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Initial Environmental Examination

Project number: 55119001
June 2026

Baku Metro Signaling Modernization and Operations Digitalization Project

Prepared by Azerbaijan Railways Joint Stock Company for the Asian Development Bank.

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ABBREVIATIONS AND DEFINITIONS

Abbreviation	Definition
ADB	Asian Development Bank
ALS	Automatic Locomotive Signaling
AM	Accountability Mechanism
ARS	Automatic Train Regulation
ARS-ALS	Automatic Train Regulation / Automatic Locomotive Signaling system
AZE	Azerbaijan manat, currency unit reference used in Currency Equivalents
AZN	Azerbaijani Manat
AZS	Azerbaijan State Standard
BOD	Biochemical Oxygen Demand
CBTC	Communications-Based Train Control
CBTC-MMI	Communications-Based Train Control – Man-Machine Interface
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CJSC	Closed Joint Stock Company
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CSC	Construction Supervision Consultant
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EmoP	Environmental Monitoring Plan
EN	European Standard
EPC	Engineering, Procurement and Construction
ESCO	Energy Service Company
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EU	European Union
FAT	Factory Acceptance Testing
FGD	Focus Group Discussion
GIIP	Good International Industry Practice
GO/NO-GO	Decision checkpoint for proceeding or not proceeding to the next stage
GPN	Good Practice Note / Good Practice Sourcebook reference
GRM	Grievance Redress Mechanism
H	High
HSE	Health, Safety and Environment
IEC	International Electrotechnical Commission
IEE	Initial Environmental Examination

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Abbreviation	Definition
IFC	International Finance Corporation
IFI	International Financial Institution
IVQ	Law reference code used in Azerbaijani legal acts
LOTO	Lock-Out / Tag-Out
MAC	Maximum Admissible Concentration
MENR	Ministry of Ecology and Natural Resources
MES	Ministry of Emergency Situations
MMI	Man-Machine Interface
MOD	Moderate
MPS	Fixed-block / legacy-type signaling system referenced as an alternative
MTR	Mass Transit Railway
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric Turbidity Unit
O ₂	Oxygen
OCC	Operations Control Center
OHS	Occupational Health and Safety
OVOS	Draft Concept Statement on Environmental Impact
PCB	Polychlorinated Biphenyls
PCB-R	PCB-related reference used in the document context
pH	Acidity / alkalinity indicator
PIU	Project Implementation Unit
PPE	Personal Protective Equipment
PR	Performance Requirement
PS	Performance Standard
PVC	Polyvinyl Chloride
RAMS	Reliability, Availability, Maintainability and Safety
RAMSAR	Convention on Wetlands of International Importance
SAEMRs	Semi-Annual Environmental Monitoring Reports
SAT	System / Site Acceptance Testing
SCADA	Supervisory Control and Data Acquisition
SDG	Sustainable Development Goal
SEE	State Environmental Expertise
SEMP	Site-Specific Environmental Management Plan
SEP	Stakeholder Engagement Plan
SO ₂	Sulfur Dioxide
SO ₄ -S	Sulphate sulfur
SP-6BM	Switch machine / point machine type SP-6BM
SPNT	Specially Protected Natural Territories
SPS	Safeguard Policy Statement
TDS	Total Dissolved Solids

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Abbreviation	Definition
TLV	Threshold Limit Value
TSS	Total Suspended Solids
UG-2	Gas analyzer type used for petroleum hydrocarbon measurements
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollar
USEPA	United States Environmental Protection Agency
WAD	Weak Acid Dissociable
WEEE	Waste Electrical and Electronic Equipment
WHO	World Health Organization
WMO	World Meteorological Organization

CURRENCY EQUIVALENTS

(as of May 2025)

Currency unit	–	AZE (Azerbaijan manat)
\$1.00	=	1,7 manat

1. EXECUTIVE SUMMARY

1.1 Introduction

1. The Baku Metro Signaling Modernization and Operations Digitalization Project is a strategic urban transport modernization initiative aimed at improving the safety, reliability, capacity, energy efficiency, and operational performance of the Baku Metro system. The project will introduce a modern communications-based train control system, upgrade signaling and communication infrastructure, establish improved digital operational control, install onboard and wayside equipment, and support the structured decommissioning of the existing legacy signaling system. The project responds to the need to modernize one of Baku's most important public transport systems and is expected to generate long-term benefits for passengers, Baku Metro staff, and the wider urban transport network.
2. The project will be implemented within the existing Baku Metro operational footprint, including tunnels, stations, depots, substations, technical rooms, control facilities, rolling stock, cable routes, and related operational infrastructure. It does not include construction of new metro lines, new stations, major excavation works, permanent land acquisition, physical displacement, or expansion into natural habitats or protected areas. The modernization is therefore primarily a rehabilitation, replacement, digitalization, and operational safety improvement project, rather than a new greenfield infrastructure project.
3. Under the Asian Development Bank Safeguard Policy Statement (2009), the project is classified as **Category B**. This classification is appropriate because potential impacts are expected to be site-specific, largely reversible, and manageable through the implementation of standard and project-specific mitigation measures. The main project risks are not associated with large-scale civil construction, but with the complexity of carrying out installation, testing, operation, and decommissioning activities within a live underground metro environment.

1.2 Project Description

4. The Baku Metro Signaling Modernization and Operations Digitalization Project is a strategic infrastructure modernization project aimed at improving the safety, reliability, capacity, operational efficiency, and long-term sustainability of the Baku Metro system. The project will replace the existing legacy signaling and control systems with a modern communications-based train control system and associated digital platforms. It will also upgrade wayside and onboard equipment, improve operational control through centralized digital systems, and support better monitoring, diagnostics, maintenance planning, and passenger information.
5. The project will be implemented within the existing Baku Metro infrastructure, including tunnels, stations, depots, substations, technical rooms, control facilities, cable routes, and rolling stock. No new metro lines, new stations, major excavation works, or expansion outside the existing metro footprint are planned. The works will mainly involve installation of new signaling and communication equipment, replacement of outdated electrical and control components, integration of new digital systems, testing and commissioning, and eventual dismantling of obsolete legacy infrastructure.
6. The project will be implemented in three main phases. The first phase will include design finalization, procurement, factory acceptance testing, installation of wayside and onboard

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equipment, system integration, pilot operation, and progressive rollout across the network. The second phase will consist of a stabilization and parallel operation period, during which the new system and the existing legacy system will operate simultaneously for approximately 6–12 months to verify safety, reliability, and operational readiness. The third phase will involve structured decommissioning of the existing system, including system deactivation, safety verification, pilot dismantling, full removal of obsolete equipment, material management, and final documentation.

7. A key environmental and safety consideration of the project is the controlled removal of legacy signaling and electrical equipment, including oil-filled choke-transformers, old cables, relay systems, switch machines, tunnel telephones, control boxes, and other electrical and electronic components. Since some equipment may contain oil residues or potentially hazardous materials, the project will require careful inventory, testing, segregation, safe handling, waste management, and transfer to certified organizations. Overall, the project is expected to generate long-term positive impacts by improving metro safety, reducing reliance on obsolete systems, strengthening operational control, and supporting more reliable and efficient public transport services in Baku.

1.3 Project Alternatives

8. The alternatives analysis for the Baku Metro Signaling Modernization and Operations Digitalization Project considered the **zero alternative** and the **technology alternative** for the signaling system. The zero alternative assumes that the project is not implemented and that the existing relay-based signaling and operational control systems continue to operate without modernization. Although this option would avoid short-term installation and decommissioning impacts, it is not considered acceptable because it would leave Baku Metro dependent on aging infrastructure, obsolete electrical and signaling equipment, and outdated control systems. Over time, this would increase risks related to system failure, service disruption, reduced passenger safety, higher maintenance needs, and continued environmental risks from old oil-filled equipment.
9. The main technology alternative assessed was the choice between a modern **CBTC-based signaling system** and a more traditional fixed-block or legacy-type signaling system. While the traditional system may require lower initial investment and may be simpler to install, it provides limited operational flexibility, lower network capacity, larger train separation distances, and higher long-term maintenance requirements. By contrast, the CBTC system allows continuous communication between trains and trackside infrastructure, more accurate train positioning, shorter headways, improved safety performance, better integration with digital systems, and stronger compatibility with future automation and smart transport management.
10. Based on the alternatives assessment, the CBTC-based modernization option is considered the preferred alternative. Although it has higher initial capital cost and greater implementation complexity, it provides clear long-term benefits in terms of safety, capacity, reliability, energy efficiency, passenger service quality, and lifecycle cost effectiveness. It also supports Azerbaijan's priorities for sustainable urban mobility, digital transformation, and improved public transport performance. Therefore, the selected project alternative represents the most appropriate and sustainable solution for the modernization of the Baku Metro system.

1.4 Baseline Information

11. The Baku Metro Project is located in Baku, on the Absheron Peninsula, along the western coast of the Caspian Sea. The project area is entirely within a highly urbanized environment, where land use is dominated by transport infrastructure, residential and commercial development, public service facilities, and long-established industrial activity. The metro network extends through central and peripheral districts of the city and connects important residential, employment, educational, commercial, healthcare, and administrative areas. Therefore, the baseline conditions are defined mainly by an urban and underground infrastructure environment rather than by natural or undeveloped landscapes.
12. The physical baseline of Baku is characterized by a semi-arid coastal climate, hot and dry summers, mild winters, and strong wind conditions typical of the Absheron Peninsula. The area is influenced by the Caspian Sea and by the well-known regional wind systems, including the cold northern Khazri and the warmer southern Gilavar winds. Precipitation is relatively low and concentrated mainly in autumn and winter, but short-duration rainfall events can still contribute to localized water accumulation and increased groundwater inflow into underground infrastructure. These climatic conditions are relevant for metro operation, ventilation, tunnel humidity, drainage systems, and worker comfort during underground works.
13. The geological and hydrogeological baseline is particularly important for the project. Baku is located within the South Caspian Basin, where the subsurface is composed of thick sedimentary formations, including clays, sandy clays, silts, sands, and anthropogenic fill. Groundwater is often shallow in low-lying and coastal areas, while deeper stations may interact with saturated layers or zones of seepage. Existing information confirms that groundwater inflow is a regular operational feature of the Baku Metro system. Water enters tunnels through joints, cracks, and surrounding soil layers and is managed through drainage channels, sumps, and pumping systems. This means that drainage protection and prevention of oil or hazardous material entry into tunnel drainage systems are important baseline management issues.
14. The biological baseline is of low sensitivity because the project will be implemented within existing underground and urban metro infrastructure. No natural habitats, protected areas, wetlands, riverbeds, or ecologically sensitive areas are located within the direct project footprint. Flora and fauna are limited mainly to urban-adapted species, such as rodents, insects, and common urban birds around above-ground facilities, depots, and station surroundings. Protected areas near Baku, including Absheron National Park, the Binagadi Paleontological Nature Monument, and the Gobustan protected landscape, are located at considerable distances from the project area and are outside the likely zone of project influence.
15. The social baseline is defined by the project's location in Azerbaijan's largest and most economically active urban area. Baku is the country's main center for employment, education, healthcare, services, administration, and transport. The metro system is a critical public transport service used daily by workers, students, residents, visitors, elderly passengers, persons with disabilities, and other groups dependent on affordable and reliable mobility. The wider Baku–Absheron area has a high population concentration and strong demand for efficient public transport, which makes the reliability and safety of the metro system socially important.

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16. The existing metro infrastructure includes deep and shallow underground stations, tunnels, depots, ventilation shafts, drainage systems, relay rooms, technical rooms, legacy signaling equipment, and oil-filled electrical components. Several older stations also have architectural and cultural value, particularly Nizami Metro Station, which is identified as a listed architectural monument of national importance. Baseline monitoring carried out by the Baku Metro Laboratory shows that the metro system already has an internal environmental monitoring function covering parameters such as temperature, relative humidity, noise, ventilation conditions, and selected petroleum hydrocarbon checks. This existing monitoring capacity provides an important basis for future project monitoring, although specialized external laboratories will still be required for PCB testing, hazardous waste classification, and other complex analyses.

1.5 Environmental Impacts

17. The environmental impacts of the Baku Metro Signaling Modernization and Operations Digitalization Project are expected to be mainly site-specific, temporary, and manageable through the implementation of the Environmental Management Plan. The project will be carried out within the existing Baku Metro footprint, including tunnels, stations, depots, technical rooms, substations, control facilities, cable routes, and rolling stock areas. It does not include new metro lines, new stations, major excavation works, expansion into natural habitats, or works in protected areas. Therefore, the project is not expected to cause large-scale or irreversible environmental impacts.
18. The main environmental risks are associated with the implementation of works in a live underground metro environment and with the removal of legacy electrical and signaling equipment. Installation works may generate localized dust, fumes, odors, heat, noise, and minor waste, especially during drilling, fixing, cable routing, cleaning of cable ducts, and works in technical rooms. Since many activities will be carried out in enclosed underground areas with limited natural ventilation, indoor air quality and worker exposure are more important issues than outdoor ambient air pollution. These impacts can be controlled through ventilation, housekeeping, dust suppression, permit-to-work procedures, and use of appropriate personal protective equipment.
19. Waste management is one of the most significant environmental issues for the project, particularly during the decommissioning phase. The project will generate cable waste, scrap metals, old control boxes, relay equipment, tunnel telephones, switch machines, e-waste, packaging, oily residues, absorbents, and potentially hazardous waste. A key concern is the presence of approximately 933 oil-filled choke-transformers, which may contain old insulating oil and may require PCB screening before dismantling, transport, recycling, or disposal. If not properly managed, these materials could create risks of oil leakage, hazardous waste misclassification, worker exposure, and contamination of tunnel drainage systems.
20. Potential impacts on groundwater and drainage are also relevant because groundwater inflow is an existing operational condition in parts of the Baku Metro system. The project itself will not create new impacts on rivers, lakes, canals, or the Caspian Sea, but installation and dismantling activities could affect tunnel drainage channels, sumps, or pumping systems if waste, oils, sediments, or cleaning materials are not properly controlled. The main risk is accidental contamination of drainage water from transformer oil, lubricants, contaminated sediment, oily residues, or cleaning liquids. These impacts can be minimized through drainage protection, spill prevention, secondary containment, water quality checks where needed, and strict prohibition of discharging contaminated liquids into tunnel drainage.

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21. Impacts on soils, geology, biodiversity, and protected areas are expected to be low. The project will not involve topsoil stripping, major earthworks, agricultural land disturbance, or new land take. Any soil or surface contamination risk would be localized and linked mainly to depot areas, technical rooms, tunnel floors, cable ducts, ballast, and handling of old oil-filled equipment. Biodiversity impacts are also expected to be insignificant because the project area is highly urbanized and underground, with no natural habitat conversion. Protected areas near Baku are located outside the project's physical footprint and beyond the likely zone of influence from dust, noise, vibration, wastewater, transport, or operational emissions.
22. Cultural heritage impacts require specific attention, although significant impacts are not expected if mitigation measures are applied. Nizami Metro Station is identified as an architectural monument of national importance, and several older stations may also have architectural, artistic, or historical value. Project works such as drilling, fixing, cable routing, installation of cabinets, movement of materials, or waste removal could accidentally damage decorative finishes, mosaics, stone cladding, wall panels, lighting features, or other station-specific elements if carried out without controls. Therefore, heritage-sensitive screening, pre-work condition recording, approval of fixing points, protective coverings, and a Chance Find Procedure are required.
23. Overall, the project is expected to have important long-term positive environmental and operational impacts. By replacing aging signaling and electrical systems, improving operational control, introducing modern digital systems, and safely decommissioning obsolete equipment, the project will reduce long-term risks associated with old oil-filled infrastructure, degraded cables, operational inefficiency, and system failures. With proper implementation of the EMP, waste management plan, hazardous materials procedures, OHS controls, monitoring program, and grievance mechanism, residual environmental impacts are expected to remain low to medium and acceptable.
24. No separate land acquisition and resettlement plan is proposed for this project, as all activities will be implemented within the existing operational footprint of Baku Metro, including existing tunnels, stations, depots, substations, technical rooms, control facilities, cable routes and rolling stock areas. The project does not require construction of new metro lines or stations, major excavation works, permanent land acquisition, physical displacement, economic displacement, or restriction of access to land or natural resources. Therefore, no impacts on land ownership, land use, private property, residential structures, businesses, agricultural land or livelihoods are anticipated. The project also does not trigger Indigenous Peoples safeguards, as the activities will be carried out in a fully urbanized metropolitan transport environment and no distinct Indigenous Peoples communities, traditional territories, customary land use systems, collective attachment to ancestral lands, or culturally distinct livelihood systems are present within the project area or likely zone of influence. Accordingly, no Indigenous Peoples Plan is required.

1.6 Mitigation Measures

25. The mitigation measures for the Baku Metro Signaling Modernization and Operations Digitalization Project are based on the principle of avoiding impacts where possible, reducing risks at source, and managing residual impacts through site-specific procedures, monitoring, supervision, and corrective actions. Since the project will be implemented within the existing Baku Metro infrastructure, the first and most important mitigation measure is to keep all works within approved tunnels, stations, depots, technical rooms, control facilities, and other existing

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operational areas. No project activities, storage areas, waste sites, or ancillary facilities should be located in protected areas, natural habitats, or areas outside the approved Baku Metro footprint.

26. Before works begin, the Contractor should prepare a Site-Specific Environmental Management Plan and all required topic-specific plans, including the Waste Management Plan, Hazardous Materials and PCB Management Plan, Occupational Health and Safety Plan, Community Health and Safety / Passenger Safety Plan, Emergency Preparedness and Response Plan, Groundwater and Drainage Management Plan, Air Quality and Ventilation Management Plan, Cultural Heritage Management Plan, Stakeholder Engagement and Grievance Redress Plan, and Training Plan. These plans should be reviewed and approved by the PIU and the Construction Supervision Consultant before the Contractor is allowed to access any work area. The plans should define specific work locations, responsible persons, monitoring requirements, reporting arrangements, emergency procedures, and corrective action mechanisms.
27. Waste management measures are a priority for the project, especially during decommissioning of the existing signaling system. All waste should be segregated at source, and hazardous and non-hazardous waste must not be mixed. Waste shall not be temporarily stored in tunnels, platforms, escape routes, drainage channels, cable ducts, shafts, or underground operational areas. Waste generated underground should be collected during the same work shift and transported to the designated depot-based temporary storage area, preferably by rail during the approved night working window. Scrap metal, cables, e-waste, packaging, oily materials, used absorbents, batteries, lamps, used oils, and PCB-suspected materials should be stored separately, labelled, documented, and transferred only to certified or licensed organizations.
28. Specific mitigation is required for old oil-filled equipment, including the approximately 933 choke-transformers identified in the project documentation. These units should be treated as potentially hazardous until testing confirms their classification. Before opening, draining, dismantling, transporting, or disposing of oil-filled equipment, the Contractor should prepare an inventory, inspect equipment condition, conduct oil-quality and PCB testing where required, and apply a chain-of-custody system. Oil-filled equipment and liquid waste should be placed on impermeable surfaces with secondary containment. Liquid waste, including transformer oil, oily water, solvents, cleaning liquids, and contaminated drainage residues, should be stored in leak-proof containers placed in secondary containment with a capacity of at least 110% of the container volume.
29. To protect tunnel drainage systems and groundwater, all drainage channels, sumps, and pumping systems should remain operational and unobstructed during works. Cables, dismantled equipment, packaging, waste, tools, or construction materials should not be placed in drainage channels or near sump inlets. Any oil leakage, visible sheen, contaminated sediment, abnormal odor, or uncontrolled water inflow should trigger immediate stop-work, isolation of the affected area, notification of Baku Metro HSE staff, and implementation of corrective measures. Contaminated sludge, oily residues, absorbents, and drainage sediments should be collected separately, classified, and managed through licensed waste contractors.
30. Occupational and passenger safety measures should be applied throughout all project phases. Works in tunnels, technical rooms, relay rooms, transformer areas, and other confined or semi-confined spaces should be carried out only under approved permits. Lock-Out / Tag-Out procedures should be mandatory for electrical works, while confined-space entry should require ventilation, atmospheric checks where needed, standby personnel, communication

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arrangements, lighting, and rescue procedures. Passenger areas should be physically separated from work zones through barriers, signage, locked access points, or supervision. Emergency exits, evacuation routes, stairs, lifts, escalators, platforms, and public access routes should remain unobstructed, safe, well-lit, and accessible for vulnerable users.

31. Cultural heritage mitigation should be applied where works are planned at Nizami Metro Station or other architecturally valuable stations. Before works begin in sensitive areas, photographic and written condition records should be prepared. Drilling, cutting, fixing, anchoring, or routing of cables on decorative or heritage-sensitive surfaces should not be allowed without written approval. Protective coverings should be installed during material movement, and heavy equipment or dismantled materials should not be stored against decorative panels, stone cladding, mosaics, inscriptions, or historic finishes. A Chance Find Procedure should apply to all intrusive works. With these mitigation measures, combined with continued stakeholder engagement, grievance management, laboratory monitoring, supervision, and semi-annual reporting to ADB, residual impacts are expected to remain low to medium and manageable.

1.7 Environmental Management Plan Description

32. The Environmental Management Plan for the Baku Metro Signaling Modernization and Operations Digitalization Project provides the practical framework for implementing all environmental, occupational health and safety, community health and safety, social, cultural heritage, waste management, monitoring, and reporting measures identified in the IEE. The EMP translates the impact assessment findings into specific obligations for Baku Metropoliteni CJSC, the PIU, the Contractor, subcontractors, the supervision consultant, Baku Metro operational departments, depot management, laboratory personnel, and certified waste management organizations. The EMP will form part of the bidding and contract documents and will be binding on all contractors and subcontractors involved in project implementation.
33. The EMP applies to all project phases, including pre-construction planning, signaling modernization and operations digitalization, stabilization and parallel operation, decommissioning of the existing system, and operation of modernized system. Since the project will be implemented within an active underground metro system, the EMP gives particular attention to works in tunnels, stations, depots, technical rooms, cable routes, substations, control facilities, and rolling stock areas. It also reflects the project's main risk profile, including confined-space works, electrical safety, tunnel ventilation, night works, passenger safety, groundwater and drainage protection, hazardous materials management, waste management, cultural heritage protection, and the decommissioning of legacy equipment.
34. Before works begin, the Contractor will be required to prepare a Site-Specific Environmental Management Plan and a set of topic-specific management plans. These should include, at minimum, a Waste Management Plan, Hazardous Materials and PCB Management Plan, Spill Prevention and Response Plan, Groundwater and Drainage Management Plan, Air Quality and Ventilation Management Plan, Noise and Vibration Management Plan, Occupational Health and Safety Plan, Community Health and Safety / Passenger Safety Plan, Electrical Safety and Lock-Out / Tag-Out Plan, Confined Space Work Procedure, Emergency Preparedness and Response Plan, Cultural Heritage Management Plan, Stakeholder Engagement and Grievance Redress Plan, and Training and Capacity Building Plan. No physical works should start until these plans are reviewed and approved by the PIU and Construction Supervision Consultant.

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35. The EMP establishes specific mitigation requirements for the project's key environmental risks. Waste generated in tunnels, stations, technical rooms, and other underground areas must be collected during the same work shift and must not be temporarily stored in tunnels, platforms, escape routes, drainage channels, cable ducts, shafts, or other operational underground areas. Hazardous and non-hazardous waste must be segregated, labelled, documented, and transported to designated depot-based temporary storage areas. Liquid waste must be stored in leak-proof containers placed in secondary containment with a capacity of at least 110% of the container volume. Final waste management must be carried out only by certified or licensed organizations.
36. A central component of the EMP is the management of old oil-filled electrical equipment, including the approximately 933 choke-transformers identified in the project documentation. These units and their oils must be treated as potentially hazardous until testing confirms their classification. Before opening, draining, dismantling, moving, recycling, or disposing of any oil-filled equipment, the Contractor must complete an inventory, conduct condition checks, carry out PCB or oil-quality testing where required, and apply documented chain-of-custody procedures. PCB-suspected or PCB-confirmed waste must be isolated, labelled, stored under controlled conditions, and managed only through legally authorized hazardous waste routes.
37. The EMP also defines institutional responsibilities and monitoring requirements. Baku Metropolitani CJSC will have overall responsibility for project safeguard compliance; the PIU will provide day-to-day coordination and oversight; the Contractor will implement the approved SEMP and topic-specific plans; and the Construction Supervision Consultant will verify compliance through inspections, audits, review of records, and corrective action follow-up. The Baku Metro Laboratory will continue routine monitoring where its capacity is sufficient, while external certified laboratories will be used for specialized analysis, including PCB testing, hazardous waste classification, detailed water quality analysis, and contaminated residue testing.
38. Monitoring and reporting are essential parts of the EMP. The Contractor must maintain records of environmental monitoring, waste quantities, waste transfer notes, disposal certificates, training, work permits, incidents, near misses, grievances, non-compliances, and corrective actions. Monthly environmental, health and safety reports should be submitted to the PIU and supervision consultant. The PIU should then prepare semi-annual environmental monitoring reports for submission to ADB. With proper implementation of the EMP, residual impacts are expected to remain low to medium and manageable, while the project is expected to generate long-term positive outcomes through improved metro safety, reduced legacy contamination risks, stronger operational control, better passenger service, and enhanced environmental management capacity.

1.8 Grievance Redress Mechanism

39. The Grievance Redress Mechanism for the Baku Metro Signaling Modernization and Operations Digitalization Project will provide a formal, accessible, transparent, and timely process for receiving, registering, reviewing, responding to, and resolving complaints from passengers, workers, nearby businesses, affected persons, and other stakeholders. The GRM will cover environmental, social, occupational health and safety, passenger safety, access, livelihood, service disruption, waste management, and other project-related concerns. It will be implemented in accordance with the applicable legislation of the Republic of Azerbaijan and ADB Safeguard Policy Statement requirements, which require a mechanism for receiving and facilitating resolution of affected persons' concerns and grievances.

40. The GRM will build on the existing complaint handling system of Baku Metropoliteni CJSC, including station-level complaint intake and the Public Relations Center, which already receives and processes public complaints. Complaints may be submitted through Baku Metro stations, the Public Relations Center, the PIU, the Contractor, or other disclosed communication channels. Project-related complaints will be registered in a logbook or electronic database, reviewed by the responsible project or operational unit, and assigned for response and corrective action. If a complaint cannot be resolved at the first level, it may be escalated to the Baku Metropoliteni CJSC head office and, if still unresolved, to the court system in accordance with national legislation.
41. All grievances and the actions taken to resolve them will be documented and monitored. The Contractor will be required to report received complaints and corrective actions to the PIU, while the PIU will consolidate grievance information for inclusion in semi-annual environmental monitoring reports submitted to ADB. The GRM will be disclosed before the start of works, including contact details and complaint submission channels. It will remain available throughout project implementation and the operational phase to ensure that stakeholder concerns are addressed promptly, fairly, and transparently.

1.9 Stakeholder Engagement Plan

42. The Stakeholder Engagement Plan for the Baku Metro Signaling Modernization and Operations Digitalization Project will provide the framework for timely, inclusive, transparent, and continuous communication with stakeholders throughout project preparation, implementation, stabilization, decommissioning, and operation. The SEP should ensure that passengers, Baku Metro staff, nearby businesses, vulnerable groups, public institutions, service providers, contractors, and relevant authorities receive understandable information on the project objectives, implementation schedule, expected impacts, mitigation measures, access changes, safety arrangements, and grievance channels. This is particularly important because the project will be implemented within an operating metro system, where temporary disruption to passenger movement, business access, public safety, and service reliability may occur if works are not properly communicated.
43. The SEP should build on consultations already held with Baku Metropoliteni CJSC departments and operational services, including discussions on project objectives, current technical problems, equipment proposed for dismantling, environmental monitoring, waste management, occupational and passenger safety, complaint handling, and ADB safeguard requirements. Engagement methods should include public meetings, institutional meetings, face-to-face consultations where specific access or business impacts are expected, information leaflets, website and social media disclosure, station notices, posters, and project information boards. The approach should be inclusive and accessible, with attention to elderly passengers, persons with disabilities, women travelling with children, low-income metro users, students, workers, businesses near stations, and other groups that may be more sensitive to temporary access or service changes.
44. The SEP should remain active during implementation and operation and should be closely linked with the project Grievance Redress Mechanism. Information disclosure should be provided before works that may affect station entrances, pedestrian routes, public transport interfaces, businesses, passenger safety, service schedules, night works, waste transport, or culturally sensitive station areas. Feedback received through consultations, station-level communication, the Public Relations Center, the PIU, and the Contractor should be recorded,

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reviewed, and used to update mitigation measures where necessary. The Stakeholder Engagement and Grievance Redress Plan is also identified as a required topic-specific management plan, covering disclosure, complaint intake through Baku Metro structures, coordination with the Public Relations Center, response timelines, records, and reporting.

1.10 EMP Cost Description

45. The costs for implementation of the Environmental Management Plan for the Baku Metro Signaling Modernization and Operations Digitalization Project will include both standard contractor obligations and specific incremental safeguard costs. Standard costs, such as routine housekeeping, PPE, basic OHS measures, worker induction, safe access control, ordinary waste collection, signage, and routine supervision, are expected to be included in the Contractor's general contract price. Additional EMP costs will be required for specialist environmental and social supervision, instrumental monitoring, hazardous materials and PCB screening, waste management, emergency preparedness, stakeholder engagement, grievance management, cultural heritage protection, and training of contractor, depot, laboratory, and Baku Metro personnel.
46. The estimated EMP budget for planning purposes is approximately **USD 950,000**, including a 10% contingency. This estimate covers supervision specialists, contractor EHS staff, monitoring, transformer oil and PCB testing, hazardous waste classification, spill kits, secondary containment, depot waste storage improvements, certified hazardous waste handling support, worker and depot staff training, emergency drills, GRM and public information activities, cultural heritage protection measures, and independent safeguard review. The budget should be reviewed and refined during detailed design, contractor mobilization, and before decommissioning, particularly if PCB contamination, asbestos-containing materials, contaminated sludge, or other hazardous materials are confirmed during implementation.

1.11 Environmental Management Plan

47. The Environmental Management Plan for the Baku Metro Signaling Modernization and Operations Digitalization Project establishes the practical framework for managing environmental, occupational health and safety, community health and safety, cultural heritage, waste management, stakeholder engagement, monitoring, and reporting requirements during project implementation and operation. The EMP translates the findings of the IEE into specific mitigation and monitoring obligations and will form part of the bidding and contract documents, making its implementation mandatory for the Contractor, subcontractors, Baku Metropoliteni CJSC, the PIU, and other parties involved in the project.
48. The EMP applies to all phases of the project, including pre-construction planning, signaling modernization and operations digitalization, stabilization and parallel operation, decommissioning of the existing system, and operation after modernization. Since the project will be implemented within a live underground metro system, the EMP focuses on the key risks associated with confined-space works, electrical safety, Lock-Out / Tag-Out procedures, tunnel ventilation, night works, passenger safety, groundwater and drainage protection, hazardous materials, waste transport, and decommissioning of legacy equipment, including oil-filled choke-transformers and other electrical and electronic components.

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49. Before works begin, the Contractor will be required to prepare a Site-Specific Environmental Management Plan and topic-specific plans, including a Waste Management Plan, Hazardous Materials and PCB Management Plan, Spill Prevention and Response Plan, Groundwater and Drainage Management Plan, Air Quality and Ventilation Management Plan, Occupational Health and Safety Plan, Community Health and Safety / Passenger Safety Plan, Emergency Preparedness and Response Plan, Cultural Heritage Management Plan, Stakeholder Engagement and Grievance Redress Plan, and Training Plan. These documents must be reviewed and approved by the PIU and Construction Supervision Consultant before the Contractor is allowed to start works in any project area.
50. A central requirement of the EMP is the safe management of waste and hazardous materials. Waste shall not be temporarily stored in tunnels, platforms, escape routes, drainage channels, cable ducts, shafts, or other underground operational areas. Waste generated underground must be collected during the same work shift and transported to designated depot-based temporary storage areas. Hazardous and non-hazardous waste must be segregated, labelled, documented, and transferred only to certified or licensed organizations. Liquid waste, including transformer oil and oily residues, must be stored in leak-proof containers placed in secondary containment with capacity equal to at least 110% of the container volume.
51. The EMP also defines monitoring, reporting, and corrective action requirements. The Contractor will maintain records of inspections, monitoring results, waste quantities, disposal certificates, training, incidents, grievances, non-compliances, and corrective actions. The Construction Supervision Consultant will verify compliance through inspections and audits, while the PIU will oversee safeguard implementation and submit semi-annual environmental monitoring reports to ADB. With effective implementation of the EMP, residual environmental and social impacts are expected to remain low to medium and manageable, while the project will deliver long-term benefits through improved metro safety, reliability, operational control, and reduced risks from obsolete legacy infrastructure.

1.12 Environmental Monitoring Plan

52. The Environmental Monitoring Plan for the Baku Metro Signaling Modernization and Operations Digitalization Project defines the monitoring requirements needed to verify that the mitigation measures included in the EMP are properly implemented and effective. The EMoP identifies the parameters to be monitored, monitoring locations, frequency, responsible parties, applicable standards or criteria, reporting requirements, and corrective action procedures. It will form part of the bidding and contract documents and will be implemented throughout pre-construction, installation, stabilization, decommissioning, and operation phases.
53. Monitoring will include both instrumental monitoring and observational monitoring. Instrumental monitoring will cover key environmental and safety-related parameters such as platform microclimate, noise, ventilation conditions, indoor air quality, petroleum hydrocarbons, transformer oil quality, PCB screening, tunnel drainage water quality, contaminated residues, and vibration where works may affect heritage-sensitive station elements. The Baku Metro Laboratory will continue routine monitoring where its capacity is sufficient, while external certified laboratories will be engaged for specialized testing, including PCB analysis, hazardous waste classification, detailed water quality testing, and contaminated sludge or sediment analysis.
54. Observational monitoring will focus on the implementation of EMP requirements at work sites. This will include checking approval and implementation of the Site-Specific EMP and topic-

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specific plans, compliance with the approved work footprint, waste segregation, prohibition of waste storage in tunnels, depot-based waste handling, secondary containment for liquid waste, spill prevention, protection of tunnel drainage systems, housekeeping, PPE use, electrical isolation, confined-space controls, fire safety, passenger safety, cultural heritage protection, grievance management, and corrective action closure. Monitoring will be carried out by the Contractor and verified by the Construction Supervision Consultant and PIU.

55. The Contractor will maintain an auditable environmental and safety filing system covering monitoring results, inspection checklists, permits, waste transfer notes, disposal certificates, laboratory results, training records, incident reports, non-compliance notices, corrective actions, and grievance records. Monthly environmental, health and safety reports will be submitted to the PIU and Construction Supervision Consultant, while the PIU will prepare semi-annual environmental monitoring reports for submission to ADB. These reports will summarize EMP implementation, monitoring results, incidents, complaints, non-compliances, corrective actions, and any required updates to the monitoring programme.

1.13 Conclusions and Recommendations

56. The Baku Metro Signaling Modernization and Operations Digitalization Project is assessed as an environmentally and socially acceptable **Category B** project, provided that the Environmental Management Plan, Environmental Monitoring Plan, grievance mechanism, institutional arrangements, and topic-specific management plans are fully implemented. The project will be carried out within the existing Baku Metro infrastructure and will not require new metro lines, new stations, major excavation, land acquisition, physical displacement, or expansion into natural habitats or protected areas. Therefore, most potential impacts are expected to be localized, temporary, reversible, and manageable through standard and project-specific mitigation measures.
57. The main project risks are associated with implementation in a live underground metro environment and with the decommissioning of old signaling and electrical equipment. Key issues include occupational health and safety, confined-space works, electrical isolation, fire safety, tunnel ventilation, passenger safety, temporary access restrictions, groundwater and drainage protection, hazardous waste, e-waste, oil-filled equipment, and possible PCB contamination. Particular attention is required for the approximately 933 oil-filled choke-transformers and other legacy equipment, which must be inventoried, tested where necessary, segregated, handled under controlled conditions, and transferred only to certified or licensed organizations.
58. It is recommended that the EMP, EMoP, and all topic-specific plans be included in the bidding and contract documents and made binding on the Contractor and subcontractors. Before works begin, the Contractor should prepare a Site-Specific Environmental Management Plan, Waste Management Plan, Hazardous Materials and PCB Management Plan, Occupational Health and Safety Plan, Passenger Safety Plan, Emergency Preparedness and Response Plan, Cultural Heritage Management Plan, Stakeholder Engagement and GRM Plan, and other required procedures. No works should start until relevant method statements, permits, monitoring arrangements, emergency procedures, and waste management arrangements are reviewed and approved by the PIU and Construction Supervision Consultant.
59. Overall, the project is expected to generate significant long-term positive impacts by improving metro safety, reliability, operational efficiency, passenger information, system capacity, and staff technical capacity. With effective implementation of mitigation, monitoring, stakeholder

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engagement, grievance management, training, and corrective action procedures, residual impacts are expected to remain low to medium and acceptable. The project should therefore proceed subject to strict implementation of ADB safeguard requirements, national legislation, certified hazardous waste management, continued Baku Metro Laboratory monitoring, and regular semi-annual environmental monitoring reporting to ADB.

2. INTRODUCTION

2.1 General

60. This section provides a) the background to the railway sector and electrification in Azerbaijan, b) the needs for and objectives of the Project, c) the purpose of the IEE, d) the Project Category under ADB's SPS (2009) and e) the scope, boundaries, methodology and the structure of the IEE report.

2.2 Baku Metro Signaling Modernization and Operations Digitalization Background

61. The Baku Metro Signaling Modernization and Operations Digitalization Project is closely aligned with Azerbaijan's long-term development priorities, particularly those related to sustainable urban transport, digital transformation, and improved public service delivery. National strategies such as Azerbaijan 2030¹: National Priorities for Socio-Economic Development and urban planning frameworks² like the Baku Master Plan 2040 emphasize the need to modernize critical infrastructure, enhance mobility, and promote low-carbon development. By upgrading the metro system one of the primary modes of public transport in the capital the project directly supports these objectives, contributing to more efficient, reliable, and environmentally sustainable urban mobility.

62. From an environmental perspective, the project is expected to generate significant positive impacts by improving energy efficiency and reducing emissions associated with urban transport. The introduction of modern CBTC signaling and digital control systems will optimize train operations, reduce unnecessary energy consumption, and enable more efficient scheduling and headway management. These improvements can lead to a reduction in greenhouse gas emissions and air pollutants, particularly by encouraging greater use of public transport and reducing reliance on private vehicles. In addition, the project includes the replacement and proper management of outdated electrical equipment, including oil-filled transformers, thereby addressing potential sources of environmental contamination and improving overall environmental safety.

63. The project will also deliver important social benefits for the population of Baku and surrounding areas. Enhanced reliability, safety, and capacity of the metro system will improve daily commuting conditions for hundreds of thousands of passengers, reducing travel times and congestion. The modernization of systems, including real-time passenger information and improved operational control, will enhance the overall quality of service and accessibility. Furthermore, improved safety systems and reduced risk of operational incidents will contribute to greater public confidence in the metro as a safe and dependable mode of transport.

64. Overall, the project represents a key step toward sustainable urban development in Azerbaijan, combining technological modernization with environmental and social improvements. By integrating advanced digital systems, strengthening infrastructure resilience, and addressing legacy environmental risks, the project not only aligns with national development strategies but also supports international commitments related to climate change, environmental protection, and improved quality of life for the population.

¹ https://unece.org/sites/default/files/2025-08/2503622_E_PDF_WEB.pdf

² https://president.az/en/articles/view/50474?utm_source=chatgpt.com

2.3 Project Overview and Objectives

65. The Baku Metro Signaling Modernization and Operations Digitalization Project is a strategic infrastructure initiative aimed at transforming the performance, safety, and efficiency of the urban rail system in Baku. The project is implemented by the Baku Metro CJSC with support from the Asian Development Bank and forms part of a broader program to modernize public transport infrastructure in Azerbaijan. The project focuses on upgrading legacy systems and introducing advanced digital technologies to meet growing urban mobility demands and align with international standards.
66. At its core, the project involves the introduction of a modern communications-based train control (CBTC) system, which will replace the existing relay-based signaling infrastructure. This upgrade will allow for more precise train control, reduced headways, and increased network capacity. In parallel, the project includes the establishment of a centralized Operations Control Center (OCC) and the deployment of integrated digital platforms for asset management, diagnostics, and passenger information systems. Together, these components will enable real-time monitoring and data-driven decision-making across the metro network.
67. A key feature of the project is its phased implementation approach, which ensures continuity of operations while transitioning from legacy systems to modern infrastructure. The first phase focuses on system design, procurement, installation, and commissioning of new technologies. This is followed by a parallel operation period of approximately 6–12 months, during which both the new and existing systems operate simultaneously to validate performance and ensure safety. The final phase involves the structured dismantling of the old system, carried out in multiple stages to minimize operational and environmental risks.
68. In addition to technological upgrades, the project includes replacement of aging electrical equipment, including approximately 933 oil-filled transformers dating back to the 1980s. These components are of particular importance from an environmental perspective due to the potential presence of hazardous materials such as PCBs. The project therefore incorporates environmental due diligence measures, including sampling, testing, and safe handling procedures, to ensure compliance with national regulations and international environmental standards.
69. The main objectives of the project are centered on improving operational safety, increasing system capacity, and enhancing service reliability. By modernizing the signaling system, the project aims to reduce the risk of accidents, improve train frequency, and optimize energy consumption. The introduction of digital systems will also improve maintenance planning, reduce operational costs, and enhance the overall resilience of the metro network. Furthermore, improved passenger information systems will contribute to a better travel experience for users.
70. From a broader perspective, the project supports Azerbaijan's development priorities related to sustainable urban mobility, digital transformation, and environmental protection. By encouraging the use of public transport and reducing reliance on private vehicles, the project contributes to lower emissions and improved air quality in Baku. It also strengthens institutional capacity and aligns the metro system with international best practices in railway safety and operations.

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71. Overall, the Baku Metro modernization project represents a comprehensive effort to transition from aging infrastructure to a modern, efficient, and environmentally sustainable transport system. Through its combination of technological innovation, phased implementation, and strong environmental safeguards, the project is expected to deliver long-term benefits for both the population and the urban environment, while ensuring compliance with international standards and development objectives.

2.4 Purpose of the IEE Report

72. This Initial Environmental Examination (IEE) is part of the process of compliance with the ADB Safeguard Policy Statement (SPS 2009) in relation to the Project.

73. The IEE provides a road map to the environmental measures needed to prevent and/or mitigate negative environmental effects associated with the Project. The IEE provides a detailed description of the direct and indirect environmental effects associated with the proposed Project during key periods of work.

74. More specifically, the IEE:

- Describes the existing socio-environmental conditions within the Project area;
- Describes the project design, construction activities and operational parameters;
- Describes the extent, duration and severity of potential impacts;
- Analyzes all significant impacts; and
- Formulates the mitigation actions and monitoring program and presents it all in the form of an Environmental Management Plan (EMP).

2.5 Category of the Project

75. Under the Asian Development Bank Safeguard Policy Statement (2009), the project is appropriately classified as Category B, as it is expected to generate site-specific, largely reversible environmental impacts that can be effectively mitigated through standard management measures. The works are confined within existing metro infrastructure and rights-of-way, and no significant land acquisition, biodiversity loss, or large-scale irreversible impacts are anticipated. However, the project involves physical interventions within an operational underground system, including replacement of legacy equipment and dismantling activities, which introduce moderate environmental and occupational health risks requiring a structured environmental assessment and management approach.

76. One of the key environmental risks relates to the handling of aging oil-filled transformers, some of which may contain or be contaminated with polychlorinated biphenyls (PCBs). Although not all equipment is expected to contain PCBs, the age and origin of the infrastructure create uncertainty that necessitates laboratory testing, controlled dismantling, and specialized disposal procedures. In addition, the project will generate electronic waste (e-waste) and other hazardous materials during replacement of signaling systems, cables, and relay equipment. Improper handling of these materials could lead to localized contamination; however, these risks are well understood and can be mitigated through established waste management practices and regulatory compliance.

77. Another important factor supporting the Category B classification is the nature of the works being conducted in confined underground environments, often during nighttime hours to avoid disruption of metro operations. These conditions increase the complexity of managing risks related to ventilation, air quality, noise, and occupational safety. While these impacts are temporary and localized, they require careful planning, monitoring, and implementation of safety measures. Taken together, the presence of manageable but non-negligible risks, such as PCB handling, e-waste generation, and confined-space operations, justifies the classification of the project as Category B, reflecting the need for an Initial Environmental Examination (IEE) and an Environmental Management Plan (EMP).

2.6 IEE Boundaries

78. The project boundaries are defined by the existing operational footprint of the Baku Metro network, including tunnels, stations, depots, substations, and associated technical and administrative facilities. All activities will be confined within these established areas, and no expansion beyond current right-of-way limits is anticipated. From a spatial perspective, the project therefore covers both underground infrastructure (tunnels and station environments) and above-ground or indoor facilities (control centers, depots, technical rooms, and office premises) where system control, maintenance, and management functions are carried out.

79. Works within the tunnel and station environments will primarily involve installation of new signaling and communication systems, including trackside equipment, cables, sensors, and power supply components, as well as integration with existing infrastructure. These activities will be performed in a phased manner to maintain ongoing metro operations and will often be conducted during nighttime hours. In parallel, works within office and technical premises will include the establishment and upgrading of centralized control systems such as the Operations Control Center (OCC), installation of digital platforms, server infrastructure, and communication systems that support real-time monitoring and management of metro operations.

80. The project also includes replacement of outdated electrical and signaling equipment, including oil-filled transformers, relays, and associated cables, followed by eventual dismantling of legacy systems. These interventions involve both installation and decommissioning activities, including equipment removal, cable management, testing, and system commissioning. Overall, the project is characterized by technology upgrades and rehabilitation within existing facilities, with no new construction outside the current metro system boundaries, ensuring that environmental and social impacts remain localized and manageable.

2.7 Methodology Applied

81. The methodology is based on the ADB, Safeguard Policy Statement (2009) and the joint experience of the International and National environmental consultants involved in the IEE preparation process.

82. Background data and information was obtained from published and unpublished sources, e.g., on climate, hydrology, geology and soils, and socio-economic data. In addition, data was taken from documents and report prepared in scope of the projects, as well as site visits results.

83. Several site inspections were conducted jointly by the International Environmental Specialist and National Counterparts during April, 2026. Distribution lines corridor sites were visited (where access was possible) along with locations of transformers and areas of potential environmental significance assessed carefully.

84. Discussions were held with a number of stakeholders in order to determine their perceptions of the level of impact from the Project works (see Section 7). Data and information obtained have been incorporated where appropriate in the IEE report.

2.8 Report Structure

85. Based on the findings of the scoping report, the following report structure was recommended.

86. The IEE is structured in accordance with ADB SPS requirements³ and ADB Environment Safeguards: A Good Practice Sourcebook (Draft Working Document) (GPN, 2012).⁴ It consists of an executive summary, ten chapters, and attachments. It has been prepared based on project design work undertaken by technical specialists, primary surveys and secondary data collection and analyses carried out by environmental and social experts, and public and stakeholder consultations. The following report structure was recommended below:

- **Introduction** – The section in hand provides the introductory information.
- **Legal, Policy and Administrative Framework** – This section presents an overview of the policy/legislative framework as well as the environmental assessment guidelines of Azerbaijan that apply to the proposed project.
- **Existing Facilities and Operations** – This section of the IEE provides a clear baseline for impact assessment. This description will include a detailed characterization of infrastructure elements—such as tunnels, stations, substations, depots, and control centers—as well as the current operational systems, including signaling, power supply, ventilation, and maintenance practices. The assessment will rely on information gathered through desk review, site inspections, and consultations with technical staff, supplemented by available data on environmental quality indicators (e.g., air, noise) and operational performance.
- **Description of the Environment** – This section of the report should provide a concise but comprehensive baseline of the physical, biological, and socio-economic conditions within the area of influence of the metro system, with emphasis on urban and underground environments relevant to the project. This includes characterization of air quality, noise and vibration levels, and microclimatic conditions within tunnels and stations, as well as soil and groundwater conditions where infrastructure may interact with subsurface environments. The chapter should also describe existing infrastructure-related environmental conditions, such as ventilation performance, drainage systems, and potential contamination from legacy equipment (e.g., oil residues). From a social perspective, it should outline population distribution sensitive receptors and passenger flow characteristics, as well as current occupational health and safety conditions for workers. The baseline should rely on instrumental

³ As specified in the Annex to Appendix 1, pg. 41-42 (Approach to IEE Preparation)

⁴ Environment Safeguards: A Good Practice Sourcebook (Draft Working Document) | Asian Development Bank

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measurements, site observations, and available monitoring data, and be sufficient to support impact assessment and comparison of pre- and post-project conditions.

- **Environmental Impacts and Mitigation Measures** – Section 7 outlines the potential environmental impacts and proposes mitigation measures to manage the impacts.
- **Stakeholder Consultation, Information Disclosure** – Section 8 provides a summary of all of the stakeholder consultation activities undertaken.
- **Environmental Management Plan** – This section of the IEE comprises an Environmental Mitigation Plan and an Environmental Monitoring Plan. The Environmental Mitigation Plan: (i) Clearly identifies what specific potential impacts various types of works may have on the sensitive receptors; (ii) Provides concrete actions prescribed for managing these impacts, including location and timing of these actions; (iii) Provides cost estimates for the main discrete mitigation measures (those that are unlikely to be part of a construction company' corporate policy and will not necessarily be included into general pricing of the contract); and (iv) Specifies responsibility for the implementation of each mitigation activity.
- **The Environmental Monitoring Plan:** (i) Lists all prescribed mitigation measures by types of construction activities; (ii) Provides selected criteria of monitoring implementation of mitigation measures; (iii) Specifies methods for measuring outcomes of applied mitigation measures (visual, instrumental, survey, etc.); (iv) Identifies location and timing/frequency of monitoring mitigation measures by the prescribed criteria;
- **Environmental Management Plan** – This section of the IEE comprises an Environmental Mitigation Plan and an Environmental Monitoring Plan.
- **Conclusions and Recommendations** – The final section of the report provides the report conclusions and recommendations, including a description of any residual impacts.

3. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

87. The Project is implemented within the legal framework of the Republic of Azerbaijan. National legislation establishes mandatory requirements governing environmental protection, environmental impact assessment, pollution control, waste management, biodiversity conservation, land use, construction activities, cultural heritage protection, occupational health and safety, emergency preparedness, and sector-specific regulation for transport, power supply, and telecommunications.
88. Compliance with national legislation is obligatory at all stages of the Project lifecycle, including pre-construction, construction and installation, commissioning, and operation. National legal requirements constitute the minimum standard for compliance and are applied in conjunction with the environmental and social safeguards of the Asian Development Bank (ADB).
89. In case of inconsistency between the requirements of the national legislation of Azerbaijan and the ADB SPS (2009), the stricter requirement will be applied within the project framework.

3.1 National Legislative Framework

3.1.1 Constitution of the Republic of Azerbaijan

90. The constitution of the Republic of Azerbaijan contains precepts and principles for environmental protection, ownership of natural resources and preservation of cultural heritage. Article 14 of Chapter III (Basic rights and liberties of a person and citizen) entails the state ownership of natural resources, without prejudice to rights and interests of any persons and legal entities. Article 39 constitutes the right to live in a healthy environment, to gain information about true ecological situation and to get compensation for damage done to his/her health and property because of violation of ecological requirements. Article 40 states the rights to practice and participate in culture and protection of historical, cultural, and spiritual inheritance and memorials. In Chapter IV (Main responsibilities of citizens), Article 77 states the responsibilities for protection of historical and cultural memorials; while article 78 stipulates the citizen's responsibility for protection of environment.

3.1.2 Core Environmental Permitting / Compliance

91. Law of the Republic of Azerbaijan "On Environmental Protection" – (adopted on 9.06.1999, last updated on 29.12.2023). Key legal requirements of the Law are: (i) Protection of the environment and human health is a mandatory obligation for all legal entities and project implementers; (ii) Economic and infrastructure activities must prevent pollution, degradation, and irreversible environmental damage; (iii) Application of the precautionary principle and polluter pays principle.
92. Compliance with the requirements of the applicable law is necessary both at the project implementation and operation stages, namely:
- Implementation stage; (i) Selection of environmentally acceptable construction methods; (ii) Adoption of pollution prevention measures (dust, noise, waste, spills); (iii) Contractor environmental obligations incorporated into contracts.

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- Operation stage; (i) Continuous compliance with environmental standards; (ii) Prompt response to environmental incidents; (iii) Ongoing maintenance to prevent degradation of soils, water, and air.

93. **Law of the Republic of Azerbaijan “On Environmental Impact Assessment”** - (adopted on 06.2018, last updated on 17.02.2023). The Law establishes a mandatory regulatory framework governing the assessment, prevention, management, and control of environmental and related social impacts arising from planned activities. In practical terms, it regulates the following key areas: (i) Types of Activities Subject to Environmental Impact Assessment; (ii) Environmental Components Covered by Assessment; (iii) Social and Socio-Economic Aspects; (iv) Project Planning and Decision-Making Process; (v) Environmental Management and Monitoring; (vi) Public Participation and Information Disclosure; (vii) State Ecological Expertise and Environmental Permitting; (viii) Transboundary Environmental Impact Assessment; (ix) Amendments, Modifications, and Expansion of Activities; (x) Environmental Accountability and Compliance Control.

94. Summary of the EIA process, including mandatory requirements, is presented in **Table 1** below.

Table 1: Summary of the active EIA requirements in Azerbaijan

EIA coverage and requirements	
Activities that require EIA	Activity types for which EIA is required are listed in the Annex to the EIA Law. Among others, the list includes exploration and development of mineral resources.
EIA Scoping	A party responsible for the assessment is required to carry out the EIA on the proposed activity after initial consultation with the relevant competent authority (MENR). Preliminary consultations are required to pre-determine the contents, scope and methods of the assessment, and to ensure the completeness and accuracy of the information to be reflected in the EIA document.
EIA Report	
General	In accordance with the Law “On Environmental Protection”, the EIA report must be prepared at the project development stage and submitted to the relevant competent authority. The report should be prepared in an easy-to-understand style, characterize environmental baseline of the area where the proposed activity will take place, identify possible potential environmental and health related impacts of the activity, determine ways to eliminate these impacts, and suggest recommendations for minimizing adverse effects.
Project description	Description, purpose, stages, types of environmental impacts and environmental risk assessment methods of the proposed activity should be provided
Project alternatives	At least two alternatives to the proposed activity (including the zero-activity option), as well as an environmental justification for the most effective technological solutions, must be provided.
Regulatory requirements	Regulatory framework referred to during the preparation of the EIA document and a summary of the legal acts should be included.
Environmental and socioeconomic baseline	Environmental and socioeconomic baseline of the area must be studied and described.
Impacts and mitigation measures	All impacts (direct and indirect, localized and broader scale, acute and chronic, one-time and cumulative, emergency and irregular, temporary and permanent) should be identified and assessed according to their magnitude and severity, and measures should be proposed to prevent, reduce and mitigate these impacts.
Transboundary and emergency impacts	In case cross-border impacts are identified, they should be assessed in accordance with procedures and conditions established (not yet adopted) by the

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	relevant authority (Cabinet of Ministers). Emergency impacts should also be addressed in the EIA report.
Environmental management and monitoring	General information on the environmental management plan adopted for all phases of the project, including relevant management and monitoring plans, should be included.
Residual impacts	A summary of the residual effects and their significance should be included.
EIA Disclosure	
Public participation	The law requires that the public affected by the planned activities be informed on the EIA process. The Client is expected to engage the affected community in discussions regarding the proposed activities.
State environmental expertise	The Law on Environmental Protection requires that the EIA report is reviewed by the Ministry of Ecology and Natural Resources (MENR) (within 3 months) and the MENR prepares an expert opinion. The opinion must be published and submitted to the relevant executive authorities in the area where the proposed activities will be carried out

95. The Law applies to “planned activities” listed in the Annex to the EIA Law (a defined list of activity types requiring EIA): (i) For linear transport infrastructure, the national EIA summaries used in practice explicitly reference railway lines/corridors as activities relevant to EIA listing and screening; (ii) For the power supply elements (power facilities supporting electrification / traction power / substations), sector extracts from national legislation also emphasize that EIA documentation must be prepared and undergo state ecological expertise at the planning stage.

96. **Law of the Republic of Azerbaijan “On Ecological Safety”** - (adopted on 08.06.1999, last updated on 23.02.2024). The law regulates relations between legal entities and individuals, state and municipal bodies and officials in the field of ecological safety while conducting activities. Its purpose is to establish the legal framework to protect human life/health, society's values, and the environment (including air, water, soil/landscapes, flora and fauna) from natural and anthropogenic hazards.

97. Compliance with the requirements of the applicable law is necessary both at the project implementation and operation stages, namely:

- During construction/installation; (i) Implement controls to avoid “dangerous ecological situations,”; (ii) Maintain monitoring and information readiness (recordkeeping, incident logs, corrective actions); (iii) If an incident occurs with ecological risk take urgent measures to protect life/health and the environment;
- Operation stage (routine operation and maintenance): (i) Operate and maintain power supply and signaling assets so they do not create hazards to human health or the environment, consistent with the law's overarching objective and state-policy principles; (ii) Ensure any upgrades/major maintenance activities that may affect the environment follow the same rule: no environmentally harmful activity requiring clearance should proceed without the relevant positive state conclusion and required permissions.

98. **Law of the Republic of Azerbaijan “On Public Participation”** - (adopted on 11.2013, last updated on 05.05.2023). The Law establishes the legal basis for ensuring public involvement in decision-making processes related to state and municipal activities, including environmental protection, infrastructure development, urban planning, and operation of public utilities.

99. Compliance with the requirements of the applicable law is necessary both at the project implementation and operation stages, namely:

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- the following requirements must be met: (i) Information Disclosure; (ii) Public Consultations; (iii) Consideration of Public Comments; (iv) Cooperation with Civil Society.
- Once the reconstructed systems are commissioned and operational, the following obligations apply: (i) Ongoing Access to Information; (ii) Public Involvement in Monitoring and Oversight; (iii) Grievance and Feedback Mechanisms; (iv) Transparency in Decision-Making.

3.1.3 Pollution Control and Waste Management

100. **Law of the Republic of Azerbaijan “On Protection of Atmospheric Air”** - (adopted on 03.2001, last updated on 23.02.2024). The law establishes a state system to prevent and reduce air pollution and regulates: (i) chemical/biological emissions (pollutants) and physical impacts on air (e.g., dust, potentially other physical effects); (ii) stationary sources (e.g., fixed equipment/plant) and mobile sources (vehicles and machinery); (iii) standard-setting, permitting, inventory/accounting, monitoring, and enforcement.
101. Core compliance requirements most relevant to the project; (i) Emission permits for stationary sources (and permits for harmful physical impacts); (ii) Technical requirements and prohibitions for equipment, fuels, and technologies; (iii) Siting/coordination of facilities that may affect air quality; (iv) Waste-related air protection (open burning prohibition); (v) Inventory, accounting, and reporting of emission sources; (vi) Obligations during abnormal conditions and accidents; (vii) Mobile sources: compliance of vehicles and machinery.
102. **Law of the Republic of Azerbaijan “On Waste”** - (adopted on 06.1998, last updated on 5.03.2024). The Law establishes the legal, organizational, and economic framework for waste management, aiming to: (i) prevent and minimize waste generation; (ii) ensure environmentally sound collection, storage, transport, treatment, recycling, and disposal of waste; (iii) protect human health and the environment from adverse impacts of waste; (iv) promote resource efficiency and reuse/recycling in line with the waste hierarchy.
103. The law applies to all legal entities and individuals whose activities generate waste, including infrastructure construction and railway operation projects.
104. the following requirements apply: (i) All types of waste generated during the construction phase; (ii) Temporary Storage on Construction Sites; (iii) Transportation and Disposal; (iv) Contractor Responsibilities.
105. Once the reconstructed power supply and telecommunication-signaling systems are operational, the following obligations apply: (i) Operational Waste Streams; (ii) Waste Management Procedures; (iii) Monitoring and Reporting.

3.1.4 Water and Land (including erosion, runoff, and land access)

106. **Water Code of the Republic of Azerbaijan** - (adopted on 26.12.1997, last updated on 14.07.2025). The Water Code establishes the legal framework for: (i) Rational and sustainable use of water resources; (ii) Protection of surface waters and groundwater from pollution, depletion, and degradation; (iii) Regulation of water abstraction, discharge, and hydraulic works; (iv) Prevention of harmful impacts of water (flooding, erosion, contamination); (v) State control and monitoring of water resources.

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107. The Code applies to all water bodies, including rivers, streams, canals, reservoirs, groundwater, and coastal waters potentially affected by linear infrastructure projects such as railways.
108. During the construction of power supply and telecommunication-signaling systems, the following Water Code requirements apply: (i) Protection of Surface and Groundwater; (ii) Works Near Water Bodies; (iii) Storage of Materials and Waste; (iv) Emergency Prevention.
109. During operation and maintenance of railway power supply and signaling systems, the following obligations apply: (i) Prevention of Operational Pollution; (ii) Wastewater and Drainage Control; (iii) Maintenance within Water Protection Zones; (iv) Monitoring and Compliance.
110. **Land Code of the Republic of Azerbaijan** - (adopted on 26.12.1997, last updated on 14.07.2025). The Land Code establishes the legal framework for: land categories and legal status; allocation/provision of land plots for non-agricultural needs (including railways, power lines, communication lines), restrictions/limitations, protection of land/soil, and land cadastre/monitoring and state control.
111. Main Land Code requirements most relevant to a railway electrification/telecom-signaling reconstruction project: (i) Land must be used strictly according to its category, designation and legal status; (ii) Allocation for linear infrastructure and other “non-agricultural needs”; (iii) Land/soil protection is mandatory during siting, construction, commissioning, and use; (iv) Construction rights exist only if other legal limitations are met; (v) Land cadastre, monitoring and state control apply; (vi) Land allocation decisions can include binding obligations/limitations (important for contractors).

3.1.5 Biodiversity, Protected Areas, Trees, and Heritage

112. **Law of the Republic of Azerbaijan “On Fauna”** - (adopted on 06.1999, last updated on 44.11.2024). The Law “On Fauna” establishes the legal framework for: (i) Conservation, protection, rational use, and restoration of wildlife (wild animals, birds, reptiles, amphibians, fish, and invertebrates); (ii) Protection of habitats, breeding areas, migration routes, and feeding grounds; (iii) Regulation of economic and other activities that may have direct or indirect impacts on fauna.
113. The law applies to all land and water areas within the territory of Azerbaijan and is mandatory for infrastructure projects, including linear transport and energy facilities such as railways and associated power and signaling systems.
114. Core Legal Requirements Relevant to the Project: (i) General Protection of Fauna; (ii) Protection of Habitats and Migration Routes; (iii) Specially Protected and Rare Species; (iv) Regulation of Economic Activities.
115. During reconstruction of power supply and telecommunication-signaling systems along the railway corridor, the following requirements must be met: (i) Operational Impacts Management; (ii) Habitat Integrity and Monitoring; (iii) Incident Prevention and Response
116. During operation of the reconstructed systems, the project must ensure: (i) Safe operation of electrified and signaling infrastructure to prevent wildlife mortality; (ii) Maintenance activities

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conducted with minimal disturbance to fauna; (iii) Ongoing monitoring of wildlife interactions with railway infrastructure; (iv) Prompt corrective actions if fauna mortality or habitat disturbance is detected; (v) Continued compliance with national fauna protection requirements.

117. **Law of the Republic of Azerbaijan “On Specially Protected Natural Territories and Objects”** - (adopted on 03.2000, last updated on 27.06.2019). The Law establishes the legal basis for establishing, managing, and protecting specially protected natural territories (SPNTs) and specially protected natural objects in Azerbaijan.
118. SPNTs include land and water areas (and the airspace above them) with special ecological/scientific/cultural/aesthetic value that are fully/partly withdrawn from economic use under a special protection regime.
119. The Law defines categories/types of SPNTs (e.g., national parks, nature sanctuaries, state reserves, etc.).
120. Core compliance principles relevant to the railway project; (i) Avoidance of SPNTs and compliance with protection regimes; (ii) Use of official cadastral/monitoring information; (iii) Requirements during implementation (construction / installation stage).
121. **Forest Code of the Republic of Azerbaijan** - (adopted on 12.1997 last updated on 03.06.2025). The Forest Code regulates the protection, use, regeneration, and management of forests in Azerbaijan, establishes the state ownership of forest lands, and defines rules for activities that may affect forests, forest vegetation, and related ecosystems. Forests are recognized as a strategic natural resource with ecological, climatic, water-regulating, and protective functions.
122. Forests are classified according to their protective, ecological, recreational, and economic roles, with special protection regimes applied to protective forests (e.g., erosion-control forests, water-protection zones, green belts, and sanitary-protective forests).
123. The project involves reconstruction of power supply and telecommunication-signaling systems within an existing railway corridor. Although works are linear and largely within existing rights-of-way, they may affect: (i) Forested lands adjacent to the railway; (ii) Individual trees and shrubs within safety or sanitary clearance zones; (iii) Protective Forest belts and green zones; (iv) Temporary access roads, camps, or storage areas near forest lands.
124. **Law of the Republic of Azerbaijan “On Protection of Green Plantings”**- (adopted on 12.1997 last updated on 03.06.2025). The Law applies to green plantings within settlements and within infrastructure facilities, including special-purpose green belts in transport corridors (e.g., along main railways, protection/sanitary-protection zones, etc.).
125. Key concept for railway works: any removal/felling/relocation of trees/shrubs/other plants (“yaşıllıqların götürülməsi”) is generally prohibited unless it falls under specific legal grounds and is authorized through the required process.
126. **Law of the Republic of Azerbaijan “On Protection of Historical and Cultural Monuments”** - (adopted on 04.1998 last updated on 16.05.2025). Even though most cultural-heritage risks are construction-related, the law still implies obligations during operation/maintenance: (i) Prevent damage during maintenance: any future earthworks (repair of buried cables, drainage works, foundation repairs, new access tracks) in monument areas/protection zones must again

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follow the prior permission and authority instructions principle; (ii) Maintain protective measures: keep any agreed buffers/exclusion zones intact; avoid placing materials, parking heavy equipment, or creating vibration-intensive activities near sensitive structures (where identified by specialists); (iii) Operational Chance Finds: apply the same stop-work/notify procedure during emergency repairs or routine maintenance if heritage is unexpectedly encountered.

