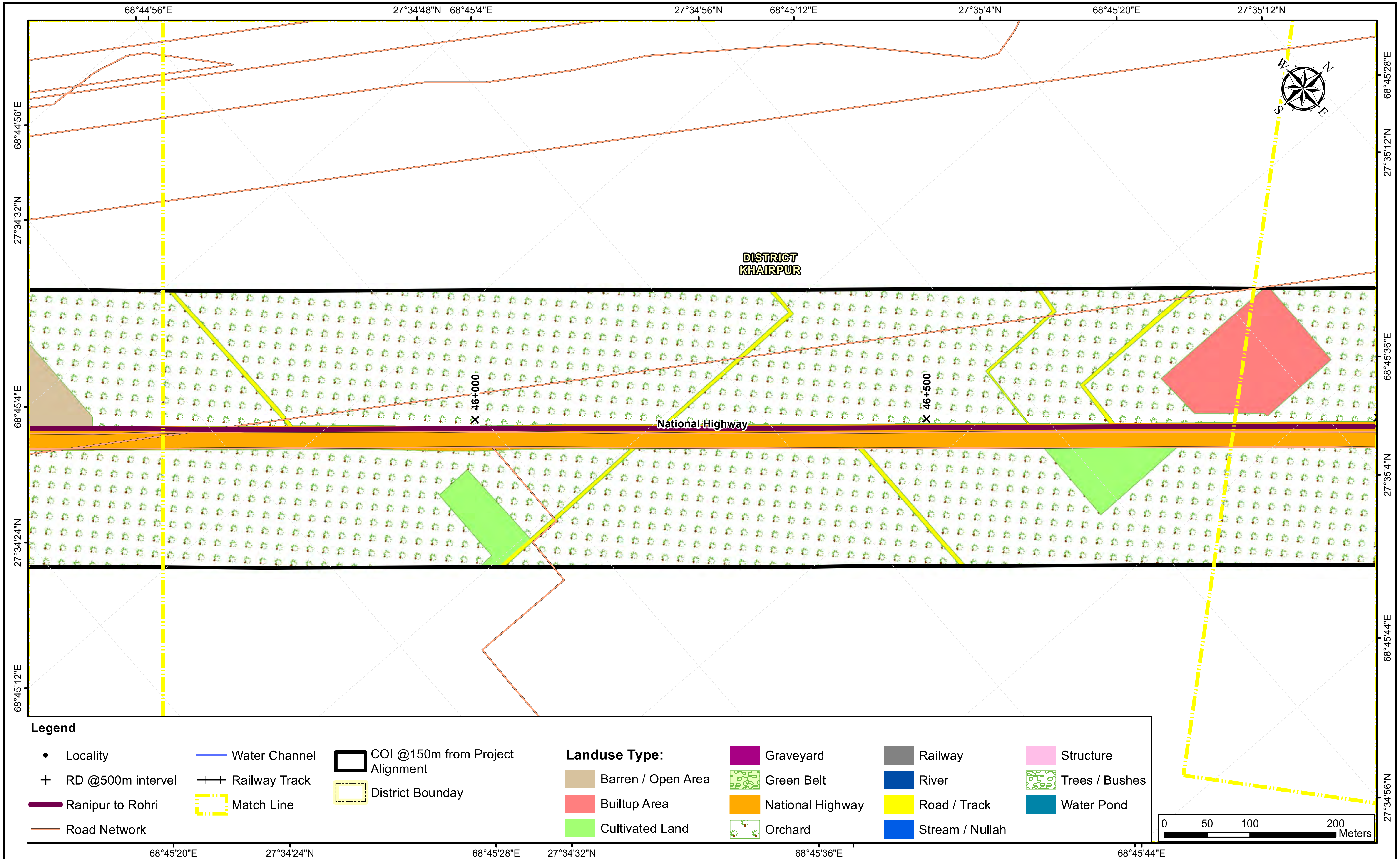
CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	FIG. NO.
		01				CHD/VER.			DECEMBER- 2024	Page 32 of 53
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	REV.	DATE	DESCRIPTION	APPROVED	APPROVED			REV.	0



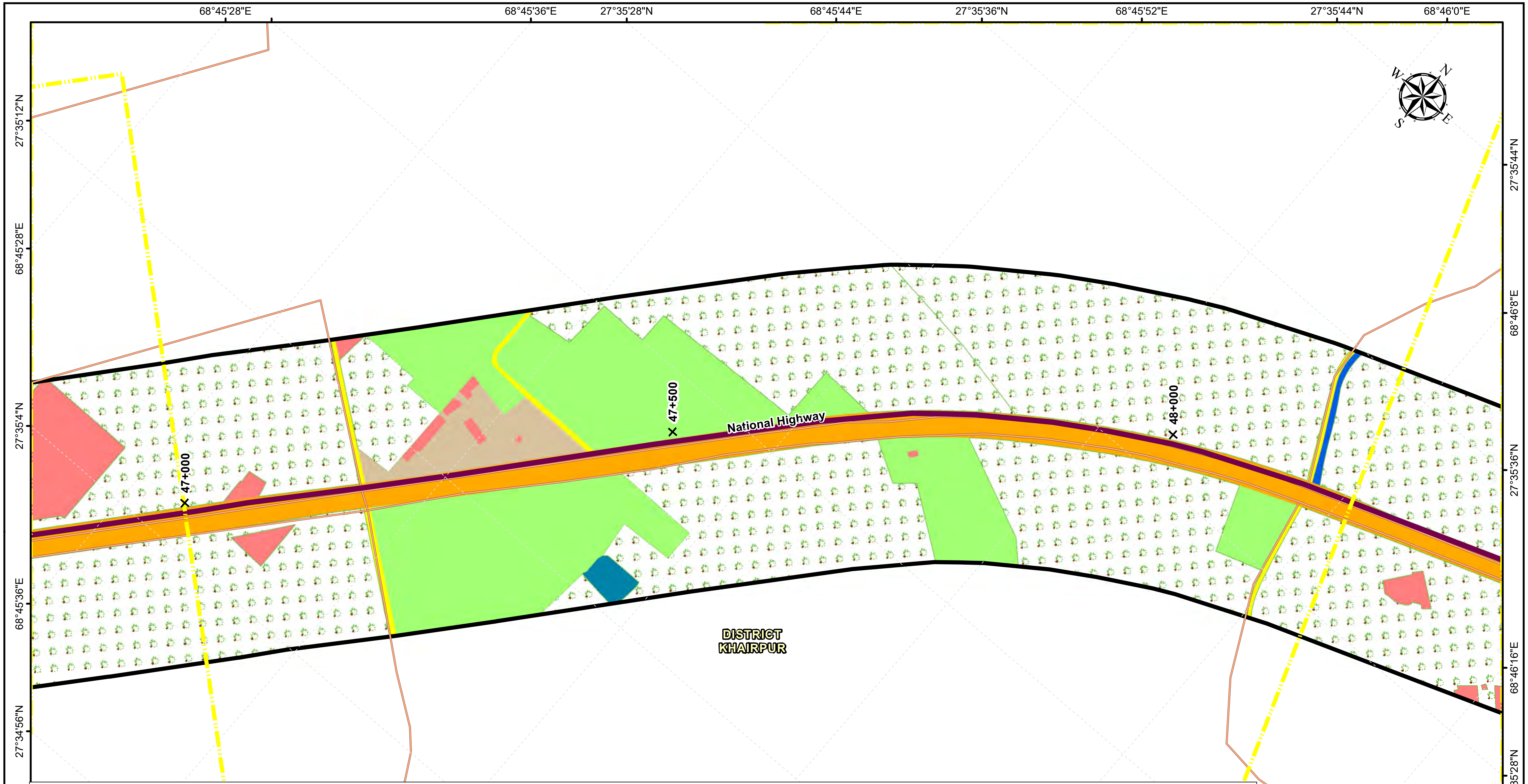
CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	FIG. NO.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DECEMBER- 2024	Page 33 of 53
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			REV.	0



CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.		DATE: DECEMBER- 2024	REV. 0
		02				RECOMMENDED			FIG. NO.: Page 34 of 53	
		01				CHD/VER.				
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	FIG. NO.
		01				CHD/VER.			DECEMBER- 2024	Page 35 of 53
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	REV.	DATE	DESCRIPTION	APPROVED	APPROVED			REV.	0



Legend

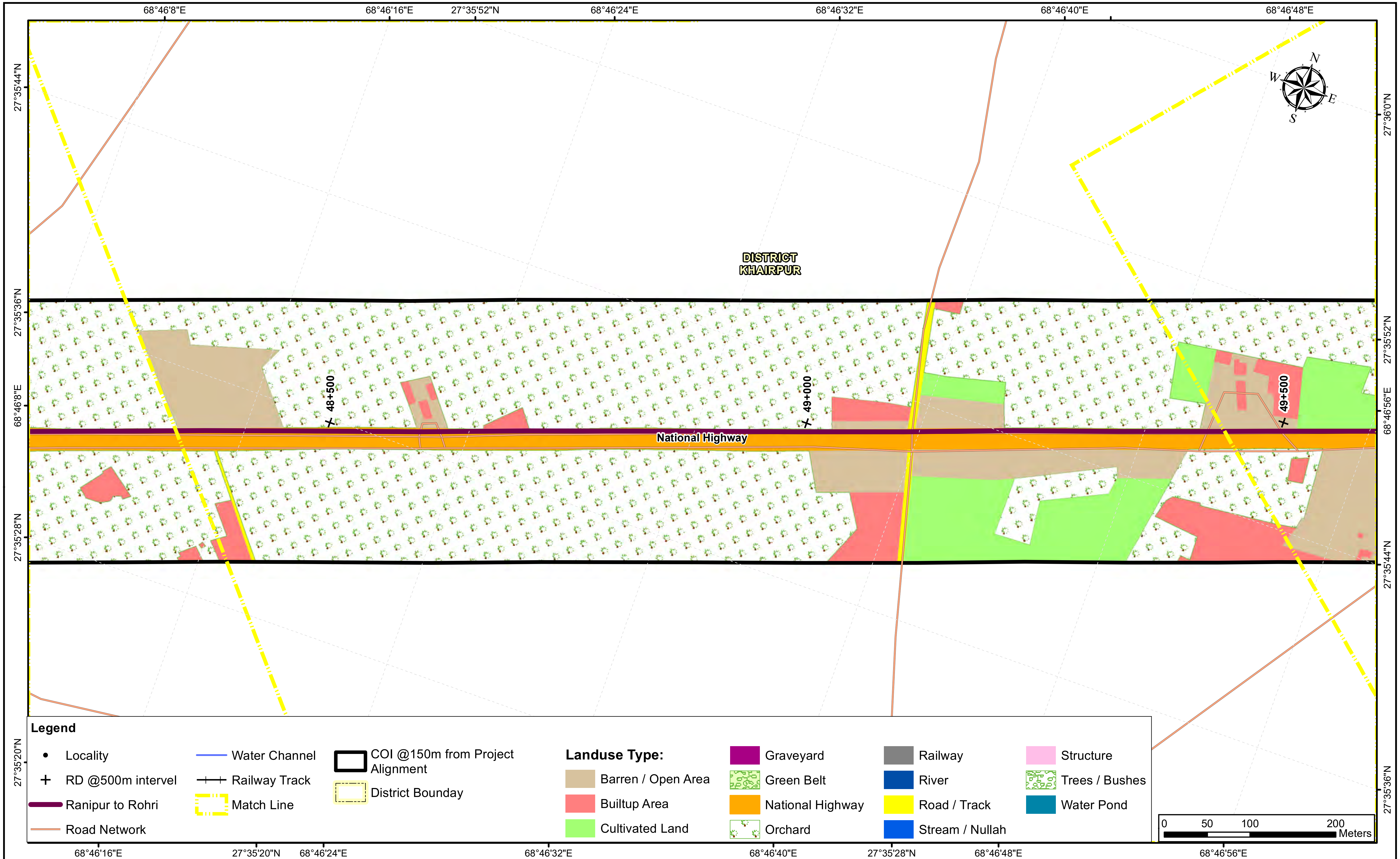
- Locality
- RD @500m intervel
- Ranipur to Rohri
- Road Network
- Water Channel
- Railway Track
- Match Line
- COI @150m from Project Alignment
- District Bounday

Landuse Type:

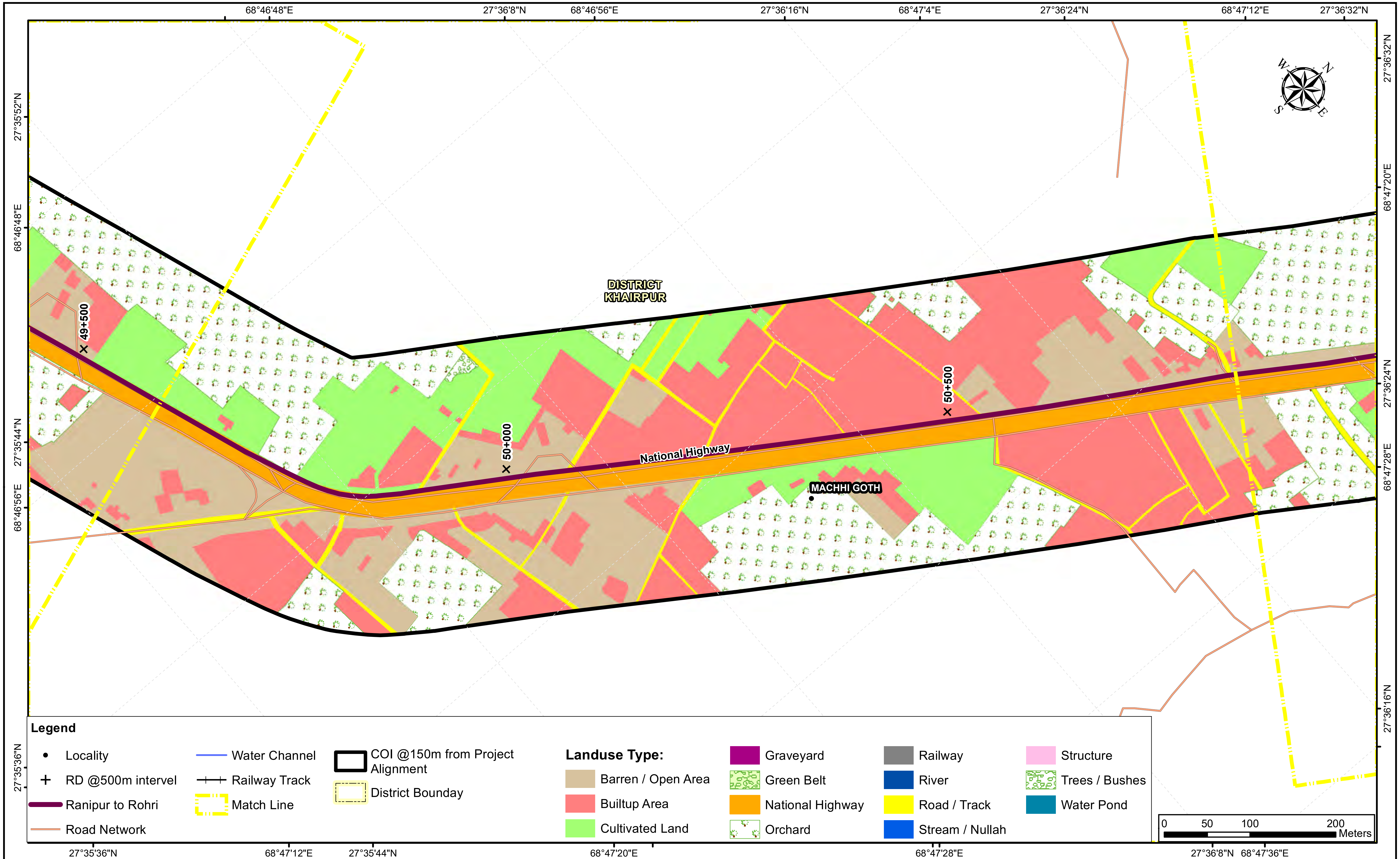
- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

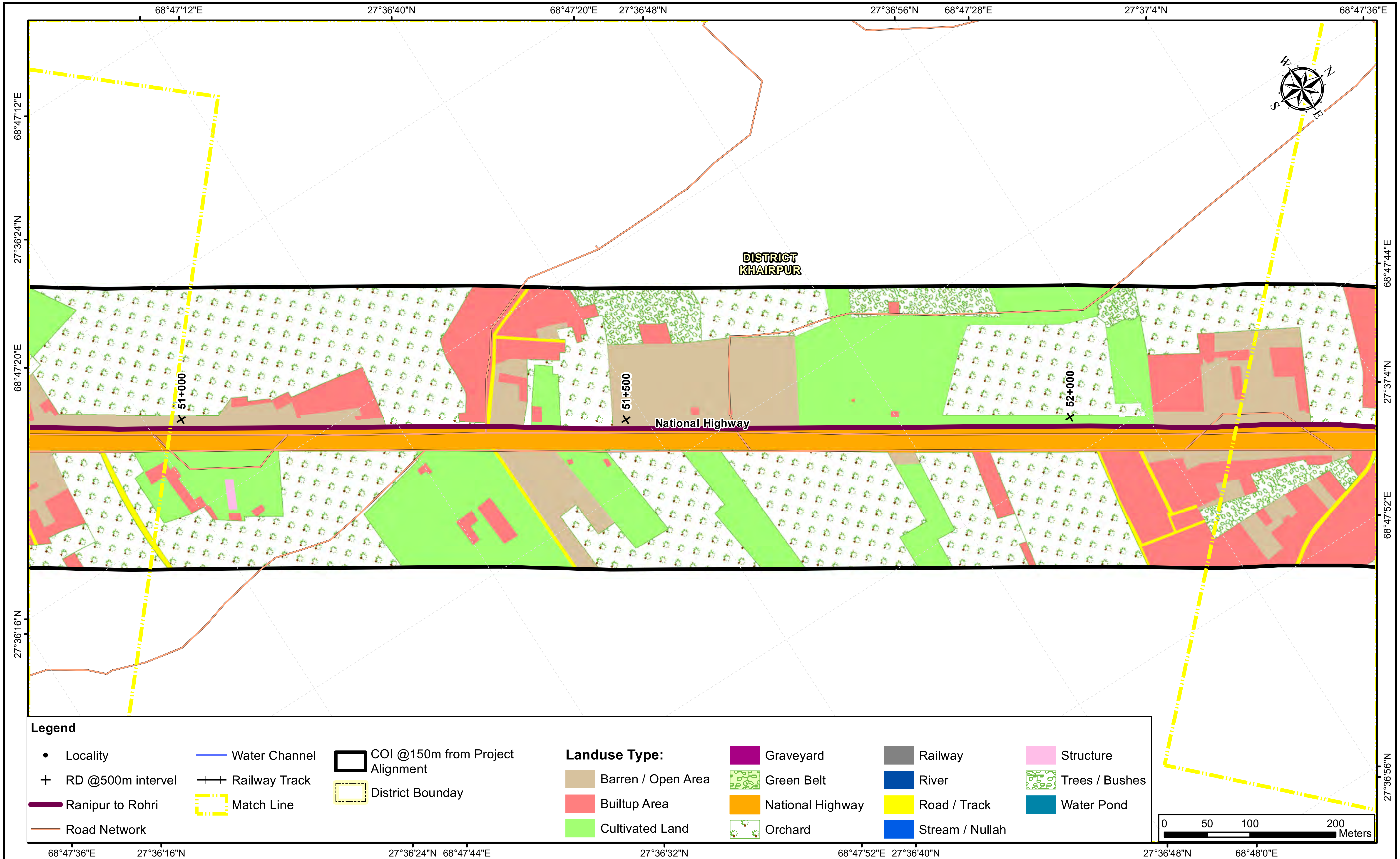
CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	FIG. NO.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DECEMBER- 2024	Page 36 of 53
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			REV.	0



CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	02				RECOMMENDED			DATE DECEMBER- 2024	FIG. NO. Page 37 of 53
		01				CHD/VER.				REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				

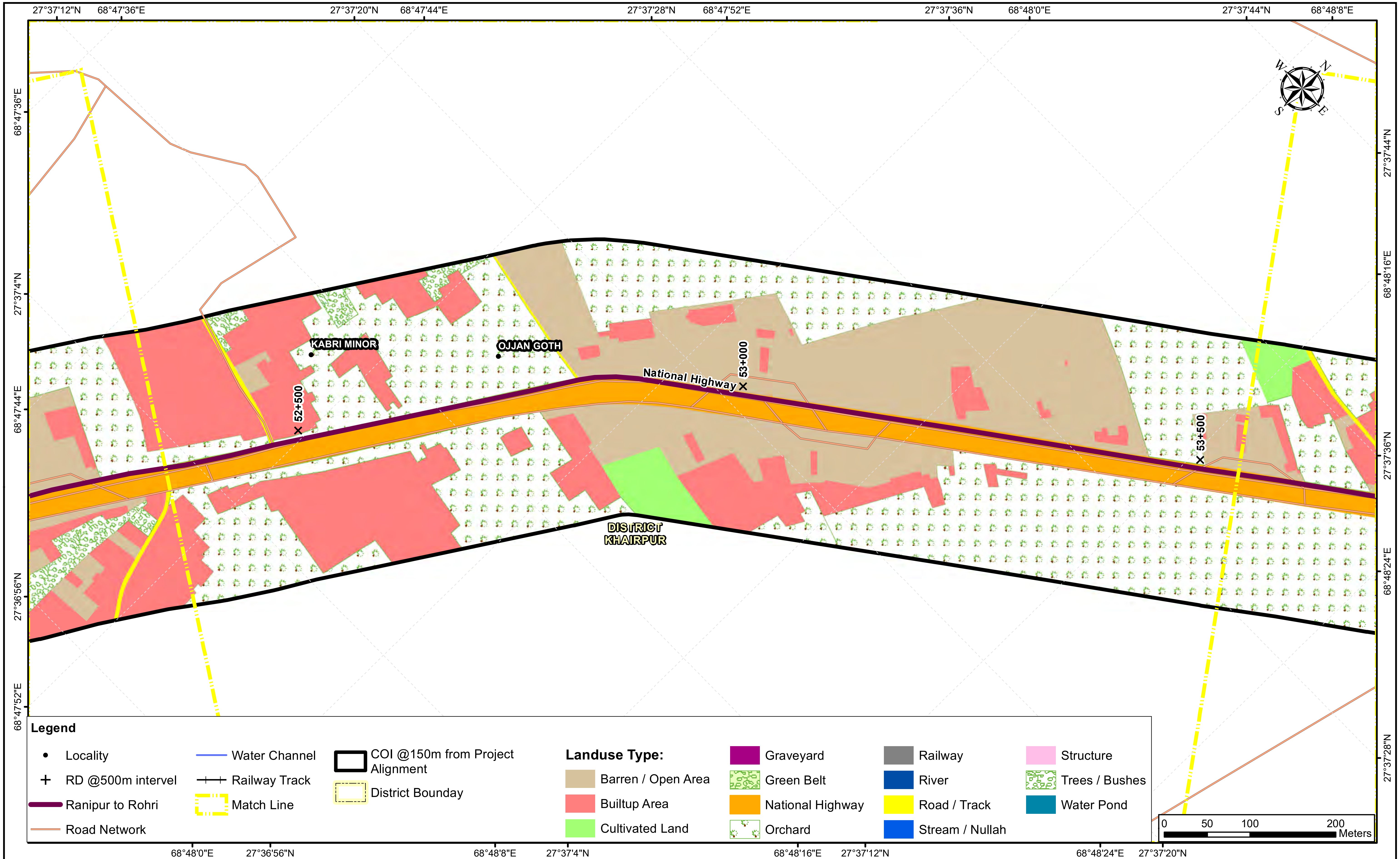


CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE DECEMBER- 2024	FIG. NO. Page 38 of 53
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.				REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



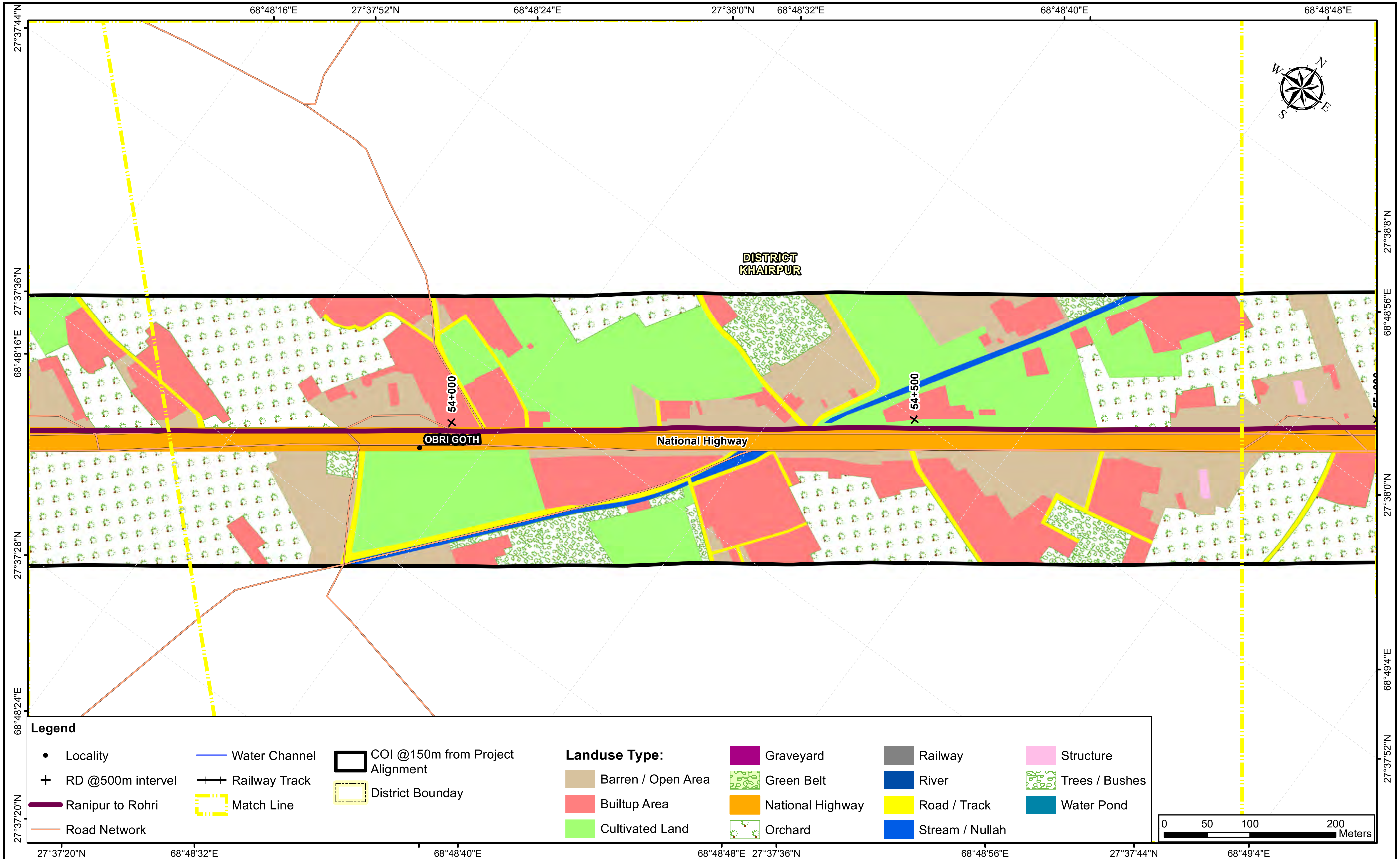
CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	FARHEEN	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)
		03				SUBMITTED	FAHAD S.	
		02				RECOMMENDED		
		01				CHD/VER.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

LAND USE MAP		SCALE	1:4,000
DATE	FIG. NO.	REV.	
DECEMBER- 2024	Page 39 of 53	0	



CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	FARHEEN	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)
		03				SUBMITTED	FAHAD S.	
		02				RECOMMENDED		
		01				CHD/VER.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

LAND USE MAP			SCALE 1:4,000
DATE DECEMBER- 2024	FIG. NO. Page 40 of 53		REV. 0



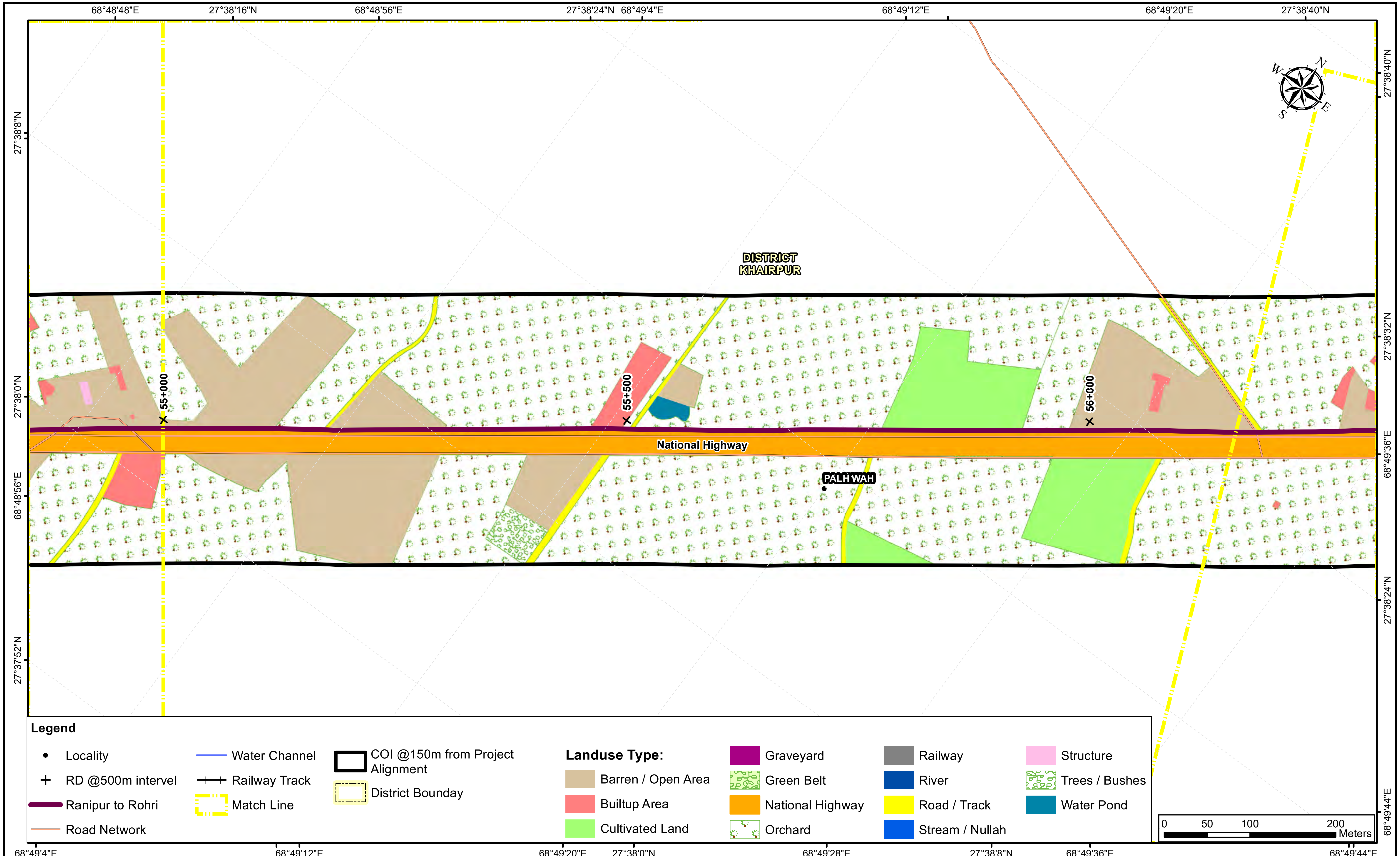
CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN				

REV.	DATE	DESCRIPTION	APPROVED		
04				DRAWN	FARHEEN
03				SUBMITTED	FAHAD S.
02				RECOMMENDED	
01				CHD/VER.	
				APPROVED	

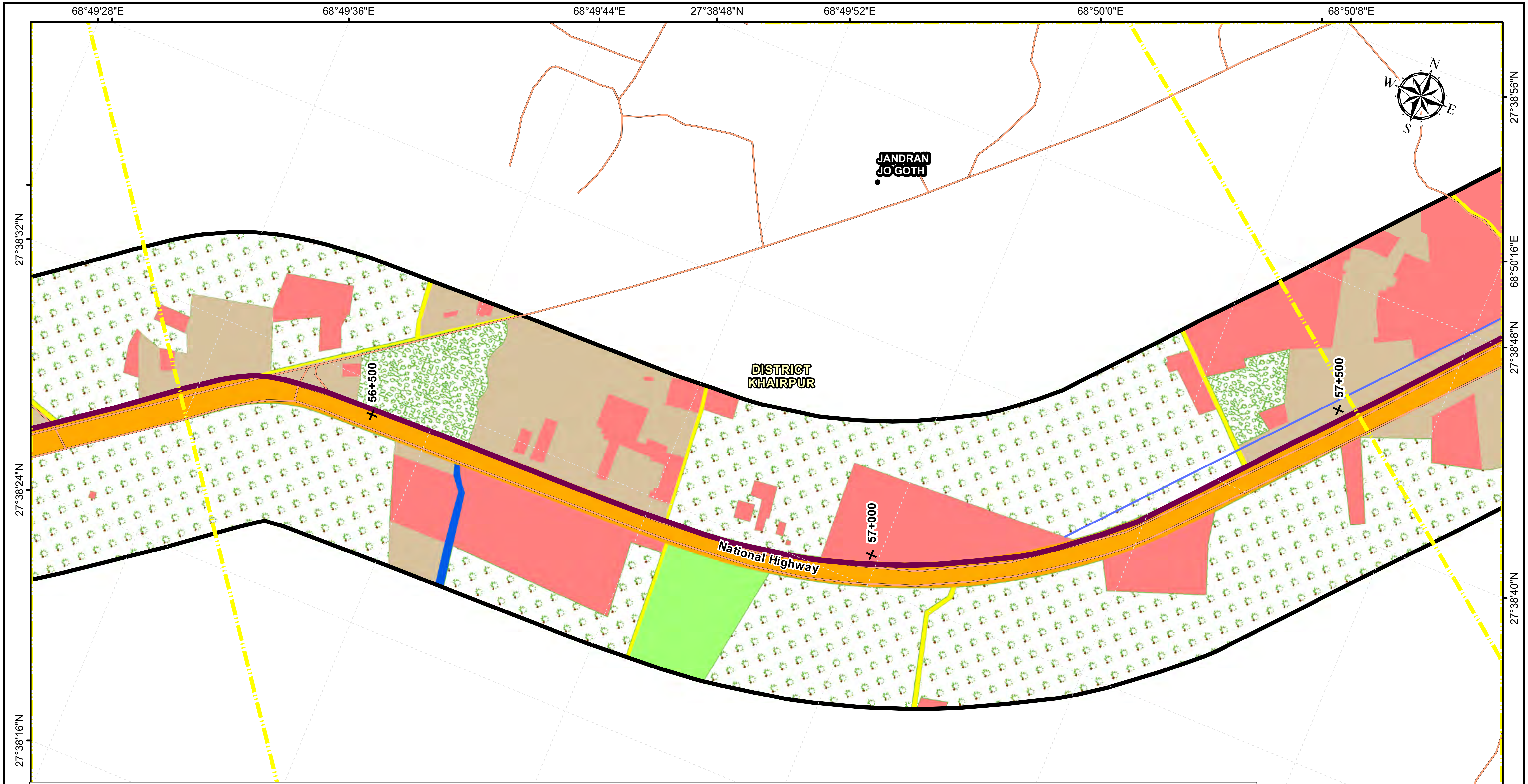
PROJECT

DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)

LAND USE MAP		SCALE 1:4,000
DATE DECEMBER- 2024	FIG. NO. Page 41 of 53	REV. 0



CLIENT	CONSULTANT							PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED			DATE	FIG. NO.	REV.
		01				CHD/VER.			DECEMBER- 2024	Page 42 of 53	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



Legend

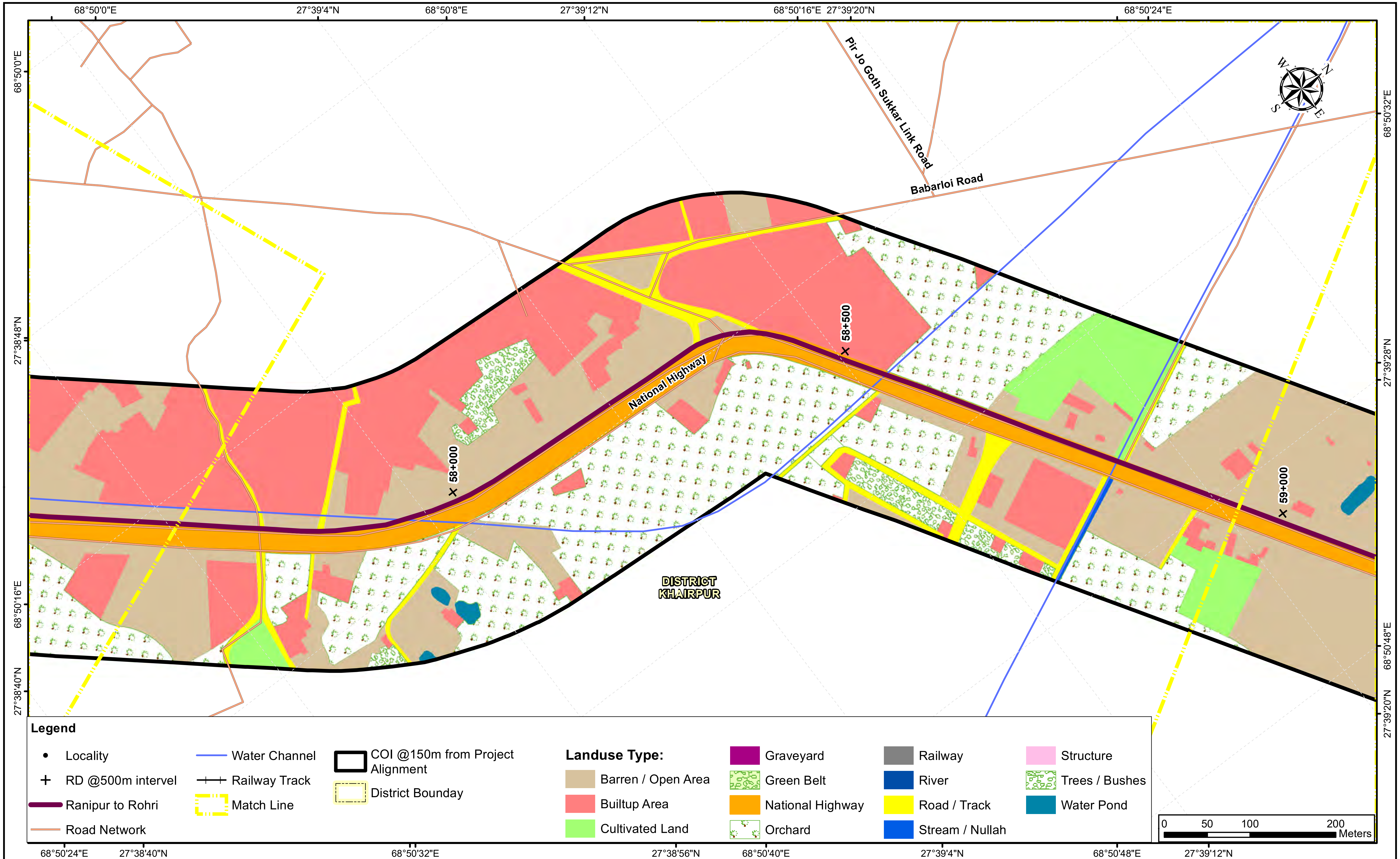
• Locality	Water Channel	COI @150m from Project Alignment	
+ RD @500m intervel	Railway Track	District Bounday	
Ranipur to Rohri	Match Line		
Road Network			