3.1.6 Transport Safety (including hazardous materials)

127. **Law of the Republic of Azerbaijan “On Transport”** - (adopted on 06.1999 last updated on 01.05.2025). The Law establishes the legal, economic, and organizational basis for transport functioning in Azerbaijan and applies to rail transport and related transport enterprises/carriers/clients.
128. It requires that transport activities comply with mode-specific rules/codes/charters and mandatory technical/technological, environmental, sanitary standards, as well as traffic safety control, labor protection, and fire safety requirements set by normative acts.
129. For lands allocated to transport (including rail corridors and associated protection zones), the Law links compliance to the Land Code, Water Code, Environmental Protection / EIA legislation, and other acts.
130. Key “On Transport” requirements most relevant to railway power & signaling reconstruction: (i) Transport safety, labor protection, fire safety, and sanitary/environmental standards; (ii) “Transport lands” and protection zones; (iii) State regulation/administration and “safe, effective, rhythmical work” of transport; (iv) Transport services are contract-based and responsibility is defined; (v) Passenger rights and reliability (important for managing operational impacts); (vi) Qualifications to operate vehicles and safety responsibility of carriers; (vii) Dangerous/valuable cargo security (if applicable during works).
131. **Cabinet of Ministers Resolution No. 207 – “Rules of transportation of dangerous goods by rail”** - (adopted on 20.12.2000 last updated on 12.01.05.2024). The Rules set mandatory safety requirements for the carriage of dangerous goods by rail within Azerbaijan, aimed at protecting human life/health, the environment, and property.
132. They apply to all involved parties: carriers, consignors/consignees, loaders/unloaders, storage operators, and freight forwarders, who must comply with the Rules and related technical safety normative documents.
133. For cases not explicitly regulated, the **general railway cargo transportation rules** are applied.
134. For **international rail shipments**, transportation is regulated through applicable international arrangements/special conditions referenced in the Rules (i.e., cross-border carriage framework).

3.1.7 Worker Health, Community Health, Emergency Preparedness

135. **Labor Code of the Republic of Azerbaijan** - (adopted on 02.2000 last updated on 13.06.2025). The Labor Code of the Republic of Azerbaijan regulates labor relations between

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employers and employees and establishes minimum standards for: (i) employment contracts; (ii) working and rest time; (iii) occupational health and safety (OHS); (iv) wages and social protection; (v) labor discipline and dispute resolution.

136. The Code applies to all employers and workers, including contractors and subcontractors engaged in infrastructure projects financed by international financial institutions.
137. Key Labor Code Requirements Relevant to the Project: (i) Employment Relations and Contracts; (ii) Working Time and Rest Time; (iii) Wages and Remuneration; (iv) Occupational Health and Safety (OHS); (v) Protection of Vulnerable Groups; (vi) Labor Discipline and Workers' Rights; (vii) Social Insurance and Benefits.
138. **Law of the Republic of Azerbaijan “On Sanitary and Epidemiological Wellbeing”** - (adopted on 11.1992 last updated on 23.04.2024). The law defines sanitary-epidemiological safety/wellbeing as a condition where environmental factors do not have dangerous/harmful effects on people and there are favorable conditions for life and activity.
139. It establishes that safety is achieved through: compliance with sanitary rules and hygiene norms, hygiene education, public information, and state sanitary control (including controls at checkpoints), plus production/public control systems. Sanitary rules, sanitary norms, and hygiene standards constitute mandatory regulatory requirements that establish criteria for the safety of environmental factors and define conditions necessary to protect human health and ensure safe living and working environments. Compliance with these requirements is mandatory for all individuals and legal entities..
140. Relevance to this railway project: any works that can affect worker/public health—dust/noise, temporary camps, drinking water, sanitation, waste, chemicals (oils/solvents), disinfection, and communicable disease control—fall under these sanitary norms and the state sanitary supervision regime.
141. **Law of the Republic of Azerbaijan “On Fire Safety”** - (adopted on 06.1997 last updated on 29.04.2024). Scope and competent authority (what the law regulates): (i) The Law establishes the legal framework for fire prevention and firefighting, defines fire safety requirements, and regulates the roles of the state, enterprises, and citizens; (ii) Fire safety compliance is overseen through State Fire Supervision/Control under the Ministry of Emergency Situations (MES), including the State Fire Control Service which performs control over compliance during design, construction and operation stages.
142. Core legal duties relevant to the Project (Proponent/Contractors). The Law sets explicit duties for “enterprises” (i.e., project owner, EPC contractor, subcontractors, operators), including to: (i) Comply with fire safety requirements and lawful instructions of competent authorities; (i) Develop and implement fire safety measures (organizational + technical); (iii) Train staff and conduct fire safety awareness (“propaganda”); (iv) Maintain fire protection systems and primary firefighting means in operable condition and prevent misuse; (v) Provide access to fire control officials for inspections and comply with information/document requests.
143. **Law of the Republic of Azerbaijan “On Civil Defense”** - (adopted on 12.1997 last updated on 19.12.2023). The Law “On Civil Defense” establishes the legal, organizational, and economic foundations for protecting the population, territories, material assets, and the environment from natural, technological, and man-made emergencies, including those related to industrial and transport infrastructure. The law applies to all state bodies, municipalities,

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enterprises, and organizations, regardless of ownership, whose activities may create emergency risks.

3.1.8 Sector Laws Directly Related to the Project (power/telecom/signaling)

144. **Law of the Republic of Azerbaijan “On Telecommunications”** - (adopted on 06.2005 last updated on 18.03.2025). The Law “On Telecommunications” regulates the organization, development, operation, and safety of telecommunication networks and services in the Republic of Azerbaijan. It establishes requirements for licensing, technical standards, protection of infrastructure, electromagnetic safety, and coordination with other sectors, including transport and energy infrastructure.
145. **Law of the Republic of Azerbaijan “On Information, Informatization and Information Protection”** - (adopted on 04.1998 last updated on 08.07.2025). The Law establishes the legal, organizational, and technical framework for: (i) Creation, collection, processing, storage, dissemination, and protection of information; (ii) Regulation of informatization processes and information systems; (iii) Protection of information, including restricted, confidential, and state-protected information; (iv) Ensuring information security, data integrity, and lawful access to information.
146. The law applies to all legal entities and individuals involved in information handling activities in Azerbaijan, including infrastructure projects involving telecommunication, control, signaling, and digital systems, such as railway electrification and signaling projects.
147. **Law of the Republic of Azerbaijan “On Power Industry”** - (adopted on 04.2023 last updated on 08.07.2025). The Law regulates: (i) State policy and governance in the electricity sector; (ii) Generation, transmission, distribution, and consumption of electric power; (iii) Safety, reliability, and continuity of electricity supply; (iv) Rights and obligations of power sector entities; (v) Technical operation, dispatch control, and protection of power facilities;
148. The law applies to all electrical infrastructure, including: (i) High-voltage and low-voltage power supply systems; (ii) Traction power supply facilities for railways; (iii) Substations, overhead lines, cables, and control systems.
149. Key Requirements Applicable at the Implementation Stage: (i) Design and Technical Compliance; (ii) Construction and Installation; (iii) Safety and Protection Measures; (iv) Coordination and Permissions.
150. Key Requirements Applicable at the Operation Stage: (i) Reliable and Continuous Power Supply; (ii) Technical Operation and Maintenance; (iii) Electrical Safety; (iv) Emergency Preparedness.
151. **Law of the Republic of Azerbaijan “On Efficient Use of Energy Resources and Energy Efficiency”** - (adopted on 07.2021 last updated on 11.04.2025). The Law establishes the state policy and regulatory framework for efficient (rational) use of energy resources and energy efficiency across the energy chain, covering production, storage, transmission, distribution, sale and consumption of energy, and it introduces mechanisms such as energy audits, energy

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management systems, energy managers, energy services/ESCOs, metering and consumer information, and state control.

152. It is implemented via a package of secondary regulations adopted/developed for: energy audit procedures and reporting, auditor certification and registers, criteria for mandatory audits (entities/buildings), requirements for energy managers and energy management systems, building minimum energy performance norms and certification, energy labelling and eco-design, and state control procedures.

3.1.9 Stakeholder Engagement Standards

153. Pertinent to the Stakeholder Engagements, the Constitution of Azerbaijan as the fundamental law of the land, among others, establishes the legislative principle for the engagement of the citizens in political and civil life of Azerbaijan; thus, provides for the following: The Right to civil participation is stipulated in Article 54.1 - "right of citizens of the Republic of Azerbaijan to participate in the political and civic life without impediments".

154. Freedom of Information – The Constitution guarantees the right to information in three aspects:

- Article 39 (Right to live in a healthy environment) – "Everyone has the right to gain information about the true ecological situation and to get compensation for damage done to his/her health and property because of violations of ecological requirements";
- Article 50 (Freedom of Information) – provides that – Everyone is free to look for, acquire, transfer, prepare and distribute information; – Freedom of mass media is guaranteed. State censorship in mass media, including press is prohibited;
- Article 57 para 1 - which gives citizens the right to petition state bodies.

155. **Law of the Republic of Azerbaijan No 1308-IVQ dated September 30, 2015 "On Citizens' Appeals"** According to the law, any citizen has a right to appeal to state and municipal bodies, and to legal entities owned by state or municipality, in written or oral form and these appeals have different procedure from appeals to Ombudsman or information requests, and may not be anonymous.

156. **Law of the Republic of Azerbaijan dated September 30, 2005 "On the right to obtain information"**. This Law establishes the legal framework for ensuring free, unrestricted and equal information access as prescribed by Article 50 of the Constitution, whereby any person is entitled to apply directly or via his /her representative to the information owner and to choose the type and form for obtaining the information.

157. **Law of the Republic of Azerbaijan № 816-IVQ (November 22, 2013) "On public participation"**. This law provides the framework and regulates the involvement of citizens in the implementation of state management in accordance with the Article 49 (Freedom of assembly) of the Constitution. The law stipulates that public participation consists of:

- Participation in various areas of state and public life, the preparation and implementation of the state policy and the adoption of national and local decisions;
- Participation in public control over the activity of central and local executive authorities, local self-government bodies;
- Participation of civil society institutions in the process of consultations of state and local self-government bodies with the public and in the study of public opinion (through Public Councils).

158. The law considers the following forms of public participation:

- Public Councils under central and local executive authorities, local self-government bodies;
- Public discussions during the adoption of decisions of public importance;
- Public hearings on draft legal acts and different issues of state and public life;
- Study of public opinion;
- Public discussion of draft legal acts;
- Written consultations on the study of opinions of civil society institutions on draft legal acts.

159. In addition to the described legislative acts, the environmental and social impact assessment process also should include disclosure and stakeholder engagement activities, as per Azerbaijan legislation.

160. The Law on Environmental Impact Assessment (EIA Law, 2018) covers scope, procedure and responsibilities for Environmental Impact Assessment, as well as public consultation and disclosure requirements during environmental assessment.

161. According to the Law the Client (Implementing Agency) has to inform the local population and society in the project area through the media and public hearings and inform them of the results of the EIA before committing the intended activity (Article 12.1.4).

162. The Client should conduct public hearings in accordance with the Law of the Republic of Azerbaijan "On Public Participation" and involve individuals, legal entities, as well as property owners (Article 4.10). Information on the results of the public hearings and discussions should be included in the EIA document (Article 5.3.12).

163. The law also specifies the responsibilities of municipalities for the public hearing activities (Article 11). Thus, the relevant municipality in the area, where the project (or intended activity) is implemented, must take part in the implementation of the EIA and provide the necessary information required for the preparation of the EIA document.

164. In addition, the municipalities should assist people and legal entities, real estate owners, as well as other stakeholders (non-governmental organizations, citizens' initiative groups and neighborhood committees of municipalities, etc.) to participate in public consultations, if requested by them. In addition, people and civil society institutions have the right to request the client and the planning organization to hold public hearings on the EIA (13.2.2).

165. In addition, people and civil society institutions have the right to request the client and the planning organization to hold public hearings on the EIA (13.2.2).

166. Similarly, Article 15 of the Law on Acquisition of Land for State Needs (2010) requires public meetings on social impacts. Public meetings should be organized and documented by the Client. The objectives of these consultations are to listen and record any statements or objections made by local residents, interested person or representative of the organization on the issues related to the proposed project, and to discuss alternative proposals, as well as to inform the society on the grievance redress process and other related matters.

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167. The law also stipulates a requirement for disclosure of the land acquisition and resettlement related information and documents through public consultation and official announcements. Specifically, article 14 demands the Client to disseminate an official announcement on the affected land/property in the area where the affected lands are located and shall take all measures to deliver this announcement to the affected persons.

3.2 Project Standards and Assessment Criteria

168. Project will be implemented and managed in accordance with the relevant national and international environmental standards. The following summarizes these laws and standards along with other international best practice standards. The project standards for ensuring environmental and social compliance of project activities are considered in below sections.

169. The Project standards were established for each of the identified sources of pollution and wastes, taking into account capacity of the environmental agents to accept, disperse and absorb the pollutants.

170. The following tables in below sections compare international standards for each environmental quality component.

3.2.1 Water Quality

171. The project will comply with the stringent EU and WHO guidelines water quality standards, highlighted in bold in the **Table 2** below. Within the scope of the project, stricter standards will be applied, which are marked in bold in the table.

Table 2: Water quality standards

Parameters	Azerbaijan (drinking water) ⁵	WHO, drinking water ⁶	EU Health ⁷
PH	6-9	-	6.5-8.5
Temperature, °C	-	-	-
Turbidity, NTU	2.6	5	-
Dissolved oxygen, mg/l O ₂	-	-	-
TDS, mg/l	< 1000	-	500
Nitrates, mg/l NO ₃ -N	45	50	50
Nitrites, mg/l NO ₂ -N	5	3	0.50
Ammonium, mg/l NH ₄ -N	-	1.5	0.2
Phosphates, mg/l PO ₄ -P	3-5	-	1
Chlorides, mg/l	350	250	350
Sulphates, mg/l SO ₄ -S	500	250	250
BOD, mg/l	-	-	100
COD, mg/l	-	-	10
Free cyanides, mg/l	-	-	0.05
Total cyanides, mg/l	-	-	0.05
WAD cyanides #, mg/l	-	-	-

⁵ AZS 929:2023. Drinking water. Hygiene requirements and quality control.

⁶ WHO's Guidelines for Drinking-water Quality, Geneva, 1993

⁷ European Union Drinking Water Standards. Council Directive 98/83/EC on the quality of water intended for human consumption. Nov 1998

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Hardness, mg/l CaCO ₃	>30	-	180
Calcium, mg/l	250	-	130
Magnesium, mg/l	50	-	30
Potassium, mg/l	-	-	200
Aluminum, mg/l	-	0.2	0.2
Arsenic, As, mg/l	0.3	0.05	0.01
Copper, mg/l	1	1	2.0
Cadmium, mg/l	0.001	0.003	0.005
Chrome, mg/l	-	0.05	0.05
Iron, mg/l	0.3	0.3	0.2
Manganese, mg/l	0.1(0.5)	0.1	0.05
Mercury, mg/l	0.0005	0.006	0.001
Lead, mg/l	0.03	0.01	0.01
Zinc, mg/l	5	3	5
Nickel, mg/l	0.1	0.02	0.02
Oil, mg/l	0.05	-	100
Faecal coliforms #/100 ml	0	0	0
Total coliforms #, per 100 ml	0	0	0

3.2.2 Air quality

172. International ambient air quality standards were established by the World Health Organization (WHO). There are also standards in force in Azerbaijan (**Table 3**). Within the scope of the project, stricter standards will be applied, which are marked in bold in the table.

Table 3: Air quality standards

Parameter	Averaging period	IFC (WHO) standards µg/m ³	EU Directive 2008/50/EC ⁸ µg/m ³	Azerbaijan MAC ⁹ µg/m ³
Solids – PM10	1 hour	-	-	300
	24 hours	45¹⁰	50	-
	Annual	15¹¹	40	-
Solids – PM2.5	24 hours	25	25	
	Annual	10	10	
Arsenic	One time	-	-	30
	24 hours	-	-	3
	Annual	-	0.006	-
Nitrogen dioxide (NO ₂)	1 hour	200	200	-
	24 hours	25	25	25
	Annual	10	10	10

⁸ EU Directive 2008/50/EC

⁹ GOST 17.2.3.02-78 "Төбәтә мөһәфәзә. Атмосфер. Сәнәе мөһәсәсәләриндән атмосферагә атлан зәрәрли мәддәләрин йол вирилән һәддләри". GOST 17.2.3.01 - 77 "Yaşayış Stationlərində havanın keyfiyyətinə nəzarət qaydaları"(GOST 17.2.3.02-78 "Nature protection. Atmosphere. Permissible limits of harmful substances released into the atmosphere from industrial enterprises. GOST 17.2.3.01 - 77 "Rules of air quality control in residential areas")

¹⁰ World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile. Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

¹¹ These standards are not included in the WHO Air Quality Guidelines Global Update 2005 but can be found in the WHO Air Quality Guidelines for Europe (WHO, 2000).

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Sulphur dioxide (SO ₂)	1 hour	-	-	-
	24 hours	40	40	125
	Annual	-	-	-
Carbon monoxide (CO)	1 hour	30000	-	-
	24 hours	4	10000	-
	Annual	-	-	-

3.2.3 Noise and vibration

173. Noise and vibration standards of the Project will be based on the “Norms of vibration and noise pollution, which have negative impact on the environment and human health” accepted in Azerbaijan¹². Detailed breakdown of the limits is shown in **Table 4** below.

Table 4: Maximum allowable noise levels in residential and public buildings, as well as other places of concentration in Azerbaijan

Object	Noise standards (max.), dBA	
	Daylight (07:00-23:00)	Night (23:00-7:00)
Residential areas	40	30
Commercial areas	55-60	55-60
Hotels and shared households	45	35
Industrial areas		
High-specialization facilities	50	50
Equipment locations or permanent work places inside buildings	80	80
Work places drivers and maintenance of trucks	70	70
Work places for drivers and maintenance of tractors and other similar agricultural / irrigation mechanisms	80	80
Vulnerable areas		
Hospitals and sanatoriums	35	25
Schools, libraries and conference halls	40	40

174. Measurements will be made at noise receptors located outside the project facilities. It should be noted that the national noise limits given in **Table 4** are intended for maximum instantaneous noise effects. Therefore, adjustment limits should only be used to assess the sound impact of an instantaneous noise such as an explosion. As these limits do not cover the mean day and night noise levels, it is considered appropriate to assess the impact of night and day noise in accordance with the IFC HSE Guidelines for the Project.

IFC Environmental Health and Safety Guidelines / General HSE Guidelines

¹² Decree of the President of the Republic of Azerbaijan No. 796 of July 8, 2008 on approval of “Norms of vibration and noise pollution adversely affecting the environment and human health”. http://www.e-qanun.az/framework/15124#_edn1

175. The International Finance Corporation (IFC) has developed General EHS Guidelines for Noise (Table 5). They refer to noise from facilities and fixed noise sources and are commonly used as design standards for industrial facilities. Although the document provides general guidelines on noise effects, the IFC noted that they were not directly related to transport or mobile noise sources.

Table 5: IFC Noise Guidelines

Receptor	Maximum allowable noise levels, LAeq,1Time, dBA, free area	
	Daylight 07:00-22:00	Night 22:00-7:00
Residential, administrative and education buildings ¹³	55	45
Industrial; commercial	70	70

176. Therefore, 55 dB (A) and 45 dB (A) absolute noise levels will be accepted by the Project as compliance criteria for both day and night periods.

177. IFC EHS Guidelines for noise¹⁴ provide a summary of noise exposure standards for employees (Table 6). These standards will be accepted as the Project standards.

Table 6: Allowable noise levels at workplaces

Location/work type	Equivalent level, LAeq,	Maximum level, LMax, ani
Heavy production (crushing line, open pit and mechanized areas, stationary devices and mobile equipment)	85 dBA	110 dBA
Light production (limited number of stationary devices and mobile equipment in a limited area)	50-65 dBA	110 dBA
Open offices, control rooms, service stations or similar	45- 50 dBA	-
Individual offices (no annoying noise)	40-45 dBA	-
Classrooms, auditoriums	35-40 dBA	-
Hospitals	30-35 dBA	40 dBA

Vibration

178. Due to the remoteness of the project area and its facilities from the residential areas and other and facilities, vibration impacts on the environment and the population have not been considered.

Vibration at workplaces

¹³ Noise monitoring should be carried out using a Type 1 or 2 sound level meter meeting all appropriate IEC standards

¹⁴ IFC. Environmental, Health, and Safety (EHS) Guidelines. GENERAL EHS GUIDELINES: OCCUPATIONAL HEALTH AND SAFETY

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179. Allowable limits of the effects of vibration on workers' hands were set by the American State Conference on Industrial Hygiene (ACGIH), as well as the EU Directive on the Permissible Impact of Vibration on the Human Body¹⁵. The allowable limits are presented in **Table 7** below.

Table 7: Comparison of ACGIH limit values (TLVs) for hand vibration exposure in X, Y or Z direction and daily exposure in EU Directive 2002/44/EC

Total daily impact duration (hours) ACGIH	Maximum velocity level measured from any direction (m/s ²).
4-8 hours	4
2-4 hours	6
1-2 hours	8
Less than 1 hour	12
Daily impact (AB Directive - 2002/44/EC)	The maximum value of acceleration measured with frequency in any direction (m/s ²)
8-hour value of the daily impact	5
Daily exposure limit	2.5

180. There is no direct comparison between these two sets of instructions. This is because ACGIH has values that depend on the duration of exposure and is based on any single axis greater than 4 m/s². The EU has set a daily exposure limit of 5 m/s² as the vector sum of the three axes and is based on an 8-hour exposure time. There is no significant difference in the standard of the two guidelines, so the Project will use the EU's Daily Impact Limit as it has multidisciplinary compliance criteria.

181. All body vibrations defined as ACGIH limits are defined by Z and XY vector graphs; ACGIH also refers to the EU Impact Limit of 0.5 m/s² activity level. The EU Directive (2002/44 / EC) uses limits in any of the three axes and the Project will use EU Impact Limits as a criterion for compliance (**Table 8**).

Table 8: EU Vibration Directive (2002/44/EC): Impact limits

Type	Daily activity exposure limit (m/s ²)	Daily exposure limit (m/s ²)
All body vibration	0.5	1.15

3.2.4 Soils and Land Use

182. Maximum allowable soil contamination in Azerbaijan is determined by the MACs of harmful substances in the soil. **Table 9** below presents the MACs accepted in Azerbaijan, as well as internationally accepted MACs of the following agencies:

- UK common assessment criteria guidelines;

¹⁵ Directive of the European Parliament and the Council of the EU 2002/44 / EU dated 25 June 2002 on minimum requirements for safety and protection of health of workers from risks associated with the action of physical factors (vibration).

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- USEPA Guidelines for Comprehensive Regional Level Assessment. The assessment of permissible limits in this document is based on an analysis of risk factors throughout human life.

183. MACs accepted in Azerbaijan and the background values were used to assess the content of potential contaminants. For comparative purposes, the concentrations were also compared with the UK General Assessment Criteria Guidelines. The Guidelines are in line with EU directives and are constantly updated. They provide values for specific groups that differ in their methods of impact, and therefore provide a more informative assessment than the MACs accepted in Azerbaijan.

Table 9: Allowable concentration levels of potential soil contaminants (ppm/L)

Parameter	Azerbaijan MAC	Technical Guidelines for Contaminated Soil Impact Assessment (UK)	
		Gardens	Residential lands
Copper (Cu)	500	520	2400
Lead (Pb)	32	80	200
Zinc (Zn)	500	620	3700
Arsenic (As)	2	43	37
Manganese (Mn)	1500	-	-
Cadmium (Cd)	0.5	1.9	11
Vanadium (V)	150	91	410
Mercury (Hg)	2.1	21	1.2
Fluoride (F)	2.8	-	-
Nickel (Ni)	30	53	130
Boron (B)	-	45	290
Beryllium (Be)	-	35	1.7
Cobalt (Co)	5.0	-	-
Chromium	6.0	15	627
Iron (Fe)	-	-	-
Molybdenum (Mo)	-	-	670
Selenium (Se)	-	88	250
Hydrocarbons	500	1200	1600

3.2.5 Ionizing Radiation

184. The Law of the Azerbaijan Republic "On Radiation Safety of the Population" (December 30, 1997) regulates the issues of ensuring radiation safety of the population to protect human health from the harmful effects of ionizing radiation.

185. To compare radiation doses, current IEE uses internationally accepted criteria presented in the IFC EHS Guidelines (2007). Permissible effective doses of radiation hazards for workplaces are based on the IFC criteria (2007) and the norms of the British Agency for Public Health. The criterion for the maximum effective annual allowable radiation dose for employees is 20 mSv per year, and for cadets aged 16-18 years - 6 mSv per year.

186. The limit of the population's exposure to radiation-causing activities is 1 mSv per year. According to the UK legislation and recommendations of the International Radiological

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Protection Commission, the limit of the population's exposure is set as 300 μ Sv (0.3 mSv) per year, when exposed to ionizing radiation from single object/source.

187. Recommendations on personnel's radiation protection developed by the International Radiological Protection Commission are taken into account in the basic safety standards of the International Atomic Energy Agency (IAEA).

188. **Table 10** presents the IFC criteria for maximum radiation exposure. Maximum exposure limits of the EU and IFC will be used as eligibility criteria for the Project.

Table 10: Maximum effective radiation doses allowed for workplaces

Duration	Workers above 19 years old	Students and probationers (16-18 years old)
5 years of continuous effective dose	20 mS/year	
1 year of continuous effective dose	50 mS/year	6 mS/year
Impact on eyes	150 mS/year	50 mS/year
Impacts on extremities and skin	500 mS/year	150 mS/year

3.3. International Conventions, Protocols and Agreements

189. **Table 11** below presents the list of the main international and regional conventions which Azerbaijan has ratified over years and are relevant to the Project. Many of the international ones are incorporated into the IFC PSs, EBRD PRs, ADB Safeguard Policy and associated guidance

Table 11: International and regional conventions

#	Convention	Year of Ratification
1	International Labor Organization (Fundamental)	
1.1	C029 - Forced Labor Convention, 1930	1992
1.2	C087 - Freedom of Association and Protection of the Right to Organize Convention, 1948	1992
1.3	C098 - Right to Organize and Collective Bargaining Convention, 1949	1992
1.4	C100 - Equal Remuneration Convention, 1951	1992
1.5	C105 - Abolition of Forced Labor Convention, 1957	2000
1.6	C111 - Discrimination (Employment and Occupation) Convention, 1958	1992
1.7	C138 - Minimum Age Convention, 1973. Minimum age specified: 16 years	1992
1.8	C182 - Worst Forms of Child Labor Convention, 1999	2004
2	Pollution prevention	
2.1	Stockholm Convention on Persistent Organic Pollutants	Acceded in ¹⁶ 2004
2.2	Convention on the Transboundary Effects of Industrial Accidents*	Acceded in 2004

¹⁶ In international law, accession is the formal act by which a state that did not originally negotiate or sign a treaty agrees to be legally bound by its terms.

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2.3	Basel Convention on the Control of Transboundary Shipment of Hazardous Wastes	2001
2.4	Kyoto Protocol, 1997	Acceded in 2000
2.5	UN Convention on the Protection of the Ozone Layer (Vienna Convention)	Acceded in 1996
2.5	Montreal Protocol on Substances that Deplete the Ozone Layer, 1987	Acceded in 1996
2.6	United Nations Framework Convention on Climate Change, 1992	Acceded in 1992
2.7	UNECE Geneva Convention on Long-Distance Transboundary Air Pollution*	2002
2.8	UN Convention on Control of Transboundary Movements of Hazardous Wastes and their Disposals	2001
2.9	International Carriage of Dangerous Goods by Road*	2000
2.10	Espoo Convention* (To promote environmentally sound and sustainable development through the application of ESIA, especially as a preventive measure against transboundary environmental degradation)	Acceded in 1999
2.11	Aarhus Convention* (To guarantee the rights of access to information, public participation in decision-making and access to justice in environmental matters)	Acceded in 2000
3	Biodiversity Protection	
3.1	UNESCO Convention on Wetlands of International Importance especially as Waterfowl Habitat / RAMSAR Convention	2001
3.2	UN Convention on Biological Diversity, 1992	2000
3.3	Bern Convention on conservation of wild flora and fauna and their natural habitats	In force since 2002
3.4	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	1999
4	Cultural Heritage	
4.1	Convention for the Safeguarding of the Intangible Cultural Heritage. Paris 2003	2007
4.2	Convention concerning the Protection of the World Cultural and Natural Heritage. Paris, 16 November 1972.	1993
4.3	European Convention on the Protection of the Archaeological Heritage	2000
5	Human Rights	
5.1	European Convention for the Protection of Human Rights and Fundamental Freedoms	2002
5.2	UN Convention on the Elimination of All Forms of Discrimination against Women	1995
5.3	UN Convention against Torture and Other Cruel, Inhuman or degrading treatment or punishment	1996
5.4	UN International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families	1999
5.5	UN International Covenant on Economic, Social and Cultural Rights	1992
5.6	UN Convention on the Rights of the Child / Protocol Faculty in connection with the participation of children in armed conflicts	1992/2002
5.7	UN Convention on the Elimination of All Forms of Racial Discrimination	1996
5.8	Regional Framework Convention for the Protection of National Minorities	2000
5.9	UN Convention on the Rights of Persons with Disabilities	2009
5.10	UN International Covenant on Civil and Political Rights	1992
5.11	The high-level conference on the future of the European Court of Human Rights. Interlaken Declaration	2010

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5.12	The high-level conference on the future of the European Court of Human Rights. Izmir Declaration	2011
5.13	The high-level conference on the future of the European Court of Human Rights. Brighton Declaration	2012
**UNECE agreement; Azerbaijan became a member of the UNECE in 1993. The major aim of the UNECE is to promote pan-European integration through the establishment of norms, standards and conventions.		

3.4 Asian Development Bank Safeguard Policies 2009

190. The ADB has three safeguard policies that seek to avoid, minimize or mitigate adverse environmental impacts and social costs to third parties, or vulnerable groups as a result of development projects. The Project requires the application of both environmental safeguard and social safeguard.

Safeguard Requirements 1: Environment

191. The objectives are to ensure the environmental soundness and sustainability of projects, and to support the integration of environmental considerations into the project decision-making process. Environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts. Eleven 'Policy Principles' have been adopted as part of the ADBs Safeguard Policy Statement (SPS 2009), including:

192. Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks **(The Project was screened by the ADB and classified as a Category B project).**

193. Conduct an environmental assessment for the proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including climate change. Use strategic environmental assessment where appropriate. **(The IEE herewith provides the environmental assessment for the Project, including an assessment of climate change. Transboundary impacts are not applicable).**

194. Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative.

195. Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an environmental management plan (EMP) that includes the proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle. **(An EMP has been prepared for the Project and is outlined in detail in Section 9, - ENVIRONMENTAL MANAGEMENT PLAN).**

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196. Carry out meaningful consultation with affected people and facilitate their informed participation. Ensure women's participation in consultation. Involve stakeholders, including affected people and concerned nongovernment organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account. Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment. Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance. **(Consultations were held to discuss environmental issues, the findings of the consultations (and a description of the Project grievance redress mechanism) are presented in Section 8 - 9. STAKEHOLDER ENGAGEMENT, INFORMATION DISCLOSURE AND GRIEVANCE REDRESS MECHANISM).**

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197. Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders. **(This IEE and its EMP will be disclosed on the ADB web-site).**

198. Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports. **(The IEE and its EMP outline a plan to monitor the implementation of the EMP and the institutional responsibilities for monitoring and reporting throughout the Project lifecycle: Section 9 - ENVIRONMENTAL MANAGEMENT PLAN).**

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199. Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the overall benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources. (Critical habitats have not been identified that maybe significantly impacted by the Project at this stage. Additional measures have been incorporated which should prevent any future impacts to these areas).

200. Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phase-outs. Purchase, use, and manage pesticides based on integrated pest management approaches and reduce reliance on synthetic chemical pesticides. (The IEE outline the mitigation plan of the EMP: Section 9 - ENVIRONMENTAL MANAGEMENT PLAN).

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201. Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities. (The IEE and its EMP outline the requirement for specific community health and safety plans: Section 9 - ENVIRONMENTAL MANAGEMENT PLAN).
202. Conserve physical cultural resources and avoid destroying or damaging them by using field-based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of “chance find” procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation. (A sample chance find procedure is provided in this IEE).

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Safeguard Requirements 2: Involuntary Resettlement.

203. The objectives are to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups. The safeguard requirements underscore the requirements for undertaking the social impact assessment and resettlement planning process, preparing social impact assessment reports and resettlement planning documents, exploring negotiated land acquisition, disclosing information and engaging in consultations, establishing a grievance mechanism, and resettlement monitoring and reporting.
204. The involuntary resettlement requirements apply to full or partial, permanent or temporary physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) resulting from (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. Resettlement is considered involuntary when displaced individuals or communities do not have the right to refuse land acquisition that results in displacement.

Safeguard Requirements 3: Indigenous Peoples

205. The objective is to design and implement projects in a way that fosters full respect for Indigenous Peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness as defined by the Indigenous Peoples themselves so that they (i) receive culturally appropriate social and economic benefits, (ii) do not suffer adverse impacts as a result of projects, and (iii) can participate actively in projects that affect them..
206. The project also does not trigger Indigenous Peoples safeguards, as the activities will be carried out in a fully urbanized metropolitan transport environment and no distinct Indigenous Peoples communities, traditional territories, customary land use systems, collective attachment to ancestral lands, or culturally distinct livelihood systems are present within the project area or likely zone of influence. Accordingly, no Indigenous Peoples Plan is required.

3.5 Gap Analysis

207. The environmental assessment of the Project will need to satisfy both, the national requirements of Azerbaijan and ADB. A harmonized safeguard framework is developed for conducting the IEE study of the Project. The framework is given below **Table 12**.

Table 12: Comparison of ADB and Azerbaijan Legislation Requirements

Aspect	ADB	Azerbaijan	Harmonized Framework
Environmental Policy and Regulations	ADB's SPS (2009) sets out the policy objectives, scope and triggers, and principles for three key safeguard areas: -Environmental safeguards, -Involuntary resettlement safeguards, and -Indigenous peoples safeguards	EIA is called State Environmental Expertise (SEE) in Azerbaijan. State Environmental Expertise (SEE) is governed primarily by the Law on Ecological Expertise (1996), supported by Cabinet of Ministers Resolution No. 491 (2001), and implemented under broader environmental legislation including the Law on Environmental Protection (1999)	The Project follows both ADB's SPS (2009) and Resolution No.491, December 2001.
Screening	This Project is Category B.	This Project falls into Category II of the environmental impact with medium risk.	The project will follow the Category B of ADB.
Alternatives	Examination of financially and technically feasible alternatives to the project location, design, technology and components, their potential environmental and social impacts.	National legislation does not explicitly require systematic analysis of alternatives, including the 'no project' option, representing a gap with ADB SPS (2009)	Assessment of alternatives will be included, as well as the 'no project' option.
EIA Report	Guidelines and Table of Contents are provided for IEE report in SPS (2009). EMP will include proposed mitigation measures, monitoring and reporting requirements, institutional arrangements, schedules and cost estimates. The report should be in English.	Draft of Concept Statement on Environmental Impact (national acronym OVOS) requires, Baseline, analysis of alternatives, Pollution prevention plan, Waste storage, and other mitigation. Official language is Azerbaijani . National EIA documentation does not fully align with ADB SPS requirements regarding climate change, biodiversity (critical habitats), cumulative impacts, and structured ESMPs.	The Project prepared IEE report in English following the form of ADB. After that IEE report is translated in Azerbaijan and change the format in Azerbaijan style. The contents of two reports are same but layout and language is different.
Public Consultations	"Meaningful" consultation with affected people is required for the project.	Public consultation is not required in the process of Draft of Concept Statement.	A wide range of public consultations have been undertaken to ensure they are 'meaningful'.

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Aspect	ADB	Azerbaijan	Harmonized Framework
Public Disclosure	Draft IEE will be published in ADB website before Project approval by the Board.	If the report has secrets of official or private organization, it should not be disclosed. National disclosure requirements are less prescriptive than ADB SPS, particularly regarding timing, accessibility, and language of disclosure.	Draft IEE report (English and Azerbaijan) will be published in ADB Website. The copies of the Azerbaijan version of Draft of Concept Statement on Environmental Impact will be made available at the affected villages.

4. PROJECT DESCRIPTION

4.1 Introduction

208. The proposed project, implemented by the Baku Metro CJSC, aims to modernize signaling systems and digitalize operational processes across the metro network, with the ultimate objective of improving operational safety, capacity, and service reliability. As described in the project documentation, the modernization involves the introduction of a Communications-based train control (CBTC) system, centralized operational management through an Operations Control Center, and deployment of integrated digital platforms for asset management and diagnostics. In addition to these technological upgrades, the project also includes replacement of aging electrical infrastructure, including oil-filled transformers, which introduces specific environmental considerations such as potential PCB contamination.
209. The project locations include all Baku Metro lines and associated operational facilities where signaling modernization, digitalization, testing, commissioning, parallel operation and decommissioning activities will be undertaken. At this stage, the inventory confirms that the project will be implemented across the existing Baku Metro operating network, within existing metro premises, including 27 stations, tunnels, depots, substations, relay rooms, technical rooms, cable routes, rolling stock areas and OCC/control facilities. Signaling modernization will cover all three Baku Metro lines, approximately 54.4 km: the Red Line (13 stations, 19.30 km, 25 train sets), the Green Line (15 stations, 23.05 km, 38 train sets), and the Purple Line (10 stations, 16.30 km, 9 train sets), including sections planned for future extension under ADB and AIIB financing.
210. The works are expected to cover all operating stations of the Baku Metro system; however, station-by-station verification and the final list of affected trainsets, relay rooms, control cabinets and cable routes will be confirmed during detailed design and contractor mobilization. The project will replace the existing legacy signaling and control systems with a modern CBTC-based system, including wayside equipment, onboard train equipment, communication systems, control cabinets, sensors, power supply interfaces, cables, digital platforms and OCC-related systems. The IEE confirms that the works will be confined to the existing Baku Metro footprint and will not require new metro lines, new stations, major excavation, land acquisition or expansion into natural habitats or protected areas.
211. The preliminary inventory has identified the main types and indicative quantities of equipment that will be replaced, dismantled or managed during the project. The most environmentally significant equipment group is approximately 933 oil-filled drossel-transformers / choke-transformers, including DTM-0.17-1000M, DTM-0.17-1000 and DTM-0.17-1500 units, each generally containing about 25–28 liters of insulating oil. These units are treated as PCB-suspect until laboratory testing confirms otherwise. In addition, approximately 200 SP-6BM or equivalent switch machines, around 500–900 trackside signaling junction/control boxes, and approximately 200–400 tunnel telephones may be present across the network. These will be replaced or dismantled together with old cables, relay equipment, onboard legacy devices, control panels, cable trays, junction boxes and associated electrical/electronic components. Exact quantities of cables to be installed or removed, trainsets to be equipped, relay rooms and control cabinets will be confirmed through the detailed equipment inventory before implementation and decommissioning works begin.
212. The project is structured into three main stages, ensuring a controlled and risk-managed transition from legacy systems to modern digital infrastructure. The first stage consists of Signaling Modernization and Operations Digitalization, during which the new systems are

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designed, procured, installed, and tested across the metro network. This stage includes installation of both wayside and onboard equipment, system integration, and progressive commissioning. It is characterized by phased implementation to ensure that metro operations continue without interruption, while gradually introducing the new CBTC system into live service conditions.

213. The second stage involves a parallel operation period, during which both the existing and new systems operate simultaneously for approximately 6–12 months. This stage serves as a stabilization and validation phase, allowing the project team to confirm the reliability, safety performance, and full operational capability of the new system under real conditions. It also provides a critical safety buffer, ensuring that the legacy system remains available as a fallback option until all technical and operational criteria for full transition are met.
214. The third stage comprises the dismantling of the existing system, which is carried out in a structured, multi-stage process to minimize risks related to safety, environment, and operational continuity. As detailed in the decommissioning plan, this phase includes system deactivation, safety verification, pilot dismantling, full removal of equipment, material management, and final documentation. The use of a GO/NO-GO decision framework ensures that dismantling only proceeds once the new system has demonstrated stable and fully certified performance.
215. Based on international practice for metro signaling modernization projects, the first stage (installation and digitalization) typically requires approximately 24 to 36 months, depending on network size, system complexity, and operational constraints such as working within active metro environments. This duration reflects the need for phased installation, integration, and progressive commissioning across multiple lines. The third stage (dismantling of the existing system) is generally shorter but still technically intensive, typically requiring approximately 6 to 12 months, depending on the extent of legacy infrastructure and the sequencing of removal activities. Together with the defined 6–12-month parallel operation period, the overall project implementation follows a structured timeline consistent with international best practices, ensuring a safe and efficient transition to modern signaling and digital systems.

4.2 Signaling Modernization and Operations Digitalization

216. The Signaling Modernization and Operations Digitalization stage represents the first and most technically intensive phase of the project, during which the foundation for the transition to a modern CBTC-based system is established. As described in the project documentation, this stage encompasses a sequence of interrelated activities, including system design finalization, procurement, installation of infrastructure and onboard equipment, and comprehensive system integration and testing. The objective is to ensure that all components of the new signaling and digital systems are fully installed, compatible, and capable of functioning as a unified and reliable operational platform.
217. This stage is implemented through a phased and controlled approach, allowing the new system to be gradually introduced while maintaining uninterrupted metro operations. Progressive testing, pilot operation, and staged rollout across the network ensure that system performance is validated under real operating conditions and that any technical or operational issues are addressed before full deployment. This structured methodology minimizes risks and ensures that the transition to the new system is carried out safely, efficiently, and in accordance with international best practices.

4.2.1 Design Finalization and System Integration Planning

218. The Design Finalization and System Integration Planning stage establishes the technical foundation for the entire modernization program, ensuring that all system components are coherently defined, coordinated, and ready for implementation. During this phase, preliminary designs are refined into detailed engineering solutions covering the CBTC system, SCADA, OCC, communications, power supply interfaces, and associated digital platforms. Particular attention is given to defining system architecture, functional requirements, and interoperability between new and existing infrastructure. This includes mapping all physical and digital interfaces, such as trackside equipment, onboard units, control centers, and legacy systems, to ensure seamless integration without disrupting ongoing metro operations.
219. A critical aspect of this stage is the development of integration strategies and implementation methodologies, which define how the new system will be introduced into a live operational environment. This involves preparing installation sequencing plans, work phasing schedules, and risk assessments that take into account operational constraints, safety requirements, and the need for uninterrupted passenger service. The stage also includes validation of system redundancy, fallback (degraded mode) scenarios, and cybersecurity considerations, ensuring that the design meets both performance and safety objectives. Close coordination between engineering teams, operators, and system suppliers is essential to ensure that all technical solutions are practical, implementable, and aligned with real operating conditions.
220. The basis for finalizing the design should include a combination of factors to ensure robustness and compliance with international best practice. These include: (i) results of feasibility studies and preliminary design documents; (ii) applicable international standards (e.g., CBTC specifications, SIL4 safety requirements); (iii) existing infrastructure constraints and field verification data obtained from site inspections; (iv) operational requirements and feedback from metro personnel; and (v) regulatory and safeguard requirements, including environmental considerations. In addition, lessons learned from comparable metro modernization projects and system supplier technical specifications should be incorporated. Final design approval should only be granted once all interfaces are verified, risks are assessed and mitigated, and the system is demonstrated to meet both technical and safety performance criteria.

4.2.2 Procurement and Factory Acceptance Testing (FAT)

221. The Design Procurement and Factory Acceptance Testing (FAT) stage translates the finalized design into physical systems and ensures, prior to delivery, that all procured components meet the required technical and safety specifications. During procurement, detailed technical specifications and contractual requirements are issued to qualified suppliers for signaling hardware, communications equipment, control systems, and digital platforms. Vendor selection is carried out based on compliance with performance criteria, safety standards (including SIL4 where applicable), interoperability requirements, and lifecycle considerations. Close coordination is maintained with suppliers to confirm design conformity, interface compatibility, and adherence to installation and integration plans defined in the previous stage.
222. Once manufacturing is complete, all critical equipment undergoes Factory Acceptance Testing (FAT) at the supplier's facilities. FAT is a structured verification process in which systems are tested under controlled conditions to confirm that they meet specified functional, performance, and safety requirements before shipment. This includes testing of signaling logic, communication protocols, fail-safe behavior, redundancy features, and system responses

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under simulated operational scenarios. Where applicable, integrated testing of subsystems (e.g., CBTC components with control interfaces) is conducted to verify compatibility and readiness for on-site integration.

223. The FAT stage serves as a key quality assurance checkpoint, minimizing the risk of defects, delays, or incompatibilities during installation in the live metro environment. Test results are documented and formally approved by the project team, including representatives of the implementing agency and, where required, independent experts or certification bodies. Only equipment that successfully passes FAT is authorized for delivery and installation, ensuring that the subsequent stages of implementation proceed efficiently and with reduced technical risk.

4.2.3 Installation of Wayside and Infrastructure Equipment

224. The Installation of Wayside and Infrastructure Equipment stage marks the transition from planning and procurement to physical implementation within the operational metro environment. During this phase, all trackside components of the new signaling and digital systems are installed along tunnels, stations, and technical facilities. This includes communication networks, signaling devices, control cabinets, sensors, power supply units, and associated cabling systems. Installation activities are carefully sequenced and coordinated with ongoing metro operations, typically carried out during nighttime or non-operational hours to minimize disruption to passenger services and ensure safety.
225. A key focus of this stage is the safe and precise integration of new equipment into existing infrastructure, which often requires working within confined underground environments and around legacy systems that remain in operation. This involves routing and securing cables, installing equipment in relay rooms and technical areas, and preparing interfaces for future system integration. Particular attention is given to maintaining the integrity of existing systems, avoiding interference with active operations, and ensuring compliance with safety protocols, including electrical isolation and protection measures.
226. In addition to installation, this stage includes continuous quality control and verification of works, ensuring that all equipment is installed in accordance with design specifications and technical standards. Field testing of individual components may be conducted to confirm correct installation and functionality prior to system-wide integration. The successful completion of this stage provides the physical foundation for subsequent system integration and testing activities, ensuring that the infrastructure is fully prepared to support the new CBTC-based control system.

4.3.4 Installation of Onboard Equipment

227. The Installation of Onboard Equipment stage focuses on upgrading the rolling stock to interface fully with the new CBTC-based control system. During this phase, trains are equipped with onboard control units, communication modules, antennas, odometry systems, and driver interfaces (MMI), enabling continuous data exchange between trains and trackside infrastructure. Installation is carried out in depots under controlled conditions, where each trainset is systematically retrofitted in accordance with detailed engineering specifications and manufacturer requirements.

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228. A key consideration in this stage is the coordination with ongoing metro operations, as trains must remain available for passenger service while being progressively upgraded. This typically involves a phased approach in which individual trains are temporarily withdrawn from service, equipped with CBTC components, tested, and then returned to operation. Integration with existing onboard systems, such as braking, traction, and safety systems, is carefully managed to ensure compatibility and avoid any unintended interactions. At the same time, legacy onboard equipment associated with the old signaling system is either deactivated or prepared for later removal during the decommissioning phase.
229. Following installation, each train undergoes functional testing and validation to confirm proper operation of all onboard systems, including communication with wayside equipment, accuracy of positioning, and correct display of information to drivers. These tests are conducted both in depot conditions and during controlled trial runs to ensure that the upgraded trains meet operational and safety requirements. Successful completion of this stage ensures that the rolling stock is fully prepared to operate under the new signaling regime and can support subsequent system integration and commissioning activities

4.2.4 System Integration and Interface Testing (SAT)

230. The System Integration and Interface Testing (SAT) stage verifies that all installed components wayside equipment, onboard systems, and central control platforms operate together as a single, coherent system in the field. Following completion of installation works, comprehensive testing is carried out to confirm that data exchange, control commands, and safety functions are correctly transmitted and executed across all interfaces. This includes validating communication between trains and trackside equipment, integration with the Operations Control Center, and interoperability with auxiliary systems such as power supply, ventilation, and supervisory control systems. Testing is performed under controlled conditions that replicate real operating scenarios to ensure that the system behaves consistently and reliably.
231. A key focus of this stage is the validation of system performance and fail-safe behavior, ensuring that the integrated system meets all functional and safety requirements defined during the design phase. This involves testing normal operations, degraded modes, and emergency scenarios, including loss of communication, equipment faults, and system redundancies. Particular attention is given to confirming that safety-critical functions such as train separation, speed control, and automatic braking operate correctly under all conditions and in accordance with international standards. Interface testing also ensures that no conflicts or unintended interactions occur between new and existing systems during the transition period.
232. The SAT stage serves as the final technical verification before the system is introduced into live operational conditions. All test results are documented, reviewed, and formally approved by the project team, including system suppliers, operators, and independent verification bodies where required. Successful completion of this stage provides assurance that the integrated system is fully functional, safe, and ready for pilot operation, thereby reducing the risk of operational disruptions during subsequent commissioning and rollout phases.

4.2.6 Pilot Operation and Controlled Commissioning

233. The Pilot Operation and Controlled Commissioning stage introduces the newly integrated CBTC system into live operations within a limited, controlled section of the network, allowing its performance to be evaluated under real conditions. During this phase, selected line

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segments or corridors are operated using the new system while maintaining close supervision from technical teams and the operations control center. The objective is to validate system behavior in an actual operating environment, including train movement control, communication reliability, passenger flow management, and interaction with station and tunnel infrastructure. This stage bridges the gap between laboratory/system testing and full network deployment.

234. A key aspect of this stage is the controlled nature of operations, where predefined operational scenarios are tested, including normal service conditions, peak-hour performance, and degraded or emergency modes. Operational staff, including drivers and dispatchers, are actively involved in the process, allowing them to become familiar with the new system and provide feedback on usability and performance. Any discrepancies, system faults, or integration issues identified during this period are carefully analyzed and addressed through system adjustments, software updates, or procedural improvements. This iterative approach ensures that the system is progressively optimized before wider implementation.
235. The pilot phase also plays a critical role in risk reduction and operational readiness, as it confirms that the system can safely and reliably support metro operations without dependence on the legacy infrastructure. Performance data, incident logs, and operational feedback are systematically collected and reviewed to support decision-making. Only after the system demonstrates stable performance and meets all technical and safety criteria does the project proceed to the next stage of full-scale rollout. This controlled commissioning approach ensures a smooth transition, minimizes operational risks, and builds confidence among stakeholders in the reliability of the new system.

4.2.7 Progressive System Rollout Across Network

236. The Progressive System Rollout Across Network stage involves the systematic expansion of the CBTC system from the pilot section to the entire metro network, ensuring that all lines and operational segments are gradually brought under the control of the new signaling system. This rollout is implemented in a phased and carefully sequenced manner, typically corridor by corridor or line by line, to maintain operational stability and minimize risks. Each newly integrated section undergoes final checks and validation before being fully incorporated into live operations, ensuring that performance standards established during the pilot phase are consistently met across the network.
237. A key feature of this stage is the continued parallel operation of the legacy and new systems, which provides a critical safety buffer during the transition. While the CBTC system progressively assumes operational control, the existing system remains available as a fallback in case of unexpected issues. This dual-system approach allows operators to monitor performance, verify reliability, and ensure that any anomalies are promptly addressed without affecting passenger service. Operational teams, including drivers, dispatchers, and maintenance personnel, are gradually transitioned to the new system through training and real-time experience, supporting a smooth and controlled changeover.
238. Throughout this stage, continuous performance monitoring and system optimization are carried out to ensure that the expanded network operates efficiently and safely. Data collected from each newly commissioned section, such as communication stability, train headways, and system responsiveness, are analyzed to identify any remaining issues and implement corrective measures. This iterative process ensures that the system achieves full operational maturity by the end of the rollout. Ultimately, this stage completes the transition to a fully

modernized signaling system, setting the foundation for the final stabilization phase and subsequent decommissioning of the legacy infrastructure.

4.3 Stabilization and Parallel Operation Period

239. The Stabilization and Parallel Operation Period represent a critical transitional phase in which the newly installed CBTC system operates concurrently with the legacy signaling system across the metro network. During this period, typically lasting 6–12 months, the new system is subjected to continuous real-time operation under normal, peak, and stressed conditions, while the existing system remains available as a fallback. This dual-system configuration allows operators to verify that all operational functions - train control, communication, traffic management, and safety responses, are performed reliably and consistently by the new system without compromising service continuity.
240. From a safety perspective, this phase is essential to protect passengers, staff, and infrastructure during the transition to a new control regime. Metro systems operate in high-risk, high-density environments, where even minor system failures can have significant consequences. Maintaining the legacy system as a backup ensures that, in the event of unexpected faults, communication failures, or software anomalies in the CBTC system, operations can be safely maintained or reverted without disruption. This redundancy significantly reduces the risk of accidents, service interruptions, or unsafe operating conditions, particularly during the early stages of live system operation when unknown issues may still emerge.
241. The stabilization period also serves as a comprehensive system validation phase, allowing for the collection and analysis of operational data over an extended timeframe. This includes monitoring system reliability, response times, communication stability, train headways, and performance under degraded or emergency scenarios. Feedback from operators, maintenance teams, and control center staff is systematically incorporated to fine-tune system parameters and resolve any residual technical issues. This iterative process ensures that the system achieves full operational maturity and that all performance indicators meet the required standards before the legacy system is permanently decommissioned.
242. In addition, this phase provides an opportunity to verify safety certification assumptions in real operating conditions, including those related to SIL4 safety integrity requirements. While certification is typically achieved during earlier stages, real-world operation may reveal conditions not fully captured during testing. The stabilization period ensures that safety-critical functions such as train separation, braking, and fail-safe responses perform reliably over time and under varying operational conditions, thereby strengthening confidence in the system's long-term safety.
243. The inclusion of a stabilization and parallel operation phase is consistent with international best practices for railway and metro signaling upgrades. While not always explicitly mandated as a fixed-duration requirement, such a phase is strongly embedded in guidance and standards such as IEC 62290 (Urban Guided Transport Management and Command/Control Systems), EN 50126/50128/50129 (RAMS and railway safety standards), and widely applied CBTC implementation frameworks. These standards emphasize the need for progressive commissioning, staged validation, and demonstration of system reliability under real operating conditions before full transition. In practice, major metro modernization projects worldwide

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(e.g., London Underground, Paris Metro, Hong Kong MTR) have adopted similar parallel operation periods as part of their safety assurance strategies.

244. Ultimately, this phase plays a dual role: it acts as a risk mitigation mechanism and as a performance validation process. By ensuring that the new system operates safely, reliably, and independently over a sustained period, the project minimizes the likelihood of operational failures and provides a robust basis for decision-making under the GO/NO-GO principle. Only after successful completion of this phase demonstrating stable performance, full compliance with safety requirements, and operator readiness can the project proceed confidently to the final stage of dismantling the legacy system.
245. From an environmental and operational standpoint, the stabilization period also allows for the identification of any secondary impacts or system interactions that may not have been evident during testing phases. This includes potential effects on energy consumption, ventilation systems, or maintenance practices. By addressing these aspects proactively, the project ensures that the transition to the new signaling system not only meets safety requirements but also supports sustainable and efficient long-term operation of the metro network.

4.4 Decommissioning Plan

4.4.1 Introduction

246. The proposed project, implemented by the Baku Metro CJSC, envisages a phased transition from the existing signaling system to a modern CBTC-based system, ensuring operational continuity and safety. Following the installation and commissioning of the new system, the existing infrastructure will remain in operation for a stabilization period of approximately 6–12 months, during which the new system will be tested under real operational conditions. This period is critical to confirm the reliability, safety certification (including SIL4 requirements), and full functionality of fallback operational modes before any physical dismantling begins.
247. Once these preconditions are met and formal approval is obtained, the decommissioning process will commence in a structured, multi-stage approach, beginning with functional deactivation of the old system while it remains physically in place. This is followed by safety verification procedures to ensure that train operations are fully controlled by the new CBTC system. A pilot dismantling phase will then be implemented within a limited section of the network to test the removal process and confirm that no operational disruptions occur. Only after successful validation will the project proceed to full-scale dismantling.
248. The complete decommissioning process will be carried out in a total of eight stages, covering system shutdown, verification, pilot testing, sequential removal of wayside and onboard equipment, cable and infrastructure dismantling, material management, safety control measures, and final documentation. This phased methodology ensures that risks, particularly those related to safety, environmental impacts, and operational continuity, are minimized and effectively managed throughout the transition from legacy systems to modern digital infrastructure.
249. The GO/NO-GO principle in the context of this project represents a decision-making checkpoint that determines whether the decommissioning of the existing signaling system can safely proceed. Under this approach, dismantling activities will only commence if all predefined technical, safety, and operational criteria are fully met. In practical terms, this means that the newly installed CBTC system must demonstrate stable and reliable operation over a

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continuous period (approximately 6–12 months), achieve full functional control of train movements across the network, and obtain all required safety certifications (e.g., SIL4). If any of these conditions are not satisfied, the decision defaults to “NO-GO,” and the existing system remains in place until deficiencies are resolved.

250. Within the Baku Metro modernization project, the GO/NO-GO principle ensures that operational safety and service continuity are not compromised during the transition phase. It provides a structured mechanism to verify that critical elements such as fallback (degraded mode) operation, emergency braking functionality, and system redundancy, are fully operational before irreversible steps, such as dismantling legacy equipment, are undertaken. This is particularly important given the complexity of metro operations and the need to maintain uninterrupted passenger services in a confined underground environment.
251. From an environmental and risk management perspective, the GO/NO-GO principle also serves as a safeguard to prevent premature dismantling that could introduce unnecessary risks, including improper handling of legacy equipment, accidental releases of hazardous materials, or disruption of safety systems. By enforcing a strict “proceed only when ready” approach, the project ensures that both technical readiness and environmental preparedness are achieved prior to entering the decommissioning phase, thereby aligning with international best practices and ADB safeguard requirements.

4.4.2 Preconditions for Decommissioning

252. The first stage of the decommissioning process is governed by a set of strict preconditions that must be fully satisfied before any physical intervention on the existing system is allowed to begin. During this stage, the newly installed CBTC system must demonstrate stable and uninterrupted operation over an extended period of approximately 6–12 months, ensuring that it can reliably manage real-time train operations under varying conditions. This operational validation period is critical for identifying and resolving any technical issues, fine-tuning system performance, and confirming that the system can handle peak loads and emergency scenarios without reliance on the legacy signaling infrastructure.
253. In parallel, the CBTC system must achieve full operational control across all metro lines, meaning that train movement, track occupancy detection, and signaling functions are entirely managed by the new system. A key requirement at this stage is the successful completion of SIL4 safety certification, which verifies that the system meets the highest international safety integrity standards for railway operations. Additionally, the project must confirm that the fallback (degraded mode) scenario is fully functional, ensuring that safe operations can be maintained even in the event of partial system failure. This redundancy is essential for maintaining operational resilience and passenger safety.
254. The final step in this stage involves obtaining formal management approval for system cutover, based on comprehensive technical, operational, and safety assessments. This approval signifies that all readiness criteria have been met and that the system can safely transition to exclusive CBTC operation. Only after this authorization is granted can the project proceed to subsequent stages of decommissioning. This structured approach ensures that the transition from the legacy system is carried out in a controlled and risk-informed manner, minimizing the potential for operational disruption and environmental or safety incidents.

4.4.3 System Deactivation

255. The second stage of the decommissioning process involves the functional deactivation of the existing signaling system while all physical components remain in place. This stage serves as a controlled transition phase in which the legacy system is systematically taken out of operation without immediate dismantling. The primary objective is to ensure that the newly installed CBTC system assumes full operational responsibility for train control, while the old system is retained in a non-operational state as a precautionary measure. This approach allows for verification of system independence and stability without introducing the risks associated with premature removal of equipment.
256. During this phase, key functional elements of the legacy system are progressively disabled. This includes the deactivation of Automatic Train Regulation (ARS) functions, the termination of ALS signal transmission, and the shutdown of code generators that previously supported signaling operations. In addition, the ARS system is fully disconnected from the central dispatching system, ensuring that it no longer influences train movement or operational decisions. These actions are carried out in a coordinated manner to avoid any interference with ongoing metro operations and to confirm that all signaling and control functions are exclusively managed by the CBTC system.
257. Despite being functionally inactive, the legacy system remains physically installed and accessible throughout this stage. This provides an important safety buffer, allowing operators to revert to the previous system if unforeseen issues arise during the early period of full CBTC operation. Maintaining the physical infrastructure in place also facilitates monitoring and verification activities, ensuring that no unintended interactions occur between the old and new systems. This staged approach reduces operational risk and provides confidence in the reliability of the new system before irreversible actions are taken.
258. Overall, the system deactivation stage is a critical step in the transition process, as it confirms the complete functional separation between the legacy and modern systems. By ensuring that the old system is fully inactive but still physically available, the project minimizes the risk of disruption while maintaining operational flexibility. This controlled shutdown phase lays the foundation for subsequent stages of decommissioning, where physical removal of equipment can proceed with greater certainty and reduced risk.

4.4.4 Safety Verification

259. The third stage of the decommissioning process focuses on comprehensive safety verification, ensuring that the newly implemented CBTC system fully and reliably governs all train operations within the Baku Metro. At this point, the legacy signaling system has already been functionally deactivated, and the CBTC system is expected to operate as the sole control mechanism. The objective of this stage is to confirm, through systematic testing and validation, that all operational functions, particularly those critical to safety, are performed exclusively and correctly by the new system.
260. A key element of this stage is the confirmation that train movements are entirely controlled by the CBTC system, with no residual influence from the legacy infrastructure. This involves verifying that all commands related to train speed, spacing, and routing are generated and executed through the CBTC platform. In parallel, the system's ability to accurately detect and

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monitor track occupancy is rigorously tested. This ensures that the CBTC system can reliably determine train positions and maintain safe separation distances under all operating conditions, including peak traffic and potential system disturbances.

261. Another critical component of safety verification is the testing of emergency braking functions, which are essential for preventing accidents and ensuring passenger safety. These tests are conducted under controlled conditions to confirm that the system can respond appropriately to emergency scenarios, such as unexpected obstacles, system faults, or operator interventions. The performance of these safety-critical functions is evaluated against predefined standards to ensure compliance with international safety requirements, including those associated with SIL4 certification.
262. Overall, this stage provides assurance that the CBTC system meets all necessary safety and performance criteria before proceeding to physical dismantling of the legacy system. By validating operational control, detection accuracy, and emergency response capabilities, the project ensures that risks are minimized and that the transition to the new system is both technically sound and operationally secure.

4.4.5 Pilot Area Decommissioning

263. The fourth stage of the decommissioning process introduces a pilot decommissioning phase, designed to validate the full removal of the legacy system under controlled conditions before proceeding across the entire network. At this stage, a limited section of the metro system is selected, typically between two stations, where the operational complexity can be effectively managed and closely monitored. The selection of this pilot section is based on technical considerations such as traffic intensity, accessibility, and representativeness of typical infrastructure conditions.
264. Within the selected section, the legacy ARS-ALS signaling system is completely dismantled, including all associated equipment, cables, and transmission components. This marks the first instance of full physical removal of the old system, transitioning from functional deactivation to actual decommissioning. The process is carefully executed to ensure that all activities are performed safely and without disruption to ongoing operations, relying entirely on the CBTC system for train control within this segment.
265. Following the removal, a monitoring period of approximately 2–4 weeks is implemented, during which the performance of the CBTC system is closely observed under real operating conditions. This monitoring phase is critical for identifying any unforeseen issues related to system stability, train control, communication reliability, or safety performance. Operational data, incident logs, and feedback from technical staff are systematically reviewed to ensure that the absence of the legacy system does not negatively affect performance or safety.
266. If the monitoring period confirms stable and reliable operation without any significant issues, the project proceeds to full-scale decommissioning across the remaining network. This staged approach minimizes risk by allowing the project team to test and validate the decommissioning methodology in a controlled environment, ensuring that lessons learned from the pilot phase are incorporated into subsequent stages and that the transition to the new system is carried out with confidence and operational security.