Landuse Type:

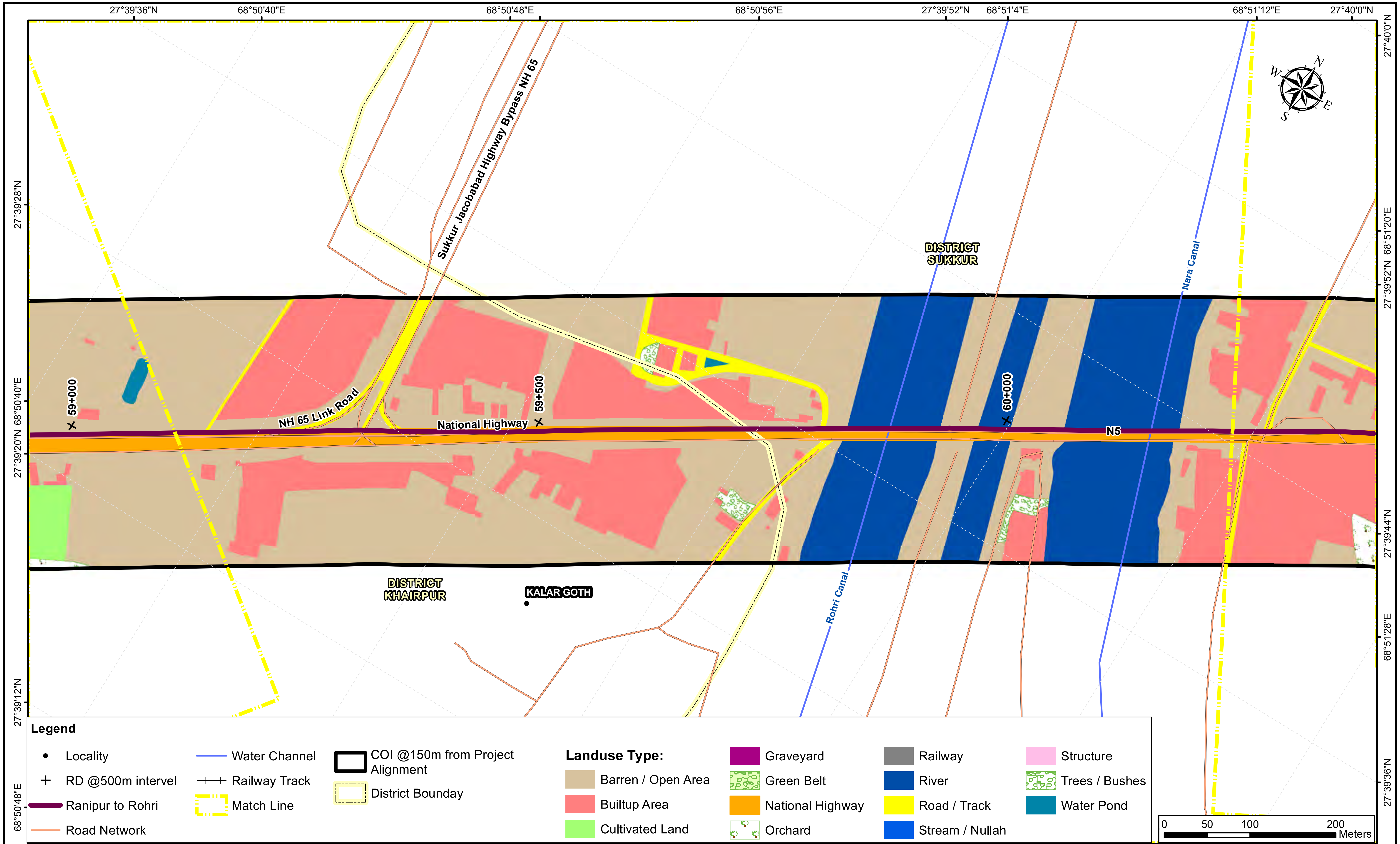
Barren / Open Area	Graveyard	Railway	Structure
Builtup Area	Green Belt	River	Trees / Bushes
Cultivated Land	National Highway	Road / Track	Water Pond
	Orchard	Stream / Nullah	

0 50 100 200 Meters

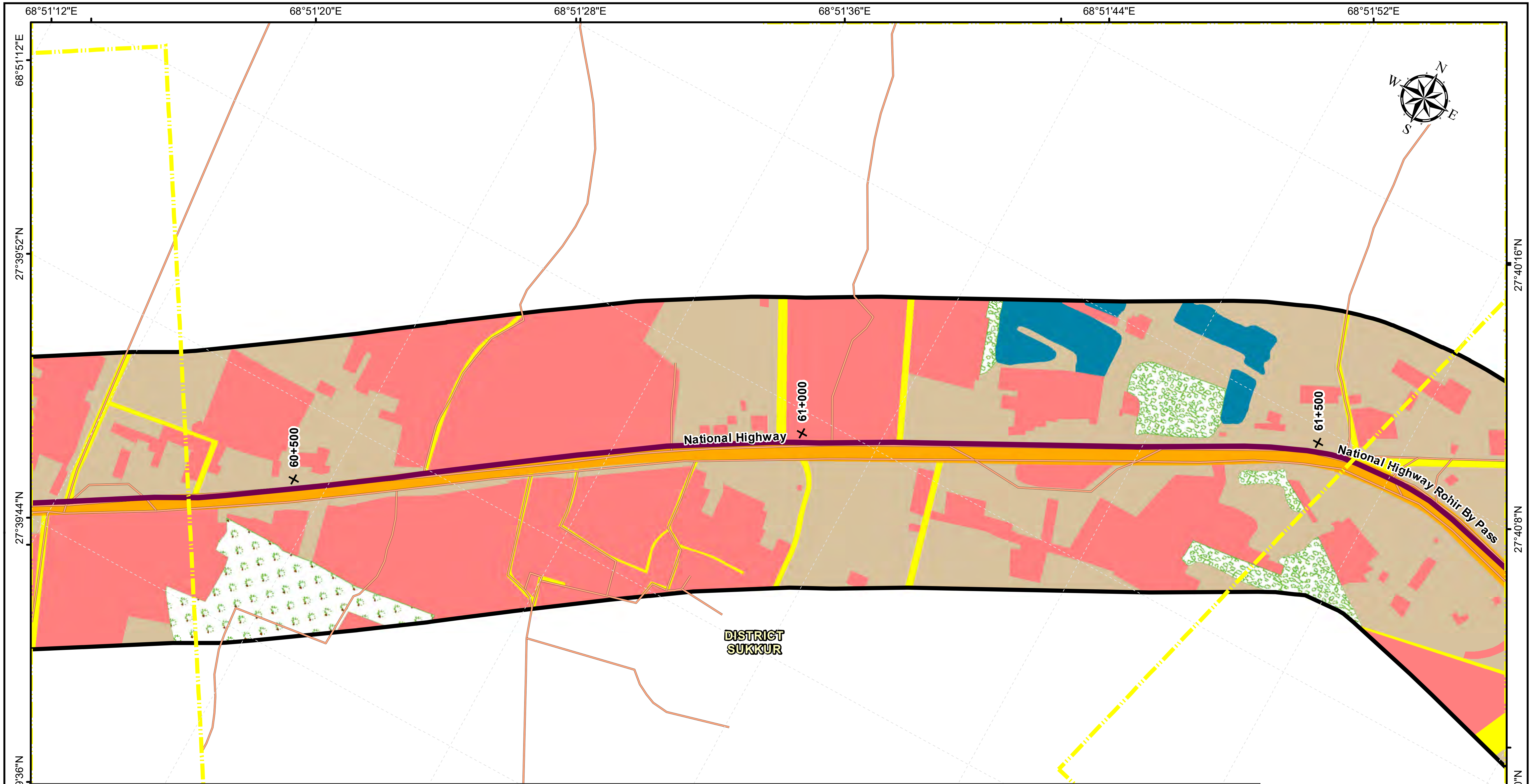
CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: DECEMBER- 2024	REV. 0
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			FIG. NO.: Page 43 of 53	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	FIG. NO.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DECEMBER- 2024	Page 44 of 53
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			REV.	0



CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	FIG. NO.
		01				CHD/VER.			DECEMBER- 2024	Page 45 of 53
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	REV.	DATE	DESCRIPTION	APPROVED	APPROVED			REV.	0



Legend

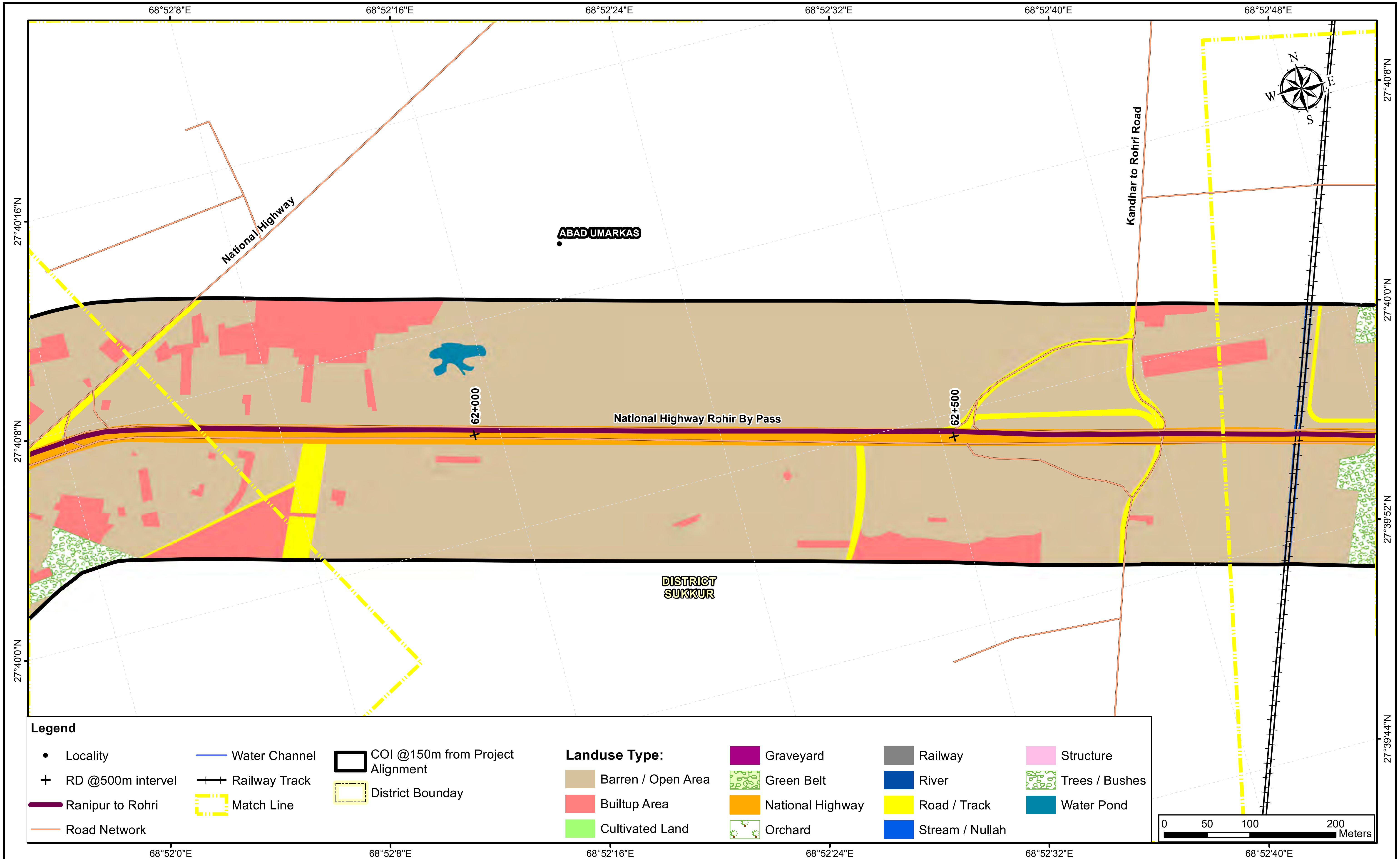
- Locality
- RD @500m intervel
- Ranipur to Rohri
- Road Network
- Water Channel
- Railway Track
- Match Line
- COI @150m from Project Alignment
- District Bounday

Landuse Type:

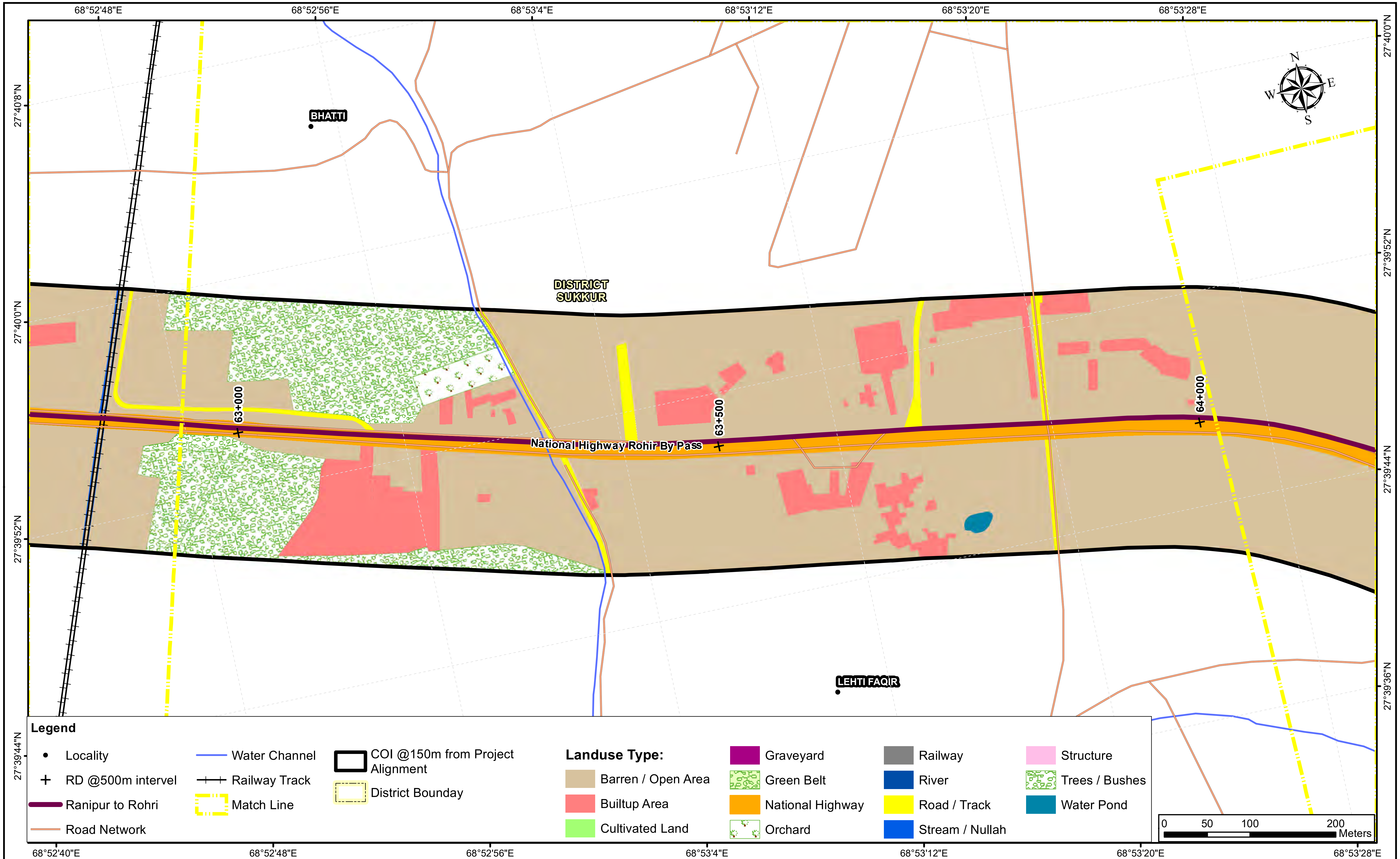
- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

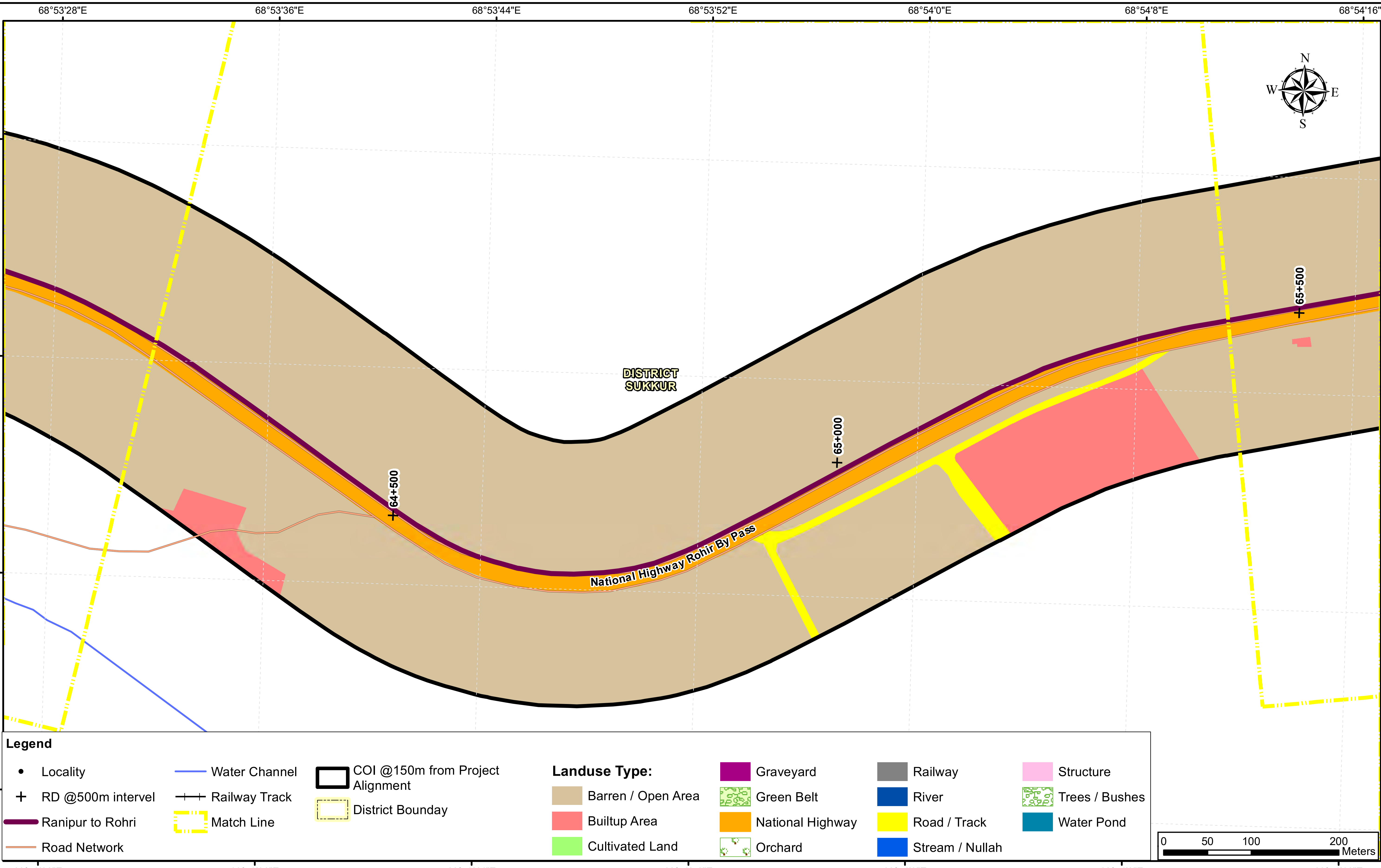
CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: DECEMBER- 2024	REV. 0
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			FIG. NO.: Page 46 of 53	
						APPROVED				



CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE DECEMBER- 2024	FIG. NO. Page 47 of 53
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.				REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.		DATE: DECEMBER- 2024	FIG. NO. Page 48 of 53
		02				RECOMMENDED				REV. 0
		01				CHD/VER.				
						APPROVED				



Legend

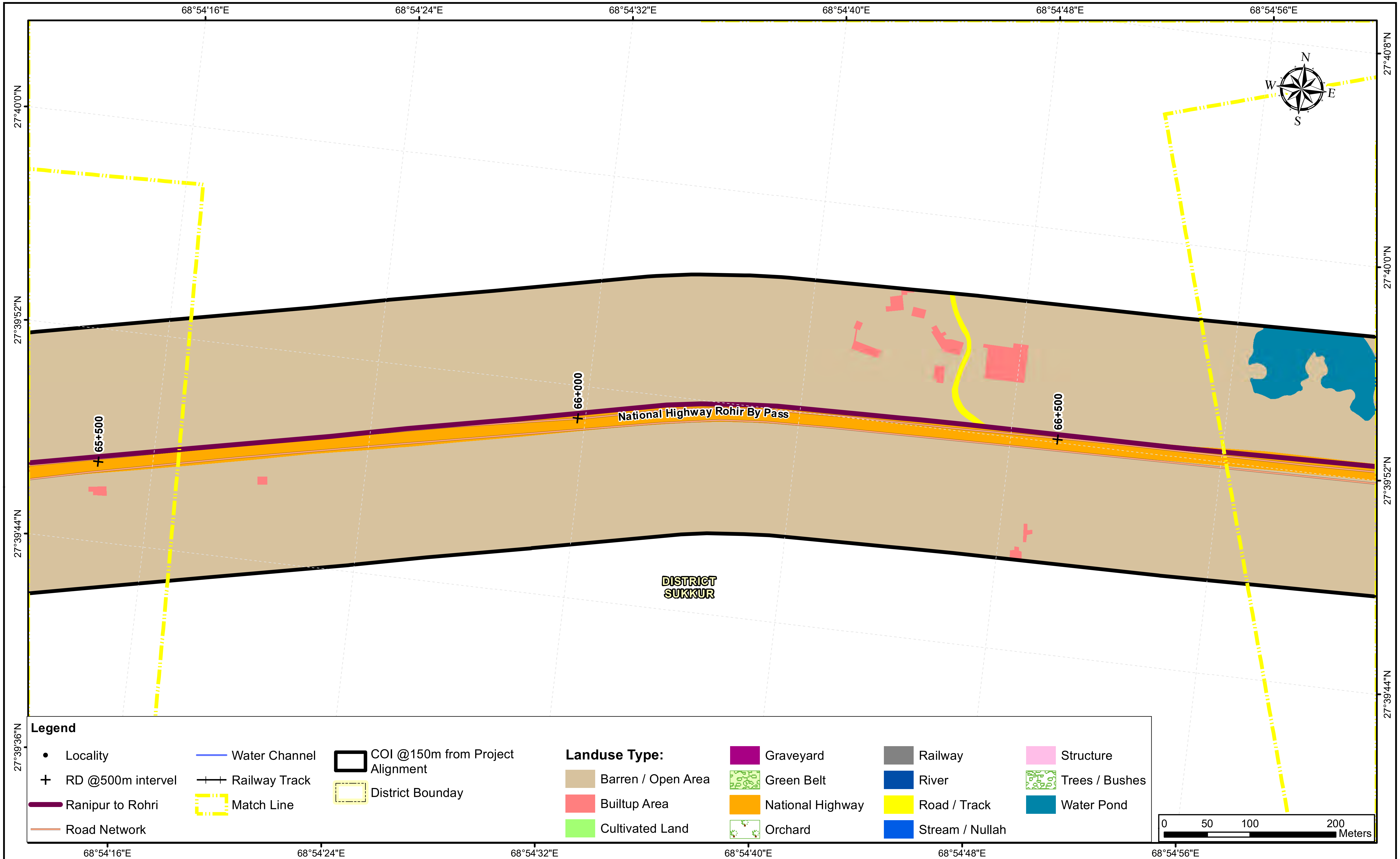
Locality	Water Channel	COI @150m from Project Alignment
RD @500m intervel	Railway Track	District Bounday
Ranipur to Rohri	Match Line	
Road Network		

Landuse Type:

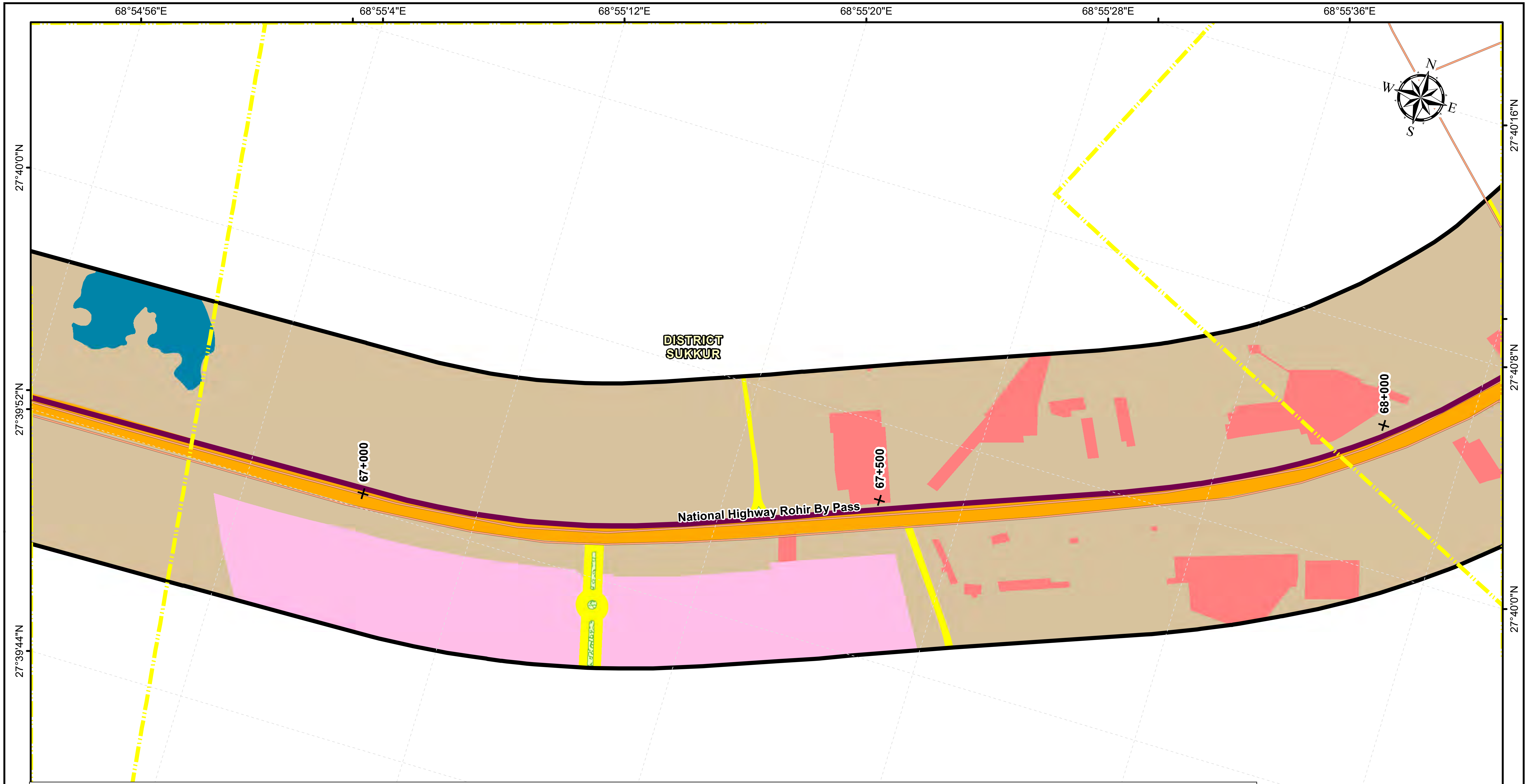
Barren / Open Area	Graveyard	Railway	Structure
Builtup Area	Green Belt	River	Trees / Bushes
Cultivated Land	National Highway	Road / Track	Water Pond
	Orchard	Stream / Nullah	

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED			DATE	FIG. NO.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DECEMBER- 2024	Page 49 of 53	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	FIG. NO.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DECEMBER- 2024	Page 50 of 53
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			REV.	0



Legend

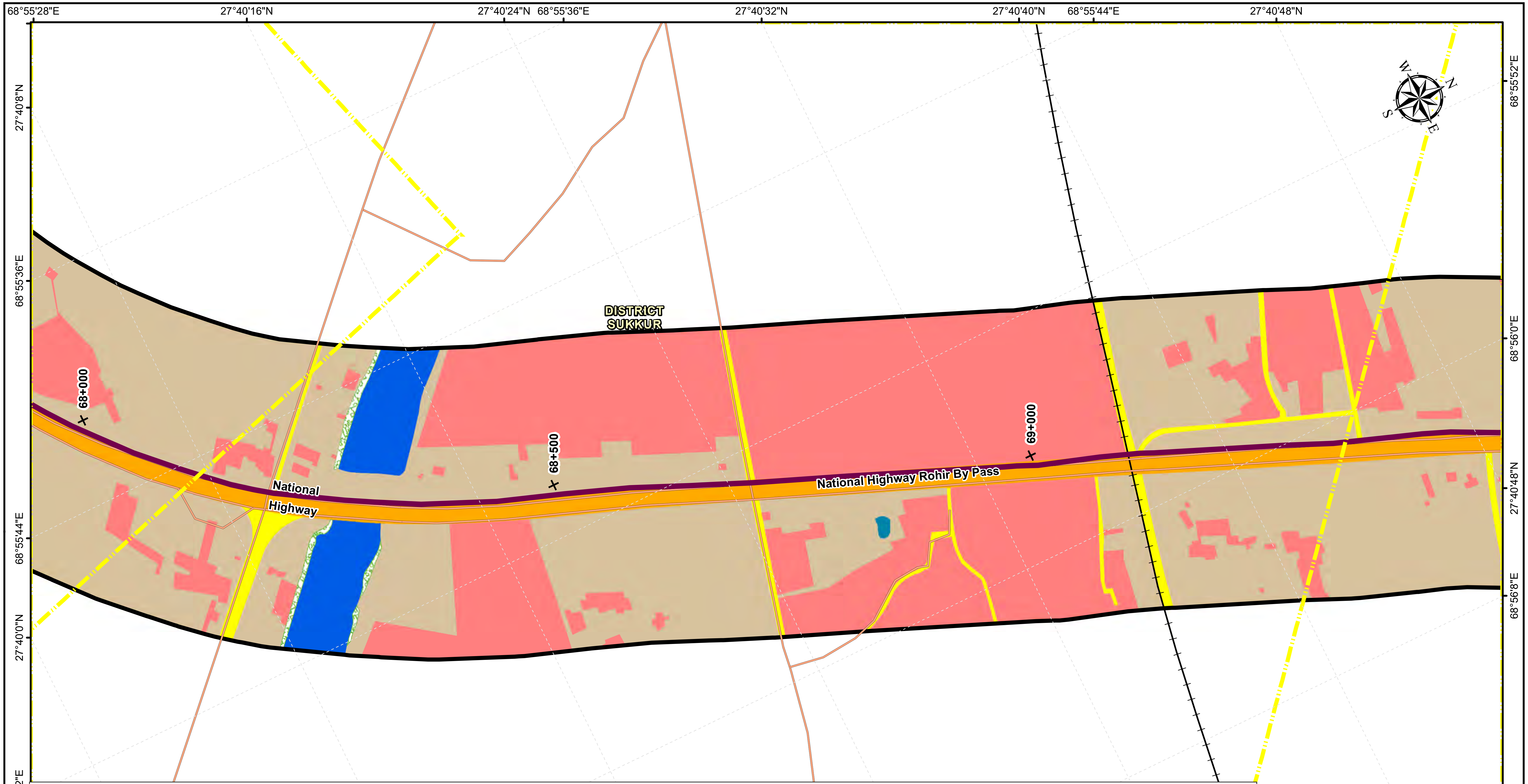
- Locality
- RD @500m intervel
- Ranipur to Rohri
- Road Network
- Water Channel
- Railway Track
- Match Line
- COI @150m from Project Alignment
- District Bounday

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT		
NHA NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE DECEMBER- 2024	FIG. NO. Page 51 of 53
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.				REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



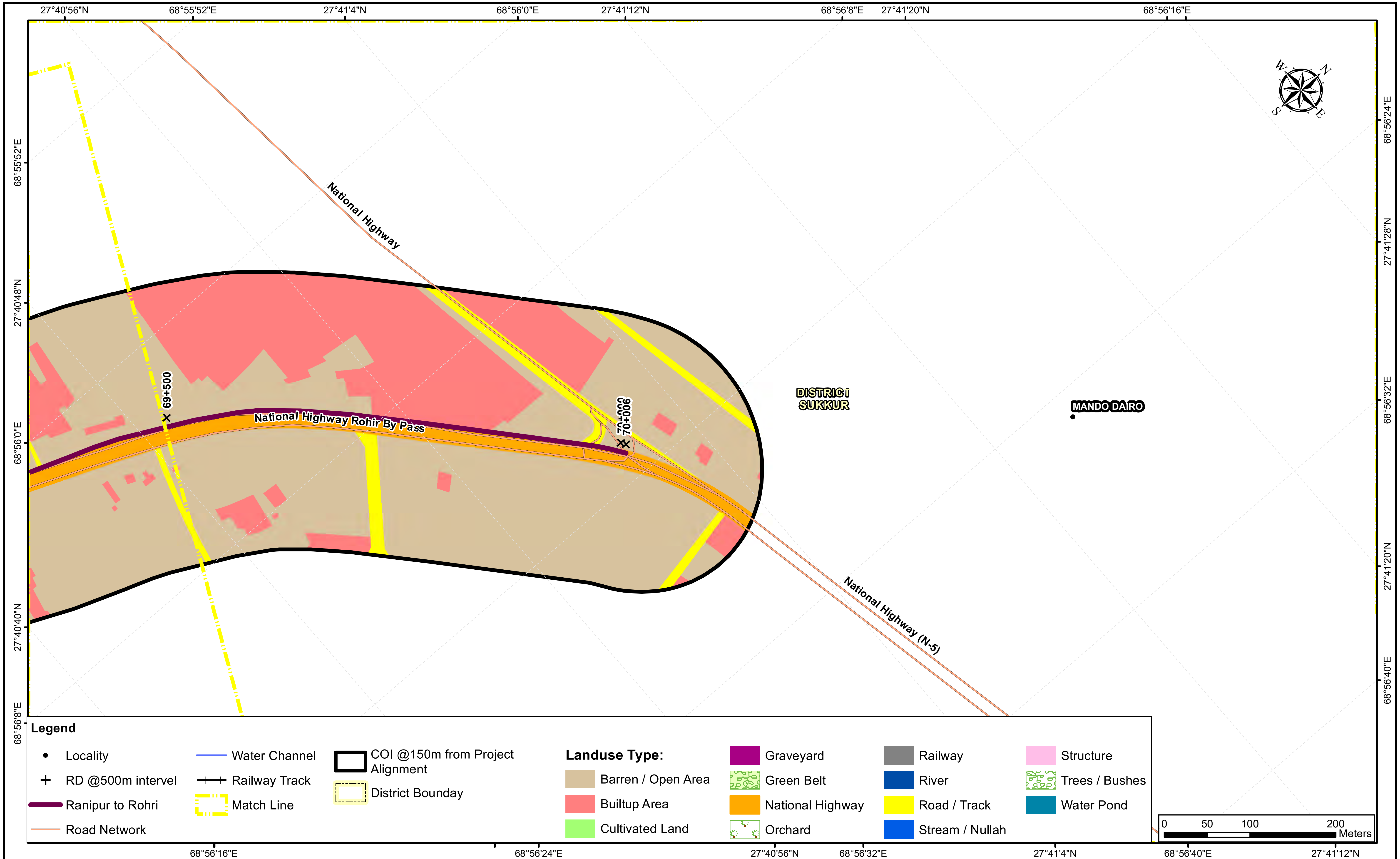
Legend

Locality	Water Channel	COI @150m from Project Alignment
RD @500m intervel	Railway Track	District Bounday
Ranipur to Rohri	Match Line	
Road Network		

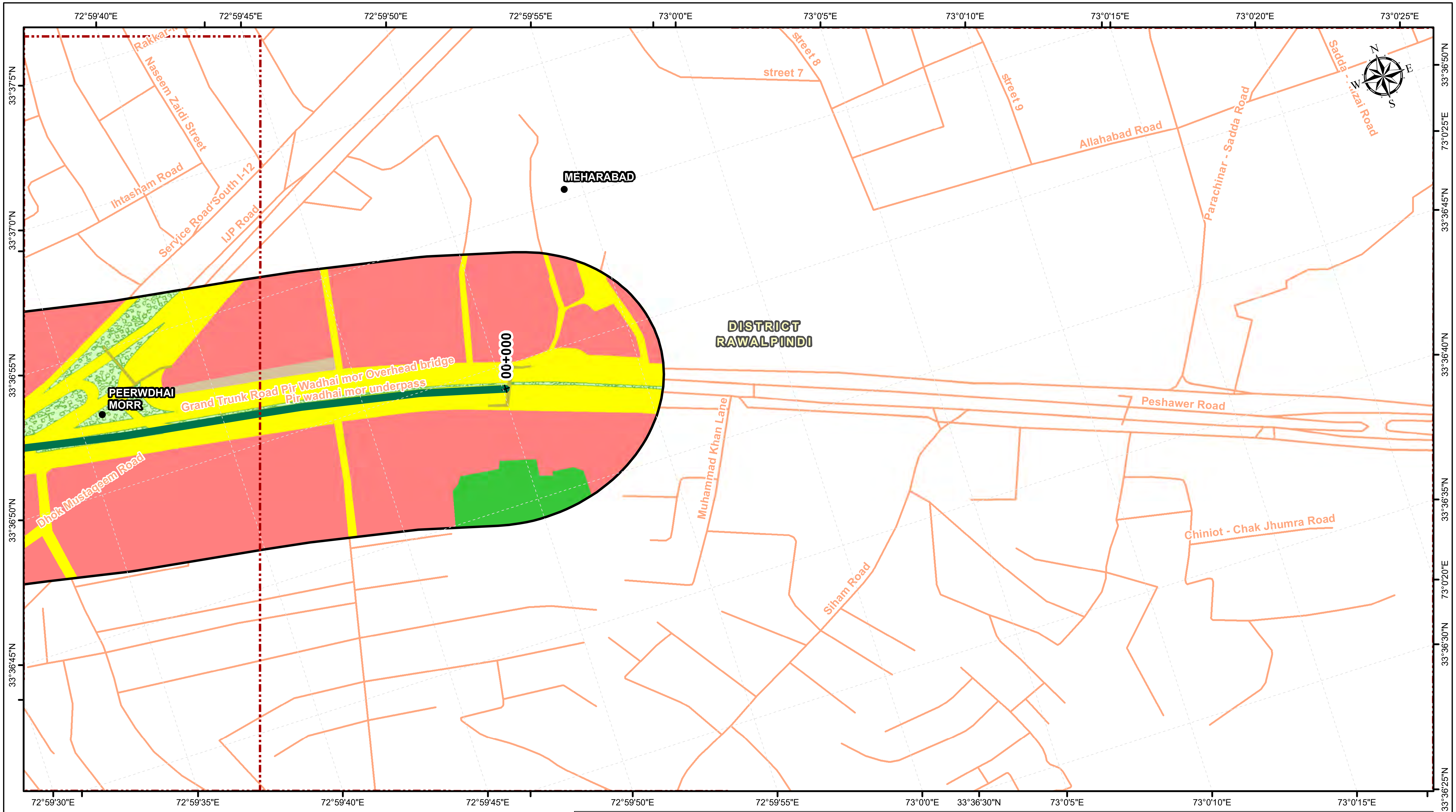
Landuse Type:

Barren / Open Area	Graveyard	Railway	Structure
Builtup Area	Green Belt	River	Trees / Bushes
Cultivated Land	National Highway	Road / Track	Water Pond
	Orchard	Stream / Nullah	

CLIENT	CONSULTANT							PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED			DATE	FIG. NO.	REV.
		01				CHD/VER.			DECEMBER- 2024	Page 52 of 53	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



CLIENT	CONSULTANT							PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	FARHEEN	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-2: RANIPUR TO ROHRI)	LAND USE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED			DATE	FIG. NO.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DECEMBER- 2024	Page 53 of 53	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



Legend

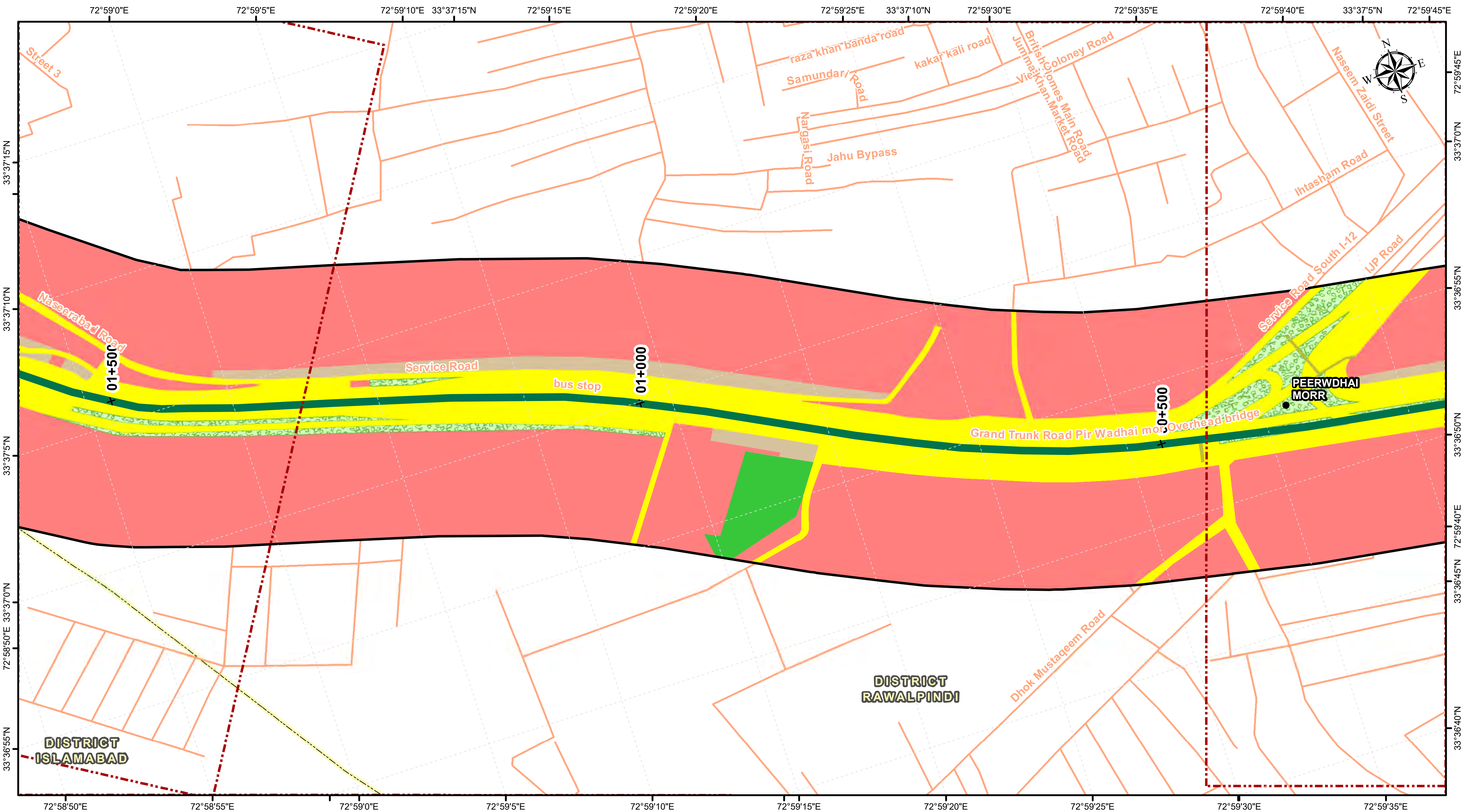
- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV. 0
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DRAWING No.: SHEET 1 OF 39	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				

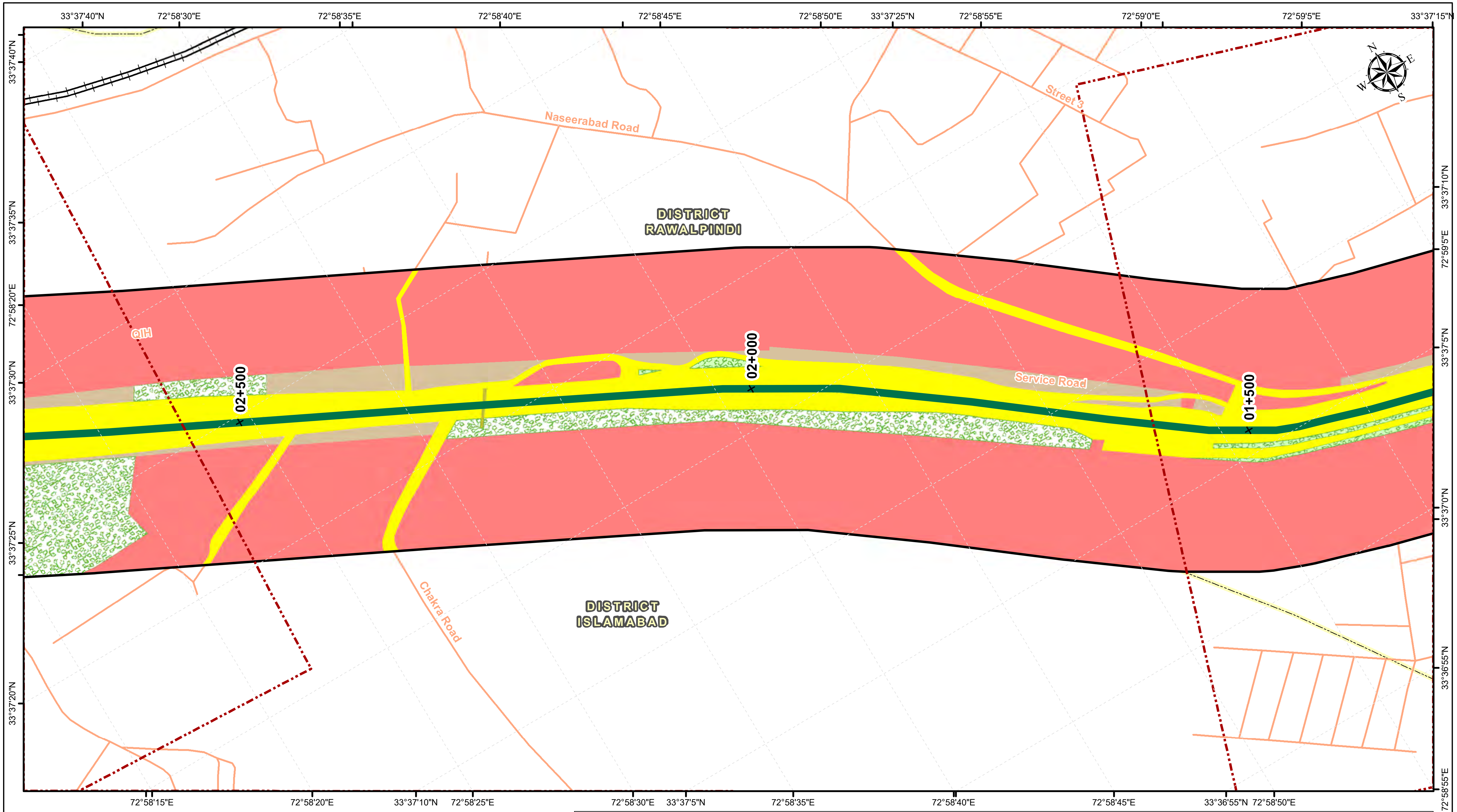


Legend

Locality	Road Network	Match Line	**Landuse Type:**	Builtup Area	Graveyard	Play Ground	Road / Track
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Communication Tower	Green Belt	Railway	Stream / Nullah
Rawalpindi to Burhan	Railway Track		Brick Kiln	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes
							Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT			SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP		1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED			DATE	DRAWING No.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024	SHEET 2 OF 39	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



0 50 100 200 Meters

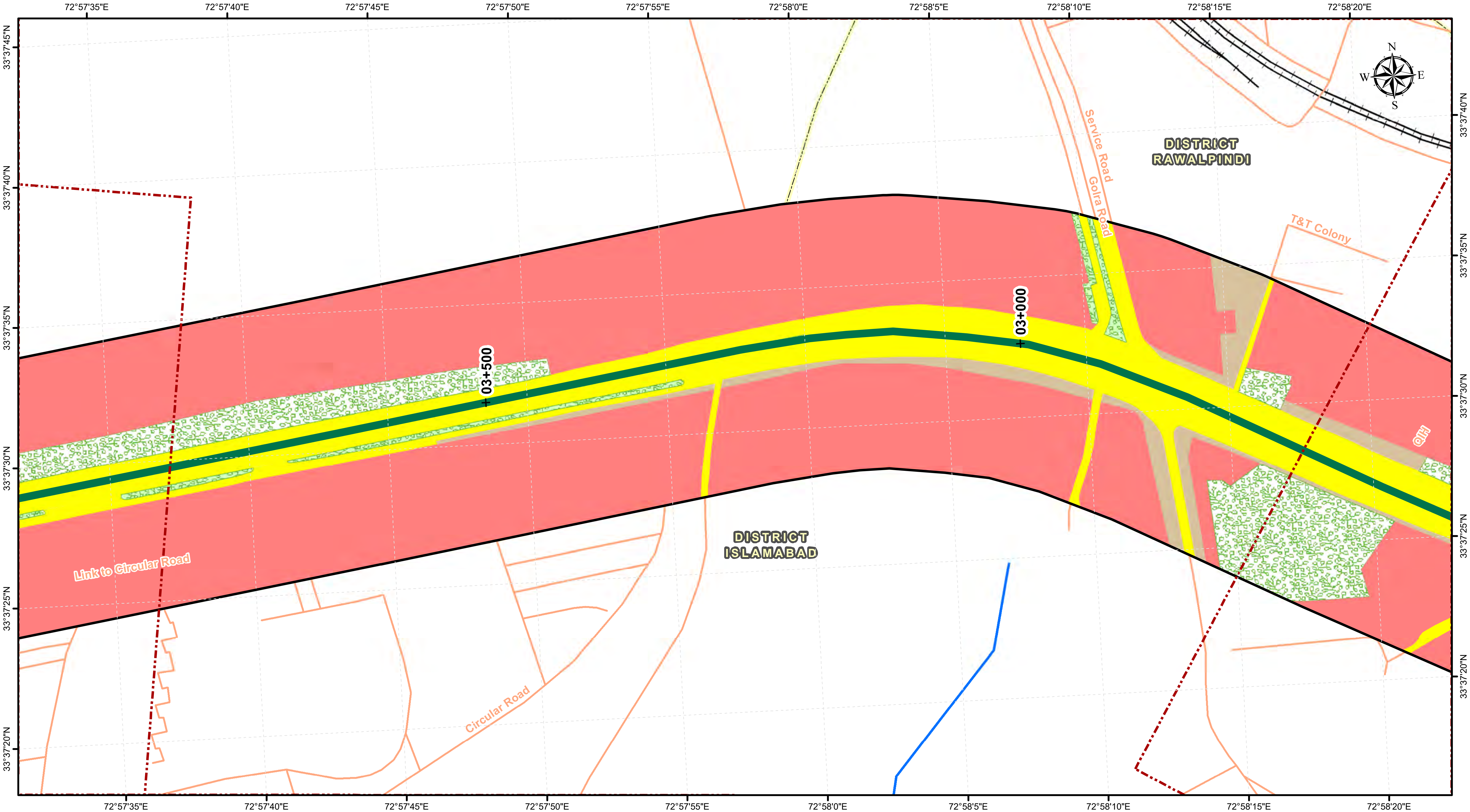
Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV. 0
		01				CHD/VER.			DRAWING No.: SHEET 3 OF 39	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200 Meters

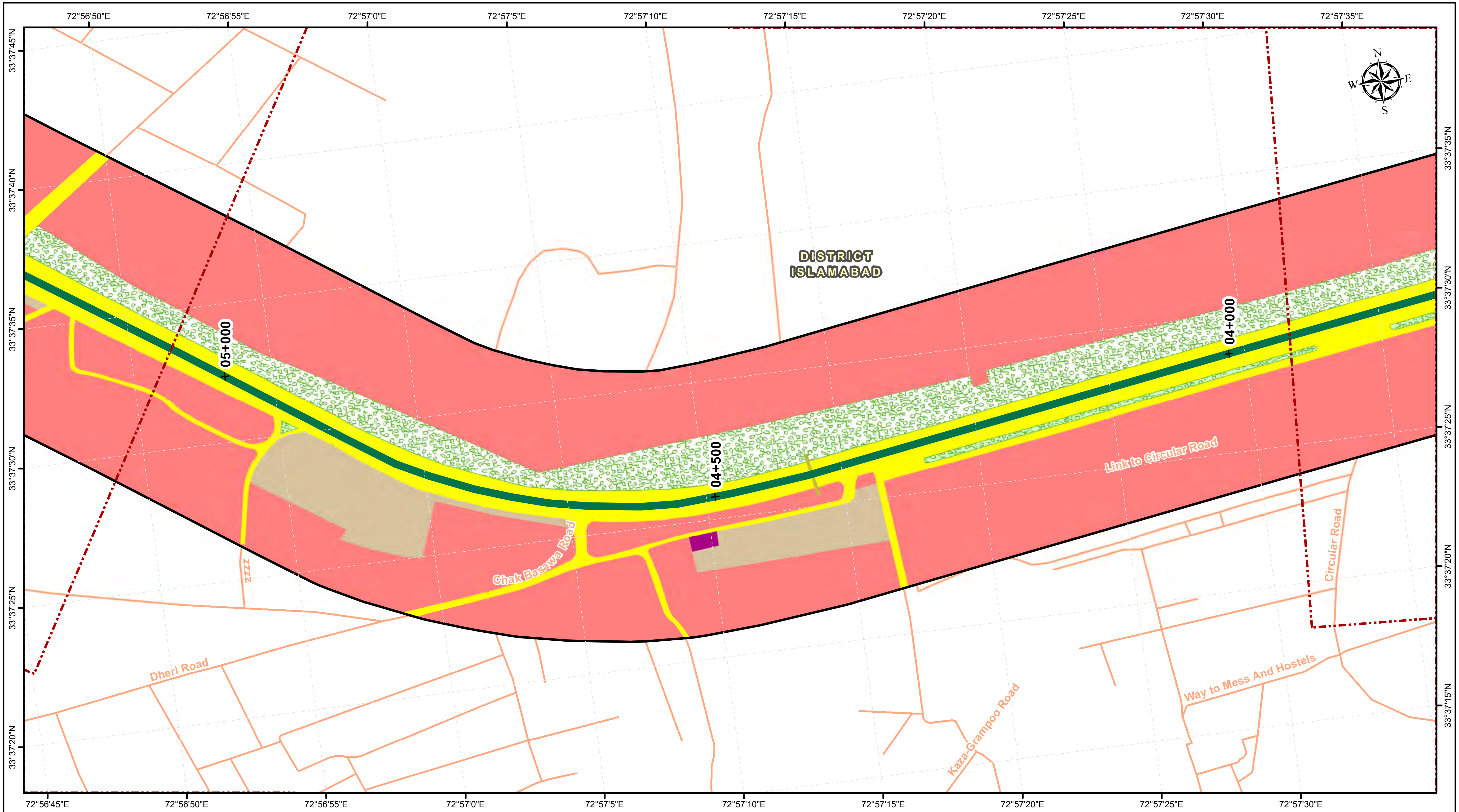
Legend

Locality	Road Network	Match Line	
RD @500m interval	Water Channel	District Boundary	
Rawalpindi to Burhan	Railway Track		

Landuse Type:

Barren / Open Area	Builtup Area	Graveyard	Play Ground	Road / Track	
Brick Kiln	Communication Tower	Green Belt	Railway	Stream / Nullah	
	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes	
				Water Pond	

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV.
		01				CHD/VER.			DRAWING No.: SHEET 4 OF 39	0
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



Legend

Locality	Road Network	Match Line	**Landuse Type:**	Builtup Area	Graveyard	Play Ground	Road / Track
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Communication Tower	Green Belt	Railway	Stream / Nullah
Rawalpindi to Burhan	Railway Track		Brick Kiln	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes
							Water Pond

0 50 100 200 Meters

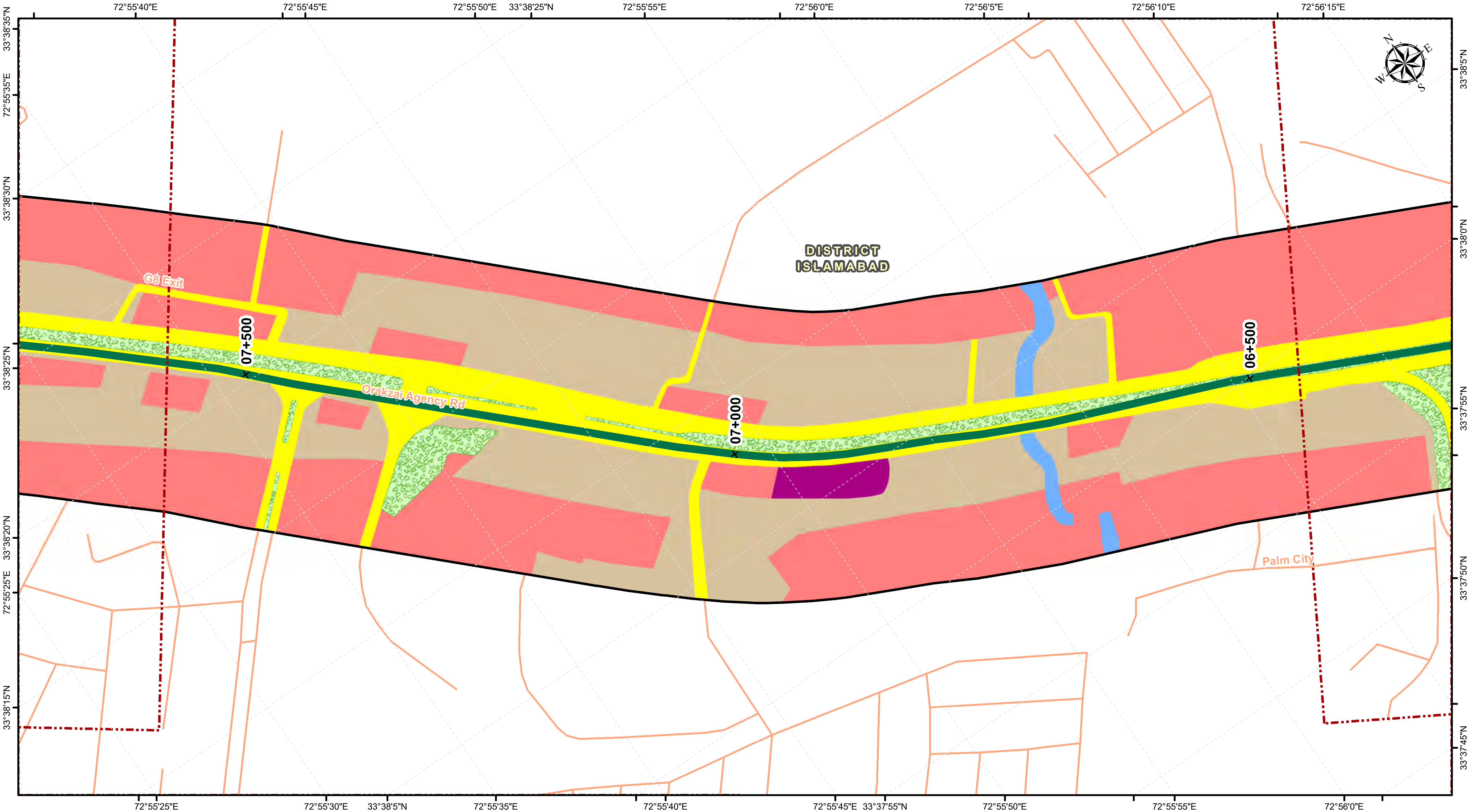
CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE: NOVEMBER-2024 / DRAWING No.: SHEET 5 OF 39	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				

Legend

Locality	Road Network	Match Line	**Landuse Type:**	Builtup Area	Graveyard	Play Ground	Road / Track
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Communication Tower	Green Belt	Railway	Stream / Nullah
Rawalpindi to Burhan	Railway Track		Brick Kiln	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes
							Water Pond

0 50 100 200 Meters

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE NOVEMBER-2024	DRAWING No. SHEET 6 OF 39	REV. 0
		01				CHD/VER.				
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE / DRAWING No.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024 / SHEET 7 OF 39	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				

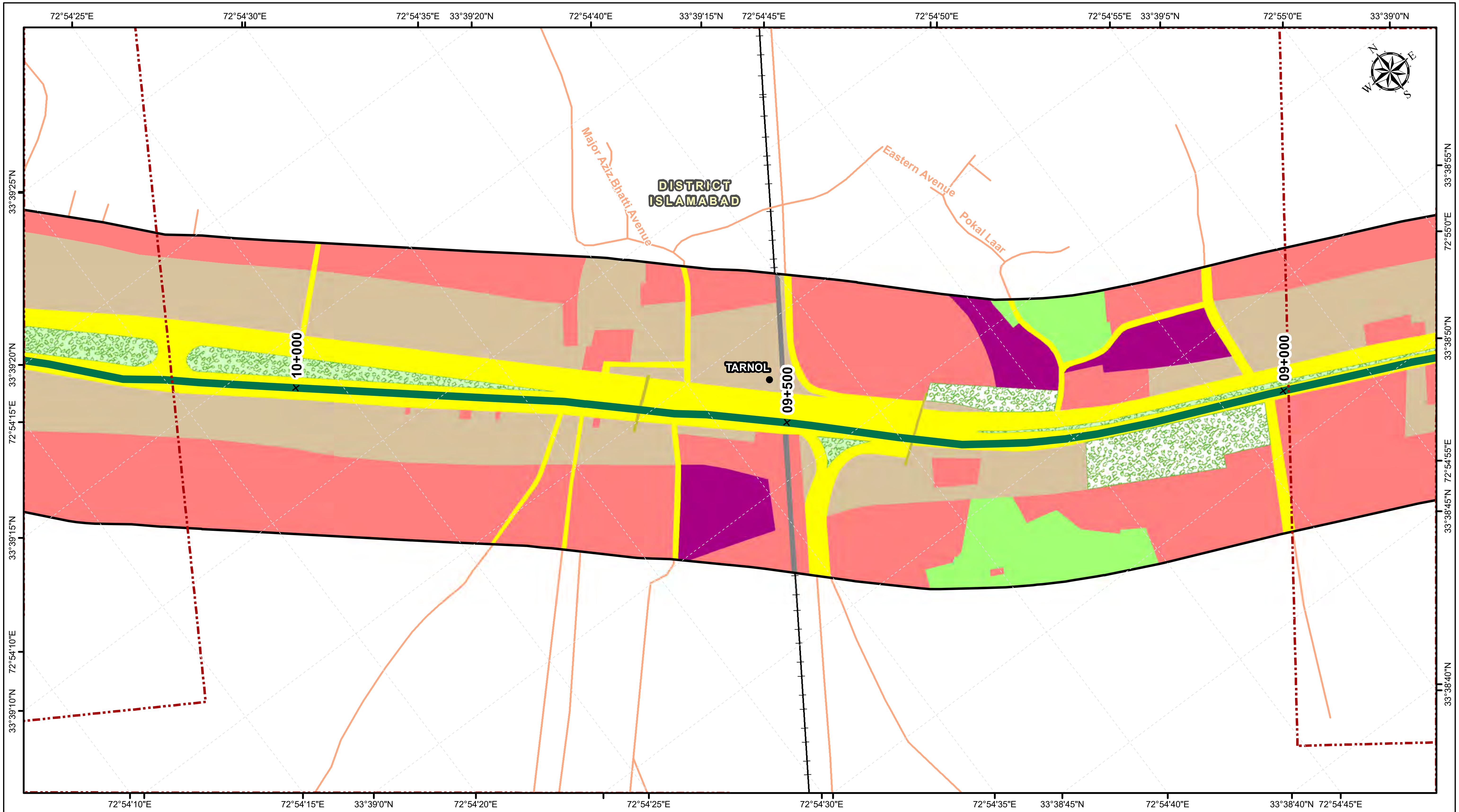
Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE: NOVEMBER-2024 / DRAWING No.: SHEET 8 OF 39	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200 Meters

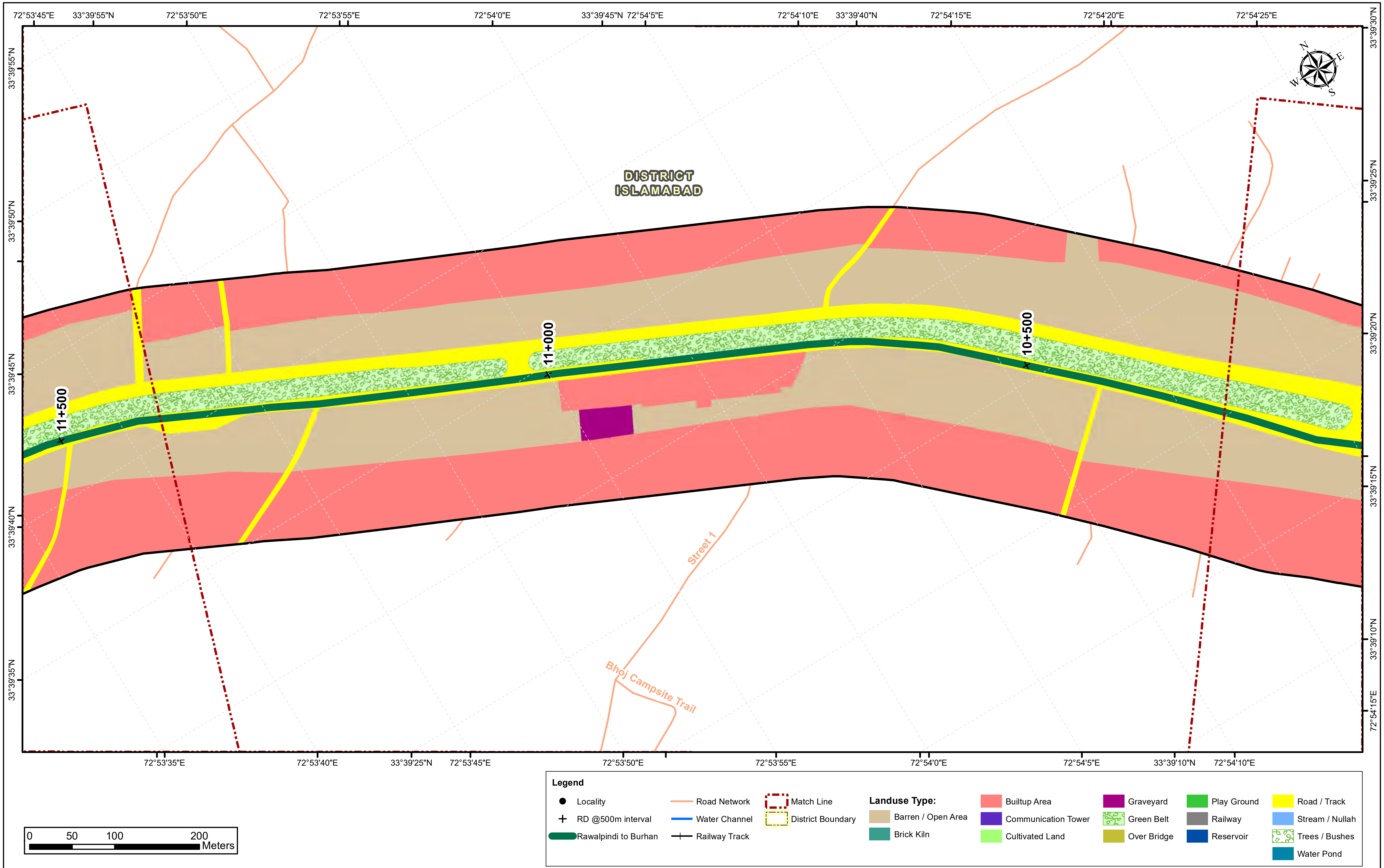
Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

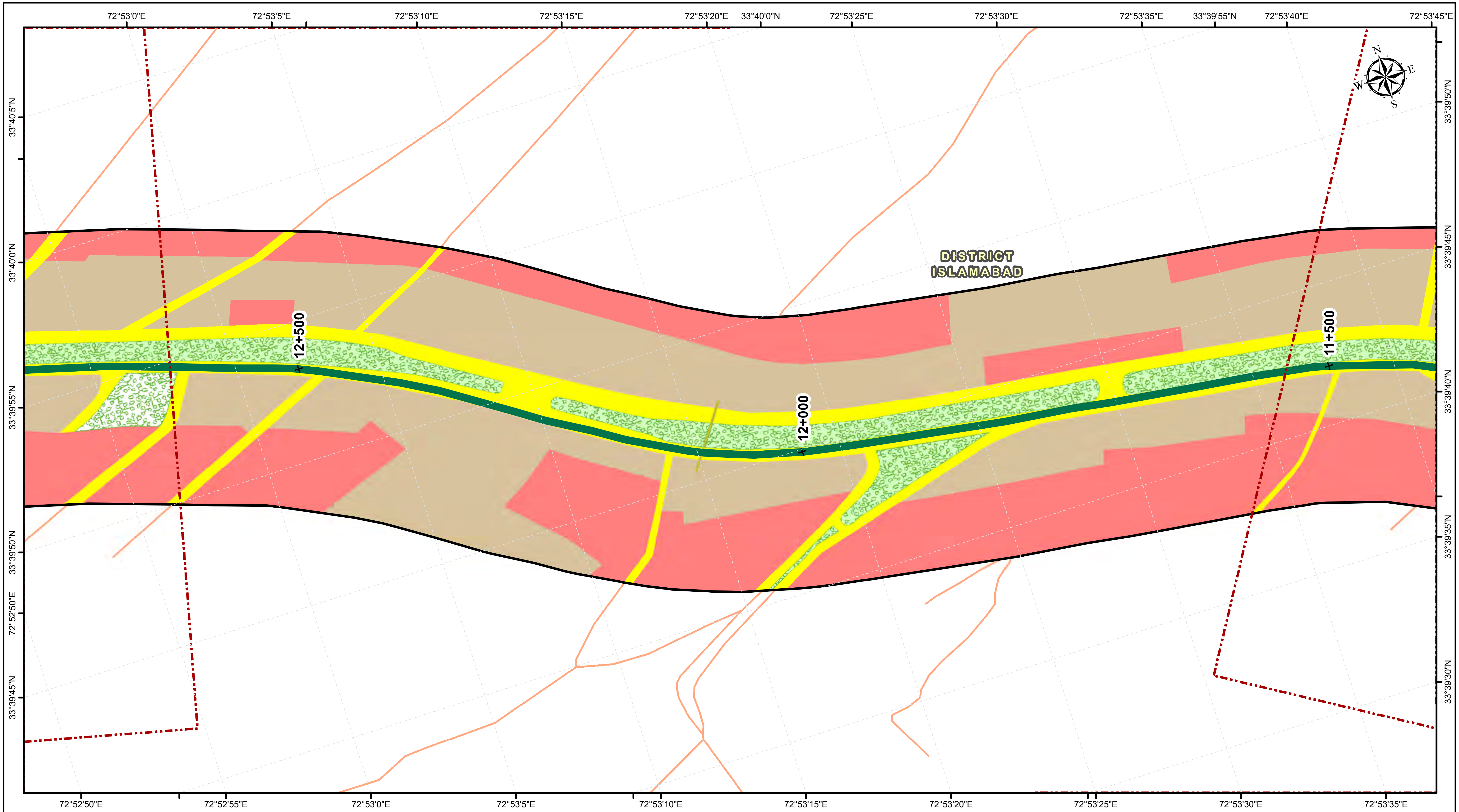
Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	02				RECOMMENDED			DATE	DRAWING No.	REV.
		01				CHD/VER.			NOVEMBER-2024	SHEET 9 OF 39	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DRAWING No.: SHEET 10 OF 39	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200
Meters

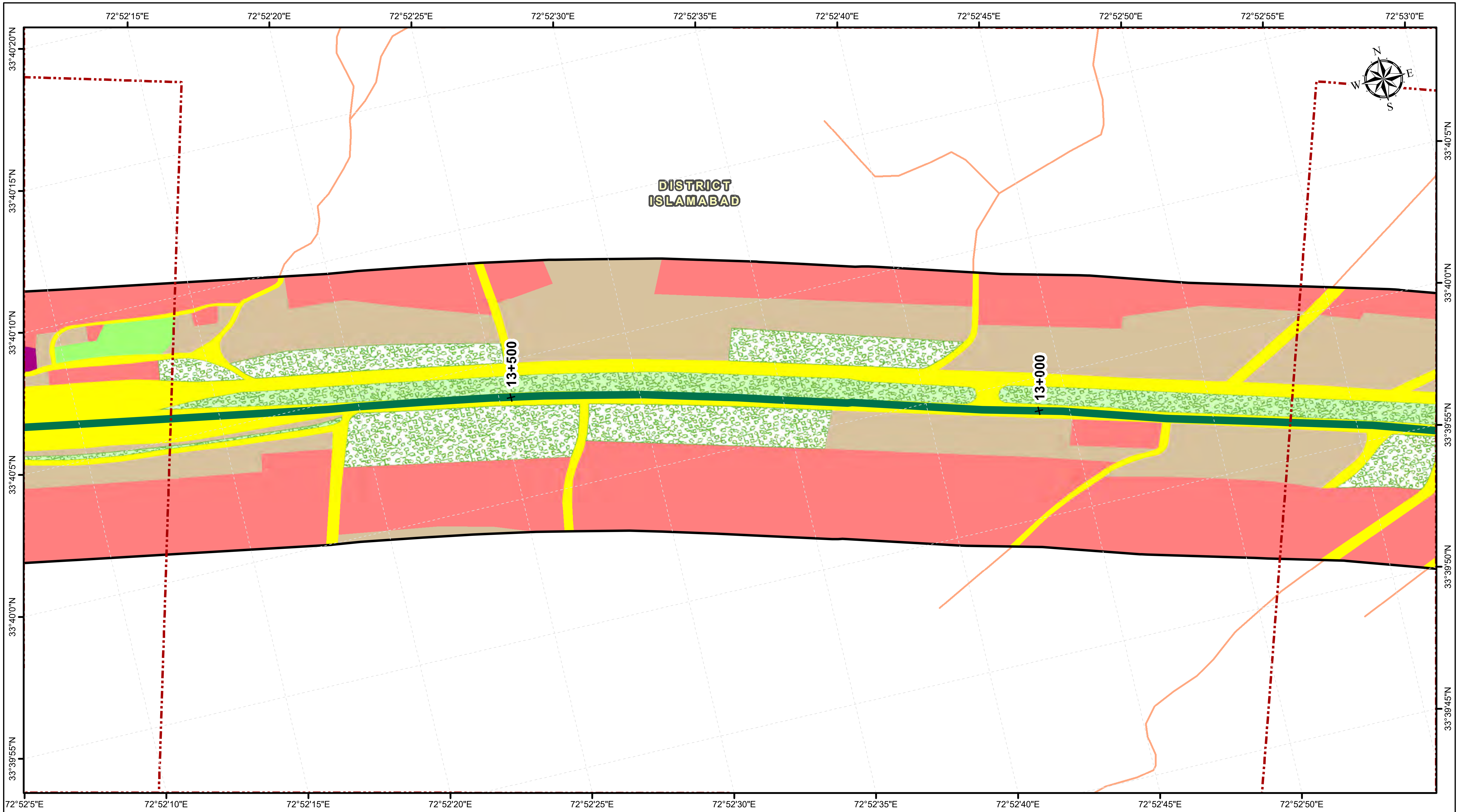
Legend

- ● Locality
- + RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DRAWING No.: SHEET 11 OF 39	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				