4.4.6 Full Decommissioning Phase

267. The fifth stage represents the full decommissioning phase, during which the legacy signaling system is physically removed from the metro infrastructure in a structured and sequential manner. Following the successful completion of the pilot phase, this stage expands the dismantling activities across the entire network, ensuring that all components of the outdated ARS-ALS system are systematically eliminated. The process is carefully planned to maintain operational safety and continuity, with works typically scheduled during off-peak hours or nighttime periods to minimize disruption to metro services.
268. The first sub-stage focuses on the removal of wayside and tunnel equipment, which forms the backbone of the legacy signaling system. This includes the dismantling of ALS cables and line transmission wires that run along tunnels and tracks, as well as the removal of track circuit equipment responsible for train detection in the old system. In addition, significant work is carried out within relay rooms, where key components such as relay blocks, code generators, control servers, and associated controllers are disconnected and removed. Signal transformers and power supply modules, which supported the functioning of the legacy system, are also dismantled. These activities require careful handling due to the presence of electrical systems and, in some cases, oil-filled equipment, which may pose environmental and safety risks.
269. The second sub-stage addresses the removal of onboard equipment installed within trains. This includes ALS receivers, ARS indicators located in the driver's cab, and other interface panels that were previously used to support communication between the train and the trackside signaling system. As part of the modernization process, all such equipment must be fully removed and replaced with interfaces compatible with the CBTC system, specifically the CBTC-MMI (Man-Machine Interface). This transition ensures that train operators interact solely with the new system, eliminating any dependency on legacy components and improving operational efficiency and safety.
270. The third sub-stage involves the removal and optimization of cables and supporting infrastructure throughout the metro network. Over decades of operation, a large volume of cables and auxiliary systems may have accumulated, many of which become redundant following the transition to CBTC. This phase includes the removal of unused or obsolete cables, reorganization and optimization of cable trays, and thorough cleaning of underground cable ducts. These activities not only reduce physical clutter but also improve accessibility for maintenance and reduce potential fire and environmental risks associated with aging or damaged cables.
271. Throughout this stage, material management plays a critical role, as the dismantling process generates significant quantities of equipment, metals, and electrical components. Materials are categorized based on their condition and potential reuse: serviceable components may be retained as spare parts, while obsolete or non-functional equipment is designated for disposal or recycling. Particular attention is given to components that may contain hazardous substances, ensuring that they are handled, transported, and disposed of in accordance with environmental regulations and international best practices.
272. In parallel, strict safety measures and environmental controls are implemented to manage the risks associated with dismantling activities in confined underground environments. This includes the application of lock-out/tag-out (LOTO) procedures, isolation of electrical systems,

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and protection against exposure to hazardous voltages or materials. Ventilation, fire safety, and worker protection measures are maintained at all times to ensure safe working conditions. These controls are essential to prevent accidents and minimize environmental impacts during large-scale removal activities.

273. Overall, the fifth stage represents the most intensive phase of the decommissioning process, involving coordinated technical, environmental, and operational efforts. By systematically removing legacy equipment and optimizing infrastructure, this stage not only completes the transition to the new CBTC system but also improves the overall safety, efficiency, and environmental performance of the metro network.
274. During the third stage of the project, the main volume of waste will be generated during the decommissioning and dismantling of the existing legacy signaling system. This stage will include removal of wayside and tunnel equipment, old ALS/ARS cables, line transmission wires, track circuit equipment, relay blocks, code generators, control servers, control cabinets, onboard legacy equipment, tunnel telephones, switch machines, junction/control boxes, cable trays, and associated metal structures. The most environmentally significant waste stream will be the removal of approximately 933 oil-filled drossel-transformers / choke-transformers, each containing about 25–28 liters of insulating oil, which gives an estimated total oil inventory of approximately 23,000–26,000 liters. Before laboratory testing, this waste stream should be considered Medium to High risk, because the oil must be treated as PCB-suspect until analysis confirms that PCB concentrations are below the applicable threshold.
275. Other significant waste streams will include electrical and electronic waste, cables, scrap metals, and oil-contaminated materials. Based on the preliminary inventory, the decommissioning phase may generate approximately 500–900 trackside signaling junction/control boxes, 200–400 tunnel telephones, around 200 SP-6BM or equivalent switch machines, relay equipment, onboard devices, electronic modules, and other control components. The expected e-waste quantity is estimated at approximately 10–50 tons, and its risk level is assessed as Medium, because some components may contain hazardous substances, batteries, lead solder, degraded insulation or contaminated residues. Cable waste may reach approximately 50–200 tons, while scrap metal from cabinets, frames, switch machines, supports and housings may reach approximately 50–150 tons. These streams are generally Low to Medium risk if properly segregated and transferred to licensed recycling facilities.
276. Additional hazardous or potentially hazardous waste may include used absorbents, contaminated rags, PPE, oily residues, sludge from cable ducts or drainage areas, contaminated packaging, used oils, and residues generated during handling of oil-filled equipment. Excluding transformer oil, this waste stream is preliminarily estimated at approximately 1–5 tons, although the quantity may increase if contaminated sediment, sludge or PCB-positive materials are identified during dismantling. This waste stream should be assessed as Medium to High risk, especially where it has been in contact with transformer oil, tunnel drainage systems, or PCB-suspect equipment. Such materials must be collected in sealed and labelled containers, stored with secondary containment, documented through chain-of-custody records, and transferred only to certified hazardous waste organizations.
277. Overall, the third stage will generate the largest quantity and highest-risk waste under the project. Most metal and cable waste can be recycled if properly segregated, while e-waste, oil-filled transformers, transformer oil, oily absorbents, contaminated residues and PCB-suspect materials require stricter control. The final waste quantities must be confirmed through a

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detailed pre-dismantling inventory, but the preliminary assessment indicates that waste management during Stage III should be treated as a key environmental management issue requiring PCB testing, waste segregation, depot-based temporary storage, licensed transport, certified recycling or disposal, and full documentation.

4.4.7 Material Management

278. The sixth stage of the decommissioning process focuses on material management and disposition of all removed equipment, ensuring that dismantled components are handled in an environmentally responsible and resource-efficient manner. Following the physical removal of legacy systems, all equipment is systematically inspected, sorted, and categorized based on its condition and potential for reuse. Components that remain functional or repairable are identified and retained as part of a spare parts inventory, which can support maintenance of remaining systems or provide contingency resources during ongoing operations.
279. At the same time, equipment that is deemed obsolete, damaged, or no longer compatible with the new CBTC system is designated for final disposal. This process is carried out in accordance with applicable environmental regulations and international best practices, particularly where hazardous materials may be present. Special attention is given to ensuring that disposal pathways are properly documented and that any potentially contaminated components are managed by licensed entities to prevent environmental harm.
280. In parallel, materials with intrinsic value, primarily metals such as copper, aluminum, and steel are separated and directed toward recycling streams. This not only reduces the volume of waste requiring disposal but also contributes to sustainable resource management by recovering valuable materials for reuse. Overall, this stage ensures that the decommissioning process is completed in a manner that minimizes environmental impact, supports circular economy principles, and maintains compliance with environmental and safety standards

4.4.8 Safety Measures

281. The seventh stage of the decommissioning process is dedicated to the implementation of comprehensive safety measures to ensure that all dismantling and installation activities are carried out without risk to workers, passengers, or ongoing metro operations within the Baku Metro. Given the complexity of working in an active metro environment, this stage emphasizes strict operational controls, including scheduling activities during nighttime or non-operational hours, when passenger traffic is minimal or suspended. This approach significantly reduces the potential for accidents and allows work to be conducted in a controlled and secure setting.
282. A critical element of this stage is the complete isolation of work zones from active train operations, ensuring that no interaction occurs between construction personnel and moving trains. This includes physical segregation of work areas, coordination with operational control centers, and strict adherence to access control procedures. In parallel, the application of Lock-out / Tag-out (LOTO) procedures is mandatory to ensure that all electrical systems are properly de-energized and secured before any work begins. This prevents accidental energization of equipment and protects workers from exposure to hazardous voltages.
283. In addition to procedural controls, the stage includes the implementation of protective measures against electrical and other occupational hazards, including the use of appropriate

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personal protective equipment (PPE), grounding systems, and verification of zero-energy states prior to intervention. Continuous supervision and safety monitoring are maintained throughout all activities to ensure compliance with safety protocols. This stage is essential to maintaining a safe working environment and minimizing the risk of incidents during the most intensive phases of decommissioning.

4.4.9. Documentation and Finalization

284. The eighth and final stage of the decommissioning process focuses on documentation and formal closure of the transition from the legacy system to the new CBTC system within the Baku Metro. At this stage, all completed works are systematically recorded to reflect the actual configuration of the installed systems. This includes the preparation of comprehensive as-built documentation, which captures the final layout of equipment, cabling, control systems, and interfaces following completion of installation and dismantling activities. These documents serve as a critical reference for future operation, maintenance, and any subsequent upgrades, ensuring that the system is fully traceable and technically documented.
285. In parallel, formal procedures are undertaken to certify the completion of both decommissioning and commissioning activities. The official decommissioning certificate confirms that the legacy signaling system has been fully and safely removed in accordance with approved procedures, and that no residual dependencies remain. At the same time, the final commissioning certificate of the CBTC system verifies that the new system has been fully installed, tested, and validated to meet all operational and safety requirements. These certifications are typically issued following final inspections, technical verification, and acceptance by relevant authorities and project stakeholders.
286. This stage ensures that the project is formally closed in a controlled and accountable manner, with all technical, safety, and regulatory requirements satisfied. Proper documentation and certification not only confirm compliance with applicable standards but also provide assurance that the metro system is fully transitioned to modern operational conditions. As such, this final stage plays a crucial role in consolidating the results of the entire decommissioning process and enabling sustainable, safe, and efficient long-term operation of the upgraded system.

4.4.9 Waste Streams

287. During project implementation, waste streams shall be managed using a source segregation and risk-based classification approach. All waste shall be separated at the point of generation into clearly defined categories, including non-hazardous general waste, packaging materials, scrap metal, cable waste, waste electrical and electronic equipment, used oils, oily absorbents, contaminated PPE, batteries, lamps, liquid waste, PCB-suspect materials and other hazardous waste. Hazardous and non-hazardous waste shall not be mixed under any circumstances. Oil-filled drossel-transformers / choke-transformers, transformer oils, oily residues and other equipment with unknown contamination status shall be treated as potentially hazardous until laboratory testing and waste classification confirm the appropriate management route. This approach is particularly important because the project includes removal of approximately 933 oil-filled choke-transformers and other legacy electrical and signaling equipment.
288. No temporary waste storage shall be allowed in tunnels, platforms, escape routes, drainage channels, cable ducts, shafts or other underground operational areas. Waste generated in

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tunnels, stations and technical rooms shall be collected during the same work shift, packed or containerized according to its type, and transported to designated depot-based temporary storage areas. Depending on the quantity and type of waste, transport from underground work areas to the depot should be carried out by rail during the approved night working window, when passenger operations are suspended or limited. Temporary storage at the depot shall be organized in clearly demarcated, secure and access-controlled areas with impermeable surfaces, labels, spill kits, firefighting equipment, secondary containment for liquids, and separate zones for scrap metal, cables, e-waste, hazardous waste and PCB-suspect materials.

289. Final waste management shall be carried out only through certified, licensed or otherwise legally authorized organizations. Recyclable materials such as scrap metal, copper and aluminum cables, cabinets and brackets shall be transferred to approved recycling facilities, while e-waste shall be managed through licensed e-waste handlers. Used oils, oily residues, contaminated absorbents, sludge, PCB-suspect or PCB-confirmed materials and other hazardous waste shall be managed under strict chain-of-custody procedures, including waste logs, transfer notes, laboratory results where applicable, and final disposal or recycling certificates. If PCBs are confirmed, affected oil, equipment and contaminated materials shall be isolated, labelled, stored separately with secondary containment, and managed only through organizations authorized to handle PCB-contaminated waste.

4.5 Time-bound, Phased Implementation Program

290. The proposed project is structured as a time-bound, phased implementation program in line with international financial institution (IFI) requirements, ensuring clear sequencing, risk control, and performance verification at each stage. As outlined in the project documentation, the overall implementation is divided into three major phases: (i) Signaling Modernization and Operations Digitalization, (ii) Stabilization and Parallel Operation, and (iii) Decommissioning of the existing system. Within these phases, the work is further subdivided into clearly defined sub-stages, each with specific objectives, deliverables, and timelines. This structured approach is consistent with ADB, World Bank, and EBRD practices, which require transparent scheduling, milestone-based implementation, and measurable progress tracking.
291. The time-bound plan reflects the complexity of working within an operational metro environment, where installation, testing, and dismantling must be carefully coordinated to avoid service disruption and ensure safety. The first phase (modernization and digitalization) is the longest and most technically intensive, requiring detailed design, procurement, installation, and system integration across multiple lines. The second phase provides a mandatory stabilization period (6–12 months) for system validation, while the third phase focuses on controlled dismantling of legacy infrastructure using a staged approach. Each sub-stage is assigned a realistic duration based on international experience in CBTC and metro modernization projects.

4.6 Time-Bound Plan and Schedule

292. The following three tables present a comprehensive, time-bound implementation framework for the project, structured in accordance with international financial institution (IFI) requirements. The first table outlines **Table 14 – Signaling Modernization and Operations**

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Digitalization, detailing the sequence of sub-stages from design finalization through system rollout, including estimated durations and cumulative timelines. The second table summarizes

Table 13: Signaling Modernization and Operations Digitalization (Estimated: 24–36 months)

Sub-Stage	Description	Estimated Duration	Cumulative Timeline
1.1	Design Finalization & System Integration Planning	4–6 months	Month 1–6
1.2	Procurement & Factory Acceptance Testing (FAT)	6–8 months	Month 4–12
1.3	Installation of Wayside & Infrastructure Equipment	10–14 months	Month 8–22
1.4	Installation of Onboard Equipment	8–12 months	Month 10–22
1.5	System Integration & Interface Testing (SAT)	4–6 months	Month 18–24
1.6	Pilot Operation & Controlled Commissioning	3–5 months	Month 22–27
1.7	Progressive System Rollout Across Network	6–9 months	Month 24–33

293. **Table 15 – Stabilization and Parallel Operation**, highlighting the period during which the new and existing systems operate simultaneously to ensure system reliability and safety validation. The third table presents.

Table 14: Stabilization and Parallel Operation (Estimated: 6–12 months)

Sub-Stage	Description	Duration	Timeline
2.1	Parallel operation of CBTC and legacy systems	6–12 months	Month 30–42

294. **Table 16 – Decommissioning of the Existing System**, describing the structured dismantling process, including preparatory steps, pilot removal, full decommissioning, and final documentation, along with corresponding timelines and dependencies. Together, these tables provide a clear overview of the project schedule, sequencing of activities, and expected duration of each phase.

Table 15: Decommissioning of Existing System (Estimated: 6–12 months)

Sub-Stage	Description	Estimated Duration	Timeline
3.1	Preconditions / GO–NO–GO Decision	1–2 months	Month 42–44
3.2	System Deactivation	1 month	Month 44–45
3.3	Safety Verification	1 month	Month 45–46
3.4	Pilot Area Decommissioning	1–2 months	Month 46–48
3.5	Full Decommissioning (Equipment Removal)	3–5 months	Month 48–53
3.6	Material Management	Parallel (throughout Stage 3)	Month 48–54
3.7	Safety Measures Implementation	Continuous	Month 44–54

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Sub-Stage	Description	Estimated Duration	Timeline
3.8	Documentation & Finalization	1 month	Month 53–54

5. ANALYSIS OF ALTERNATIVES

295. As part of the project preparation process, an analysis of alternatives has been undertaken to ensure that the proposed solution represents the most appropriate option from technical, environmental, and economic perspectives. In accordance with international best practice and the requirements of environmental assessment frameworks, the project considered two main alternatives: (i) the “zero alternative”, which assumes that no modernization measures are implemented and the existing systems continue to operate, and (ii) the selection of an appropriate signaling system, involving a comparison between different technological options for upgrading the metro control system.
296. The evaluation of these alternatives is essential to demonstrate that the chosen approach provides the optimal balance between safety, efficiency, environmental performance, and long-term sustainability. The zero alternative allows for assessment of the consequences of maintaining the status quo, while the comparison of signaling technologies enables identification of the most suitable system for meeting operational and strategic objectives. The detailed analysis of these alternatives, including their advantages, limitations, and associated impacts, is presented in the sections below.

5.1 Zero Alternative

297. The “zero alternative”, or the option of not implementing the project, assumes that the existing metro signaling and operational systems would continue to function without modernization. Under this scenario, the Baku Metro would remain dependent on aging, relay-based signaling infrastructure and outdated control systems. While this option would avoid short-term construction-related impacts, it would not address the growing operational, safety, and environmental challenges associated with legacy equipment and increasing passenger demand.
298. From a technical and safety perspective, the zero alternative is not acceptable due to the progressive deterioration of existing systems and the associated increase in operational risks. Aging signaling equipment, including obsolete relays and oil-filled transformers, is more prone to failure, which may lead to service disruptions or safety incidents. In addition, the current system limits the ability to optimize train frequency and capacity, thereby constraining the efficiency of the metro network. Without modernization, the system would not meet current international safety standards, including those related to automated control and fail-safe operation.
299. From an environmental standpoint, maintaining the existing infrastructure would prolong the presence of potentially hazardous materials, such as aging oil-filled equipment with possible PCB contamination, and increase the risk of leaks, spills, or improper waste management over time. The absence of modern monitoring and control systems would also limit the ability to improve energy efficiency and environmental performance, resulting in higher operational emissions and resource consumption compared to a modernized system.
300. Finally, from a strategic and socio-economic perspective, the zero alternative would be inconsistent with Azerbaijan’s development priorities related to sustainable urban mobility, digital transformation, and environmental protection. It would hinder improvements in service reliability, passenger safety, and overall quality of public transport, while limiting the capacity of the metro system to support urban growth. For these reasons, the non-implementation

alternative is considered unacceptable, as it fails to address critical risks and does not provide a viable long-term solution for the metro system.

5.2 Signaling System Alternative

301. The comparison between the CBTC-type signaling system and the Russian-made MPS (fixed-block or legacy-type system) must be assessed not only in terms of capital cost, but also lifecycle cost, operational efficiency, and long-term benefits. Although detailed cost figures for proprietary systems vary significantly by project, international studies show that modern CBTC systems generally require higher upfront investment due to advanced communication infrastructure, onboard equipment, and integration complexity. However, these systems provide substantial long-term economic advantages, including reduced maintenance costs, increased capacity, and improved reliability, which offset initial capital expenditures over time.
302. In contrast, traditional or semi-modern systems such as MPS (typically based on fixed-block signaling principles) are generally less expensive at the installation stage, as they rely on simpler infrastructure and lower levels of automation. However, these systems are inherently limited in terms of capacity and operational flexibility. Fixed-block systems require larger safety margins between trains, resulting in lower network efficiency and higher long-term operational costs, particularly in high-demand urban environments. In addition, maintenance of such systems becomes increasingly costly over time due to aging components and limited availability of spare parts.
303. Modern CBTC systems provide continuous communication between trains and trackside equipment, allowing for precise train positioning and dynamic control of train movements. This enables reduced headways, increased passenger capacity, and improved safety performance, which are critical for large metropolitan systems such as Baku. Furthermore, CBTC systems support higher levels of automation and integration with digital platforms, including real-time monitoring, predictive maintenance, and centralized traffic management, which significantly enhances operational efficiency and reduces lifecycle costs.
304. From a cost-efficiency perspective, international experience indicates that CBTC systems deliver net economic benefits over their lifecycle, even when initial costs are higher. Studies have demonstrated that improvements in travel time, service reliability, and operational efficiency result in measurable economic gains, including reduced delays and lower operating costs. In addition, CBTC systems are more adaptable to future upgrades, allowing for gradual transition toward higher levels of automation without requiring full system replacement, which further improves long-term cost effectiveness.
305. Another important factor is the integration capability and scalability of the systems. CBTC-based solutions are designed for modern urban transport networks and are widely adopted globally due to their compatibility with digital infrastructure and smart transport systems. Market trends show a strong global shift toward CBTC technology, driven by the need for higher capacity and improved operational efficiency in urban rail systems. In contrast, systems such as MPS are less flexible and may require significant additional investment in the future to meet evolving operational and safety requirements.
306. From an environmental and safety perspective, CBTC systems also offer clear advantages. By optimizing train movements and reducing unnecessary acceleration and braking, they contribute to lower energy consumption and reduced emissions. Improved system control and

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automation also reduce the risk of human error, enhancing overall safety performance. These benefits are particularly important in densely populated urban environments, where efficient and reliable public transport systems play a key role in reducing traffic congestion and improving air quality.

307. In conclusion, while the MPS system may appear more cost-effective in the short term due to lower initial investment, the CBTC system is clearly superior when evaluated on a full lifecycle basis. Its advantages in capacity, safety, operational efficiency, scalability, and environmental performance outweigh the higher upfront costs. Therefore, in line with international best practice and long-term urban transport planning objectives, the adoption of the CBTC-based system represents the most appropriate and sustainable solution for the Baku Metro modernization project.
308. **Table 17** provides a comparison of the two signaling systems described above, based on various components.

Table 16: Comparative Evaluation of Signaling System Alternatives

Evaluation Criteria	CBTC System (Modern)	MPS System (Traditional / Fixed-Block)	Assessment
Technology Type	Moving-block, communication-based	Fixed-block, track-circuit-based	CBTC is more advanced
Initial Capital Cost	High	Moderate	MPS cheaper initially
Lifecycle Cost	Low–Moderate (optimized maintenance)	High (aging components, maintenance intensive)	CBTC more cost-efficient long-term
Operational Capacity	High (reduced headways, dynamic spacing)	Limited (fixed spacing between trains)	CBTC significantly superior
Energy Efficiency	High (optimized acceleration, braking, scheduling)	Moderate–Low	CBTC more efficient
System Reliability	High (real-time monitoring, redundancy)	Moderate (dependent on physical components)	CBTC more reliable
Safety Performance	Very high (automation, fail-safe design, SIL4)	Moderate (manual intervention required)	CBTC superior
Automation Level	High (supports GoA2–GoA4)	Low	CBTC future-ready
Maintenance Requirements	Lower (predictive maintenance possible)	High (frequent manual maintenance)	CBTC advantage
Spare Parts Availability	High (global suppliers)	Limited (aging / regional systems)	CBTC more sustainable
Integration with Digital Systems	Fully compatible (SCADA, OCC, smart systems)	Limited	CBTC superior
Scalability / Future Expansion	High	Low	CBTC preferred
Environmental Impact (Operation)	Lower emissions, optimized energy use	Higher energy consumption	CBTC better
Environmental Risk (Implementation)	Moderate (complex installation)	Moderate	Comparable
Compliance with International Standards	High (IEC, EN, SIL standards)	Limited alignment	CBTC preferred

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Implementation Complexity	High	Moderate	MPS easier initially
Passenger Experience	Improved (reduced waiting time, reliability)	Limited improvement	CBTC better
Long-Term Strategic Fit	Fully aligned with digitalization goals	Limited	CBTC strongly preferred

6. EXISTING FACILITIES AND OPERATIONS

6.1 Introduction

309. The Baku Metro is one of the oldest and most technically complex underground railway systems in the former Soviet region, reflecting both the engineering standards and urban planning priorities of its time. Construction began in the early 1960s, and the first section was commissioned in 1967, linking the historic city center with emerging residential and industrial districts. From the outset, the metro was designed as a backbone of urban transport, intended to relieve surface congestion and support the rapid growth of Baku as a major industrial and administrative hub.
310. During the Soviet period (1967–1991), construction progressed in stages, expanding the network primarily along what is now the Red Line, with additional branching toward eastern residential areas. The architectural design of stations followed the Soviet tradition of combining functionality with monumental aesthetics, incorporating marble, granite, and decorative elements. However, the engineering systems installed during this period, particularly relay-based signaling, analog communications, and oil-filled electrical equipment have since become outdated and require modernization.
311. The expected environmental risks vary significantly depending on the station type, depth, construction typology, and age/rehabilitation status presented in the **Table 18**. Deep underground stations, particularly those constructed in the Soviet period using pylon-type designs generally present higher environmental and safety risks. These include limited natural ventilation, higher accumulation of heat and pollutants, and more complex emergency evacuation conditions. In such stations, aging infrastructure may also increase the likelihood of hazardous material presence (e.g., asbestos, PCB-contaminated oils in electrical equipment) and leakage risks from old drainage or oil-filled systems.

Table 17: Baku Metro – Technical Station Characteristics

Station	Year Opened	Line	Station Type	Depth (m)	Construction Type	Platforms / Tracks	Reconstruction / Rehab
İçərişəhər	1967	Red	Deep underground	~22 – 25	Pylon	1 / 2	2008 – 2010 (renovation)
Sahil	1967	Red	Deep underground	~20 – 25	Pylon	1 / 2	2012 – 2015
28 May	1967	Interchange	Deep underground	~20	Column	1 / 2 (× 2 halls)	Ongoing upgrades
Gənclik	1967	Red	Shallow underground	~10 – 15	Column	1 / 2	2010s
Nəriman Nərimanov	1967	Red	Shallow underground	~8 – 12	Column	1 / 2	Partial upgrades
Xətai	1968	Green	Deep underground	~25 – 30	Single-vault	1 / 2	2019 – 2020
Ulduz	1970	Red	Shallow underground	~10	Column	1 / 2	Limited
Koroğlu	1972	Red	Surface / elevated	~0 – 5	Surface	1 / 2	2010 reconstruction

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Qara Qarayev	1972	Red	Shallow underground	~10	Column	1 / 2	Minor
Neftçilər	1972	Red	Shallow underground	~10	Column	1 / 2	Minor
Nizami	1976	Red	Deep underground	~30 – 35	Pylon	1 / 2	2010s
Bakmil	1979	Red (branch)	Surface	~0	Surface	1 / 1	Minimal
Elmlər Akademiyası	1985	Red	Deep underground	~30 – 35	Pylon	1 / 2	2010s
İnşaatçılar	1985	Red	Deep underground	~25	Pylon	1 / 2	Limited
20 Yanvar	1985	Red	Shallow underground	~10	Column	1 / 2	2010s
Memar Əcəmi	1985	Interchange	Shallow underground	~10 – 15	Column	1 / 2	Upgraded
Xalqlar Dostluğu	1989	Red	Shallow underground	~10	Column	1 / 2	Limited
Əhmədli	1989	Red	Shallow underground	~10	Column	1 / 2	Limited
Cəfər Cəbbərlı	1993	Green	Deep underground	~25	Column	1 / 2	Integrated upgrades
Həzi Aslanov	2002	Red	Shallow underground	~10	Column	1 / 2	Modern
Nəsimi	2008	Red	Shallow underground	~10	Column	1 / 2	New
Azadlıq prospekti	2009	Red	Shallow underground	~12	Column	1 / 2	New
Dərnəgül	2011	Red	Shallow underground	~10	Column	1 / 2	New
Memar Əcəmi-2	2016	Purple	Deep underground	~30	Single-vault	1 / 2	New
Avtovağzal	2016	Purple	Deep underground	~30 – 35	Single-vault	1 / 2	New

312. The Existing Facilities and Operations chapter describes the current condition, layout, and functioning of the Baku Metro system that will be affected by the proposed modernization project. The project is implemented by the Baku Metro CJSC and focuses on upgrading critical signaling and operational systems to improve safety, efficiency, and reliability. The existing system is largely based on legacy technologies, including relay-based signaling, outdated communication systems, and aging electrical infrastructure, which continue to operate across the metro network.

313. The project covers both underground infrastructure (tunnels and station environments) and above-ground or indoor facilities (offices, control rooms, depots, and technical premises). Activities within the tunnel environment include installation of trackside signaling equipment, communication cables, sensors, and associated power supply systems. These works are carried out within confined underground conditions, typically during nighttime hours to ensure operational safety and minimize disruption to passenger services. In parallel, works in office and technical facilities include the establishment and upgrading of centralized control systems, including the Operations Control Center (OCC), and installation of digital platforms that support real-time monitoring and management of metro operations.

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314. A key component of the project involves the replacement of outdated equipment, including relay systems, signaling devices, cables, and approximately 933 oil-filled transformers dating back to the 1980s. These components are critical from both operational and environmental perspectives, as they are associated with reduced efficiency, higher failure rates, and potential environmental risks such as oil leakage or contamination. In addition, onboard equipment within trains will be upgraded to ensure compatibility with the new CBTC system, replacing legacy interfaces and control units.
315. Overall, project activities will be carried out entirely within the existing metro footprint, including tunnels, stations, substations, depots, and administrative buildings, without expansion into new areas. The modernization is therefore characterized as a rehabilitation and upgrade of existing infrastructure, rather than new construction, with the objective of transitioning the metro system to a modern, digitally integrated, and safer operational environment while maintaining continuous service throughout the implementation period.

6.2 Underground Infrastructure

316. The underground infrastructure of the Baku Metro constitutes the core physical environment within which the proposed modernization project will be implemented. The metro system is largely developed within deep and shallow tunnel systems constructed during the Soviet period and subsequently expanded, forming a complex network of tunnels, stations, technical rooms, and service corridors. These underground environments are characterized by confined conditions, limited natural ventilation, and continuous exposure to operational stresses such as vibration, moisture, temperature fluctuations, and accumulation of dust and pollutants. As a result, the infrastructure presents both engineering and environmental challenges, particularly in relation to aging materials, legacy systems, and potential contamination sources.
317. From an operational perspective, underground infrastructure hosts a wide range of critical systems, including track structures, signaling and communication equipment, power supply installations, drainage systems, and emergency facilities. Many of these components are based on outdated technologies, including relay-based signaling systems, oil-filled electrical equipment, and extensive cabling networks that have been in service for several decades. The presence of such legacy equipment introduces environmental risks, including potential oil leakage, accumulation of contaminants in concrete and ballast, and the presence of hazardous materials such as PCBs or degraded insulation. These risks are particularly relevant in tunnel environments, where contaminants may persist over long periods and remediation is technically challenging.
318. Within the scope of the project, the underground infrastructure will be subject to both installation of new systems and dismantling of existing equipment, requiring careful management of environmental and safety risks. Activities will be carried out under constrained conditions, often during nighttime hours, and must ensure uninterrupted metro operations. Therefore, a detailed understanding of the existing underground infrastructure including its physical condition, operational characteristics, and environmental sensitivities is essential for the identification of potential impacts and the development of appropriate mitigation measures in line with international standards and the Asian Development Bank safeguard requirements.

6.2.1 Track Drossel-Transformer

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319. Within the project area, a total of 933 choke-transformers (impedance bonds) of three types - DTM-0.17-1000M, DTM-0.17-1000, and DTM-0.17-1500 - are installed along the metro track system. These devices are part of the legacy signaling infrastructure and are used to separate traction return current from signaling circuits, ensuring safe and stable operation of track circuits. All units are oil-filled, which is typical for Soviet-era designs, and this characteristic is particularly important from an environmental perspective, as it introduces potential risks related to oil leakage and possible contamination.
320. The DTM-0.17-1000M (**Figure 1**) is a modernized version of the standard 1000 A class impedance bond. It is designed to carry traction return currents of up to approximately 1000 A while maintaining an inductance of about 0.17 mH per winding section. The "M" designation generally indicates an improved or modified version, often with enhanced insulation or mechanical design. These units typically contain 25–28 liters of insulating oil, depending on manufacturer and production year. Given their age and operational conditions, these units may present moderate environmental risks associated with oil degradation or leakage (**Figure 1**).

Figure 1: Drossel-Transformer DTM-0.17-1000M¹⁷



321. The DTM-0.17-1000 represents the earlier standard configuration of the same capacity class and is widely used in legacy railway and metro systems. Its technical function is identical providing current return continuity and signal isolation but its design is typically less optimized compared to the "M" version. These transformers are also oil-filled, with a typical oil volume in the range of 25–28 liters per unit. Due to their older design and longer operational history, they are more likely to exhibit aging-related issues, including insulation degradation, potential oil seepage, and higher probability of contamination.
322. The DTM-0.17-1500 is a higher-capacity impedance bond designed to handle traction currents of up to approximately 1500 A, making it suitable for sections of the network with higher

¹⁷ The photo was taken during a visit to the Baku Metro Training Center

electrical load or traffic intensity. Structurally, these units are larger and heavier than the 1000 A variants and contain a correspondingly greater volume of insulating oil. The typical oil content for this type is 28 liters per unit, again depending on design and manufacturer specifications. The larger oil volume increases the potential environmental risk in case of leakage or failure (Figure 2).

Figure 2: Drossel-Transformer DTM-0.17-1500

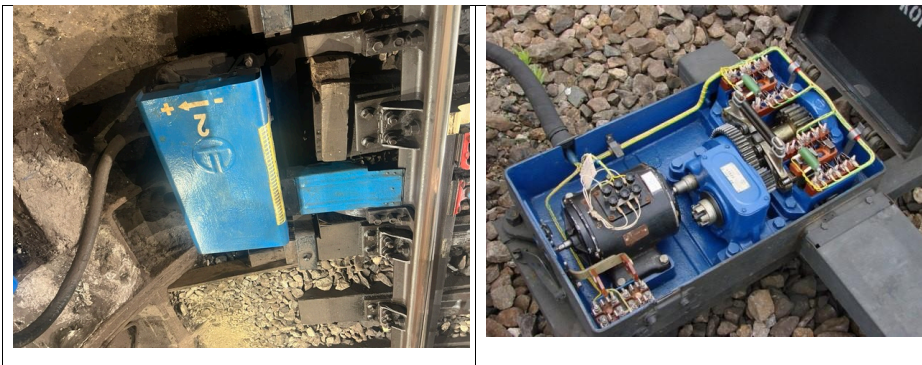


323. From an environmental standpoint, the presence of oil-filled transformers across the network represents a cumulative risk, particularly given the total number of units involved. While the insulating oil used in such equipment is generally mineral-based, the age of the transformers many dating back to the 1980s introduces uncertainty regarding their composition and condition. As a result, there is a moderate risk of contamination, including the possibility of PCB presence due to historical maintenance practices, which requires confirmation through laboratory testing.
324. In addition to contamination risks, the physical condition of the equipment is a key factor influencing environmental impact. Over time, seals, gaskets, and insulation materials may deteriorate, increasing the likelihood of oil leakage into surrounding soil, ballast, or drainage systems. Given that these devices are installed in track environments, often within confined tunnel conditions, any leakage may be difficult to detect and remediate without targeted inspection and monitoring.
325. Overall, the three types of choke-transformers present similar functional roles but differ in capacity, size, and oil volume, which directly influences their environmental risk profile. The larger DTM-0.17-1500 units pose a higher potential impact due to greater oil content, while the older DTM-0.17-1000 units may present higher uncertainty due to age. For the purposes of the project, all units should be treated as potentially hazardous equipment, requiring detailed inventory, condition assessment, oil sampling, and controlled handling during the decommissioning phase to ensure compliance with environmental and safety standards.

6.2.2 SP-6BM Switch (switch machine / point machine)

326. The SP-6BM (**Figure 3**) switch (switch machine / point machine) is an electromechanical device used to control railway turnouts (switches) in signaling systems (Figure 3). It is widely applied in metro and railway infrastructure of Soviet and post-Soviet origin, including systems similar to those currently being modernized. Its primary function is to move and lock the switch rails (points), ensuring that trains are safely directed from one track to another. In modern terminology, it is classified as a switch machine, which enables remote or automated control of track alignment within signaling systems.

Figure 3: SP-6BM switch (switch machine / point machine)



327. From an environmental and operational perspective, SP-6BM units are generally dry-type electromechanical devices, meaning they do not typically contain large volumes of oil like transformers. However, they may include lubricants, electrical components, and metal assemblies, which require proper handling and disposal during decommissioning. Their replacement is primarily driven by the need to improve reliability, automation level, and compatibility with modern digital signaling systems, rather than by direct environmental risk, although waste management considerations (e.g., e-waste and metal recycling) remain relevant during project implementation.
328. Approximately 200 SP-6BM or equivalent switch machines may be present across the Baku Metro system.

6.2.3 Trackside Signaling Junction/control Boxes

329. The trackside electrical junction/control box serves as a local interface and distribution unit within the metro signaling system, ensuring reliable connection between track circuits, field equipment, and centralized control systems. Its main function is to transmit and regulate low-voltage signaling currents, which are used for train detection, track occupancy monitoring, and communication with interlocking systems. By providing secure and organized connections, the device helps maintain the integrity of signaling circuits and ensures safe train movement. In addition, the enclosure protects sensitive electrical components from harsh tunnel conditions, including moisture, dust, vibration, and temperature fluctuations.
330. In terms of composition, the device typically consists of a metal protective housing, internal terminal blocks for cable connections, relays or switching elements, insulated wiring, cable

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glands, and mounting fixtures (**Figure 4**). The internal components are generally low-voltage and do not contain large quantities of hazardous substances; however, they may include plastic insulation, small electronic parts, and minor lubricants or protective coatings. Over time, these materials may degrade, especially in underground environments, requiring periodic inspection and eventual replacement during modernization works.

Figure 4: Trackside Signaling Junction/control Boxes



331. Following dismantling, such devices are generally classified as waste electrical and electronic equipment (e-waste). The metal enclosure and structural components can be recycled as scrap metal, while copper wiring can be recovered through specialized recycling processes. Non-recyclable parts, such as degraded insulation materials and mixed electronic components, are disposed of as industrial or hazardous waste, depending on their composition, in accordance with national waste management regulations. Proper segregation, handling, and disposal through licensed operators are essential to prevent environmental contamination and ensure compliance with environmental standards.
332. Approximately 500–900 similar devices across the Baku Metro network, depending on the density of track circuits, number of interlockings, and depot layouts. These devices should be verified during the site inventory by recording their location, identification number, condition, cable connections, and whether they will be retained, replaced, or dismantled.

6.2.4 Tunnel Telephones

333. Tunnel telephones in the Baku Metro are typically industrial railway/metro communication units installed at intervals along tunnels and near technical rooms to provide direct voice communication between field staff and the Operations Control Center (OCC). A standard set comprises a rugged metal enclosure, a handset or speaker-microphone, a call/line interface module, a ringer/buzzer, push buttons or a call selector, and terminal blocks for connection to the communication cable (**Figure 5**).

Figure 5: Tunnel Telephones



334. After dismantling, these devices should be classified as Waste Electrical and Electronic Equipment (WEEE / e-waste). The metal housing and brackets can be recycled as scrap metal, while copper cabling is recoverable through specialized recycling. Internal components (circuit boards, plastics, insulation, small batteries if present) should be segregated and managed through licensed e-waste handlers; any batteries or specific components containing hazardous substances (e.g., lead solder, small accumulators) should be treated as hazardous waste in accordance with national regulations and IFI good practice.
335. Regarding quantities, while an exact inventory requires operator data, a reasonable engineering estimate for a network of ~40 km with multiple stations and service areas is that tunnel emergency/maintenance telephones are installed at regular intervals (e.g., every 200–300 m) plus additional units at stations, crossovers, and technical rooms. On this basis, the Baku Metro is likely to have on the order of 200–400 tunnel telephone units in total. This figure should be confirmed through asset registers and field surveys during the environmental audit.

6.2.5 Other Equipment Subject to Dismantling

336. Within the scope of the project, a significant volume of auxiliary electrical and communication equipment will also be subject to dismantling alongside primary installations. This includes power supply cables (both low- and medium-voltage), signaling and control cables, grounding conductors, cable trays, junction boxes, and associated connectors. These components form the backbone of the existing railway or metro systems, enabling energy transmission, signaling operations, and communication between field equipment and control centers. Over time, many of these materials may have degraded insulation, mechanical damage, or outdated technical specifications, making them unsuitable for continued operation under modernized systems.
337. From an environmental and waste management perspective, dismantled cables and associated accessories are typically classified into several waste streams depending on their composition. Metallic components such as copper and aluminum conductors are considered valuable recyclable materials, while cable insulation (often composed of PVC, rubber, or

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polyethylene) may require specialized handling due to the potential presence of hazardous additives. Older installations may also contain lead sheathing or oil-impregnated paper insulation, which can pose contamination risks. Similarly, junction boxes and cable support, often made of metals and plastics, must be segregated accordingly. Proper dismantling, segregation, and disposal practices are essential to ensure compliance with international environmental standards, minimize environmental impacts, and maximize opportunities for material recovery and recycling.

6.2.6 Groundwater Inflow and Drainage in Baku Metro Tunnels

338. The presence of groundwater infiltration into metro tunnels is a well-documented operational characteristic of underground infrastructure in Baku. Due to the high groundwater table and hydrogeological conditions of the Absheron Peninsula, water continuously enters tunnel structures through joints, cracks, and surrounding soil layers. To manage this, the metro system is equipped with drainage channels and pumping systems, which collect infiltrated water and discharge (Figure 6) it into the municipal sewer network. These systems are an integral part of tunnel operation and are designed to ensure structural safety, operational reliability, and environmental protection¹⁸.

Figure 6: Drainage in Baku Metro Tunnels



339. Available information confirms that groundwater accumulation occurs at multiple metro stations, and the issue is significant enough to be included in national infrastructure planning documents. According to recent reports, water collected in metro stations is even being considered as a potential technical water resource, indicating that volumes are substantial and continuous¹⁹. In practice, water inflow varies significantly depending on local geological conditions, tunnel depth, and seasonal factors, with reported volumes ranging from approximately 10 m³ to 200 m³ per day. This variation reflects differences in permeability, proximity to aquifers, and structural conditions of individual stations and tunnel sections.
340. Although detailed station-by-station data on water inflow volumes is not publicly disclosed, broader infrastructure and environmental reports indicate that stations located in low-lying or

¹⁸ https://www.aiib.org/en/projects/details/2025/_download/Azerbaijan/Baku-Metro-ESMPF-281125-to-Disclose.pdf?utm_source=chatgpt.com

¹⁹ https://en.apa.az/infrastructure/use-of-water-accumulated-at-baku-metro-stations-to-be-studied-488706?utm_source=chatgpt.com

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industrial areas, as well as deeper underground sections, are more prone to higher groundwater inflow. These areas typically require continuous pumping through dedicated tunnel drainage pumping stations, which are specifically designed to remove water from tunnels and associated facilities. In addition, emergency reports from the city confirm that tunnel sections and transport infrastructure in areas such as Heydar Aliyev Avenue corridors and low-elevation districts experience periodic water accumulation requiring active pumping during high rainfall events²⁰.

341. From an operational and environmental perspective, the management of groundwater inflow is critical. The presence of drainage systems and pumping stations ensures that water does not accumulate within tunnels, which could otherwise affect track integrity, electrical systems, and passenger safety. At the same time, the controlled discharge of collected water into sewer systems must be managed to prevent secondary environmental impacts, particularly if water becomes contaminated by oils or other substances present in the tunnel environment. As a result, groundwater management in Baku Metro represents both an engineering necessity and an environmental management issue, requiring continuous monitoring and maintenance.

6.2.7 Historical Pollution

342. The environmental conditions of the Baku Metro are influenced by both natural hydrogeological factors and historical industrial impacts characteristic of the Absheron Peninsula. One of the most prominent issues observed in the metro system is the continuous inflow of groundwater into tunnels and stations, which is a result of high groundwater levels and complex subsurface conditions. This water is actively collected and pumped through dedicated drainage systems, and in some cases, the volume is significant enough to be considered a resource for technical use, including irrigation purposes²¹. The presence of such groundwater inflow indicates not only engineering challenges but also potential environmental concerns, particularly if the water becomes contaminated through contact with tunnel infrastructure.
343. Historically, the broader Baku region has experienced intensive environmental degradation, largely due to long-term oil extraction and industrial activities. The Absheron Peninsula is widely recognized as one of the most environmentally impacted regions, with soil and groundwater contamination from petroleum products and industrial pollutants. These conditions increase the likelihood that groundwater entering metro tunnels may contain dissolved contaminants, including hydrocarbons or other industrial residues. As groundwater flows through tunnel systems, it may interact with infrastructure materials, potentially mobilizing pollutants and contributing to localized contamination within drainage systems.
344. Within the metro system itself, historical pollution has been associated primarily with aging electrical equipment, oil leakage, and operational incidents. For example, past events such as the 1995 metro fire, linked to electrical malfunction, highlight the risks associated with outdated systems and materials in confined underground environments. In addition, long-term use of oil-filled equipment, including transformers and trackside systems, creates the potential for chronic low-level contamination of tunnel surfaces, drainage channels, and surrounding soils. These impacts may not always be immediately visible but can accumulate over time, especially in poorly ventilated or high-moisture environments.

²⁰https://operativmm.az/en/post/baku-manages-heavy-rainfall-with-emergency-drainage-measures/69777?utm_source=chatgpt.com

²¹https://metro.gov.az/en/news/712/bas-nazirin-muavini-sahin-mustafayev-grunt-sularindan-semereli-istifade-edilmesi-layihesi-ile-tanis-olub?utm_source=chatgpt.com

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345. Looking forward, the project is expected to encounter similar environmental conditions, particularly related to groundwater inflow, interaction with legacy contamination, and accumulation of pollutants in confined spaces. Without proper management, risks may include contamination of pumped water, spread of pollutants through drainage systems, and exposure of workers to hazardous substances during maintenance or dismantling activities. However, with appropriate environmental controls—such as monitoring of water quality, safe handling of contaminated materials, and modernization of infrastructure—the project provides an opportunity to reduce existing pollution risks and improve the overall environmental performance of the metro system.

6.3 Metro Signaling System

346. The current Metro Signaling system is supported by four parallel dispatch functions that operate independently but collectively ensure safe and continuous service (**Table 19**).

Table 18: Metro Signaling system

The Machine Dispatch is the core operational controller responsible for train movements. It oversees routing, timetable adherence, and platform management, coordinating closely with station staff and train drivers. While the legacy signaling system enforces safety constraints (e.g., train separation and speed limits), the Machine Dispatch manages service regulation, including adjustments to headways, responses to delays, and coordination during incidents or degraded operations.	
The Energy Dispatch is responsible for the stability and reliability of the metro's power supply systems. This includes monitoring and controlling traction power substations, distribution networks, and electrical loads associated with trains, stations, and tunnel infrastructure. The Energy Dispatch ensures continuous power availability, manages switching operations, responds to faults or outages, and coordinates maintenance activities that require electrical isolation. It also plays a critical safety role by implementing procedures such as de-energization (LOTO) during works and ensuring protection against hazardous voltages.	

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The Sanitation Dispatch (groundwater monitoring) focuses on environmental control within tunnels and stations, particularly the management of groundwater ingress. Given the hydrogeological conditions of Baku, this function monitors water levels, pumping stations, and drainage systems to prevent flooding and maintain safe operating conditions. The dispatch coordinates the operation of pumps, tracks inflow volumes, and ensures that collected water is safely conveyed to the sewer system. It also provides early warning for abnormal inflows that could affect infrastructure integrity or electrical systems.	
The Excavator Dispatch (often associated with maintenance and civil works coordination) manages activities related to track access, infrastructure repairs, and construction support within the metro system. This includes scheduling and supervising maintenance teams, coordinating access windows—typically during nighttime hours—and ensuring that works are performed safely without interfering with operations. The dispatch liaises with Machine and Energy Dispatch units to secure safe conditions for work, including track possession and electrical isolation.	

347. These four dispatch functions operate with distinct responsibilities but require constant coordination to maintain system-wide safety and efficiency. For example, maintenance activities managed by the Excavator Dispatch depend on approvals from Machine Dispatch (for track access) and Energy Dispatch (for power shutdowns), while Sanitation Dispatch may need to coordinate with all units during flooding events. Despite this coordination, the systems are not fully integrated, and information exchange often relies on manual communication and operator experience.
348. The current arrangement ensures that critical operational domains - train movement, power supply, environmental conditions, and maintenance, are each managed by specialized teams. However, the lack of full integration between these dispatch systems limits real-time data sharing and automated decision-making. This can result in slower response times, reduced operational efficiency, and increased reliance on human coordination, particularly during complex or emergency situations.
349. The modernization project aims to address these limitations by integrating these functions into a unified digital control environment, where operational, energy, environmental, and maintenance data are managed within a centralized system. This will allow for real-time coordination, improved situational awareness, and more efficient decision-making, while maintaining the high safety standards required for metro operations.

7. DESCRIPTION OF THE ENVIRONMENT - BASELINE DATA

7.1 Physical Environment

7.1.1 Project Location and Geographic Setting

350. The project is located in Baku, on the Absheron Peninsula along the western coast of the Caspian Sea. Baku is the largest urban center in Azerbaijan and a major industrial and administrative hub, characterized by dense urban development, extensive transport infrastructure, and long-standing oil and gas activities (**Figure 7**). The metro network extends across central and peripheral districts of the city, connecting residential, commercial, and industrial zones. The project area is therefore situated entirely within a highly urbanized environment, where land use is dominated by built infrastructure, transport corridors, and public service facilities.

Figure 7 : Project Area



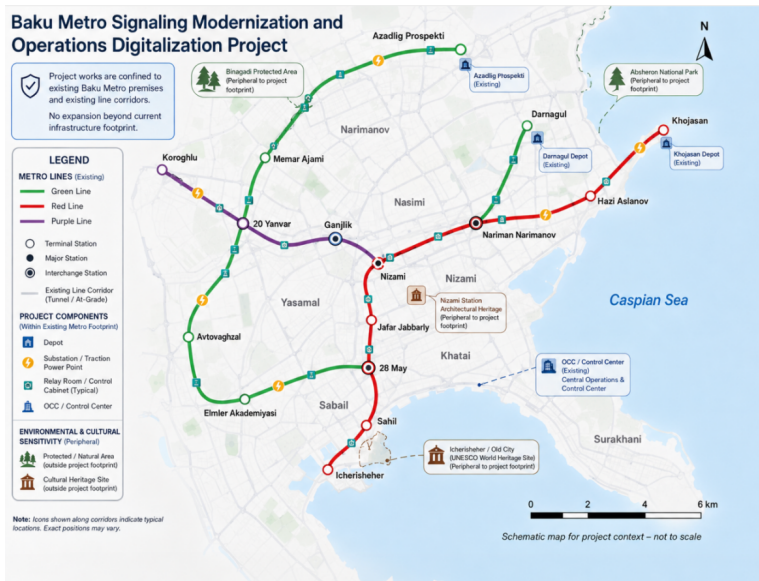
351. The **Figure 8** illustrates how the project is positioned within the existing metropolitan transport system and to show that the proposed activities are confined to the current Baku Metro footprint. The map highlights the existing metro network, principal stations, depots, the Operations Control Center, and other key infrastructure elements relevant to project implementation.

352. In addition to the transport network itself, the map provides an overview of the project's relationship with the surrounding urban context. It identifies central urban districts through which the metro system passes and illustrates the location of major project components within the city structure. This helps clarify that the project is not a greenfield development, but rather a modernization initiative that will take place within existing stations, tunnels, depots, relay rooms, substations, and control facilities.

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353. The map also has an important environmental and cultural function, as it helps show the spatial relationship between the project footprint and nearby environmentally or culturally sensitive areas. By indicating protected areas and selected cultural heritage receptors near the metro environment, the map supports the conclusion that the project works are concentrated within already developed transport corridors and that potential interactions with sensitive receptors are limited and manageable through appropriate environmental and operational controls.

Figure 8: Project Context Map



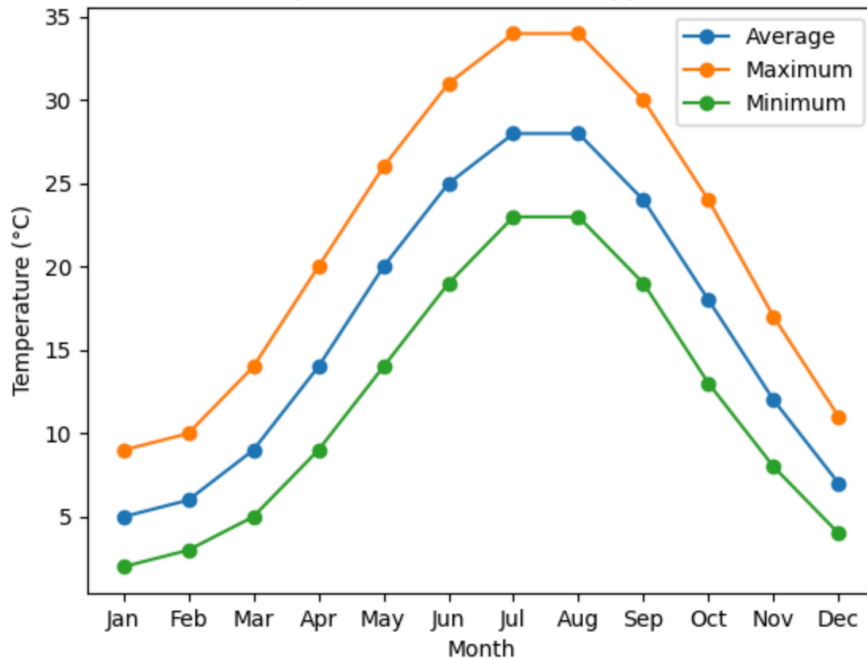
354. Overall, the map serves as an important visual summary of the Baku Metro project area and its wider urban setting. It demonstrates the geographic extent of the metro system, the location of the main project components, and the relationship of the project activities to the surrounding city districts and nearby sensitive receptors. The map therefore supports the project description and environmental assessment by clearly showing that the planned activities are limited to the existing Baku Metro infrastructure and will be implemented within an established urban transport network, without expansion beyond the existing operational footprint.

7.1.2 Climate

355. The climatic conditions of Baku in 2025 follow the typical semi-arid, coastal pattern of the Absheron Peninsula, characterized by mild winters and hot, dry summers. Based on aggregated meteorological datasets (including Meteostat, NOAA Climate Data Online, and World Meteorological Organization (WMO) summaries), the annual average temperature in 2025 is estimated at approximately 16–17°C (**Figure 9**), with noticeable seasonal variation. Winter months (January–February) show average temperatures around 5–6°C, while summer peaks (July–August) reach average values of 28°C, with maximum temperatures frequently

exceeding 33–34°C²². These conditions are strongly influenced by the moderating effect of the Caspian Sea and regional atmospheric circulation patterns.\

Figure 9: Maximum, average and minimum temperatures in Baku for 2025



356. Monthly temperatures increase steadily from spring to summer, peak during July-August, and gradually decrease thereafter. Maximum temperatures range from approximately 9–11°C in winter to 34°C in midsummer, while minimum temperatures vary between 2–4°C in winter and 22–23°C during summer nights. This relatively narrow diurnal variation during summer reflects maritime influence, while larger seasonal contrasts are typical for the region. From an environmental and infrastructure perspective, such temperature patterns are important for metro operations, particularly in relation to tunnel ventilation, equipment performance, and energy demand.

357. The climate in the Baku Metro is regulated primarily through the existing ventilation system, ventilation shafts, tunnel air exchange, and operational air circulation created by train movement, which together help maintain acceptable conditions in platforms, tunnels, technical rooms, and other underground areas. These systems are particularly important in balancing seasonal external temperature differences, reducing excessive humidity, and providing continuous air exchange in enclosed underground spaces.

²² <https://meteostat.net>

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358. According to the existing practice of Baku Metro, the current condition of the underground environment is regularly monitored by the Baku Metro Laboratory, which carries out instrumental measurements of microclimate parameters. These measurements include, at minimum, air temperature and relative humidity, and they are used to assess the adequacy of ventilation and the comfort and safety conditions at stations and in technical areas. The available measurement information indicates that microclimate conditions in the surveyed metro areas are generally maintained within acceptable operational ranges, although some seasonal and location-specific variation is naturally observed depending on station depth, passenger flow, and external weather conditions.
359. With regard to air quality, the metro environment differs from open urban conditions because it is affected mainly by ventilation efficiency, train-induced air movement, confined-space conditions, and the presence of technical equipment rather than by open atmospheric dispersion. Available results indicate that the monitored air quality conditions in the surveyed areas were generally satisfactory and did not show evidence of critical deterioration. In addition to microclimate measurements, the Baku Metro Laboratory also monitors selected environmental quality indicators in technical areas, including locations where oil-containing equipment is present, which is important for identifying any localized air-quality concerns related to maintenance activities or legacy infrastructure.
360. Overall, the existing monitoring data suggest that the current underground climate and air environment of Baku Metro are actively regulated and routinely controlled, and that the metro already has an institutional system for tracking relevant parameters (see chapter 7.1.11). At the same time, this baseline situation is highly relevant for the project, because during implementation—especially during night works, dismantling of legacy equipment, handling of oil-filled components, and work in confined underground areas—additional pressure may be placed on ventilation and air quality. For this reason, continued laboratory monitoring, effective ventilation management, and supplemental air-quality checks in active work areas should form an integral part of project environmental and occupational safety management.

7.1.3 Wind

361. The Absheron peninsula (Baku section) is characterized by bimodal wind regime dominated by the cold, strong *Khazri* (predominantly from N–NW / N–NE) and the warm *Gilavar* winds (mainly S–SE / S–SW), which alternate seasonally through the year.
362. The proximity of the Caspian Sea and the coastal configuration of the Absheron peninsula intensify and channel wind flows, making this area one of the windiest parts of Azerbaijan, with frequent moderate to strong winds, particularly during the autumn fall and winter seasons.
363. Monthly prevailing wind directions and typical wind strengths for 2025 are presented in **Table 20**.

Table 19: 2025 monthly prevailing wind directions

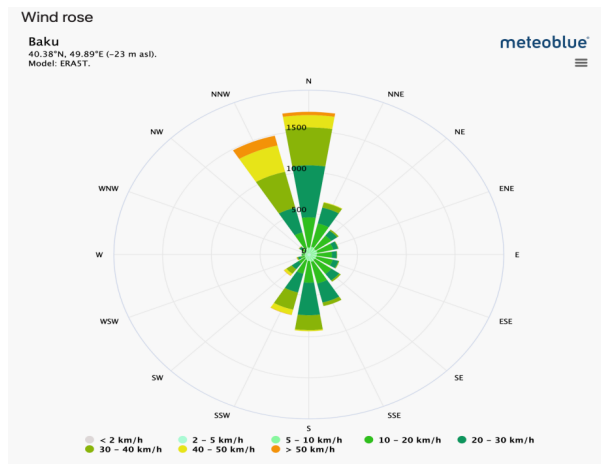
Month 2025	Prevailing direction (main)	Secondary direction	Typical mean strength
Jan	N–NE (<i>Khazri</i> -dominant)	S–SE (<i>Gilavar</i> episodes)	~6–8 m/s (22–29 km/h)
Feb	N–NE	S–SE	~6–8 m/s (22–29 km/h)
Mar	N–NE	E / SE	~5–7 m/s (18–25 km/h)

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Apr	N / NE	SE	~4–6 m/s (14–22 km/h)
May	N / NE	SE	~4–6 m/s (14–22 km/h)
Jun	N–NE (cooling sea wind influence)	E	~5–7 m/s (18–25 km/h)
Jul	N–NE (very frequent in Absheron)	E	~5–7 m/s (18–25 km/h)
Aug	N–NE	E / SE	~5–7 m/s (18–25 km/h)
Sep	N / NE	E / SE	~4–6 m/s (14–22 km/h)
Oct	N–NE (strengthening again)	E / SE	~5–7 m/s (18–25 km/h)
Nov	N–NE (frequent strong-wind periods)	E	~6–8 m/s (22–29 km/h)
Dec	N–NE (Khazri-dominant)	S–SE	~6–8 m/s (22–29 km/h)

364. The **Figure 10** shows the main wind directions and typical wind strengths for 2025, based on meteorological data for Baku area.

Figure 10: Wind rose (2025 - Baku)



7.1.4 Cloudy, Sunny, and Precipitation Days

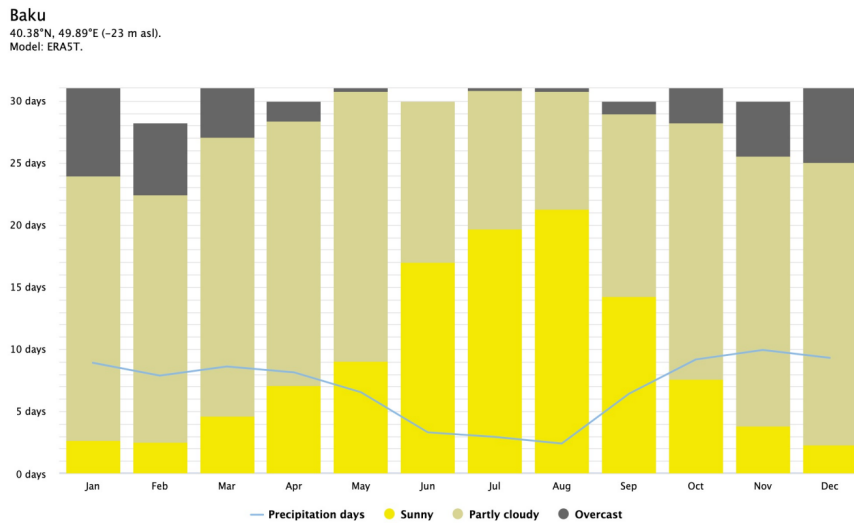
365. 240 sunny days annually, reflecting the dominance of stable, dry weather conditions over the Absheron Peninsula. The highest frequency of sunny conditions is typically observed between May and September, when cloud cover is limited and precipitation is minimal. These conditions are favorable for construction and infrastructure works, although they may also contribute to elevated dust generation and increased heat stress risks for workers within confined underground environments.

366. Cloudy and overcast conditions are more common during the winter and early spring months, particularly between November and March, when regional atmospheric circulation patterns increase humidity and cloud formation over the Caspian coastal zone. The region experiences

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approximately 90–110 cloudy or partially cloudy days annually, with the highest concentration occurring during January, February, and December (**Figure 11**). During these periods, reduced solar radiation and stronger northern winds contribute to cooler conditions and more variable weather patterns. For metro operations and underground works, such conditions may influence tunnel ventilation performance, groundwater infiltration rates, and maintenance requirements associated with moisture accumulation.

Figure 11: Rainy, sunny and cloudy days in 2025 (Baku)²³



367. Precipitation in the Baku region remains relatively low compared to many other urban areas, with an annual average precipitation of approximately 200–300 mm. Rainfall is generally concentrated in autumn and winter months, while summers remain predominantly dry. Statistical analysis indicates approximately 60–80 precipitation days per year, most of which are associated with light to moderate rainfall events rather than prolonged storms. Nevertheless, short-duration intensive rainfall events may still create localized flooding and groundwater inflow issues, particularly in low-lying urban areas and underground infrastructure.

7.1.5 Geology and Seismology

368. The Baku Metro system is located within the Absheron Peninsula, which is characterized by complex geological and hydrogeological conditions. For this project, the most relevant geological factors are not deep regional geological structures, but the condition of the upper soil and rock layers around existing tunnels, stations, shafts, technical rooms and underground infrastructure. Since the project will be implemented within the existing metro system and does not involve construction of new tunnels or major excavation works, the geological baseline is

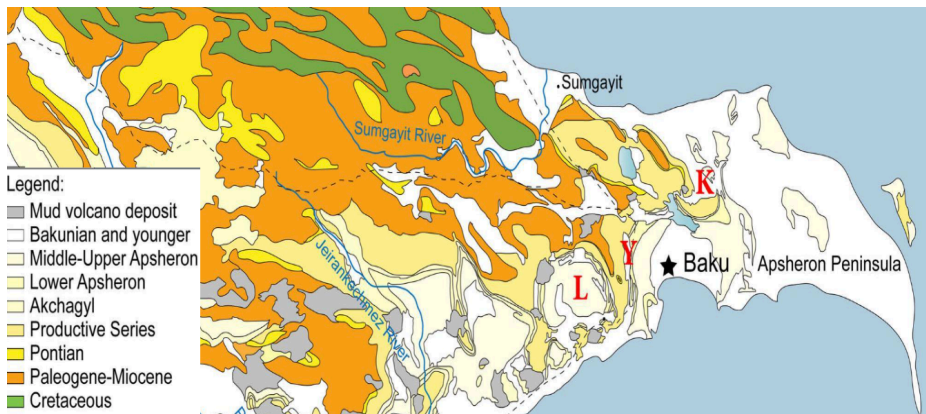
²³ <https://weatherspark.com/y/104871/Average-Weather-in-Baku-Azerbaijan-Year-Round>

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mainly important for understanding groundwater inflow, tunnel stability, equipment installation conditions, drainage performance and seismic safety.

369. Near the ground surface, the Baku area is generally composed of Quaternary sediments, including sands, silts, sandy clays, clayey materials and anthropogenic fill. These materials can be variable in strength, compressibility and water content. In shallow underground areas, such conditions may contribute to seepage, moisture ingress, settlement sensitivity and deterioration of older concrete or utility structures. However, because the project activities will mainly include installation, replacement, testing and dismantling of signaling and electrical equipment within existing infrastructure, direct disturbance of natural soils is expected to be limited.
370. Beneath the upper deposits, the geological profile includes clay, sandy clay and interbedded sand layers typical of the Absheron Peninsula (**Figure 12**). These alternating layers create conditions where groundwater may occur in localized horizons and may enter underground structures through joints, cracks, service openings or older tunnel linings. This is particularly relevant for the Baku Metro because groundwater inflow is already an operational feature of the system and is managed through drainage channels, sumps and pumping systems. Therefore, the key project-related geotechnical issue is not new ground excavation, but ensuring that project works do not block drainage systems, damage waterproofing elements, or allow oils, residues or hazardous materials to enter tunnel drainage.

Figure 12: Geological map of the Absheron Peninsula



371. Deep stations and older tunnel sections may be more sensitive from a geotechnical and operational perspective because they are located in confined underground conditions where groundwater pressure, humidity, ventilation limitations and access constraints can complicate maintenance and installation works. In these areas, new equipment, cable trays, cabinets, supports and control systems should be fixed without compromising tunnel linings, drainage routes, inspection points, emergency access, or structural elements. Any drilling, anchoring or fixing works should therefore be preceded by review of existing drawings, site verification and approval by Baku Metro technical staff.

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372. The Baku region is located in a seismically active area, and earthquakes have historically affected the broader Baku–Absheron area. For this project, seismicity is relevant mainly for the design and installation of new signaling, communication, control, and electrical equipment. Cabinets, racks, cable trays, control panels, power supply modules and other installed equipment should be properly anchored and designed to remain stable under vibration and seismic loading. This is particularly important in stations, relay rooms, technical rooms, depots, and control facilities where equipment failure could affect operational safety or emergency response.
373. Overall, the geological and seismological conditions do not create a constraint that would prevent implementation of the project, because the works are confined to existing Baku Metro infrastructure and do not involve major new underground construction. The main project-relevant requirements are to protect existing tunnel and station structures, maintain drainage and pumping systems, avoid unnecessary disturbance of tunnel linings and floors, use appropriate fixing and anchoring methods, and apply seismic-resistant installation standards for new equipment. These requirements should be reflected in the detailed design, method statements, Environmental Management Plan, and Occupational Health and Safety procedures.²⁴

7.1.6 Hydrology

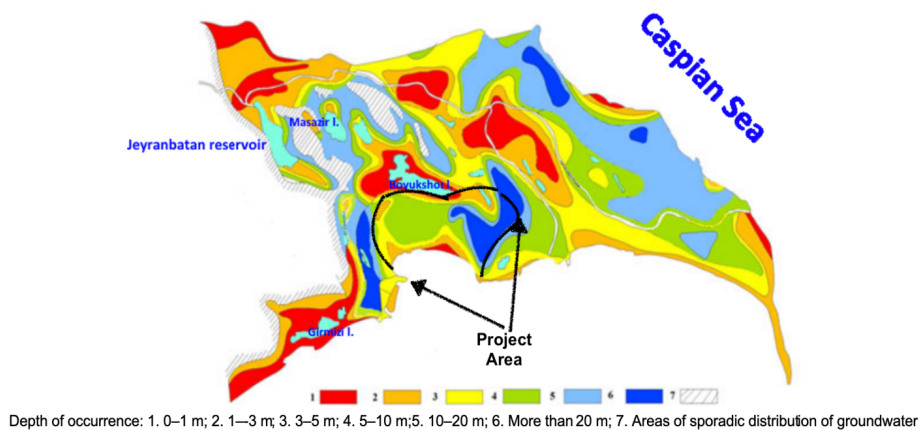
374. The hydrological setting of Baku is influenced by its location on the western coast of the Caspian Sea within the Absheron Peninsula, an area characterized by semi-arid climate conditions, low natural surface runoff, and complex groundwater system. Surface water resources within the urban area are limited and largely seasonal; therefore, groundwater plays a dominant role in the hydrological regime. The peninsula is composed primarily of sedimentary formations (clays, sands, and limestones), which create multi-layered aquifer systems with variable permeability. Urbanization and long-term industrial activity have significantly altered natural drainage patterns, leading to localized changes in groundwater levels and quality.
375. Groundwater conditions in Baku are typically shallow, particularly in coastal and low-lying areas, where the water table may occur at depths ranging from approximately 1 to 5 meters below ground level. In contrast, in elevated areas of the city, groundwater depth can reach 10–20 meters or more depending on topography and geological structure (**Figure 13**). The groundwater system is influenced by both natural factors (precipitation, geological formations) and anthropogenic inputs, including leakage from water supply systems, infiltration from surface runoff, and historical industrial contamination. In coastal zones, there is also a strong hydraulic connection with the Caspian Sea, resulting in saline or brackish groundwater conditions and fluctuations linked to sea level changes.
376. Within the Baku Metro system, groundwater interaction is particularly relevant due to the underground nature of stations and tunnels. Based on available engineering and geological data, stations such as Xətai metro station, Nizami metro station, Elmlər Akademiyası metro station, and Avtovağzal metro station are among those located at significant depths (approximately 25–35 meters) where groundwater presence is highly probable. At these depths, tunnels often intersect saturated layers or zones of increased permeability, requiring continuous waterproofing, drainage, and pumping systems. In some cases, groundwater inflow

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is managed through engineered lining systems and sump drainage networks to prevent water accumulation within tunnels and station structures.

377. Shallow stations, including Gənclik metro station, Nəriman Nərimanov metro station, and Əhmədli metro station, are generally constructed above the main groundwater table or in less permeable strata; however, they may still be affected by localized groundwater conditions, particularly during periods of increased infiltration or due to leakage from urban infrastructure. In these locations, groundwater is typically encountered at depths of approximately 5–15 meters, and while direct interaction with tunnel structures is less intense, risks related to seepage, moisture ingress, and structural degradation remain relevant.

Figure 13: Map of Groundwater Depth in the Absheron Peninsula²⁵



378. From an environmental perspective, groundwater within the metro environment is of particular concern due to its potential role in contaminant transport. Oil leaks from transformers, historical spills, and degraded materials may migrate through cracks in concrete structures and enter surrounding soils and groundwater systems. Conversely, groundwater inflow into tunnels can mobilize existing contaminants and spread them along drainage pathways. These conditions highlight the importance of groundwater monitoring, waterproofing systems, spill prevention, and contamination control measures as part of the project's Environmental Management Plan (EMP).

7.1.7 Soils

379. The soils within the area of the Baku Metro CJSC modernization project are characteristic of the Absheron Peninsula and are predominantly represented by gray-brown semi-desert soils,

²⁵ MODERN HYDROGEOLOGICAL CONDITIONS OF THE ABSHERON PENINSULA. https://www.researchgate.net/publication/388538099_MODERN_HYDROGEOLOGICAL_CONDITIONS_OF_THE_ABSHERON_PENINSULA

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coastal sandy soils, and heavily anthropogenically transformed urban soils. Natural soil conditions of the Absheron Peninsula are generally characterized by clayey, loamy, and sandy-deposits, formed under semi-arid climatic conditions. Within the urban environment of Baku, however, much of the original soil cover has been substantially altered by intensive industrialization, urbanization, historical oil extraction, and infrastructure development. As a result, the project area is largely characterized by technogenic soils and artificial fill materials associated with roads, metro infrastructure, industrial sites, and urban construction.

380. The dominant natural soil types in the broader Baku and Absheron region include gray-brown semi-desert soils with relatively high carbonate content, clay minerals, and moderate salinity. Sandy coastal soils are also common near the Caspian shoreline, particularly within low-lying and reclaimed urban areas. Due to shallow groundwater conditions and strong evaporation processes, many soils in the region exhibit elevated salinity and poor natural drainage. In addition, a substantial proportion of soils in the Baku region have been affected by historical petroleum activities, resulting in widespread hydrocarbon contamination, especially in industrial districts such as Binagadi, Sabunchu, Surakhani, and Garadagh. These soils frequently contain residual oil products, heavy metals, and disturbed physical structure caused by long-term industrial use.
381. From an engineering and environmental perspective, the soils in the project area are generally characterized by variable bearing capacity, moderate to high compressibility, and localized contamination risks. Clay-rich soils may exhibit swelling and low permeability, while sandy deposits are more susceptible to groundwater movement and erosion. The presence of artificial fill and disturbed urban ground conditions may further contribute to heterogeneous subsurface conditions within some project areas. Although the project is primarily rehabilitation and modernization in nature and is expected to involve limited excavation, localized soil disturbance may occur during installation, cable replacement, equipment removal, and associated civil works.

7.1.8 Environmental Quality Baseline and Monitoring Results

382. Instrumental environmental measurements for the Baku Metro Project were carried out by the Baku Metro Laboratory, operating under the Health, Safety and Environmental Protection Department of Baku Metro. The monitoring program covered microclimate parameters at metro station platforms, ventilation shafts, and selected technical areas. The measurements included temperature, relative humidity, noise levels, and petroleum hydrocarbon checks at the Koroglu Station technical area. The structure of this chapter follows the format of the provided EIA sample, where baseline monitoring results are summarized in narrative form and supported by tables showing measured values and applicable limits.
383. The results of the Baku Metro Laboratory measurements indicate that microclimate conditions at the monitored metro stations were generally stable. Temperature values recorded at station platforms were within the applicable range of +5°C to +28°C (**Table 20**), while relative humidity values were below the reference value of 75% in the reviewed measurements. Noise levels were generally within or close to the indicated reference range of 80–85 dB, with some localized readings approaching the upper limit. The monitoring results therefore do not indicate systematic exceedances that would require major corrective action; however, continued routine monitoring is recommended due to the enclosed underground environment, passenger density, train movement, ventilation conditions, and seasonal variations.

Table 20: Summary of Platform Microclimate Monitoring Results, January–March 2026

Monitoring period	Parameters measured	Applicable reference value	General results
January 2026	Temperature, relative humidity, noise / dust indicator as recorded in the laboratory tables	Temperature: +5°C to +28°C; Relative humidity: 75%; Noise reference in separate report: 80–85 dB	Temperatures generally ranged from approximately 14°C to 22°C. Humidity remained below 75%. Several noise readings were close to the upper reference range, but no systematic exceedance pattern was identified.
February 2026	Temperature, relative humidity, noise / dust indicator as recorded in the laboratory tables	Temperature: +5°C to +28°C; Relative humidity: 75%; Noise reference in separate report: 80–85 dB	Temperatures generally ranged from approximately 14°C to 21°C. Humidity remained below 75%. Noise-related readings were mostly within or close to the reference range.
March 2026	Temperature, relative humidity, noise	Temperature: +5°C to +28°C; Relative humidity: 75%; Noise: 80–85 dB	Temperatures generally ranged from approximately 15°C to 20°C. Humidity remained below 75%. Noise levels were mainly within the indicated range, with isolated readings near the upper limit.

384. The monthly monitoring records cover all main operating stations, including Darnagul, Azadlig Prospekti, Nasimi, Memar Ajami, Memar Ajami-2, 8 Noyabr, Avtovagzal, 20 Yanvar, Inshaatchilar, Elmlar Akademiyasi, Nizami, 28 May, Jafar Jabbarli, Khatai, Icharishahar, Sahil, Ganjlik, Narimanov, Ulduz, Koroglu, Gara Garayev, Neftchilar, Khalglar Dostlugu, Ahmadli, and Hazi Aslanov. This station coverage indicates that the Baku Metro Laboratory carries out regular and system-wide monitoring of the underground passenger environment rather than isolated or one-time measurements.

385. A more detailed measurement was carried out on 29 January 2026 at selected stations. The measurements covered temperature, relative humidity, and noise at eight stations: Elmlar Akademiyasi, Nizami, 28 May, Jafar Jabbarli, Khatai, Ganjlik, Narimanov, and Ulduz. The results showed temperatures between 15.3°C and 17.9°C, relative humidity between 55.8% and 67.3%, and noise levels between 75.6 dB and 84.8 dB (**Table 21**). These values indicate that platform temperature and humidity were within the applicable reference limits, while noise levels were generally within or close to the reference interval of 80–85 dB.

Table 21: Selected Platform Measurement Results, 29 January 2026

No.	Station	Temperature, °C	Relative humidity, %	Noise, dB
1	Elmlar Akademiyasi	16.5	58.3	79.7
2	Nizami	16.0	59.6	81.6
3	28 May	17.4	60.1	83.8
4	Jafar Jabbarli	15.3	66.7	75.6
5	Khatai	16.1	67.3	79.0
6	Ganjlik	17.8	55.8	84.8
7	Narimanov	17.9	56.4	82.7
8	Ulduz	17.5	57.2	78.6
	Applicable reference value	+5 to +28	75	80–85

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386. The same monitoring report also includes measurements at ventilation shafts. Measurements were recorded at Ulduz Station, Shaft No. 40, at 09:45, and Koroglu Station, Shaft No. 42, at 10:05. Both shafts were recorded as being in flow mode, indicating that the ventilation system was operating during the measurement period (**Table 22**). This is relevant for the EIA because the effectiveness of ventilation is an important control measure for maintaining acceptable air quality and microclimate conditions in underground metro facilities.

Table 22: Ventilation Shaft Monitoring, 29 January 2026

Station	Shaft No.	Time	Observation
Ulduz	40	09:45	In flow mode
Koroglu	42	10:05	In flow mode

387. In addition to microclimate and noise measurements, petroleum hydrocarbon monitoring was conducted at Koroglu Station. The measurement was carried out using a UG-2 gas analyzer at 09:15 by the responsible laboratory specialist. The results showed 0 in air at both YSQ-1 and YSQ-2, while the well measurement showed 0 at YSQ-1 and 50 at YSQ-2 against the stated reference value of 300 mg/m³. A thin layer of 0.1 cm was recorded at YSQ-2, and the temperature was recorded as 10°C (**Table 23**). The laboratory notes states that the results were within the applicable standards.

Table 23: Petroleum Hydrocarbon Measurement Results at Koroglu Station

Sampling medium	point /	YSQ-1	YSQ-2	Reference value	Instrument	Time	Result interpretation
Air		0	0	300 mg/m ³	UG-2 gas analyzer	09:15	Within norm
Well		0	50	300 mg/m ³	UG-2 gas analyzer	09:15	Within norm
Layer thickness, cm		0	0.1	—	Visual / field record	09:15	Recorded at YSQ-2
Temperature		—	10°C	—	Field record	09:15	Recorded

388. The monitoring results confirm that the Baku Metro Laboratory maintains regular internal environmental monitoring over the operational metro environment. The results are particularly important for the IEE because they provide project-specific evidence on existing underground environmental conditions, including passenger platform microclimate, ventilation performance, noise exposure, and potential hydrocarbon presence in technical areas. These measurements establish a baseline against which future project-related activities or operational changes can be assessed.
389. Overall, the available measurement results indicate that existing environmental quality conditions within the monitored Baku Metro stations are generally within applicable standards and reference values. No significant or systematic exceedances were identified for temperature, humidity, ventilation shaft operation, or petroleum hydrocarbons. Noise levels in some platform areas were approaching the upper reference limits, which is typical for operating underground railway environments and should continue to be monitored. During project implementation and operation, the Baku Metro Laboratory should continue periodic environmental monitoring and maintain records to support environmental monitoring

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requirements, occupational health and safety management, and environmental performance reporting.

7.2 Ecological Resources

7.2.1 Flora and Fauna

390. The Baku Metro CJSC modernization project is located entirely within the highly urbanized environment of Baku and is confined to existing metro infrastructure, including underground tunnels, stations, depots, technical buildings, and operational facilities. As a result, the project area does not include natural habitats or ecologically sensitive areas, and overall biodiversity value within the direct area of influence is considered low. Nevertheless, urban and underground environments can support a limited range of fauna species that have adapted to anthropogenic conditions. The biodiversity assessment for the project therefore focuses primarily on urban-adapted fauna and species associated with underground structures, technical facilities, and built environments rather than natural ecosystems.
391. Within the tunnel systems, underground stations, depots, and technical buildings, the fauna most likely to occur includes small mammals such as rodents (primarily rats and mice), which are commonly associated with underground transport infrastructure due to the availability of shelter, warmth, and food sources generated by human activity. In addition, various invertebrate species, including insects such as cockroaches, beetles, ants, spiders, and moths, may be present within tunnels, drainage systems, and technical rooms. These organisms are typical for enclosed urban infrastructure environments and generally do not represent species of conservation concern. Bat species are considered unlikely to establish permanent roosts within active metro tunnels due to continuous vibration, noise, lighting, and human presence; however, occasional transient use of abandoned or low-disturbance technical cavities cannot be fully excluded. Above-ground facilities and depot areas may also attract common urban bird species such as pigeons (*Columba livia*), sparrows (*Passer domesticus*), crows (*Corvus cornix*), and gulls associated with the coastal urban environment of Baku.
392. From an ecological perspective, the project is not expected to result in significant impacts on biodiversity because all activities are confined within existing operational infrastructure and do not require expansion into natural habitats or protected areas. Potential impacts are therefore limited to temporary disturbance of urban-adapted fauna during construction, installation, and decommissioning activities, including increased noise, vibration, lighting, and human activity. Proper waste management, housekeeping, and control of food waste are important to avoid attracting rodents or nuisance species to construction areas. In addition, careful management of drainage systems and hazardous materials is necessary to prevent indirect impacts on urban fauna through contamination pathways. Overall, the biodiversity sensitivity of the project area is considered low, and with implementation of standard environmental management measures, no significant long-term impacts on fauna or urban ecological conditions are anticipated.

7.2.2 Protected Areas

393. Azerbaijan's protected area system includes national parks, state nature reserves, state nature sanctuaries, natural monuments, and other specially protected natural areas. The Ministry of Ecology and Natural Resources notes that Azerbaijan has specially protected natural areas covering about 893,000 ha, including national parks, state nature reserves, and state nature sanctuaries. For the Baku Metro Project, the most relevant protected and sensitive areas are

those located within Baku, the Absheron Peninsula, Gobustan, and the wider Greater Baku region.

394. **Table 24** provides information on the protected areas located nearest to the Baku Metro Project area, including their protection status, approximate distance from the proposed project components, and relevance to the project's environmental and social assessment.

Table 24: Protected Areas near Baku and Approximate Distance from the Baku Metro Project Area

No.	Protected area / sensitive natural site	Type / status	Approximate distance from Baku Metro project area
1	Binagadi Paleontological Nature Monument	Natural monument / protected paleontological site	Approx. 10–15 km north-west of central Baku
2	State Nature Reserve of Baku and the Absheron Peninsula Mud Volcanoes Group	State nature reserve / mud volcano protected area	Approx. 20–60 km , depending on the specific mud-volcano group
3	Absheron National Park	National Park	Approx. 50–60 km east / south-east of central Baku, at the end of the Absheron Peninsula
4	Gobustan Rock Art Cultural Landscape / Gobustan State Historical-Artistic Reserve	UNESCO World Heritage cultural landscape and protected reserve	Approx. 60–70 km south-west of Baku

395. Due to the urban and underground nature of the Baku Metro Project, as well as the considerable distance between the proposed project components and the nearest legally protected natural areas, no direct or indirect impacts on protected areas are anticipated during either the implementation or operation stages. Construction activities will be confined to existing urban infrastructure corridors, metro facilities, stations, tunnels, shafts, depots, and associated work areas within Baku city, while the nearest protected areas are located outside the project's physical footprint and beyond the likely zone of influence for dust, noise, vibration, traffic disruption, wastewater discharge, spoil handling, or operational emissions.

7.3 Socio-economic Information

7.3.1 Introduction

396. This socio-economic baseline has been prepared for the Baku Metro Project and follows the general structure and content approach of the provided sample social baseline chapter, which presents population, employment, social protection, education, healthcare, utilities, and livelihood-related information for Azerbaijan's project-influenced regions. For the Baku Metro Project, the main area of influence is the city of Baku, while the wider contextual area includes the Absheron Peninsula and national-level socio-economic conditions in Azerbaijan.
397. For statistical presentation, the Absheron Peninsula is treated as a practical socio-economic zone comprising Baku city and the surrounding Absheron-Khizi economic region, including Absheron district, Sumgait city, and Khizi district. This approach is consistent with the way official Azerbaijani statistics present Baku city separately and Absheron-Khizi as a surrounding economic region.

7.3.2 Population

398. Azerbaijan's population continues to grow gradually. According to the State Statistical Committee, the population of the country reached approximately 10.24 million persons as of 1 July 2025, with 54.4% urban population, 45.6% rural population, 49.8% men, and 50.2% women. This confirms the country's continued urbanization pattern, with Baku remaining the largest demographic and economic center.
399. The Baku–Absheron area is the most densely populated and urbanized part of Azerbaijan. According to the statistical information presented in the sample, Baku city had a population of 2,344.9 thousand persons in 2024, while the surrounding Absheron district, Sumgait city, and Khizi district together had approximately 876.5 thousand persons. Therefore, the wider Baku–Absheron socio-economic area may be estimated at 3.22 million persons in 2024 (**Table 25**).

Table 25: Population profile of Azerbaijan, Absheron Peninsula and Baku

Area	Population / Indicator	Comment
Azerbaijan	10.24 million persons, 2025	urban population 54.4%
Absheron Peninsula / Greater Baku area	3.22 million persons, 2024	Baku + Absheron district + Sumgait + Khizi
Baku city	2.3449 million persons, 2024	Main direct project area

400. The demographic significance of Baku is important for the Baku Metro Project because metro infrastructure serves a highly concentrated urban population, including commuters, students, workers, visitors, and vulnerable groups. Population growth and continued migration toward Baku and the Absheron Peninsula increase the importance of reliable, safe, accessible, and environmentally efficient public transport.

7.3.3 Employment and Livelihoods

401. In 2024, Azerbaijan's labor force was reported at approximately 5,312.1 thousand persons, of whom 5,029.8 thousand persons were employed and 282.3 thousand persons were unemployed. The number of employed persons reached its highest recorded level in 2024 according to labor market data sourced from the State Statistical Committee.
402. Baku is the largest employment market in Azerbaijan. According to the sample data, in 2024 Baku had a labor force of 1,265.6 thousand persons, of whom 1,204.9 thousand persons were employed and 60.7 thousand persons were unemployed, giving an unemployment rate of approximately 4.8% (**Table 26**). The surrounding Absheron Peninsula settlements also show relatively low unemployment levels compared with many regional areas, reflecting the concentration of industry, services, trade, logistics, construction, public administration, and transport-related employment around Baku.

Table 26: Employment indicators, 2024

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Area	Labor force, thousand persons	Employed, thousand persons	Unemployed, thousand persons	Unemployment rate
Azerbaijan	5,312.1	5,029.8	282.3	5.3%
Absheron Peninsula	Approx. 1,680.4	1,599.3	81.2	4.8%
Baku city	1,265.6	1,204.9	60.7	4.8%

403. The Baku Metro Project is therefore located in the country's most active labor market. During implementation, the project may generate direct and indirect employment opportunities, including construction, engineering, electrical works, signaling, safety systems, logistics, cleaning, security, and maintenance services. At the same time, construction activities may temporarily affect local businesses, pedestrian movement, access to services, and traffic conditions around stations, depots, ventilation shafts, or work sites.

7.3.4 Social Protection and Vulnerable Groups

404. Social protection in Azerbaijan includes labor pensions, targeted state social assistance, disability-related benefits, and other forms of state support. The official Sustainable Development Goals statistical reporting indicates that the share of population covered by social protection floors or systems was 53.6% nationally, while the indicator was 42.1% in Baku city and 48.2% in the Absheron-Khizi economic region.
405. The sample statistics indicate that in 2024 Baku had 387,105 pensioners, with an average monthly assigned pension of 679.6 AZN. In the wider Absheron Peninsula proxy area, including Baku, Absheron district, Sumgait and Khizi, the number of pensioners was approximately 443,169 persons. The number of family members receiving addressed public social aid was 43,559 persons in Baku and approximately 60,943 persons in the wider Baku–Absheron area (Table 27).

Table 27: Social protection indicators, 2024

Area	Number of pensioners	Average monthly pension, AZN	Family members receiving targeted social aid
Absheron Peninsula / Greater Baku area	Approx. 443,169	Varies by district	Approx. 60,943
Baku city	387,105	679.6	43,559
Absheron district	17,628	410.0	7,238
Sumgait city	37,166	417.0	9,705
Khizi district	1,270	379.3	441

406. For the Baku Metro Project, socially vulnerable groups may include elderly passengers, persons with disabilities, low-income households, internally displaced persons or migrant households living in the wider metropolitan area, women travelling with children, and people dependent on public transport for daily access to employment, education, healthcare, markets, and public services. Universal accessibility, safe pedestrian access, clear information disclosure, affordable transport integration, and an operational grievance mechanism should therefore be treated as key social management measures.

7.3.5 Education

407. Azerbaijan's education system is state-regulated and centrally coordinated. The official statistical yearbook on education, science and culture covers preschool, general, vocational, secondary specialized, higher education, PhD programs, science, and cultural institutions. In Baku, educational infrastructure is highly concentrated, including schools, universities, colleges, vocational institutions, libraries, museums, and cultural facilities (**Table 28**).
408. According to the sample data, in 2024 Baku had 491 preschool educational institutions, 391 general educational institutions, 97 public libraries, and 37 museums. In the wider Baku–Absheron area, the total number of preschool institutions was 601, while general educational institutions numbered 502.

Table 28: Educational and cultural institutions, 2024

Area	Preschool institutions	General educational institutions	Public libraries	Museums
Absheron Peninsula	601	502	128	44
Baku city	491	391	97	37
Absheron district	41	45	10	2
Sumgait city	60	52	12	2
Khizi district	9	14	9	3

409. The Baku Metro Project may have positive long-term social effects by improving access to educational institutions and reducing travel time for students, teachers, and university staff. During construction, however, temporary restrictions around work sites may affect pedestrian safety, school access routes, traffic flow, and public transport connections. Such risks should be managed through traffic management plans, pedestrian safety measures, prior notification to nearby institutions, and special attention to children and students.

7.3.6 Healthcare

410. Azerbaijan completed the nationwide implementation of compulsory health insurance in 2021, covering primary care, inpatient care, emergency care, specialized outpatient care, laboratory services, physiotherapy, and other services. Baku has the highest concentration of healthcare facilities and medical personnel in the country, reflecting its role as the national administrative, educational, and medical center (**Table 29**).
411. According to the sample statistics, Baku had 23,905 physicians and 20,698 hospital beds in 2024. The number of physicians per 10,000 population in Baku was 101.7, which is significantly higher than in the surrounding Absheron district, Sumgait city, and Khizi district.

Table 29: Healthcare indicators, 2024

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Area	Number of physicians	Physicians per 10,000 population	Hospital beds	Hospital beds per 10,000 population
Absheron Peninsula / Greater Baku area	25,873	Varies by area	22,899	Varies by area
Baku city	23,905	101.7	20,698	88.0
Absheron district	434	10.0	451	10.4
Sumgait city	1,500	35.1	1,713	40.1
Khizi district	34	20.3	37	22.1

412. For the Baku Metro Project, healthcare relevance is linked to occupational health and safety during construction, emergency preparedness, public safety in stations and tunnels, and accessibility for passengers with reduced mobility or health limitations. Construction contractors should maintain emergency response arrangements with nearby medical facilities, while operational designs should consider evacuation, ventilation, fire safety, passenger assistance, and emergency access.

7.3.7 Cultural Heritage

413. The Baku Metro project is located within an urban environment that contains important cultural heritage features at both station level and in the surrounding city fabric. Project activities will be implemented primarily within existing operational metro infrastructure, including underground stations, tunnels, technical rooms, depots, and associated facilities. Although the project is not expected to involve large-scale excavation or construction of new stations, certain modernization, installation, dismantling, and equipment replacement activities may occur within or near culturally sensitive areas and therefore require appropriate heritage protection measures. The most clearly identified cultural heritage asset directly associated with the metro system is Nizami Metro Station (**Table 30**), which is included in the electronic register of the Ministry of Culture of the Republic of Azerbaijan as an architectural monument of national importance. Its heritage value is linked not only to the station building itself, but also to its architectural composition, interior artistic treatment and cultural references to the poet Nizami Ganjavi. Any works within this station should therefore be implemented with particular care to avoid damaging original architectural and artistic features.

Table 30: Cultural Heritage Site: “Nizami” Metro Station

Metro station	Heritage status	Type of heritage asset	Level of importance	Date / period	Registered number / code	Source
Nizami Metro Station	Listed cultural heritage / protected monument	Architectural monument	National importance / “Ölkə əhəmiyyətli”	1970s	No. 170, system code AJA000189	Ministry of Culture electronic heritage registry lists “Metropolitenin ‘Nizami’ stansiyasının binası” as an architectural monument of national importance in Baku, at C. Cabbarlı Street.

414. Several other metro stations may not be formally listed as protected monuments, but still have architectural, artistic and historical value as part of the Soviet-period and post-Soviet urban

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transport heritage of Baku. These stations include underground halls, entrance pavilions, decorative panels, mosaics, stone cladding, lighting features, inscriptions and other design elements that form part of the visual and cultural identity of the metro system. Although not all stations are officially listed as heritage assets, modernization works within such facilities may create risks of accidental damage, alteration, or loss of historically important interior features if not properly managed. Any rehabilitation, installation, dismantling or replacement works inside stations should therefore be screened carefully to avoid accidental damage to original finishes, decorative elements or station-specific design features.

415. The surrounding areas of some metro stations are also culturally sensitive because Baku contains a dense historic urban landscape with listed monuments, historic residential buildings, public squares, cultural institutions, memorials and archaeological potential in older parts of the city. Stations located near central Baku, including areas close to Icherisheher, Nizami Street, 28 May, Sahil, Elmlar Akademiyasi and other central districts, may be located in proximity to historic buildings or streetscapes. Particular cultural sensitivity is associated with stations located in central Baku and in proximity to historic urban areas, including Icherisheher, Nizami, Sahil, 28 May, and Elmlar Akademiyasi stations. Even where the station itself is not listed, project activities such as construction traffic, vibration, excavation, utility relocation, temporary access restrictions and storage of materials could indirectly affect nearby heritage assets, historic streetscapes, monuments, and public spaces.
416. The Icherisheher area is of particular importance because it is associated with the historic core of Baku and the UNESCO-listed Walled City of Baku, including the Shirvanshahs' Palace and Maiden Tower. Although the project is not expected to directly affect UNESCO-listed structures, the metro station serving this area should be considered highly sensitive from a cultural heritage management perspective. Any works in this area or along access routes to it should therefore be carefully planned to avoid physical disturbance, excessive vibration, visual intrusion, obstruction of public access to heritage sites, or disruption to tourism and cultural activities.
417. In addition, to built heritage, the project area may contain elements of intangible and social heritage, including traditional public spaces, historically important streets, memorial places, cultural institutions, religious buildings and community landmarks used by local residents. Temporary disruption around stations may affect access to such places, particularly where works are carried out near pedestrian routes, public squares, museums, theatres, educational institutions, mosques, churches or cemeteries. These sensitivities should be reflected in the project's stakeholder engagement, traffic management and community health and safety planning.
418. Overall, due to the predominantly underground and rehabilitation-oriented nature of the project, significant impacts on cultural heritage are not anticipated. However, site-specific risks associated with installation, dismantling, vibration, equipment replacement, and temporary construction activities may occur in culturally sensitive stations and historic urban areas. Prior to commencement of works, heritage-sensitive locations should therefore be screened in coordination with relevant authorities, including the Ministry of Culture, and appropriate protection measures should be incorporated into construction planning and environmental management procedures. In addition, chance-find procedures should be implemented for any activities involving excavation or intrusive works in historically sensitive areas.

7.3.8 Utilities and Urban Services

419. Baku and the Absheron Peninsula have the most developed utility infrastructure in Azerbaijan, including electricity supply, gas distribution, water supply, sewerage networks, telecommunications, and municipal waste services. Official SDG reporting indicates that Baku and Absheron-Khizi have high levels of access to basic drinking water services, with figures reported at 97.7% for Baku city and 98.0% for Absheron-Khizi in the referenced indicator table.
420. At the same time, safely managed drinking water services show a lower indicator: 69.2% for Baku city and 71.5% for Absheron-Khizi economic region, indicating that although basic access is widespread, quality, continuity, wastewater management, and service reliability may still require improvement in some locations.
421. The Baku Metro Project is likely to interact with underground and surface utilities, including water pipelines, sewerage networks, power cables, communication lines, drainage systems, gas pipelines, and road infrastructure. This is particularly important because metro works are commonly located in dense urban areas with complex underground infrastructure. Utility mapping, coordination with service providers, emergency repair procedures, and careful construction sequencing will be essential to avoid service interruptions and public inconvenience.

7.3.9 Waste Management and Urban Environmental Services

422. Waste management in Baku is more developed than in most other parts of Azerbaijan. The wider Baku–Absheron area benefits from more organized municipal waste collection, transfer, disposal, and treatment systems, although construction and demolition waste, hazardous waste, and contaminated materials still require careful project-specific management. The sample baseline also notes that hazardous waste landfill capacity in Azerbaijan remains limited and concentrated around the Absheron/Baku region, while construction waste is often managed through municipal landfills, designated disposal areas, reuse as fill, or licensed contractors.
423. For the Baku Metro Project, waste streams may include excavated material, concrete, asphalt, scrap metal, packaging, oils, lubricants, filters, contaminated ballast or track-related residues, asbestos-containing materials in old infrastructure, and general municipal waste from construction camps or work sites. The project should therefore apply a waste hierarchy, segregate waste at source, identify licensed disposal routes, maintain waste transfer documentation, and prepare specific procedures for hazardous and contaminated materials.

7.3.10 Mobility, Public Transport and Social Accessibility

424. Baku Metro is one of the most important public transport systems in the capital. It provides daily mobility for workers, students, residents, and visitors and supports economic activity by connecting residential districts with employment centers, commercial areas, educational institutions, and public services. The social value of the project is therefore not limited to transport infrastructure; it is directly linked to urban inclusion, affordability of mobility, road congestion reduction, and improved access to essential services.
425. The main social risks during implementation may include temporary disruption of pedestrian movement, traffic congestion near work sites, noise and vibration impacts on nearby residents

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and businesses, temporary changes in access to shops or public institutions, safety risks around excavations and construction areas, and inconvenience to passengers where works are carried out in or near operating metro facilities. These risks should be addressed through stakeholder engagement, public information disclosure, safe pedestrian routes, traffic management, construction noise controls, grievance redress procedures, and coordination with local executive authorities.

7.3.11 Summary of Key Social Baseline Issues for the Baku Metro Project

426. The Baku Metro Project is located in Azerbaijan's most urbanized, economically active, and densely populated area. Baku city alone had approximately 2.345 million residents in 2024, while the wider Baku–Absheron area had approximately 3.22 million residents. This creates strong demand for efficient, safe, and accessible public transport infrastructure.
427. The project area has a strong employment base, high concentration of educational and healthcare institutions, and comparatively developed utility infrastructure. However, the dense urban setting also increases construction-stage social risks, including disruption of access, traffic impacts, utility interference, public safety risks, and nuisance impacts on residents, businesses, students, and vulnerable passengers.
428. The project should therefore integrate social management measures from the early design and construction planning stages. Priority measures should include inclusive stakeholder engagement, accessible information disclosure, a functioning grievance mechanism, traffic and pedestrian safety planning, protection of vulnerable groups, coordination with utility operators, and clear communication with communities, businesses, schools, healthcare facilities, and metro users.

8. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

8.1 Impact Assessment Methodology and Risk Assessment

429. This section presents the environmental and safety risk assessment for the Baku Metro Signaling Modernization and Operations Digitalization Project. The project is implemented within the existing operational footprint of Baku Metro, including tunnels, stations, depots, substations, technical rooms, control facilities, and rolling stock. No new land acquisition or expansion into natural habitats or protected areas is envisaged. The project is structured into three main phases: Phase 1 – Signaling Modernization and Operations Digitalization, Phase 2 – Stabilization and Parallel Operation, and Phase 3 – Decommissioning of the Existing System.
430. The risk assessment follows the impact assessment approach used in the project IEE, under which project aspects are identified, sensitive receptors are defined, potential impacts are assessed, mitigation and management measures are proposed, and residual risks are determined. The assessment considers environmental, occupational health and safety, community health and safety, operational safety, and social risks. Particular attention is given to the specific characteristics of the Baku Metro environment, including confined underground spaces, active passenger operations, legacy oil-filled electrical equipment, groundwater inflow, tunnel drainage, ventilation, noise, vibration, hazardous waste, e-waste, and the need to maintain uninterrupted metro services during implementation.

8.1.1 Project Aspects

431. The main project aspects are linked to the modernization of signaling and operational control systems across the Baku Metro network. The first phase includes final design, procurement, factory acceptance testing, installation of wayside and onboard equipment, system integration, pilot operation, and progressive rollout across the network. The second phase consists of 6–12 months of parallel operation, during which both the new CBTC system and the legacy signaling system operate simultaneously. The third phase includes deactivation, safety verification, pilot decommissioning, full dismantling of the existing system, material management, safety control, and final documentation (**Table 31**).
432. The project does not involve large-scale civil works or new surface development; however, it includes intensive technical works in operational underground environments. The most environmentally relevant aspects are the removal and replacement of old electrical and signaling equipment, including approximately 933 oil-filled choke-transformers, possible PCB-containing oils, legacy cables, relay equipment, switch machines, junction boxes, tunnel telephones, and other electronic and electrical components. These activities may generate hazardous waste, e-waste, scrap metal, cable waste, oil residues, contaminated materials, and packaging waste. The existing baseline also identifies continuous groundwater inflow and tunnel drainage as an operational feature of the Baku Metro system, which requires attention during installation and dismantling activities.

Table 31: Main Project Aspects by Phase

Phase	Main project activities	Key environmental and safety relevance
Phase 1: Signaling Modernization and Operations Digitalization	Design finalization, procurement, FAT, wayside installation, onboard installation, SAT, pilot operation, progressive rollout	Work in tunnels, stations, depots and technical rooms; electrical safety; confined-space risks; limited waste generation; integration with live operations
Phase 2: Stabilization and Parallel Operation	6–12 months of parallel operation of CBTC and legacy systems	Dual-system management; operational safety; system reliability; increased monitoring needs; possible energy inefficiency during transition
Phase 3: Decommissioning of Existing System	GO/NO-GO decision, deactivation, safety verification, pilot dismantling, full dismantling, waste/material management, final documentation	Highest environmental risk phase due to removal of oil-filled transformers, cables, relay equipment, e-waste, possible PCB-contaminated materials, and confined-space dismantling

8.1.2 Identification of Sensitive Receptors

433. Sensitive receptors were identified based on the existing baseline conditions of the Baku Metro system and the wider urban setting of Baku. The project is located in a dense urban and underground environment, where the most important receptors are passengers, Baku Metro staff, contractors, nearby residents and businesses, underground infrastructure, technical systems, and environmental media potentially affected by legacy contamination. Natural habitats and protected areas are not considered sensitive direct receptors for this project because the nearest protected areas are located outside the project footprint and beyond the likely zone of influence. A list of key sensitive receptors within the project is provided in **Table 32**.
434. The baseline confirms that Baku Metro includes both deep and shallow underground stations, old Soviet-period infrastructure, continuous groundwater inflow in some tunnel sections, drainage systems, ventilation shafts, legacy signaling systems, and oil-filled equipment. Some stations and technical facilities are more sensitive due to their depth, age, confined layout, groundwater conditions, passenger density, and the presence of old electrical installations.

Table 32: Sensitive Receptors Relevant to the Risk Assessment

No.	Sensitive receptor / asset	Relevance to project risk assessment
Environmental Receptors		
1	Groundwater and tunnel drainage systems	Potentially vulnerable to contamination from oil residues, hazardous materials, contaminated wash water, oily sludge, drainage sediment, or accidental spills during dismantling and waste handling.
2	Tunnel floors, ballast, cable ducts and technical-room surfaces	May be affected by oil leakage, contaminated dust, residues from legacy equipment, degraded insulation, or improper storage of dismantled materials.
3	Indoor air quality in tunnels, stations and technical rooms	May be affected by dust, fumes, vapors, odors, poor ventilation, hot works, handling of old oil-filled equipment, or dismantling of degraded cable and electrical materials.

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4	Urban environment around depots and surface facilities	May be affected by temporary waste storage, vehicle movements, loading and unloading, spills, noise, dust, or movement of dismantled materials from underground areas to depot storage areas.
5	Urban-adapted fauna	Rodents, insects, common birds and other urban-adapted species may be temporarily disturbed or attracted by poor housekeeping, food waste, open waste storage or drainage contamination.
6	Urban utilities and service infrastructure	Potentially affected where cable routing, electrical connections, communication systems, drainage interfaces, or depot access works interact with existing utility networks.
7	Legacy electrical and signaling equipment	Potential source of hazardous materials, including oil residues, degraded insulation, e-waste and possible PCB contamination during dismantling, transport, storage, recycling or disposal.
8	Oil-filled drossel-transformers / choke-transformers	Main PCB-suspect equipment group under the project. These units contain insulating oil and require inventory, condition assessment, sampling, controlled handling and certified waste management before dismantling or disposal.
Occupational Safety and Health Receptors		
1	Baku Metro operational staff	Exposed to operational safety, electrical safety, confined-space, ventilation, emergency response, system transition, and parallel operation risks.
2	Contractors and installation teams	Exposed to occupational health and safety risks during installation, testing, commissioning, dismantling, cable removal, transformer handling, hazardous waste management, and night works.
3	Depot, maintenance, laboratory and waste-handling personnel	May be exposed to risks associated with depot-based waste storage, handling of dismantled equipment, oil-filled transformers, e-waste, contaminated materials, PCB-suspect materials, laboratory sampling, and transport of waste.
4	Existing metro stations and tunnels as operational work areas	Sensitive to electrical interference, equipment failure, fire risk, drainage disruption, ventilation constraints, access restrictions, and occupational safety risks during works in a live metro environment.
5	Depots, substations and technical rooms as work areas	Key locations for onboard equipment installation, transformer handling, electrical isolation, waste segregation, temporary storage, and coordination of decommissioning activities.
6	Operations Control Center, dispatch systems and control rooms	Critical for maintaining train movement, power supply coordination, emergency response, system transition, parallel operation, safe access control, and coordination of works.
Social Receptors		
1	Metro passengers	May be affected by temporary access restrictions, operational changes, emergency situations, noise, dust, or works near operating station areas.
2	Vulnerable passengers	Includes elderly persons, persons with disabilities, visually impaired users, mobility-impaired users, children, women travelling with children, passengers with reduced mobility, and passengers sensitive to crowding or emergency evacuation constraints. These groups may be more sensitive to temporary rerouting, access changes, service disruption, or emergency situations.
3	Nearby residents	May be affected by temporary noise, dust, odour, traffic movement, waste transport, or access changes near stations, depots, technical buildings, or surface facilities.
4	Nearby businesses, kiosks, vendors and service providers	May be affected by temporary access restrictions, reduced pedestrian movement, loading/unloading activities, station access changes, or short-term disruption during implementation.
5	Public transport users and pedestrians around stations	May be affected by temporary changes to pedestrian routes, station entrances, public transport interfaces, signage, access arrangements, or safety barriers.

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6	Public institutions near station areas	Educational, healthcare, administrative, cultural, or public service facilities near stations may be affected by temporary access changes, traffic management measures, or public information requirements.
7	Nizami Metro Station	Listed architectural monument of national importance. Project works may affect decorative finishes, stone cladding, panels, lighting, inscriptions, or other heritage-sensitive station elements if not properly managed.
8	Older metro station interiors	Some older stations may contain architectural, artistic, historical, or social value, including mosaics, decorative panels, stone finishes, lighting features and station-specific design elements.
9	Historic buildings and central urban areas near stations	Relevant where works occur near Icherisheher, Nizami Street, 28 May, Sahil, Elmlar Akademiyasi or other central areas with heritage-sensitive buildings or streetscapes.
10	Protected areas near Baku	Not directly affected because the project is confined to existing urban and underground metro infrastructure and protected areas are located outside the project footprint and likely zone of influence.

8.1.3 Impact Significance Rating Approach

435. Impact significance is determined by considering the consequence of the impact and the probability of its occurrence. Consequence is assessed based on magnitude, spatial scale, and timeframe. Magnitude considers the sensitivity of receptors, severity of change, number of receptors affected, regulatory thresholds, and public concern. Spatial scale considers whether the impact is limited to a work site, station, depot, tunnel section, district, or wider network. Timeframe considers whether the impact is short-term, medium-term, long-term, intermittent, or continuous. Impact Significance Definitions Applied to the Project are presented in **Table 33**.
436. For this project, most impacts are expected to be localized and temporary because works are confined to existing metro infrastructure. However, some risks require higher attention because they occur in confined underground spaces, involve safety-critical systems, or relate to hazardous materials. The most important risks are associated with electrical isolation, system transition, emergency preparedness, handling of oil-filled transformers, possible PCB contamination, e-waste, tunnel ventilation, groundwater drainage, and occupational health and safety.

Table 33: Impact Significance Definitions Applied to the Project

Rating	Description	Mark
Low	Localized, short-term, reversible impact; limited receptors; manageable through standard good practice	L
Medium	Measurable impact or safety risk; several receptors may be affected; requires specific mitigation and monitoring	M
High	Potentially serious environmental, safety, operational, or regulatory impact; requires priority control, specialist procedures, and close supervision	H
Positive	Beneficial effect, such as improved safety, energy efficiency, service reliability, or public transport performance	P

8.1.4 Risk Assessment by Project Phase

437. The phase-specific impacts, several risks apply across all phases of the project. These include occupational health and safety, emergency preparedness, stakeholder communication, passenger safety, groundwater and drainage protection, waste management, and monitoring (Table 34). Because the project is implemented within an active metro system, these cross-cutting risks must be managed continuously rather than only during individual work stages.

Table 34: Cross-Cutting Environmental and Safety Risks

Risk area	Relevant baseline condition	Phase affected	Significance before mitigation	Main controls	Residual significance
Occupational health and safety	Confined underground works, electrical systems, night works, old equipment	All phases, especially 1 and 3	High	OHS Plan, permit-to-work, LOTO, confined-space procedures, PPE, training, supervision	Medium
Fire and emergency preparedness	Underground stations and tunnels; legacy electrical equipment; cable removal	All phases	High	Fire safety plan, emergency response plan, fire watch, clear evacuation routes, coordination with OCC and emergency services	Medium
Groundwater and drainage	Continuous groundwater inflow and tunnel drainage systems	Phases 1 and 3	Medium	Protect drainage channels, avoid oil discharge, water quality checks where contamination suspected, maintain pumping systems	Low / Medium
Hazardous materials	Oil-filled transformers, possible PCB contamination, old cables and e-waste	Phase 3	High	Testing, inventory, labeling, licensed hazardous waste handling, chain-of-custody documentation	Medium
Passenger safety	Works in or near operating metro areas	Phases 1 and 2	High	Work segregation, safe access, signage, communication, station-level safety plans, emergency procedures	Medium
Community and access impacts	Dense urban setting, nearby businesses, institutions and residents	Mainly Phase 1 and waste transport in Phase 3	Medium	Traffic/access management, prior notification, grievance mechanism, off-peak transport	Low / Medium
Protected areas and biodiversity	Project confined to existing urban/underground	All phases	Low	No ancillary facilities near protected areas; keep works within	Low

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Risk area	Relevant baseline condition	Phase affected	Significance before mitigation	Main controls	Residual significance
	infrastructure; protected areas are distant			approved metro footprint	
Social benefits	Improved safety, reliability and efficiency of Baku Metro	Operation after all phases	Positive	Maintain affordable, reliable and safe public transport; improve information systems and operational control	Positive

8.1.6 Mitigation, Management and Good Practice Measures

438. The mitigation hierarchy applied to the project gives priority to avoiding risks where possible, reducing risks at source, protecting receptors through management controls, and applying corrective or compensatory measures where necessary. For the Baku Metro Project, avoidance is achieved primarily by confining works to the existing metro footprint, avoiding protected areas, avoiding land acquisition, and using phased implementation to avoid disruption to metro operations. Risk reduction is achieved through technical design, work sequencing, electrical isolation, testing, environmental monitoring, and controlled decommissioning.
439. The following management plans and procedures should be prepared or updated before the start of relevant activities: Environmental Management Plan; Occupational Health and Safety Plan; Confined Space Work Procedure; Electrical Safety and LOTO Procedure; Hazardous Materials and PCB Management Procedure; Waste and E-Waste Management Plan; Spill Prevention and Response Plan; Fire Safety and Emergency Response Plan; Traffic and Access Management Procedure; Passenger Safety and Station Access Procedure; Groundwater and Drainage Management Procedure; and Chance Find Procedure.
440. The Baku Metro Laboratory should continue routine environmental monitoring during project implementation and operation. Its existing monitoring role is important because baseline measurements already cover platform microclimate, temperature, humidity, noise, ventilation shaft operation, and petroleum hydrocarbon checks at technical areas. Continued monitoring will support early identification of changes in environmental quality during installation, stabilization, and decommissioning activities.

8.1.7 Residual Impacts

441. With implementation of the proposed mitigation measures, most environmental impacts are expected to be reduced to Low or Low / Medium significance. The project is not expected to cause significant impacts on protected areas, natural habitats, land resources, or surface water bodies because it is located within existing urban metro infrastructure. Positive long-term impacts are expected through improved safety, reliability, operational efficiency, energy performance, and passenger service quality (**Table 35**).
442. The main residual risks that remain at Medium significance are related to safety-critical and hazardous-material activities, particularly during system integration, parallel operation, and

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decommissioning. These include electrical hazards, confined-space works, fire safety, passenger safety during transition, handling of oil-filled transformers, possible PCB contamination, e-waste management, and safe dismantling of legacy cables and equipment. These risks do not prevent project implementation but require strict supervision, qualified contractors, documented procedures, and continuous monitoring.

Table 35: Summary of Residual Risk Significance by Project Phase

Project phase	Main risk profile before mitigation	Residual risk after mitigation	Overall assessment
Phase 1: Signaling Modernization and Operations Digitalization	Medium to High, mainly related to installation in live underground environments and system integration	Low to Medium	Manageable with work permits, LOTO, controlled access, testing and supervision
Phase 2: Stabilization and Parallel Operation	High operational safety risk due to dual-system transition	Medium	Acceptable as a risk-reduction and validation phase if fallback and monitoring are maintained
Phase 3: Decommissioning of Existing System	High environmental and OHS risk due to hazardous materials, oil-filled equipment, electrical dismantling and confined spaces	Medium	Acceptable only with PCB testing, licensed waste handling, LOTO, emergency preparedness and strict documentation
Operation after modernization	Low environmental risk; positive social and operational benefits	Low / Positive	Improved safety, reliability, capacity, energy efficiency and passenger information

443. In conclusion, the Baku Metro Signaling Modernization and Operations Digitalization Project is assessed as a manageable Category B-type project, with site-specific and largely reversible environmental and safety impacts. The highest risks are not associated with new construction, but with the technical complexity of modernization within a live underground metro system and the decommissioning of legacy electrical and signaling infrastructure. Provided that the phased implementation program, GO/NO-GO decision process, EMP, hazardous materials procedures, safety controls, and Baku Metro Laboratory monitoring are fully applied, no significant residual environmental impacts are expected, and the project is expected to deliver substantial long-term safety, operational and environmental benefits.

8.2 Physical Resources

8.2.1 Air Quality

444. This section assesses potential impacts on air quality during the implementation and operation of the Baku Metro Signaling Modernization and Operations Digitalization Project and presents the mitigation and management measures to be applied. The structure follows the provided sample, which assesses air quality impacts by project phase, identifies receptors, evaluates significance, and presents mitigation and residual impacts. The Baku Metro Project differs from a conventional construction project because the works will be carried out mainly within existing underground tunnels, stations, depots, technical rooms, control facilities, and rolling stock areas, without major earthworks or new surface construction.

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445. Air pollution may be caused by damage to asbestos-containing materials (ACMs) in the existing subway. Asbestos-containing materials may potentially be present in older sections of the Baku Metro system, especially in infrastructure constructed or equipped during the Soviet period, when asbestos-based materials were commonly used for fire resistance, thermal insulation, sealing and electrical protection. Potential ACMs may occur in cable penetrations through walls and floors, old electrical rooms, relay rooms, transformer or technical rooms, cable ducts, ventilation-related structures, insulation layers, fire-resistant panels, sealing materials, old floor or wall panels, pipe insulation, gaskets, and other legacy building or technical materials. The risk is more relevant in older stations, tunnels, technical rooms, depots and service areas than in newly rehabilitated or recently constructed facilities. At this stage, the presence of ACMs has not been confirmed and will require verification during detailed design and pre-construction inspections. If suspected ACMs are encountered during implementation, they shall be managed in accordance with an asbestos management procedure and applicable regulatory requirements.

Pre-construction Phase

446. The main air quality-related requirements at this stage are linked to design finalization, environmental planning, procurement specifications, and preparation of site-specific work procedures. The design and procurement process should ensure that all new signaling, communication, control, power supply, and digital systems are energy-efficient, compliant with applicable technical standards, and suitable for safe operation in underground and enclosed metro environments.
447. The pre-construction phase should include: preparation of an air quality and ventilation control procedure for enclosed work areas; identification of works that may generate dust, fumes, vapors, or heat; inventory of legacy equipment requiring dismantling; identification of potentially contaminated equipment and materials; confirmation of ventilation requirements for tunnel and technical-room works; and integration of these requirements into contractor method statements and occupational health and safety plans.

Construction / Implementation Phase

448. The main project activities with potential to affect air quality during implementation include installation of wayside and infrastructure equipment, installation of onboard equipment, cable routing, drilling and fixing works, dismantling of obsolete equipment, removal of old cables and control units, replacement of electrical components, handling of oil-filled transformers, transportation of dismantled materials, and temporary storage of wastes. These works will generally be localized and conducted within existing metro infrastructure, mostly during nighttime or limited access windows to avoid disruption to passenger services.
449. Unlike large-scale civil works, the project is not expected to generate significant outdoor dust emissions because no major excavation, demolition, earthworks, or new road construction is envisaged. However, minor dust may be generated during drilling, cutting, cleaning of cable trays, opening of old ducts, removal of degraded insulation, and cleaning of technical rooms.
450. Indoor air quality is the more important air quality issue for this project. Works will take place in enclosed underground and technical spaces where natural ventilation is limited. Potential sources of indoor air quality impacts include dust from drilling and dismantling, fumes from welding or cutting if used, vapors from oils or solvents, heat generated by equipment testing,

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accidental release of oil residues from old transformers, and airborne contaminants from old cable insulation or degraded materials.

451. Sensitive receptors during the implementation phase include Baku Metro workers, contractors, maintenance personnel, passengers where works occur near operating stations, station staff, depot personnel. The most sensitive receptors are workers operating in tunnels, relay rooms, technical rooms, transformer areas, and other confined or semi-confined spaces.
452. Particular attention should be given to works involving old oil-filled transformers and other legacy electrical equipment. Before dismantling, equipment should be inspected and, where relevant, sampled for PCB or other hazardous substances. Cutting, opening, draining, or moving old oil-filled units without prior testing and control may create risks of vapor exposure, odor, spills, and contamination of indoor work areas.
453. During project implementation, asbestos risk is not expected to be associated with normal installation of new CBTC equipment itself, but with activities that may disturb old structures or legacy materials. These include drilling, fixing, anchoring, cutting, opening cable ducts, removing old cables, dismantling old electrical cabinets, cleaning technical rooms, opening wall or floor penetrations, and moving equipment through old service areas. If asbestos-containing materials are intact and not disturbed, the risk is generally low. However, if materials are damaged, friable, cracked, deteriorated, drilled, cut, broken, or removed without controls, the risk may become medium to high, mainly due to potential worker exposure to airborne asbestos fibres.
454. For the Baku Metro Project, ACMs represent a potential risk that requires verification prior to implementation activities that may disturb legacy materials. However, specific locations where old insulation, sealing materials, panels or cable penetrations are present should be treated as higher-risk areas until inspected. The risk of damage is highest during decommissioning of legacy signaling and electrical infrastructure, when old cables, control boxes, relay systems and equipment supports are removed from technical rooms, tunnels and cable ducts. Therefore, any material suspected of containing asbestos should be managed in accordance with an asbestos management procedure until its composition has been confirmed by qualified personnel. Additionally, an asbestos screening survey should be undertaken in areas where disturbance of legacy materials is anticipated prior to commencement of dismantling works.

Operational Phase

455. No significant adverse ambient air quality impacts are expected during operation. The project will not introduce new combustion sources within the metro system and will not result in additional direct emissions to the urban environment. Indoor air quality will continue to depend on effective ventilation, maintenance of tunnel and station systems, cleanliness, drainage control, equipment performance, and routine monitoring. The Baku Metro Laboratory should continue periodic monitoring of microclimate and relevant environmental quality indicators in stations, tunnels, shafts, and technical areas.

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Impact Significance Assessment

456. **Table 36** presents the assessment of potential air quality impacts before implementation of mitigation measures. The rating approach follows the provided sample, using project phase, potential impact, receptors, receptor sensitivity, magnitude, timeframe, spatial scale, consequence, probability, and significance.

Table 36: Potential Impacts on Air Quality

Phase	Potential impact	Receptors	No. of receptors	Sensitivity of public	Level of Risk of exceeding	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance	
PC	Inadequate planning for ventilation, dust, fumes and hazardous materials	Workers, contractors, Baku Metro staff	L	M	L	L	MIN	ST	SMA	LOW	POSS	L
C	Minor dust from drilling, fixing, cable works and cleaning of ducts / technical rooms	Workers, station staff, passengers in adjacent areas	L	M	L	L	MIN	ST	SMA	LOW	POSS	L
C	Exhaust emissions from service vehicles and equipment at depots / access points	Workers, nearby communities, road users	L	L	L	L	MIN	ST	SMA	LOW	POSS	L
C	Indoor air quality deterioration in tunnels, technical rooms and relay rooms	Workers, contractors, maintenance staff	M	M	L	M	MOD	ST	SMA	MED	POSS	M
C	Vapors, odor or contamination risk during handling of old oil-filled equipment	Workers, contractors, drainage systems, technical rooms	L	M	L	M	MOD	ST	SMA	MED	POSS	M
C	Dust or fumes from dismantling old cables, control boxes and e-waste. Overall asbestos risk	Workers, contractors	L	M	L	L	MIN / MOD	ST	SMA	LOW / MED	POSS	L / M
O	Routine indoor air quality risks in operating stations and tunnels	Passengers, station staff, maintenance staff	M	M	L	L	MIN	LT	SMA	LOW	POSS	L
O	Improved operational efficiency and reduced indirect emissions through optimized metro operation	Baku population, metro users, urban environment	H	M	M	L	POS	LT	EXT	POS	DEF	POS

Key: PC – Pre-construction; C – Construction / Implementation; O – Operation; H – High; M – Medium; L – Low; MIN – Minor; MOD – Moderate; MAJ – Major; ST – Short-term; MT – Medium-term; LT – Long-term; SMA – Small; INT – Intermediate; EXT – Extensive; POSS – Possible; DEF – Definite; POS – Positive.

Mitigation and Management Measures

Pre-construction / Planning Phase

457. During the pre-construction phase, Baku Metro and the contractor shall ensure that air quality, ventilation, and hazardous-material control requirements are included in the detailed design, procurement documents, method statements, and site-specific environmental and occupational health and safety plans.
458. Before works begin in older technical rooms, relay rooms, cable corridors, depots and station service areas, the Contractor shall carry out an asbestos screening survey. If suspected asbestos-containing materials are identified, they should be photographed, mapped, labelled, and either avoided, encapsulated, or removed only by appropriately trained and licensed specialists. Workers should be prohibited from drilling, cutting, breaking, sanding, sweeping or air-blowing suspect materials. Where disturbance is unavoidable, asbestos-specific method statements, PPE, controlled wet methods, restricted access, safe packaging, licensed disposal and post-removal and verification should be applied. This approach is consistent with the audit logic used for legacy hazardous materials in the Baku Metro documentation, where unidentified legacy materials require precautionary management before dismantling or disposal.
459. The following measures shall be implemented:
- Include air quality, dust, fumes, vapor, and ventilation control requirements in contractor environmental and OHS documentation;
 - Prepare an inventory of legacy electrical and signaling equipment to be removed, including oil-filled transformers, cables, control boxes, relay equipment and e-waste;
 - Identify equipment requiring PCB or hazardous-material testing before removal or dismantling;
 - Define ventilation requirements for tunnels, technical rooms, relay rooms, transformer areas, and other enclosed workspaces.
 - Require contractors to submit method statements for works that may generate dust, fumes, vapors, odors or indoor air quality risks;
 - Confirm emergency response arrangements for spills, odor events, poor ventilation, fire, smoke, or accidental exposure to hazardous substances;
 - Ensure that all workers receive training on air quality risks in underground and enclosed work environments.

Construction / Implementation Phase

460. Measures to prevent and minimize exhaust emissions and fugitive dust during implementation shall include the following:
- Use only technically sound and regularly maintained vehicles, generators, lifting equipment and service machinery;
 - Avoid unnecessary idling of vehicles and equipment at depots, access points, station areas and technical facilities;
 - Prohibit open burning of any waste, packaging, cable insulation, plastics, oily materials or other materials;

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- Carry out drilling, cutting and fixing works using dust-control methods, including local extraction or wet methods where technically feasible;
- Clean work areas regularly to prevent accumulation and re-suspension of dust;
- Store dusty materials, waste insulation and dismantled materials in closed containers or covered areas;
- Ensure that waste transport vehicles are covered where loose or dusty materials are transported. Maintain good housekeeping in tunnels, technical rooms, depots and station work areas;
- Ensure adequate ventilation before and during works in tunnels, shafts, technical rooms, transformer areas and confined spaces;
- Apply permit-to-work procedures for activities in confined or poorly ventilated spaces;
- Conduct air quality or gas checks where works involve oils, solvents, fumes, suspected contamination, or confined spaces
- Provide appropriate PPE, including dust masks, respirators, gloves and eye protection, based on task-specific risk assessment;
- Avoid welding, cutting or hot works in poorly ventilated areas unless a hot-work permit, ventilation and fire watch are in place;
- Remove dust and residues using safe cleaning methods; dry sweeping in enclosed technical areas should be avoided where it may re-suspend dust;
- Maintain access to emergency ventilation and evacuation routes at all time;
- Stop work immediately if strong odor, smoke, unusual vapor, oil release, or signs of poor ventilation are detected.

461. Community protection measures shall be applied where surface works, depot activities, material transport or waste removal may affect nearby residents, businesses, pedestrians or road users. These measures shall include prior notification of works, use of approved transport routes, avoidance of unnecessary vehicle idling, maintenance of clean access roads, and operation of the grievance redress mechanism for complaints related to dust, odor, vehicle emissions, or other nuisance impacts.

Operational Phase

462. No major project-specific air quality mitigation is anticipated during the operational phase, as the project is expected to improve operational efficiency and will not introduce new direct combustion sources. However, standard operational controls shall continue. These include regular maintenance of ventilation systems, routine environmental monitoring by the Baku Metro Laboratory, inspection of technical rooms and tunnels, rapid response to oil leaks or odor complaints, proper maintenance of drainage systems, and safe management of maintenance waste.

Residual Impacts

463. With implementation of the mitigation measures described above, residual impacts on ambient air quality are expected to be Low. The project does not include major earthworks or new construction activities that would create substantial external dust or exhaust emissions. Temporary and localized dust or emissions may occur during installation, transport and dismantling activities, but these impacts will be controlled through standard good practice.

464. Residual indoor air quality risks are assessed as Low to Medium (**Table 37**), mainly because some works will be undertaken in enclosed underground environments and may involve old

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equipment, oil-filled transformers, cable insulation, dust, or degraded materials. These risks are manageable through ventilation, permit-to-work systems, hazardous-material testing, PPE, Baku Metro Laboratory monitoring, and strict work supervision.

Table 37: Air Quality Residual Impacts

Phase	Potential impact	Impact significance before mitigation	Residual impact	Residual impact significance after mitigation
PC	Inadequate planning for air quality, ventilation and hazardous material risks	Low / Medium	Integration of mitigation requirements into design, procurement, and method statements will reduce planning-related risks.	Low
C	Dust from drilling, fixing, cable works and dismantling	Low	Dust will be temporary and localized; housekeeping, dust suppression and PPE will reduce residual impacts.	Low
C	Exhaust emissions from vehicles and equipment	Low	Emissions will be limited to service vehicles and equipment; maintenance and anti-idling controls will minimize impacts.	Low
C	Indoor air quality deterioration in tunnels and technical rooms	Medium	Ventilation, work permits, monitoring, PPE and emergency procedures will reduce impacts to acceptable levels.	Low / Medium
C	Vapors or odor from oil-filled equipment and contaminated materials	Medium	Sampling, controlled handling, spill prevention, licensed disposal and ventilation will reduce residual impacts.	Low / Medium
O	Routine indoor air quality risks during metro operation	Low	Routine ventilation, maintenance and Baku Metro Laboratory monitoring will maintain acceptable conditions.	Low
O	Improved operational efficiency and reduced indirect emissions	Positive	The project will support more efficient metro operations and improved public transport performance.	Positive

8.2.2 Hydrology

465. This section assesses the potential impacts of the Baku Metro Signaling Modernization and Operations Digitalization Project on surface water, groundwater, tunnel drainage systems, and related water management infrastructure during the implementation and operation phases. The structure follows the provided sample, which assesses surface water and groundwater impacts, identifies project activities with potential water-related risks, defines sensitivities, evaluates impact significance, and presents mitigation and residual impacts.