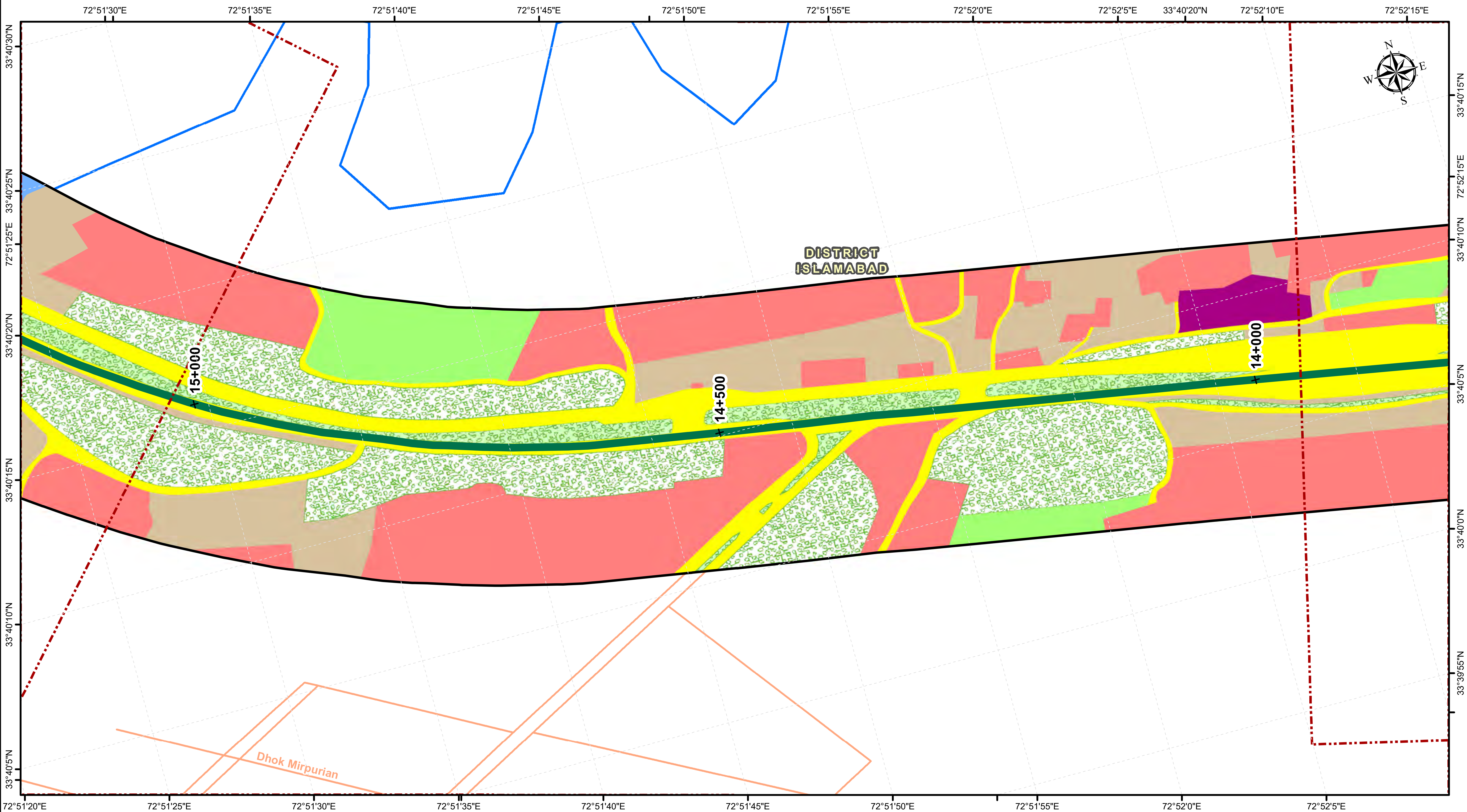


0 50 100 200
Meters

Legend

Locality	Road Network	Match Line	**Landuse Type:**	Builtup Area	Graveyard	Play Ground	Road / Track
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Communication Tower	Green Belt	Railway	Stream / Nullah
Rawalpindi to Burhan	Railway Track		Brick Kiln	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes
							Water Pond

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DRAWING No.: SHEET 12 OF 39	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200 Meters

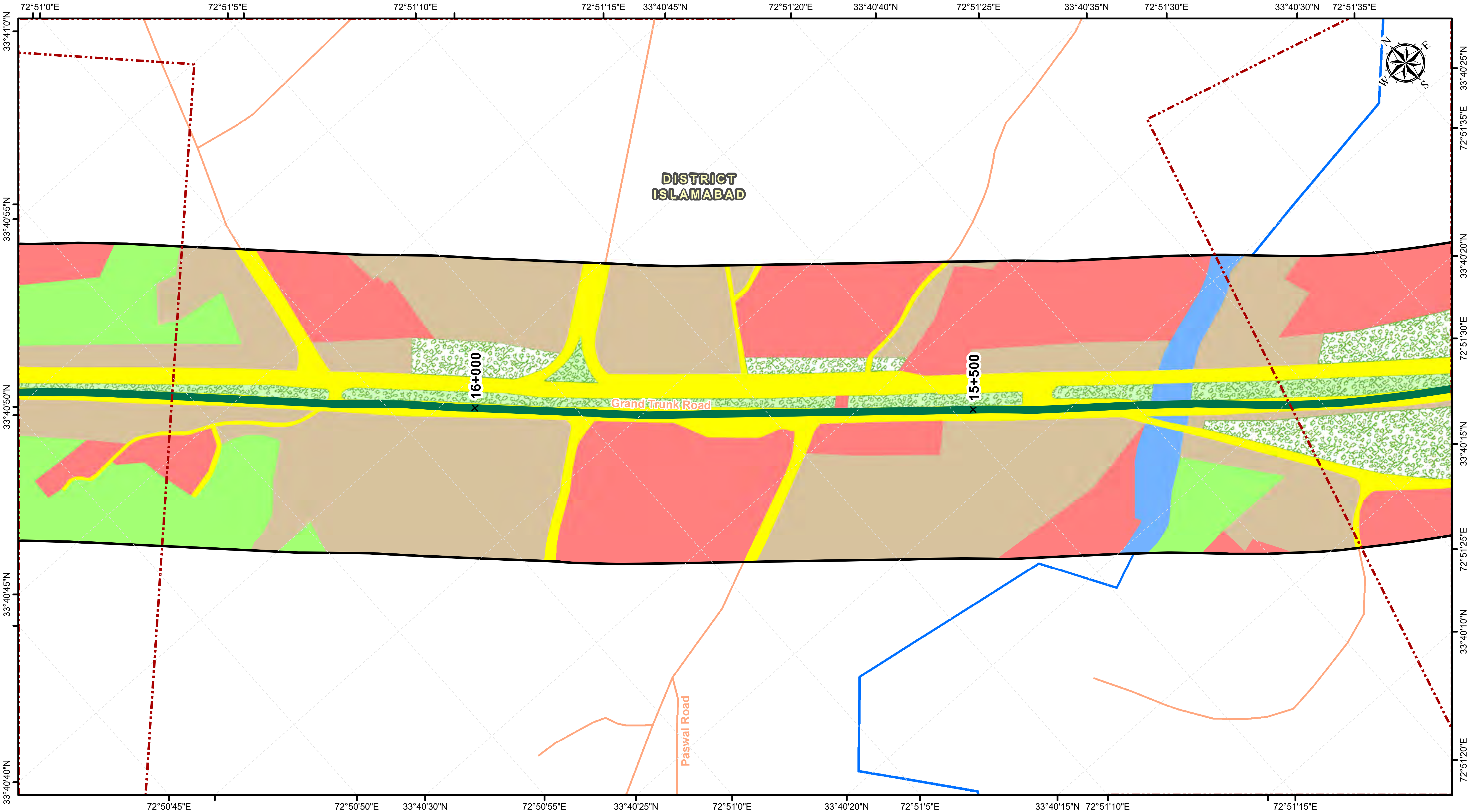
Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV. 0
		01				CHD/VER.			DRAWING No.: SHEET 13 OF 39	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



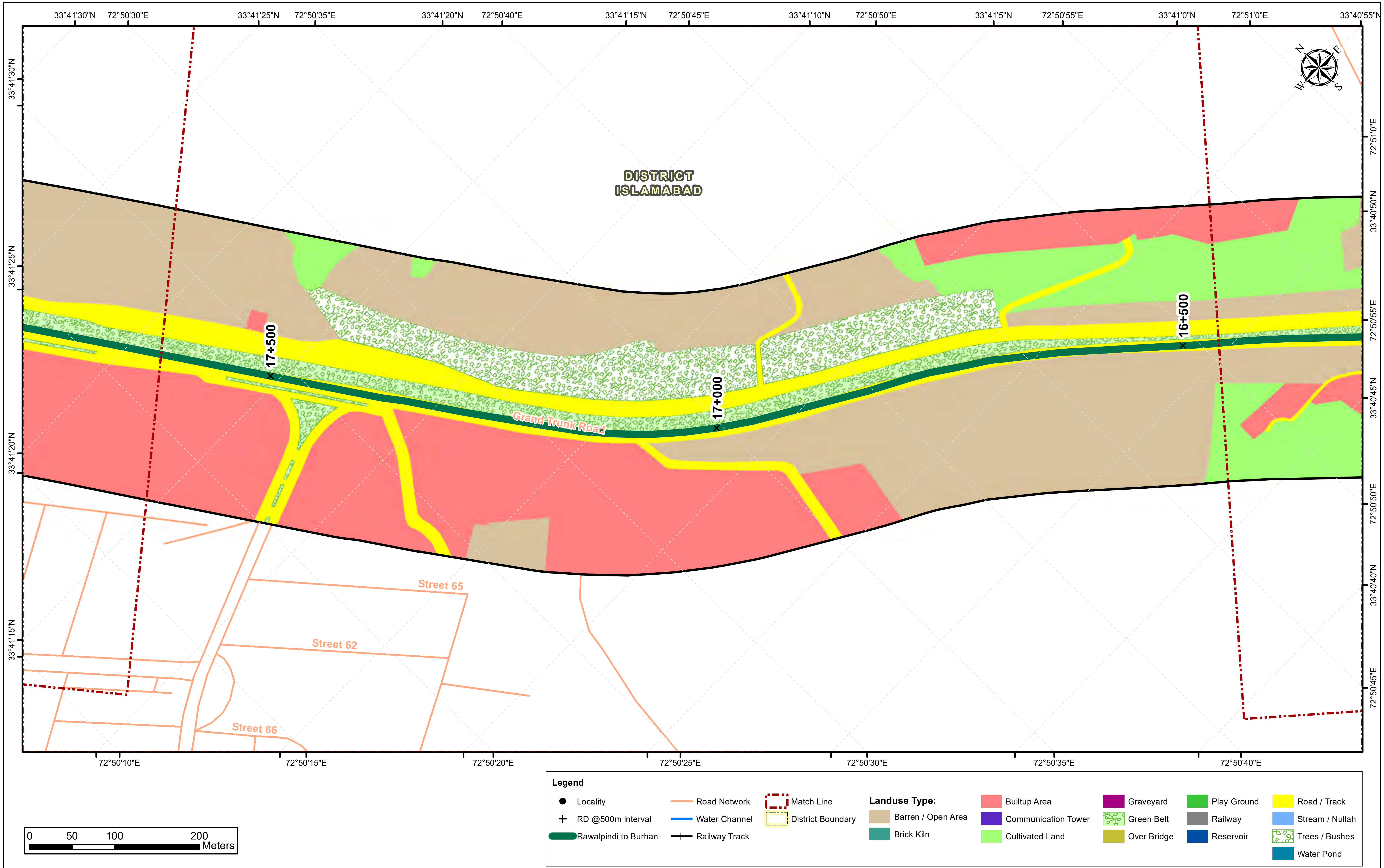
Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

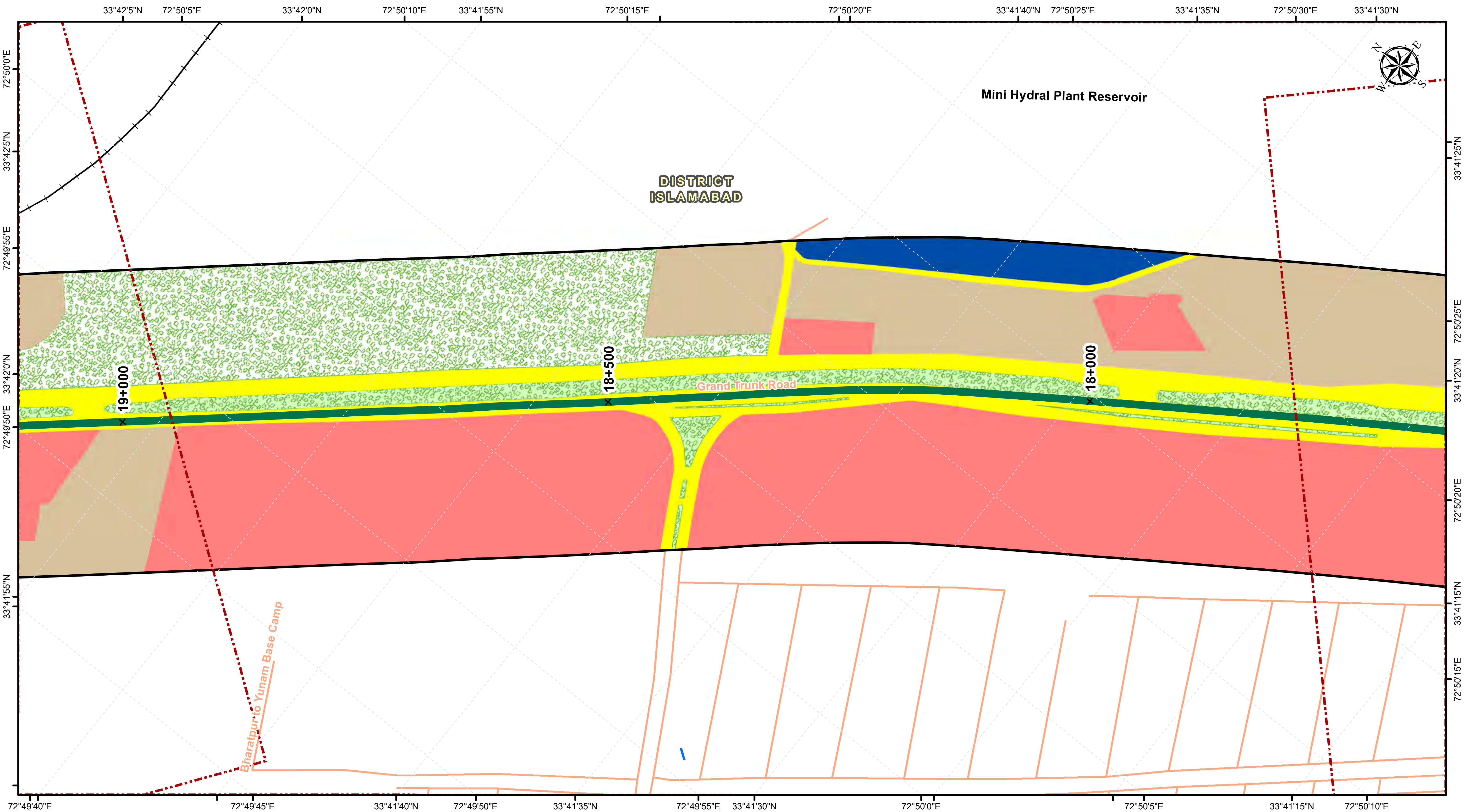
Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED					
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE	DRAWING No.	REV.
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			NOVEMBER-2024	SHEET 14 OF 39	0



CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE: NOVEMBER-2024 / DRAWING No.: SHEET 15 OF 39	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200 Meters

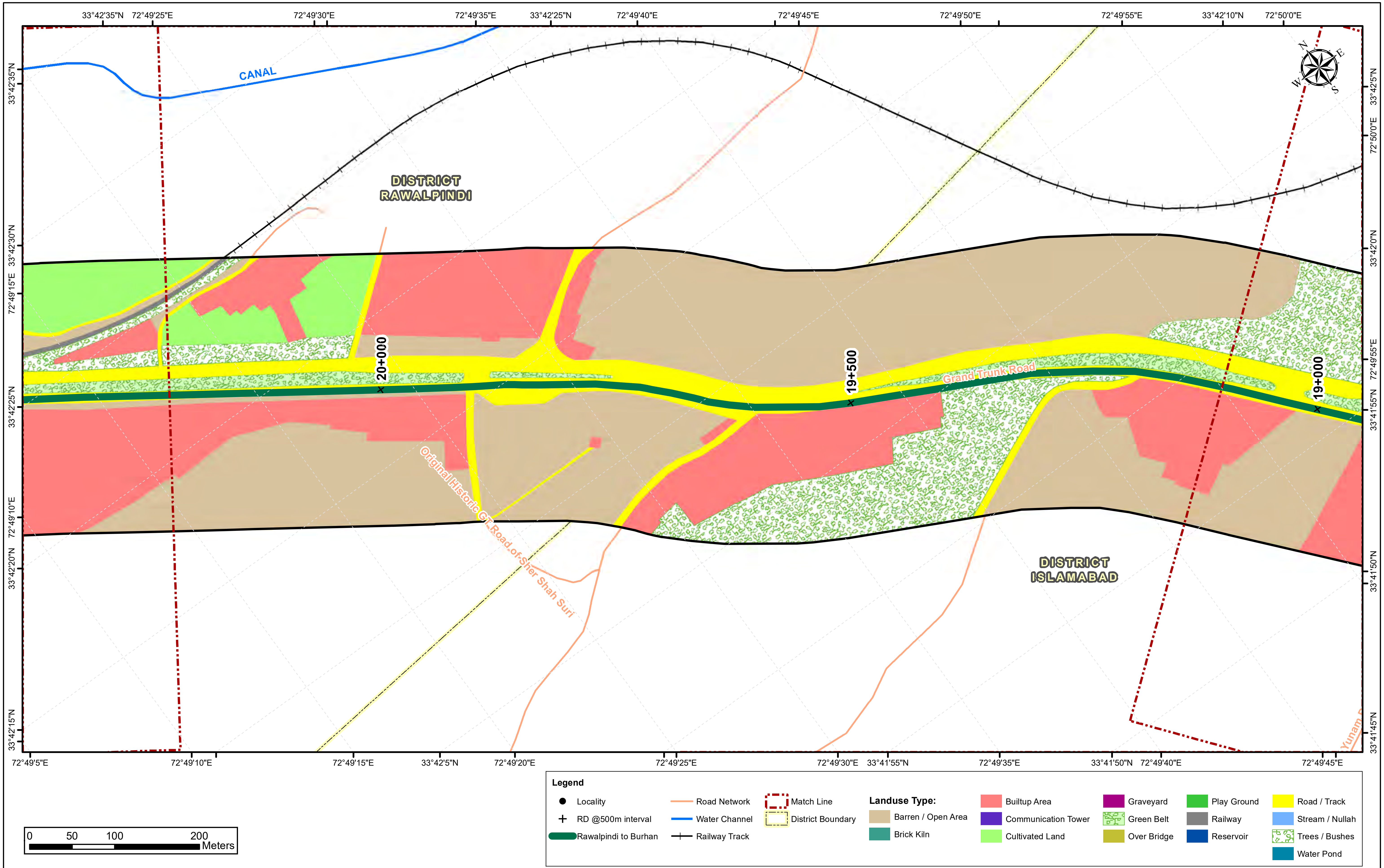
Legend

Locality	Road Network	Match Line
RD @500m interval	Water Channel	District Boundary
Rawalpindi to Burhan	Railway Track	

Landuse Type:

Barren / Open Area	Builtup Area	Graveyard	Play Ground	Road / Track
Brick Kiln	Communication Tower	Green Belt	Railway	Stream / Nullah
	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes
				Water Pond

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DRAWING No.: SHEET 16 OF 39	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV. 0
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DRAWING No.: SHEET 17 OF 39	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				

Legend

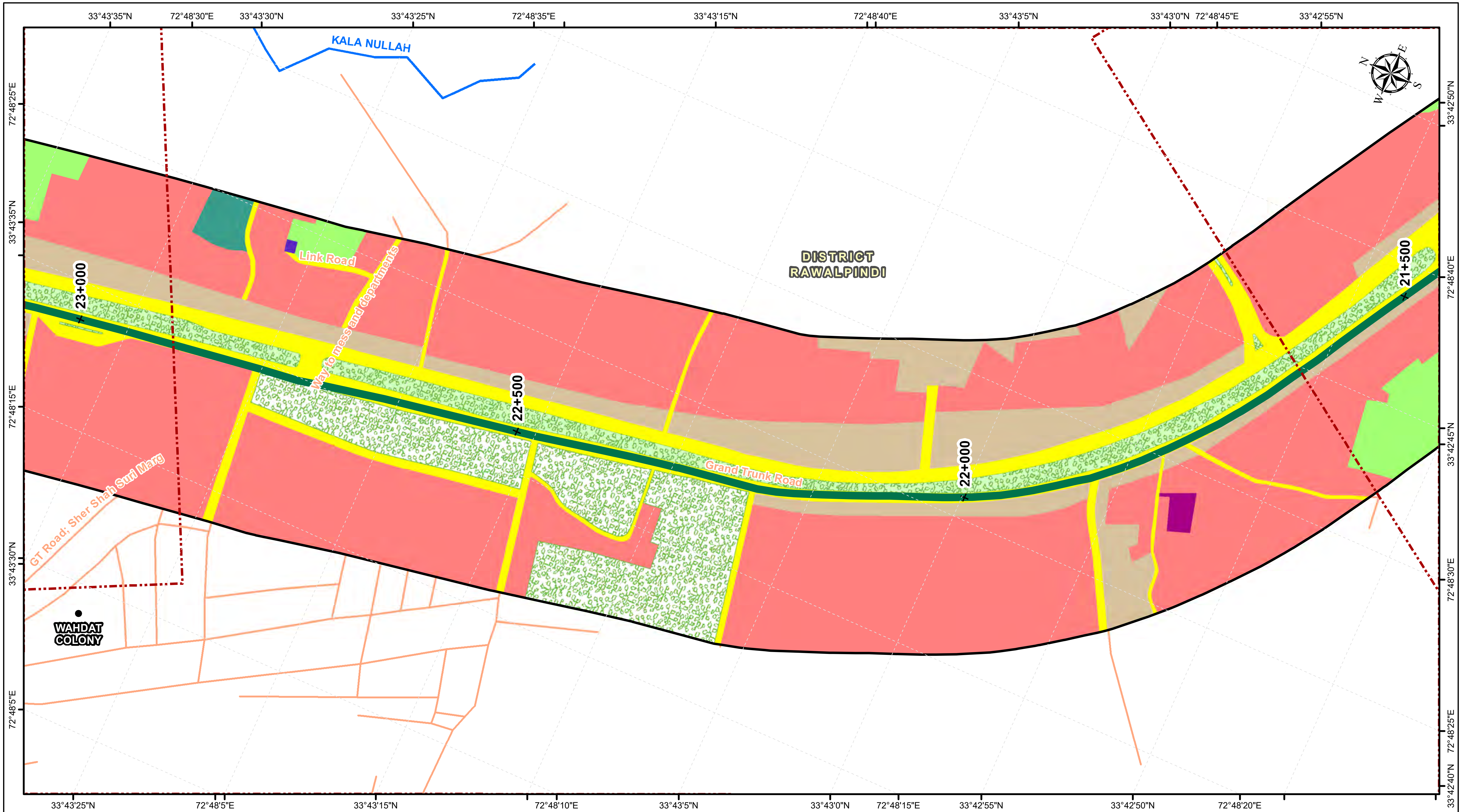
- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	03				SUBMITTED	FAHAD S.		DATE: NOVEMBER-2024	REV. 0
		02				RECOMMENDED			DRAWING No.: SHEET 18 OF 39	
		01				CHD/VER.				
						APPROVED				



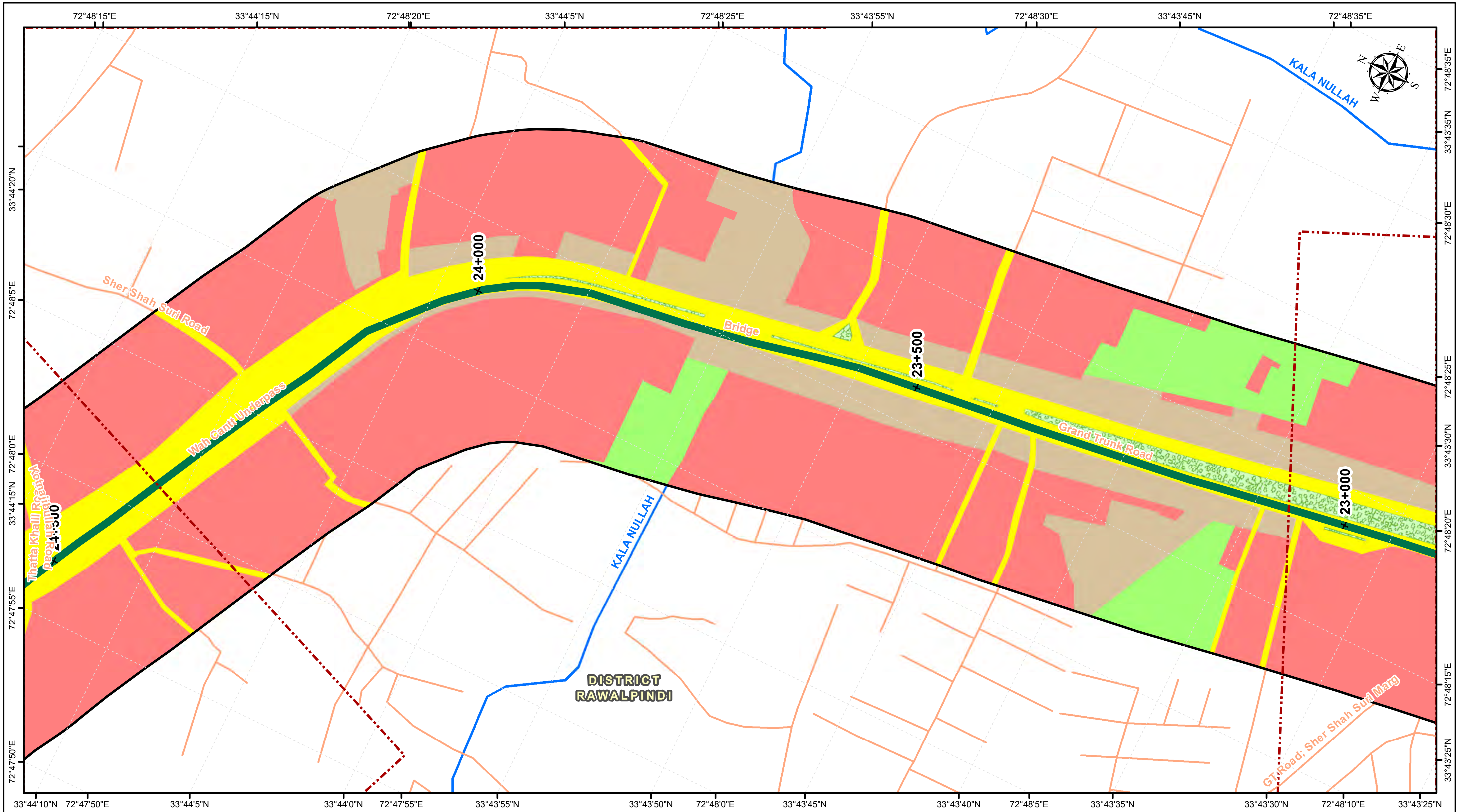
Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT: NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD — HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04		DRAWN	M.MUNEEB	PROJECT: DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP — SCALE 1:4,000
		03		SUBMITTED	FAHAD S.		
		02		RECOMMENDED			DATE: NOVEMBER-2024
		01		CHD/VER.			DRAWING No.: SHEET 19 OF 39
		REV.	DATE / DESCRIPTION / APPROVED	APPROVED			REV.: 0



Legend

Locality	Road Network	Match Line	**Landuse Type:**	Builtup Area	Graveyard	Play Ground	Road / Track
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Communication Tower	Green Belt	Railway	Stream / Nullah
Rawalpindi to Burhan	Railway Track		Brick Kiln	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes
							Water Pond

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE: NOVEMBER-2024	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			DRAWING No.: SHEET 20 OF 39	

Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	REV.: 04, 03, 02, 01	DATE	DESCRIPTION	APPROVED	DRAWN: M.MUNEEB SUBMITTED: FAHAD S. RECOMMENDED CHD/VER. APPROVED	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)

LANDUSE MAP			SCALE 1:4,000
DATE: NOVEMBER-2024	DRAWING No.: SHEET 21 OF 39		REV.: 0

Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

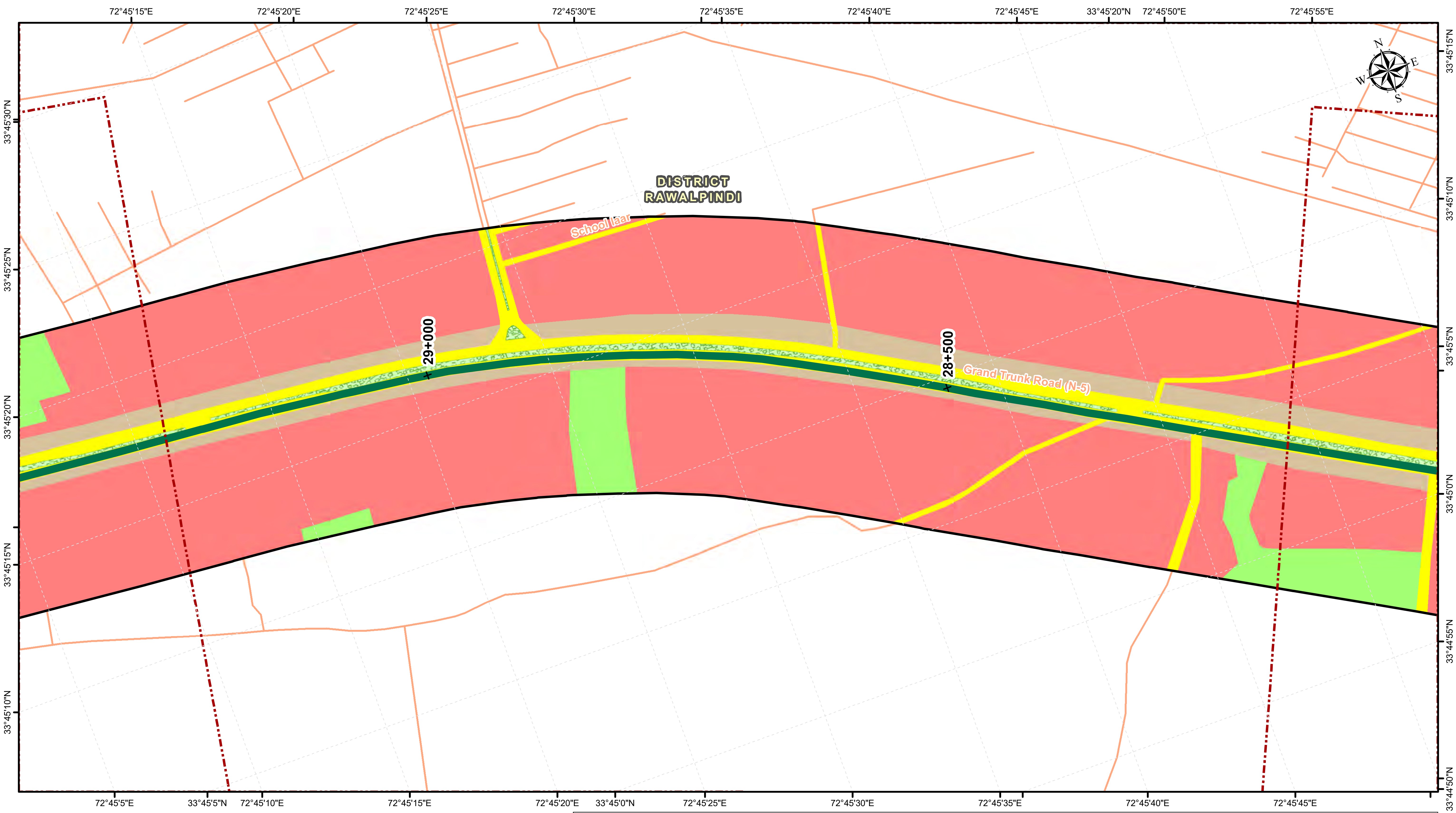
CLIENT	CONSULTANT								PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB		DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.					
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	02				RECOMMENDED				DATE	DRAWING No.	REV.
		01				CHD/VER.				NOVEMBER-2024	SHEET 22 OF 39	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED						

Legend

Locality	Road Network	Match Line	**Landuse Type:**	Builtup Area	Graveyard	Play Ground	Road / Track
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Communication Tower	Green Belt	Railway	Stream / Nullah
Rawalpindi to Burhan	Railway Track		Brick Kiln	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes
							Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	DRAWING No.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024	SHEET 23 OF 39	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200 Meters

Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT

NATIONAL HIGHWAY AUTHORITY OF PAKISTAN

CONSULTANT

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD

HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN	M.MUNEEB
SUBMITTED	FAHAD S.
RECOMMENDED	
CHD/VER.	
APPROVED	

PROJECT

DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)

LANDUSE MAP

SCALE 1:4,000

DATE NOVEMBER-2024

DRAWING No. SHEET 24 OF 39

REV. 0

0 50 100 200
Meters

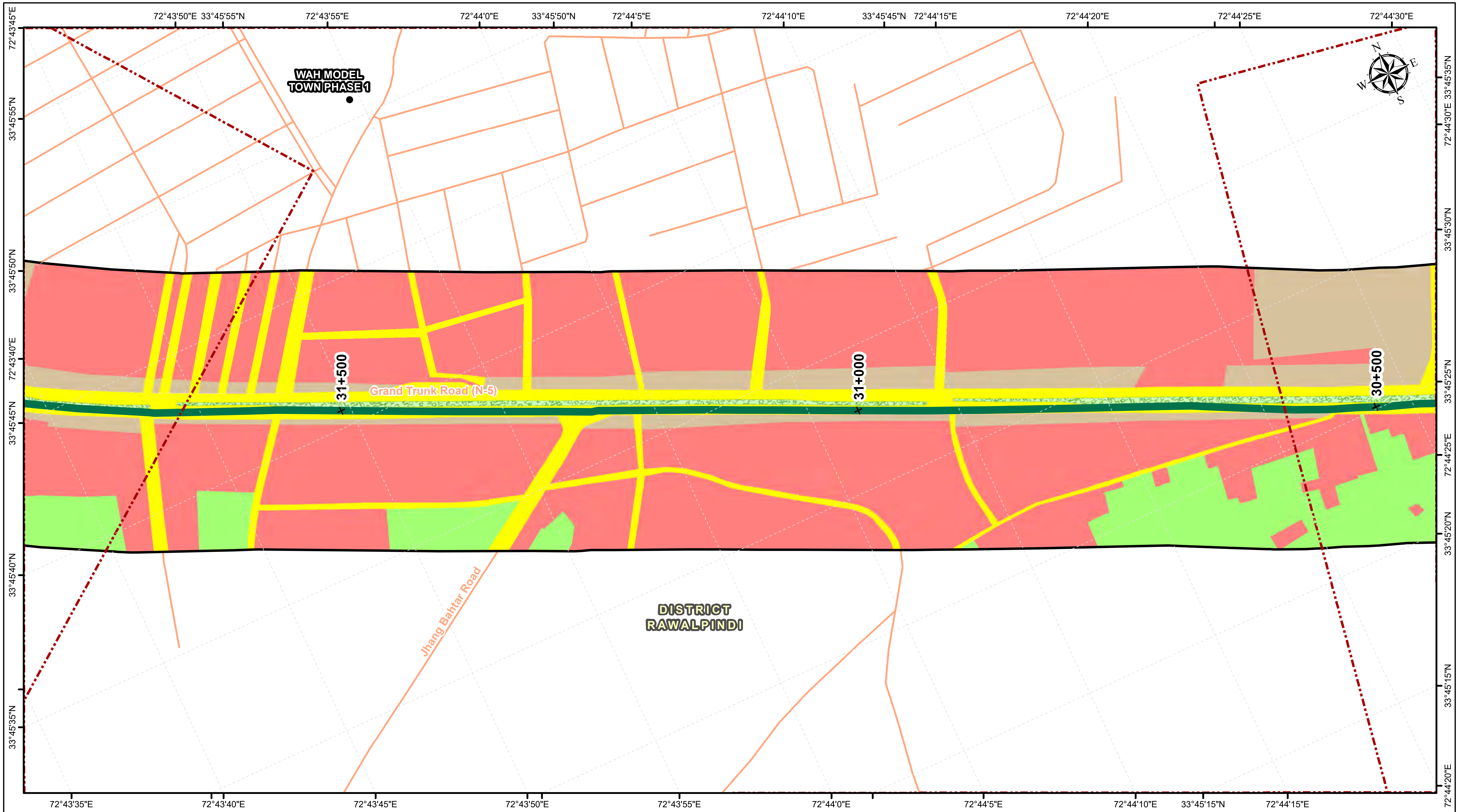
Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE: NOVEMBER-2024; DRAWING No.: SHEET 25 OF 39	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04					
		03					
		02					
		01					
		REV.	DATE	DESCRIPTION	APPROVED		

DRAWN	M.MUNEEB
SUBMITTED	FAHAD S.
RECOMMENDED	
CHD/VER.	
APPROVED	

PROJECT

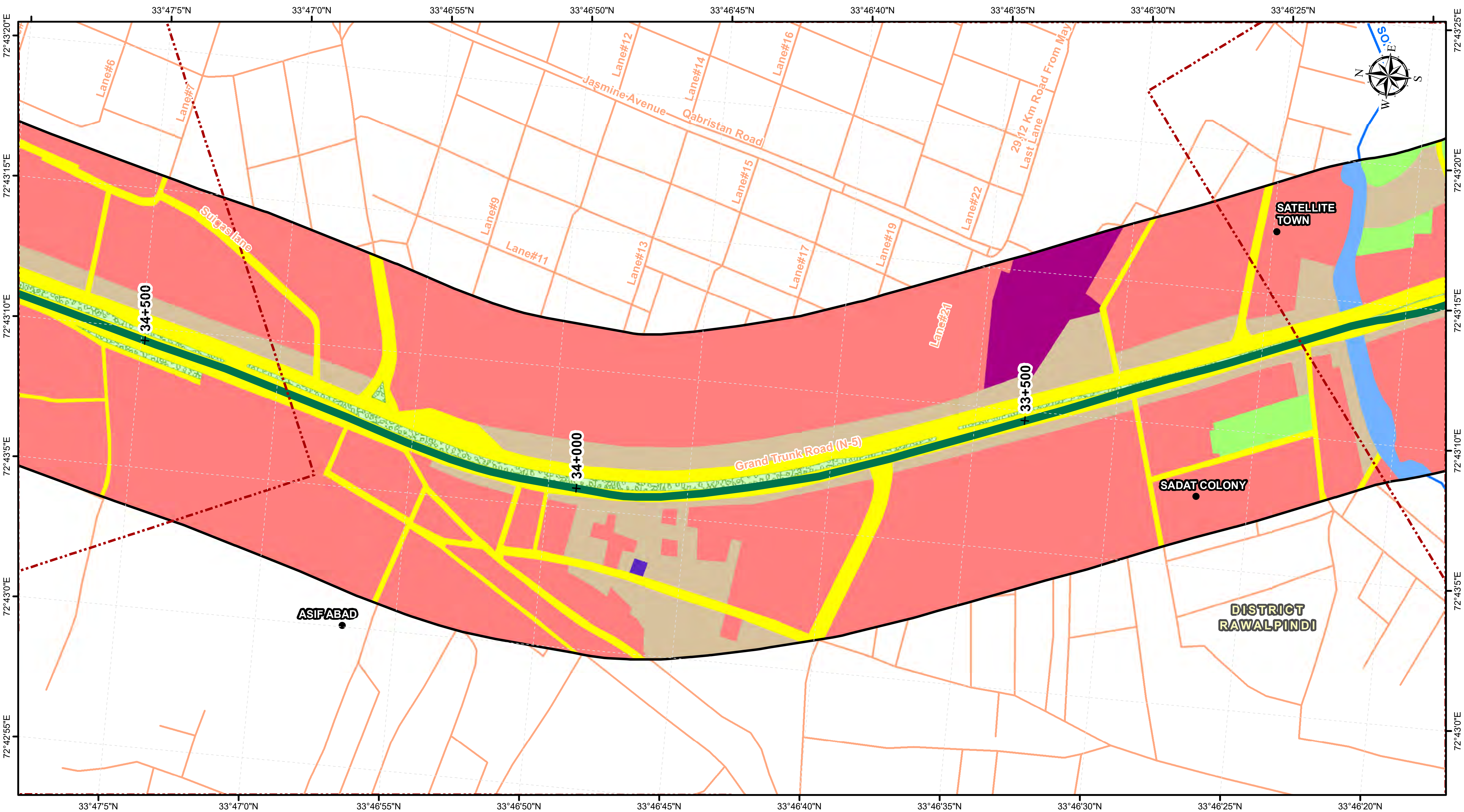
DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)