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466. The Baku Metro Project is not expected to result in significant adverse impacts on surface water or groundwater resources. The project is implemented within the existing Baku Metro operational footprint, including tunnels, stations, depots, substations, technical rooms, and control facilities. No new river crossings, in-stream works, major excavation works, or new surface infrastructure outside the existing metro system are planned. Therefore, potential impacts on hydrology are mainly related to localized risks within underground and technical areas, including groundwater inflow management, tunnel drainage, accidental spills, handling of oil-filled legacy equipment, and discharge of water collected in tunnels.
467. The existing baseline confirms that groundwater inflow into Baku Metro tunnels is a regular operational condition due to the hydrogeological setting of Baku and the Absheron Peninsula. Water enters tunnel structures through joints, cracks and surrounding soil layers and is managed through drainage channels and pumping systems, which collect infiltrated water and discharge it into the municipal sewer network. The project documentation also notes that inflow volumes may vary depending on station depth, geological conditions, and seasonal factors, with deeper stations and low-lying sections being more prone to groundwater interaction.

Potential Impacts on Groundwater and Tunnel Drainage Systems

468. The risk of surface water pollution is considered **low**, because the project does not include works in or near natural surface watercourses and is not expected to create new discharge points to rivers, lakes, canals, or the Caspian Sea. Surface activities will be limited mainly to depots, access points, technical buildings and transport of equipment or waste. Any surface runoff risks are therefore expected to be localized and manageable through standard housekeeping, spill prevention, and waste storage measures.
469. The risk of groundwater and tunnel drainage contamination is assessed as **low to medium** before mitigation. Potential impacts may arise if oils, lubricants, transformer fluids, contaminated sediment, cleaning water, or hazardous residues are released during equipment removal, dismantling, storage or transport. Particular attention is required for oil-filled choke-transformers and other legacy electrical equipment, because old insulating oil may leak during handling and may contain hazardous substances if not tested and managed properly. The project baseline identifies these oil-filled transformers as a key environmental risk due to their age, oil content, and possible PCB uncertainty.
470. Another potential impact is temporary disruption of tunnel drainage systems during installation or decommissioning works. Cable routing, equipment removal, storage of dismantled materials, or cleaning activities may block drainage channels or interfere with pumping systems if not properly managed. Any blockage of tunnel drainage could lead to local water accumulation, increased humidity, damage to electrical systems, slip hazards, or operational safety risks. For this reason, drainage protection must be treated as both an environmental and safety requirement.
471. Groundwater inflow itself is not caused by the project, as it is an existing operational condition of the Baku Metro system. However, the project may interact with groundwater management systems during works in wet tunnel areas, deep stations, technical rooms and drainage channels. Therefore, the objective of mitigation is to prevent deterioration of existing drainage performance, avoid contamination of collected groundwater, and ensure that pumped water continues to be safely discharged through approved routes.

Impact Summary and Assessment of Significance

472. **Table 38** provides an assessment of the significance of potential surface water, groundwater and tunnel drainage impacts before implementation of mitigation measures. The structure is aligned with the significance rating approach used in the provided sample.

Table 38: Potential Impacts on Surface Water, Groundwater and Tunnel Drainage

Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding legal	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
PC	Inadequate identification of groundwater, drainage and contamination risks in method statements	Tunnel drainage systems, workers, Baku Metro operations	M	M	L	M	MOD	ST	SMA	MED	POSS	M
C	Accidental contamination of tunnel drainage water from oils, lubricants or cleaning materials	Tunnel drainage system, municipal sewer, workers	M	M	L	M	MOD	ST	SMA	MED	POSS	M
C	Oil leakage during removal or storage of old oil-filled transformers	Drainage channels, groundwater, technical rooms, workers	M	H	M	H	MOD	ST	SMA	MED	POSS	M
C	Mobilization of contaminated sediment or residues during cable duct / drainage cleaning	Tunnel drainage system, workers	L	M	L	M	MOD	ST	SMA	MED	POSS	L/M
C	Temporary blockage or disruption of tunnel drainage channels	Tunnels, electrical systems, workers, passengers indirectly	M	H	M	M	MOD	ST	SMA	MED	POSS	M
C	Surface runoff or spill risk at depots, access areas and temporary storage points	Local drainage, nearby urban receptors	L	M	L	L	MIN	ST	SMA	LOW	POSS	L
O	Routine groundwater inflow and drainage management during operation	Tunnel drainage systems, workers, passengers, electrical systems	M	M	L	L	MIN	LT	SMA	LOW	POSS	L
O	Improved monitoring and reduced legacy contamination risk after modernization	Metro infrastructure, workers, drainage system	M	M	M	L	POS	LT	SMA	POS	DEF	POS

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Key: PC – Pre-construction; C – Construction / Implementation; O – Operation; H – High; M – Medium; L – Low; MAJ – Major; MOD – Moderate; MIN – Minor; ST – Short-term; LT – Long-term; SMA – Small; POSS – Possible; DEF – Definite; POS – Positive.

Mitigation and Management Measures

Pre-construction Phase

473. The following measures shall be implemented during the design and pre-construction phase to minimize interaction with groundwater and tunnel drainage systems:

- Identify all work areas where groundwater seepage, drainage channels, sumps, pumping systems or wet tunnel conditions are present;
- Prepare method statements for works in wet tunnels, drainage areas, transformer locations, cable ducts and technical rooms;
- Include drainage protection requirements in contractor work plans and permit-to-work systems;
- Prepare an inventory of oil-filled transformers and other equipment that may contain oils or hazardous substances;
- Carry out PCB and oil-quality testing before dismantling or draining old oil-filled equipment, where required;
- Identify temporary storage locations for dismantled equipment away from drainage channels, floor drains and seepage areas;
- Ensure that spill prevention, containment, and emergency response procedures are approved before decommissioning works begin;
- Confirm that no untreated water, contaminated wash water, oil residues or cleaning water will be discharged into drainage or sewer systems without appropriate control
- Ensure that the Baku Metro Laboratory monitoring programme is linked to project activities where water quality or hydrocarbon risks may arise.

Construction / Implementation Phase

474. The following mitigation measures shall be implemented during installation, testing, replacement, and decommissioning works:

- Maintain all existing tunnel drainage channels, sumps and pumping systems in operational condition during works;
- Do not store cables, dismantled equipment, waste, packaging, tools or construction materials in drainage channels or near sump inlets;
- Keep work areas clean and remove waste promptly to prevent blockage of drainage systems.
- Store oils, lubricants, solvents, cleaning agents and other liquids in sealed containers with secondary containment;
- Carry out refueling, oil transfer, draining or maintenance activities only in designated controlled areas with impermeable surfaces and spill kits;
- Use drip trays, absorbent pads and spill containment during removal or movement of oil-filled transformers and other oil-containing equipment;
- Prohibit washing of contaminated parts, oily equipment or tools in tunnel areas unless wastewater is collected and managed as potentially contaminated waste;
- Prevent discharge of oil, sediment, cleaning water, transformer oil, contaminated groundwater or sludge into tunnel drainage without prior assessment and approval;

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- Collect contaminated sediment, sludge, absorbents and oily residues separately and manage them as hazardous or special waste, as appropriate;
- Use licensed contractors for collection, transport and disposal of hazardous liquid waste, PCB-contaminated oil, oily sludge and contaminated absorbents;
- Ensure that all spill incidents are immediately contained, cleaned, recorded and reported to Baku Metro HSE management;
- Conduct toolbox talks for workers on protection of drainage systems, spill prevention, and response to unexpected groundwater or oil releases;
- Stop work if uncontrolled water inflow, oil leakage, strong odour, visible sheen, or contaminated drainage water is observed;
- Resume works only after the source of contamination or drainage risk has been identified and corrective actions have been implemented.

Operational Phase

475. During the operational phase, the project is expected to improve the environmental reliability of the metro system by replacing obsolete equipment, improving system control, and reducing the long-term risks associated with aging oil-filled and electrical infrastructure. No significant adverse impact on groundwater or surface water is expected during operation, provided that routine drainage management and maintenance procedures are continued.
476. The following operational measures shall be applied:
- Continue routine inspection and maintenance of tunnel drainage channels, sumps and pumping systems;
 - Maintain records of groundwater inflow, abnormal water accumulation and drainage incidents;
 - Continue monitoring by the Baku Metro Laboratory, including hydrocarbon checks where relevant;
 - Inspect technical rooms, transformer locations and cable ducts for signs of leakage, water ingress or contamination;
 - Maintain spill response materials at relevant depots, substations, technical rooms and maintenance areas;
 - Ensure that maintenance waste, oily residues and cleaning materials are not discharged into tunnel drainage systems;
 - Investigate any visible oil sheen, unusual odor or change in drainage water quality;
 - Maintain emergency procedures for tunnel flooding, pump failure, contaminated drainage water, and major spills.

Residual Impacts

477. With implementation of the proposed mitigation measures, potential impacts on groundwater, tunnel drainage and surface water are expected to remain localized, temporary, and manageable. The project will not create new surface water abstractions, river crossings, or direct discharges to natural water bodies. The main residual risk is associated with accidental contamination of tunnel drainage systems during dismantling of old oil-filled equipment and cleaning or removal of legacy materials.
478. Residual impacts after mitigation are expected to be Low for surface water and Low to Medium for groundwater and tunnel drainage during high-risk decommissioning activities. The low-to-

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medium residual rating is retained because the project involves old oil-filled equipment and works in wet underground environments, where strict procedures are necessary to prevent contamination (Table 39). During operation, residual impacts are expected to be **Low**, while the replacement of aging equipment and continued monitoring will provide long-term environmental benefits.

Table 39: Surface Water, Groundwater and Tunnel Drainage Residual Impacts

Phase	Potential impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
PC	Inadequate planning for groundwater, drainage and contamination risks	Medium	Integration of drainage protection, spill prevention, and hazardous-material controls into method statements will reduce planning-related risk.	Low
C	Accidental contamination of tunnel drainage water	Medium	Spill prevention, containment, housekeeping, and controlled waste management will reduce risk of contamination.	Low / Medium
C	Oil leakage during removal or storage of oil-filled transformers	Medium	PCB testing, controlled handling, drip trays, spill kits, sealed containers and licensed disposal will reduce impacts to acceptable levels.	Low / Medium
C	Mobilization of contaminated sediment or residues	Low / Medium	Controlled cleaning, segregation of sludge and residues, and licensed disposal will reduce residual impacts.	Low
C	Temporary blockage or disruption of drainage channels	Medium	Protection of drainage channels, daily inspections and rapid removal of obstructions will reduce the risk.	Low
C	Surface runoff or spill risk at depots and access points	Low	Good housekeeping, impermeable storage areas and spill control will minimize residual impacts.	Low
O	Routine groundwater inflow and drainage management	Low	Continued maintenance of drainage and pumping systems will maintain operational control.	Low
O	Reduction of legacy contamination risks after modernization	Positive	Replacement and controlled disposal of old equipment will reduce long-term contamination risks.	Positive

8.2.3 Soils, Geology and Geohazards

479. This section assesses potential impacts of the Baku Metro Signaling Modernization and Operations Digitalization Project on soils, geology and geohazards during the implementation and operation phases, and defines the associated mitigation and management measures. The

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structure follows the provided sample, which identifies project activities that may affect soils and geology, defines key sensitivities, assesses impact significance, and presents mitigation and residual impacts.

480. The Baku Metro Project differs from conventional construction projects because it is not expected to involve major earthworks, new land take, agricultural land disturbance, or construction of new surface infrastructure. The project activities are therefore expected to have limited interaction with natural soils. However, the project may interact with technogenic soils, ballast, tunnel floors, concrete surfaces, drainage channels, contaminated residues, and historically affected areas associated with old metro infrastructure and the broader industrial history of Baku.
481. The project will be implemented entirely within existing Baku Metro infrastructure and will not require acquisition of new land or disturbance of agricultural land. No stripping of natural topsoil is expected. Surface activities will be limited mainly to depots, workshops, substations, technical buildings, access points and temporary storage areas within existing operational facilities. Therefore, impacts such as topsoil loss, agricultural soil compaction, erosion of natural soils, and large-scale landform alteration are not expected.
482. Minor disturbances of existing surfaces may occur during installation works, including drilling, fixing of brackets, routing of cables, installation of cabinets, removal of old cable trays and cleaning of ducts. These activities may generate small quantities of dust, debris and disturbed material. As the works will be conducted in previously developed and enclosed areas, impacts will be localized and short-term.
483. The most important soil and contamination risk is associated with the decommissioning of old electrical and signaling equipment, particularly oil-filled choke-transformers and associated components. The existing project description identifies approximately 933 oil-filled choke-transformers installed along the metro track system, with oil volumes typically around 25–28 liters depending on type and manufacturer. These units may present risks of oil leakage, degraded insulating oil and possible PCB contamination, especially given the age of some equipment. If not properly managed, oil or contaminated residues may affect concrete surfaces, ballast, cable ducts, drainage channels, or localized materials requiring special handling.
484. Historical pollution is also relevant because the broader Baku and Absheron Peninsula area has been heavily influenced by industrial development and oil-related activities. Within the metro system, historical pollution may be associated with old electrical equipment, oil leakage, aged cable insulation, tunnel residues, drainage sediment and long-term operation of legacy systems. These conditions do not necessarily indicate widespread contamination in the project area, but they require a precautionary approach during dismantling, cleaning and material handling.
485. Geohazard risks are not expected to be generated by the project because no major excavation, tunnelling or new underground construction is planned. However, the project is implemented in existing underground infrastructure located within a geologically and seismically active region. Therefore, design and installation of new equipment, cabinets, cable trays, control systems and power supply interfaces must consider seismic stability, anchoring, vibration, moisture, groundwater seepage, and long-term durability. New installations must not compromise the structural integrity, drainage function, or emergency performance of existing tunnels and stations.

486. During operation, the project is expected to have a positive long-term effect by reducing the environmental risks associated with aging legacy systems. Replacement and proper management of old equipment will reduce the likelihood of future oil leakage, chronic contamination, cable degradation, and accumulation of obsolete materials. The modernized system will also improve maintenance planning, monitoring, and operational control.

Impact Summary and Assessment of Significance

487. **Table 40** provides an assessment of the significance of potential impacts to soils, geology and geohazards before implementation of the proposed mitigation measures. The assessment approach follows the format of the provided sample.

Table 40: Potential Impacts to Soils, Geology and Risks from Geohazards

Phase	Potential Impact	Receptors	No. of Receptors Affected	Sensitivity of Receptors	Level of Public Concern	Risk of Exceeding Legal	Magnitude	Timeframe	Spatial Scale	Consequence	Probability	Significance
PC	Inadequate identification of contaminated materials, legacy equipment and geotechnical constraints	Workers, Baku Metro infrastructure, drainage systems	M	M	L	M	MOD	ST	SMA	MED	POSS	M
C	Minor disturbance of existing tunnel floors, cable ducts and technical-room surfaces	Workers, tunnel infrastructure	L	L	L	L	MIN	ST	SMA	LOW	POSS	L
C	Accidental oil leakage from old oil-filled equipment during handling or removal	Concrete surfaces, ballast, drainage channels, workers	M	M	M	M	MOD	ST	SMA	MED	POSS	M
C	Mobilization of contaminated dust, sediment or residues during cable / equipment removal	Workers, tunnel environment, drainage systems	L/M	M	L	M	MOD	ST	SMA	MED	POSS	M
C	Temporary contamination at storage or loading areas	Depot surfaces, technical yards, drainage points	L	M	L	M	MOD	ST	SMA	MED	POSS	L/M
C	Soil compaction or disturbance at depots / access areas	Existing paved or developed surfaces	L	L	L	L	MIN	ST	SMA	LOW	POSS	L

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Phase	Potential Impact	Receptors	No. of Receptors Affected	Sensitivity of Receptors	Level of Public Concern	Risk of Exceeding Legal	Magnitude	Timeframe	Spatial Scale	Consequence	Probability	Significance
O	Long-term geohazard and seismic risk to installed equipment	Metro infrastructure, passengers, workers	M	H	M	M	MOD	LT	SMA	MED	POSS	M
O	Reduction of future contamination risks through replacement of old equipment	Metro infrastructure, workers, drainage systems	M	M	M	L	POS	LT	SMA	POS	DEF	POS

Key: PC – Pre-construction; C – Construction / Implementation; O – Operation; H – High; M – Medium; L – Low; MAJ – Major; MOD – Moderate; MIN – Minor; ST – Short-term; LT – Long-term; SMA – Small; MED – Medium; POSS – Possible; DEF – Definite; POS – Positive.

Mitigation and Management Measures

Design / Pre-construction Phase

488. The following measures shall be implemented during the design and pre-construction phase:

- Confirm that all project works remain within existing Baku Metro infrastructure, depots, technical rooms, tunnels and stations;
- Prepare a detailed inventory of legacy equipment to be removed, including oil-filled choke-transformers, cables, junction boxes, switch machines, tunnel telephones and relay equipment;
- Identify equipment and locations with potential contamination risks, including oil leakage, degraded insulation, residues in cable ducts and drainage sediment;
- Conduct oil sampling and PCB testing for oil-filled equipment where required before dismantling, draining, transport or disposal;
- Prepare method statements for dismantling works in areas with possible contamination, groundwater seepage, drainage channels or confined underground condition;
- Ensure that all new equipment supports, cabinets, cable trays and fixings are designed for relevant vibration and seismic conditions;
- Avoid any design or installation solution that blocks existing drainage channels, sump access, inspection points or emergency routes;
- Define temporary storage areas for dismantled equipment on impermeable surfaces, away from drainage inlets and groundwater seepage zones;
- Include soil, contamination, hazardous-material, and geohazard requirements in contractor EMP, OHS Plan and waste management procedures.

Construction / Implementation Phase

489. The following measures shall be implemented during construction, installation and decommissioning activities:

- Limit all physical disturbance to the minimum area required for installation, cable routing, testing and dismantling;
- Avoid unnecessary breaking, cutting or disturbance of existing concrete floors, tunnel linings, ballast or cable ducts;
- Keep work areas clean and remove debris, dust, obsolete equipment and dismantled materials promptly;
- Use drip trays, absorbent materials and spill kits during handling of oil-filled equipment;
- Do not place oil-filled equipment, oily materials, contaminated parts or waste directly on unprotected surfaces;
- Store fuels, oils, lubricants, solvents and chemicals on impermeable surfaces with secondary containment;
- Prohibit refueling, draining of oil, equipment maintenance or chemical handling directly on soil, ballast or unprotected concrete surfaces;
- Segregate potentially contaminated materials, cable insulation, oily residues, sludge and absorbents from general waste;
- Manage contaminated materials, oily waste, PCB-contaminated oil and hazardous residues through licensed contractors;
- If contaminated material is discovered, stop work in the affected area, isolate the material, notify Baku Metro HSE management and define disposal requirements;
- Restore any disturbed surfaces, technical rooms or depot areas after completion of works;
- Maintain records of all contaminated materials removed, including quantities, classification, transport and disposal destination;
- Maintain access to drainage channels, pumps and inspection points throughout works;
- Conduct toolbox talks for workers on spill prevention, contamination recognition, safe handling of old equipment and reporting procedures.

Operational Phase

490. During the operational phase, no significant adverse impacts on soils or geology are expected. The project will not involve routine soil disturbance and is expected to reduce long-term contamination risks through the replacement and controlled disposal of old equipment. The following measures shall be maintained during operation:

- Inspect technical rooms, transformer areas, tunnels and depots for oil leakage, residue accumulation or damaged cable insulation;
- Maintain records of maintenance waste, oily residues, e-waste and removed components;
- Continue routine monitoring and inspections by Baku Metro HSE staff and the Baku Metro Laboratory where relevant;
- Ensure that new equipment anchoring, supports and cable trays remain stable under vibration and seismic conditions;
- Maintain emergency procedures for oil spills, tunnel flooding, fire, equipment failure and discovery of contaminated material;
- Ensure future repair works follow the same contamination-control and geohazard-safety procedures.

Residual Impacts

491. With implementation of the proposed mitigation measures, residual impacts on soils and geology are expected to be **Low** for most project activities. The project does not involve significant soil excavation, topsoil stripping, agricultural land disturbance or new land take. Residual risks are mainly associated with the handling of legacy equipment, potential oil contamination, old cable materials and localized contaminated residues in tunnel or technical areas.
492. Residual impacts related to oil-filled equipment and potentially contaminated materials are assessed as **Low to Medium** because the risk depends on the condition of the equipment, the presence or absence of PCBs, and the effectiveness of handling and disposal procedures (Table 41). These risks can be reduced to acceptable levels through testing, controlled removal, secondary containment, waste segregation, licensed disposal and proper documentation.

Table 41: Soils, Geology and Geohazards Residual Impacts

Phase	Potential Impact	Potential Impact Significance before Mitigation	Residual Impact	Residual Impact Significance after Mitigation
PC	Inadequate identification of contamination and geohazard risks	Medium	Design review, inventory, hazardous-material screening and method statements will reduce planning-related risks.	Low
C	Minor disturbance of tunnel floors, cable ducts and technical areas	Low	Disturbance will be localized and limited to existing developed surfaces.	Low
C	Oil leakage from old oil-filled equipment	Medium	PCB/oil testing, drip trays, containment, spill response and licensed disposal will reduce risk.	Low / Medium
C	Mobilization of contaminated dust, sediment or residues	Medium	Controlled cleaning, PPE, segregation and disposal of contaminated materials will reduce impacts.	Low
C	Temporary contamination at storage or loading areas	Low / Medium	Impermeable storage surfaces, labeling, containment, and waste tracking will minimize residual risk.	Low
C	Soil compaction or surface disturbance at depots/access areas	Low	Works will occur mainly on existing paved or developed surfaces; no productive soils will be affected.	Low
O	Geohazard / seismic risk to installed equipment	Medium	Design according to relevant seismic and structural requirements will reduce operational risk.	Low
O	Reduction of future contamination risk	Positive	Removal and proper management of old equipment will reduce long-term contamination risk.	Positive

493. In conclusion, the Baku Metro Project is not expected to cause significant adverse impacts on soils, geology or land resources. The main issue requiring management is not natural soil

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disturbance, but the potential for localized contamination associated with old oil-filled equipment, degraded materials, cable ducts, drainage areas and historical residues within the existing metro environment. With proper hazardous-material screening, controlled dismantling, licensed waste handling, spill prevention and seismic-resilient installation of new equipment, residual impacts are expected to remain low and manageable.

8.3 Ecological Resources

8.3.1 Flora, Fauna and Habitat

494. This section assesses the potential impacts of the Baku Metro Signaling Modernization and Operations Digitalization Project on flora, fauna, habitats and protected areas during the implementation and operation phases, and defines the mitigation and management measures to be applied. The structure follows the provided sample, which assesses biodiversity impacts by identifying project activities, sensitive receptors, potential impacts, significance, mitigation measures, and residual impacts.
495. The project does not involve construction in natural or semi-natural habitats, expansion into undeveloped land, vegetation clearance of ecological significance, works in protected areas, or modification of riverbeds, wetlands or coastal habitats. Therefore, the overall biodiversity sensitivity of the project footprint is considered low.
496. The existing baseline confirms that the project area is located in the highly urbanized environment of Baku and is confined to existing metro infrastructure. No natural habitats or ecologically sensitive areas are located within the direct project footprint. Fauna likely to occur within the project area is limited to urban-adapted and disturbance-tolerant species, including rodents, insects and occasional common urban birds around above-ground facilities, depots and station areas. Bat presence is considered unlikely in active metro tunnels due to continuous noise, vibration, lighting and human presence, although occasional transient use of low-disturbance technical cavities cannot be fully excluded.
497. Given the urban, underground and existing-infrastructure nature of the project, no significant adverse impacts on flora, fauna, habitats or protected areas are anticipated during the implementation phase. Works will be confined to existing stations, tunnels, depots and technical facilities, where natural vegetation is absent or limited to low-value ornamental or ruderal vegetation around above-ground facilities. No clearance of natural vegetation or habitat conversion is expected.
498. Temporary disturbance to urban-adapted fauna may occur during installation and decommissioning works. This may include disturbance to rodents, insects or common birds due to increased lighting, noise, vibration, human presence, cleaning, removal of old equipment, waste handling, or works in technical rooms and drainage areas. Such impacts are expected to be localized, temporary, and reversible.
499. Indirect biodiversity risks may arise if waste, oils, lubricants, contaminated residues or hazardous materials are improperly managed. This is particularly relevant during decommissioning of old oil-filled equipment, including choke-transformers, and during cleaning of cable ducts or drainage-adjacent areas. Poor housekeeping may also attract rodents or nuisance species to work areas, depots or temporary storage locations.

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500. The project is not expected to affect protected areas. The nearest protected areas are located outside the project footprint and beyond the likely influence area for dust, noise, vibration, wastewater discharge, spoil handling, traffic disturbance or operational emissions. Therefore, no direct, indirect or cumulative impacts on protected areas are anticipated during either implementation or operation, provided that all works and ancillary facilities remain within the approved Baku Metro infrastructure footprint.
501. During operation, the modernized signaling and digital systems are not expected to create new biodiversity risks. On the contrary, improved maintenance planning, replacement of old equipment, better system control and reduced legacy contamination risks may provide a minor positive environmental benefit. Routine operational risks will remain limited to pest management, housekeeping, waste management, drainage maintenance and prevention of oil or chemical releases.

Impact Summary and Assessment of Significance

502. **Table 42** provides an assessment of the significance of potential biodiversity impacts before implementation of mitigation measures. The structure is aligned with the provided sample biodiversity impact table.

Table 42: Potential Impacts to Flora, Fauna, Habitat and Protected Areas

Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding legal	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
C	Disturbance of urban-adapted fauna in tunnels, depots and technical rooms	Rodents, insects, common urban fauna	L	L	L	L	MIN	ST	SMALL	LOW	POSS	L
C	Minor disturbance of ruderal or ornamental vegetation around depots or above-ground facilities	Low-value urban vegetation	L	L	L	L	MIN	ST	SMALL	LOW	POSS	L
C	Indirect impact from poor waste management attracting rodents or nuisance species	Workers, urban fauna, station environments	L	L	L	L	MIN	ST	SMALL	LOW	POSS	L
C	Indirect contamination risk from spills entering drainage pathways	Urban fauna, drainage systems	L	M	L	M	MOD	ST	SMALL	MED	POSS	L
C/O	Impacts on protected areas	Designated sites near Baku	L	H	M	L	MIN	LT	SMALL	LOW	UN	L

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Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding legal	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
O	Routine disturbance from maintenance activities	Urban-adapted fauna	L	L	L	L	MIN	ST	SMALL	LOW	POSS	L
O	Reduced long-term contamination risk after removal of old equipment	Urban environment, drainage systems	M	M	M	L	POS	LT	SMALL	POS	DEF	POS

Key: C – Construction / Implementation; O – Operation; H – High; M – Medium; L – Low; MOD – Moderate; MIN – Minor; ST – Short-term; LT – Long-term; SMALL – limited to project work areas; POSS – Possible; UN – Unlikely; DEF – Definite; POS – Positive.

Mitigation and Management Measures

503. As the project is located entirely within existing urban and underground metro infrastructure, mitigation shall focus on avoidance, good housekeeping, prevention of indirect contamination, pest control, and ensuring that project activities do not extend into protected or ecologically sensitive areas.

Construction / Implementation Phase Mitigation Measures:

- All project activities shall be confined to existing Baku Metro tunnels, stations, depots, technical rooms, control facilities and approved access areas;
- No works shall be carried out in protected areas, natural habitats, semi-natural habitats, coastal habitats, wetlands, riverbeds or areas outside approved project facilities;
- No vegetation clearance shall be undertaken unless technically unavoidable and approved by Baku Metro; any vegetation affected shall be limited to low-value ornamental or ruderal vegetation around existing facilities;
- Work areas shall be kept clean to avoid attracting rodents, insects, stray animals or nuisance species;
- Food waste shall be collected in closed containers and removed regularly from work areas, depots and temporary storage locations;
- Waste shall not be dumped in tunnels, drainage channels, shafts, depots, station yards or adjacent urban areas;
- If bats, nesting birds or other fauna are discovered in technical cavities, low-disturbance rooms or above-ground structures, works shall stop in the immediate area and Baku Metro HSE staff shall determine an appropriate action before works resume;

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- Workers shall be instructed not to harm animals, disturb nests, collect wildlife, or block access points used by fauna unless required for hygiene or safety reasons and approved by responsible staff;
- Spill prevention measures shall be implemented during handling of oils, lubricants, transformers, batteries, solvents and hazardous materials to prevent indirect contamination of drainage systems;
- Dismantled materials, oily equipment and contaminated residues shall be stored on impermeable surfaces and protected from contact with drainage channels;
- Any contaminated sediment, oily residue or waste discovered in drainage areas shall be segregated and managed through approved waste procedures
- Pest control, where required, shall be carried out using safe and controlled methods and shall avoid unnecessary use of hazardous chemicals.

Operation Phase Mitigation Measures:

- Routine maintenance shall remain within the established Baku Metro infrastructure footprint;
- No expansion of operational facilities into natural or protected areas shall occur without separate environmental screening and approval;
- Drainage channels and technical rooms shall be regularly inspected to prevent accumulation of waste, organic material, oily residues or contaminated sediment; Good housekeeping shall be maintained in stations, depots, tunnels, technical rooms and storage areas to avoid attracting rodents and nuisance species;
- Waste generated during maintenance shall be collected, segregated and removed to approved facilities;
- Oil leaks, chemical spills or contaminated residues shall be cleaned immediately to avoid indirect impacts on drainage systems and urban fauna.

Residual Impacts

504. With implementation of the mitigation measures described above, residual biodiversity impacts are expected to remain Low.
505. The project will not affect natural habitats, protected areas, important bird areas, wetlands, rivers, or ecologically valuable vegetation. Temporary disturbance to urban-adapted fauna may occur, but such disturbance will be localized, short-term and reversible (**Table 43**).
506. The main residual risk is indirect and relates to poor housekeeping, waste management, pest attraction, and accidental contamination of drainage pathways. These risks can be effectively controlled through standard environmental management measures, including waste segregation, spill prevention, good housekeeping, drainage protection and routine inspections.

Table 43: Biodiversity Residual Impacts

Phase	Potential impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
C	Disturbance of urban-adapted fauna	Low	Temporary disturbance may occur in tunnels, depots or technical rooms, but no significant residual impact is anticipated.	Low
C	Minor disturbance of ruderal or ornamental vegetation	Low	Any vegetation disturbance will be limited to low-value urban vegetation and will not affect biodiversity value.	Low
C	Poor waste management attracting rodents or nuisance species	Low	Good housekeeping and waste control will reduce the risk of pest attraction.	Low
C	Indirect contamination of drainage pathways affecting urban fauna	Low	Spill prevention, drainage protection and proper hazardous-material management will reduce residual impacts.	Low
C/O	Impacts on protected areas	Low	Works will remain within the existing metro footprint; no residual impacts on protected areas are expected.	Low
O	Routine maintenance disturbance	Low	Maintenance will remain within existing infrastructure and will not affect natural habitats.	Low
O	Reduced long-term contamination risk	Positive	Replacement and controlled disposal of old equipment will reduce potential contamination risks over time.	Positive

507. In conclusion, the Baku Metro Project is not expected to result in significant adverse biodiversity impacts. The project is located within a highly urbanized and underground environment, where biodiversity value is low and sensitive habitats are absent. Provided that works remain within the approved metro footprint and standard measures for housekeeping, waste management, spill prevention and drainage protection are applied, residual impacts on flora, fauna, habitats and protected areas will remain low and manageable.

8.4 Socio-Economic Environment

8.4.1 Waste Management

8.4.1.1 Introduction

508. This section assesses the types of waste expected to be generated during the implementation and operation of the Baku Metro Signaling Modernization and Operations Digitalization Project, defines the approximate quantities of waste by project stage, identifies appropriate collection and disposal methods, and presents mitigation and residual impact levels. The assessment is based on the project description, which identifies three main implementation phases: Phase 1 – Signaling Modernization and Operations Digitalization, Phase 2 – Stabilization and Parallel Operation, and Phase 3 – Decommissioning of the Existing System.
509. Waste management is one of the most important environmental issues for this project because the works include replacement and decommissioning of legacy signaling, communication, electrical and control equipment within an operating underground metro system. While the project does not involve major civil works, excavation, or large-scale construction waste generation, it will produce different categories of waste, including electrical and electronic waste, scrap metals, old cables, packaging materials, oily residues, absorbents, lubricants, contaminated materials, and potentially hazardous waste associated with old oil-filled transformers.
510. The highest waste-related risk is expected during Phase 3 – Decommissioning of the Existing System, when the legacy signaling infrastructure will be physically removed. The project baseline identifies approximately 933 oil-filled choke-transformers installed along the metro track system, as well as switch machines, control boxes, tunnel telephones, relay equipment, cables and other auxiliary electrical and communication equipment. These materials require careful inventory, segregation, testing, collection, temporary storage, transport and final disposal or recycling.

8.4.1.2 Project Activities with Potential to Generate Waste

511. The following project activities are expected to generate waste during the implementation and operation phases (**Table 44**).

Table 44: Main flows of expected revenues at different stages of project implementation

No.	Project phase / activity	Main waste-generating activity
1	Design finalization and planning	Limited office waste, printed documents, packaging from samples or survey equipment
2	Procurement and Factory Acceptance Testing	Packaging materials from equipment delivery; non-compliant or damaged components if any
3	Installation of wayside and infrastructure equipment	Cable offcuts, packaging, fixing materials, small electrical parts, drilling dust and minor debris
4	Installation of onboard equipment	Old onboard units, wiring, small electronic parts, packaging and workshop waste
5	System integration, testing and commissioning	Minor equipment waste, temporary test materials, packaging and defective components

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No.	Project phase / activity	Main waste-generating activity
6	Stabilization and parallel operation	Minor maintenance waste, replacement parts and consumables
7	System deactivation and pilot decommissioning	Removed relay components, cable sections, control units, switchgear elements and e-waste
8	Full decommissioning	Large quantities of obsolete electrical and signaling equipment, cables, transformers, metals, oils and potentially hazardous waste
9	Material management	Sorting, packaging, labelling, temporary storage, recycling and disposal of removed materials
10	Operation and maintenance	Routine maintenance waste, e-waste, filters, lamps, batteries, oils, absorbents and packaging

8.4.1.3 Approximate Waste Quantities and Collection Methods

512. Exact quantities will be confirmed after the detailed inventory of legacy equipment is completed. The quantities below are indicative and should be used for planning purposes only. They are based on the identified equipment types (Table 45) and the expected scale of replacement and decommissioning across the Baku Metro network.

Table 45: Indicative Waste Types, Approximate Quantities and Collection Methods by Project Stage

Project stage	Waste type	Approximate quantity	Collection method	Preferred management route
Phase 1: Design finalization and planning	Office waste, paper, packaging	Minor, less than 0.5 t	Office bins / separate paper collection	Municipal collection / recycling
Phase 1: Procurement and delivery	Cardboard, wooden pallets, plastic wrapping, foam packaging	Approx. 5–15 t over the phase	Separate labelled containers at depots / storage areas	Reuse, recycling, municipal disposal
Phase 1: Wayside equipment installation	Cable offcuts, small fixings, brackets, drilling dust, damaged trays	Approx. 5–20 t	Work-area containers; daily removal from tunnels and stations	Metal recycling; non-hazardous disposal
Phase 1: Onboard equipment installation	Removed small onboard devices, wiring, packaging	Approx. 2–10 t	Depot-based segregation bins; e-waste containers	E-waste recycling / licensed disposal
Phase 1: SAT, pilot operation and rollout	Defective components, test materials, minor e-waste	Approx. 1–5 t	Dedicated e-waste boxes and supplier take-back where available	Return to supplier / licensed e-waste handler
Phase 2: Stabilization and parallel operation	Minor maintenance waste, replaced parts, consumables	Approx. 1–3 t	Existing Baku Metro maintenance waste system	Recycling / licensed disposal
Phase 3: System deactivation	Relay modules, signal components, obsolete panels	Approx. 10–30 t	Labelled containers; inventory-based collection	Reuse if serviceable; scrap / e-waste management
Phase 3: Pilot decommissioning	Old cables, control boxes, relays, small oil	Approx. 5–20 t	Segregated containers; hazardous waste boxes where needed	Recycling / licensed hazardous waste disposal

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Project stage	Waste type	Approximate quantity	Collection method	Preferred management route
	contaminated items if present			
Phase 3: Full decommissioning	Oil-filled choke-transformers	Approx. 933 units; estimated oil volume approx. 23–26 m ³ total, assuming 25–28 L per unit	Individually labelled; sealed; placed on drip trays or in bunded areas	PCB testing; reuse only if permitted; licensed hazardous waste / recycling
Phase 3: Full decommissioning	Scrap metal from cabinets, frames, supports, switch machines and housings	Approx. 50–150 t	Metal skips or containers; separation by metal type where feasible	Scrap metal recycling
Phase 3: Full decommissioning	Cable waste, including copper / aluminum conductors and insulation	Approx. 50–200 t	Cable drums, pallets or covered containers; separate from oily waste	Cable recycling by licensed facility
Phase 3: Full decommissioning	E-waste from control boxes, relays, tunnel telephones, electronic modules	Approx. 10–50 t	Dedicated e-waste containers; protected from rain and damage	Licensed e-waste recycling / disposal
Phase 3: Full decommissioning	Used oil, oily residues, absorbents, contaminated rags and PPE	Approx. 1–5 t, excluding transformer oil	Sealed drums / hazardous waste containers	Licensed hazardous waste treatment / disposal
Phase 3: Full decommissioning	Contaminated sediment, sludge or residues from cable ducts / drainage areas	Unknown; expected localized	Sealed containers after inspection / sampling	Testing and licensed disposal if contaminated
Operation	Routine maintenance waste, e-waste, lamps, batteries, packaging, used PPE	Approx. 1–5 t/year depending on maintenance intensity	Existing maintenance waste system with additional segregation	Recycling / licensed disposal

513. The estimated transformer oil quantity is indicative. If all 933 choke-transformers contain approximately 25–28 liters of oil, the total oil inventory may be approximately 23,000–26,000 **liters**. This does not mean that all oil will become waste, but the entire volume must be treated as potentially hazardous until tested and classified. Any PCB-positive oil, or equipment contaminated with PCB oil, must be managed as hazardous waste in accordance with national requirements and international good practice.

8.4.1.5 Waste Collection, Segregation and Temporary Storage Approach

514. Waste generated during the Baku Metro Signaling Modernization and Operations Digitalization Project shall be collected and managed in a controlled manner, with strict separation of waste streams from the point of generation. No temporary storage of waste shall be carried out inside tunnels, station platforms, technical passages, escape routes, drainage channels, cable ducts, shafts, or any other underground operational areas. Waste generated during installation, dismantling, testing, maintenance, or decommissioning works shall be collected immediately at the work location, packed or containerized according to its type, and removed from the tunnel environment during the same work shift. This approach is necessary to avoid obstruction

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of access routes, interference with drainage systems, increased fire load, pest attraction, worker exposure, or risk to metro operations.

515. All waste generated in tunnels, stations, technical rooms, and other underground work areas shall be transported to designated depot-based temporary storage areas. Depending on the quantity and type of waste, transportation from the work area to the depot shall be carried out by rail during the permitted night working window, from 1:30 AM to 5:30 AM, when passenger operations are suspended or limited and safe work access can be ensured. Waste shall be loaded, secured, and transported in a manner that prevents spillage, leakage, dust generation, falling objects, or damage to metro infrastructure. Waste transport routes, loading points, rolling stock or service vehicles, responsible personnel, and emergency response arrangements shall be defined in advance in the contractor's method statement and approved by Baku Metro.
516. Hazardous and non-hazardous waste shall not be mixed under any circumstances. Separate collection shall be provided for general non-hazardous waste, scrap metal, cable waste, electrical and electronic waste, packaging waste, oil-contaminated materials, used absorbents, batteries, lamps, used oils, liquid waste, PCB-suspected equipment, and other hazardous waste streams. Each waste container shall be clearly labelled to indicate the waste type, source location, date of generation, responsible contractor, and hazard classification where applicable. Waste suspected of containing hazardous substances, including oil-filled transformers or equipment potentially contaminated with PCBs, shall be treated as hazardous until testing and classification confirm otherwise.
517. Liquid waste, including used oils, transformer oil, oily water, solvents, cleaning liquids, contaminated drainage residues, and any other liquid hazardous or potentially hazardous waste, shall be stored only in closed, leak-proof containers placed within secondary containment. The capacity of the secondary containment shall be at least 110% of the volume of the liquid waste container placed inside it. Where several containers are stored together, the containment volume shall be calculated to safely retain the largest container volume or the required combined volume, depending on applicable safety requirements. Liquid waste storage areas shall be located on impermeable surfaces, protected from rainwater entry, away from drainage channels, sump pits, sewer inlets, pedestrian routes, ignition sources, and areas with risk of mechanical damage.
518. Temporary storage of waste at the depot shall be organized in designated and clearly demarcated areas only. These areas shall be secure, access-controlled, ventilated where necessary, protected from weather conditions, and equipped with spill kits, firefighting equipment, warning signage, impermeable flooring, and secondary containment for hazardous and liquid wastes. Waste shall not be stored directly on soil or unprotected surfaces. Scrap metal, cable waste, e-waste, hazardous waste, and general waste shall be stored separately. Storage duration shall be minimized, and accumulated waste shall be removed regularly to prevent excessive stockpiling, fire risk, odor, contamination, or operational inconvenience.
519. During transportation and temporary storage, all waste shall be handled in accordance with documented procedures. Waste shall be packed in suitable containers, drums, crates, bags, pallets, or skips depending on its physical form and hazard classification. Sharp metal parts, cable ends, broken electrical components, oily equipment, and contaminated materials shall be secured to prevent injury, leakage, or release of residues. Loading and unloading shall be supervised by trained personnel, and workers shall use appropriate PPE, including gloves, protective footwear, eye protection, respiratory protection where needed, and task-specific

safety equipment. Any spill, leakage, container damage, mislabeling, or incorrect segregation shall be immediately reported and corrected.

520. A waste tracking system shall be maintained for all significant waste streams. The records shall include the waste type, estimated quantity, source location, date of generation, temporary storage location, transport method, responsible contractor, final receiving organization, and disposal or recycling certificate. Hazardous waste, e-waste, oil waste, PCB-suspected materials, batteries, lamps, contaminated absorbents, and oily residues shall be subject to stricter chain-of-custody control. No waste shall be removed from the depot without proper documentation, approval, and confirmation that the receiving organization is authorized to handle the relevant waste type.
521. Final waste management shall be carried out only by certified, licensed, or otherwise legally authorized organizations. The contractor shall not dispose of waste through informal recyclers, unauthorized dumpsites, municipal bins not approved for the waste type, uncontrolled landfills, or direct discharge to drains or sewer systems. Certified organizations shall be used for recycling, treatment, neutralization, hazardous waste handling, PCB-contaminated waste management, used oil management, e-waste processing, and final disposal. Copies of licenses, contracts, waste transfer notes, recycling certificates, and disposal certificates shall be retained by the contractor and submitted to Baku Metro as part of environmental monitoring and compliance reporting.

8.3.1.6 Potential Impacts

522. The main potential impacts from waste generation and management include: uncontrolled accumulation of waste in tunnels and stations; obstruction of drainage channels and emergency access; contamination from oil-filled equipment; mixing of hazardous and non-hazardous waste; improper disposal of e-waste; exposure of workers to contaminated materials; illegal dumping by subcontractors; and failure to document the final destination of waste.
523. During Phase 1, waste-related impacts are expected to be minor and localized, mainly involving packaging, cable offcuts, small electrical components and minor installation debris. During Phase 2, waste generation will be limited to maintenance and adjustment activities. During Phase 3, waste-related impacts increase significantly because of the removal of legacy systems, including oil-filled transformers, cables, electrical panels, relays and possible contaminated residues.
524. The most significant waste-related risk is associated with old oil-filled equipment and possible PCB contamination. If PCB testing is not carried out, or if PCB-positive materials are mixed with ordinary scrap or oil waste, this could result in serious regulatory, environmental and occupational health risks. Therefore, all oil-filled equipment must be inventoried, labelled, tested where required, and managed under a strict chain-of-custody system (**Table 47**).

Table 46: Potential Waste Management Impacts

Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding legal	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
PC	Inadequate waste inventory and failure to identify hazardous materials	Workers, Baku Metro, waste handlers, environment	M	M	M	H	MOD	ST	SMA	MED	POSS	M
C	Poor housekeeping and accumulation of general waste in tunnels / technical rooms	Workers, passengers indirectly, metro operations	L	M	L	L	MIN	ST	SMA	LOW	POSS	L
C	Improper collection of cable waste, scrap metal and e-waste	Workers, waste handlers, recycling facilities	M	M	L	M	MOD	ST	SMA	MED	POSS	M
C	Oil leakage during handling of oil-filled transformers	Workers, drainage systems, tunnel surfaces	M	H	M	H	MOD	ST	SMA	MED	POSS	M/H
C	Improper management of PCB-contaminated or suspected PCB waste	Workers, public health, environment, disposal facilities	M	H	H	H	MAJ	MT	INT	HIGH	POSS	H
C	Obstruction of drainage channels or emergency access by stored waste	Workers, metro operations, passengers indirectly	L/M	H	M	M	MOD	ST	SMA	MED	POSS	M
C	Illegal dumping or disposal by unlicensed contractors	Environment, communities, regulatory authorities	M	M	M	H	MOD	MT	INT	MED	POSS	M
O	Routine maintenance waste not properly segregated	Workers, Baku Metro facilities	L	M	L	M	MIN	LT	SMA	LOW	POSS	L
O	Reduced long-term hazardous legacy waste risk after modernization	Workers, Baku Metro, environment	M	M	M	L	POS	LT	SMA	POS	DEF	POS

Key: PC – Pre-construction; C – Construction / Implementation; O – Operation; H – High; M – Medium; L – Low; MAJ – Major; MOD – Moderate; MIN – Minor; ST – Short-term; MT – Medium-term; LT – Long-term; SMA – Small; INT – Intermediate; POSS – Possible; DEF – Definite; POS – Positive.

8.3.1.8 Mitigation and Management Measures

Design / Pre-construction Phase

525. Before physical works begin, the following waste management measures shall be implemented:

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- Prepare a project-specific Waste Management Plan covering all three phases of the project;
- Prepare a detailed inventory of all equipment to be removed, including transformers, cables, switch machines, control boxes, relay systems, tunnel telephones and onboard units;
- Classify expected waste streams as reusable, recyclable, non-hazardous, e-waste, hazardous, PCB-suspected or PCB-confirmed;
- Identify all oil-filled equipment and define sampling and PCB testing requirements before removal, draining or disposal;
- Identify approved temporary waste storage areas within depots or technical facilities, preferably on impermeable surfaces and away from drainage points;
- Identify licensed waste transporters, recycling facilities and hazardous waste disposal facilities before waste generation begins;
- Include waste management obligations in contractor and subcontractor contracts;
- Prepare waste tracking forms, chain-of-custody templates and disposal certificate requirements;
- Train workers on waste segregation, hazardous waste recognition, PCB precautions, spill prevention and emergency response.

Construction / Implementation Phase

526. During installation, testing, commissioning and decommissioning activities, the following measures shall be implemented:

- Segregate waste at source and do not mix hazardous and non-hazardous waste;
- Remove waste from tunnels, platforms, technical rooms and access areas at the end of each work shift;
- Keep all work areas free of loose cables, packaging, debris and dismantled materials that may obstruct access or drainage;
- Store scrap metal, cable waste and e-waste in separate labelled containers;
- Store oil-filled equipment and oily materials on impermeable surfaces with secondary containment
- Use drip trays and absorbent materials during handling or temporary storage of oil-filled equipment;
- Do not cut, drain or dismantle oil-filled transformers before classification and approval of the handling method;
- Treat all old transformer oil as potentially hazardous until laboratory testing confirms otherwise;
- Treat PCB-suspected and PCB-confirmed waste as hazardous waste and keep it isolated from other waste streams;
- Prohibit open burning of waste, including cable insulation, packaging, plastics, rags or oily materials;
- Prohibit disposal of waste into tunnels, drainage channels, shafts, station areas, vacant land or municipal bins not approved for that waste type;
- Use licensed contractors for hazardous waste, e-waste and PCB-contaminated waste transport and disposal;
- Maintain waste logs showing type, quantity, source, storage location, transporter and final destination;
- Obtain disposal certificates and recycling records for all significant waste streams;

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- Investigate and report all spills, waste mismanagement incidents, illegal dumping or loss of waste traceability.

Operation Phase

527. During operation, routine maintenance waste shall continue to be managed under Baku Metro procedures, strengthened by project-specific lessons learned. The following measures shall be maintained:

- Maintain segregation of routine maintenance waste, including e-waste, metals, cables, oils, batteries and lamps;
- Continue safe storage and disposal of used oils, oily absorbents, filters and contaminated materials;
- Maintain records of waste generated during maintenance and repair works;
- Ensure that no waste is stored in drainage channels, tunnels, escape routes or technical access areas;
- Use licensed waste contractors for hazardous waste and e-waste;
- Continue periodic inspection of technical areas for obsolete materials or uncontrolled waste accumulation;
- Review waste management performance annually and update procedures where necessary

8.3.1.10 Residual Impacts

528. With implementation of the proposed mitigation measures, most waste management impacts are expected to be reduced to **Low** or Low / Medium significance. The project will generate manageable waste streams during installation and operation, and most materials such as metals and cables can be reused or recycled if properly segregated.

529. The main residual risk remains associated with old oil-filled transformers and potential PCB contamination. Because PCB status will only be confirmed through testing, the residual impact is assessed as **Low / Medium** after mitigation, provided that all oil-filled equipment is inventoried, labelled, tested, stored on impermeable surfaces, and managed through licensed hazardous waste contractors (**Table 47**). If PCB contamination is confirmed, the affected waste must be managed under stricter hazardous waste procedures and exported or treated only through legally approved routes, if no national treatment capacity is available.

Table 47: Waste Management Residual Impacts

Phase	Potential impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
PC	Inadequate waste inventory and hazardous material identification	Medium	Detailed inventory, waste classification and contractor planning will reduce risk.	Low
C	Poor housekeeping and general waste accumulation	Low	Daily waste removal and housekeeping will keep residual impact low.	Low

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Phase	Potential impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
C	Improper collection of cable waste, scrap metal and e-waste	Medium	Segregated collection, recycling and licensed e-waste handling will reduce risk.	Low
C	Oil leakage during handling of oil-filled transformers	Medium / High	Drip trays, containment, spill kits, testing and controlled handling will reduce risk.	Low / Medium
C	Improper management of PCB-contaminated or suspected PCB waste	High	PCB testing, isolation, labelling, licensed hazardous waste management and chain-of-custody documentation will reduce risk.	Medium
C	Obstruction of drainage or emergency access by stored waste	Medium	Daily inspections and prohibition of storage in drainage or access routes will reduce risk.	Low
C	Illegal dumping or unlicensed disposal	Medium	Licensed contractors, waste transfer records and disposal certificates will reduce risk.	Low
O	Routine maintenance waste not properly segregated	Low	Strengthened Baku Metro maintenance waste procedures will maintain low residual risk.	Low
O	Reduction of long-term hazardous legacy waste risk	Positive	Replacement and controlled disposal of old equipment will reduce long-term contamination and safety risks.	Positive

530. In conclusion, waste generation under the Baku Metro Project will be significant mainly during the decommissioning phase, but it can be effectively managed through early inventory, source segregation, hazardous waste classification, PCB testing, safe storage, licensed transport, recycling and documented final disposal. The project is expected to create a positive long-term environmental outcome by removing obsolete legacy equipment and reducing future risks associated with oil-filled electrical infrastructure, degraded cables and uncontrolled accumulation of old materials

8.3.2 Occupational Health and Safety

531. Occupational health and safety is one of the key risk areas for this project because the works will be implemented within an active underground metro environment, including tunnels, stations, depots, technical rooms, relay rooms, cable routes, power supply areas, and rolling stock facilities. The project will be implemented in three phases: Phase 1 – Signaling Modernization and Operations Digitalization, Phase 2 – Stabilization and Parallel Operation, and Phase 3 – Decommissioning of the Existing System. The project description confirms that the works include installation of wayside and onboard equipment, system integration, pilot operation, parallel operation of the new and legacy systems, and structured decommissioning of existing signaling infrastructure.

532. The highest OHS risks are expected during works in tunnels and technical rooms, electrical isolation and testing, installation near active systems, night works, handling of old oil-filled equipment, dismantling of legacy cables and relay systems, and work in areas affected by groundwater, poor ventilation, limited access, or confined-space conditions. OHS risks are manageable if strict permit-to-work, lock-out/tag-out, access control, ventilation, emergency

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preparedness, supervision, training, and personal protective equipment requirements are applied.

Aspects of the Project that Have the Potential to Affect Occupational Health and Safety

533. The following project activities may generate occupational health and safety risks:

No.	Project activity / aspect	OHS relevance
1	Installation of wayside signaling and communication equipment in tunnels and stations	Work near active tracks, confined-space conditions, night work, electrical risks, manual handling
2	Installation of onboard equipment in trains and depots	Electrical isolation, working inside rolling stock, depot traffic, lifting and ergonomic risks
3	Cable routing, drilling, fixing, and installation of cabinets or control panels	Dust, noise, vibration, hand-arm vibration, eye injury, slips/trips/falls, work at height in some locations
4	System integration, testing and commissioning	Electrical testing, software/system failure risk, interface with live metro operations
5	Parallel operation of new and legacy systems	Operator workload, communication failures, system transition risks, emergency response complexity
6	Deactivation and dismantling of old systems	Electrical shock, incorrect isolation, fire risk, falling objects, sharp materials, confined-space exposure
7	Removal of oil-filled choke-transformers and legacy equipment	Hazardous material exposure, oil leakage, possible PCB risk, manual handling, spill response
8	Waste collection and transport to depots	Lifting injuries, falling objects, contact with contaminated waste, rail movement risk during night window
9	Works in wet tunnels or drainage areas	Slips, electrical hazards, contaminated water exposure, poor footing
10	Emergency works and maintenance during operation	Time pressure, confined-space risks, live systems, emergency evacuation requirements

Key OHS Sensitivities Identified

534. The main OHS receptors are Baku Metro staff, contractors, subcontractors, maintenance teams, laboratory personnel, drivers, dispatchers, depot staff, waste handlers, and emergency response teams. Passengers are mainly addressed under community health and safety; however, workers responsible for maintaining safe passenger operations are also considered sensitive OHS receptors.

535. The existing baseline identifies Baku Metro as a complex underground system with deep and shallow stations, tunnels, technical rooms, drainage systems, ventilation shafts, groundwater inflow, legacy signaling systems, and old oil-filled equipment. The baseline also notes that the Baku Metro Laboratory carries out routine instrumental measurements of temperature, humidity, noise and hydrocarbon indicators, which is important for worker health monitoring in underground and technical areas. OHS Receptors and Sensitivities are presented in **Table 48**.

Table 48: OHS Receptors and Sensitivities

No.	Receptor / sensitivity	Relevance
1	Installation workers and contractors	Direct exposure to electrical, mechanical, confined-space, night-work and waste-handling risks
2	Baku Metro operational staff	Interface with live operations, dispatch coordination, system transition and emergency response
3	Maintenance workers	Exposure to tunnels, technical rooms, drainage areas, old equipment and routine repair hazards
4	Depot and rolling stock workers	Onboard installation risks, lifting, electrical isolation and workshop hazards
5	Waste handlers	Contact with e-waste, scrap metal, oil-filled equipment, oily residues and potentially hazardous waste
6	Workers in tunnels and deep stations	Confined-space risks, poor ventilation, humidity, limited evacuation routes and emergency access
7	Electrical workers	High exposure to electrical isolation, testing, energization and LOTO-related risks
8	Emergency response personnel	Fire, spill, flooding, confined-space rescue and evacuation scenarios
9	Baku Metro Laboratory personnel	Monitoring in operational and technical environments, including hydrocarbon and microclimate checks

Potential OHS Impacts

536. The main OHS impacts during Phase 1 – Signaling Modernization and Operations Digitalization relate to working in active metro environments. Installation of wayside equipment, cable routing and technical-room works may expose workers to electrical hazards, moving trains, confined spaces, poor lighting, slips and trips, noise, dust, manual handling, and work during restricted nighttime access windows. These risks are considered medium to high before mitigation because the works are undertaken in operational infrastructure.
537. During Phase 2 – Stabilization and Parallel Operation, physical construction risks are lower, but operational safety risks remain important. Staff may be exposed to increased workload, dual-system control complexity, communication errors, unfamiliar procedures, interface failures, and emergency response uncertainty. Although this phase is designed as a risk-reduction measure, it requires strong operational discipline, training, supervision and incident reporting.
538. During Phase 3 – Decommissioning of the Existing System, OHS risks increase again because workers will physically remove legacy signaling and electrical equipment. Risks include electrical shock, incorrect deactivation, exposure to oil residues and possible PCB-contaminated materials, fire, confined-space work, lifting injuries, sharp edges, falling objects, cable removal hazards, poor ventilation, and waste-handling risks. This phase requires the strictest OHS controls, including verified isolation, hazardous material procedures, PPE, emergency rescue arrangements and competent supervision.
539. Additional cross-cutting OHS risks include exposure to contaminated drainage water, wet surfaces, heat stress in enclosed areas, noise exposure, fatigue from night work, inadequate

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communication between work teams and dispatchers, and emergency evacuation challenges. These risks are typical for underground metro projects and must be managed through an integrated OHS management system.

Impact Summary and Assessment of Significance

540. **Table 49** provides an assessment of OHS risks before implementation of mitigation measures.

Table 49: Potential Occupational Health and Safety Impacts

Phase	Potential OHS impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of concern	Risk of exceeding legal / safety threshold	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
PC	Inadequate OHS planning, method statements and emergency procedures	Workers, Baku Metro staff	M	H	M	H	MOD	ST	SMALL	MED	POSS	M
C	Electrical shock or arc-flash during installation, testing or isolation	Electrical workers, contractors, maintenance staff	M	H	H	H	MAJ	ST	SMALL	HIGH	POSS	H
C	Confined-space hazards in tunnels, shafts and technical rooms	Contractors, maintenance workers	M	H	H	H	MAJ	ST	SMALL	HIGH	POSS	H
C	Work near active metro operations and moving trains	Contractors, Baku Metro staff	M	H	H	H	MAJ	ST	SMALL	HIGH	POSS	H
C	Slips, trips and falls in tunnels, wet areas and cable routes	Workers, supervisors	M	M	M	M	MOD	ST	SMALL	MED	POSS	M
C	Dust, fumes, poor ventilation or indoor air quality deterioration	Workers in enclosed areas	M	M	M	M	MOD	ST	SMALL	MED	POSS	M
C	Manual handling, lifting and ergonomic injuries	Contractors, depot staff, waste handlers	M	M	M	M	MOD	ST	SMALL	MED	POSS	M

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Phase	Potential OHS impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of concern	Risk of exceeding legal / safety threshold	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
C	Exposure to oil residues, hazardous materials or possible PCB-contaminated equipment	Workers, waste handlers, HSE staff	M	H	H	H	MAJ	ST/MT	SMALL	HIGH	POSS	H
C	Fire risk during hot works, cable works or electrical faults	Workers, emergency teams, metro staff	M	H	H	H	MAJ	ST	SMALL	HIGH	POSS	H
C	Noise and vibration exposure from tools and equipment	Workers	L/M	M	M	M	MOD	ST	SMALL	MED	POSS	M
C/O	Fatigue and reduced alertness due to night works	Contractors, supervisors, dispatch staff	M	M	M	M	MOD	MT	SMALL	MED	POSS	M
O	Operational maintenance risks after modernization	Maintenance staff, Baku Metro workers	M	M	M	M	MOD	LT	SMALL	MED	POSS	M
O	Improved operational safety from modernized signaling and digital systems	Baku Metro staff, operators, passengers indirectly	H	H	H	L	POS	LT	NETWORK	POS	DEF	POS

Key: PC – Pre-construction; C – Construction / Implementation; O – Operation; H – High; M – Medium; L – Low; MAJ – Major; MOD – Moderate; ST – Short-term; MT – Medium-term; LT – Long-term; POSS – Possible; DEF – Definite; POS – Positive.

Mitigation and Management Measures

Pre-construction / Planning Phase

541. Before works begin, Baku Metro and the contractor shall prepare and approve a project-specific OHS Management Plan. This plan shall cover all phases of the project and shall be

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aligned with Baku Metro internal safety procedures, national OHS legislation, and good international industry practice.

- Prepare a project-specific OHS Management Plan covering installation, testing, parallel operation, decommissioning, waste handling and operation;
- Prepare task-specific method statements and risk assessments for all high-risk works;
- Establish a permit-to-work system for tunnel access, confined spaces, electrical works, hot works, night works and hazardous-material handling;
- Prepare and approve Lock-Out / Tag-Out procedures for all works on or near electrical systems;
- Prepare emergency response procedures for fire, electrical accident, tunnel flooding, spill, confined-space rescue, injury and evacuation;
- Define communication protocols between contractors, Baku Metro dispatch units, station staff, energy dispatch, sanitation dispatch and maintenance teams;
- Identify competent supervisors for each work front and shift;
- Ensure all workers receive induction training before accessing metro work areas;
- Confirm fitness-for-work requirements for night work, confined-space work, electrical work and hazardous-material handling;
- Confirm that all required PPE, gas detectors, spill kits, rescue equipment, fire extinguishers and first-aid kits are available before work starts.

Construction / Implementation Phase

542. The following OHS measures shall be applied during installation, testing, commissioning and decommissioning works:

- All works in tunnels and operational areas shall be performed only under an approved work permit;
- Access to tunnels shall be controlled and coordinated with the Operations Control Center and relevant dispatch units;
- Work areas shall be physically separated from active train operations where feasible;
- No work shall be undertaken near energized equipment without verified isolation and LOTO;
- Electrical testing shall be carried out only by qualified personnel using approved instruments and procedures;
- Confined-space entry shall require prior atmospheric checks, ventilation, standby personnel and rescue arrangements;
- Adequate lighting shall be provided in tunnels, cable areas, technical rooms and temporary work areas;
- Walkways, escape routes, drainage channels and emergency access points shall be kept clear at all times;
- Tools, cables, waste and dismantled equipment shall not be stored in a manner that creates trip, fire or evacuation hazards;
- Hot works shall be subject to a hot-work permit, fire watch, ventilation and availability of fire extinguishers;
- Workers shall use task-specific PPE, including safety footwear, helmets, gloves, eye protection, respiratory protection, hearing protection, high-visibility clothing and electrical PPE where required;

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- Works involving oil-filled transformers or suspected hazardous materials shall follow hazardous-material procedures and shall include PPE, spill control and restricted access;
- Manual handling shall be minimized through mechanical aids, team lifting and pre-planned movement routes;
- Workers shall be protected from fatigue by controlling night work duration, rest periods and shift rotation;
- Toolbox talks shall be conducted before each shift and before any high-risk activity.;
- All incidents, near misses, unsafe conditions and non-conformities shall be reported, investigated and corrected.

Hazardous Materials and PCB-Related OHS Measures

543. Because the project includes old oil-filled equipment, additional OHS controls shall be applied where workers may handle transformers, oily components, contaminated absorbents, sludge, or PCB-suspected materials.

- Treat old transformer oil and oil-filled equipment as potentially hazardous until testing confirms classification;
- Do not open, cut, drain or dismantle oil-filled equipment without an approved method statement;
- Use chemical-resistant gloves, coveralls, eye protection and respiratory protection where required;
- Use drip trays, absorbents and sealed containers during handling;
- Prohibit eating, drinking or smoking in hazardous-material work areas;
- Provide washing facilities and decontamination arrangements for workers handling oily or contaminated materials;
- Isolate PCB-suspected materials and restrict access to trained personnel only;
- Ensure waste handlers are trained on hazardous waste recognition, labelling, transport and emergency response.

Operation Phase

544. During operation, the project is expected to improve safety through modernized signaling, better system monitoring, improved control, and more reliable train operation. However, routine maintenance activities will continue to require OHS controls.

- Maintain preventive maintenance procedures for CBTC, communication, power supply and digital systems;
- Continue LOTO procedures for all electrical maintenance;
- Maintain routine training for operators, dispatchers and maintenance teams;
- Continue Baku Metro Laboratory monitoring of relevant microclimate and environmental quality indicators;
- Maintain emergency drills for fire, evacuation, communication failure, power failure, tunnel flooding and system failure;
- Maintain records of incidents, near misses, corrective actions and safety audits;
- Ensure that future repair works follow the same permit-to-work, confined-space and electrical safety procedures.

Residual Impacts

545. With implementation of the proposed OHS measures, most occupational health and safety risks can be reduced to Low or Low / Medium significance (**Table 50**). However, certain risks will remain at Medium residual level due to the inherent complexity of working in an operational underground metro environment. These include electrical works, confined-space activities, night works, decommissioning of legacy equipment, hazardous-material handling, and emergency preparedness.
546. The modernization project is expected to generate a positive long-term OHS outcome by improving operational control, reducing reliance on outdated systems, improving system diagnostics, and reducing risks associated with aging signaling and electrical infrastructure. The positive effect will be realized only if staff are properly trained and maintenance procedures are updated for the new CBTC and digital systems.