LANDUSE MAP		SCALE 1:4,000
DATE NOVEMBER-2024	DRAWING No. SHEET 26 OF 39	REV. 0

Legend

Locality	Road Network	Match Line	**Landuse Type:**	Builtup Area	Graveyard	Play Ground	Road / Track
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Communication Tower	Green Belt	Railway	Stream / Nullah
Rawalpindi to Burhan	Railway Track		Brick Kiln	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes
							Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP SCALE 1:4,000 DATE NOVEMBER-2024 DRAWING No. SHEET 27 OF 39 REV. 0
		03				SUBMITTED	FAHAD S.		
		02				RECOMMENDED			
		01				CHD/VER.			
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			



0 50 100 200 Meters

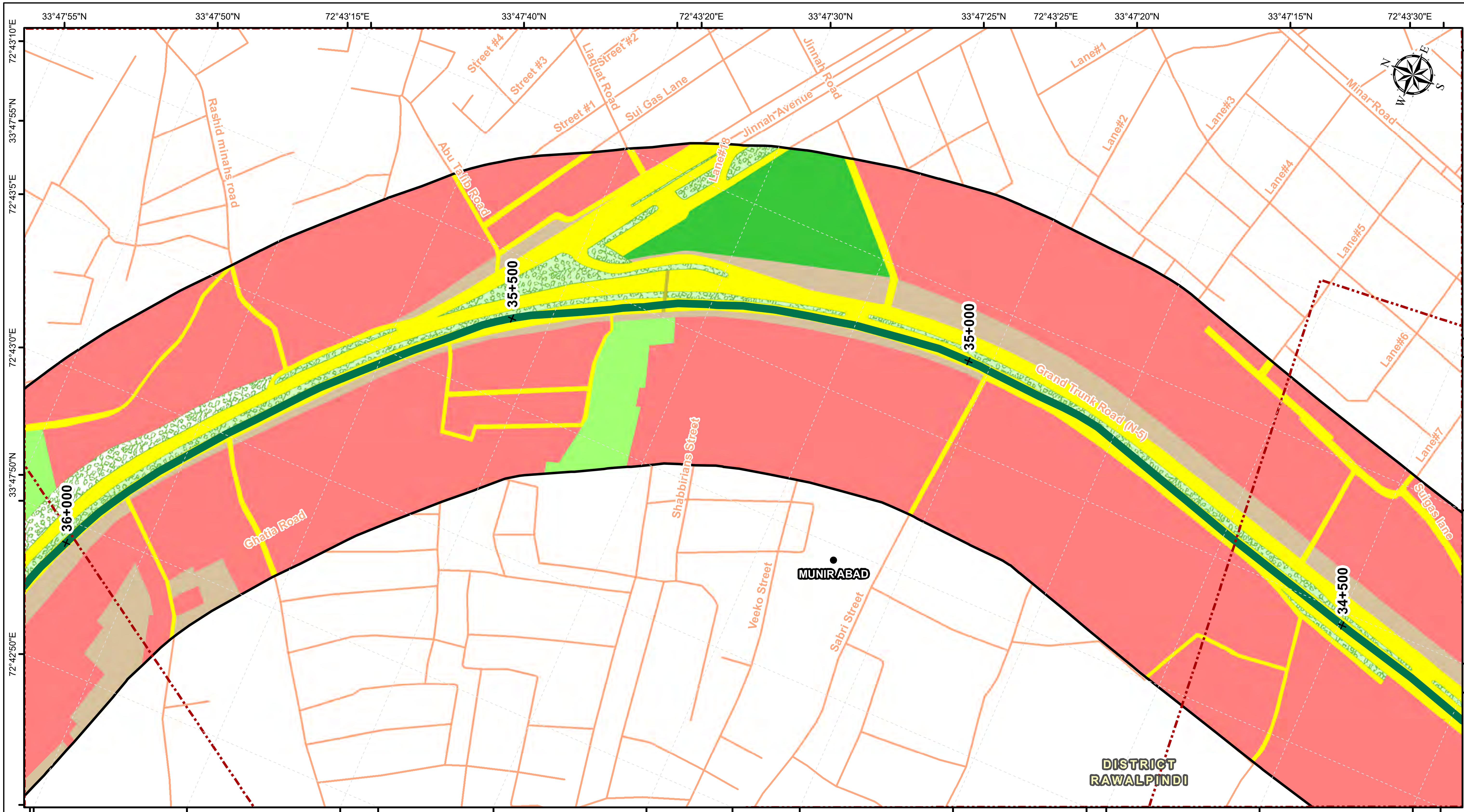
Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE: NOVEMBER-2024 / DRAWING No.: SHEET 28 OF 39	REV.: 0
						APPROVED				



0 50 100 200 Meters

Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
		01				CHD/VER.			DATE NOVEMBER-2024	DRAWING No. SHEET 29 OF 39
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				REV. 0

0 50 100 200 Meters

Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB	PROJECT
		03				SUBMITTED	FAHAD S.	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)
		02				RECOMMENDED		
		01				CHD/VER.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

LANDUSE MAP		SCALE 1:4,000
DATE NOVEMBER-2024	DRAWING No. SHEET 30 OF 39	REV. 0

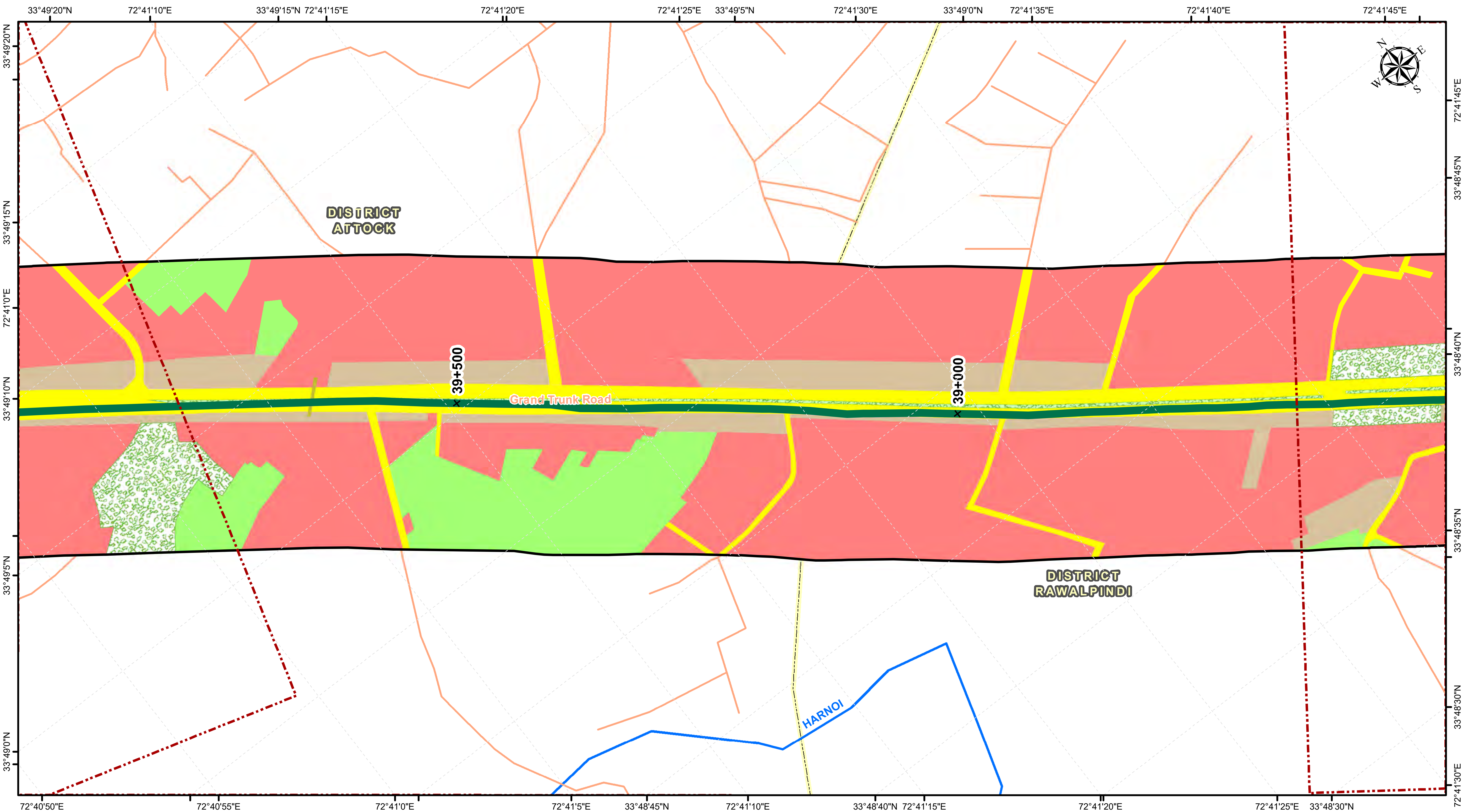
Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04 / 03 / 02 / 01 / REV. — DATE — DESCRIPTION — APPROVED	DRAWN: M.MUNEEB SUBMITTED: FAHAD S. RECOMMENDED: CHD/VER.: APPROVED:	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP DATE: NOVEMBER-2024 DRAWING No.: SHEET 31 OF 39	SCALE 1:4,000 REV. 0

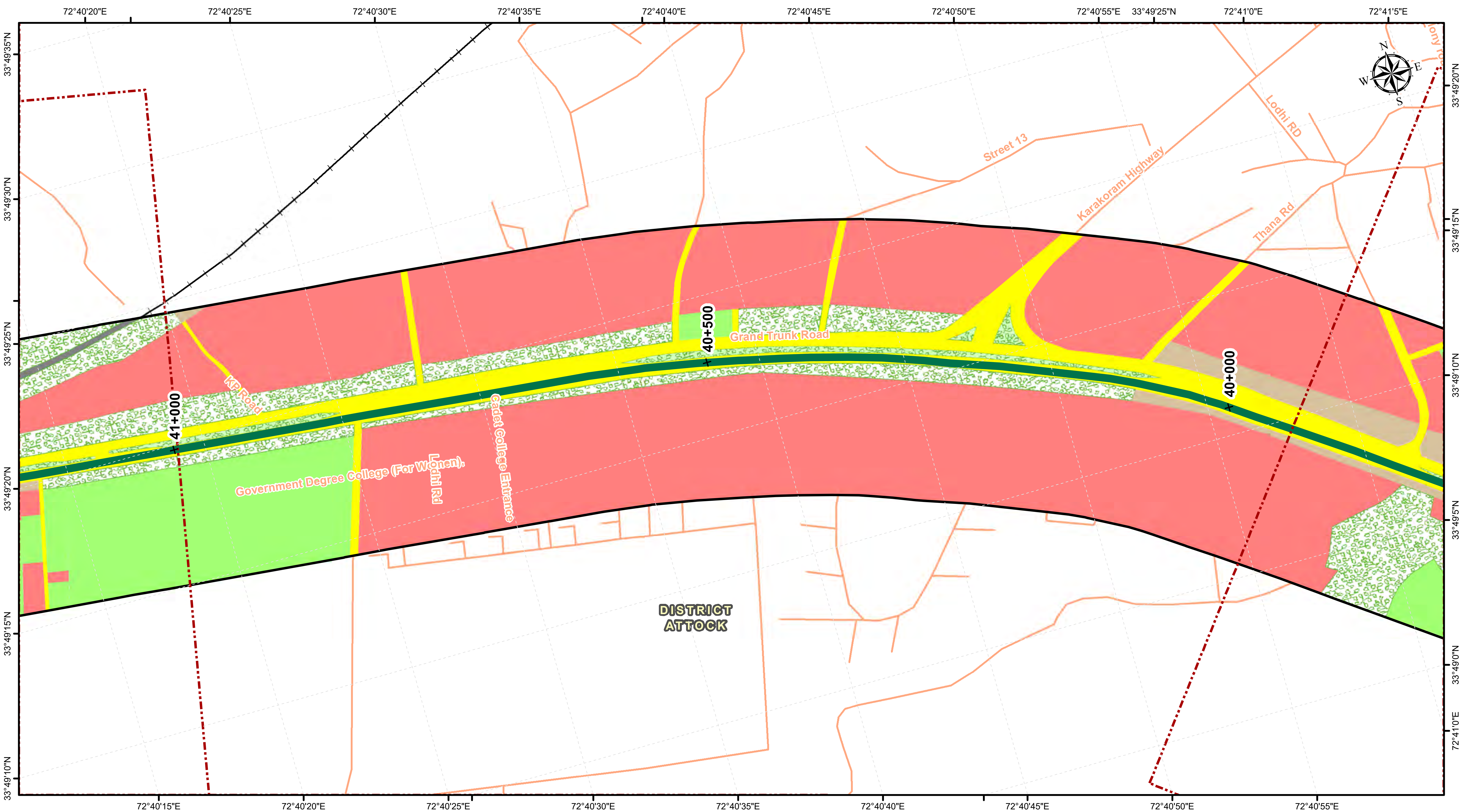


0 50 100 200 Meters

Legend

Locality	Road Network	Match Line	**Landuse Type:**	Builtup Area	Graveyard	Play Ground	Road / Track
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Communication Tower	Green Belt	Railway	Stream / Nullah
Rawalpindi to Burhan	Railway Track		Brick Kiln	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes
							Water Pond

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE / DRAWING No.	REV.
		01				CHD/VER.			NOVEMBER-2024 / SHEET 32 OF 39	0
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200 Meters

Legend

- ● Locality
- + RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04 / 03 / 02 / 01 / REV.	DATE	DESCRIPTION	APPROVED	

DRAWN	M.MUNEEB
SUBMITTED	FAHAD S.
RECOMMENDED	
CHD/VER.	
APPROVED	

PROJECT

DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)

LANDUSE MAP		SCALE 1:4,000
DATE NOVEMBER-2024	DRAWING No. SHEET 33 OF 39	REV. 0

0 50 100 200 Meters

Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04			DRAWN	M.MUNEEB	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)
		03			SUBMITTED	FAHAD S.	
		02			RECOMMENDED		
		01			CHD/VER.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	

LANDUSE MAP		SCALE 1:4,000
DATE NOVEMBER-2024	DRAWING No. SHEET 34 OF 39	REV. 0

0 50 100 200 Meters

Legend

- ● Locality
- + RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)
		03				SUBMITTED	FAHAD S.	
		02				RECOMMENDED		
		01				CHD/VER.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

LANDUSE MAP		SCALE 1:4,000
DATE NOVEMBER-2024	DRAWING No. SHEET 35 OF 39	REV. 0

0 50 100 200
Meters

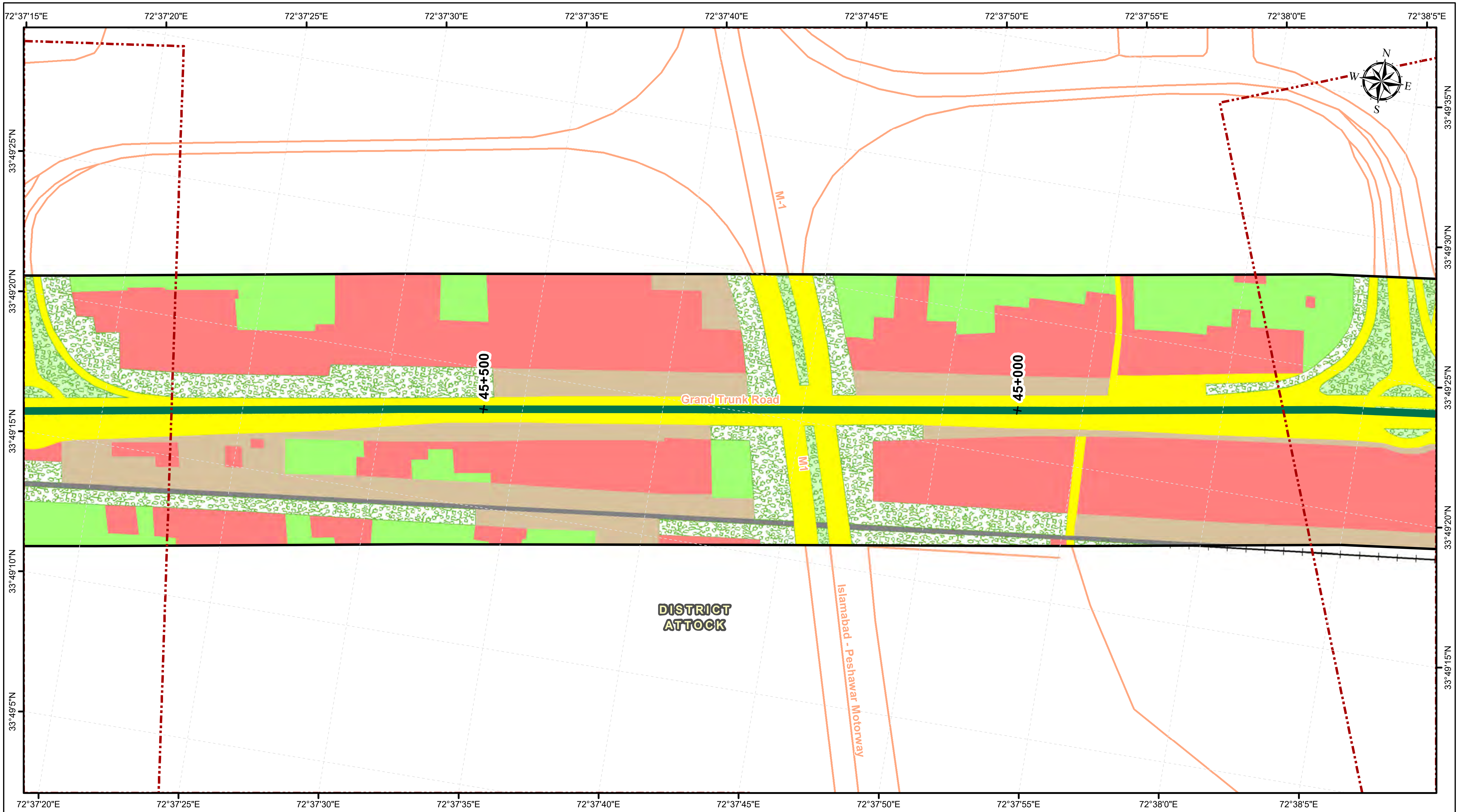
Legend

- ● Locality
- + RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT	04				DRAWN	M.MUNEEB	PROJECT	LANDUSE MAP	SCALE 1:4,000
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	03				SUBMITTED	FAHAD S.	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)		
		02				RECOMMENDED			DATE	DRAWING No.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024	SHEET 36 OF 39	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



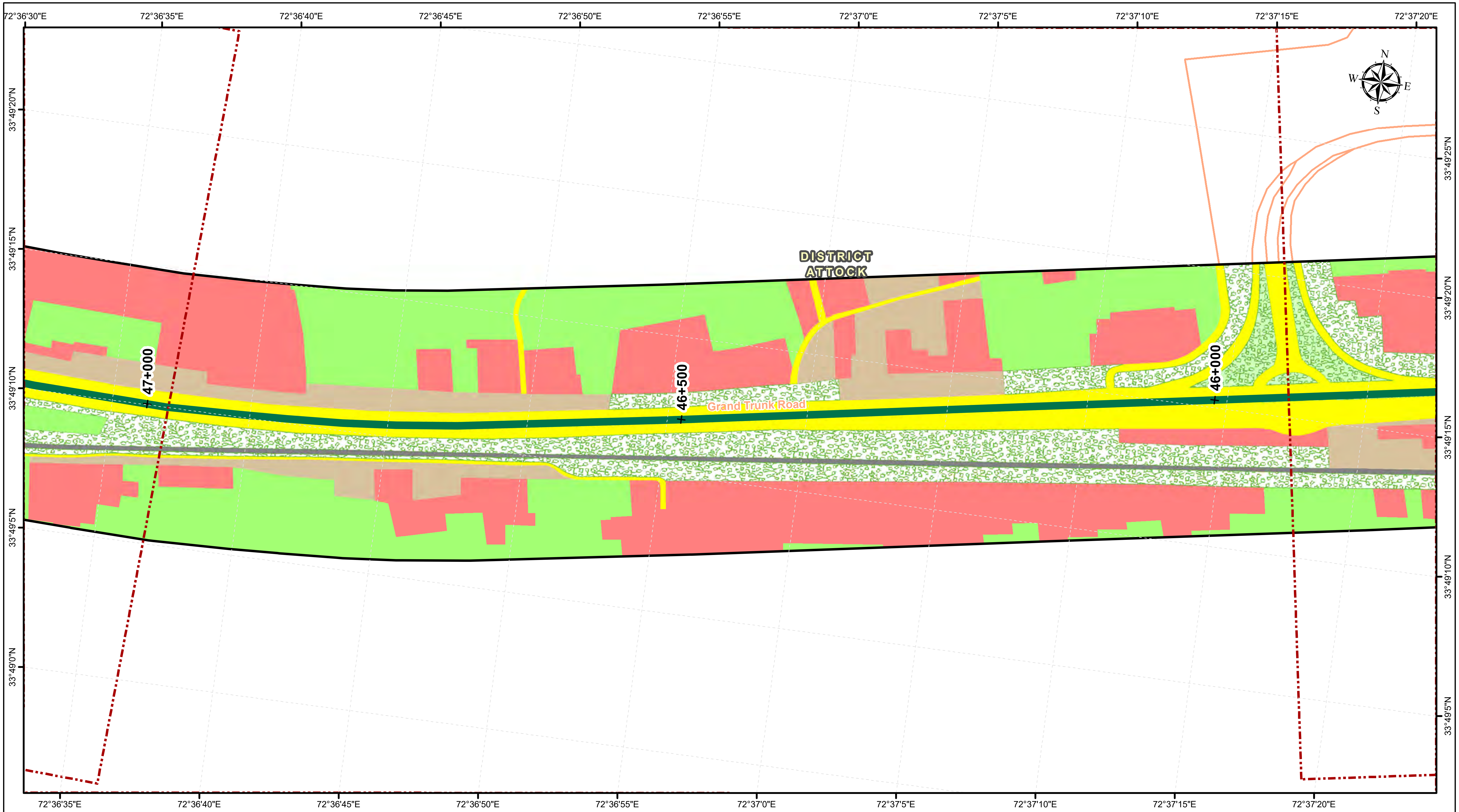
0 50 100 200 Meters

Legend

Locality	Road Network	Match Line	**Landuse Type:**	Builtup Area	Graveyard	Play Ground	Road / Track
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Communication Tower	Green Belt	Railway	Stream / Nullah
Rawalpindi to Burhan	Railway Track		Brick Kiln	Cultivated Land	Over Bridge	Reservoir	Trees / Bushes
							Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB	PROJECT
		03				SUBMITTED	FAHAD S.	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)
		02				RECOMMENDED		
		01				CHD/VER.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

LANDUSE MAP			SCALE 1:4,000
DATE NOVEMBER-2024	DRAWING No. SHEET 37 OF 39		REV. 0



Legend

- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

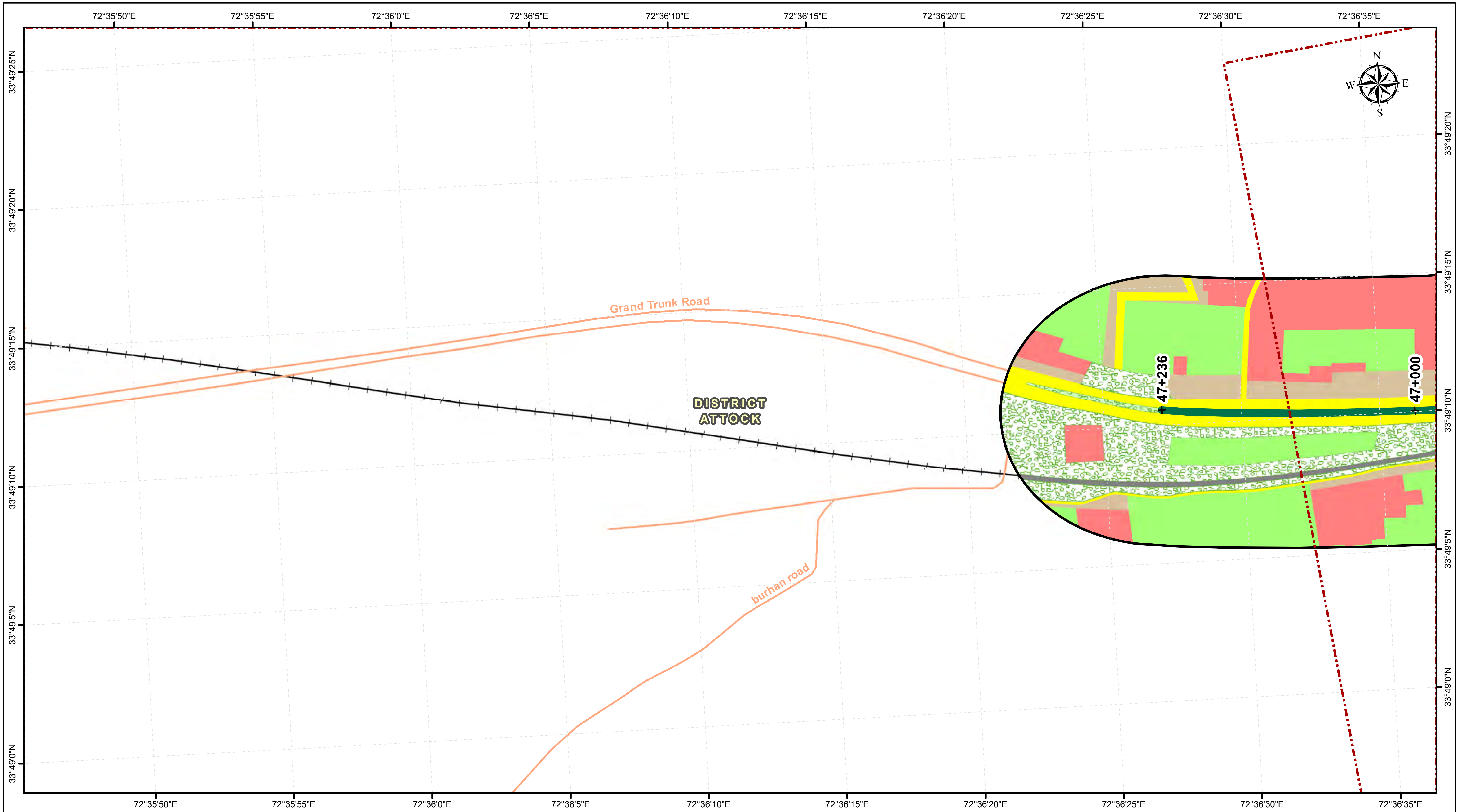
Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB
		03				SUBMITTED	FAHAD S.
		02				RECOMMENDED	
		01				CHD/VER.	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	

PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
DATE NOVEMBER-2024	DRAWING No. SHEET 38 OF 39	REV. 0



Legend

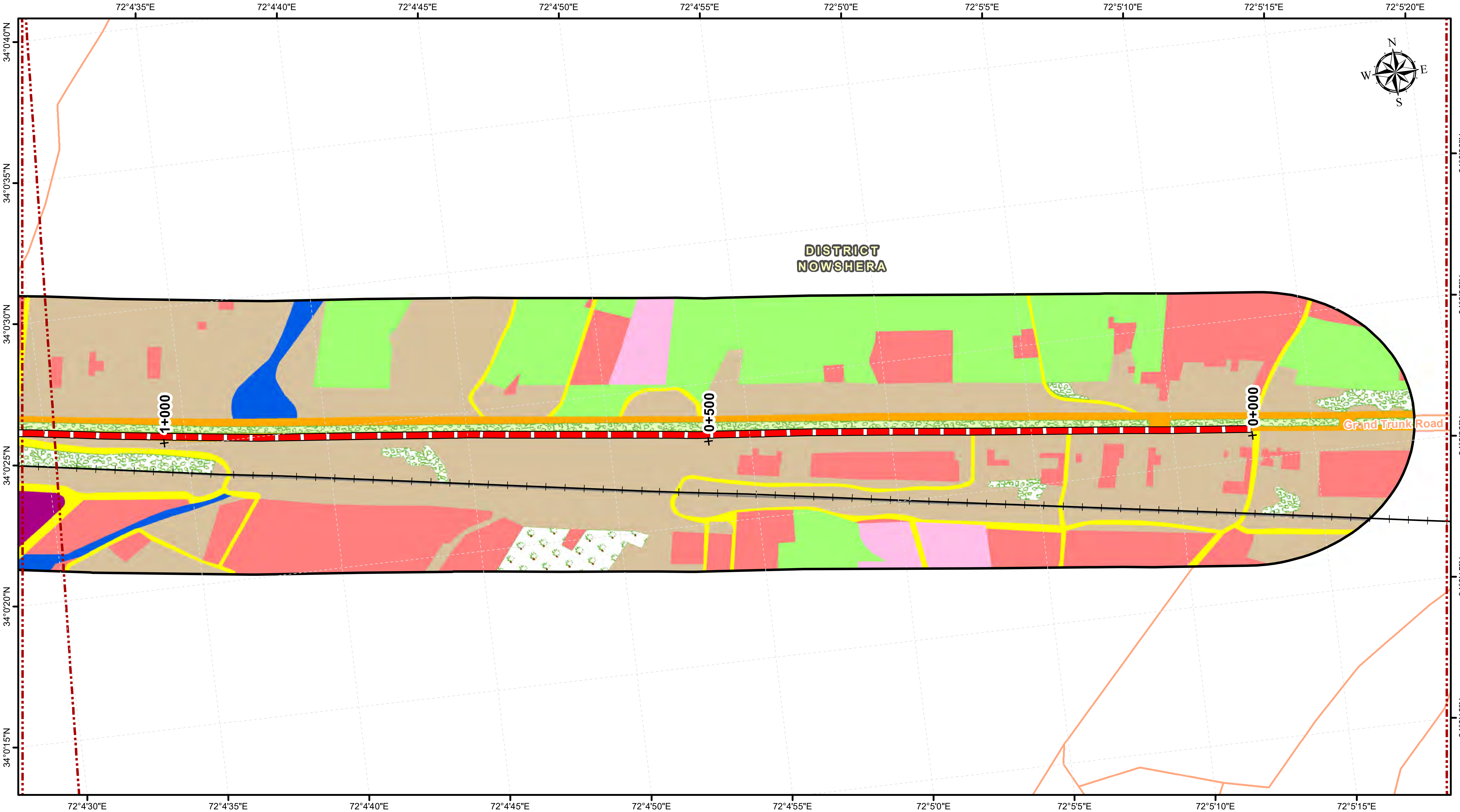
- Locality
- RD @500m interval
- Rawalpindi to Burhan
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Brick Kiln
- Builtup Area
- Communication Tower
- Cultivated Land
- Graveyard
- Green Belt
- Over Bridge
- Play Ground
- Railway
- Reservoir
- Road / Track
- Stream / Nullah
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-7: RAWALPINDI TO BURHAN)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE: NOVEMBER-2024	DRAWING No.: SHEET 39 OF 39
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				REV. 0



0 50 100 200 Meters

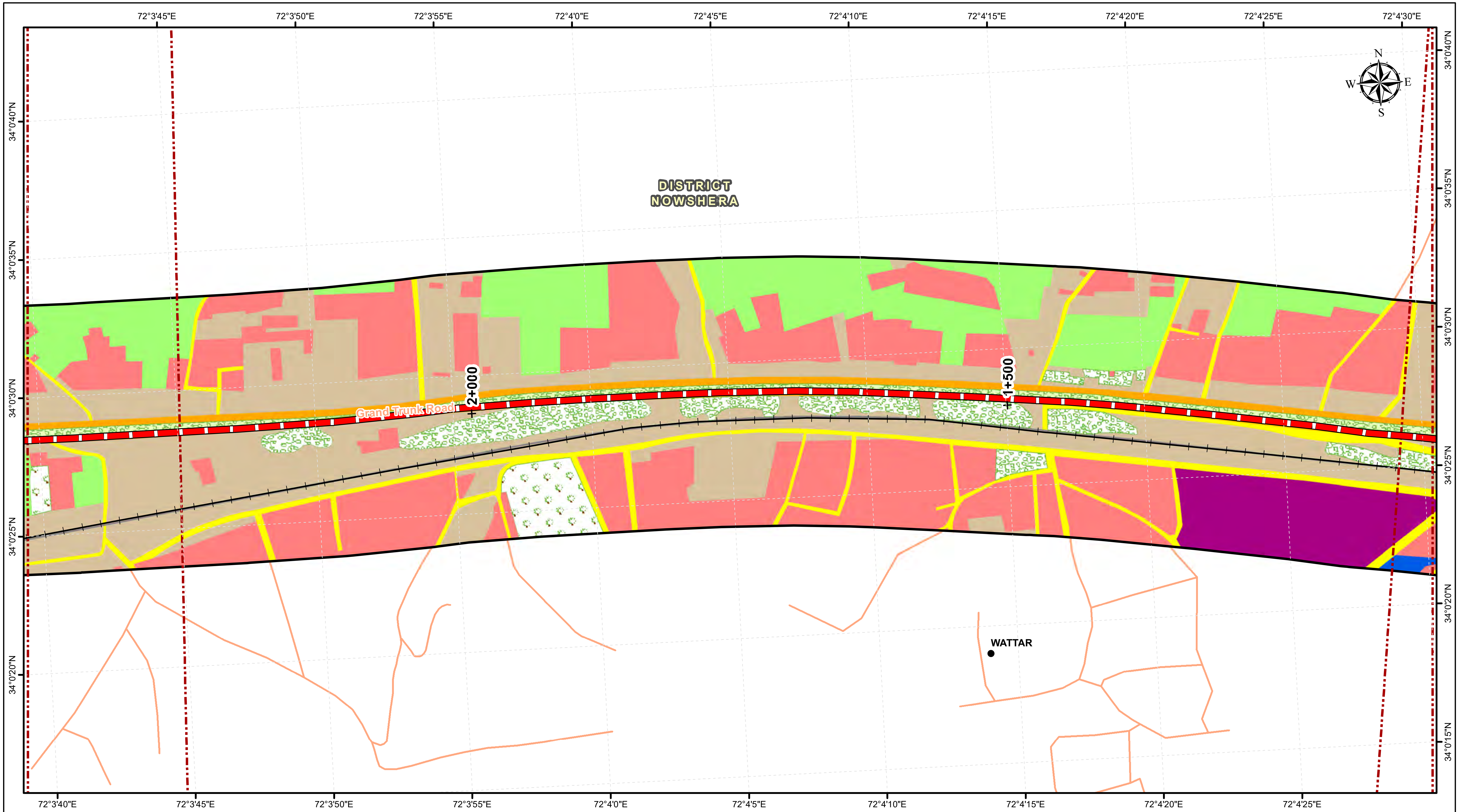
Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DRAWING No.: SHEET 1 OF 35	0
						APPROVED				



0 50 100 200 Meters

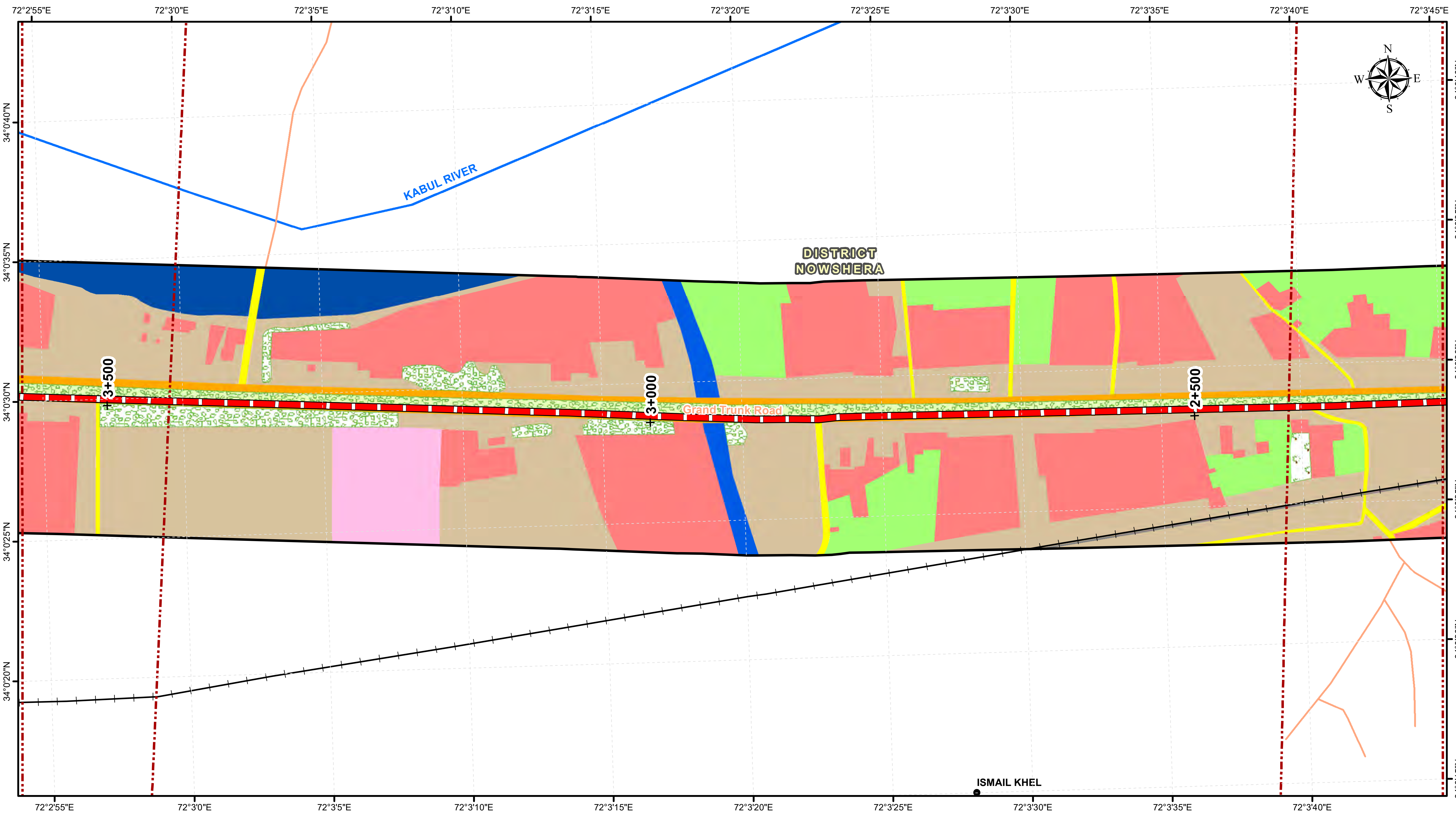
Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT NHA NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NESPAK NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04			DRAWN: M.MUNEEB	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP
		03			SUBMITTED: FAHAD S.		SCALE 1:4,000
		02			RECOMMENDED		DATE: NOVEMBER-2024
		01			CHD/VER.		DRAWING No.: SHEET 2 OF 35
		REV.	DATE	DESCRIPTION	APPROVED / APPROVED		REV.: 0