Table 50: Occupational Health and Safety Residual Impacts

Phase	Potential OHS impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
PC	Inadequate OHS planning and emergency procedures	Medium	OHS Plan, method statements, permits and emergency procedures will reduce planning-related risks.	Low
C	Electrical shock or arc-flash	High	LOTO, qualified personnel, isolation verification and electrical PPE will reduce risk.	Medium
C	Confined-space hazards	High	Permit-to-work, ventilation, gas checks, standby personnel and rescue arrangements will reduce risk.	Medium
C	Work near active metro operations	High	Access control, coordination with dispatch, physical separation and work windows will reduce risk.	Medium
C	Slips, trips and falls	Medium	Housekeeping, lighting, clear access routes and removal of waste each shift will reduce risk.	Low
C	Poor ventilation, dust or fumes	Medium	Ventilation, monitoring, PPE and stop-work procedures will reduce risk.	Low / Medium
C	Manual handling and ergonomic injuries	Medium	Mechanical aids, team lifting and lifting plans will reduce risk.	Low
C	Exposure to oil residues or possible PCB-contaminated equipment	High	Testing, hazardous-material controls, PPE, containment and licensed handling will reduce risk.	Medium
C	Fire risk	High	Hot-work permits, fire watch, extinguishers, cable	Medium

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Phase	Potential OHS impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
			management and emergency response will reduce risk.	
C/O	Fatigue from night works	Medium	Shift planning, rest periods and supervision will reduce risk.	Low / Medium
O	Routine operational maintenance risks	Medium	Preventive maintenance, training and permit systems will reduce risk.	Low / Medium
O	Improved operational safety after modernization	Positive	Modern signaling and digital systems will improve safety and reliability.	Positive

547. In conclusion, the Baku Metro Project involves significant occupational health and safety considerations because works will be carried out in a live underground transport system with electrical, confined-space, night-work, hazardous-material and emergency-response risks. These risks are manageable through a robust OHS Management Plan, strict permit-to-work and LOTO systems, competent supervision, worker training, ventilation, PPE, emergency preparedness and continuous monitoring. After implementation of the proposed measures, residual OHS risks are expected to remain acceptable, while the project will provide long-term positive safety benefits through modernization of the metro signaling and operational control systems.

8.3.4 Community Health and Safety

548. The main population safety risks are not associated with new land acquisition or large-scale civil works, but with the fact that modernization will be carried out within a live underground metro system used daily by the public. Potential risks include passenger movement disruption, temporary access restrictions, works near operating station areas, emergency evacuation constraints, fire and smoke risks, electrical incidents, night-time material transport, waste handling, traffic and pedestrian safety around depot or station access points, and communication failures during the transition between old and new signaling systems.

549. The project is located in Baku, Azerbaijan's largest and most densely populated urban area. The socio-economic baseline identifies Baku as the country's main urban, economic, educational and healthcare center, with significant daily dependence on metro transport. The Baku Metro serves workers, students, residents, visitors, elderly persons, persons with disabilities, women travelling with children, and low-income users dependent on affordable public transport.

550. Population safety receptors include both direct metro users and people who may be affected around stations, depots, access roads and technical facilities. Special attention is required for vulnerable groups who may be more affected by access restrictions, poor signage, crowding, emergency conditions, or temporary service disruption.

Potential Impacts

551. During **Phase 1 – Signaling Modernization and Operations Digitalization**, population safety risks may arise where installation or testing activities occur near operating stations, platforms,

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entrances, exits, passenger circulation areas or trains. Although most technical works will be undertaken in restricted areas or during night-time access windows, any poorly managed interface with passenger spaces could create risks of slips, trips, restricted movement, falling materials, noise, dust, confusion, or reduced emergency access.

552. During **Phase 2 – Stabilization and Parallel Operation**, the main population safety risk is operational rather than physical. The project description identifies this phase as a 6–12-month period during which the new CBTC system and the legacy system operate simultaneously. This phase is essential to validate safety and reliability; however, it may involve temporary operational complexity, fallback procedures, system testing, communication requirements, and possible degraded-mode scenarios. If not properly managed, these issues could affect service reliability, passenger information, evacuation coordination, or response to incidents.
553. During **Phase 3 – Decommissioning of the Existing System**, population safety risks may arise from dismantling works, electrical isolation, movement of dismantled materials, waste transport, fire load from old cables, hazardous material handling, and temporary access restrictions. Since the user-specified waste management approach states that no waste will be temporarily stored in tunnels and that waste will be transported to depots by rail during the night working window, population safety risks can be substantially reduced if this procedure is strictly implemented.
554. Community-level impacts outside the metro system are expected to be limited. The project does not involve large-scale surface construction, new roads, land acquisition, or extensive excavation. However, temporary impacts may occur at depots, technical buildings, station access points, loading areas or transport interfaces, including pedestrian disruption, traffic risk, noise, dust, odor, or concern regarding removal of old equipment and hazardous waste.
555. The project is expected to have a significant long-term positive population safety impact. Modern signaling and digital control systems are expected to improve train control, reduce operational risks, improve service reliability, enhance passenger information, support emergency management, and reduce reliance on aging legacy systems.
556. Impact Summary and Assessment of Significance see in **Table 51**.

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Table 51: Potential Population Safety Impacts

Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding safety threshold	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
PC	Inadequate planning of passenger safety, access control and emergency procedures	Passengers, station staff, vulnerable groups	M	H	M	H	MOD	ST	SMALL	MED	POSS	M
C	Temporary restriction of passenger movement in stations or entrances	Passengers, vulnerable users, businesses	M	H	M	M	MOD	ST	SMALL	MED	POSS	M
C	Slips, trips, falling objects or unsafe work interface near public areas	Passengers, station staff	L/M	H	H	H	MAJ	ST	SMALL	HIGH	POSS	H
C	Temporary disruption of access near stations, depots or technical buildings	Pedestrians, residents, businesses, road users	M	M	M	M	MOD	ST	SMALL	MED	POSS	M
C	Noise, dust, odour or nuisance from works and waste movement	Passengers, workers, nearby residents	L/M	M	L	L	MIN/MOD	ST	SMALL	LOW/MED	POSS	L/M
C	Fire, smoke or electrical incident affecting public areas	Passengers, station staff, emergency services	M	H	H	H	MAJ	ST	SMALL	HIGH	POSS	H
C	Hazardous material or waste incident during removal of legacy equipment	Passengers indirectly, workers, public areas, depot surroundings	L/M	H	H	H	MAJ	ST	SMALL	HIGH	POSS	H
C/O	Service disruption or passenger information failure during testing or rollout	Passengers, vulnerable users, station staff	H	H	H	M	MOD	ST/MT	NETWORK	MED	POSS	M/H
O	Emergency evacuation constraints if new	Passengers, station staff,	M	H	H	H	MAJ	LT	NETWORK	HIGH	UN/POSS	M/H

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Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding safety threshold	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
	systems are not fully integrated	emergency services										
O	Improved passenger safety, reliability and operational control after modernization	Passengers, Baku population, station staff	H	H	H	L	POS	LT	NETWORK	POS	DEF	POS

Key: PC – Pre-construction; C – Construction / Implementation; O – Operation; H – High; M – Medium; L – Low; MAJ – Major; MOD – Moderate; MIN – Minor; ST – Short-term; MT – Medium-term; LT – Long-term; POSS – Possible; UN – Unlikely; DEF – Definite; POS – Positive.

Mitigation and Management Measures

Pre-construction / Planning Phase

557. Prior to implementation, Baku Metro and the contractor shall prepare a project-specific Community Health and Safety / Population Safety Plan. This plan shall be coordinated with the OHS Plan, Emergency Preparedness and Response Plan, Traffic and Access Management Plan, Waste Management Plan, Stakeholder Engagement Plan, and station-level operational procedures.

558. Pre-construction mitigation measure:

- Prepare a Population Safety Plan covering passengers, pedestrians, road users, nearby residents, businesses and vulnerable groups;
- Prepare station-specific access and passenger movement plans where works may occur near public areas;
- Define clear separation between public areas and work areas using barriers, signage, locked doors, guards or access control;
- Prepare emergency response procedures for fire, smoke, electrical incident, flooding, hazardous material release, service disruption and evacuation.;
- Coordinate all work planning with the Operations Control Center, station managers, dispatchers and emergency response teams;
- Identify vulnerable-user needs, including accessible routes, lifts, escalators, alternative access and clear public information;
- Establish public communication procedures for planned works, service changes, access restrictions or temporary closures;
- Confirm that no waste, equipment or materials will be stored in tunnels, platforms, public access areas or evacuation routes;

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- Define night-time waste transport arrangements by rail to depots during the permitted work window.
- Ensure that all contractors understand passenger safety requirements before mobilization.

Construction / Implementation Phase

559. During installation, testing, rollout and decommissioning works, the following mitigation measures shall be implemented:

- Works affecting public areas shall be scheduled, where practicable, outside peak passenger hours or during night-time access windows;
- Public access routes shall remain safe, clearly marked, well lit, and free from tools, cables, waste, materials and trip hazards;
- Physical barriers shall be installed between work areas and public areas wherever there is a risk of accidental access;
- Warning signs shall be provided in Azerbaijani and, where appropriate, in simple pictograms understandable to all users;
- Station staff shall be briefed on work activities, passenger rerouting, emergency procedures and complaint handling;
- Temporary access arrangements shall consider persons with disabilities, elderly passengers, parents with children and passengers with luggage;
- All emergency exits, evacuation routes, fire doors, stairs, escalators, lifts and emergency equipment shall remain unobstructed;
- Hot works, electrical works and hazardous-material handling shall not be conducted in areas accessible to passengers;
- Waste shall not be temporarily stored in tunnels, station platforms, passenger areas, evacuation routes or drainage channels;
- All waste generated underground shall be collected and transported to depot areas by rail during the permitted night working period from 1:30 AM to 5:30 AM, depending on quantity and operational arrangements;
- Hazardous and non-hazardous waste shall be segregated and securely packed before movement through metro infrastructure;
- Liquid waste shall be placed in leak-proof containers with secondary containment equal to at least 110% of the liquid waste volume;
- Loading and movement of dismantled equipment shall be supervised to prevent falling objects, spills, obstruction or unsafe interaction with operational systems;
- If works create temporary service changes, Baku Metro shall provide advance notice through station announcements, signage, website/social media channels or other appropriate means;
- A grievance mechanism shall be available for passengers, nearby residents, businesses and institutions to raise safety or access concerns.

Stabilization and Parallel Operation Phase

560. During the 6–12-month stabilization and parallel operation period, population safety shall be managed through enhanced operational control and communication. This phase is essential for demonstrating that the new CBTC system can operate safely and reliably before the old system is decommissioned.

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561. Stabilization phase mitigation measure:

- Maintain the legacy system as a fallback until all GO/NO-GO readiness criteria are satisfied;
- Monitor system performance, communication stability, train headways, failures and degraded-mode events;
- Ensure dispatchers, drivers, station staff and emergency teams are trained in both normal and fallback procedures;
- Maintain clear passenger information during any test operation, delay, temporary service change or degraded operation;
- Record and investigate all operational incidents, passenger safety events and near misses;
- Do not proceed to full decommissioning until the new system demonstrates stable performance and required safety certification.

Operation Phase

562. During operation, the project is expected to improve population safety. Nevertheless, routine controls shall remain in place:

- Maintain regular inspection and preventive maintenance of signaling, communications, passenger information and emergency systems;
- Conduct regular emergency drills covering fire, smoke, evacuation, power failure, flooding, communication failure and service disruption;
- Maintain accessible routes, lifts, escalators, signage and passenger guidance systems in good condition;
- Continue public information procedures for planned maintenance or service changes;
- Maintain a grievance and feedback mechanism for passengers and the public;
- Continue Baku Metro Laboratory monitoring where environmental conditions may affect passenger comfort and safety;
- Review passenger safety incidents and update procedures as necessary

Residual Impacts

563. With implementation of the mitigation measures described above, most population safety risks during implementation are expected to be reduced to **Low** or **Low / Medium**. Some residual risks remain at **Medium** because the project will be implemented in a live underground transport system where passengers, station staff, emergency access and operational continuity must be protected at all times.

564. The most important residual risks relate to work near operating station areas, fire and electrical incidents, temporary service disruption, emergency evacuation, and system transition during parallel operation (**Table 52**). These risks are acceptable only where strict access control, station-level planning, emergency preparedness, public communication, and continuous operational supervision are implemented.

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Table 52: Population Safety Residual Impacts

Phase	Potential impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
PC	Inadequate planning of passenger safety and emergency procedures	Medium	Station-level planning, emergency procedures and access management will reduce risk.	Low
C	Temporary restriction of passenger movement	Medium	Safe rerouting, signage, barriers and communication will reduce impact.	Low / Medium
C	Slips, trips, falling objects or unsafe public interface	High	Physical separation, housekeeping, supervision and access control will reduce risk.	Medium
C	Temporary disruption of access near stations or depots	Medium	Access management and prior notification will reduce impact.	Low / Medium
C	Noise, dust, odor or nuisance	Low / Medium	Good housekeeping, waste controls and communication will reduce nuisance.	Low
C	Fire, smoke or electrical incident affecting public areas	High	Hot-work controls, LOTO, emergency response and exclusion zones will reduce risk.	Medium
C	Hazardous material or waste incident	High	Segregation, sealed containers, secondary containment, depot storage and certified waste contractors will reduce risk.	Medium
C/O	Service disruption or information failure during rollout	Medium / High	Operational monitoring, staff training and passenger communication will reduce risk.	Medium
O	Emergency evacuation constraints	Medium / High	Modernized systems, drills, maintenance and emergency planning will reduce risk.	Low / Medium
O	Improved passenger safety and operational reliability	Positive	Modern signaling and digital systems will improve public safety and service quality.	Positive

565. In conclusion, the Baku Metro Project presents manageable population safety risks provided that works are carefully planned, separated from public areas, coordinated with metro operations, and supported by clear communication and emergency preparedness. The project will not create long-term adverse population safety impacts. On the contrary, once implemented, the modernized signaling and digital control systems are expected to improve passenger safety, service reliability, emergency response capacity and overall public confidence in the Baku Metro system.

8.3.5 Land Acquisition, Resettlement and Economic Displacement

566. The project will be implemented within the existing operational footprint of Baku Metro, including tunnels, stations, depots, substations, relay rooms, control rooms, technical buildings, cable routes, rolling stock facilities, and other existing metro infrastructure. The project description confirms that no expansion beyond existing Baku Metro infrastructure is

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anticipated, and the works are primarily related to signaling modernization, operations digitalization, stabilization and parallel operation, and decommissioning of the existing legacy system.

567. Based on the current project scope, no permanent land acquisition, physical displacement, relocation of households, or loss of residential structures is expected. The project does not involve construction of new tunnels, new stations, new depots, or new surface infrastructure outside the existing metro system. Therefore, the project is not expected to trigger any involuntary resettlement impacts. However, temporary and localized economic or access-related impacts may occur if works affect station entrances, access routes, depot gates, service roads, pedestrian routes, nearby kiosks, small businesses, parking areas, or public transport interfaces.
568. Such impacts will be avoided or minimized through the EMP, including site-specific access management measures, safe pedestrian routing, advance public notification, clear signage, maintenance of access to businesses and public facilities, protection of vulnerable users, and timely restoration of any temporarily affected access routes. Any access-related complaints will be registered and addressed through the project GRM.

Sensitive Receptors

569. Although no permanent resettlement impacts are expected, several receptors may be temporarily affected by access restrictions or short-term disruption (**Table 53**). These include passengers, nearby businesses, kiosks, service providers, pedestrians, public transport users, road users, and vulnerable groups. The socio-economic baseline confirms that Baku is the country's main urban, economic and transport center, with high dependence on metro services for access to employment, education, healthcare and public services.

Table 53: Potential Resettlement, Access and Economic Displacement Impacts

Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding safeguard threshold	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
PC	Inadequate screening of temporary access and livelihood impacts	Businesses, passengers, vulnerable groups	M	M	M	M	MOD	ST	SMALL	MED	POSS	L
C	Permanent land acquisition	Landowners, residents, businesses	L	H	H	H	MAJ	LT	SMALL	HIGH	UN	L

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Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding safeguard threshold	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
C	Physical displacement of households or businesses	Residents, businesses	L	H	H	H	MAJ	LT	SMALL	HIGH	UN	L
C	Temporary restriction of access to station entrances or pedestrian routes	Passengers, vulnerable users, nearby residents	M	H	M	M	MOD	ST	SMALL	MED	POSS	L
C	Temporary economic impact on nearby shops, kiosks or service providers	Small businesses, vendors, tenants	L/M	M	M	M	MOD	ST	SMALL	MED	POSS	L
C	Temporary disruption at depot gates, service roads or loading areas	Road users, pedestrians, Baku Metro staff	L/M	M	L	L	MIN/MOD	ST	SMALL	LOW/MED	POSS	L
C/O	Lack of timely information on access changes	Passengers, businesses, vulnerable groups	M	M	M	M	MOD	ST/MT	SMALL	MED	POSS	M
O	Long-term access or livelihood restriction	Passengers, businesses, residents	L	M	L	M	MIN	LT	SMALL	LOW	UN	L
O	Improved public transport reliability and access to services	Baku population, passengers, workers, students	H	H	H	L	POS	LT	NETWORK	POS	DEF	POS

Key: PC – Pre-construction; C – Construction / Implementation; O – Operation; H – High; M – Medium; L – Low; MAJ – Major; MOD – Moderate; MIN – Minor; ST – Short-term; LT – Long-term; POSS – Possible; UN – Unlikely; DEF – Definite; POS – Positive.

Mitigation and Management Measures

Pre-construction / Planning Phase

570. Before the start of works, Baku Metro and the contractor shall confirm that all project activities will remain within existing Baku Metro land, buildings, tunnels, depots and technical facilities. Any proposal to use land outside the existing footprint shall be subject to prior screening for land ownership, land use, access, livelihood impacts and safeguard requirements.
571. Pre-construction mitigation measure:
- Confirm the physical footprint of each work area and verify that no private land acquisition is required;
 - Screen all station, depot and surface access areas for possible temporary access impacts;
 - Identify nearby businesses, kiosks, vendors, public institutions and vulnerable users that may be affected by temporary access changes;
 - Prepare site-specific access management plans where works may affect station entrances, exits, pedestrian routes, service roads or depot gates;
 - Ensure that temporary pedestrian routes are safe, clearly marked, well lit and accessible for vulnerable users;
 - Include access protection and livelihood disruption avoidance requirements in contractor method statements;
 - Consult affected businesses, station tenants, vendors or institutions in advance where temporary access restrictions are expected;
 - Provide public information before any temporary closure, rerouting or access change;
 - Establish a grievance mechanism for complaints related to access, business disruption, pedestrian safety and service changes;
 - If any unavoidable temporary economic impact is identified, prepare a corrective action or compensation approach consistent with ADB SPS requirements.

Construction / Implementation Phase

572. During implementation, the following measures shall be applied to avoid or minimize access and economic displacement impacts:
- Keep all works within approved Baku Metro facilities and work zone;
 - Avoid closure of station entrances or pedestrian routes unless technically necessary and approved by Baku Metro;
 - Maintain at least one safe and accessible route to each affected station, building, business or public facility wherever practicable;
 - Install clear signs showing alternative pedestrian routes, station access points and temporary changes;
 - Ensure temporary routes are suitable for persons with disabilities, elderly passengers and people with luggage or children;
 - Avoid blocking shop entrances, kiosks, delivery access, emergency access or public transport stops;
 - Schedule works affecting public access during low-passenger periods where practicable; Ensure that loading, unloading and waste movement do not obstruct public access or business activity;

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- Provide advance notice to affected businesses and institutions regarding the timing, duration and nature of access changes
- Record and respond promptly to grievances related to access restriction, business disturbance or service disruption;
- If temporary economic displacement occurs and cannot be avoided, assess the impact and apply agreed mitigation or compensation measures;
- Reinstate affected access routes, signage, pedestrian areas and service areas immediately after completion of works.

Operation Phase

573. During operation, no permanent resettlement impacts are expected. The following measures shall be maintained:

- Keep routine maintenance within existing Baku Metro infrastructure and approved work areas;
- Avoid long-term obstruction of station access, pedestrian routes, public transport interfaces or business entrances;
- Provide advance public information on planned maintenance that may affect access or service;
- Maintain accessible routes for vulnerable passengers;
- Maintain the grievance mechanism for passengers, nearby businesses and the public;
- Screen any future expansion or ancillary facility outside the existing footprint for land acquisition and resettlement impacts before approval.

Residual Impacts

574. With implementation of the proposed measures, residual impacts related to land acquisition and physical displacement are expected to remain **Low**, because the project will be implemented within existing Baku Metro infrastructure and no permanent acquisition of private land is expected.

575. Residual risks related to temporary access restriction and minor economic disruption are assessed as **Low to Medium**, depending on the location, duration and timing of works (**Table 54**). These risks are manageable through access planning, public information, consultation with affected businesses, safe pedestrian routing, grievance management and prompt reinstatement.

Table 54: Resettlement and Access Residual Impacts

Phase	Potential impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
PC	Inadequate screening of access and livelihood impacts	Low	Footprint verification and access screening will reduce planning-related risk.	Low

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Phase	Potential impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
C	Permanent land acquisition	Low	No land acquisition is expected because works are within existing Baku Metro facilities.	Low
C	Physical displacement of households or businesses	Low	No physical displacement is expected.	Low
C	Temporary restriction of passenger or pedestrian access	Low	Safe rerouting, signage, accessible routes and advance notice will reduce impact.	Low
C	Temporary economic impact on businesses or kiosks	Low	Access protection, consultation, scheduling and grievance response will reduce impact.	Low
C	Temporary disruption at depots or service roads	Low	Traffic and access management will reduce impact.	Low
C/O	Lack of information on access changes	Medium	Public communication and station-level notices will reduce impact.	Low
O	Long-term access or livelihood restriction	Low	No long-term access or livelihood restrictions are expected.	Low
O	Improved mobility and access to services	Positive	Modernized metro operation will improve reliability and access for the public.	Positive

576. In conclusion, the Baku Metro Project is not expected to cause permanent land acquisition, physical displacement, or significant economic displacement. The main resettlement-related issue is the possibility of temporary and localized access disruption around stations, depots, technical buildings or service areas during implementation. These impacts can be effectively managed through footprint control, access planning, prior information disclosure, stakeholder engagement, grievance management and prompt reinstatement. If any unforeseen land or livelihood impact is identified, works in the affected area should not proceed until the impact has been assessed and appropriate mitigation or compensation measures have been agreed in accordance with national legislation and ADB SPS requirements.

8.3.6 Cultural Heritage

577. The Baku Metro project area is located within an urban environment that contains important cultural heritage features at station level and within the surrounding city fabric. The most clearly identified cultural heritage element directly associated with the metro system is Nizami Metro Station, which is included in the electronic register of the Ministry of Culture of the Republic of Azerbaijan as an architectural monument of national importance. Its heritage value is linked to the station building, architectural composition, interior artistic treatment, and cultural references to the poet Nizami Ganjavi.

578. Several other Baku Metro stations may not be formally listed as protected monuments, but they still have architectural, artistic, and historical value as part of the Soviet-period and post-Soviet urban transport heritage of Baku. These stations may include underground halls, entrance pavilions, decorative panels, mosaics, stone cladding, lighting features, inscriptions,

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and other design elements that form part of the visual and cultural identity of the metro system. Rehabilitation, installation, dismantling, cable routing, or replacement works inside such stations should therefore be carefully screened to avoid accidental damage to original finishes, decorative elements, or station-specific design features.

579. The surrounding areas of several metro stations are culturally sensitive because Baku contains a dense historic urban landscape with listed monuments, historic residential buildings, public squares, cultural institutions, memorials, and areas of archaeological potential. Stations located near central Baku, including areas close to Icherisheher, Nizami Street, 28 May, Sahil, Elmlar Akademiyasi, and other central districts, may be located near historic buildings or streetscapes. Even where the station itself is not listed, construction traffic, vibration, installation works, utility interfaces, temporary access restrictions, and storage or movement of materials could indirectly affect nearby heritage assets if not properly managed.
580. The Icherisheher area is of particular importance because it is associated with the historic core of Baku and the UNESCO-listed Walled City of Baku, including the Shirvanshahs' Palace and Maiden Tower. The metro station serving this area should therefore be considered sensitive from a cultural heritage management perspective, even where the station itself is not the listed asset. Works in this area, or along access routes serving it, should be planned to avoid physical disturbance, vibration impacts, visual intrusion, obstruction of public access to heritage sites, and disruption to tourism and cultural use.
581. The project area may also contain intangible and social heritage elements, including traditional public spaces, historically important streets, memorial places, cultural institutions, religious buildings, and community landmarks used by local residents. Temporary disruption around stations may affect access to such places, particularly where works are carried out near pedestrian routes, public squares, museums, theatres, educational institutions, mosques, churches, or cemeteries. These sensitivities should be reflected in stakeholder engagement, traffic management, population safety planning, and access management.

Sensitive Receptors

582. The main cultural heritage receptors are built heritage assets, architecturally valuable metro stations, station interiors, protected monuments, historic streetscapes, cultural institutions, and potential chance finds. The most sensitive directly identified receptor is Nizami Metro Station, due to its registered national heritage status. Other stations and surrounding areas may be sensitive because of their artistic, historical, social, or urban landscape value, even if they are not formally listed (**Table 55**).

Table 55: Cultural Heritage Receptors Relevant to the Project

No.	Receptor	Sensitivity	Relevance
1	Nizami Metro Station	High	Listed architectural monument of national importance; direct project receptor if works occur within or near the station
2	Older metro station interiors	Medium to high	Decorative panels, mosaics, stone cladding, lighting, inscriptions, and station-specific design elements may be affected by installation or dismantling works

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No.	Receptor	Sensitivity	Relevance
3	Icherisheher / historic core of Baku	High	UNESCO-listed historic urban area near the metro network; requires access, vibration, and visual impact control
4	Historic buildings and streetscapes near central stations	High	May be indirectly affected by vibration, access restrictions, traffic, or material movement
5	Cultural institutions, public squares, religious buildings, memorial places	Medium to high	Access may be temporarily affected by station-area works
6	Unknown archaeological or cultural materials	Medium to high	Chance finds are unlikely but cannot be excluded during intrusive works
7	Public perception and cultural identity of stations	Medium	Metro stations may have social and cultural value for passengers and the city

Potential Impacts

583. The project is not expected to result in significant direct impacts on archaeological resources, because no new tunnels, major excavations, or expansion into new land areas are planned. Most works will be undertaken inside existing technical spaces, tunnels, stations, depots, control rooms, and rolling stock facilities. However, the project may involve drilling, fixing, routing of cables, installation of cabinets, removal of old equipment, and movement of materials, which could affect cultural heritage if carried out in sensitive stations or near protected buildings without proper controls.
584. The most important direct cultural heritage risk is potential accidental damage to Nizami Metro Station, if project activities are carried out inside or near the station without heritage-sensitive work methods. Possible impacts include damage to decorative finishes, stone cladding, panels, lighting elements, inscriptions, or other architectural details. Any intervention in this station should be treated as work in a protected monument and should be subject to prior screening, documentation, approval, and close supervision.
585. A broader but lower-level risk applies to other older or architecturally valuable metro stations. Although they may not be formally protected, their interiors may include original design elements that contribute to Baku's metro heritage. Damage could occur through uncontrolled drilling, routing cables across visible surfaces, installing equipment in inappropriate locations, moving heavy materials through public halls, or failing to protect finishes from dust, scratches, staining, or impact.
586. Indirect impacts may occur in station surroundings, particularly in central Baku and near Icherisheher, Nizami Street, 28 May, Sahil, Elmlar Akademiyasi, and other historic districts. Potential impacts include temporary obstruction of access to cultural sites, public squares, museums, theatres, educational institutions, religious buildings, or tourist routes; vibration or accidental damage to nearby historic buildings; visual intrusion from temporary works; and disturbance to cultural or tourism use.
587. Chance find risk is assessed as low because the project does not involve major excavation. However, if any works require breaking floors, opening old structural elements, intrusive drilling, or work in previously inaccessible areas, unexpected cultural materials may be discovered. Therefore, a Chance Find Procedure must be applied to all intrusive activities.

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588. During operation, no significant adverse cultural heritage impact is expected. The modernized signaling and digital control systems may provide positive indirect benefits by improving system safety, maintenance planning, reliability, and control of future works. However, future maintenance activities must continue to apply cultural heritage screening where they affect protected or architecturally valuable stations.

589. In **Table 56** see the Impacts summary and assessments of significance

Table 56: Potential Cultural Heritage Impacts

Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding legal / heritage threshold	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
PC	Inadequate identification of listed stations, heritage-sensitive interiors, or nearby protected buildings	Nizami Station, older stations, historic buildings	M	H	M	H	MOD	ST	SMALL	MED	POSS	M
C	Accidental damage to Nizami Metro Station architectural features	Listed architectural monument	L	H	H	H	MAJ	ST	SMALL	HIGH	POSS	H
C	Damage to decorative elements in non-listed but architecturally valuable stations	Older station interiors	L/M	M	M	M	MOD	ST	SMALL	MED	POSS	M
C	Damage during movement of materials, equipment, or waste	Station interiors, entrances, public areas	L	M	M	M	MIN/MOD	ST	SMALL	LOW/MED	POSS	L/M
C	Indirect vibration or accidental impact near historic buildings	Protected buildings, historic streetscapes	L	H	M	M	MOD	ST	SMALL	MED	UN/POSS	L/M
C	Temporary obstruction of access to cultural	Tourists, public institutions,	M	M	M	M	MOD	ST	SMALL	MED	POSS	M

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Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding legal / heritage threshold	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
	sites or public cultural spaces	religious/cultural users										
C	Chance finds during intrusive works	Unknown cultural materials	L	H	M	H	MAJ	ST	SMALL	HIGH	UN	M
O	Routine maintenance affecting heritage-sensitive station features	Nizami Station and older stations	L	M/H	M	M	MOD	LT	SMALL	MED	POSS	M
O	Improved long-term safety and maintenance of metro infrastructure	Metro system, passengers, station environment	M	M	M	L	POS	LT	NETWORK	POS	DEF	POS

Key: PC – Pre-construction; C – Construction / Implementation; O – Operation; H – High; M – Medium; L – Low; MAJ – Major; MOD – Moderate; MIN – Minor; ST – Short-term; LT – Long-term; POSS – Possible; UN – Unlikely; DEF – Definite; POS – Positive.

Mitigation and Management Measures

Pre-construction / Planning Phase

590. Before works begin, Baku Metro and the contractor shall carry out cultural heritage screening for all stations and facilities where works are planned. This screening shall identify whether the work area is located within Nizami Metro Station, another architecturally valuable station, a central historic urban area, or near a protected building, monument, cultural institution, or public cultural space.

591. Pre-construction mitigation measure:

- Confirm whether planned works will affect Nizami Metro Station or any other heritage-sensitive station area;
- Prepare a photographic and written pre-work condition record for Nizami Metro Station and other sensitive station interiors before works begin;
- Identify original decorative elements, stone cladding, mosaics, wall panels, lighting features, inscriptions, entrance pavilions, and other station-specific features requiring protection;

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- Prioritize existing cable ducts, technical rooms, service routes, concealed spaces, and non-visible areas for new equipment installation;
- Avoid routing new cables, conduits, cabinets, or fixing points across visible decorative or heritage-sensitive surfaces;
- Require written approval from Baku Metro and, where applicable, competent cultural heritage authorities before works in listed or legally protected areas;
- Define no-go areas, protection zones, and permitted access routes within heritage-sensitive stations;
- Include cultural heritage requirements in method statements, work permits, contractor EMP, OHS Plan, and site induction training;
- Screen works near Icherisheher, Nizami Street, 28 May, Sahil, Elmlar Akademiyasi, and other central areas for possible indirect impacts on historic buildings and cultural access;
- Prepare a Chance Find Procedure and ensure workers understand stop-work and notification requirements.

Construction / Implementation Phase

592. During installation, testing, decommissioning, material movement, and waste removal, the following measures shall be implemented:

- Works shall be confined to approved technical areas, tunnels, service spaces, and designated work zones;
- No drilling, cutting, fixing, anchoring, or equipment installation shall be carried out on decorative or heritage-sensitive surfaces without written approval;
- At Nizami Metro Station, all works shall be supervised under heritage-sensitive procedures and preceded by condition documentation;
- Existing ducts, cable trays, hidden service corridors, and technical rooms shall be used wherever feasible;
- Protective coverings shall be installed on floors, walls, corners, decorative surfaces, stair areas, and access routes used for material movement in sensitive stations;
- Heavy equipment, cable drums, waste containers, tools, and dismantled materials shall not be leaned against or stored near decorative panels, stone cladding, monuments, inscriptions, or historic features;
- Waste and dismantled equipment shall be removed using controlled routes that avoid damage to station interiors and public cultural spaces;
- Vibration-intensive works near historic buildings or protected station elements shall be avoided where possible; if unavoidable, pre-work condition checks and monitoring shall be considered;
- Temporary works shall not obstruct public access to cultural institutions, religious buildings, memorials, museums, theatres, or tourism routes unless an alternative route is clearly provided;
- Good housekeeping shall be maintained to avoid dust deposition, staining, or damage to station finishes;
- Any accidental damage to station architectural features or nearby heritage assets shall be reported immediately, documented, and repaired using appropriate materials and methods;
- If a chance find is discovered, works shall stop immediately in the affected area and the Chance Find Procedure shall be applied.

Operation Phase

593. During operation, the following measures shall be maintained to protect cultural heritage:

- Maintenance works in Nizami Metro Station shall be screened for potential effects on protected architectural features before implementation;
- Future works in older or architecturally valuable stations shall avoid unnecessary modification of original finishes and design features;
- Baku Metro shall maintain records of heritage-sensitive stations, features, and any special protection requirements;
- Routine maintenance shall use existing technical routes and concealed service areas wherever feasible;
- Emergency repairs affecting heritage-sensitive areas shall be documented and followed by appropriate reinstatement;
- Chance Find Procedure shall remain applicable to future intrusive maintenance works;
- Any future project component outside the existing metro footprint shall be screened separately for cultural heritage and archaeological risks.

Chance Find Procedure

594. The Chance Find Procedure shall apply to any activity involving intrusive works, breaking of floors, opening of old structures, drilling in previously inaccessible areas, or disturbance of subsurface materials. If archaeological objects, historic materials, inscriptions, structural remains, human remains, or any other suspected cultural heritage items are discovered, the following steps shall be implemented:

- Stop all works immediately in the area of the find
- Protect the find from damage, removal, vibration, contamination, weather, or unauthorized access;
- Inform the site supervisor, Baku Metro HSE / environmental specialist, and project management;
- Mark and isolate the find location; do not move, clean, or disturb the material unless instructed by competent specialists;
- Notify the relevant cultural heritage authority in accordance with national legislation;
- Allow qualified specialists or authorities to inspect and evaluate the find;
- Resume works only after written clearance is provided and any required protection, recovery, or documentation measures are completed;
- Record the event, instructions received, actions taken, and final outcome in project monitoring documentation.

Residual Impacts

595. With implementation of the proposed mitigation measures, residual impacts on cultural heritage are expected to be **Low** for most project activities. The project does not involve major excavation, new tunnel construction, demolition of historic buildings, or expansion into new land areas. Most activities will be carried out in technical spaces and existing metro infrastructure.

596. Residual risk is higher for Nizami Metro Station because it is a listed architectural monument of national importance. However, with pre-work documentation, heritage-sensitive method

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statements, use of existing technical routes, protection of decorative elements, approval controls, and close supervision, residual impacts can be reduced to Low / Medium or Low, depending on the exact work scope. For other stations and surrounding historic areas, residual impacts are expected to remain low if access, vibration, material movement, and chance find controls are properly applied (**Table 59**).

Table 57: Cultural Heritage Residual Impacts

Phase	Potential impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
PC	Inadequate identification of listed stations or heritage-sensitive areas	Medium	Screening, condition records, and method statement review will reduce risk.	Low
C	Accidental damage to Nizami Metro Station	High	Heritage-sensitive procedures, approval controls, protection of finishes, and supervision will reduce risk.	Low / Medium
C	Damage to decorative elements in other architecturally valuable stations	Medium	Use of existing routes, protective coverings, and supervision will reduce risk.	Low
C	Damage during movement of materials or waste	Low / Medium	Controlled routes, protective coverings, and housekeeping will reduce risk.	Low
C	Indirect vibration or accidental impact near historic buildings	Low / Medium	Avoidance of vibration-intensive works and condition checks where needed will reduce risk.	Low
C	Temporary obstruction of access to cultural sites or public cultural spaces	Medium	Access planning, alternative routes, signage, and stakeholder communication will reduce impact.	Low
C	Chance finds during intrusive works	Medium	Chance Find Procedure will ensure stop-work, protection, notification, and clearance.	Low
O	Routine maintenance affecting heritage-sensitive station features	Medium	Maintenance screening and heritage-sensitive procedures will reduce risk.	Low
O	Improved long-term safety and maintenance of metro infrastructure	Positive	Modernized systems will support safer and more controlled operation and maintenance.	Positive

597. In conclusion, the Baku Metro Project is not expected to cause significant adverse impacts on cultural heritage, provided that the project applies heritage-sensitive planning and supervision. The key issue is the presence of Nizami Metro Station, which is a registered architectural monument of national importance, and the broader cultural sensitivity of central Baku station areas, including Icherisheher and other historic urban locations. With pre-work screening, condition documentation, careful cable routing, protection of station interiors,

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control of vibration and material movement, public access management, and implementation of the Chance Find Procedure, residual cultural heritage impacts are expected to remain low and manageable.

8.3.7 Economy, Employment and Livelihoods

598. The Baku Metro Project is located in the country's largest and most economically active urban area. The socio-economic baseline identifies Baku as Azerbaijan's main employment, service, education, healthcare, administrative, and transport center. In 2024, Baku had a labor force of approximately 1,265.6 thousand people, of whom 1,204.9 thousand persons were employed, with an unemployment rate of approximately 4.8%. The wider Baku–Absheron area represents the most concentrated labor and service economy in the country.
599. The project is expected to generate positive long-term economic and livelihood benefits by improving the reliability, safety, capacity, and operational efficiency of Baku Metro. Improved metro services will support access to employment, education, healthcare, public services, markets, and commercial areas. However, during implementation, temporary and localized livelihood impacts may occur if works affect station access, pedestrian flows, businesses near station entrances, kiosks, transport interchanges, or service providers operating in or around metro facilities.
600. Aspects of the Project that Have the Potential to Affect Economy, Employment and Livelihoods. The following project activities may affect economic activity, employment, and livelihoods.

No.	Project activity / aspect	Potential economic, employment and livelihood relevance
1	Installation of signaling and communication equipment in stations, tunnels and technical rooms	Creates temporary technical jobs; may cause short-term access restrictions in some stations
2	Installation of onboard equipment in depots and trains	Creates skilled employment for electrical, signaling, rolling stock and testing teams
3	Procurement and delivery of new equipment	Generates demand for logistics, warehousing, technical support and supplier services
4	Testing, commissioning and system rollout	Requires skilled labor, operator training, technical supervision and system supplier involvement
5	Parallel operation of old and new systems	Requires additional staff training, supervision, monitoring and operational support
6	Decommissioning of legacy systems	Creates temporary employment in dismantling, waste handling, recycling, hazardous materials management and documentation
7	Temporary works near station entrances or public areas	May temporarily affect passenger flows, small shops, kiosks, vendors or nearby businesses
8	Waste transport and temporary storage at depots	May create limited traffic or access disruption around depot areas if not properly managed
9	Long-term operation of modernized metro system	Improves service reliability, passenger mobility, economic productivity and access to employment

Potential Impacts

601. During the implementation phase, the project will generate temporary employment opportunities for skilled and semi-skilled workers, including electrical engineers, signaling specialists, communication specialists, software and digital systems technicians, rolling stock specialists, cable installation teams, HSE personnel, waste handlers, transport workers, security staff, and supervisors. Although many specialized roles may require experienced technical staff or system supplier personnel, opportunities may also arise for local workers in logistics, support services, cleaning, material handling, site preparation, waste management, and depot-based activities.
602. The project will also support institutional and workforce capacity development within Baku Metro. Staff will require training on CBTC operation, digital control systems, safety procedures, emergency response, maintenance planning, data management, and operation of new equipment. These activities are expected to improve the technical capacity of Baku Metro personnel and strengthen long-term employment quality within the organization.
603. Temporary negative impacts may occur if implementation activities restrict access to metro stations, affect passenger flows, or create short-term disruption near station entrances, commercial units, kiosks, vending points, public transport stops or pedestrian routes. Such impacts are expected to be localized and short-term, but they may be important for small businesses and informal or semi-formal service providers that depend on high daily passenger flows.
604. During the stabilization and parallel operation phase, the main economic risk is linked to service reliability. Any testing-related delays, system instability, passenger information failures, or temporary service changes could affect commuters, workers, students and businesses. However, the parallel operation phase is also a risk-reduction measure because it allows the new system to be validated while the legacy system remains available as a fallback.
605. During the decommissioning phase, waste removal, equipment dismantling and transport to depots may create temporary work opportunities and demand for licensed waste management, recycling, hazardous waste handling, and logistics services. At the same time, poorly planned decommissioning could create temporary nuisance, access disruption or concern among station users and nearby businesses. These risks should be managed through scheduling, access planning, public information, and grievance management.
606. During operation, the project is expected to have significant positive economic and livelihood impacts (**Table 58**). Modern signaling and digital control systems will improve reliability, capacity, safety, passenger information and operational efficiency. Better metro performance can reduce travel time, improve punctuality, support labour mobility, reduce congestion pressure on surface transport, and improve access to jobs, education, healthcare and services across Baku.

Table 58: Potential Economy, Employment and Livelihood Impacts

Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding safeguard / social threshold	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
PC	Inadequate screening of business access and livelihood risks	Small businesses, kiosks, station users	M	M	M	M	MOD	ST	SMALL	MED	POSS	M
C	Temporary employment generation	Local workers, contractors, technical specialists	M	M	M	L	POS	ST/MT	NETWORK	POS	DEF	POS
C	Skills development and training for Baku Metro staff	Baku Metro staff, operators, maintenance teams	M	M	M	L	POS	MT	NETWORK	POS	DEF	POS
C	Temporary disruption of access to businesses near station entrances	Shops, kiosks, vendors, service providers	L/M	M	M	M	MOD	ST	SMALL	MED	POSS	M
C	Temporary disruption to passenger movement affecting commuting	Passengers, workers, students, vulnerable users	M/H	H	M	M	MOD	ST	SMALL / NETWORK	MED	POSS	M
C	Nuisance from works, material movement or waste transport affecting business activity	Nearby businesses, station users	L/M	M	L	L	MIN/MOD	ST	SMALL	LOW/MED	POSS	L/M

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Phase	Potential impact	Receptors	No. of receptors affected	Sensitivity of receptors	Level of public concern	Risk of exceeding safeguard / social threshold	Magnitude	Timeframe	Spatial scale	Consequence	Probability	Significance
C/O	Service disruption or information failure during testing and rollout	Passengers, employers, students, businesses	H	H	H	M	MOD	ST/MT	NETWORK	MED	POSS	M/H
O	Improved access to jobs, education and services	Baku population, metro users, vulnerable groups	H	H	H	L	POS	LT	NETWORK	POS	DEF	POS
O	Improved productivity through reduced delays and better reliability	Workers, employers, businesses	H	M/H	H	L	POS	LT	NETWORK	POS	DEF	POS
O	Long-term adverse livelihood impacts	Businesses, passengers	L	M	L	M	MIN	LT	SMALL	LOW	UN	L

Key: PC – Pre-construction; C – Construction / Implementation; O – Operation; H – High; M – Medium; L – Low; MOD – Moderate; MIN – Minor; ST – Short-term; MT – Medium-term; LT – Long-term; POSS – Possible; UN – Unlikely; DEF – Definite; POS – Positive.

Mitigation and Management Measures

Pre-construction / Planning Phase

607. Prior to implementation, Baku Metro and the contractor shall identify locations where works may affect station access, pedestrian flow, business activity, vending areas, public transport interchanges, or service providers. This screening shall be integrated with the stakeholder engagement, resettlement/access, population safety and traffic management procedures. Pre-construction mitigation measure:

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- Screen all work locations for possible impacts on businesses, kiosks, vendors, service providers and passenger access;
- Identify stations where passenger flows are high and where access restrictions could affect business activity;
- Prepare station-specific access management plans where works may affect entrances, exits, pedestrian flows or commercial areas;
- Inform affected businesses and service providers in advance about planned works, timing, duration and access arrangements;
- Require contractors to maximize use of local labor where skills are available;
- Include fair recruitment, equal opportunity, non-discrimination and labor rights requirements in contractor contracts;
- Prepare a training plan for Baku Metro staff covering CBTC, digital systems, safety procedures and emergency response;
- Establish a grievance mechanism for businesses, passengers and workers affected by economic or access-related impacts;
- Define procedures for documenting and addressing any unforeseen temporary livelihood impact.

Construction / Implementation Phase

608. During implementation, the following measures shall be applied to minimize negative economic and livelihood impacts and enhance employment benefits:

- Maintain safe access to station entrances, nearby shops, kiosks, service providers and public transport connections wherever practicable;
- Avoid blocking shopfronts, vending areas, delivery access, pedestrian routes or business entrances unless unavoidable and approved;
- Schedule works affecting public access during low passenger-flow periods where technically feasible;
- Provide clear signs and alternative access routes if pedestrian flows are temporarily changed;
- Ensure station staff are informed about access changes and can guide passengers and customers;
- Notify businesses in advance of any temporary access changes that may affect customer access;
- Avoid unnecessary noise, dust, odor, waste storage or material movement near commercial areas;
- Ensure that waste and materials are not stored in station areas, business access routes or public circulation areas;
- Give preference to local employment for suitable non-specialized and semi-skilled positions, where possible;
- Ensure transparent recruitment procedures and prohibit discrimination, forced labor and child labor;
- Provide workers with contracts, wages, working hours and working conditions consistent with national law and project requirements;
- Provide training and capacity building to Baku Metro staff and contractors involved in operation and maintenance of new systems;
- Record and respond to grievances from businesses, passengers, workers and service providers;

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- If temporary economic displacement is identified, assess the impact and develop a corrective action in line with applicable safeguard requirements

Stabilization and Parallel Operation Phase

609. During the stabilization and parallel operation phase, the main economic and livelihood protection measure is maintaining reliable passenger service and providing clear information. Stabilization phase mitigation measure:

- Maintain the legacy system as a fallback until the new system is fully validated;
- Provide timely public information on any service change, delay, testing period or temporary disruption;
- Monitor service reliability, delays, incidents and passenger complaints;
- Ensure station staff can explain temporary changes and direct passengers to alternatives;
- Avoid unnecessary peak-hour disruption to passenger services;
- Record any business or passenger complaints related to service disruption and respond through the grievance mechanism.

Operation Phase

610. During operation, the project should maximize long-term economic and livelihood benefits by maintaining reliable, accessible and safe metro services. Operational mitigation / enhancement measure:

- Maintain reliable metro operations through preventive maintenance of signaling and digital systems;
- Use passenger information systems to provide timely information on train movement, delays and service changes;
- Maintain affordable and accessible public transport services for workers, students and vulnerable users;
- Monitor passenger safety, service reliability, and complaints related to access or disruption;
- Continue training and skills development for Baku Metro staff;
- Maintain the grievance mechanism for passengers, businesses and the public;
- Screen future maintenance works for potential temporary impacts on businesses and access routes.

Residual Impacts

611. With implementation of the proposed mitigation measures, temporary negative impacts on livelihoods, business access, passenger movement and local economic activity are expected to be **Low to Medium** before mitigation and **Low** or **Low / Medium** after mitigation (**Table 59**). The main residual risks are associated with temporary access restrictions near station entrances and possible short-term service disruption during testing or rollout.

612. The project is expected to have significant positive residual impacts during operation. Improved signaling, digitalized control, better service reliability, enhanced safety, and improved passenger information will support economic productivity, reduce commuting uncertainty,

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improve access to employment and services, and strengthen the overall role of Baku Metro as a key public transport system.

Table 59: Economy, Employment and Livelihood Residual Impacts

Phase	Potential impact	Potential impact significance before mitigation	Residual impact	Residual impact significance after mitigation
PC	Inadequate screening of business access and livelihood risks	Medium	Screening and station-specific access planning will reduce risk.	Low
C	Temporary employment generation	Positive	Local hiring and contractor employment will provide temporary benefits.	Positive
C	Skills development for Baku Metro staff	Positive	Training will strengthen long-term institutional capacity.	Positive
C	Temporary disruption of access to businesses	Medium	Access management, prior notice and grievance response will reduce impact.	Low / Medium
C	Temporary disruption to passenger movement and commuting	Medium	Scheduling, signage, alternative routes and information disclosure will reduce impact.	Low / Medium
C	Nuisance affecting business activity	Low / Medium	Good housekeeping, waste controls and scheduling will reduce nuisance.	Low
C/O	Service disruption or information failure during rollout	Medium / High	Parallel operation, fallback procedures, monitoring and public information will reduce risk.	Medium
O	Improved access to jobs, education and services	Positive	Modernized metro operation will improve mobility and access across Baku.	Positive
O	Improved productivity through service reliability	Positive	Reduced delays and better operational control will support economic efficiency.	Positive
O	Long-term adverse livelihood impacts	Low	No long-term adverse livelihood impacts are expected.	Low

613. In conclusion, the Baku Metro Project is not expected to cause significant adverse impacts on the economy, employment or livelihoods. The main temporary risks relate to short-term disruption of passenger movement and access to businesses or services near station areas. These impacts can be managed through advance notice, station-specific access planning, protection of business entrances, clear signage, grievance management and careful scheduling. The project is expected to provide important long-term positive impacts by improving public transport reliability, supporting labor mobility, strengthening technical employment capacity, and improving access to jobs, education, healthcare and services across Baku.

8.4 Cumulative, Transboundary and Induced Impacts

8.4.1 Cumulative Impacts

614. This section assesses the potential cumulative, transboundary and induced impacts of the Baku Metro Signalling Modernization and Operations Digitalization Project. The structure follows the presented sample, which considers whether the project may interact with other infrastructure projects, whether impacts may extend beyond national boundaries, and whether the project may generate indirect or induced effects through improved transport performance and economic activity.
615. No significant adverse cumulative impacts are expected from the Baku Metro Project. The project will be implemented within the existing operational footprint of Baku Metro, including stations, tunnels, depots, technical rooms, substations, rolling stock areas and control facilities. It does not include new metro corridors, new stations, new land acquisition, large-scale excavation, or expansion into undeveloped areas. As a result, the project's direct environmental and social impacts will remain localized, temporary and mainly associated with installation, testing, decommissioning of legacy equipment, waste handling and occupational safety management.
616. Potential cumulative impacts may arise only if modernization works overlap in time and space with other urban infrastructure activities in Baku, such as road works, utility repairs, building rehabilitation, public transport upgrades, or station-area improvement projects. In such cases, cumulative impacts could include temporary access restrictions, traffic disruption near station entrances or depots, increased noise, waste transport movements, or temporary inconvenience for passengers and nearby businesses. These impacts would be short-term and manageable through coordination with relevant municipal authorities, Baku Metro operations, utility providers and contractors.
617. The most relevant cumulative issue within the Baku Metro system itself is the interaction between the proposed modernization works and ongoing metro operations. Since the project will be carried out in a live underground transport environment, cumulative operational pressure may occur if installation works, testing, maintenance, and passenger service activities are not properly coordinated. This risk is addressed through phased implementation, night-time work windows, permit-to-work procedures, parallel operation of legacy and new systems, and the GO/NO-GO decision process before decommissioning.
618. Overall, the project is not expected to contribute to significant cumulative impacts on air quality, groundwater, biodiversity, protected areas, cultural heritage, land use or communities. The project may instead contribute to positive cumulative urban transport outcomes by improving the reliability, safety and efficiency of Baku Metro, which may complement wider sustainable urban mobility measures in Baku.

8.4.2 Transboundary Impacts

619. No significant transboundary impacts are anticipated. The Baku Metro Project is located entirely within Baku city and will be implemented within existing underground and surface metro infrastructure. The project does not involve activities that could generate transboundary emissions, transboundary water pollution, cross-border waste movement under normal conditions, impacts on shared water bodies, or impacts on migratory species at a scale relevant to neighboring countries.

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620. The project may have a minor positive climate-related effect by improving metro operational efficiency and supporting greater use of public transport in Baku. Modern signaling and digitalized operation can improve train management, reduce inefficient operation, and support a more reliable metro service. These benefits may indirectly contribute to reduced reliance on private vehicles and lower urban transport emissions; however, the scale of this benefit is local and urban rather than transboundary.

8.4.3 Induced Impacts

621. The project is expected to generate positive induced impacts, primarily through improved public transport reliability, safety, efficiency and passenger confidence. By modernizing signaling systems, introducing CBTC-based control, improving operational digitalization and strengthening centralized control, the project will support better train frequency, reduced operational delays, safer train control and improved system resilience. These improvements are likely to enhance the attractiveness of Baku Metro as a daily transport mode.
622. Positive induced impacts may include improved access to employment, education, healthcare, public services and commercial areas. The socio-economic baseline identifies Baku as Azerbaijan's largest employment and service center, with strong dependence on public transport for daily mobility. Improved metro reliability may therefore support labor mobility, reduce commuting uncertainty and contribute to the productivity of workers, students and businesses across the city.
623. The project may also contribute to a modal shift from private vehicles, taxis or surface transport to metro use, particularly if modernization improves service quality, frequency and passenger information. Such a shift would support reduced road congestion, lower accident exposure on surface roads, reduced local vehicle emissions, and improved travel time reliability. These effects are expected to be positive and consistent with sustainable urban transport objectives.
624. Employment and skills-related induced benefits are also expected. During implementation, the project will generate temporary demand for technical specialists, installation workers, electrical and communication experts, safety personnel, waste handlers and support services. In the longer term, Baku Metro staff will benefit from training in modern signaling, digital operations, system diagnostics, emergency procedures and maintenance planning. This will strengthen institutional capacity and improve the quality of technical employment within the metro sector.
625. No significant adverse induced impacts are expected because the project does not create new urban development corridors, open new land for development, or alter land use patterns beyond existing planning controls. Any station-area commercial benefits resulting from improved metro reliability are expected to occur within already urbanized areas and existing economic activity zones. Therefore, induced impacts are assessed as predominantly positive, while any temporary implementation-stage disruption can be managed through access planning, public communication, stakeholder engagement and grievance management.

9. STAKEHOLDER ENGAGEMENT, INFORMATION DISCLOSURE AND GRIEVANCE REDRESS MECHANISM

9.1 Public Consultation Requirements

626. According to the ADB Safeguard Policy Statement (2009): “The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Meaningful consultation is a process that:
- (i) Begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;
 - (ii) Provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;
 - (iii) Is undertaken in an atmosphere free of intimidation or coercion;
 - (iv) Is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and
 - (v) Enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.
627. Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results are to be documented and reflected in the environmental assessment report.

9.2 Stakeholder Engagement Activities

9.2.1 General Principles

628. Stakeholder engagement has been undertaken throughout the development of the Project, with the view to determining and responding to the views of interested and parties potentially affected by the Project throughout the life of the Project, and ensure open and transparent communication between Baku Metropoliteni CJSC, Construction Contractor and stakeholders. The approach to engagement seeks to meet both national and international requirements.
629. The following general principles will govern stakeholder engagement activities:
- The content of documents for public comment will provide accessible and adequate information on the Project, and not create undue fears (regarding potential negative impacts) or expectations (regarding potential positive impacts such as job creation, etc.);
 - The information will be disclosed in the local language(s) where needed and in a manner that is accessible and culturally appropriate, taking into account any vulnerable people; and
 - Efforts will be made to explain not only the proposed project and IEE process, but also the applicable national laws and legislations, relevant international principles and standards and how Baku Metropoliteni CJSC and Construction Contractor will ensure compliance.

9.3 Consultation Methods

630. The main communication methods and mechanisms that will be used to consult with key stakeholders are presented below.

9.3.1 Public Meetings

1. Public meetings are open forums held in communities and urban areas to present project alternatives, maps, and expected impacts. The main advantages of public consultations are: (i) identification of stakeholder's concerns, (ii) obtaining local knowledge, (iii) strengthening project acceptance, (iv) high transparency and visibility; (v) allowing two-way dialogue and collective discussion; (vi) building trust at an early decision-making stage; (vii) suitability for explaining alternatives and trade-offs.
2. At the same time, when holding public meetings, it is necessary to take into account the potential limitations of such meetings, which are: (i) dominant voices may overshadow vulnerable groups; (ii) requires effective facilitation and time management; (iii) the possibility of limited participation from women, elderly persons, or working individuals or other stakeholder groups if meetings are not scheduled at convenient times or locations.

9.3.2 Meetings with Local Authorities and Institutions

3. Target groups for such meetings include rayon administrations, utilities, police, emergency services, municipal authorities, planning departments, environmental authorities, transport agencies, and other relevant institutions.
4. Such meetings are useful for addressing the following issues: (i) identification of regulatory requirements, (ii) coordination of construction activities, (iii) ensuring institutional alignment; (ii) supporting integration with urban plans; (iii) facilitating permitting and approvals; (iv) enabling technical input on alternatives.
5. At the same time, it should be noted that the information obtained during such meetings: (i) may not reflect community concerns; (ii) may result in overly technical focus; (iii) may have limited public visibility. Therefore, consultations with local authorities and institutions should complement, rather than replace, engagement with affected persons and other stakeholders.

9.3.3 Individual Meetings / Face-to-face Consultations

6. Face-to-face meetings require a lot of time and human resources, therefore, they are typically conducted with project-affected persons, vulnerable groups, businesses, tenants, and other stakeholders requiring targeted engagement. In our particular case, face-to-face meetings should definitely be planned with illegal owners of land plots or businesses whose buildings have already been demolished. Face-to-face meetings offer several advantages including (i) providing highly tailored information and feedback; (ii) building trust with affected persons and stakeholders; (iii) facilitating discussions of sensitive issues, such as land acquisition, livelihood impacts, or compensation; (iv) reducing misinformation and misunderstandings.
7. However, they also have certain limitations, such as: (i) As mentioned, very time-consuming; (ii) Requires trained social specialists; (iii) Limited reach.

9.3.4 Focus Group Discussions (FGDs)

8. Focus groups will be conducted with identified vulnerable groups such as persons with disabilities, women, low-income households, people receiving social benefits, and other potentially vulnerable or disadvantaged stakeholders. A simple non-technical language will be used to ensure that the project impacts are communicated transparently to participants.
9. There are several positive aspects to conducting focus group discussions: (i) providing inclusive and safe environment; (ii) enabling detailed understanding of social impacts; (iii) encouraging greater participation of vulnerable groups; and (iv) generating high-quality qualitative feedback.
10. However, when conducting such meetings and evaluating the results, it should be taken into account that focus group meetings: (i) are not statistically representative; (ii) can be time- and resource-intensive; (iii) require skilled facilitators.

9.3.5 Information Leaflets and Brochures

631. This approach is used to disseminate information about the project, mainly to inform affected persons, residents, businesses, institutions, and other stakeholders within and around the project area.
632. The approach has a number of positive aspects, such as: (i) being simple and accessible; (ii) being easy to distribute widely; (iii) providing a useful reference material for stakeholders; and (iv) useful for low-internet areas.
633. It is also necessary to consider limitations of this approach to dissemination of information, such as: (i) reliance on one-way communication; (ii) limited space for detail information; and (iii) the potential for misunderstanding if information is provided without opportunities for clarification or follow-up discussion.
634. Where appropriate, information materials should be prepared in clear, non-technical language and made accessible to all stakeholder groups, including vulnerable persons.

9.3.6 Project Website / Social Media Pages

635. Environmental and social documentation prepared for the project is subject to public disclosure, as required by both national legislation and ADB policy. The publication of these documents allows interested parties to familiarize themselves with the project alternatives, as well as the positive and negative sides of the prepared alternatives, before the public discussion begins.
636. Project websites and social media platforms offer several advantages, including: (i) broad and rapid dissemination of information; (ii) cost-effective communication; (iii) enabling access to document downloads; (iv) supporting transparency, accountability and traceability of project information.
637. At the same time, several limitations should be considered, including: (i) potentially limited reach among stakeholders with limited internet access or digital literacy; (ii) the need for regular

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maintenance and updating of information; and (iii) limited opportunities for detailed discussion and direct interaction compared with face-to-face consultation method.

9.3.7 Project Information Boards and Posters

638. Project Information Boards and Posters are placed in prominent locations within the project area as required by law. This method of information dissemination provides: (i) high visibility; (ii) continuous access to project information; (iii) relatively low maintenance requirements; and (iv) support for transparency and public awareness.

639. At the same time, it should be noted that this method has certain limitations, including : (i) the absence of a direct feedback mechanism; (ii) limited space for detailed information; and (iii) the possibility that stakeholders may become less attentive to the information over time.

9.4 Consultations with Baku Metropoliteni CJSC Departments

640. During preparation of the IEE, consultations were held with relevant departments of Baku Metropoliteni CJSC, including the Signaling and Communications Service, Safety and Environmental Protection Service, Public Relations Center, depot management, and PIU safeguards personnel. These consultations provided technical, operational, environmental, health and safety, waste management, and stakeholder engagement information that was used to prepare the IEE, assess project risks, and develop mitigation and management measures.

9.4 Public Consultations

641. The public hearing for the Baku Metro Signaling Modernization and Operations Digitalization Project was held on 12 May 2026 at the Baku Metro Training Center (**Figure 19**). The meeting was organized within the framework of the Initial Environmental Examination prepared for the project financed by the Asian Development Bank.

642. Information about the planned public hearing was disseminated in advance through Baku Metropoliteni CJSC's existing communication and information channels. In particular, announcements of the public hearing were posted at metro stations, enabling metro users, employees, and other interested stakeholders to receive information on the date, venue, and purpose of the meeting. In addition, information on the planned hearing was provided in response to telephone inquiries from interested individuals and organizations including those seeking clarification regarding the project, the public consultation process, or participation arrangements.

643. According to the attendance sheet, 55 participants were registered at the public hearing. The participants mainly represented Baku Metropoliteni CJSC and its operational and technical services, including signaling and communication-related units, depot and maintenance personnel, technical departments, public relations / communication representatives, and environmental / safety-related personnel. In addition, representatives from ADB, Azerenergy, and other project-relevant organizations attended the meeting. The attendance records indicate that participation was primarily from Baku Metropoliteni CJSC and project-related institutions; however, the public hearing was publicly announced and open to all interested stakeholders.

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644. The gender balance was male-dominated, which is typical for technical public discussions involving signaling, electrical, depot, engineering, and operational departments. Based on the names recorded in the handwritten attendance register, approximately 9 participants appeared to be women and approximately 46 participants appeared to be men. These figures are approximate and based on the attendance records available at the time of reporting.
645. The meeting was opened by Niyazi Guliyev, Head of the Signaling and Communications Service, who introduced the purpose of the event, and emphasized the importance of the project for improving the safety, reliability and operational efficiency of the Baku Metro system. The attendance list confirms participation of representatives from Baku Metro departments, project-related technical services, and other stakeholders.
646. The presentation was delivered by Irakli Kaviladze, a consultant engaged by the Asian Development Bank. During the presentation, he explained that the project is not a new metro construction project but involves modernization of the existing Baku Metro infrastructure. He described the main components of the project, including upgrading the signaling system, introduction of CBTC technology, establishment of a modern Operations Control Center, integration of digital monitoring and asset management systems, and the eventual decommissioning and removal of obsolete signaling equipment. He also explained that the project will be implemented in three stages: signaling modernization and digitalization, parallel operation of the old and new systems, and decommissioning of the existing system.
647. The presentation also focused on the main environmental and safety risks identified during the Initial Environmental Examination. Particular attention was given to the presence of old oil-filled choke transformers (drossel-transformers), the possible risk of PCB contamination, hazardous waste management, tunnel drainage and groundwater inflow, e-waste generation, occupational health and safety, fire safety, confined-space work, electrical safety, and passenger safety during implementation. Irakli Kaviladze explained that the project will be implemented within an operating metro system, and therefore works must be carefully planned, supervised and coordinated with Baku Metro operational services.
648. The mitigation measures presented during the meeting included the preparation and implementation of the Environmental Management Plan, hazardous waste and PCB management procedures, waste segregation, engagement of licensed waste management contractors, prohibition of temporary waste storage in tunnels, rail transport of waste to the depot during approved working windows, secondary containment for liquid waste, Lock-Out / Tag-Out procedures, ventilation and confined-space controls, emergency preparedness, stakeholder engagement, and operation of a grievance redress mechanism. It was also explained that where national legislation and ADB safeguard requirements differ, the stricter requirement will be applied.

Figure 14: Public Consultations at the Baku Metro Training Center

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649. During the question-and-answer session, participants raised questions regarding continuation of metro operations during implementation, management of hazardous waste, potential PCB contamination in transformer oil, protection of workers and passengers, and the potential for temporary service disruptions or environmental impacts outside the metro system. In response, the project team explained that the project would remain within the existing metro footprint, the new and existing systems will operate in parallel before decommissioning, hazardous materials would be tested and managed through certified organizations, and all works would be implemented in accordance with approved environmental, safety, and monitoring procedures.

Table 60: Questions and Answers Raised During the Public Hearing

No.	Question	Answer
1	Will the project require construction of new metro lines, stations or new land acquisition?	No. The project will be implemented within the existing Baku Metro infrastructure, including tunnels, stations, depots, technical rooms and control facilities. No new metro lines, new stations or permanent land acquisition are expected.
2	Will metro services be interrupted during implementation?	The project is planned in phases to avoid major disruption to passenger services. Most installation and dismantling works will be carried out during controlled access windows, mainly outside peak passenger periods or during night-time work periods.
3	Why is a parallel operation period required?	The parallel operation period allows the new CBTC system and the existing legacy system to operate simultaneously for approximately 6–12 months. This provides a safety buffer and allows the new system to be tested under real operational conditions before the old system is dismantled.
4	What is the main environmental risk of the project?	The main environmental risk is associated with dismantling of old electrical and signaling equipment, especially oil-filled drossel-transformers. These may contain old insulating oil and may require PCB testing before removal, transport or disposal.
5	How will hazardous waste be managed?	Hazardous waste will be identified, segregated, labelled and stored separately from non-hazardous waste. Waste will not be stored in tunnels or passenger areas. It will be transported to designated depot areas and then transferred only to certified or licensed waste management organizations.

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No.	Question	Answer
6	What will happen if PCBs are found in transformer oil?	If PCBs are confirmed, the affected oil, equipment, absorbents and contaminated materials will be isolated, labelled, stored under secure conditions with secondary containment, and managed only by organizations authorized to handle PCB-contaminated waste.
7	Can hazardous waste contaminate tunnel drainage water?	This risk will be controlled through spill prevention, secondary containment, prohibition of waste storage near drainage channels, immediate removal of waste from tunnels, and emergency response procedures. Any oil leakage or visible contamination will require stop-work and corrective action.
8	How will workers be protected during underground works?	Workers will be protected through approved OHS plans, permit-to-work procedures, electrical isolation, Lock-Out / Tag-Out, confined-space controls, ventilation, PPE, toolbox talks, emergency response arrangements and continuous supervision.
9	Will passengers be exposed to safety risks during works?	Work areas will be separated from passenger areas using barriers, signage and access controls. Emergency exits, platforms, stairs, escalators and public routes must remain safe and unobstructed. Public information will be provided where temporary changes are required.
10	How can citizens or passengers submit complaints?	A project grievance redress mechanism will be established and linked with Baku Metro's existing complaint handling system. Complaints may be submitted through Baku Metro stations, the Public Relations Center, the PIU or other disclosed communication channels. Complaints will be registered, reviewed and responded to within defined timeframes.

650. The stakeholder engagement process shall begin at the project initiation stage and continue throughout the full project cycle, including detailed design, procurement, installation, testing and commissioning, stabilization and parallel operation, decommissioning of the existing system, and the operational phase. Accordingly, stakeholder engagement shall not be limited to consultations already conducted during project preparation, but shall remain an ongoing process during subsequent stages of project implementation.

651. During implementation, Baku Metro, the PIU, the Contractor, and other responsible parties shall continue to disclose timely and understandable information to affected and interested stakeholders on the project schedule, planned works, temporary access changes, passenger safety measures, environmental and social mitigation measures, waste management activities, emergency arrangements, and grievance submission channels. Particular attention shall be given to passengers, vulnerable users, nearby businesses, public institutions, station staff, and other groups that may be affected by temporary access restrictions or service-related changes.

9.5 Information Disclosure

652. In compliance with ADB's SPS (2009) the draft IEE will be disclosed on the ADB website, and on the Baku Metropoliteni CJSC website (in Azerbaijani language).

653. With regard to information disclosure, ADB is committed to working with Baku Metropoliteni CJSC to ensure that relevant information (whether positive or negative) about environmental and social safeguard issues is made available in a timely manner, at an accessible place, and in a form and language(s) understandable to affected people and other stakeholders, including

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the general public, so they can provide meaningful inputs into project design and implementation.

654. ADB SPS requires the borrower to provide relevant environmental information from environmental monitoring reports in a timely manner, at an accessible place and in a form and language(s) understandable to affected people and other stakeholders. The final version of the full IEE will be translated into Azerbaijani language. The IEE in Azerbaijani will also be disclosed at the offices of the Baku Metropoliteni CJSC and on its website.
655. In order to maintain transparency of the public disclosure process, the semiannual environmental monitoring reports (SAEMRs) will be published on the ADB and Baku Metropoliteni CJSC websites as well. The hard copies of SAEMRs translated into Azerbaijani language (understandable to affected people) will also be made available to relevant local administrative offices. This will be disclosed on Baku Metropoliteni CJSC website.

9.6 Grievance Redress Mechanism

9.7.1 General

656. A Grievance Redress Mechanism (GRMs) is a locally based and formalized system for receiving, assessing, and resolving feedback, concerns and complaints from affected people and other stakeholders. The GRM provides a predictable, transparent, and credible process that is accessible to all parties, promotes fair and timely resolution of issues, and facilitates corrective actions and early engagement. It also defines clear responsibilities and timeframes for grievance resolution.
657. The Project GRM will serve as a platform for receiving and addressing concerns and grievances from project-affected people related to environmental, social, and land acquisition impacts. The GRM will ensure that grievances are addressed promptly through an understandable, transparent, gender responsive, and culturally appropriate process that is accessible to all community members, including vulnerable groups. The overall approach is to resolve grievances at the lowest possible level, escalating them to higher level only if resolution cannot be achieved.
658. The ADB Accountability Mechanism (AM) provides an independent forum and process for people to voice and seek solutions to their problem as well as alleged non-compliance by ADB with its operational policies and procedures. As ADB adheres to early problem prevention and problem-solving, Project complaints and concerns should first be addressed promptly and effectively at the Project, through the GRM, and operational levels. The AM is the “last resort” process for dealing with problems and compliance issues that were not prevented or solved at GRM and operational levels.
659. The GRM should be established and operated in accordance with the applicable legislation of the Republic of Azerbaijan and requirements of the ADB SPS (2009), which requires the borrower/client to establish a mechanism that will receive and facilitate the resolution of affected persons’ concerns and grievances about physical and economic displacement and other Project impacts, paying particular attention to vulnerable groups.

660. In addition to ADB requirements grievance redress in Azerbaijan is governed by the national legislation, notably by the Law of the Republic of Azerbaijan # 1308-IVQ “On Citizens’ Appeals” dated 30 September 2015. According to this regulation, the application or complaint shall be considered within fifteen days from the date of receipt in the state authority, which is obliged to resolve the issue on the merits. If an additional study, set of additional/supporting documents or check procedure is needed, the term of complaint’s resolving may be extended for up to one month.

9.7.2 Process

661. Based on the experience from other ADB-assisted projects in Azerbaijan and local practices, and also taking into account the complaints mechanisms that already was established within previous project – The Metro Signaling Project, the following grievance resolution process is envisaged under the project presented below.

662. The following GRM was proposed which consisted of several levels:

- **Level 1.** The aggrieved person applies to any station of Baku Metropoliteni Line. Head of station or designated officer will be in charge for receiving and registration complaints. PIU representatives at the construction site will collect information about received complaints from supervising stations on daily base. All complaints received at station or construction-site level shall be registered and reported to the PIU at Baku Metropoliteni head office. Following review of the complaint’s nature, the PIU shall assign it only to the relevant responsible party. Routine construction and operational complaints shall be addressed by the Contractor or the relevant Baku Metro unit, while external authorities shall be involved only where the matter falls within their statutory jurisdiction. PIU representatives will be assisted by Construction Supervision Consultant (CSC) and PIU EPS in GRM implementation. At this level, complaint should be resolved during 2 weeks.
- **Level 2.** In case the grievance was not redressed on the first stage or applicant is not satisfied with the decision made/solution, s/he can submit the grievance directly to head office of Baku Metropoliteni. In accordance with established procedure, the secretariat will review the complaint and will forward complaints to respective department to made decision on its redress. In case the grievance is not related directly to the project, the further instance will be recommended to the applicant where s/he should apply for the decision making during 2 weeks.
- **Level 3.** If the issue was not solved or the applicant is dissatisfied with the decision/resolution, the aggrieved person may submit grievance to the Court where decision will be made in accordance with relevant national legislation.

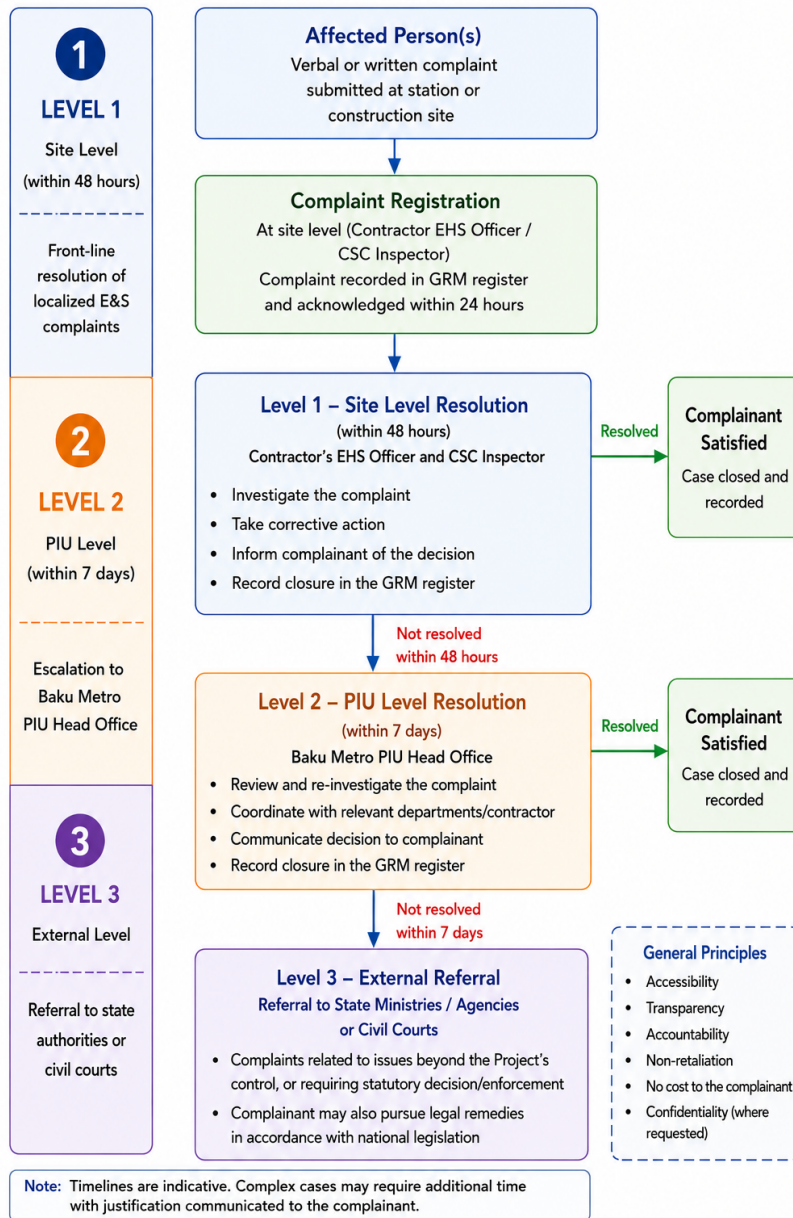
663. For component related to construction of committee will be appointed to record complaints, which later will be collected by PIU’s representatives on construction site for further actions as described in previous para. The scheme of GRM is presented in

Figure 20.

Figure 15: Schematic structure of GRM

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664. Each contractor will also establish a mechanism for receiving, registration and documentation of grievances on the construction sites. Both types of grievances from workers and surrounded communities in any form (anonymous or signed complaints) will be reviewed and addressed. The Contractor will have to report about received complaints and undertaken actions to address them to PIU.
665. Most of environmental grievances are expected to be resolved at the first or the second levels of grievance redress process. All grievances received from the public will be registered in a logbook, which should be available at all levels: at the site office of Contractor, each station of Baku Metropolitani. Even so, the information on received by Contractor grievances and applications from the aggregated persons, and undertook measures should be submitted to the representatives of PIU on the project site for the accounting all grievances. Consequently / Thereafter the information on all received grievances will be collected at the PIU.
666. Baku Metro has already established a Complaints Receiving and Review Service, which provides an important institutional basis for the project-level Grievance Redress Mechanism. Therefore, the GRM for the Baku Metro Signaling Modernization and Operations Digitalization Project will not operate as a separate or isolated mechanism.. Instead, there should be a clear structural and procedural connection between the project GRM and the existing Complaints Receiving and Review Service. This connection will ensure that complaints received through Baku Metro's existing channels, including calls, written submissions, station-level communication, or public inquiries, are promptly identified as project-related where relevant and redirected to the appropriate GRM focal point, PIU specialist, contractor, or responsible Baku Metro department for review and response.
667. The main function of this structural linkage will be to ensure proper routing, registration, tracking and follow-up of complaints. If a complaint concerns project activities, such as installation works, temporary access restrictions, safety risks, service disruption, waste movement, noise, dust, hazardous materials, or worker behavior, the Complaints Receiving and Review Service should immediately transfer the complaint to the project GRM structure. At the same time, the GRM should provide feedback to the Service on the status of review, corrective actions taken, and closure of the complaint. This will avoid duplication, prevent delays, and ensure that complainants receive a coordinated and timely response through the communication channels already familiar to Baku Metro users.
668. To strengthen this arrangement, it is recommended that one employee of the Complaints Receiving and Review Service be formally assigned or seconded to the project GRM as a designated liaison officer. This person would be responsible for screening incoming complaints, identifying project-related issues, forwarding them to the GRM focal point, maintaining communication between the Service and the PIU, and ensuring that complaint records are properly reflected in the project grievance database. Such an arrangement would improve coordination, transparency and accountability, while also ensuring that the project GRM builds on Baku Metro's existing complaint management capacity rather than creating a parallel system.
669. The Contractor should include the information on grievances in monthly progress reports submitted to the PIU, who in their turn will include aggregated information to the semiannual reports on environmental monitoring submitted to ADB.

9.7.3 Communication

670. Prior to start of site works, the Construction Contractor shall:

- Communicate the GRM to communities in the project impact zone.
- Ensure that names and contact numbers of representatives of Baku Metropoliteni PIU are placed on notice boards outside the construction site.

9.7.4 Records and Documentation

671. The Baku Metropoliteni PIU will ensure all grievances and resolution process are documented in a Logbook at the office of the Baku Metropoliteni PIU in paper and in the electronic form. The cities administrations of the project districts may use their procedures for registration and addressing the citizens' complaints. The staff of the Baku Metropoliteni, station administration who registered the grievance, shall, forward it to the Baku Metropoliteni PIU Environmental and Social Safeguards Specialist (GRM Focal Person) along with all information. The complainant should be informed about the decision and actions to be taken at every resolution level.

672. The Baku Metropoliteni should incorporate the grievance cases in their semiannual monitoring reports to be submitted to ADB. All grievances and their resolution status will be monitored and reflected in the project's progress reports.

10. ENVIRONMENTAL MANAGEMENT PLAN

10.1 Introduction

673. The EMP provides a structured and practical framework for managing environmental, occupational health and safety, and community health and safety risks associated with the Project during pre-construction, construction, commissioning, and operation phases. It translates the findings of the environmental impact assessment into specific mitigation, monitoring, and institutional measures to ensure that adverse impacts are avoided where possible and otherwise minimized and managed to acceptable levels.
674. The Project primarily involves reconstruction, and modernization works within an existing railway corridor, including installation and upgrading of traction power supply infrastructure, signaling and telecommunication systems, substations, overhead contact lines, and associated cabling. As such, potential impacts are expected to be largely site-specific, temporary, and reversible, provided that appropriate environmental management measures are consistently implemented. The EMP therefore focuses on controlling construction-related impacts such as noise, dust, waste generation, occupational and electrical safety risks, traffic and community safety, and localized disturbance to land and vegetation, as well as operational risks related to maintenance activities and emergency preparedness.
675. The EMP defines clear roles and responsibilities for Baku Metropolitani, the Project Implementation Unit (PIU), contractors, and supervision consultants, and establishes requirements for environmental supervision, monitoring, reporting, training, and corrective actions. The EMP comprises an Environmental Mitigation Plan and an Environmental Monitoring Plan, which together form a binding part of Project implementation. The EMP will be incorporated into bidding and contract documents and will be implemented and monitored in accordance with ADB requirements throughout the Project lifecycle.

10.2 Environmental Management Plans

676. The EMP defines the environmental, occupational health and safety, community health and safety, stakeholder engagement, monitoring, reporting, and institutional measures required to manage project risks during pre-construction, installation, commissioning, stabilization, decommissioning, and operation. The approach follows the provided EMP sample, which requires the EMP to define mitigation, monitoring, institutional and reporting measures, to remain a live document, and to become a mandatory contractual obligation for the contractor.
677. The EMP is based on the findings of the IEE and reflects the specific nature of the Baku Metro Project. The project will be implemented within the existing metro footprint and will not involve new land acquisition, new metro corridors, or expansion into natural habitats. However, it includes technically complex works in a live underground system, including installation of CBTC-based signaling and digital systems, parallel operation of the new and legacy systems, and structured decommissioning of old signaling and electrical equipment. The project description identifies three main phases: signaling modernization and operations digitalization, stabilization and parallel operation, and decommissioning of the existing system.
678. Implementation of the EMP shall be mandatory for Baku Metropolitani CJSC, the PIU, the Contractor, subcontractors, suppliers, and any other parties engaged in project

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implementation. The EMP shall be included in bidding and contract documents and shall form part of the contractual obligations of the selected Contractor. No works shall commence until the required site-specific and topic-specific management plans have been prepared by the Contractor and approved by Baku Metropoliteni CJSC / PIU and the Engineer or Construction Supervision Consultant. Where required by ADB, selected plans shall also be submitted to ADB for review or no-objection.

679. The EMP shall be treated as a live document. It may be updated during project implementation if detailed design changes, monitoring results, unforeseen site conditions, changes in work methodology, stakeholder comments, or incidents indicate that additional mitigation or monitoring measures are required. Any material changes to the EMP or associated topic-specific plans shall be reviewed and approved by the PIU and the Engineer, and where the change relates to ADB safeguard compliance, submitted to ADB as required.
680. During the mobilization period, and before access to any work area is granted, the Contractor shall prepare a Site-Specific Environmental Management Plan (SEMP) and the associated topic-specific plans listed below. The SEMP shall explain how the Contractor will implement the commitments of the IEE and EMP, identify the exact locations where mitigation and monitoring will be applied, define responsible personnel, provide implementation schedules, describe reporting arrangements, and include site-specific procedures for working in stations, tunnels, depots, technical rooms, control facilities and other Baku Metro areas. The provided sample requires the contractor's SEMP and topic-specific plans to describe precise locations, responsibilities, schedules and reporting methodology before taking possession of work sites (Table 61).

Table 61: Topic-Specific Environmental and Social Management Plans Required for the Baku Metro Project

Plan	Description / minimum content	Approval by Baku Metro PIU	Approval by Engineer / Supervision Consultant	ADB review / no-objection
Site-Specific Environmental Management Plan (SEMP)	Describes how the Contractor will implement the IEE and EMP at each work location; includes work areas, responsibilities, mitigation measures, monitoring, reporting, incident management, and corrective action procedures.	Yes	Yes	Yes, if requested
Waste Management Plan	Defines waste streams, expected quantities, collection, segregation, labeling, transportation, depot-based temporary storage, recycling, reuse, final disposal, certified waste contractors, waste tracking and disposal documentation. Must include hazardous and non-hazardous waste separation and prohibition of waste storage in tunnels.	Yes	Yes	No
Hazardous Materials and PCB Management Plan	Covers inventory, inspection, sampling, testing, handling, labeling, transport, temporary storage and disposal of oil-filled transformers, oils, oily residues, contaminated absorbents, e-waste and PCB-suspected or PCB-confirmed materials.	Yes	Yes	Yes, if requested

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Plan	Description / minimum content	Approval by Baku Metro PIU	Approval by Engineer / Supervision Consultant	ADB review / no-objection
Spill Prevention and Response Plan	Defines spill prevention, secondary containment, spill kits, response procedures, reporting, responsibilities, training and clean-up requirements for oils, lubricants, transformer oils, solvents, contaminated water and other hazardous liquids.	Yes	Yes	No
Groundwater, Drainage and Wastewater Management Plan	Covers tunnel groundwater inflow, drainage protection, pump and sump protection, prevention of oil entry into drainage, control of contaminated water, water sampling where required, and management of any wastewater generated by cleaning or maintenance works.	Yes	Yes	No
Air Quality and Ventilation Management Plan	Covers dust, fumes, vapors, odors, ventilation of tunnels and technical rooms, indoor air quality controls, hot works ventilation, monitoring requirements and stop-work procedures for poor air quality.	Yes	Yes	No
Noise and Vibration Management Plan	Identifies noise- and vibration-generating activities, sensitive receptors, work timing, equipment controls, monitoring, worker protection and measures to avoid damage to sensitive structures and station finishes.	Yes	Yes	No
Occupational Health and Safety Plan	Covers worker safety, legal requirements, induction, PPE, tunnel access, confined spaces, night works, electrical works, LOTO, working near active metro operations, hazardous materials, manual handling, worker welfare, incident reporting and worker grievance mechanism.	Yes	Yes	Yes
Community Health and Safety / Passenger Safety Plan	Covers passenger safety, station access, public separation from works, emergency routes, public information, vulnerable users, service disruption management, works near station entrances, and coordination with Baku Metro operations.	Yes	Yes	No
Electrical Safety and Lock-Out / Tag-Out Plan	Defines electrical isolation, de-energization, verification of zero-energy state, authorization, signage, tagging, re-energization procedures, and coordination with Energy Dispatch and Operations Control Center.	Yes	Yes	No
Confined Space Work Procedure	Covers entry permits, atmospheric testing, ventilation, standby personnel, rescue arrangements, communications, lighting, emergency access and worker training for tunnels, shafts, cable ducts and technical rooms.	Yes	Yes	No
Emergency Preparedness and Response Plan	Covers fire, smoke, electrical accidents, tunnel flooding, hazardous material release, spills, evacuation, rescue, first aid, coordination with	Yes	Yes	No

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Plan	Description / minimum content	Approval by Baku Metro PIU	Approval by Engineer / Supervision Consultant	ADB review / no-objection
	OCC, station staff and emergency services, and emergency drills.			
Fire Safety and Hot Works Plan	Covers hot-work permits, fire watch, fire extinguishers, cable fire risk, combustible waste control, emergency response and coordination with Baku Metro fire safety procedures.	Yes	Yes	No
Traffic, Access and Material Transport Plan	Covers access to depots and stations, pedestrian and road safety, material loading and unloading, night-time rail transport of waste from tunnels to depots, and prevention of obstruction of public access routes.	Yes	Yes	No
Cultural Heritage Management Plan	Covers Nizami Metro Station, architecturally valuable stations, central Baku heritage-sensitive areas, protection of station finishes, pre-work condition records, approval of fixing points, material movement controls and Chance Find Procedure.	Yes	Yes	No
Stakeholder Engagement and Grievance Redress Plan	Updates stakeholder engagement arrangements for implementation and operation; defines information disclosure, complaint intake through Baku Metro structures, coordination with the Public Relations Center, response timelines, records and reporting.	Yes	Yes	No
Training and Capacity Building Plan	Defines training for Baku Metro staff, contractors, depot personnel, laboratory personnel and operations staff on ADB safeguards, waste management, hazardous materials, OHS, CBTC-related operational safety and emergency response.	Yes	Yes	No
Code of Conduct	Defines rules for worker behavior, safety discipline, access control, non-discrimination, respectful interaction with passengers and communities, prohibition of harassment, and disciplinary measures.	Yes	Yes	Yes
Security and Access Control Procedure	Defines control of access to tunnels, stations, depots, technical rooms, waste storage areas and hazardous-material zones; includes coordination with Baku Metro security and operations staff.	Yes	Yes	No

10.3 Bid Documents

681. The Bid Documents for the potential Contractors will contain two sections relating to environmental issues, firstly a basic clause indicating that the Contractor will be responsible for following the requirements of the EMPs and that he should prepare his own SEMP for the Project. Secondly, the EMPs shall be repeated in its entirety as an Annex to the Bid Documents so as the bidder is aware of his environmental requirements under the Project and help him

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put environmental costs to his proposal.

10.4 Contract Documents

682. The Contract Documents will follow a broadly similar pattern to the Bid Documents. It is not considered necessary to repeat the mitigation measures verbatim in a list of environmental contract provisions, rather the Contract will specify that the Contractor is responsible for implementation of the EMPs via his SEMP. Again, the EMPs will be included as an Annex to the Contract so the Contractor will be liable for any non-conformance with the EMPs, and thereby this EIA.

10.5 Institutional Arrangements: Roles and Responsibilities

683. Effective implementation of the Environmental Management Plan requires clearly defined roles, responsibilities, reporting lines and decision-making authority among the institutions involved in the Baku Metro Signalling Modernization and Operations Digitalization Project. The institutional arrangements presented below are based on the structure of the provided sample chapter, adapted to the specific implementation context of Baku Metropoliteni CJSC, the Project Implementation Unit, contractors, supervision arrangements and the Asian Development Bank.

684. The project will be implemented within an operational underground metro system and will include signaling modernization, installation of wayside and onboard equipment, system integration, stabilization and parallel operation, and decommissioning of the existing signaling system. The institutional framework therefore needs to cover not only conventional environmental management, but also occupational health and safety, passenger safety, emergency preparedness, hazardous materials, waste management, PCB screening, cultural heritage protection, grievance redress, and coordination with Baku Metro's operational services.

10.5.1 Baku Metropoliteni CJSC – Executing Agency

685. Baku Metropoliteni CJSC, acting as the Project Executing Agency, is responsible for ensuring that the project is implemented in full compliance with the requirements of the ADB Safeguard Policy Statement (2009), the applicable environmental and social legislation of the Republic of Azerbaijan, and the commitments set out in the approved Initial Environmental Examination and Environmental Management Plan.

686. The key responsibilities of Baku Metropoliteni CJSC include:

- Providing overall leadership and accountability for environmental, social, occupational health and safety, and community health and safety compliance throughout the project lifecycle;
- Ensuring that the PIU is established and maintained with adequate authority, staffing, technical capacity and resources to manage safeguard obligations;
- Ensuring that EMP requirements are incorporated into bidding documents, contracts, supervision arrangements, technical specifications and method statement requirements;
- Ensuring that project activities remain within the existing Baku Metro footprint unless any future additional area is separately screened and approved;

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- Ensuring that no works proceed without approved site-specific and topic-specific environmental, social, OHS and safety management plans;
- Ensuring effective operation of the project-level Grievance Redress Mechanism, including coordination with the existing Public Relations Center;
- Ensuring coordination with relevant state authorities, local executive bodies, emergency services, certified waste management organizations and other stakeholders;
- Providing adequate budget and resources for EMP implementation, monitoring, training, reporting; and
- Ensuring that semi-annual environmental monitoring reports and other safeguard reports are submitted to ADB as required corrective actions.

10.5.2 Project Implementation Unit – PIU

687. The **Project Implementation Unit**, established under Baku Metropolitani CJSC, will be responsible for day-to-day management and oversight of environmental and social safeguard implementation during the project preparation, implementation, stabilization, decommissioning and early operation stages. The PIU will act as the main coordination body between Baku Metropolitani CJSC, contractors, the supervision consultant, Baku Metro operational departments, ADB and other stakeholders.

688. The PIU's key responsibilities include:

- Ensuring implementation of the approved IEE, EMP and all associated management plans in accordance with ADB SPS and national legislation;
- Coordinating environmental, social, OHS, passenger safety, hazardous materials, waste management, cultural heritage and grievance-related activities;
- Reviewing and approving the Contractor's Site-Specific Environmental Management Plan and topic-specific plans before works commence;
- Ensuring that contractors allocate adequate personnel, equipment, budget and technical resources for safeguard implementation;
- Coordinating with the Engineer / Supervision Consultant on routine inspections, audits, monitoring and non-compliance management;
- Reviewing contractor monitoring data, incident records, waste documentation, training records, grievance records and corrective action reports;
- Ensuring that decommissioning activities do not begin until GO/NO-GO preconditions, safety verification and environmental readiness requirements are met;
- Coordinating PCB testing, hazardous waste classification, waste transfer documentation and use of certified waste management organizations;
- Maintaining the project grievance database and ensuring that complaints are received, assigned, resolved and closed within agreed timeframes;
- Preparing and submitting periodic environmental and social monitoring reports to Baku Metropolitani CJSC and ADB.

10.5.3 PIU Environmental and Social Safeguards Specialist

689. The PIU shall include, or have access to, an Environmental and Social Safeguards Specialist responsible for technical oversight of EMP implementation. This specialist will support the PIU in reviewing contractor plans, monitoring field implementation, maintaining safeguard records and coordinating reporting.

690. The key responsibilities of the PIU Environmental and Social Safeguards Specialist include:

- Reviewing contractor environmental, social, OHS, waste, hazardous materials, emergency, cultural heritage and stakeholder engagement plans;
- Conducting regular field inspections with the supervision consultant and contractor EHS staff;
- Verifying implementation of mitigation measures in tunnels, stations, depots, technical rooms and temporary waste storage areas;
- Ensuring that waste is not stored in tunnels and is transported to designated depot areas in accordance with approved procedures;
- Coordinating with the Baku Metro Laboratory and external certified laboratories for environmental monitoring, PCB testing and specialized analyses;
- Reviewing incident reports, non-compliance notices and corrective action plans;
- Supporting stakeholder engagement, public disclosure and grievance management;
- Preparing safeguard inputs for semi-annual environmental monitoring reports to ADB

10.5.4 Construction Contractor

691. The Contractor is responsible for the direct implementation of all environmental, social, occupational health and safety, passenger safety and waste management measures during project implementation. This includes works related to installation, testing, commissioning, stabilization support, decommissioning, waste transport and reinstatement of affected areas.

692. The Contractor's key responsibilities include:

- Preparing, updating and implementing the Site-Specific Environmental Management Plan and all required topic-specific plans;
- Implementing all mitigation and monitoring measures required by the IEE, EMP, contract documents and approved method statements;
- Ensuring that all subcontractors comply with EMP requirements and that safeguard obligations are cascaded through the supply chain;
- Appointing qualified environmental, health and safety personnel, including an Environmental Management Officer and Health and Safety Officer;
- Implementing permit-to-work, confined-space, hot-work, electrical safety and LOTO procedures;
- Ensuring that all workers receive induction, task-specific training and toolbox talks;
- Ensuring that works in tunnels, stations, depots and technical rooms are coordinated with Baku Metro operational departments;
- Ensuring that no waste is temporarily stored in tunnels, station platforms, escape routes, drainage channels or operational underground areas;
- Ensuring that waste is segregated, labelled, transported to depot storage areas and transferred only to certified organizations;
- Implementing hazardous materials and PCB procedures before handling oil-filled transformers or suspected contaminated equipment;
- Maintaining records of inspections, monitoring results, waste quantities, waste transfer notes, incidents, accidents, training and corrective actions;

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- Reporting significant environmental, OHS, passenger safety or community incidents immediately to the PIU and supervision consultant. Supporting grievance resolution and providing information required for investigation of complaints.

693. The Contractor shall retain a dedicated Environmental Management Officer and Health and Safety Officer throughout the implementation period. Depending on the scale and sequencing of works, the Contractor may also require hazardous waste specialists, electrical safety supervisors, confined-space supervisors, emergency response coordinators and cultural heritage focal points.

10.3.6 Engineer / Construction Supervision Consultant

694. The **Engineer / Construction Supervision Consultant** will provide independent day-to-day supervision of project implementation and verify compliance with the approved IEE, EMP, Site-Specific EMP, topic-specific plans, contract documents, national legislation and ADB safeguard requirements. This role is particularly important because the project will be implemented in a high-risk underground operational environment.

695. The Engineer / Supervision Consultant's key responsibilities include:

- Reviewing and providing recommendations on the Contractor's Site-Specific EMP and topic-specific management plans before commencement of works;
- Confirming that required mitigation measures are in place before approving specific activities or work fronts;
- Conducting routine site inspections and audits in tunnels, stations, depots, technical rooms, waste storage areas and access points;
- Monitoring high-risk activities, including electrical works, confined-space works, hazardous-material handling, waste transport, decommissioning and works near passenger areas;
- Verifying that construction and decommissioning methods comply with approved method statements and EMP requirements;
- Ensuring that no activity proceeds unless associated environmental, OHS, passenger safety and emergency controls are ready for implementation;
- Identifying, documenting and reporting non-compliances;
- Issuing non-compliance notices and monitoring the implementation and closure of corrective actions;
- Recommending suspension of works in case of serious or repeated violations posing environmental, safety or public risk;
- Reviewing contractor environmental and safety monitoring data, waste records, incident reports and training records;
- Supporting the PIU in communications with ADB, including safeguard review missions and audits;
- Providing technical guidance and on-the-job support to the Contractor and PIU on safeguard compliance;
- Preparing inputs for periodic environmental and social monitoring reports

10.3.7 Asian Development Bank

696. The **Asian Development Bank** is responsible for safeguard oversight and compliance assurance in accordance with the ADB Safeguard Policy Statement (2009). ADB does not manage day-to-day project implementation, but it reviews safeguard documentation, monitors implementation performance and requires corrective action where needed. This role is consistent with the sample institutional arrangements chapter.

697. ADB's key responsibilities include:

- Reviewing and clearing the IEE and EMP prior to project approval and ensuring disclosure in accordance with ADB requirements;
- Reviewing semi-annual environmental monitoring reports and other safeguard reports submitted by the PIU;
- Conducting safeguard review missions and site visits where necessary;
- Requiring corrective actions or additional mitigation measures in case of non-compliance, incidents or unforeseen impacts;
- Monitoring the functioning of the GRM and ensuring that affected persons have access to ADB's Accountability Mechanism where project-level resolution is not achieved.

10.4 EMP Summary Costs

698. Most costs associated with implementation of the Environmental Management Plan for the Baku Metro Signaling Modernization and Operations Digitalization Project are expected to be integrated into project design, procurement, contractor pricing, supervision arrangements and standard implementation practice. These include routine good housekeeping, safe access control, standard occupational health and safety measures, worker induction, use of PPE, normal waste collection, station-level coordination, signage, and standard contractor environmental management obligations. This approach is consistent with the provided EMP cost template, which distinguishes between standard construction obligations and incremental costs required for specific mitigation, monitoring and supervision measures.

699. For the Baku Metro Project, the main incremental EMP costs are related to safeguard supervision, contractor environmental and OHS staffing, instrumental monitoring, hazardous materials and PCB screening, waste management, training, stakeholder engagement, grievance management, emergency preparedness, and protection of cultural heritage-sensitive station areas. The project has specific risks because it will be implemented within an operational underground metro system and includes decommissioning of legacy signaling and electrical equipment, including approximately 933 oil-filled choke-transformers, old cables, control boxes, relay systems, tunnel telephones and other electrical and electronic equipment.

700. The cost estimates below are indicative and should be refined during detailed design and procurement, once the contractor's method statements, equipment inventory, PCB testing requirements, waste volumes, implementation schedule and supervision arrangements are finalized. Costs associated with safe construction methods, standard OHS compliance, PPE, routine waste collection, and normal contractor management are assumed to be included in the contractor's contract price and are not repeated as separate EMP costs unless they require additional specialist services, monitoring, training or certified disposal (**Table 62**).

Table 62: Estimated EMP Costs for the Baku Metro Project

No.	Item	Unit	No. of months / quantity	Unit cost, USD	Total cost, USD
1	International Environmental Specialist / Safeguards Specialist of Supervision Consultant	Salary / intermittent input	8 months	20,000	160,000
2	National Environmental Specialist of Supervision Consultant	Salary	36 months	2,000	72,000
3	National Social / Stakeholder Engagement Specialist of Supervision Consultant	Salary	24 months	2,000	48,000
4	National Health and Safety Specialist of Supervision Consultant	Salary	36 months	2,000	72,000
5	Hazardous Materials / Waste Management Specialist	Intermittent specialist input	6 months	3,000	18,000
6	Cultural Heritage Specialist	Intermittent / as required for Nizami Station and sensitive central stations	2 months	3,000	6,000
7	Contractor Environmental Management Officer	Salary	36 months	1,500	54,000
8	Contractor Health and Safety Officer	Salary	36 months	1,500	54,000
9	Contractor Waste / Hazardous Materials Focal Point	Salary / intermittent	18 months	1,500	27,000
10	Instrumental environmental monitoring during implementation, including microclimate, noise, ventilation checks, hydrocarbons and targeted additional measurements	Month	36 months	3,500	126,000
11	Specialized laboratory testing for transformer oil / PCB screening	Sample / package	100–150 samples	150	15,000–22,500
12	Additional hazardous waste classification testing, including oily residues, sludge, contaminated absorbents or unknown materials	Lump sum	—	—	15,000
13	Spill kits for depots, technical rooms, transformer handling points and work teams	Piece	25	300	7,500
14	Secondary containment, drip trays, sealed drums and hazardous waste storage equipment	Lump sum	—	—	20,000
15	Temporary depot waste storage area improvement, including signage, segregation zones, impermeable surface protection, labels and access control	Lump sum	—	—	25,000
16	Certified hazardous waste transport and disposal support for oil-contaminated materials, absorbents, sludge and PCB-suspected materials, excluding large-scale final disposal if PCB quantities are confirmed	Lump sum	—	—	40,000

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No.	Item	Unit	No. of months / quantity	Unit cost, USD	Total cost, USD
17	E-waste and cable waste management documentation, segregation, packaging and licensed transfer support	Lump sum	—	—	20,000
18	Worker training on ADB safeguards, OHS, waste segregation, PCB awareness, emergency response and cultural heritage protection	Training package	6 sessions	2,500	15,000
19	Depot staff training on ADB waste management requirements, secondary containment, documentation and certified transfer procedures	Training package	2 sessions	2,500	5,000
20	GRM, stakeholder engagement and public information materials	Lump sum	—	—	10,000
21	Emergency preparedness drills, including fire, spill, tunnel access, evacuation and hazardous material response	Drill / package	4	3,000	12,000
22	Cultural heritage protection measures for sensitive station interiors, including pre-work photo records, protective coverings and monitoring	Lump sum	—	—	15,000
23	External audit / independent safeguard review during implementation	Audit	2	7,500	15,000
	Estimated Total				856,000–863,500
	Contingency	10%			86,350
	Estimated Sub-Total				949,850

701. The total estimated EMP cost for planning purposes is therefore approximately **USD 950,000**, including a 10% contingency. This figure excludes costs that are expected to be included in the contractor's general contract price, such as routine PPE, standard site housekeeping, ordinary tools and equipment, standard fire extinguishers, regular worker supervision, routine work permits, and normal safe working practices. It also excludes major unforeseen costs that may arise if extensive PCB contamination, asbestos-containing materials, or large quantities of contaminated sludge are confirmed during implementation; such costs should be treated as provisional and priced separately following laboratory confirmation.
702. If PCB contamination is confirmed in transformer oil or equipment, the cost of final treatment, export, or specialized disposal may increase significantly and should be managed through a dedicated provisional sum or variation mechanism. Similarly, if asbestos-containing materials, contaminated soil, or contaminated drainage sediment are encountered in quantities greater than currently anticipated, additional testing, packaging, transport, disposal and worker protection costs will be required. These potential costs should be addressed through the project's hazardous materials management procedure and approved only after evidence-based classification.
703. The EMP budget shall be reviewed during detailed design, contractor mobilization, and prior to the decommissioning phase. The contractor shall provide updated costed management

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plans as part of the Site-Specific Environmental Management Plan. The PIU and Supervision Consultant shall verify that adequate funds are available for implementation of all mitigation, monitoring, training, waste management, emergency preparedness and reporting requirements before works commence.

10.5 Environmental Management Plan

704. This Environmental Management Plan establishes the framework for managing environmental, occupational health and safety, community health and safety, and social risks during the implementation and operation of the Baku Metro Signaling Modernization and Operations Digitalization Project. It has been prepared in accordance with the approach used in the provided EMP template, which presents mitigation measures, monitoring requirements, and responsible parties for pre-construction, construction and operation phases.
705. The Baku Metro Project will be implemented within the existing metro infrastructure and will include modernization of signaling and communication systems, installation of wayside and onboard equipment, integration and testing of the new CBTC-based system, a stabilization and parallel operation period, and decommissioning of the existing legacy signaling system. The project does not include new metro corridors, new stations, major excavation works, or expansion into natural habitats or protected areas. However, the project involves works in an active underground metro environment and the removal of legacy electrical and signaling equipment, including oil-filled choke-transformers, old cables, control boxes, tunnel telephones, relay systems and other electrical/electronic components.
706. The objective of this EMP is to translate the impact assessment findings of the IEE into practical and enforceable mitigation, monitoring and institutional measures. It is binding on the Contractor, subcontractors and all parties involved in project implementation. The Contractor shall prepare a Site-Specific Environmental Management Plan and topic-specific plans before the start of works. These shall be approved by the PIU and Supervision Consultant before access to any work area is granted.

Table 63: Pre-construction Phase EMP

Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Pre-Construction				
Inadequate pre-construction planning for environmental, OHS, passenger safety, waste, hazardous materials and emergency risks	Before works begin, the Contractor shall prepare and submit for approval the Site-Specific Environmental Management Plan and all topic-specific plans, including Waste Management Plan, Hazardous Materials and PCB Management Plan, Spill Prevention and Response Plan, Groundwater and Drainage Management Plan, Air Quality and Ventilation Management Plan, Noise and Vibration Management Plan, Occupational Health and Safety Plan, Community Health and Safety / Passenger Safety Plan, Electrical Safety and LOTO Plan, Confined Space Procedure, Emergency Preparedness and Response Plan, Fire Safety and Hot Works Plan, Traffic and Access Management Plan, Cultural Heritage Management Plan, Stakeholder Engagement and GRM Plan, Training Plan, and Code of Conduct. No works shall start until the relevant plans and method statements are approved.	See table 66	Contractor	PIU / Supervision Consultant
Impact on air quality	• Include air quality, dust, fumes, vapour, and ventilation control requirements in contractor environmental and OHS documentation; • Prepare an inventory of legacy electrical and signaling equipment to be removed, including oil-filled transformers, cables, control boxes, relay equipment and e-waste; • Identify equipment requiring PCB or hazardous-material testing before removal or dismantling; • Define ventilation requirements for tunnels, technical rooms, relay rooms, transformer areas, and other enclosed workspaces. • Require contractors to submit method statements for works that may generate dust, fumes, vapors, odors or indoor air quality risks; • Confirm emergency response arrangements for spills, odor events, poor ventilation, fire, smoke, or accidental exposure to hazardous substances;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Pre-Construction				
	Ensure that all workers receive training on air quality risks in underground and enclosed work environments.			
Impacts to Groundwater and Tunnel Drainage Systems	- Identify all work areas where groundwater seepage, drainage channels, sumps, pumping systems or wet tunnel conditions are present; - Prepare method statements for works in wet tunnels, drainage areas, transformer locations, cable ducts and technical rooms; - Include drainage protection requirements in contractor work plans and permit-to-work systems; - Prepare an inventory of oil-filled transformers and other equipment that may contain oils or hazardous substances; - Carry out PCB and oil-quality testing before dismantling or draining old oil-filled equipment, where required; - Identify temporary storage locations for dismantled equipment away from drainage channels, floor drains and seepage areas; - Ensure that spill prevention, containment, and emergency response procedures are approved before decommissioning works begin; - Confirm that no untreated water, contaminated wash water, oil residues or cleaning water will be discharged into drainage or sewer systems without appropriate control - Ensure that the Baku Metro Laboratory monitoring program is linked to project activities where water quality or hydrocarbon risks may arise.	See table 66	Contractor	PIU / Supervision Consultant
Impact on soils, geology and geohazards	- Confirm that all project works remain within existing Baku Metro infrastructure, depots, technical rooms, tunnels and stations; - Prepare a detailed inventory of legacy equipment to be removed, including oil-filled choke-transformers, cables, junction boxes, switch machines, tunnel telephones and relay equipment;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Pre-Construction				
	- Identify equipment and locations with potential contamination risks, including oil leakage, degraded insulation, residues in cable ducts and drainage sediment; - Conduct oil sampling and PCB testing for oil-filled equipment where required before dismantling, draining, transport or disposal; - Prepare method statements for dismantling works in areas with possible contamination, groundwater seepage, drainage channels or confined underground condition; - Ensure that all new equipment supports, cabinets, cable trays and fixings are designed for relevant vibration and seismic conditions; - Avoid any design or installation solution that blocks existing drainage channels, sump access, inspection points or emergency routes; - Define temporary storage areas for dismantled equipment on impermeable surfaces, away from drainage inlets and groundwater seepage zones; - Include soil, contamination, hazardous-material and geohazard requirements in contractor EMP, OHS Plan and waste management procedures			
Waste Management	- Prepare a project-specific Waste Management Plan covering all three phases of the project; - Prepare a detailed inventory of all equipment to be removed, including transformers, cables, switch machines, control boxes, relay systems, tunnel telephones and onboard units; - Classify expected waste streams as reusable, recyclable, non-hazardous, e-waste, hazardous, PCB-suspected or PCB-confirmed; - Identify all oil-filled equipment and define sampling and PCB testing requirements before removal, draining or disposal;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Pre-Construction				
	- Identify approved temporary waste storage areas within depots or technical facilities, preferably on impermeable surfaces and away from drainage points; - Identify licensed waste transporters, recycling facilities and hazardous waste disposal facilities before waste generation begins; - Include waste management obligations in contractor and subcontractor contracts; - Prepare waste tracking forms, chain-of-custody templates and disposal certificate requirements; - Train workers on waste segregation, hazardous waste recognition, PCB precautions, spill prevention and emergency response			
Occupational Health and Safety	- Prepare a project-specific OHS Management Plan covering installation, testing, parallel operation, decommissioning, waste handling and operation; - Prepare task-specific method statements and risk assessments for all high-risk works; - Establish a permit-to-work system for tunnel access, confined spaces, electrical works, hot works, night works and hazardous-material handling; - Prepare and approve Lock-Out / Tag-Out procedures for all works on or near electrical systems; - Prepare emergency response procedures for fire, electrical accident, tunnel flooding, spill, confined-space rescue, injury and evacuation; - Define communication protocols between contractors, Baku Metro dispatch units, station staff, energy dispatch, sanitation dispatch and maintenance teams; - Identify competent supervisors for each work front and shift; - Ensure all workers receive induction training before accessing metro work areas;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Pre-Construction				
	- Confirm fitness-for-work requirements for night work, confined-space work, electrical work and hazardous-material handling; - Confirm that all required PPE, gas detectors, spill kits, rescue equipment, fire extinguishers and first-aid kits are available before work starts.			
Community Health and Safety	- Prepare a Population Safety Plan covering passengers, pedestrians, road users, nearby residents, businesses and vulnerable groups; - Prepare station-specific access and passenger movement plans where works may occur near public areas; - Define clear separation between public areas and work areas using barriers, signage, locked doors, guards or access control; - Prepare emergency response procedures for fire, smoke, electrical incident, flooding, hazardous material release, service disruption and evacuation.; - Coordinate all work planning with the Operations Control Center, station managers, dispatchers and emergency response teams; - Identify vulnerable-user needs, including accessible routes, lifts, escalators, alternative access and clear public information; - Establish public communication procedures for planned works, service changes, access restrictions or temporary closures; - Confirm that no waste, equipment or materials will be stored in tunnels, platforms, public access areas or evacuation routes; - Define night-time waste transport arrangements by rail to depots during the permitted work window. - Ensure that all contractors understand passenger safety requirements before mobilization.	See table 66	Contractor	PIU / Supervision Consultant
Land Acquisition, Resettlement and Economic Displacement	- Confirm the physical footprint of each work area and verify that no private land acquisition is required; - Screen all station, depot and surface access areas for possible temporary access impacts;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Pre-Construction				
	- Identify nearby businesses, kiosks, vendors, public institutions and vulnerable users that may be affected by temporary access changes; - Prepare site-specific access management plans where works may affect station entrances, exits, pedestrian routes, service roads or depot gates; - Ensure that temporary pedestrian routes are safe, clearly marked, well lit and accessible for vulnerable users; - Include access protection and livelihood disruption avoidance requirements in contractor method statements; - Consult affected businesses, station tenants, vendors or institutions in advance where temporary access restrictions are expected; - Provide public information before any temporary closure, rerouting or access change; - Establish a grievance mechanism for complaints related to access, business disruption, pedestrian safety and service changes; - If any unavoidable temporary economic impact is identified, prepare a corrective action or compensation approach consistent with ADB SPS requirements.			
Cultural Heritage	- Confirm whether planned works will affect Nizami Metro Station or any other heritage-sensitive station area; - Prepare a photographic and written pre-work condition record for Nizami Metro Station and other sensitive station interiors before works begin; - Identify original decorative elements, stone cladding, mosaics, wall panels, lighting features, inscriptions, entrance pavilions, and other station-specific features requiring protection; - Prioritize existing cable ducts, technical rooms, service routes, concealed spaces, and non-visible areas for new equipment installation;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Pre-Construction				
	• Avoid routing new cables, conduits, cabinets, or fixing points across visible decorative or heritage-sensitive surfaces; • Require written approval from Baku Metro and, where applicable, competent cultural heritage authorities before works in listed or legally protected areas; • Define no-go areas, protection zones, and permitted access routes within heritage-sensitive stations; • Include cultural heritage requirements in method statements, work permits, contractor EMP, OHS Plan, and site induction training; • Screen works near Icherisheher, Nizami Street, 28 May, Sahil, Elmlar Akademiyasi, and other central areas for possible indirect impacts on historic buildings and cultural access; • Prepare a Chance Find Procedure and ensure workers understand stop-work and notification requirements.			
Economy, Employment and Livelihoods	• Screen all work locations for possible impacts on businesses, kiosks, vendors, service providers and passenger access; • Identify stations where passenger flows are high and where access restrictions could affect business activity; • Prepare station-specific access management plans where works may affect entrances, exits, pedestrian flows or commercial areas; • Inform affected businesses and service providers in advance about planned works, timing, duration and access arrangements; • Require contractors to maximize use of local labor where skills are available; • Include fair recruitment, equal opportunity, non-discrimination and labor rights requirements in contractor contracts; • Prepare a training plan for Baku Metro staff covering CBTC, digital systems, safety procedures and emergency response; • Establish a grievance mechanism for businesses, passengers and workers affected by economic or access-related impacts;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Pre-Construction				
	Define procedures for documenting and addressing any unforeseen temporary livelihood impact.			

Table 64: Construction Phase EMP

Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
Impact on air quality	- Use only technically sound and regularly maintained vehicles, generators, lifting equipment and service machinery; - Avoid unnecessary idling of vehicles and equipment at depots, access points, station areas and technical facilities; - Prohibit open burning of any waste, packaging, cable insulation, plastics, oily materials or other materials; - Carry out drilling, cutting and fixing works using dust-control methods, including local extraction or wet methods where technically feasible; - Clean work areas regularly to prevent accumulation and re-suspension of dust; - Store dusty materials, waste insulation and dismantled materials in closed containers or covered areas; - Ensure that waste transport vehicles are covered where loose or dusty materials are transported. Maintain good housekeeping in tunnels, technical rooms, depots and station work areas; - Ensure adequate ventilation before and during works in tunnels, shafts, technical rooms, transformer areas and confined spaces; - Apply permit-to-work procedures for activities in confined or poorly ventilated spaces; - Conduct air quality or gas checks where works involve oils, solvents, fumes, suspected contamination, or confined spaces	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
	• Provide appropriate PPE, including dust masks, respirators, gloves and eye protection, based on task-specific risk assessment; • Avoid welding, cutting or hot works in poorly ventilated areas unless a hot-work permit, ventilation and fire watch are in place; • Remove dust and residues using safe cleaning methods; dry sweeping in enclosed technical areas should be avoided where it may re-suspend dust; • Maintain access to emergency ventilation and evacuation routes at all time; • Stop work immediately if strong odor, smoke, unusual vapor, oil release, or signs of poor ventilation are detected.			
Impacts to Groundwater and Tunnel Drainage Systems	• Maintain all existing tunnel drainage channels, sumps and pumping systems in operational condition during works; • Do not store cables, dismantled equipment, waste, packaging, tools or construction materials in drainage channels or near sump inlets; • Keep work areas clean and remove waste promptly to prevent blockage of drainage systems. • Store oils, lubricants, solvents, cleaning agents and other liquids in sealed containers with secondary containment; • Carry out refueling, oil transfer, draining or maintenance activities only in designated controlled areas with impermeable surfaces and spill kits; • Use drip trays, absorbent pads and spill containment during removal or movement of oil-filled transformers and other oil-containing equipment; • Prohibit washing of contaminated parts, oily equipment or tools in tunnel areas unless wastewater is collected and managed as potentially contaminated waste; • Prevent discharge of oil, sediment, cleaning water, transformer oil, contaminated groundwater or sludge into tunnel drainage without prior assessment and approval;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
	• Collect contaminated sediment, sludge, absorbents and oily residues separately and manage them as hazardous or special waste, as appropriate; • Use licensed contractors for collection, transport and disposal of hazardous liquid waste, PCB-contaminated oil, oily sludge and contaminated absorbents; • Ensure that all spill incidents are immediately contained, cleaned, recorded and reported to Baku Metro HSE management; • Conduct toolbox talks for workers on protection of drainage systems, spill prevention, and response to unexpected groundwater or oil releases; • Stop work if uncontrolled water inflow, oil leakage, strong odor, visible sheen, or contaminated drainage water is observed; • Resume works only after the source of contamination or drainage risk has been identified and corrective actions have been implemented.			
Impact on soils, geology and geohazards	• Limit all physical disturbance to the minimum area required for installation, cable routing, testing and dismantling; • Avoid unnecessary breaking, cutting or disturbance of existing concrete floors, tunnel linings, ballast or cable ducts; • Keep work areas clean and remove debris, dust, obsolete equipment and dismantled materials promptly; • Use drip trays, absorbent materials and spill kits during handling of oil-filled equipment; • Do not place oil-filled equipment, oily materials, contaminated parts or waste directly on unprotected surfaces; • Store fuels, oils, lubricants, solvents and chemicals on impermeable surfaces with secondary containment; • Prohibit refueling, draining of oil, equipment maintenance or chemical handling directly on soil, ballast or unprotected concrete surfaces;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
	• Segregate potentially contaminated materials, cable insulation, oily residues, sludge and absorbents from general waste; • Manage contaminated materials, oily waste, PCB-contaminated oil and hazardous residues through licensed contractors; • If contaminated material is discovered, stop work in the affected area, isolate the material, notify Baku Metro HSE management and define disposal requirements; • Restore any disturbed surfaces, technical rooms or depot areas after completion of works; • Maintain records of all contaminated materials removed, including quantities, classification, transport and disposal destination; • Maintain access to drainage channels, pumps and inspection points throughout works; • Conduct toolbox talks for workers on spill prevention, contamination recognition, safe handling of old equipment and reporting procedures.			
Impact on flora, fauna and habitat	• All project activities shall be confined to existing Baku Metro tunnels, stations, depots, technical rooms, control facilities and approved access areas; • No works shall be carried out in protected areas, natural habitats, semi-natural habitats, coastal habitats, wetlands, riverbeds or areas outside approved project facilities; • No vegetation clearance shall be undertaken unless technically unavoidable and approved by Baku Metro; any vegetation affected shall be limited to low-value ornamental or ruderal vegetation around existing facilities; • Work areas shall be kept clean to avoid attracting rodents, insects, stray animals or nuisance species; • Food waste shall be collected in closed containers and removed regularly from work areas, depots and temporary storage locations; • Waste shall not be dumped in tunnels, drainage channels, shafts, depots, station yards or adjacent urban areas;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
	• If bats, nesting birds or other fauna are discovered in technical cavities, low-disturbance rooms or above-ground structures, works shall stop in the immediate area and Baku Metro HSE staff shall determine an appropriate action before works resume; • Workers shall be instructed not to harm animals, disturb nests, collect wildlife, or block access points used by fauna unless required for hygiene or safety reasons and approved by responsible staff; • Spill prevention measures shall be implemented during handling of oils, lubricants, transformers, batteries, solvents and hazardous materials to prevent indirect contamination of drainage systems; • Dismantled materials, oily equipment and contaminated residues shall be stored on impermeable surfaces and protected from contact with drainage channels; • Any contaminated sediment, oily residue or waste discovered in drainage areas shall be segregated and managed through approved waste procedures • Pest control, where required, shall be carried out using safe and controlled methods and shall avoid unnecessary use of hazardous chemicals.			
Waste Management	• Segregate waste at source and do not mix hazardous and non-hazardous waste; • Remove waste from tunnels, platforms, technical rooms and access areas at the end of each work shift; • Keep all work areas free of loose cables, packaging, debris and dismantled materials that may obstruct access or drainage; • Store scrap metal, cable waste and e-waste in separate labelled containers; • Store oil-filled equipment and oily materials on impermeable surfaces with secondary containment • Use drip trays and absorbent materials during handling or temporary storage of oil-filled equipment; • Do not cut, drain or dismantle oil-filled transformers before classification and approval of the handling method;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
	• Treat all old transformer oil as potentially hazardous until laboratory testing confirms otherwise; • Treat PCB-suspected and PCB-confirmed waste as hazardous waste and keep it isolated from other waste streams; • Prohibit open burning of waste, including cable insulation, packaging, plastics, rags or oily materials; • Prohibit disposal of waste into tunnels, drainage channels, shafts, station areas, vacant land or municipal bins not approved for that waste type; • Use licensed contractors for hazardous waste, e-waste and PCB-contaminated waste transport and disposal; • Maintain waste logs showing type, quantity, source, storage location, transporter and final destination; • Obtain disposal certificates and recycling records for all significant waste streams; • Investigate and report all spills, waste mismanagement incidents, illegal dumping or loss of waste traceability.			
Occupational Health and Safety	• All works in tunnels and operational areas shall be performed only under an approved work permit; • Access to tunnels shall be controlled and coordinated with the Operations Control Center and relevant dispatch units; • Work areas shall be physically separated from active train operations where feasible; • No work shall be undertaken near energized equipment without verified isolation and LOTO; • Electrical testing shall be carried out only by qualified personnel using approved instruments and procedures; • Confined-space entry shall require prior atmospheric checks, ventilation, standby personnel and rescue arrangements; • Adequate lighting shall be provided in tunnels, cable areas, technical rooms and temporary work areas;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
	• Walkways, escape routes, drainage channels and emergency access points shall be kept clear at all times; • Tools, cables, waste and dismantled equipment shall not be stored in a manner that creates trip, fire or evacuation hazards; • Hot works shall be subject to a hot-work permit, fire watch, ventilation and availability of fire extinguishers; • Workers shall use task-specific PPE, including safety footwear, helmets, gloves, eye protection, respiratory protection, hearing protection, high-visibility clothing and electrical PPE where required; • Works involving oil-filled transformers or suspected hazardous materials shall follow hazardous-material procedures and shall include PPE, spill control and restricted access; • Manual handling shall be minimized through mechanical aids, team lifting and pre-planned movement routes; • Workers shall be protected from fatigue by controlling night work duration, rest periods and shift rotation; • Toolbox talks shall be conducted before each shift and before any high-risk activity.; • All incidents, near misses, unsafe conditions and non-conformities shall be reported, investigated and corrected.			
Community Health and Safety	• Works affecting public areas shall be scheduled, where practicable, outside peak passenger hours or during night-time access windows; • Public access routes shall remain safe, clearly marked, well lit, and free from tools, cables, waste, materials and trip hazards; • Physical barriers shall be installed between work areas and public areas wherever there is a risk of accidental access; • Warning signs shall be provided in Azerbaijani and, where appropriate, in simple pictograms understandable to all users; • Station staff shall be briefed on work activities, passenger rerouting, emergency procedures and complaint handling;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
	• Temporary access arrangements shall consider persons with disabilities, elderly passengers, parents with children and passengers with luggage; • All emergency exits, evacuation routes, fire doors, stairs, escalators, lifts and emergency equipment shall remain unobstructed; • Hot works, electrical works and hazardous-material handling shall not be conducted in areas accessible to passengers; • Waste shall not be temporarily stored in tunnels, station platforms, passenger areas, evacuation routes or drainage channels; • All waste generated underground shall be collected and transported to depot areas by rail during the permitted night working period from 1:30 AM to 5:30 AM, depending on quantity and operational arrangements; • Hazardous and non-hazardous waste shall be segregated and securely packed before movement through metro infrastructure; • Liquid waste shall be placed in leak-proof containers with secondary containment equal to at least 110% of the liquid waste volume; • Loading and movement of dismantled equipment shall be supervised to prevent falling objects, spills, obstruction or unsafe interaction with operational systems; • If works create temporary service changes, Baku Metro shall provide advance notice through station announcements, signage, website/social media channels or other appropriate means; • A grievance mechanism shall be available for passengers, nearby residents, businesses and institutions to raise safety or access concerns.			
Land Acquisition, Resettlement and Economic Displacement	• Keep all works within approved Baku Metro facilities and work zone;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
	• Avoid closure of station entrances or pedestrian routes unless technically necessary and approved by Baku Metro; • Maintain at least one safe and accessible route to each affected station, building, business or public facility wherever practicable; • Install clear signs showing alternative pedestrian routes, station access points and temporary changes; • Ensure temporary routes are suitable for persons with disabilities, elderly passengers and people with luggage or children; • Avoid blocking shop entrances, kiosks, delivery access, emergency access or public transport stops; • Schedule works affecting public access during low-passenger periods where practicable; Ensure that loading, unloading and waste movement do not obstruct public access or business activity; • Provide advance notice to affected businesses and institutions regarding the timing, duration and nature of access changes • Record and respond promptly to grievances related to access restriction, business disturbance or service disruption; • If temporary economic displacement occurs and cannot be avoided, assess the impact and apply agreed mitigation or compensation measures; • Reinstate affected access routes, signage, pedestrian areas and service areas immediately after completion of works.			
Cultural Heritage	• Works shall be confined to approved technical areas, tunnels, service spaces, and designated work zones; • No drilling, cutting, fixing, anchoring, or equipment installation shall be carried out on decorative or heritage-sensitive surfaces without written approval; • At Nizami Metro Station, all works shall be supervised under heritage-sensitive procedures and preceded by condition documentation; • Existing ducts, cable trays, hidden service corridors, and technical rooms shall be used wherever feasible;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
	• Protective coverings shall be installed on floors, walls, corners, decorative surfaces, stair areas, and access routes used for material movement in sensitive stations; • Heavy equipment, cable drums, waste containers, tools, and dismantled materials shall not be leaned against or stored near decorative panels, stone cladding, monuments, inscriptions, or historic features; • Waste and dismantled equipment shall be removed using controlled routes that avoid damage to station interiors and public cultural spaces; • Vibration-intensive works near historic buildings or protected station elements shall be avoided where possible; if unavoidable, pre-work condition checks and monitoring shall be considered; • Temporary works shall not obstruct public access to cultural institutions, religious buildings, memorials, museums, theatres, or tourism routes unless an alternative route is clearly provided; • Good housekeeping shall be maintained to avoid dust deposition, staining, or damage to station finishes; • Any accidental damage to station architectural features or nearby heritage assets shall be reported immediately, documented, and repaired using appropriate materials and methods; • If a chance find is discovered, works shall stop immediately in the affected area and the Chance Find Procedure shall be applied.			
Economy, Employment and Livelihoods	• Maintain safe access to station entrances, nearby shops, kiosks, service providers and public transport connections wherever practicable; • Avoid blocking shopfronts, vending areas, delivery access, pedestrian routes or business entrances unless unavoidable and approved; • Schedule works affecting public access during low passenger-flow periods where technically feasible; • Provide clear signs and alternative access routes if pedestrian flows are temporarily changed;	See table 66	Contractor	PIU / Supervision Consultant

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Construction				
	• Ensure station staff are informed about access changes and can guide passengers and customers; • Notify businesses in advance of any temporary access changes that may affect customer access; • Avoid unnecessary noise, dust, odor, waste storage or material movement near commercial areas; • Ensure that waste and materials are not stored in station areas, business access routes or public circulation areas; • Give preference to local employment for suitable non-specialized and semi-skilled positions, where possible; • Ensure transparent recruitment procedures and prohibit discrimination, forced labor and child labor; • Provide workers with contracts, wages, working hours and working conditions consistent with national law and project requirements; • Provide training and capacity building to Baku Metro staff and contractors involved in operation and maintenance of new systems; • Record and respond to grievances from businesses, passengers, workers and service providers; • If temporary economic displacement is identified, assess the impact and develop a corrective action in line with applicable safeguard requirements			

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Table 65: OperationalPhase EMP

Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Operation				
Impacts to Groundwater and Tunnel Drainage Systems	• Continue routine inspection and maintenance of tunnel drainage channels, sumps and pumping systems; • Maintain records of groundwater inflow, abnormal water accumulation and drainage incidents; • Continue monitoring by the Baku Metro Laboratory, including hydrocarbon checks where relevant; • Inspect technical rooms, transformer locations and cable ducts for signs of leakage, water ingress or contamination; • Maintain spill response materials at relevant depots, substations, technical rooms and maintenance areas; • Ensure that maintenance waste, oily residues and cleaning materials are not discharged into tunnel drainage systems; • Investigate any visible oil sheen, unusual odor or change in drainage water quality; • Maintain emergency procedures for tunnel flooding, pump failure, contaminated drainage water, and major spills.	See table 66	PIU	Baku Metropoliteni CJSC
Impact on soils, geology and geohazards	• Inspect technical rooms, transformer areas, tunnels and depots for oil leakage, residue accumulation or damaged cable insulation; • Maintain records of maintenance waste, oily residues, e-waste and removed components; • Continue routine monitoring and inspections by Baku Metro HSE staff and the Baku Metro Laboratory where relevant; • Ensure that new equipment anchoring, supports and cable trays remain stable under vibration and seismic conditions; • Maintain emergency procedures for oil spills, tunnel flooding, fire, equipment failure and discovery of contaminated material; • Ensure future repair works follow the same contamination-control and geohazard-safety procedures.	See table 66	PIU	Baku Metropoliteni CJSC

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Operation				
Waste Management	• Maintain segregation of routine maintenance waste, including e-waste, metals, cables, oils, batteries and lamps; • Continue safe storage and disposal of used oils, oily absorbents, filters and contaminated materials; • Maintain records of waste generated during maintenance and repair works; • Ensure that no waste is stored in drainage channels, tunnels, escape routes or technical access areas; • Use licensed waste contractors for hazardous waste and e-waste; • Continue periodic inspection of technical areas for obsolete materials or uncontrolled waste accumulation; • Review waste management performance annually and update procedures where necessary	See table 66	PIU	Baku Metropoliteni CJSC
Occupational Health and Safety	• Treat old transformer oil and oil-filled equipment as potentially hazardous until testing confirms classification; • Do not open, cut, drain or dismantle oil-filled equipment without an approved method statement; • Use chemical-resistant gloves, coveralls, eye protection and respiratory protection where required; • Use drip trays, absorbents and sealed containers during handling; • Prohibit eating, drinking or smoking in hazardous-material work areas; • Provide washing facilities and decontamination arrangements for workers handling oily or contaminated materials; • Isolate PCB-suspected materials and restrict access to trained personnel only; • Ensure waste handlers are trained on hazardous waste recognition, labelling, transport and emergency response.	See table 66	PIU	Baku Metropoliteni CJSC

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Operation				
Community Health and Safety	• Maintain regular inspection and preventive maintenance of signaling, communications, passenger information and emergency systems; • Conduct regular emergency drills covering fire, smoke, evacuation, power failure, flooding, communication failure and service disruption; • Maintain accessible routes, lifts, escalators, signage and passenger guidance systems in good condition; • Continue public information procedures for planned maintenance or service changes; • Maintain a grievance and feedback mechanism for passengers and the public; • Continue Baku Metro Laboratory monitoring where environmental conditions may affect passenger comfort and safety; • Review passenger safety incidents and update procedures as necessary.	See table 66	PIU	Baku Metropoliteni CJSC
Land Acquisition, Resettlement and Economic Displacement	• Keep routine maintenance within existing Baku Metro infrastructure and approved work areas; • Avoid long-term obstruction of station access, pedestrian routes, public transport interfaces or business entrances; • Provide advance public information on planned maintenance that may affect access or service; • Maintain accessible routes for vulnerable passengers; • Maintain the grievance mechanism for passengers, nearby businesses and the public; • Screen any future expansion or ancillary facility outside the existing footprint for land acquisition and resettlement impacts before approval.	See table 66	PIU	Baku Metropoliteni CJSC

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Potential impact / risk	Mitigation / improvement measures	Monitoring requirements	Responsibility for development / implementation	Responsibility for control
Operation				
Cultural Heritage	• Maintenance works in Nizami Metro Station shall be screened for potential effects on protected architectural features before implementation; • Future works in older or architecturally valuable stations shall avoid unnecessary modification of original finishes and design features; • Baku Metro shall maintain records of heritage-sensitive stations, features, and any special protection requirements; • Routine maintenance shall use existing technical routes and concealed service areas wherever feasible; • Emergency repairs affecting heritage-sensitive areas shall be documented and followed by appropriate reinstatement; • Chance Find Procedure shall remain applicable to future intrusive maintenance works; • Any future project component outside the existing metro footprint shall be screened separately for cultural heritage and archaeological risks.	See table 66	PIU	Baku Metropoliteni CJSC
Economy, Employment and Livelihoods	• Maintain the legacy system as a fallback until the new system is fully validated; • Provide timely public information on any service change, delay, testing period or temporary disruption; • Monitor service reliability, delays, incidents and passenger complaints; • Ensure station staff can explain temporary changes and direct passengers to alternatives; • Avoid unnecessary peak-hour disruption to passenger services; • Record any business or passenger complaints related to service disruption and respond through the grievance mechanism		PIU	Baku Metropoliteni CJSC

10.6 Environmental Monitoring Plan

707. The Environmental Monitoring Plan (EMoP) will form part of the bidding and contract documents for the Baku Metro Signaling Modernization and Operations Digitalization Project. The EMoP defines the parameters to be monitored, monitoring locations, frequency, responsible parties, applicable standards or criteria, and indicative cost arrangements. The structure follows the provided template, which distinguishes between instrumental environmental monitoring and observational monitoring of EMP implementation.
708. Instrumental monitoring will be carried out by the Baku Metro Laboratory where its technical capacity is sufficient, and by external certified laboratories where specialized analysis is required, including PCB testing, hazardous waste classification, oil analysis, and detailed water quality analysis. Observational monitoring will be carried out continuously by the Contractor's Environmental Management Officer and Health and Safety Officer, verified by the Supervision Consultant, and overseen by the PIU Environmental and Social Safeguards Specialist.
709. Monitoring will be risk-based and focused on the main environmental and safety issues identified in the IEE: indoor air quality and ventilation in underground work areas, noise, groundwater and tunnel drainage protection, petroleum hydrocarbons, oil-filled transformer handling, PCB risk, hazardous and non-hazardous waste segregation, OHS, passenger safety, cultural heritage protection, and grievance management. As required in the template, monitoring results shall be documented, retained in an auditable filing system, and summarized in semi-annual environmental monitoring reports submitted to ADB.