0 50 100 200 Meters

Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT: NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD; HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN						
REV.	DATE	DESCRIPTION	APPROVED				
04				DRAWN	M.MUNEEB		
03				SUBMITTED	FAHAD S.		
02				RECOMMENDED			
01				CHD/VER.			
				APPROVED			

PROJECT: DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)

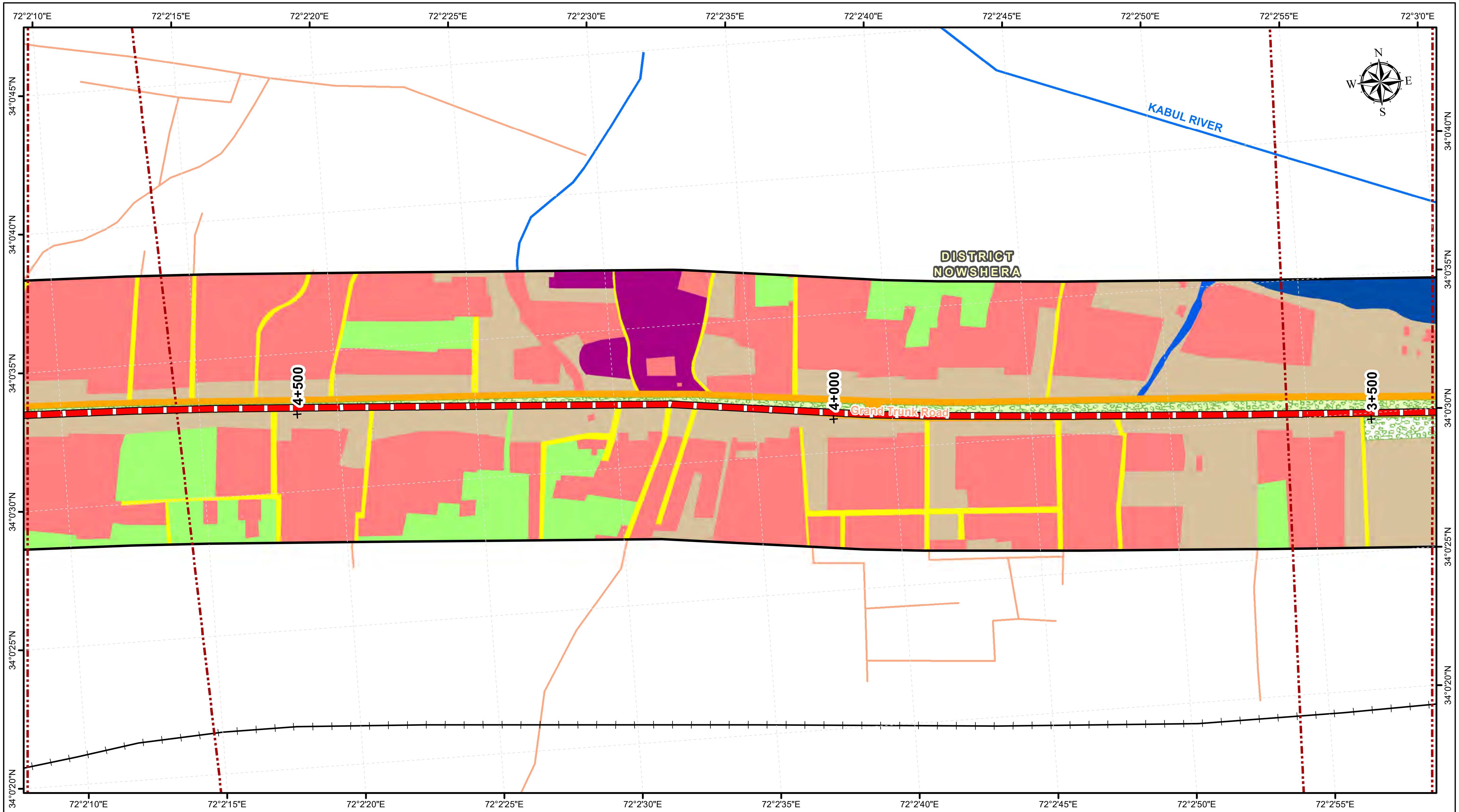
LANDUSE MAP

SCALE: 1:4,000

DATE: NOVEMBER-2024

DRAWING No.: SHEET 3 OF 35

REV.: 0



0 50 100 200 Meters

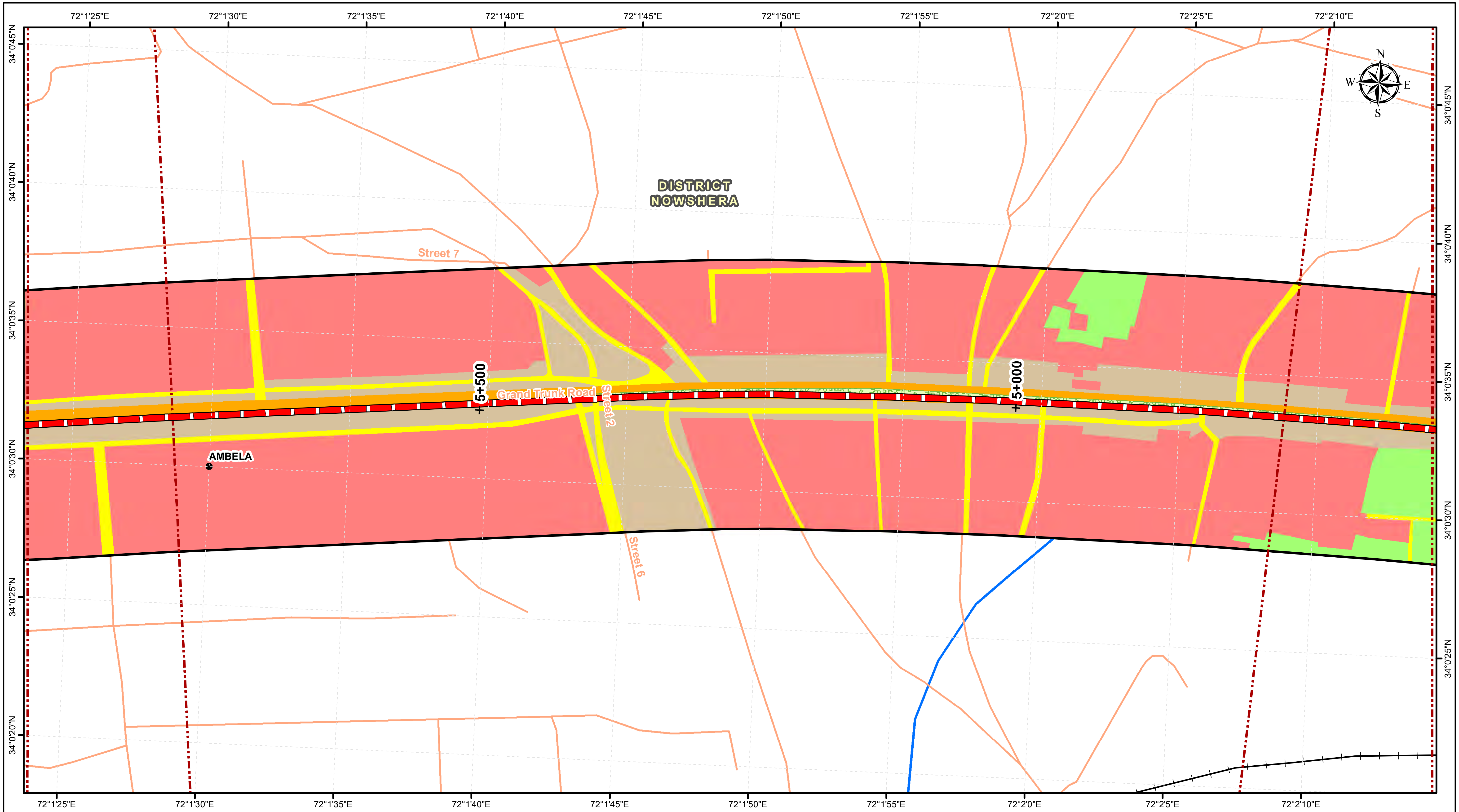
Legend

- ● Locality
- + RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE NOVEMBER-2024	
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DRAWING No. SHEET 4 OF 35	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200 Meters

Legend

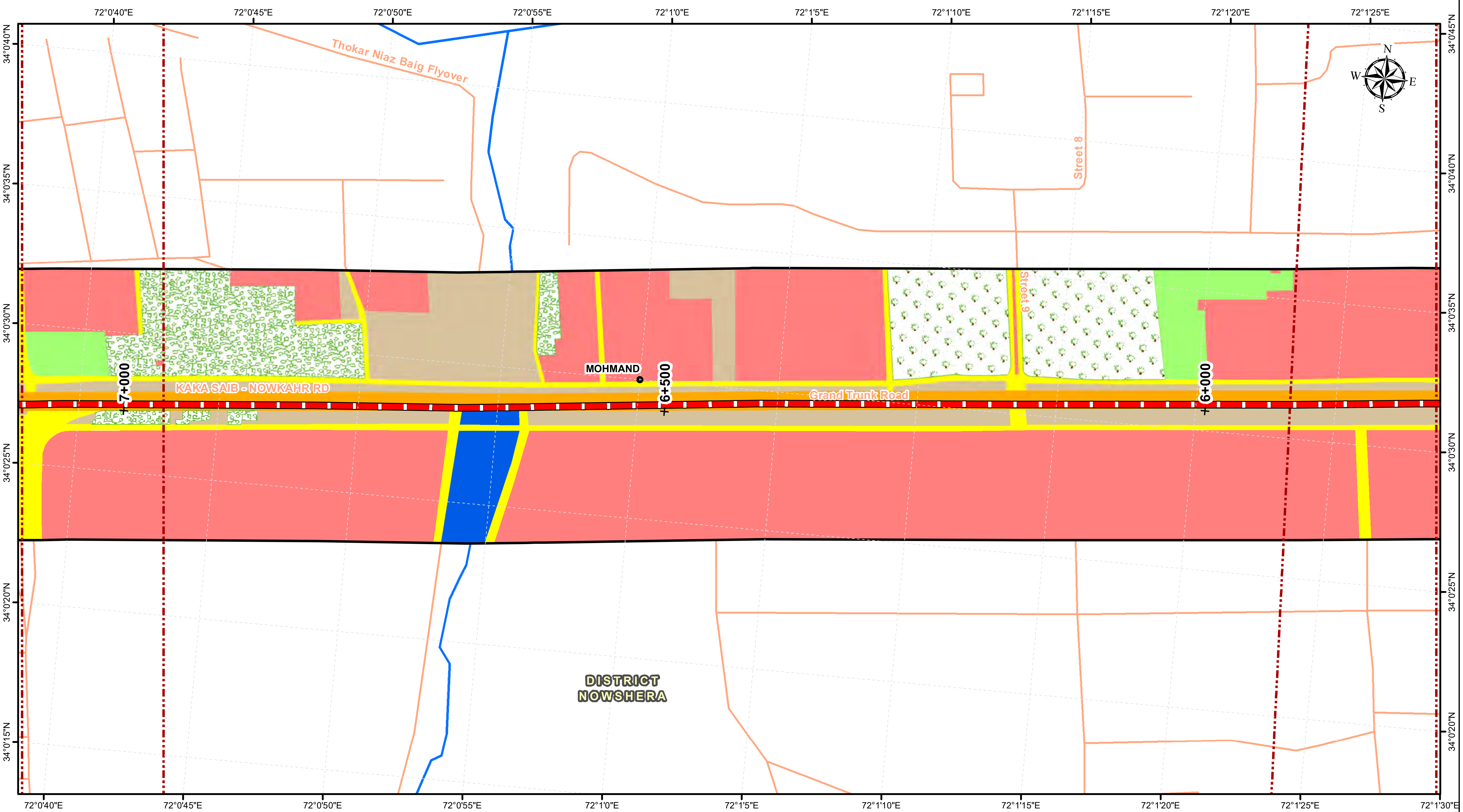
- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04			DRAWN	M.MUNEEB
		03			SUBMITTED	FAHAD S.
		02			RECOMMENDED	
		01			CHD/VER.	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED

PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
	DATE NOVEMBER-2024	DRAWING No. SHEET 5 OF 35
		REV. 0



0 50 100 200
Meters

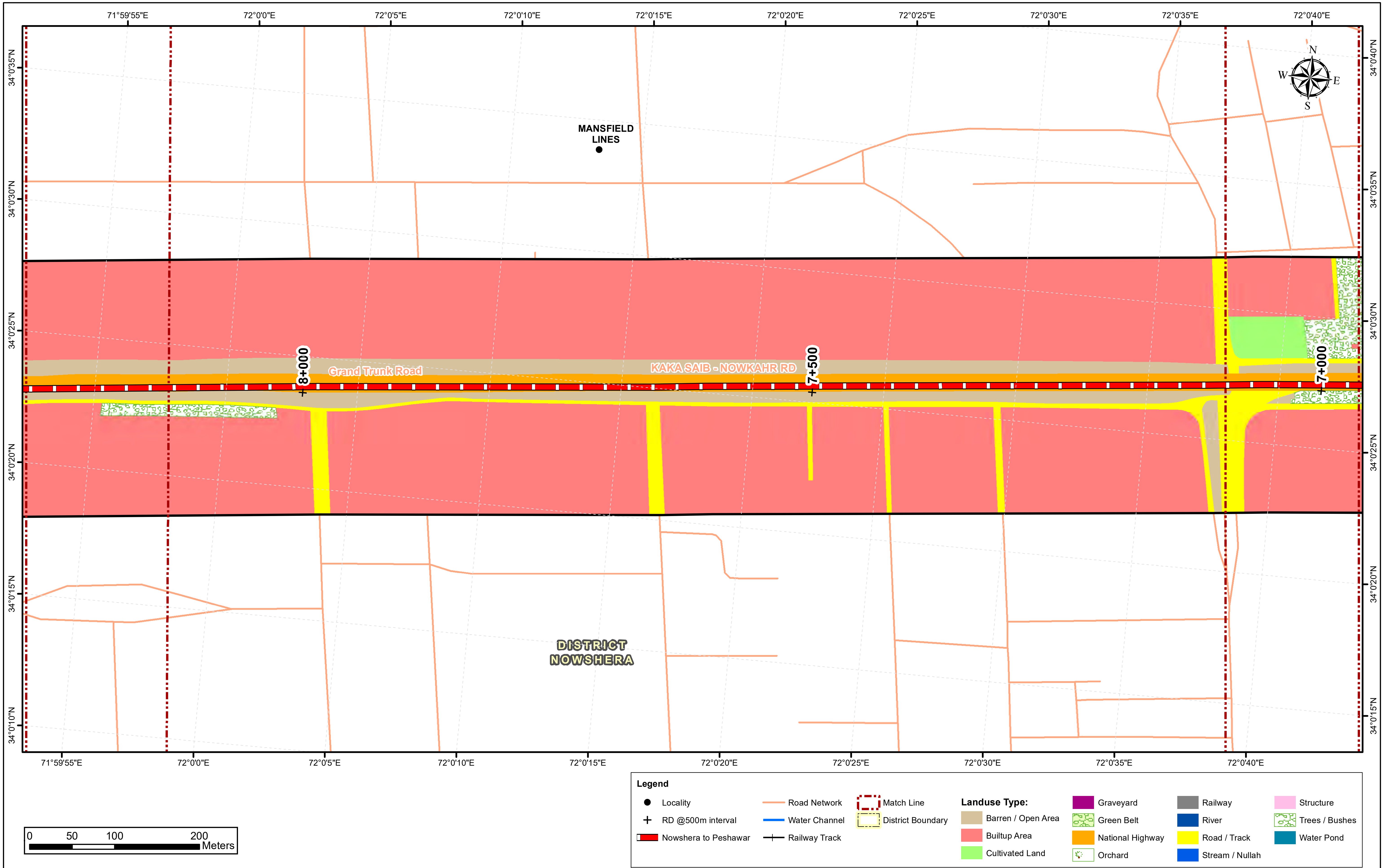
Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

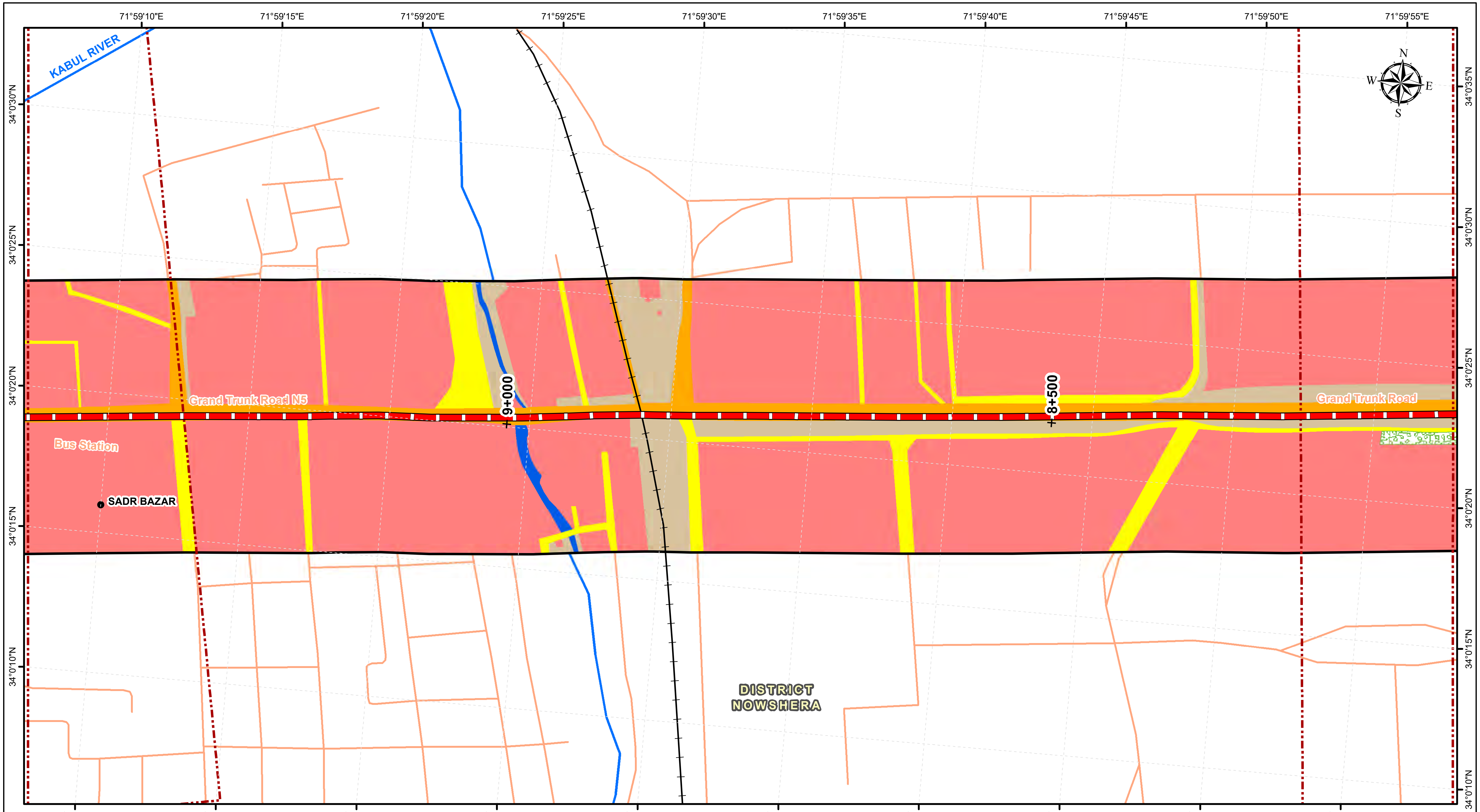
Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DRAWING No.: SHEET 6 OF 35	REV.: 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	DRAWING No.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024	SHEET 7 OF 35	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



0 50 100 200 Meters

Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04			DRAWN	M.MUNEEB	PROJECT
		03			SUBMITTED	FAHAD S.	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)
		02			RECOMMENDED		
		01			CHD/VER.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	

LANDUSE MAP		SCALE 1:4,000
DATE NOVEMBER-2024	DRAWING No. SHEET 8 OF 35	REV. 0

Legend

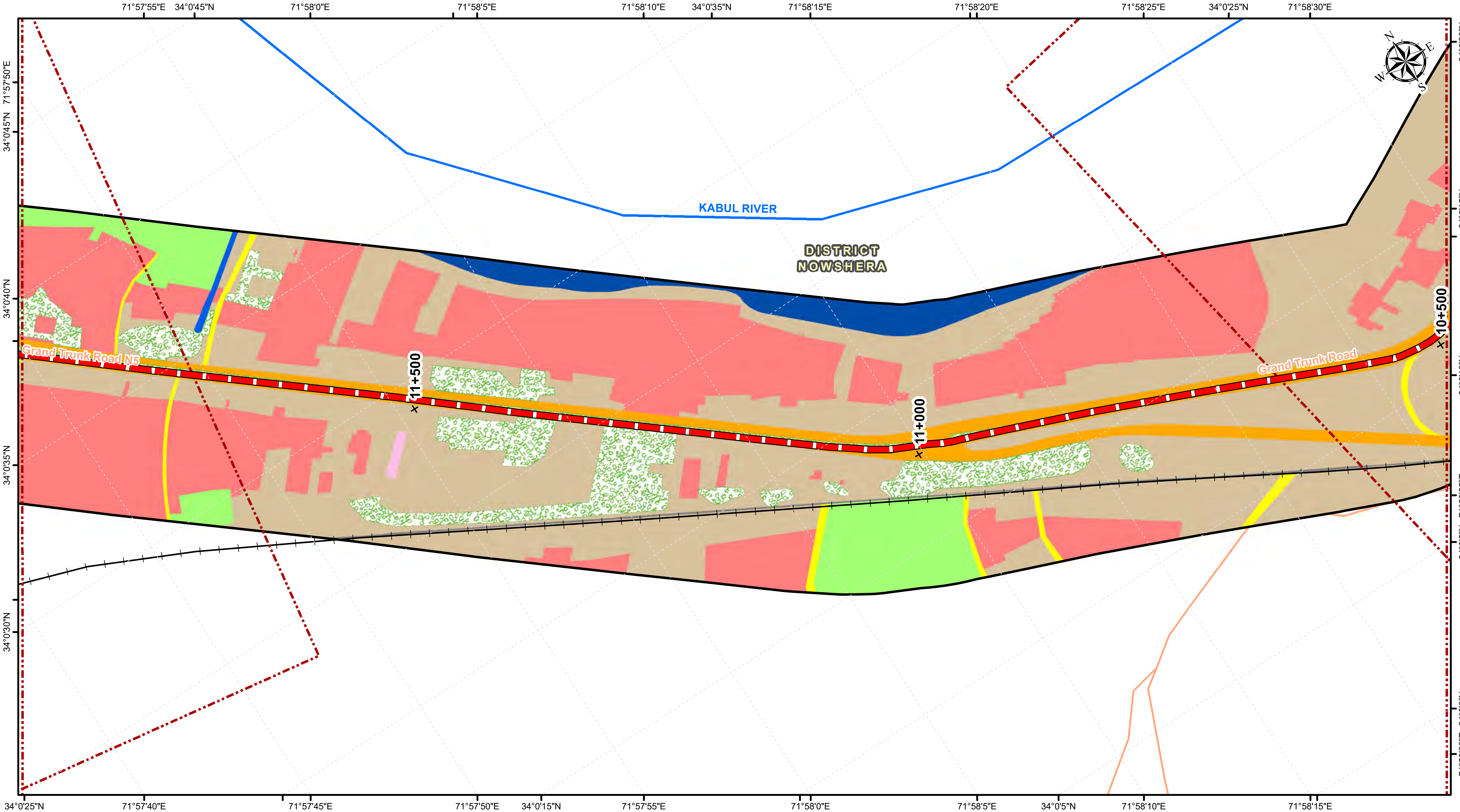
- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE NOVEMBER-2024 / DRAWING No. SHEET 9 OF 35	REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200
Meters

Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

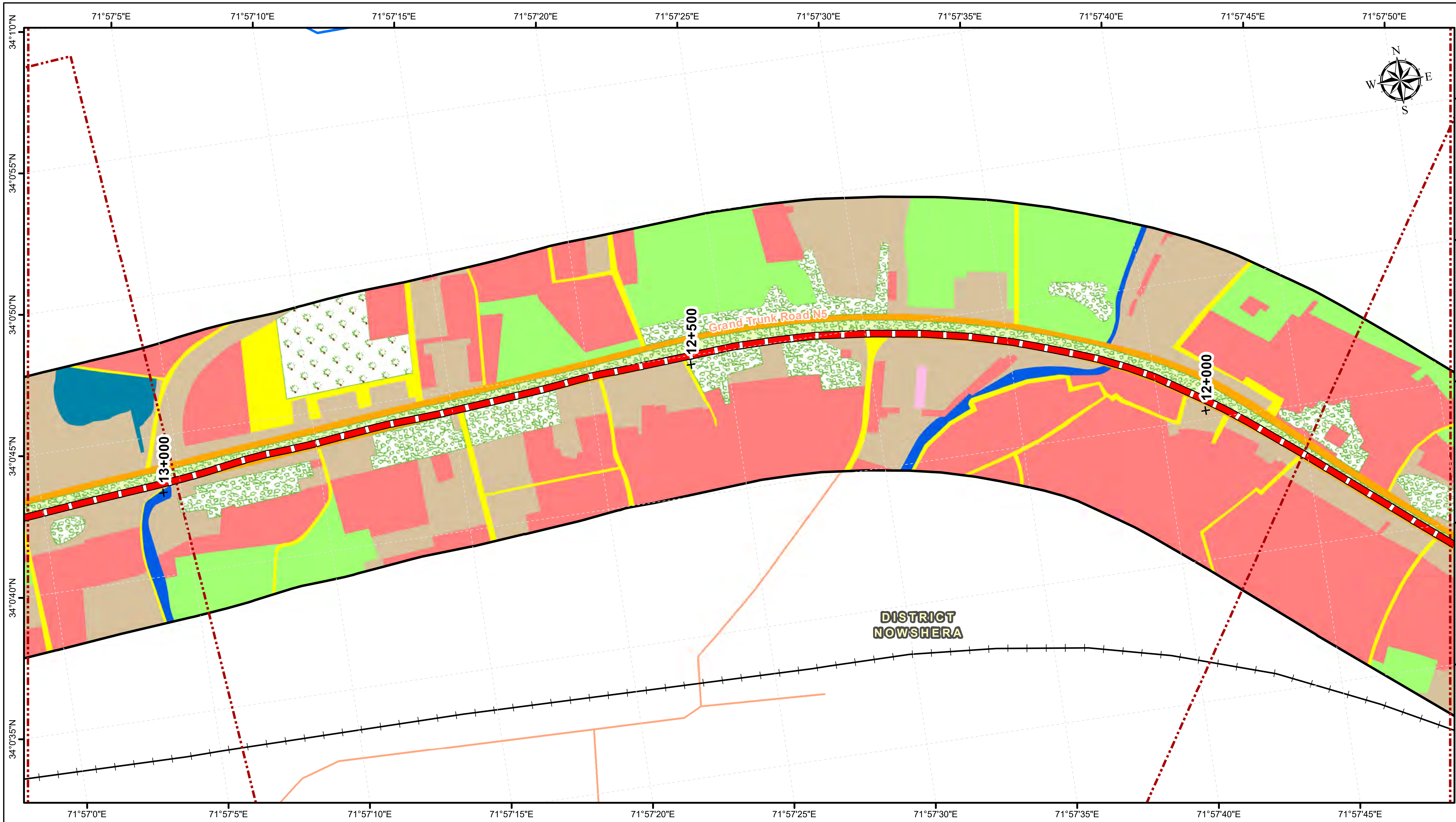
CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB
		03				SUBMITTED	FAHAD S.
		02				RECOMMENDED	
		01				CHD/VER.	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	

PROJECT

DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)

LANDUSE MAP

SCALE	DATE	DRAWING No.	REV.
1:4,000	NOVEMBER-2024	SHEET 10 OF 35	0



0 50 100 200 Meters

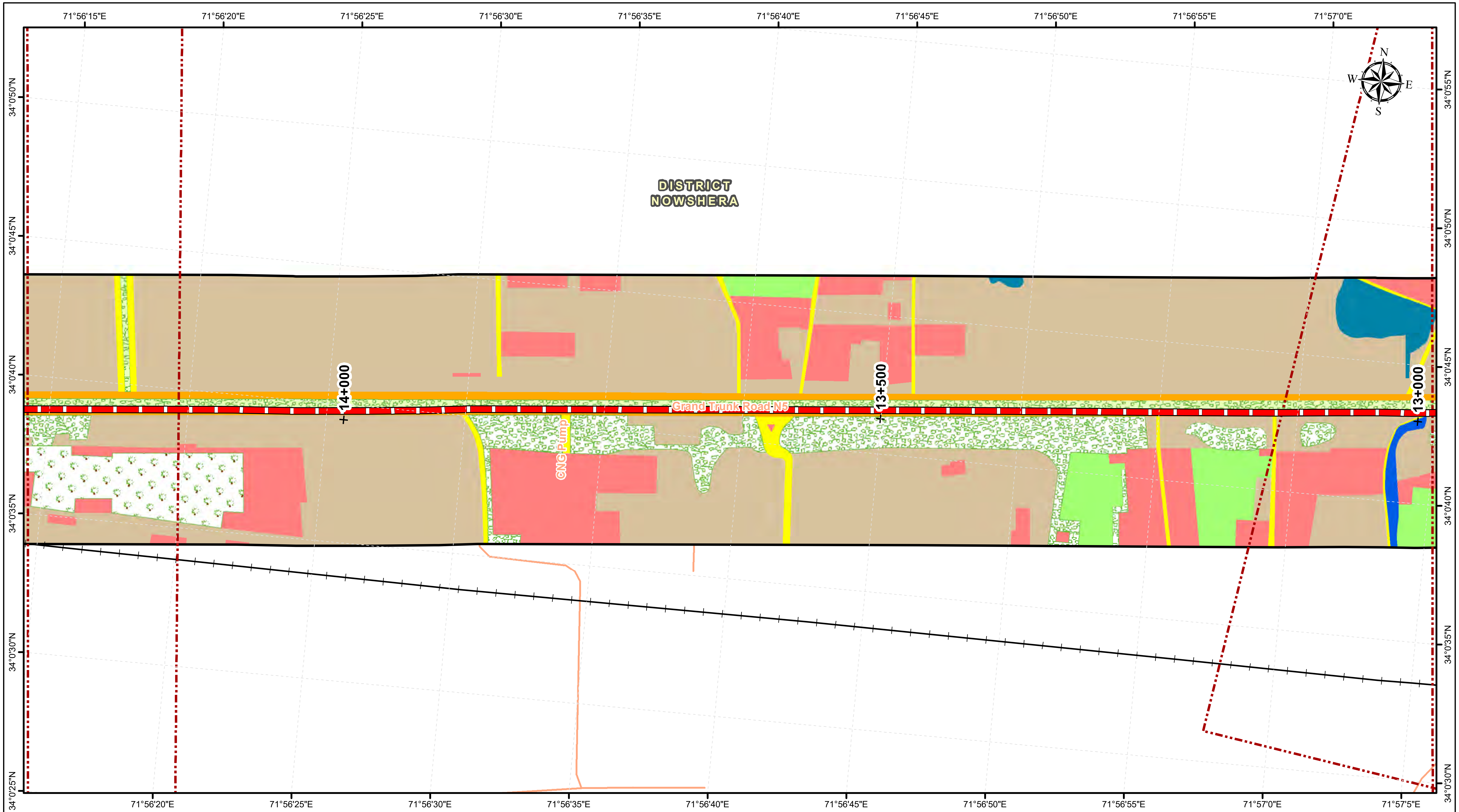
Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE NOVEMBER-2024	DRAWING No. SHEET 11 OF 35
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.				REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



Legend

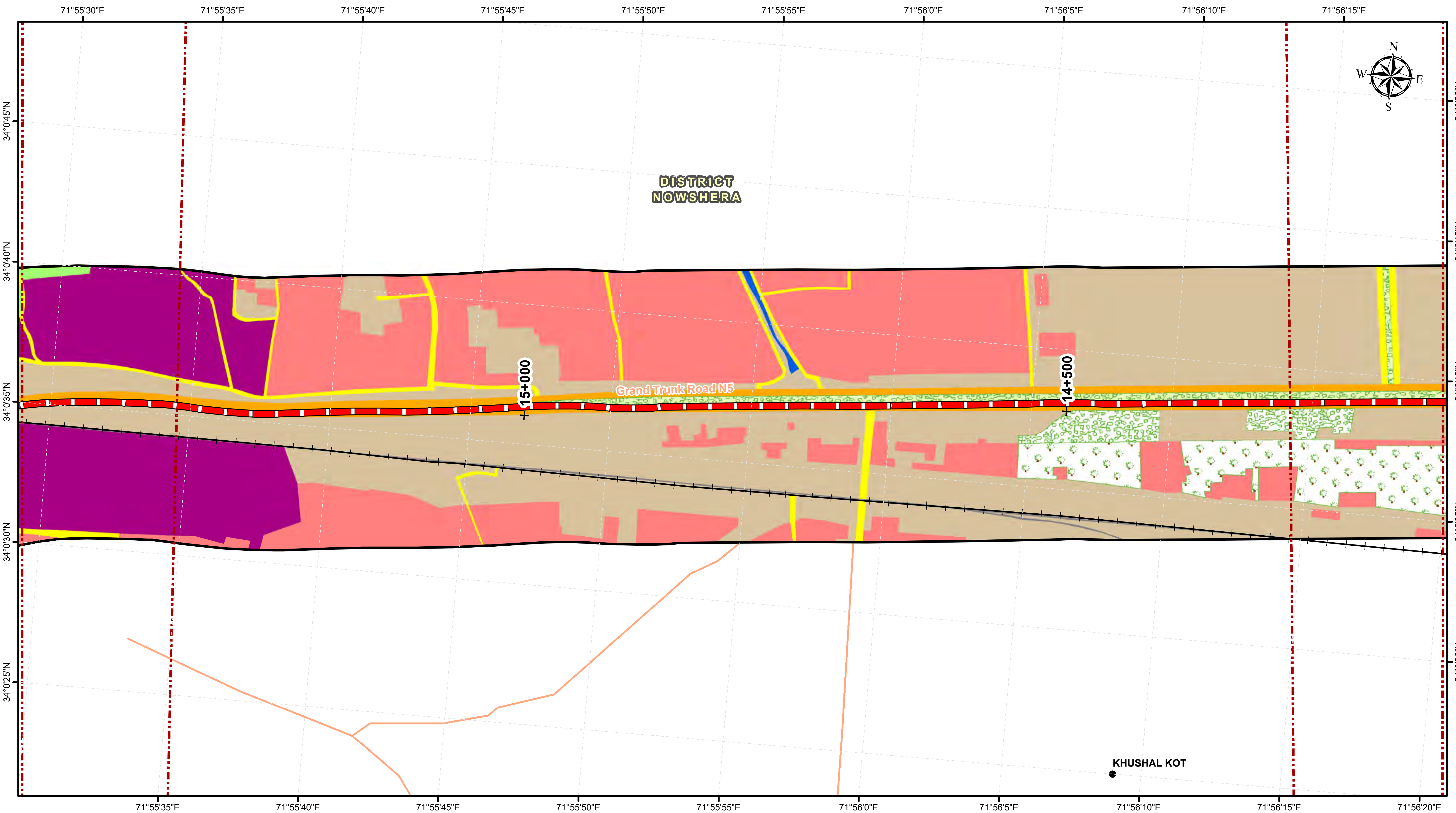
- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT: NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD; HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB	PROJECT: DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)
		03				SUBMITTED	FAHAD S.	
		02				RECOMMENDED		
		01				CHD/VER.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

LANDUSE MAP		SCALE 1:4,000
DATE: NOVEMBER-2024	DRAWING No.: SHEET 12 OF 35	REV.: 0



0 50 100 200 Meters

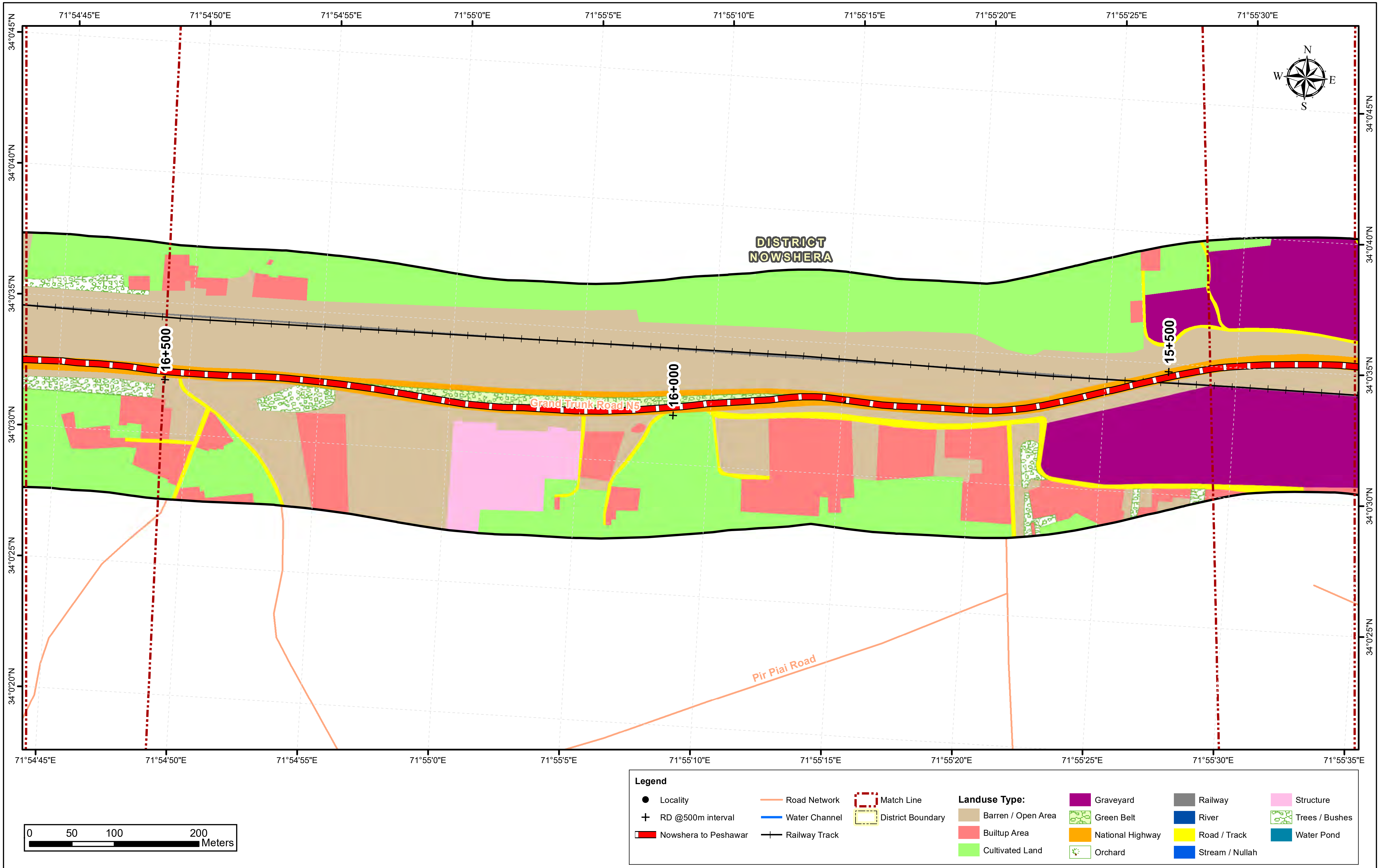
Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

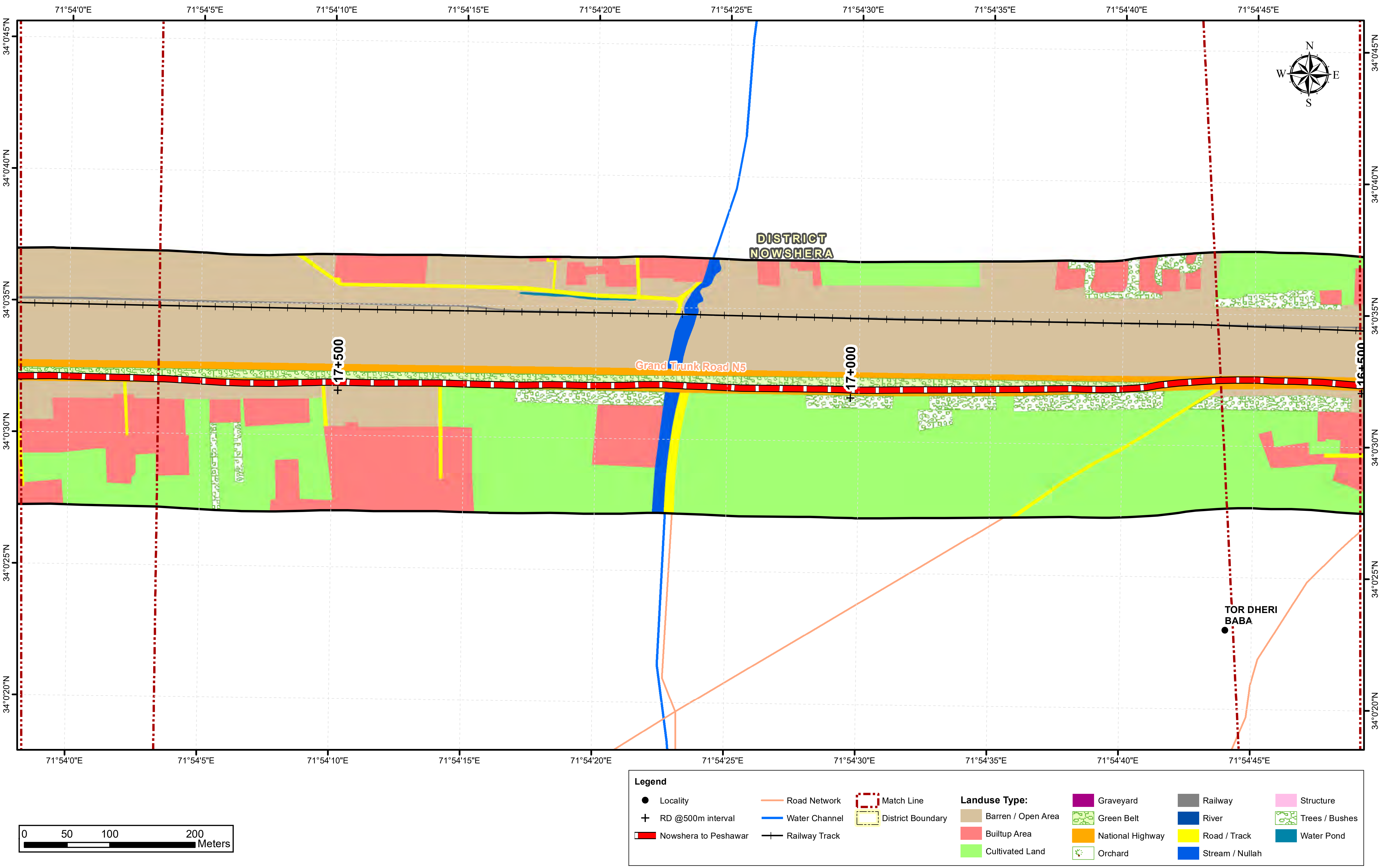
Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

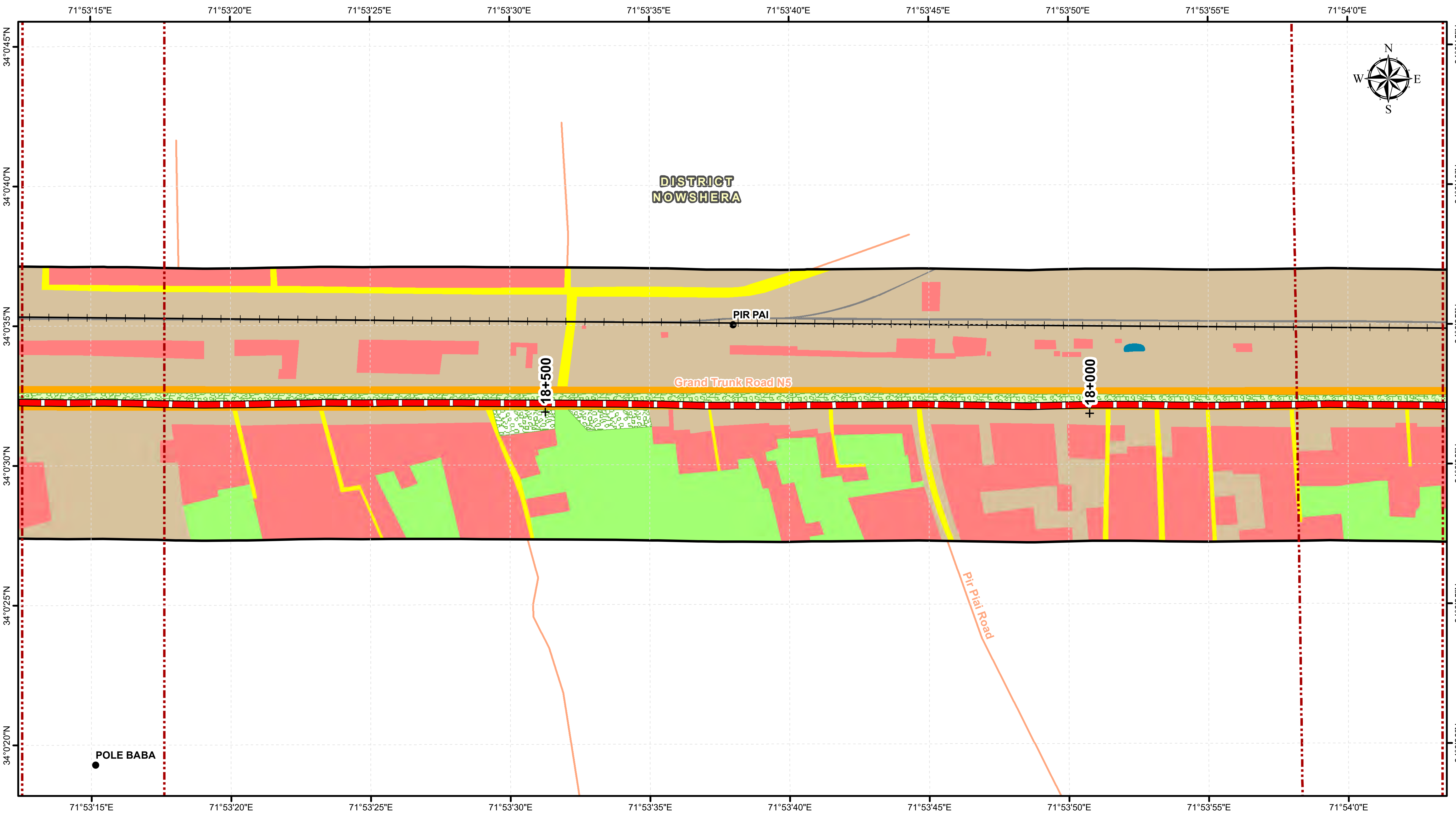
CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE: NOVEMBER-2024 / DRAWING No.: SHEET 13 OF 35	REV.: 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.		DATE	REV.
		02				RECOMMENDED			NOVEMBER-2024	0
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DRAWING No.	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			SHEET 14 OF 35	



CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP
		03				SUBMITTED	FAHAD S.		SCALE 1:4,000
		02				RECOMMENDED			DATE NOVEMBER-2024
		01				CHD/VER.			DRAWING No. SHEET 15 OF 35
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			REV. 0



0 50 100 200
Meters

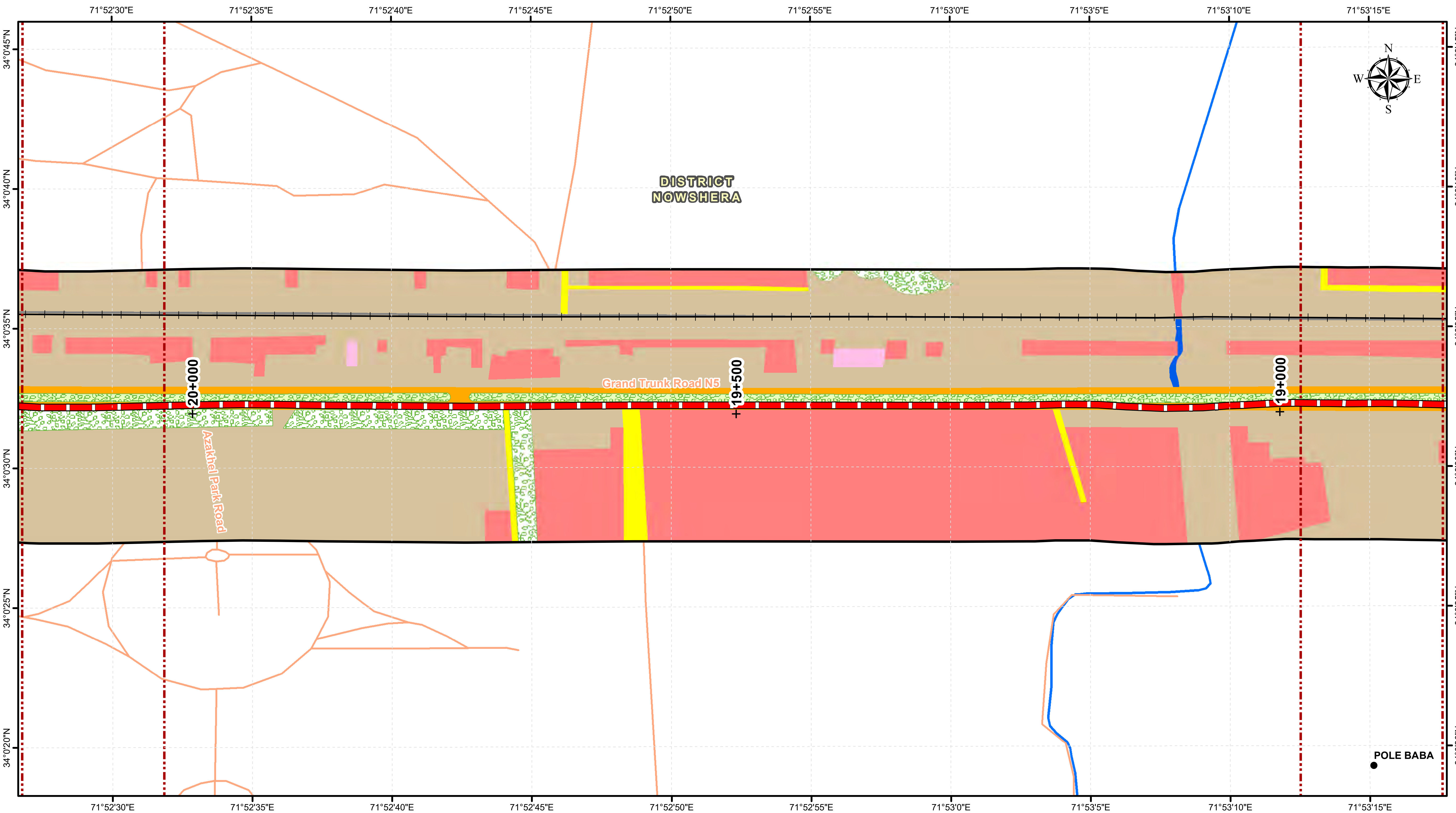
Legend

Locality	Road Network	Match Line
RD @500m interval	Water Channel	District Boundary
Nowshera to Peshawar	Railway Track	

Landuse Type:

Barren / Open Area	Graveyard	Railway	Structure
Builtup Area	Green Belt	River	Trees / Bushes
Cultivated Land	National Highway	Road / Track	Water Pond
	Orchard	Stream / Nullah	

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE: NOVEMBER-2024	REV. 0
		01				CHD/VER.			DRAWING No. SHEET 16 OF 35	
						APPROVED				



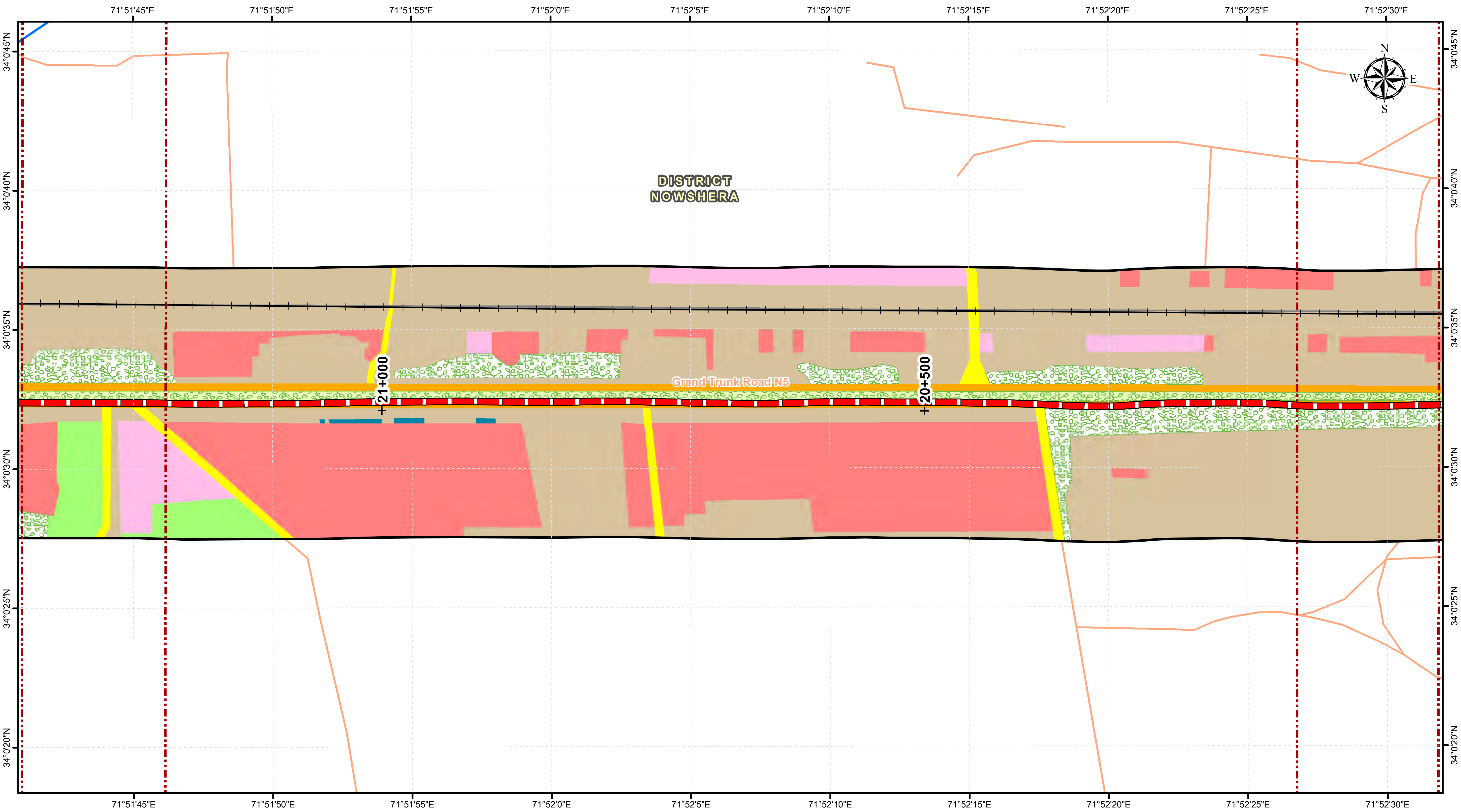
Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED			DATE	DRAWING No.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024	SHEET 17 OF 35	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



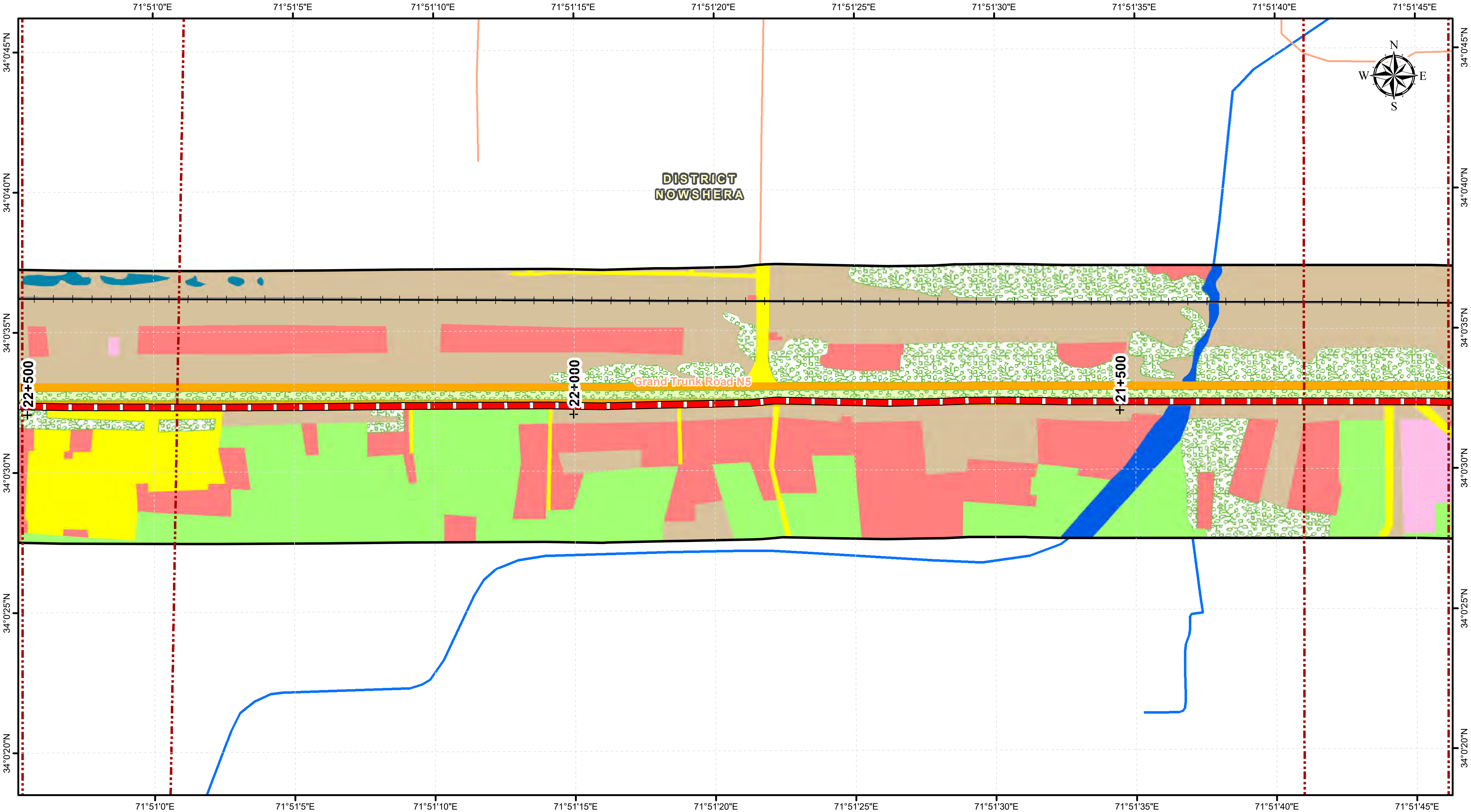
Legend

Locality	Road Network	Match Line	**Landuse Type:**	Graveyard	Railway
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Green Belt	River
Nowshera to Peshawar	Railway Track		Builtup Area	National Highway	Road / Track
			Cultivated Land	Orchard	Stream / Nullah

Structure · Trees / Bushes · Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE / DRAWING No.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024 / SHEET 18 OF 35	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE NOVEMBER-2024	DRAWING No. SHEET 19 OF 35
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				REV. 0

0 50 100 200 Meters

Legend

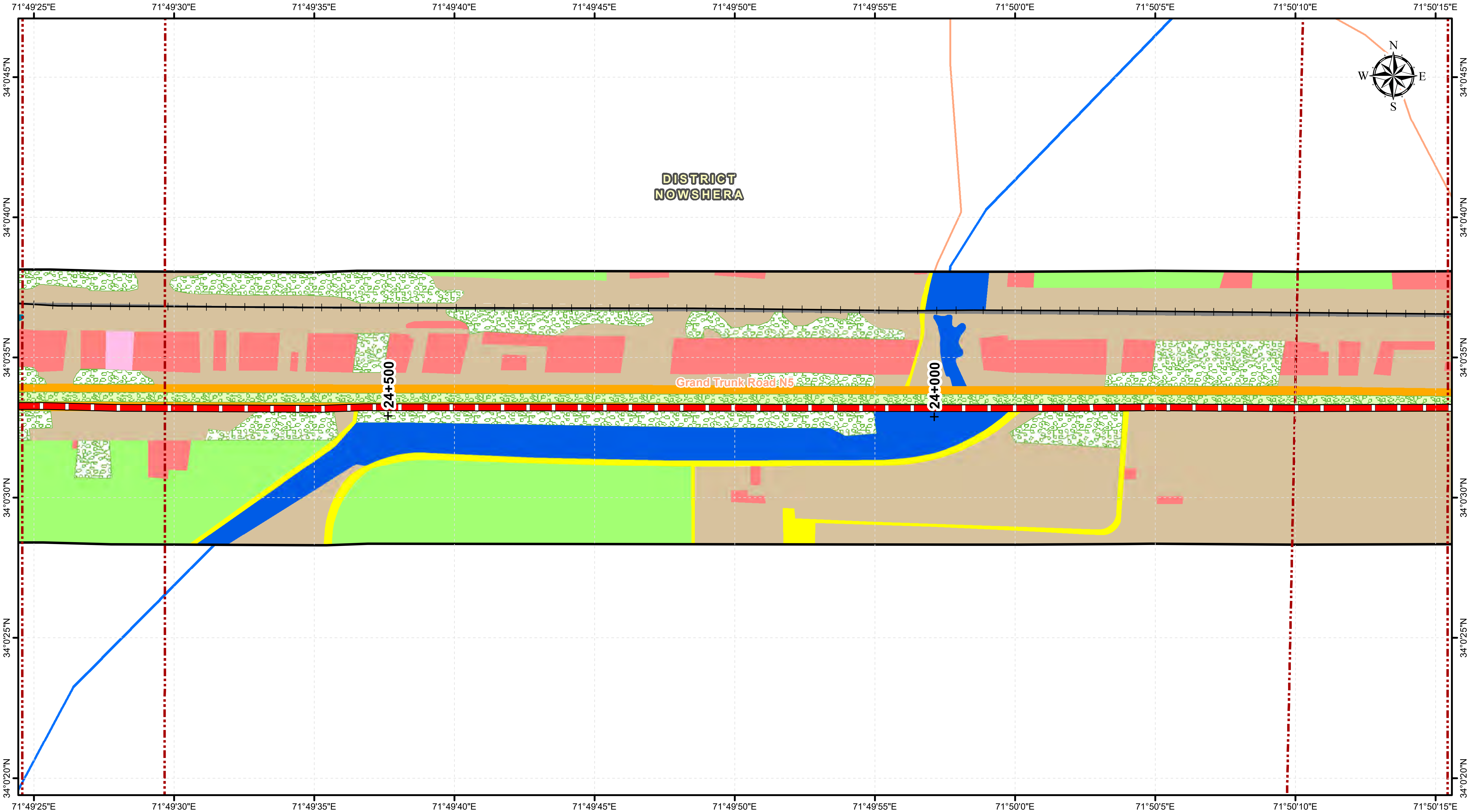
- ● Locality
- + RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB	PROJECT DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)
		03				SUBMITTED	FAHAD S.	
		02				RECOMMENDED		
		01				CHD/VER.		
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED		

LANDUSE MAP		SCALE 1:4,000
DATE NOVEMBER-2024	DRAWING No. SHEET 20 OF 35	REV. 0

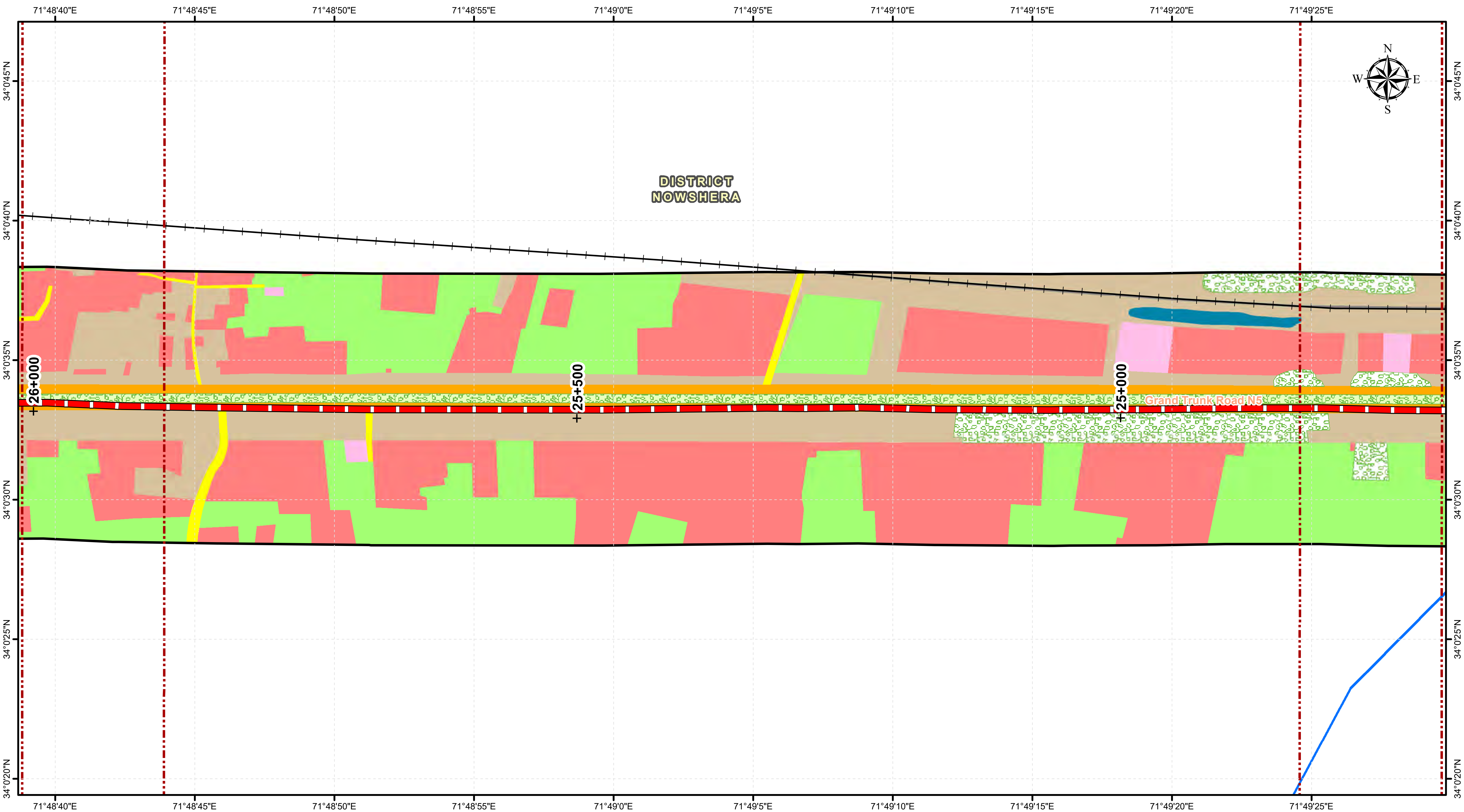


0 50 100 200
Meters

Legend

Locality	Road Network	Match Line	**Landuse Type:**	Graveyard	Railway	Structure
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Green Belt	River	Trees / Bushes
Nowshera to Peshawar	Railway Track		Builtup Area	National Highway	Road / Track	Water Pond
			Cultivated Land	Orchard	Stream / Nullah	

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE NOVEMBER-2024	DRAWING No. SHEET 21 OF 35
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.				REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200 Meters

Legend

Locality	Road Network	Match Line
RD @500m interval	Water Channel	District Boundary
Nowshera to Peshawar	Railway Track	

Landuse Type:

Barren / Open Area	Graveyard	Railway	Structure
Builtup Area	Green Belt	River	Trees / Bushes
Cultivated Land	National Highway	Road / Track	Water Pond
	Orchard	Stream / Nullah	

CLIENT: NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT: NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD — HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04			DRAWN	M.MUNEEB
		03			SUBMITTED	FAHAD S.
		02			RECOMMENDED	
		01			CHD/VER.	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED

PROJECT

DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)

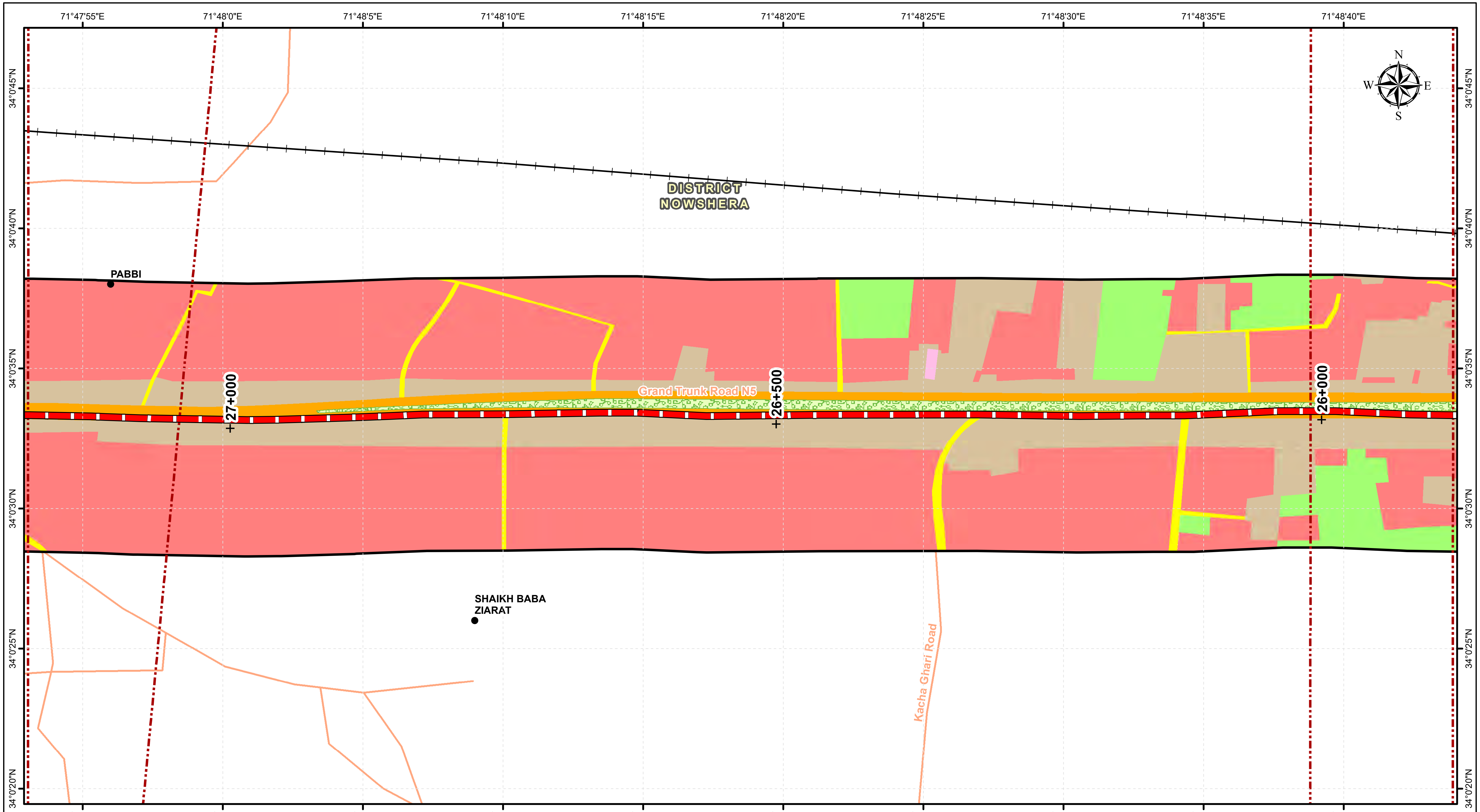
LANDUSE MAP

SCALE 1:4,000

DATE NOVEMBER-2024

DRAWING No. SHEET 22 OF 35

REV. 0



0 50 100 200 Meters

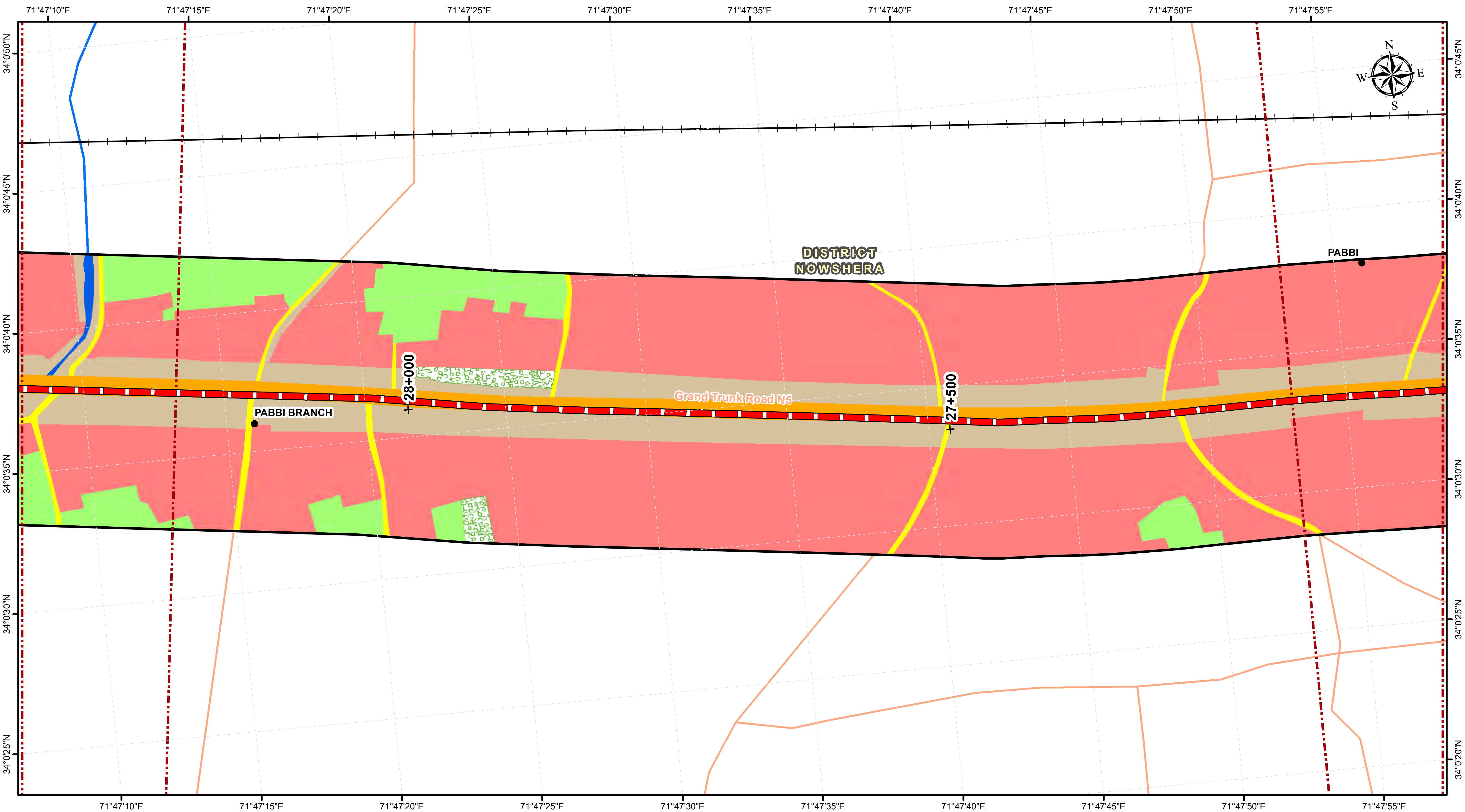
Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	03				SUBMITTED	FAHAD S.		DATE: NOVEMBER-2024	REV. 0
		02				RECOMMENDED			DRAWING No.: SHEET 23 OF 35	
		01				CHD/VER.				
						APPROVED				



Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT

NATIONAL HIGHWAY AUTHORITY OF PAKISTAN

CONSULTANT

NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD

HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN

REV.	DATE	DESCRIPTION	APPROVED
04			
03			
02			
01			

DRAWN	M.MUNEEB
SUBMITTED	FAHAD S.
RECOMMENDED	
CHD/VER.	
APPROVED	

PROJECT

DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)

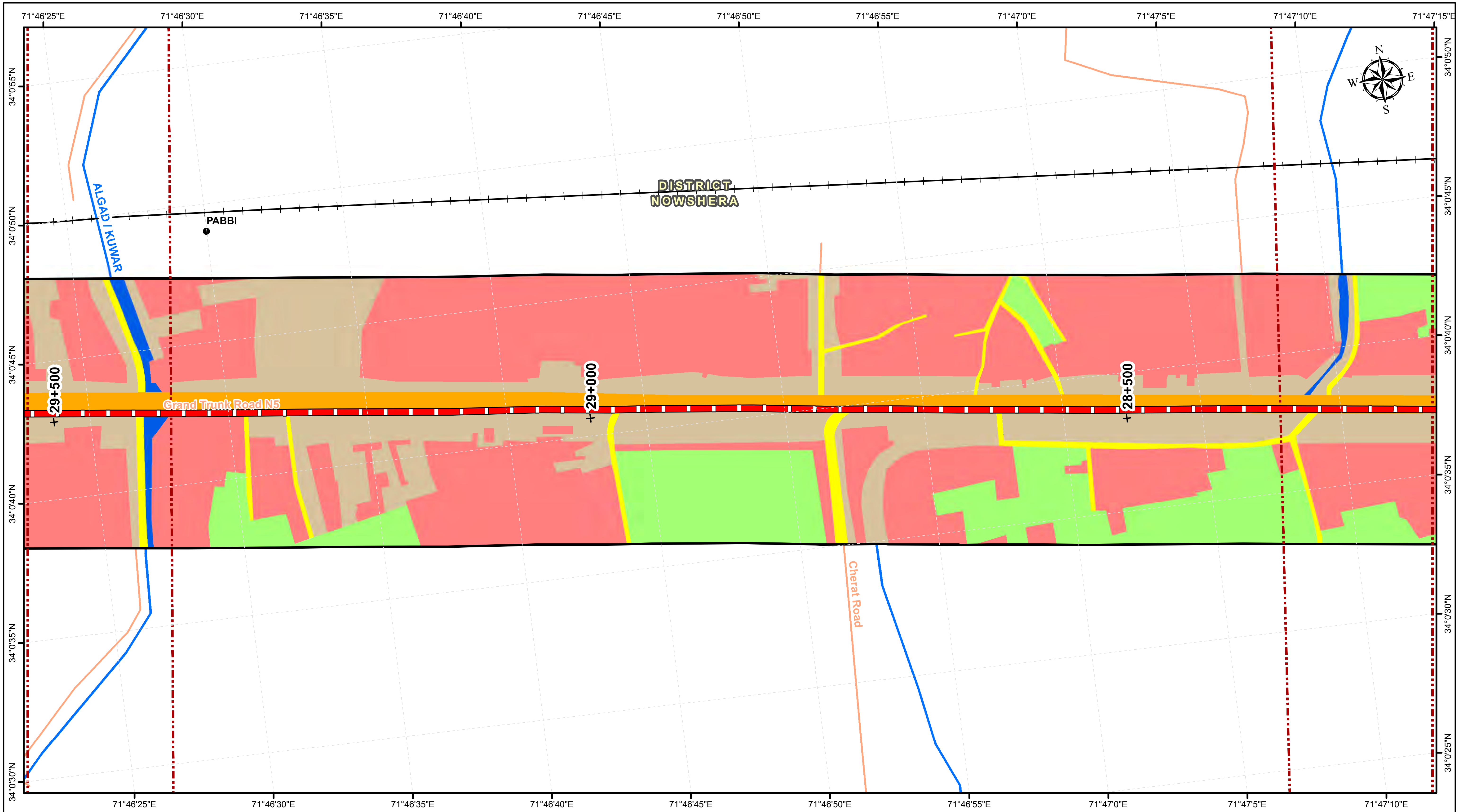
LANDUSE MAP

SCALE 1:4,000

DATE NOVEMBER-2024

DRAWING No. SHEET 24 OF 35

REV. 0



0 50 100 200 Meters

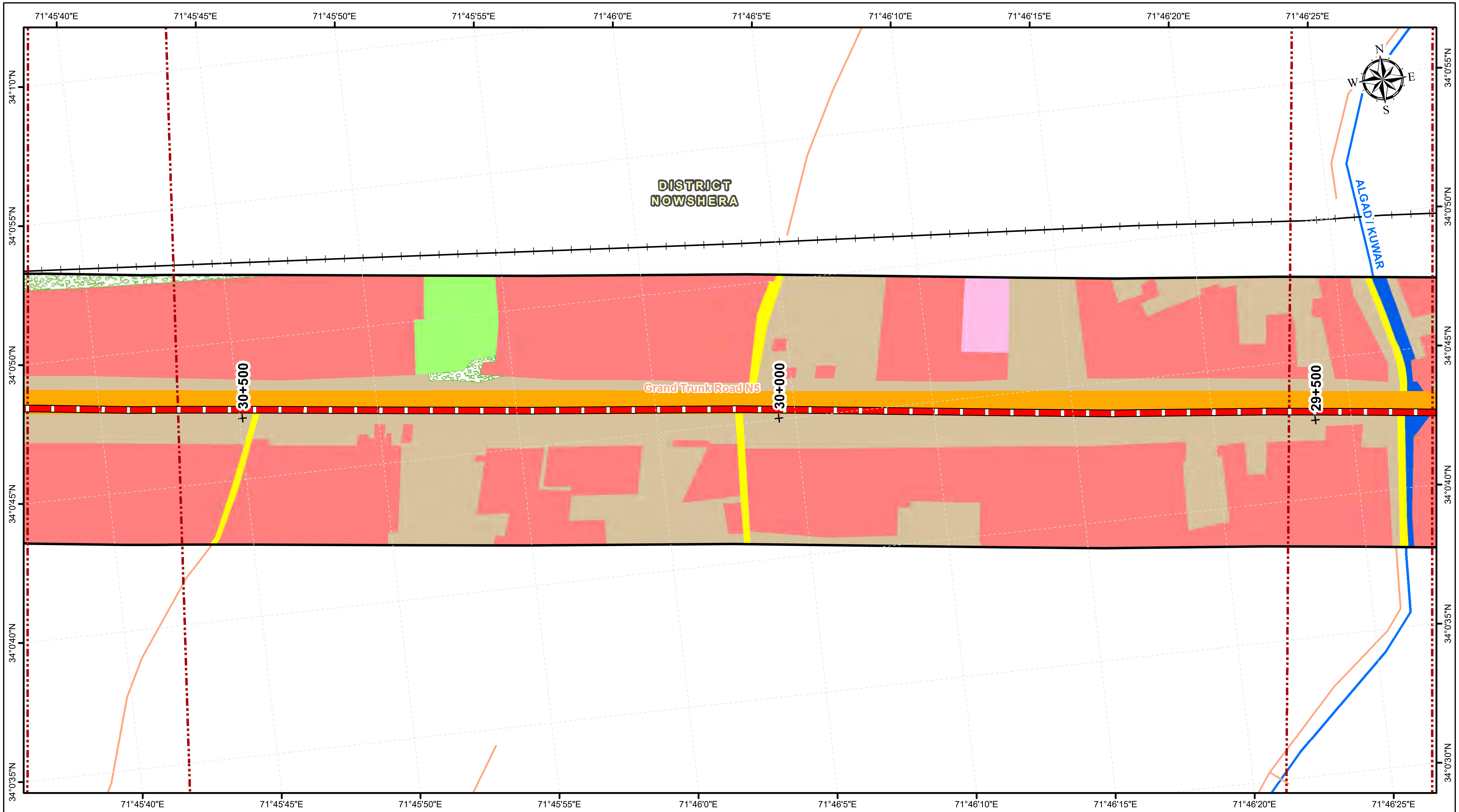
Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	02				RECOMMENDED			DATE NOVEMBER-2024	REV. 0
		01				CHD/VER.			DRAWING No. SHEET 25 OF 35	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



Legend

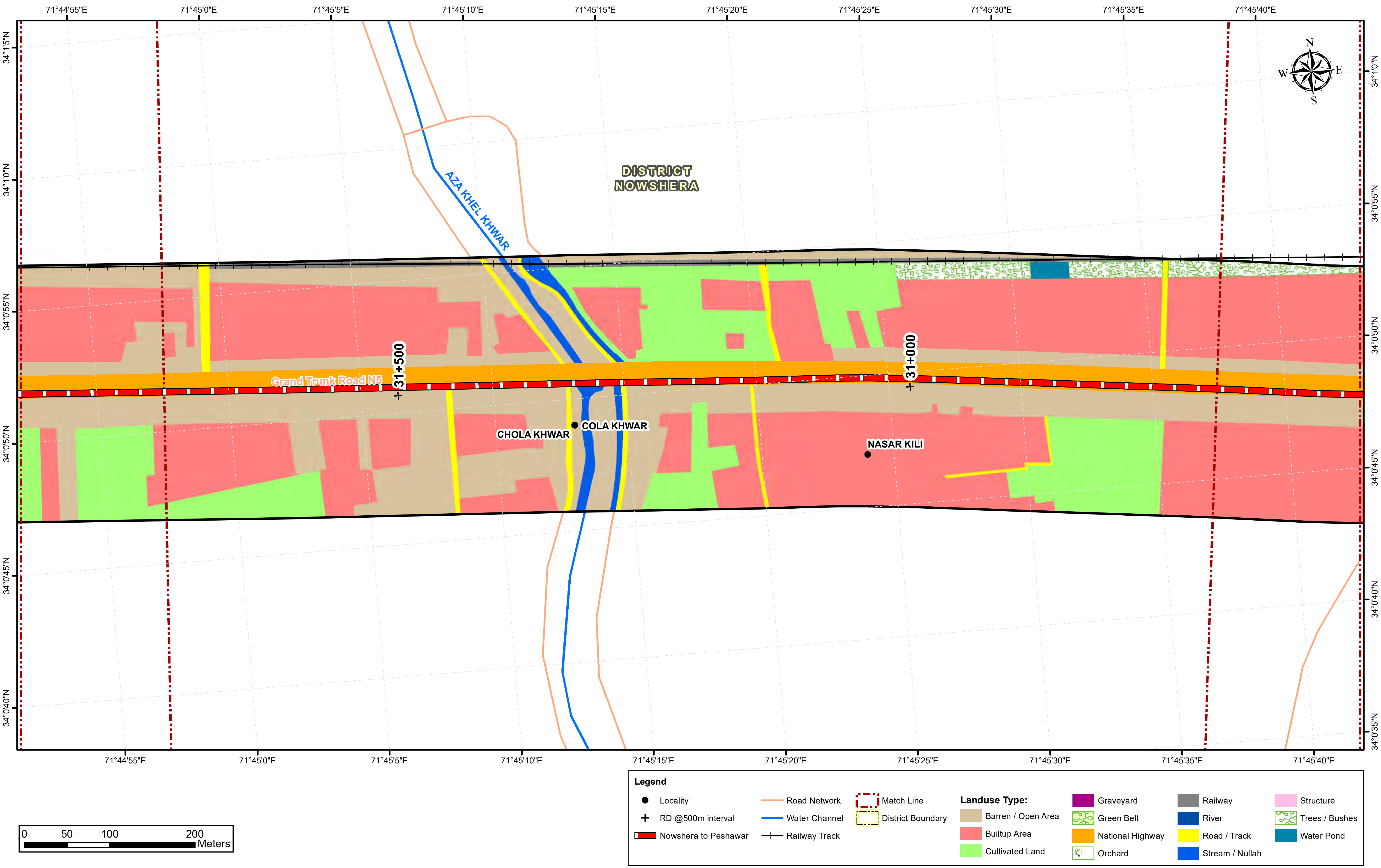
- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT		
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	SCALE 1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE NOVEMBER-2024	DRAWING No. SHEET 26 OF 35
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.				REV. 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



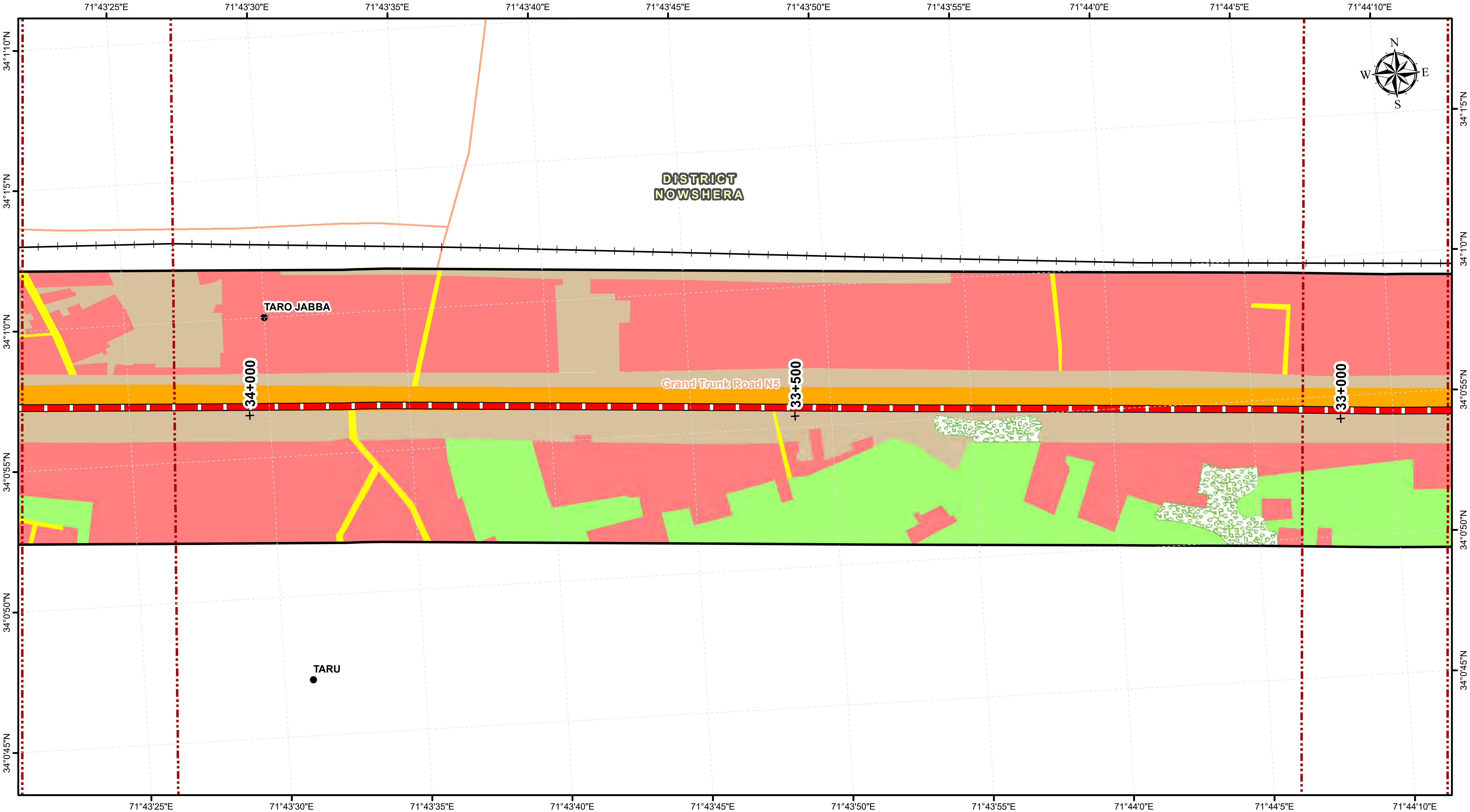
CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE / DRAWING No.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024 / SHEET 27 OF 35	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				

Legend

Locality	Road Network	Match Line	**Landuse Type:**	Graveyard	Railway	Structure
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Green Belt	River	Trees / Bushes
Nowshera to Peshawar	Railway Track		Builtup Area	National Highway	Road / Track	Water Pond
			Cultivated Land	Orchard	Stream / Nullah	

0 50 100 200 Meters

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE: NOVEMBER-2024	REV.
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			DRAWING No.: SHEET 28 OF 35	0



0 50 100 200 Meters

Legend

Locality	Road Network	Match Line
RD @500m interval	Water Channel	District Boundary
Nowshera to Peshawar	Railway Track	

Landuse Type:

Barren / Open Area	Graveyard	Railway	Structure
Builtup Area	Green Belt	River	Trees / Bushes
Cultivated Land	National Highway	Road / Track	Water Pond
	Orchard	Stream / Nullah	

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	03				SUBMITTED	FAHAD S.		DATE: NOVEMBER-2024	REV.: 0
		02				RECOMMENDED			DRAWING No.: SHEET 29 OF 35	
		01				CHD/VER.				
						APPROVED				

Legend

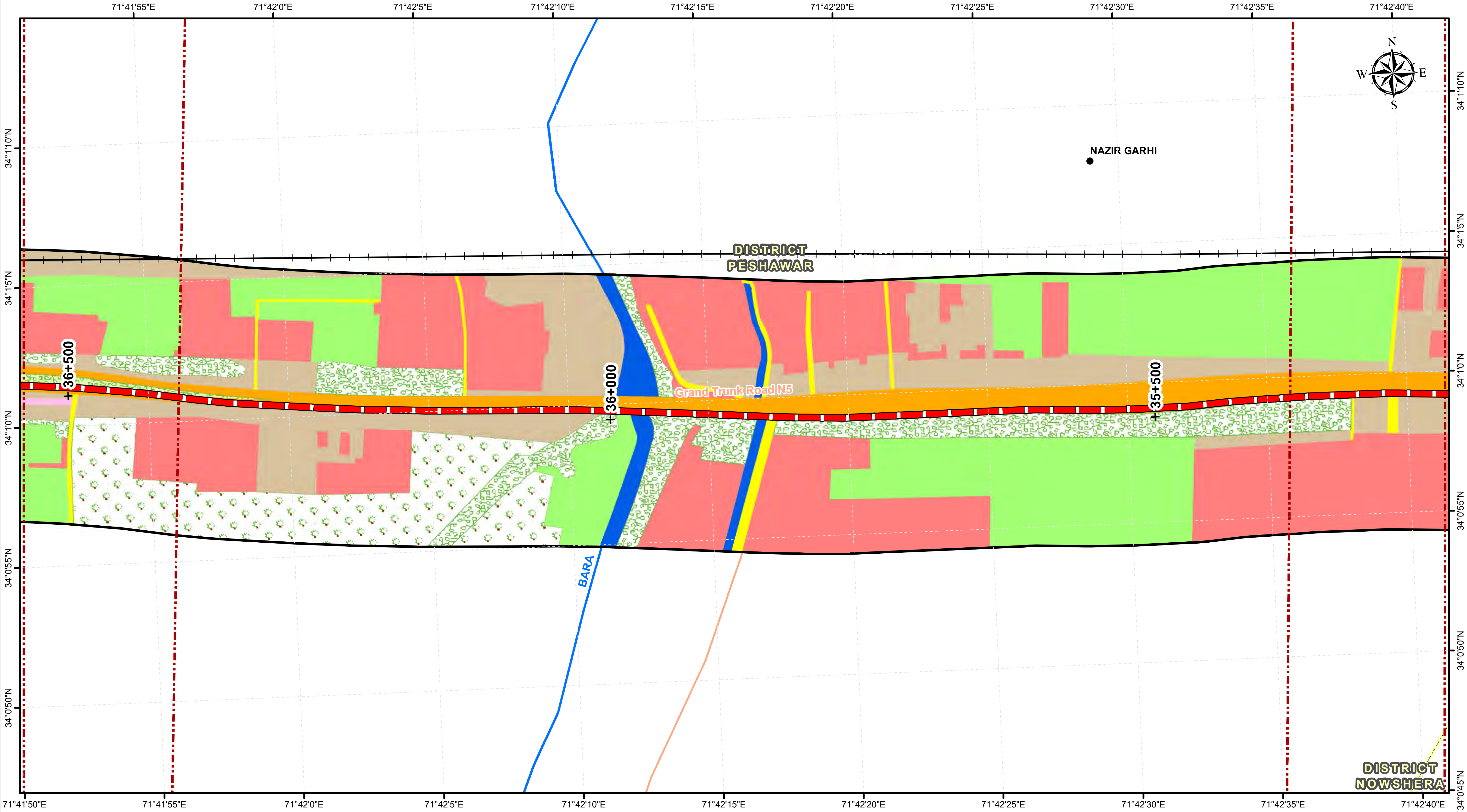
- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

0 50 100 200 Meters

CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.		DATE: NOVEMBER-2024	REV. 0
		02				RECOMMENDED			DRAWING No. SHEET 30 OF 35	
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.				
						APPROVED				



0 50 100 200 Meters

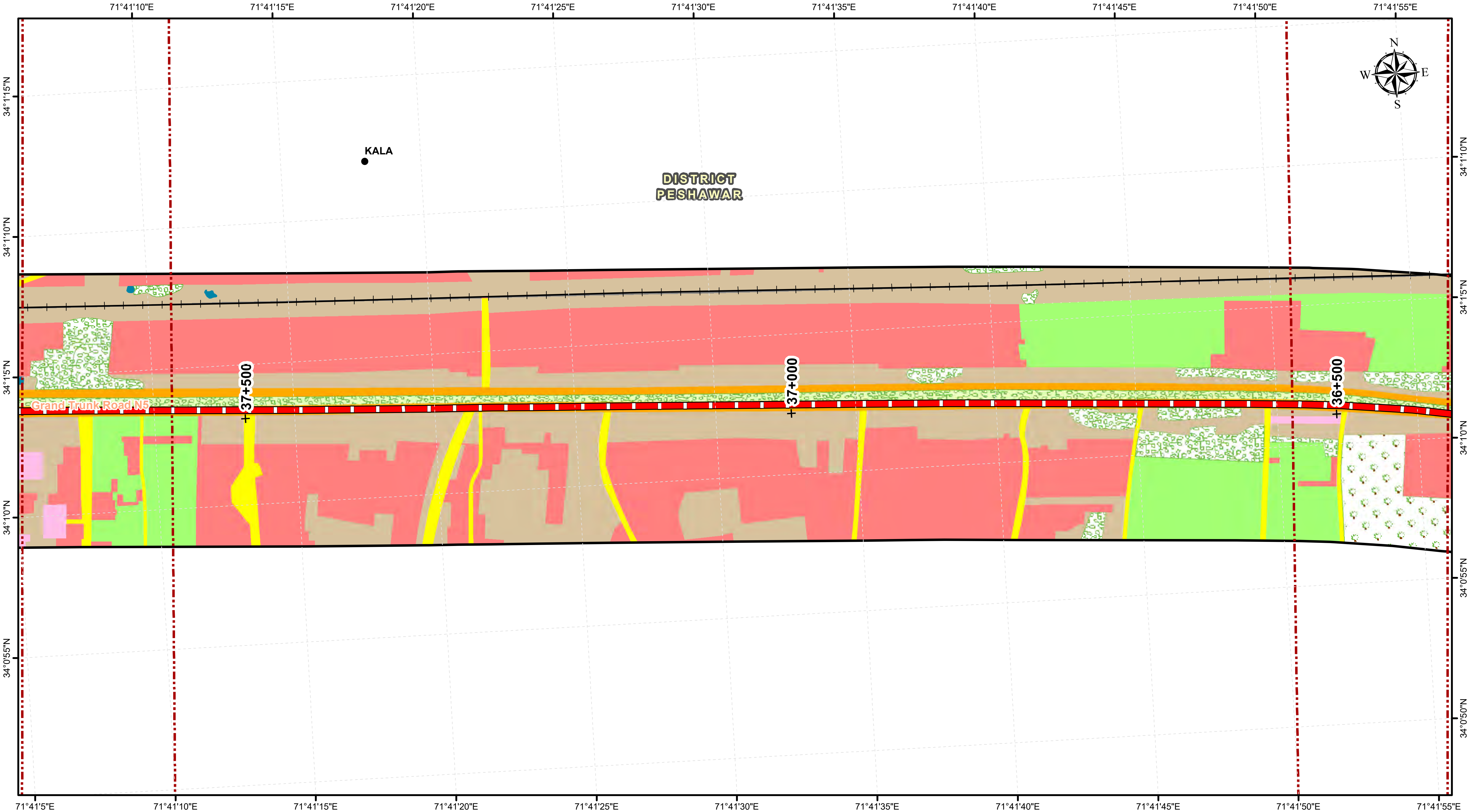
Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED				
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			DATE: NOVEMBER-2024 / DRAWING No.: SHEET 31 OF 35	REV.: 0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



0 50 100 200
Meters

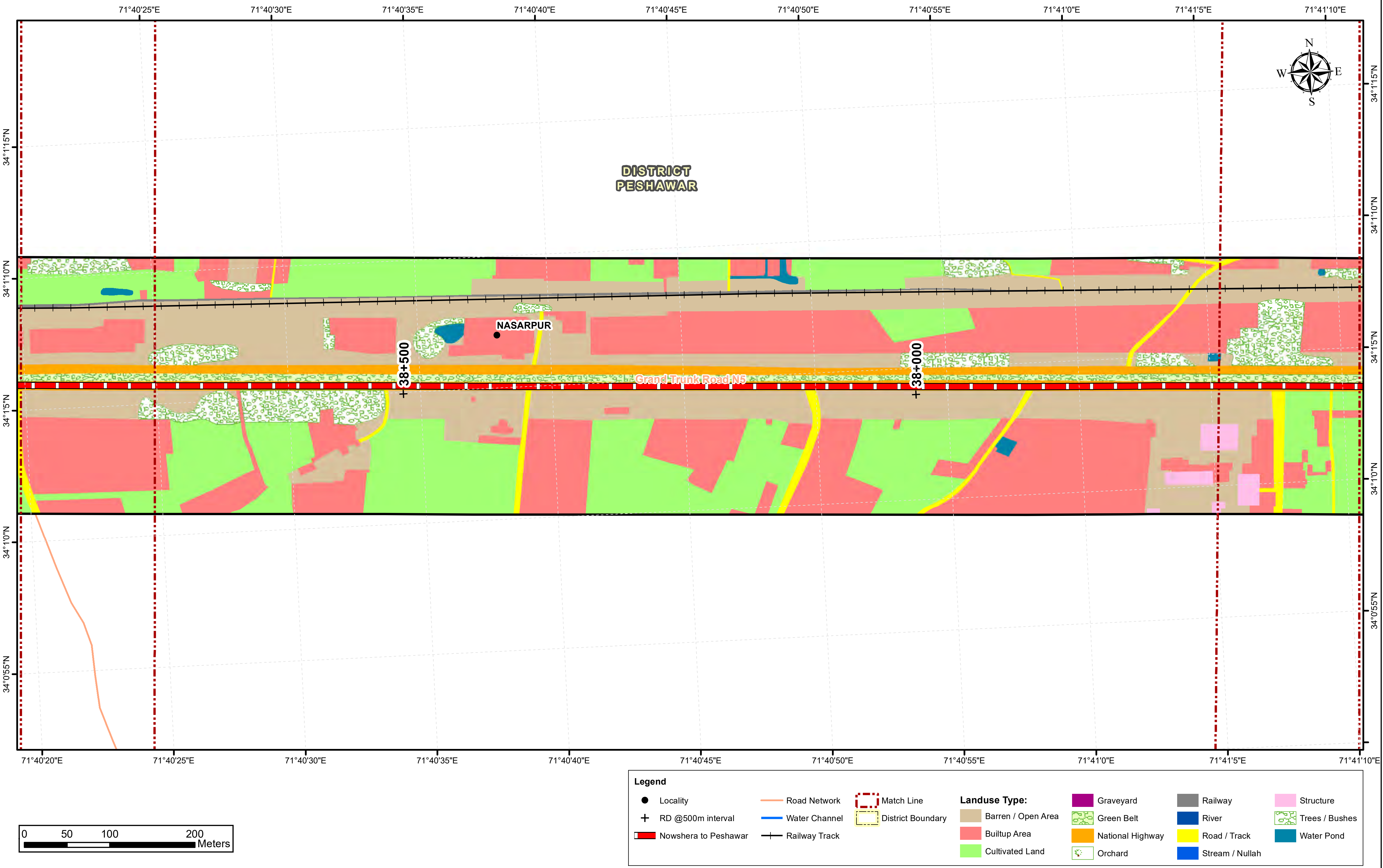
Legend

- Locality
- RD @500m interval
- Nowshera to Peshawar
- Road Network
- Water Channel
- Railway Track
- Match Line
- District Boundary

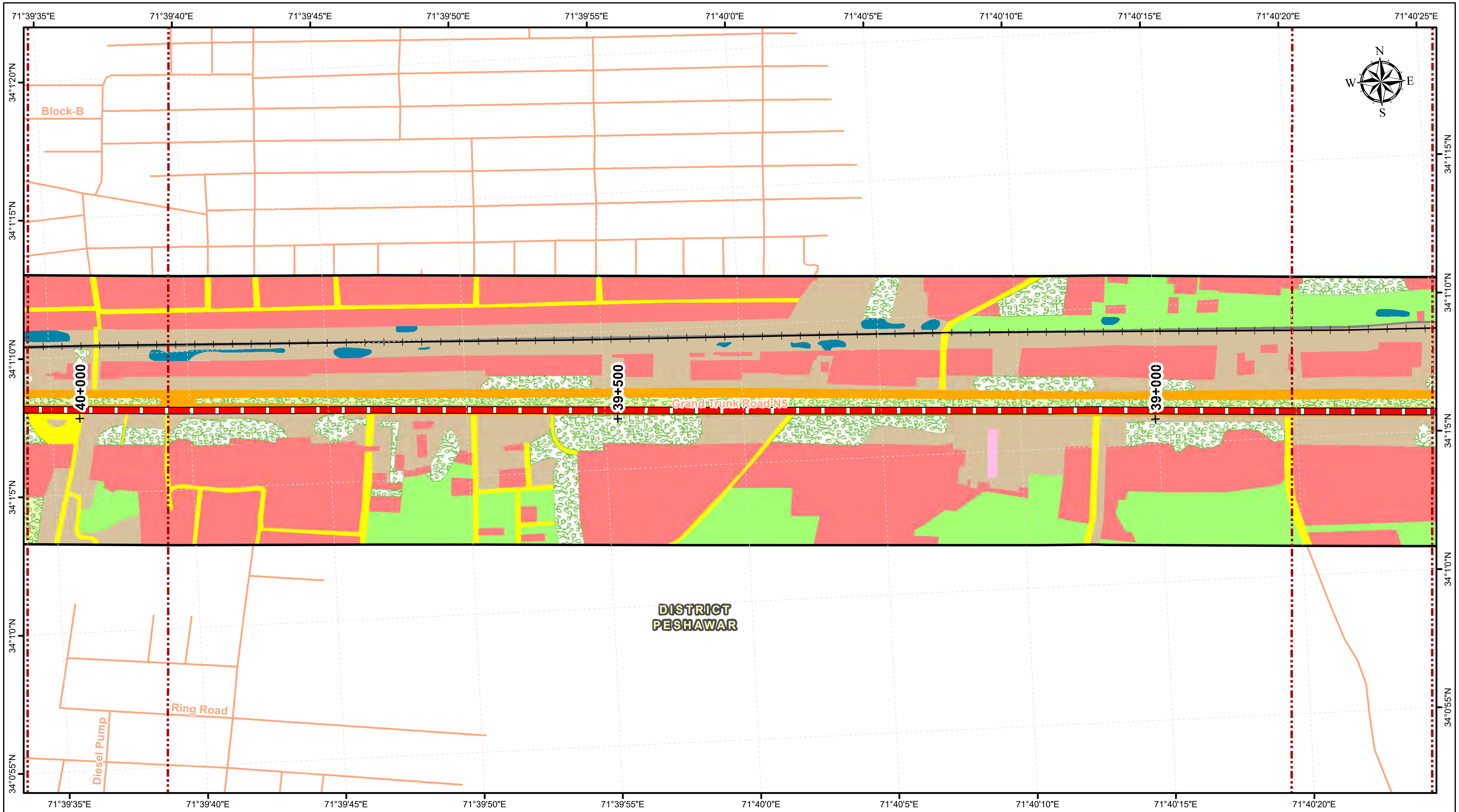
Landuse Type:

- Barren / Open Area
- Builtup Area
- Cultivated Land
- Graveyard
- Green Belt
- National Highway
- Orchard
- Railway
- River
- Road / Track
- Stream / Nullah
- Structure
- Trees / Bushes
- Water Pond

CLIENT	CONSULTANT							PROJECT			
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP		SCALE 1:4,000
		03				SUBMITTED	FAHAD S.				
		02				RECOMMENDED			DATE	DRAWING No.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024	SHEET 32 OF 35	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED					



CLIENT	CONSULTANT	REV.	DATE	DESCRIPTION	APPROVED			PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE	DRAWING No.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024	SHEET 33 OF 35
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED			REV.	0



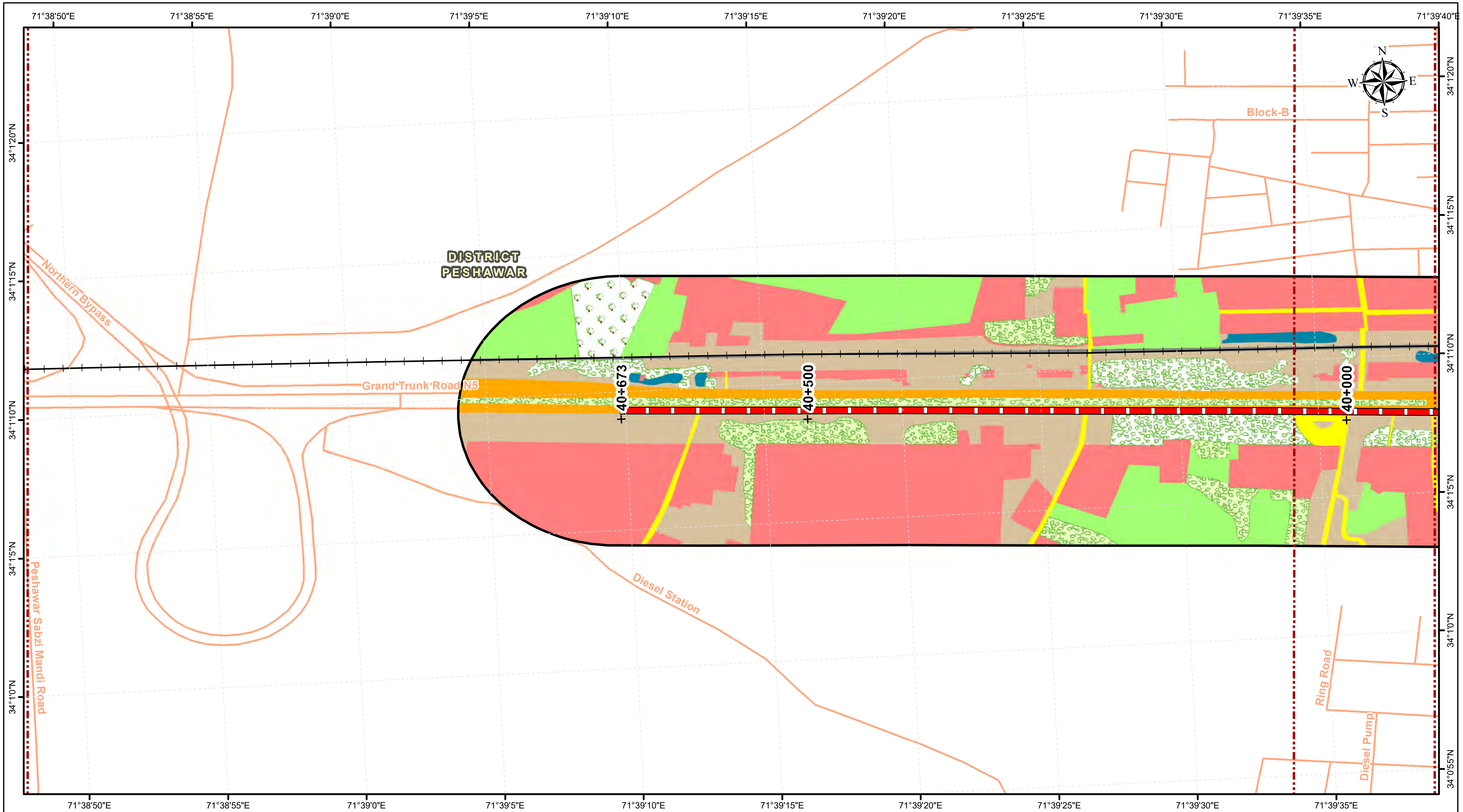
0 50 100 200
Meters

Legend

Locality	Road Network	Match Line	**Landuse Type:**	Graveyard
RD @500m interval	Water Channel	District Boundary	Barren / Open Area	Green Belt
Nowshera to Peshawar	Railway Track		Builtup Area	National Highway
			Cultivated Land	Orchard

Railway	Structure
River	Trees / Bushes
Road / Track	Water Pond
Stream / Nullah	

CLIENT	CONSULTANT							PROJECT		SCALE
NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD	04				DRAWN	M.MUNEEB	DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP	1:4,000
		03				SUBMITTED	FAHAD S.			
		02				RECOMMENDED			DATE / DRAWING No.	REV.
	HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	01				CHD/VER.			NOVEMBER-2024 / SHEET 34 OF 35	0
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED				



Legend

Locality	Road Network	Match Line	
RD @500m interval	Water Channel	District Boundary	
Nowshera to Peshawar	Railway Track		

Landuse Type:

Barren / Open Area	Graveyard	Railway	Structure
Builtup Area	Green Belt	River	Trees / Bushes
Cultivated Land	National Highway	Road / Track	Water Pond
	Orchard	Stream / Nullah	

0 50 100 200 Meters

CLIENT NATIONAL HIGHWAY AUTHORITY OF PAKISTAN	CONSULTANT NATIONAL ENGINEERING SERVICES PAKISTAN (PVT.) LTD HEAD OFFICE:- NESPAK HOUSE ,1-C, BLOCK-N MODEL TOWN EXTENSION, LAHORE, PAKISTAN	04				DRAWN	M.MUNEEB
		03				SUBMITTED	FAHAD S.
		02				RECOMMENDED	
		01				CHD/VER.	
		REV.	DATE	DESCRIPTION	APPROVED	APPROVED	

PROJECT			
DETAILED DESIGN FOR WIDENING AND IMPROVEMENT OF PRIORITY SECTIONS OF N-5 (PACKAGE-8: NOWSHERA TO PESHAWAR)	LANDUSE MAP		SCALE 1:4,000
	DATE NOVEMBER-2024	DRAWING No. SHEET 35 OF 35	REV. 0