Table 66: EMP Implementation Monitoring Plan

Aspect / mitigation measure to be monitored	Location	Monitoring method	Frequency	Responsibility for implementation	Responsibility for supervision / verification
Approval and implementation of SEMP and topic-specific plans	All project work areas	Document review and approval check	Before mobilization and before access to each work area	Contractor	PIU / CSC
Compliance with approved work footprint	Tunnels, stations, depots, technical rooms, OCC, control facilities and access points	Visual inspection; comparison with approved work zones	Weekly; daily in active high-risk areas	Contractor	CSC / PIU
Transformer oil quality and PCB screening	Oil-filled choke-transformers and any oil-containing legacy equipment selected from the inventory, including DTM-0.17-1000M, DTM-0.17-1000 and DTM-0.17-1500 units	Before opening, draining, dismantling, transport or disposal; representative sampling campaign before decommissioning; additional sampling if equipment condition is uncertain	External certified laboratory; Contractor to arrange; PIU and CSC to verify	Stockholm Convention requirements; national hazardous waste requirements; PCB threshold criteria applicable under national / international good practice	Provisional EMP cost; indicative USD 150/sample
Condition of cultural heritage-sensitive station elements	Nizami Metro Station and other architecturally valuable station interiors; central station areas near historic buildings	Pre-work photographic and written condition record; daily visual checks during works in sensitive areas; final inspection after works	Contractor; cultural heritage specialist where required; CSC to verify	No damage to protected or heritage-sensitive features; compliance with Cultural Heritage Management Plan and Chance Find Procedure	Included in Contractor budget
Hazardous waste and PCB-suspected material isolation and management	Transformer handling areas, depot hazardous waste area, temporary storage points	Visual inspection of isolation, labels, containment and access control	During each handling event; weekly while stored	Contractor	CSC / PIU
Water quality / tunnel drainage quality: oil residues, TSS, pH, mineralization, nitrates,	Tunnel drainage channels, sumps, pumping points and depot drainage areas near active works; locations	Baseline at representative drainage locations before decommissioning; monthly during high-risk	External certified laboratory for full analysis; Baku Metro Laboratory for	AZS 929:2023 where relevant; national discharge / sewer	Included in Contractor budget; indicative USD

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Aspect / mitigation measure to be monitored	Location	Monitoring method	Frequency	Responsibility for implementation	Responsibility for supervision / verification
nitrites and other parameters if required	where oil leakage, visible sheen or contaminated water is suspected	decommissioning in relevant areas; after any spill, abnormal discharge or visible deterioration	routine checks where possible; CSC to verify	acceptance requirements; IFC EHS Guidelines where more stringent	50/sample for basic parameters
Vibration affecting heritage-sensitive station finishes or nearby sensitive structures	Nizami Metro Station, Ichrisheher area, older central stations, and any heritage-sensitive locations where vibration-generating works are required	Baseline condition survey before works; instrumental vibration monitoring during vibration-generating works if required; additional monitoring following complaints or observed damage	Contractor / certified specialist; CSC to verify; cultural heritage specialist where required	Azerbaijan vibration norms approved by Presidential Decree No. 796; IFC / GIIP criteria where relevant	Included in Contractor budget; specialist monitoring as provisional cost
Protection of tunnel drainage channels, sumps and pumps	Tunnels, drainage channels, sumps, pumping points and wet technical areas	Visual inspection; obstruction checks; incident review	Daily during active works in relevant areas	Contractor / Baku Metro Sanitation Dispatch	CSC / PIU
Housekeeping and removal of loose cables, tools, packaging and debris	Tunnels, stations, technical rooms, depots and access routes	Visual inspection	Daily / each shift	Contractor	CSC
Worker PPE and OHS compliance	All active work areas	Visual inspection; worker interviews; toolbox talk records	Daily / each shift	Contractor	CSC
Fatigue management for night works	Night work teams and shift records	Review of shift duration, rest periods, attendance and incident trends	Weekly; monthly review	Contractor	CSC / PIU
Passenger safety and public separation from works	Stations, entrances, platforms, public circulation areas and access routes	Visual inspection of barriers, signage, lighting and access routes	Daily where works interface with public areas	Contractor / Station Management	CSC / PIU
Public information on access changes or service disruption	Stations, Baku Metro website / social media, Public Relations Center	Review of notices, announcements and communication records	Before and during access/service changes	Baku Metro / Contractor	PIU
Business, kiosk and pedestrian access maintained	Station entrances, commercial areas, depot gates, service roads and public transport interfaces	Visual inspection, consultation and grievance review	Before and during access-affecting works	Contractor / PIU	CSC / PIU

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Aspect / mitigation measure to be monitored	Location	Monitoring method	Frequency	Responsibility for implementation	Responsibility for supervision / verification
Cultural heritage protection measures	Nizami Metro Station, older stations and central heritage-sensitive station areas	Inspection of protective coverings, approved fixing points, condition records and material movement routes	Daily during works in sensitive areas	Contractor	CSC / PIU / cultural heritage specialist where required
Training implementation	Contractor teams, depot staff, station staff and Baku Metro personnel involved in works	Review of induction records, toolbox talks and specialized training attendance	Before works; monthly refreshers; before high-risk activities	Contractor / Baku Metro Training Center	PIU / CSC
Incident, non-compliance and corrective action management	All project sites and project records	Review of incident reports, NCRs, corrective action plans and closure evidence	Continuous; monthly review	Contractor	CSC / PIU
GRM operation and complaint closure	PIU, Public Relations Center, stations and contractor records	Review of GRM log, response time and closure evidence	Continuous; monthly review; semi-annual reporting	PIU / Public Relations Center / Contractor	Baku Metropolitani CJSC / ADB

10.7 Reporting and Documentation Requirements

710. The Contractor shall maintain an auditable environmental and safety filing system covering approved plans, permits, inspection checklists, instrumental monitoring results, waste transfer notes, disposal certificates, laboratory results, training records, incident reports, non-compliance notices, corrective action records and grievance records. Original monitoring records shall be retained and made available to the PIU, CSC and ADB upon request.
711. The Contractor shall submit monthly environmental, health and safety performance reports to the PIU and CSC. These reports shall summarize monitoring results, implementation of mitigation measures, waste quantities and disposal status, incidents, grievances, training activities, non-compliances and corrective actions. The CSC shall verify the Contractor's reports through inspections, audits and review of supporting evidence.
712. The PIU shall prepare and submit semi-annual environmental monitoring reports to ADB within one month after the end of each reporting period, consistent with the requirements of the provided monitoring template. The semi-annual reports shall include a summary of EMP implementation, instrumental monitoring results, observational monitoring findings, complaints and grievance resolution, incidents and accidents, corrective actions, and any recommended updates to the EMP or monitoring program.

11. CONCLUSIONS AND RECOMMENDATIONS

713. Based on the results of the review of existing documentation, meetings held, and field visit, the following conclusions and recommendations can be made:

11.1 Conclusions

- The Baku Metro Signaling Modernization and Operations Digitalization Project is a strategic urban transport modernization project intended to improve the safety, reliability, capacity, energy efficiency and operational performance of the Baku Metro system. The project will introduce a modern CBTC-based signaling system, digital operational control, improved system monitoring, onboard and wayside equipment upgrades, and structured decommissioning of the existing legacy signaling system. The project is consistent with the need to modernize critical urban transport infrastructure in Baku and is expected to provide long-term environmental and social benefits by supporting reliable public transport, reducing operational risks and improving passenger service quality.
- The project is classified as an environmental Category B project under the ADB Safeguard Policy Statement (2009), because its potential impacts are expected to be site-specific, largely reversible, and manageable through the implementation of standard and project-specific mitigation measures. The project will be implemented within the existing Baku Metro footprint, including tunnels, stations, depots, technical rooms, substations, control facilities and rolling stock areas. It does not involve construction of new metro lines, new stations, major excavation, permanent land acquisition, physical displacement, or expansion into natural habitats or protected areas.
- The main environmental and safety risks are linked to implementation in a live underground metro environment and to the decommissioning of old electrical and signaling equipment. Key risks include confined-space works, electrical isolation, fire safety, tunnel ventilation, night works, passenger safety, temporary access restrictions, groundwater and drainage protection, waste generation, e-waste, oil-filled equipment, and possible PCB contamination. These risks are most significant during the decommissioning phase, when legacy systems, old cables, control boxes, tunnel telephones, switch machines, relay equipment and approximately 933 oil-filled choke-transformers may be removed.
- The assessment confirms that significant adverse impacts on air quality, surface water, groundwater, soils, biodiversity, protected areas, cultural heritage, land resources and communities are not expected, provided that the EMP and associated management plans are implemented effectively. Air quality impacts will mainly relate to indoor dust, fumes, odour and ventilation risks in tunnels and technical rooms rather than to external ambient air pollution. Hydrology-related risks are mainly associated with tunnel drainage and potential contamination from oil or residues, rather than direct impacts on natural watercourses.
- The project will not affect protected areas due to its urban and underground character and the distance between project components and the nearest protected areas. Biodiversity impacts are expected to be low and limited to temporary disturbance of urban-adapted fauna, pest attraction risks, and indirect contamination pathways if waste or spills are poorly managed. No natural habitat conversion, protected area disturbance or significant vegetation clearance is anticipated.
- Cultural heritage sensitivity is relevant because the Baku Metro system includes stations with architectural and historical value, particularly Nizami Metro Station, which is identified as a listed architectural monument of national importance. Although major archaeological impacts are unlikely due to the absence of new excavation, works in heritage-sensitive stations must

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be planned carefully to avoid damage to decorative finishes, stone cladding, panels, mosaics, lighting features and other station-specific architectural elements. A Chance Find Procedure must apply to all intrusive works.

- No permanent land acquisition, physical displacement or significant economic displacement is expected. Temporary access and livelihood-related impacts may occur if works affect station entrances, pedestrian routes, nearby kiosks, small businesses, public transport interfaces or depot access points. These impacts are expected to be localized and short-term and can be managed through access planning, stakeholder engagement, signage, prior notification and a functioning grievance redress mechanism.
- The existing complaint handling structure of Baku Metropolitani CJSC, including the Public Relations Center, provides an important basis for the project-level grievance redress mechanism. Project-related complaints received through existing public communication channels should be promptly transferred to the PIU and addressed in accordance with the project GRM. This will ensure that passenger, worker, business and community concerns are properly recorded, reviewed, resolved and reported.
- The Environmental Management Plan, Environmental Monitoring Plan and topic-specific management plans will be the main tools for managing project impacts. The EMoP should form part of bidding and contract documents, and monitoring should include both instrumental monitoring and observational monitoring. The provided monitoring template requires instrumental monitoring by certified laboratories where needed, regular site inspections by the supervision consultant, multi-tier supervision by contractor, CSC and PIU staff, and submission of semi-annual environmental monitoring reports to ADB.
- With full implementation of the mitigation measures, monitoring program, institutional arrangements and corrective action system, the residual environmental and social impacts of the project are expected to remain low to medium and acceptable. The project is expected to generate significant positive long-term impacts through improved metro safety, reduced reliance on obsolete systems, better operational control, improved passenger information, enhanced reliability, strengthened staff capacity, and reduced risks associated with aging oil-filled and electrical infrastructure.

11.2 Recommendations

- The EMP, EMoP and all topic-specific management plans should be incorporated into the bidding and contract documents and made binding on the Contractor and subcontractors. Before mobilization, the Contractor should prepare and submit a Site-Specific Environmental Management Plan and all required management plans for approval by the PIU and Supervision Consultant. No works should begin until the relevant method statements, permits, emergency procedures and monitoring arrangements are approved.
- A detailed inventory of all equipment to be dismantled should be completed before the decommissioning phase. The inventory should include oil-filled choke-transformers, cables, switch machines, tunnel telephones, junction/control boxes, relay equipment, onboard equipment and associated components. The inventory should identify each item's location, type, condition, oil content where relevant, potential hazardous characteristics, reuse/recycling potential, and final management route.
- All oil-filled equipment should be treated as potentially hazardous until tested and classified. PCB screening and oil-quality testing should be carried out before opening, draining, dismantling, moving or disposing of oil-filled transformers and related equipment. PCB-suspected and PCB-confirmed materials should be isolated, labelled, stored with secondary containment, and transferred only to certified organizations authorized to handle such waste.

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- Waste management procedures should strictly prohibit temporary storage of waste in tunnels, platforms, technical passages, escape routes, drainage channels, cable ducts, shafts or any other underground operational areas. Waste generated underground should be collected during the same shift and transported to the designated depot-based temporary storage area, preferably by rail during the approved night working window. Hazardous and non-hazardous waste must not be mixed, and all liquid waste should be stored in leak-proof containers placed in secondary containment equal to at least 110% of the container volume.
- The depot should be formally prepared and approved as the main temporary waste reception and segregation point. Depot personnel should receive targeted training on ADB safeguard requirements, hazardous and non-hazardous waste segregation, PCB awareness, secondary containment, documentation, spill response, waste transfer notes and coordination with certified waste management organizations.
- Occupational health and safety controls should be treated as a priority throughout implementation. The Contractor should apply strict permit-to-work, Lock-Out / Tag-Out, confined-space entry, hot-work, electrical safety, ventilation, emergency response and fatigue management procedures. Works in tunnels, shafts, relay rooms, transformer areas, cable ducts and other enclosed spaces should proceed only under approved permits and competent supervision.
- Passenger safety and service continuity should be protected through station-specific access and passenger movement plans. Works affecting public areas should be scheduled outside peak passenger periods where feasible. Public routes, emergency exits, evacuation routes, stairs, lifts, escalators and station entrances should remain safe, clearly marked, well lit and unobstructed. Baku Metro should provide timely information to passengers on any temporary access changes, service adjustments or safety-related restrictions.
- The stabilization and parallel operation phase should be implemented as a formal safety validation period. The legacy system should remain available as a fallback until the new CBTC system demonstrates stable performance, communication reliability, emergency functionality and compliance with all GO/NO-GO readiness criteria. Decommissioning of the old system should not begin until technical, safety, environmental and operational preconditions are fully satisfied.
- The Baku Metro Laboratory should continue routine monitoring of microclimate, noise, ventilation and selected contamination indicators. Where specialized testing is required, including PCB analysis, hazardous waste classification, detailed water quality testing or contaminated sludge analysis, certified external laboratories should be engaged. All monitoring results should be retained in an auditable filing system and reflected in monthly contractor reports and semi-annual environmental monitoring reports to ADB.
- Cultural heritage screening should be completed before works at Nizami Metro Station and other architecturally valuable or central stations. Pre-work photographic condition records should be prepared for sensitive areas. Drilling, fixing, anchoring, cable routing or equipment installation on visible decorative or heritage-sensitive surfaces should not proceed without approval. Protective coverings should be used during movement of materials and waste through sensitive station interiors, and the Chance Find Procedure should be included in contractor training.
- Stakeholder engagement should continue throughout implementation and operation. The project GRM should be integrated with Baku Metro's existing complaint handling system and Public Relations Center. All project-related complaints should be recorded, assigned, investigated, responded to and closed within defined timeframes. Grievance statistics, key issues raised and corrective actions should be included in semi-annual environmental monitoring reports.

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- The PIU and Supervision Consultant should apply a strong corrective action system. Any non-compliance with the EMP, EMoP, approved plans, national legislation or ADB requirements should be recorded, assigned to a responsible party, given a deadline and followed up until closure. Serious incidents, including fire, electrical accidents, major spills, hazardous material releases, serious worker injury, passenger safety incidents or cultural heritage damage, should be reported immediately to the PIU, Baku Metropolitani CJSC management, the Supervision Consultant and ADB.
- Provided that these recommendations are implemented, the Baku Metro Signaling Modernization and Operations Digitalization Project can proceed without significant residual adverse environmental or social impacts. The project should be considered environmentally and socially acceptable, subject to full implementation of the EMP, EMoP, GRM, institutional arrangements, monitoring program, and ADB safeguard reporting requirements.

Annex 1: Environmental Audit Report

1. Goals and Objectives of the Environmental Audit

The main goal of the environmental audit for the Baku Metro Project is to identify, document and assess environmental and occupational safety risks associated with existing legacy signaling and electrical equipment before installation, dismantling, transfer, reuse, recycling or final disposal. The audit should serve as an environmental due diligence exercise and should provide a clear understanding of whether project-related facilities contain hazardous materials such as PCB-suspected transformer oils, contaminated electrical components, asbestos-containing materials, oil-stained surfaces, contaminated residues or other materials requiring special handling. Similar to the example audit, the Baku Metro audit should focus on legacy environmental liabilities and risk management rather than on regulatory enforcement against current operators.

A specific objective of the audit is to prepare a detailed inventory of all oil-filled and potentially hazardous equipment within the project scope. This should include drossel-transformers, capacitors if present, switch machines, cable systems, control boxes, relay equipment, tunnel telephones and other electrical or electronic components planned for removal. For each item, the audit should record the equipment type, location, manufacturer where available, year of manufacture, operational status, estimated oil content, visible leaks, signs of damage, waste classification and need for sampling. Equipment manufactured during the historical PCB-use period or lacking documentation proving PCB-free oil should be classified as PCB-suspect until laboratory testing confirms otherwise.

Another important objective is to define the need for analytical testing. The audit should establish a sampling strategy for transformer oil and other dielectric fluids, identify priority equipment for PCB testing, define sample collection and chain-of-custody requirements, and specify that testing must be carried out by accredited or certified laboratories using recognized methods. Until laboratory results are available, oil-filled equipment should be managed under precautionary controls, including restricted access, clear labeling, prohibition of opening or draining, spill prevention, use of PPE and safe storage arrangements.

The audit should also assess existing conditions that may increase environmental risk during implementation. This includes checking whether oil-filled equipment shows leakage or staining, whether drainage channels may receive contaminated runoff, whether underground work areas contain residues or oily materials, whether waste can be safely removed from tunnels, and whether depot storage areas have impermeable surfaces, secondary containment, access control, signage and spill response materials. Because Baku Metro tunnels are affected by groundwater inflow and drainage systems, the audit should pay particular attention to preventing oil, contaminated water, sludge, absorbents or waste from entering tunnel drainage channels.

The audit should further assess occupational health and safety risks connected with dismantling and handling old equipment. These include electrical hazards, confined-space work, poor ventilation, night works, manual handling, fire risk, contact with oils or contaminated materials, and possible PCB exposure. The audit should determine whether additional procedures are needed, including Lock-Out / Tag-Out, confined-space entry, hazardous materials handling, emergency response, spill control, worker training, PPE requirements and safe transport arrangements.

Finally, the environmental audit should produce practical management outputs for project implementation. These should include a PCB Management Procedure, Hazardous Waste and

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Spill Control Procedure, OHS and Emergency Procedure, Waste Management Plan, Environmental Monitoring Plan and a time-bound Corrective Action Plan. The CAP should identify each issue, required action, priority, responsible entity, timeframe and verification indicator. This will ensure that the Baku Metro Project can manage legacy hazardous materials in accordance with Azerbaijan's national legislation, ADB Safeguard Policy Statement requirements, and relevant international conventions such as the Stockholm and Basel Conventions.

2. Facilities Description – Existing Baku Metro Facilities and Equipment That May Contain PCBs

The Baku Metro Signaling Modernization and Operations Digitalization Project will be implemented within the existing operational metro infrastructure, including tunnels, stations, depots, technical rooms, relay rooms, cable routes, signaling equipment locations, rolling stock facilities and associated control systems. The project does not involve construction of new metro lines or new stations; however, it includes modernization of the existing signaling and communication systems and subsequent decommissioning of legacy equipment. Therefore, the main environmental concern is not related to new construction, but to the presence of old electrical and signaling equipment that may contain hazardous materials, including polychlorinated biphenyls (PCBs).

The facilities and equipment of primary concern are the existing oil-filled drossel-transformers / choke-transformers installed along the metro track system. According to the project information, approximately 933 oil-filled choke-transformers are installed across the Baku Metro network. These include equipment types such as DTM-0.17-1000M, DTM-0.17-1000 and DTM-0.17-1500. These units form part of the legacy signaling and traction return current system and are used to separate traction return current from signaling circuits. Each unit contains insulating oil, generally estimated at approximately 25–28 liters per transformer, depending on the type, manufacturer and production year.

These oil-filled transformers are considered the most relevant PCB-suspect facilities under the Baku Metro Project. Although the insulating oil in such equipment may be mineral oil, the age of the equipment and the historical period in which it was manufactured or maintained create uncertainty regarding its composition. Electrical equipment manufactured or installed during the historical PCB-use period should be treated as PCB-suspect unless documentation or laboratory testing confirms that PCB concentration is below the applicable threshold. The example audit applies a precautionary approach and notes that equipment lacking analytical confirmation should be managed as PCB-containing until proven otherwise.

In addition to drossel-transformers, other legacy electrical and signaling facilities may also require screening during the environmental audit. These include trackside signaling junction/control boxes, relay equipment, switch machines, tunnel telephones, old cables, cable ducts, control panels, electrical cabinets and associated electronic components. These items are less likely to contain PCB oils than oil-filled transformers, but they may still contain hazardous materials, degraded insulation, lubricants, lead-containing solder, contaminated dust, oily residues or other components that require classification as hazardous waste or e-waste before dismantling and disposal.

The Baku Metro facilities where PCB-suspect equipment may be located include tunnels, trackside technical areas, relay rooms, depots, workshops, technical rooms, cable corridors and other restricted operational areas. These locations are environmentally sensitive because they are enclosed underground or semi-enclosed spaces with limited ventilation, active electrical systems, groundwater inflow and drainage channels. If PCB-contaminated oil or other hazardous substances are released during dismantling, they may contaminate tunnel floors, ballast, drainage channels, absorbents, tools, containers, PPE or other materials. Therefore, the location and condition of each oil-filled unit should be recorded before any removal activity begins.

3. Legislation

3.1 National legislative framework – Azerbaijan

In Azerbaijan, resolutions of the Cabinet of Ministers and other subordinate normative legal acts are legally binding instruments adopted for implementation of primary legislation. Environmental laws establish general obligations, while secondary regulations define the mandatory procedures for compliance (e.g., hazardous-waste passportization, transport documentation, and reporting). Consequently, compliance with secondary acts is considered compliance with national law for the purposes of environmental assessment and project implementation.

The management of hazardous and industrial waste in Azerbaijan is regulated by the Law of the Republic of Azerbaijan “**On Industrial and Domestic Waste**” No. 514-IQ, adopted by the Milli Majlis on 30 June 1998 (as amended, most recently on 24 December 2021). The law establishes requirements for:

- Articles 3, 7 and 8 of the Law require identification and classification of waste according to hazard characteristics and oblige waste holders to determine whether generated waste is hazardous;
- Articles 10 and 11 require legal entities to maintain accounting records of waste generation, storage and transfer and to prepare a hazardous waste passport identifying its composition and hazard characteristics;
- Articles 12 and 13 regulate the transportation and storage of hazardous waste and require the use of specially authorized transport and controlled storage conditions with accompanying documentation;
- Articles 4, 6 and 14 require waste holders to prevent harmful environmental impacts, implement protective measures against spills and releases, and ensure environmentally safe handling and disposal of waste.

Environmental protection requirements in Azerbaijan are established by the Law of the Republic of Azerbaijan “**On Environmental Protection**” No. 678-IQ, adopted by the Milli Majlis on 8 June 1999 (as amended, most recently on 18 December 2020). The law establishes the legal basis for prevention of environmental pollution, protection of land, water and air resources, and environmental safety obligations for economic activities. The law establishes requirements for:

- Articles 3, 36 and 38 of the Law require enterprises to prevent environmental pollution during operation of installations and to implement technical and organizational measures ensuring environmental safety, including prevention of leakage of hazardous substances such as transformer oils;
- Articles 39 and 41 require identification and assessment of land contamination and oblige land users to evaluate environmental damage and undertake restoration measures where pollution is detected;
- Articles 42 and 54 establish the obligation to conduct environmental monitoring and to assess environmental conditions associated with industrial facilities, which requires documentation of the environmental status of substations prior to transfer to another operator;
- Articles 55 and 56 require implementation of measures to prevent and eliminate environmental damage and oblige operators to carry out remediation and protective actions where environmental risks are identified.

The Law “On Industrial and Domestic Waste” and the Law “On Environmental Protection” establish general obligations for environmental protection and hazardous-waste management.

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However, these laws are framework laws and require implementing regulations to define technical procedures. The Cabinet of Ministers resolutions (such as hazardous-waste passportization, transport rules, and waste inventory procedures) therefore function as mandatory implementing mechanisms.

3.2 Applicable International Conventions

Several international environmental agreements applicable to Azerbaijan regulate the identification, handling, storage, transportation, and disposal of these materials.

The key applicable international instruments are:

1. Stockholm Convention on Persistent Organic Pollutants;
2. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal;
3. Rotterdam Convention on Prior Informed Consent Procedure.

3.2.1 Stockholm Convention Requirements on Management of Polychlorinated Biphenyls (PCBs)

The Republic of Azerbaijan is a Party to the Stockholm Convention on Persistent Organic Pollutants (2001). The Convention establishes global measures to eliminate or restrict production, use, release, and disposal of persistent organic pollutants (POPs), including polychlorinated biphenyls (PCBs), which were historically used as dielectric fluids in transformers and capacitors.

PCBs are listed in **Annex A (Elimination)** of the Convention, meaning their production and new use are prohibited and existing equipment must be progressively phased out and safely disposed.

According to the requirements of the aforementioned convention:

- **Article 3** – “Measures to Reduce or Eliminate Releases from Intentional Production and Use”. This article prohibits: (i) production of PCBs; (ii) new use of PCB-containing equipment. It allows continued use only for existing equipment under strictly controlled conditions described in Annex A, Part II (**Project implication:** Any electrical equipment installed before modern environmental regulations (e.g., Soviet-era transformers and capacitors in the substations) must be considered regulated material and managed under controlled conditions.);
- **Article 6** – “Measures to Reduce or Eliminate Releases from Stockpiles and Wastes”. This article governs waste management. Parties must: (i) handle PCB wastes in an environmentally sound manner; (ii) prevent recovery or reuse of PCB oils; (iii) ensure destruction or irreversible transformation; (iv) prohibit uncontrolled disposal - dumping, burning, landfilling without treatment. (**Project implication:** Transformer oil cannot be reused, sold, or drained informally if PCBs are present or suspected);
- **Article 10** – “Public Information, Awareness and Training” Requires: (i) training of personnel; (ii) awareness of health risks; (iii) proper handling procedures. (**Project implication:** Workers handling the substations must be instructed on hazardous-material procedures);
- **Article 11** – “Research, Development and Monitoring”. Requires: (i) monitoring releases; (ii) environmental and health risk evaluation. (**Project implication:** Environmental sampling (oil and possibly soil) is justified within the environmental audit);

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- **Annex A, Part II – “Specific Exemptions for PCBs” (Key PCB Management Provisions).** This is the **main OPERATIVE section** of the Convention for electrical installations. It requires Parties to: (i) Identify and label PCB equipment; (ii) Prepare and maintain inventories; (iii) Prevent leaks and environmental release; (iv) Restrict use to intact equipment only; (v) Remove equipment from service (phase-out by 2025); (vi) Ensure environmentally sound disposal (by 2028); (vii) It also establishes the operational threshold commonly used internationally:
equipment containing PCB concentrations $\geq 0.005\%$ (50 ppm) must be treated as PCB equipment.

The Stockholm Convention establishes a **life-cycle management approach** for PCB-containing equipment.

For the substations, the following principles are applicable: (i) identification and inventory; (ii) labeling and segregation; (iii) leak prevention and safe handling; (iv) controlled storage; (v) regulated transport; (vi) environmentally sound disposal; and (vii) monitoring and documentation. The planned transfer of the existing substations to another operator requires verification of the environmental condition of the facilities, including confirmation of whether PCB-containing equipment is present. Although dismantling of the substations is not included in the project scope, the transfer and potential future decommissioning of aging electrical equipment require that any PCB-suspect materials be identified, inventoried, and managed in accordance with the requirements of the Stockholm Convention and applicable national legislation.

3.2.2 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal

The Republic of Azerbaijan acceded to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal on 1 June 2001. Accordingly, the country is obligated to ensure environmentally sound management, controlled transport, and documented disposal of hazardous waste, including PCB-containing electrical equipment.

The Convention establishes a global legal framework governing transboundary movement and environmentally sound management of hazardous wastes, including PCB-containing materials and contaminated equipment removed from service.

PCB oils, PCB-containing electrical equipment, and PCB-contaminated materials are considered hazardous waste under the Convention when they exhibit hazardous characteristics defined in Annex III and fall within waste streams listed in Annex I and Annex VIII.

- **Article 1 – Scope of the Convention** This article defines hazardous waste. PCB wastes fall within the Convention because: (i) they belong to listed waste streams in Annex I (wastes from industrial processes), and (ii) they exhibit hazardous characteristics listed in Annex III (toxicity, persistence, ecotoxicity). **(Project implication:** Decommissioned transformers, capacitors, dielectric oils, and PCB-contaminated soil from the substations must legally be treated as hazardous waste);
- **Article 4 – General Obligations.** Parties must: (i) minimize hazardous-waste generation; (ii) ensure environmentally sound management; (iii) prevent pollution; (iv) prohibit uncontrolled dumping; (v) ensure disposal occurs only in authorized facilities; (vi) prevent export to countries lacking disposal capacity. **(Project implication:** The substations cannot transfer PCB oils informally, scrap equipment, or dispose of contaminated materials without controlled management);

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- **Article 6 – Transboundary Movement** Between Parties Establishes the **Prior Informed Consent (PIC)** procedure. Requires: (i) notification to the importing country; (ii) written consent; (iii) approved transport route; (iv) tracking documentation. **(Project implication:** If PCB waste must be exported for destruction (common in countries without PCB treatment plants), Azerbaijan must follow international notification procedures);
- **Article 8 – Duty to Re-Import.** If transport or disposal cannot be completed as planned, the exporting state must take the waste back. **(Project implication:** Ensures accountability during international shipment of PCB waste);
- **Article 9 – Illegal Traffic.** Defines illegal transport or disposal as a criminal act, including: (i) movement without notification or consent of the receiving state; (ii) falsified documentation; (iii) dumping. **(Project implication:** Uncontrolled disposal or sale of PCB transformers as scrap metal would constitute illegal traffic).

3.2.3 Rotterdam Convention on Prior Informed Consent Procedure

The Republic of Azerbaijan is a Party to the Rotterdam Convention, which regulates international trade of hazardous chemicals through a **Prior Informed Consent (PIC) procedure**.

While the Stockholm Convention regulates elimination of PCBs and the Basel Convention regulates hazardous-waste disposal, the Rotterdam Convention regulates **international movement of hazardous chemicals and preparations**, including PCB-containing substances when they are traded or shipped as chemicals.

The Convention does not directly regulate disposal operations. Instead, it controls whether hazardous chemicals may legally cross international borders and ensures that importing countries are informed of risks before accepting them.

This becomes relevant to the project if PCB oils, dielectric fluids, or contaminated electrical components are exported for treatment, analysis, or destruction. Relevant Articles of the Convention:

- **Article 1 – Objective.** The objective is to promote shared responsibility in international trade of hazardous chemicals and to protect human health and the environment by enabling countries to make informed decisions on import. **(Project implication:** Any export of PCB oils or PCB-containing equipment must be disclosed to and approved by the receiving country);
- **Article 5 – Procedures for Banned or Severely Restricted Chemicals.** Parties must notify the Convention Secretariat when a chemical is banned or severely restricted nationally. This forms the basis of international control lists. **(Project implication:** PCBs are internationally recognized restricted industrial chemicals; therefore, their export is controlled);
- **Article 7 – Import Responses.** Each Party must communicate whether it: (i) consents to import; (ii) consents with conditions; (iii) or prohibits import. **(Project implication:** Before PCB waste or oils are shipped abroad, the importing country must officially agree to receive them);
- **Article 10 – Obligations in Relation to Imports.** Countries must ensure imported hazardous chemicals are handled according to their national safety requirements. **(Project implication:** The receiving disposal facility must be authorized and capable of safe treatment).
- **Article 13 – Information to Accompany Exported Chemicals.** Requires: (i) safety data sheets (SDS); (ii) hazard classification; (iii) labeling. **(Project implication:** PCB oils or contaminated components must be accompanied by hazard documentation).

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- **Article 16 – Technical Assistance.** Encourages capacity-building and safe management of hazardous chemicals. (**Project implication:** Supports training and safety procedures for handling PCB equipment).

3.3 Gap Analysis (National Law vs Stockholm Convention vs ADB SPS)

The comparison indicates that national legislation of Azerbaijan establishes general obligations for hazardous-waste management but does not provide detailed technical procedures specifically addressing PCB-containing electrical equipment. The Stockholm Convention establishes specific requirements for identification, inventory, controlled management and elimination of PCBs, while the ADB SPS requires environmental due diligence and management of legacy risks associated with project-related facilities. Consequently, an environmental audit, PCB inventory, and appropriate management procedures are required to ensure compliance with applicable international environmental standards.

Table 2: Gap Analysis (National Law vs Stockholm Convention vs ADB SPS)

Topic	Azerbaijan National Legislation	Stockholm Convention (POPs – PCBs)	ADB Safeguard Policy Statement (2009)	Gap / Project Action Required
Hazardous materials identification	Waste must be classified and documented under the Law “On Industrial and Domestic Waste”	Mandatory identification and inventory of PCB equipment (>50 ppm threshold)	Requires identification of hazardous materials and legacy risks	National law requires classification but does not specifically target PCBs → Environmental audit and PCB screening required
Inventory of PCB equipment	Waste accounting and reporting required	Mandatory national inventory and labeling of PCB equipment	Due diligence required for existing facilities	Prepare detailed equipment inventory (transformers, capacitors, oil volumes, manufacturing year)
Labeling	General hazardous-waste documentation	PCB equipment must be labeled and traceable	Hazard communication required	Label suspected PCB equipment at substations
Storage	Requires safe storage conditions	Storage must prevent release to environment	Requires pollution prevention and risk mitigation	Establish temporary controlled storage procedures before transfer
Transport	Specialized transport and documentation required	Controlled movement and documentation required	Requires safe handling of hazardous materials	Use licensed hazardous-waste transport and chain-of-custody documentation
Decommissioning	Not specifically detailed	PCB equipment must be removed from use (phase-out obligations)	Requires management of legacy environmental risks	Environmental audit prior to handover of substations
Disposal	Requires environmentally safe disposal but does not specify PCB destruction technologies	Environmentally sound destruction (high-temperature destruction, dichlorination, etc.)	Requires GIPP and international best practice	If PCBs confirmed, disposal must follow international ESM methods (may require export)
Soil contamination	Environmental damage must be prevented and remediated	Prevent release to soil and water	Requires contamination assessment and mitigation	Soil sampling at oil-stained locations and remediation plan if necessary

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Worker safety	General occupational safety obligations	Avoid exposure during handling of PCB oils	Requires occupational health and safety protection	Provide PPE, handling procedures and training during inspection and transfer
Community safety	Environmental protection obligations	Prevent environmental release and exposure	Requires community health and safety protection	Control access to substations and prevent uncontrolled leakage
Transfer of assets	Not specifically regulated for environmental liability	Inventory and identification of PCB equipment before transfer.	Requires borrower to manage associated facilities	Document environmental condition before transfer to AzerEnerji
Monitoring	Environmental monitoring required	Track PCB management and elimination	Monitoring required under ESMP	Establish monitoring and reporting procedure in ESMP
Time-bound obligations	No specific PCB deadlines	Progressive phase-out and environmentally sound management of PCB equipment in accordance with Stockholm Convention obligations.	No deadlines but require risk management	Develop PCB Management Plan aligned with Stockholm timeline

4. Audit and Site Investigation Procedure

4.1 Baku Metro Signaling Modernization and Operations Digitalization Project

The environmental audit for the **Baku Metro Signaling Modernization and Operations Digitalization Project** was carried out as a due diligence exercise to identify and assess legacy environmental and occupational health and safety risks associated with existing signaling, communication, electrical and control equipment that may be dismantled, replaced, transferred, stored, recycled or disposed of during project implementation. The audit shall focus particularly on oil-filled drossel-transformers / choke-transformers, old electrical equipment, control boxes, relays, tunnel telephones, cables, cable ducts, depot storage areas, technical rooms, and any other equipment or materials that may contain hazardous substances, including the risk of polychlorinated biphenyls (PCBs), oil residues, contaminated dust, degraded insulation or other hazardous components.

The audit follow a staged procedure similar to the environmental audit approach used for existing electrical infrastructure in Azerbaijan. As shown in the provided audit template, the audit is intended to document the environmental condition of legacy facilities, identify hazardous materials and pre-existing environmental liabilities, and define the management measures required for safe operation, dismantling, transfer or future decommissioning. It is not intended to be a regulatory enforcement exercise or to attribute historical non-compliance, but rather to identify risks that must be managed in accordance with national legislation, international conventions and ADB safeguard requirements.

4.2 Scope of the Audit

The scope of the environmental audit as covered all Baku Metro facilities and equipment that may be affected by the project and may contain oil, hazardous materials, e-waste or PCB-suspect components. The audit was included, at minimum, trackside drossel-transformers / choke-transformers, relay rooms, signaling cabinets, control boxes, switch machines, tunnel telephones, cable routes, cable ducts, depot storage and maintenance areas, technical rooms, drainage-adjacent work areas, and other legacy electrical or electronic equipment planned for removal or replacement.

It should be noted that it was not possible to visually inspect the entire Baku Metro network, as the total length of the metro lines is approximately 40.7 km²⁶. Considering the scale of the underground infrastructure, operational restrictions, safety requirements, limited access windows, and the fact that the metro system remained in operation, the survey was carried out using a sample-based inspection approach.

Particular attention was given to approximately 933 oil-filled drossel-transformers / choke-transformers installed along the metro track system, including DTM-0.17-1000M, DTM-0.17-1000 and DTM-0.17-1500 type equipment. These units are considered the main PCB-suspect equipment under the project because they contain insulating oil and may have been manufactured, installed or maintained during a period when PCB-containing dielectric fluids were historically used in electrical infrastructure. Until laboratory testing confirms otherwise, all oil-filled legacy equipment with unknown oil composition shall be treated as PCB-suspect.

²⁶ https://metro.gov.az/en/page/haqqimizda/2022/1967/baki-metropoliteni/yaranmasi/3135?utm_source=chatgpt.com

4.2.1 Stage 1 – Desk Review

The first stage of the audit was consist of a desk review of available technical, environmental, operational and legal documentation. The purpose of the desk review to understand the type, location, function, age and condition of legacy equipment before site inspections are undertaken. The review was included available equipment inventories, signaling system records, maintenance logs, transformer registers, oil replacement records, drawings, depot storage records, previous inspection reports, waste management records, incident reports, environmental monitoring records and Baku Metro internal procedures.

The desk review was also consider the applicable legal and safeguard framework. This included Azerbaijan's requirements for hazardous waste identification, classification, storage, transport and disposal; obligations under the Stockholm Convention for PCB identification, inventory, labeling and environmentally sound management; Basel Convention principles for hazardous waste movement and disposal; and ADB Safeguard Policy Statement requirements for management of environmental risks, hazardous materials, worker health and safety, and associated facilities (see chapter 3 of this annex). Where equipment lacks records confirming PCB-free oil or safe material composition, it shall be flagged for priority field verification and potential sampling.

4.2.2 Stage 2 – Site Inspection

The second stage consist of structured site inspections of relevant Baku Metro facilities. Site inspections was carried out by qualified environmental auditor in coordination with Baku Metro technical staff. Inspections used a structured environmental screening checklist adapted to the Baku Metro environment (**see annex 2**).

The site inspection included visual examination of equipment and infrastructure, photographic documentation, recording of equipment nameplates, review of visible leaks or stains, verification of equipment location and accessibility, assessment of proximity to drainage channels or groundwater inflow areas, identification of temporary waste handling locations, and interviews with operating and maintenance personnel. No transformer, sealed oil-filled equipment, electrical cabinet or PCB-suspect unit shall be opened, drained, dismantled or disturbed during the preliminary audit unless a specific approved sampling procedure and safety control system is in place.

Following completion of the audit/site inspection activities, an additional visit was made to the Baku Metro Training Center, where samples of existing metro signaling and electrical equipment were available for closer examination. During this visit, the relevant equipment was inspected in an open condition, which made it possible to better understand its internal structure, composition, functional elements, oil-containing parts, electrical components, cable connections, and dismantling characteristics without interfering with operating equipment in the live metro system. This inspection was non-destructive in nature and was used to support the audit findings, clarify potential hazardous-material risks, and improve understanding of how similar equipment should be safely handled, removed, classified, stored, and managed during the future decommissioning stage.

4.2.3 Equipment Inventory and Identification

A complete inventory was prepared for all oil-filled, electrical and electronic equipment subject to replacement or dismantling. For each item, the audit recorded the equipment type, manufacturer if available, year of manufacture or installation where known, location, operational status, estimated oil volume where applicable, physical condition, visible leaks, connection to drainage pathways, accessibility and proposed management route.

For oil-filled drossel-transformers and other equipment containing dielectric oil, the inventory identified whether documentation confirms the oil type and whether previous PCB testing has been carried out.

It should also be noted that, based on the typical design and operational practice for the above-mentioned type of drossel-transformers, PCB contain oils were not normally used in this equipment type. However, no reliable maintenance records were available to confirm what type of oil was added to the transformers over the years during topping-up, repair, or routine maintenance activities. Therefore, although the probability of original PCB oil use may be considered lower than for sealed capacitors or certain high-risk electrical equipment, the absence of documented oil history means that PCB contamination cannot be fully excluded. For this reason, all oil-filled choke-transformers should be treated as PCB-suspect equipment until laboratory analysis confirms that PCB concentrations are below the applicable threshold.

4.3 PCB Screening and Sampling Procedure

PCB screening shall be carried out using a risk-based sampling strategy. Sampling shall prioritize oil-filled drossel-transformers, any other oil-containing electrical equipment, equipment with unknown maintenance history, equipment with visible leakage or staining, and equipment located near drainage channels or groundwater inflow areas. Sampling shall be undertaken only by trained and authorized personnel under approved method statements.

Considering the scale of the Baku Metro network and the large number of oil-filled drossel-transformers / choke-transformers installed along the system, it is recommended that approximately 100 oil samples be collected and submitted for PCB analysis. This number is considered sufficient for a representative preliminary screening campaign, provided that samples are selected using a risk-based and geographically distributed approach. The sampling program should not be limited to easily accessible equipment only; instead, it should cover different metro lines, tunnel sections, stations, depots, equipment types, equipment ages, operating conditions, and locations with higher environmental sensitivity. The purpose of this approach is to identify whether PCB contamination is present in the oil-filled equipment population and to determine whether further detailed sampling or full equipment testing is required before dismantling.

The selection of equipment for sampling should be based on clear criteria. Priority should be given to equipment with missing or incomplete maintenance records; equipment for which the type of oil used for topping-up or repair is unknown; older units or units with unclear manufacturing or installation dates; equipment showing visible oil leakage, staining, corrosion, damaged seals or signs of poor condition; equipment located near drainage channels, sumps, groundwater inflow points or areas where contamination could spread through tunnel drainage systems; equipment installed in deep or poorly ventilated tunnel areas; equipment representing each identified type of drossel-transformer, including DTM-0.17-1000M, DTM-0.17-1000 and DTM-0.17-1500; and equipment located in sections planned for early dismantling or pilot decommissioning. Where

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possible, samples should also include equipment from different operational environments, such as main running tunnels, station-adjacent technical areas, depots and maintenance areas.

The proposed sampling distribution should include: (i) representative samples from all main lines or operational sections of the metro network; (ii) samples from each type of oil-filled drossel-transformer identified in the inventory; (iii) samples from equipment with visible leakage or oil staining; (iv) samples from equipment located close to drainage channels or wet tunnel sections; (v) samples from equipment with unknown oil replacement or topping-up history; and (vi) samples from equipment scheduled for early removal during the decommissioning phase. If the total number of identified oil-filled units is approximately 933, the proposed 100 samples would represent slightly more than 10% of the equipment population and should provide a reasonable first-stage screening basis. However, if PCB concentrations are detected at or above the applicable threshold in any sampled unit, additional targeted sampling should be undertaken in the same line section, equipment type, maintenance group or location category.

Before sampling, each selected item of equipment shall be assigned a unique identification number and entered into a sampling register. The register should include the equipment type, location, line / station / tunnel section, physical condition, estimated oil volume, reason for selection, proximity to drainage or sensitive receptors, visible leakage status, sample number, date of sampling, sampler name and laboratory destination. Photographs of each sampled unit, including nameplate where available and sampling location, should be attached to the sampling record. This will ensure that laboratory results can be traced back to the exact equipment item and used for future dismantling, waste classification and disposal planning.

Before sampling, equipment shall be isolated, secured and confirmed safe by qualified electrical personnel. Samples shall be collected in clean, appropriate containers, uniquely labelled and documented in a sampling log. A chain-of-custody form shall accompany each sample from collection to laboratory delivery. Laboratory analysis shall be carried out by an accredited or certified laboratory using recognized analytical methods. Until results are available, sampled equipment and associated oils shall be managed as PCB-suspect.

PCB results shall be classified using internationally recognized thresholds. Equipment or oil with PCB concentration below 50 ppm may be classified as non-PCB material, subject to confirmation by laboratory results. Equipment or oil at or above 50 ppm

4.4 Limitations of the Audit

The audit findings shall clearly state the limitations of the assessment. The audit was based primarily on visual inspection, review of available documentation and interviews with operational staff. Therefore, identification of PCB-containing equipment, contaminated materials or hazardous residues shall be considered preliminary until confirmed by laboratory analysis. The absence of visible contamination shall not be treated as proof that hazardous materials are absent.

One of the main limitations of the audit is the absence of environmental documentation or maintenance records indicating what types of oils were added to the choke-transformers over the years, at what frequency and in what quantities. Although PCB replacement oils are not normally expected to have been used as original insulating fluids in this type of equipment, the lack of records on oil topping-up, repair or maintenance history means that the possibility of PCB contamination cannot be fully excluded. For this reason, oil-filled choke-transformers with

unknown oil history shall be treated as PCB-suspect equipment until laboratory testing confirms otherwise.

Due to the large scale of the Baku Metro network, including approximately 40.7 km of metro lines and a large number of underground technical areas, it was not possible to inspect the entire project area during the environmental audit phase. The audit was therefore carried out using a sample-based inspection approach, covering representative stations, technical areas, accessible equipment locations and selected infrastructure elements. The findings should be considered representative of the inspected sample areas and should be verified further during the detailed equipment inventory, pre-dismantling inspection and implementation of the Environmental Management Plan.

Another limitation is the absence of records on historical oil spills, leakage events, clean-up actions or the extent of existing contamination. Therefore, the audit could not determine whether past spills occurred in all affected areas or whether contamination is present beneath equipment, within cable ducts, on tunnel surfaces, in drainage channels or in other inaccessible locations. Any visible staining, oil residue, sludge, unusual odour or contaminated sediment identified during future works should therefore trigger further investigation, sampling and classification.

If laboratory testing is not included in the first audit stage, the report shall classify oil-filled equipment and materials with unknown composition as PCB-suspect or hazardous-material-suspect, as appropriate. Any future dismantling, recycling, transfer or disposal shall require analytical confirmation, approved method statements and site-specific environmental and safety procedures.

4.5 Overall Risk Rating

At the end of the inspection, each facility or equipment group shall be assigned an overall risk rating:

Risk rating	Description
Low	No significant hazardous material or contamination risk identified; standard waste and OHS controls are sufficient.
Moderate	Potential hazardous material, oil leakage, e-waste or OHS issues identified; corrective actions required before dismantling or transfer.
High	PCB-suspect oil-filled equipment, visible leakage, drainage contamination risk, unsafe handling conditions or major OHS hazard identified; detailed investigation and approved management procedures required before works proceed.

In conclusion, the audit and site investigation procedure will ensure that legacy environmental risks within the Baku Metro system are identified before dismantling begins. The procedure will support safe management of PCB-suspect equipment, hazardous waste, drainage-related contamination risks and OHS hazards, and will provide a structured basis for implementing corrective actions in accordance with Azerbaijan legislation, ADB safeguard requirements and international good practice.

4.6 Assessment of PCB Risk in Choke-Transformer Oils

The risk that PCBs are present in the composition of the Baku Metro oil-filled drossel-transformer oils should be assessed as Medium before laboratory testing. This rating is based on a precautionary risk approach. The equipment type is oil-filled and old, the oil composition has not yet been confirmed by laboratory analysis, and there are no reliable maintenance records showing what type of oil was added to the transformers over the years, how often topping-up was carried out, or in what quantities. Therefore, PCB contamination cannot be fully excluded at this stage.

At the same time, the risk is not assessed as High for all choke-transformers because, based on typical design and operational practice, PCB replacement oils were not normally used as original insulating fluids in this type of choke-transformer. The highest PCB probability is usually associated with sealed capacitors and some specific transformers used during the historical PCB-use period. However, because the Baku Metro equipment has a long operational history and undocumented oil maintenance practice, the correct approach is to treat all relevant oil-filled choke-transformers as PCB-suspect equipment until laboratory analysis confirms that PCB concentrations are below the applicable threshold of 50 ppm. The existing procedure already states that oil-filled equipment and materials with unknown composition should be classified as PCB-suspect where laboratory testing has not yet been completed.

PCB Risk Assessment Matrix for drossel-transformer Oils

No.	Risk assessment criterion	Project-specific condition	Risk implication	Risk level
1	Equipment type	The equipment consists of oil-filled choke-transformers / drossel-transformers.	Since the units contain insulating oil, PCB screening is required before dismantling, draining, transport or disposal.	Medium
2	Original oil type	PCB replacement oils were not normally used as original insulating fluids in this type of choke-transformer.	This reduces the likelihood that the original oil was PCB-based.	Low / Medium
3	Age and long service life	The equipment is part of legacy metro infrastructure and has been operated over a long period.	Long service life increases uncertainty regarding oil condition and maintenance history.	Medium
4	Absence of oil maintenance records	There are no environmental or maintenance records confirming what oil was added, how frequently it was added, or in what quantity.	This is the key uncertainty; undocumented topping-up may have introduced contaminated oil.	Medium / High
5	Oil topping-up practice	Choke-transformers may have required oil topping-up during operation, but the source and type of added oil are not documented.	Even if original oil was mineral oil, cross-contamination during maintenance cannot be excluded.	Medium
11	Laboratory confirmation status	PCB analysis has not yet confirmed whether the oils are below or above 50 ppm.	Until results are available, the equipment must remain classified as PCB-suspect.	High uncertainty
12	Sampling requirement	Approximately 100 oil samples are recommended using a risk-based and geographically distributed approach.	Sampling will determine whether the risk remains only precautionary or becomes confirmed PCB contamination.	Risk-reduction measure

4.7 Action Plan if PCBs Are Found in Transformer Oils

If laboratory analysis confirms that transformer oil contains polychlorinated biphenyls (PCBs) at or above the applicable threshold, the affected oil-filled equipment shall be immediately classified as PCB-contaminated / PCB-containing equipment and managed as hazardous waste. No opening, draining, dismantling, cutting, recycling, sale as scrap, or transfer of such equipment shall be allowed until a specific PCB Management Procedure is approved and implemented. The action plan below follows the precautionary approach used in the provided environmental audit example, where PCB-suspected equipment is treated as hazardous until analytical confirmation and is managed in accordance with national legislation, the Stockholm Convention, Basel Convention principles, and ADB safeguard requirements.

No.	Action	Description / Required Measures	Priority	Responsible Party	Timeframe	Verification Indicator
1	Confirm laboratory results	Review PCB laboratory results, analytical method, detection limits, QA/QC information, sample IDs and chain-of-custody records. Confirm which equipment and oil volumes are PCB-contaminated.	High	PIU / Baku Metro / Certified laboratory	Immediate	Verified laboratory report and sample register
2	Stop work on affected equipment	Suspend dismantling, draining, cutting, movement, recycling or disposal of all PCB-confirmed equipment until an approved PCB handling method statement is in place.	High	Contractor / Baku Metro	Immediate	Stop-work instruction issued
3	Isolate PCB-confirmed equipment	Establish restricted access around PCB-confirmed transformers, oil containers, contaminated absorbents, tools, PPE and affected work areas. Prevent unauthorized access.	High	Contractor / Baku Metro Operations	Immediate	Restricted area established; warning signs installed
4	Label equipment and materials	Clearly label all affected equipment and containers as PCB-CONTAINING EQUIPMENT / HAZARDOUS WASTE – DO NOT OPEN . Labels should include equipment ID, location, PCB result, date and responsible person.	High	Contractor / PIU	Immediate–1 week	Labels installed and photo records prepared
5	Prepare PCB inventory	Prepare a detailed PCB inventory covering equipment type, ID, location, oil volume, PCB concentration, physical condition, leakage status, storage location and final management route.	High	Contractor / PIU / Baku Metro	1–2 weeks	Approved PCB inventory
6	Assess surrounding contamination	Inspect areas around PCB-confirmed equipment for oil stains, leakage, contaminated absorbents, sludge, drainage interaction or contaminated surfaces. Where required, collect	High	Contractor / Environmental specialist / Certified laboratory	1–4 weeks	Inspection records and sampling results

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No.	Action	Description / Required Measures	Priority	Responsible Party	Timeframe	Verification Indicator
7	Control active leakage	confirmatory samples of residues, sludge, soil, ballast or drainage sediment. If leakage is present, immediately place drip trays, absorbents and sealed containers below the source. Repair or stabilize leaking equipment only under approved PCB-safe procedures.	High	Contractor / Baku Metro technical staff	Immediate	Leakage stopped; spill response record
8	Provide secondary containment	Store PCB-contaminated oils, drained liquids and affected equipment on impermeable surfaces with secondary containment. Containment capacity should be at least 110% of the largest container volume .	High	Contractor / Depot Management	Immediate–2 weeks	Bunded storage area inspection record
9	Prepare PCB Management Procedure	Develop a PCB Management Procedure covering handling, PPE, storage, transport, emergency response, documentation, worker protection, labeling, disposal and reporting.	High	Contractor / PIU	2–4 weeks	Approved PCB Management Procedure
10	Train personnel	Train all workers who may handle or work near PCB-contaminated materials on PCB risks, restricted access, PPE, spill response, waste handling and emergency procedures.	High	Contractor / PIU / HSE specialist	Before handling starts	Training attendance records
11	Use appropriate PPE	Require chemical-resistant gloves, coveralls, eye protection, safety footwear and respiratory protection where required by risk assessment. Contaminated PPE shall be treated as PCB-contaminated waste.	High	Contractor	During all handling	PPE inspection records
12	Package PCB waste safely	Place PCB-contaminated oil, absorbents, residues, sludge and small components in sealed, compatible, clearly labelled containers. Damaged equipment shall be stabilized to prevent leakage.	High	Contractor / Licensed waste handler	Before transport	Container labels and packaging records
13	Prohibit mixing with other waste	PCB-contaminated oil and equipment must not be mixed with used oil, scrap metal, cable waste, ordinary hazardous waste, e-waste, municipal waste or recyclable material.	High	Contractor / Depot Management	Continuous	Waste segregation inspection records
14	Select licensed PCB waste handler	Identify and contract a certified or licensed organization authorized to manage PCB-contaminated waste. If national treatment capacity is unavailable, arrange specialized treatment or export under applicable legal procedures.	High	PIU / Baku Metro / Contractor	1–2 months	Contract and license documents
15	Arrange controlled transport	Transport PCB waste only using authorized vehicles, trained drivers,	High	Licensed waste	As required	Waste transfer

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No.	Action	Description / Required Measures	Priority	Responsible Party	Timeframe	Verification Indicator
16	Ensure final treatment / disposal	correct labeling, emergency response equipment, transport documentation and chain-of-custody forms. PCB waste shall be treated, destroyed, decontaminated or disposed of only by authorized facilities using environmentally sound methods. Ordinary landfill, open burning, informal recycling or uncontrolled scrap recovery is prohibited.	High	transporter / Contractor Licensed waste handler / As required PIU		notes and transport records Disposal / treatment certificates
17	Manage contaminated surfaces	Clean contaminated surfaces using approved methods. Contaminated absorbents, cleaning materials, sludge and wash residues shall be treated as PCB-contaminated waste.	High	Contractor / Licensed specialist	As required	Cleaning records and disposal certificates
18	Record and report	Maintain complete records of laboratory results, inventory, labels, photographs, training, incidents, waste quantities, transport documents, disposal certificates and corrective actions.	High	Contractor / PIU	Continuous	PCB management file
19	Include in monitoring reports	Summarize PCB findings, management actions, waste movements and disposal status in monthly contractor reports and semi-annual environmental monitoring reports to ADB.	Medium / High	PIU / Supervision Consultant	Monthly / semi-annual	Monitoring reports submitted
20	Update EMP and method statements	Revise the EMP, Waste Management Plan, OHS Plan, Emergency Response Plan and decommissioning method statements to reflect confirmed PCB risks and required controls.	High	Contractor / PIU / Supervision Consultant	1 month	Updated approved plans

4.7.1 Immediate Response Procedure

If PCBs are confirmed, the first response should be to stop any physical intervention on the affected equipment, isolate the area, label the equipment, and prevent leakage or unauthorized handling. The equipment should remain closed and intact unless sampling, stabilization, draining or removal is performed under an approved PCB-specific method statement. Any oil-stained absorbents, contaminated tools, PPE, containers, sludge or residues generated during the response should be treated as PCB-contaminated waste.

The PIU and Supervision Consultant should be informed immediately, and a PCB register should be opened for the affected equipment. The register should link each laboratory result to the exact equipment number, location, oil volume, photographs and planned management route. This is essential to maintain traceability and to prevent PCB-contaminated materials from entering ordinary scrap metal, used oil, e-waste or municipal waste streams.

4.7.2 Medium-Term Management Measures

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After immediate isolation and labeling, Baku Metro and the Contractor should develop a detailed PCB handling and disposal plan. This plan should define whether the equipment will remain temporarily in place, be transferred to a secure depot storage area, be drained under controlled conditions, or be transported as intact PCB-containing equipment. The selected option should minimize worker exposure, leakage risk, drainage contamination, fire risk and operational disruption.

Where national PCB treatment capacity is not available, the project should identify legally authorized treatment or disposal options in accordance with national requirements and international procedures. Any transboundary movement of PCB waste should follow Basel Convention principles, including prior notification, consent, approved transport route, chain-of-custody documentation, and confirmation of environmentally sound final treatment.

4.7.3 Key Rule for the Project

No PCB-confirmed oil, equipment or contaminated material should be reused, sold, recycled, mixed with other waste, transferred to informal handlers, or disposed of without certified documentation. The equipment should remain under controlled management until final treatment or disposal is completed and verified through official certificates.

5. Environmental Audit Findings and Recommendations

5.1 Environmental Audit Findings

The environmental audit confirmed that the Baku Metro Signaling Modernization and Operations Digitalization Project will be implemented within existing metro infrastructure, including tunnels, stations, depots, relay rooms, technical rooms, cable routes, signaling equipment locations and rolling stock facilities. The audit did not identify risks associated with new construction, land acquisition or expansion into natural areas. Instead, the main environmental concern is linked to legacy signaling and electrical equipment that may be dismantled, transferred, reused, recycled or disposed of during project implementation. The most important equipment group identified during the audit is the oil-filled drossel-transformers / choke-transformers installed along the track system. Approximately 933 such units are present in the Baku Metro network, including DTM-0.17-1000M, DTM-0.17-1000 and DTM-0.17-1500 type equipment, each generally containing about 25–28 liters of insulating oil.

The audit found that these oil-filled choke-transformers should be treated as **PCB-suspect equipment** until laboratory testing confirms otherwise. Based on the typical design and operational practice for this type of equipment, PCB-containing oils were not normally used as original insulating fluids. However, no reliable environmental documentation or maintenance records were available to confirm what type of oil was added over the years during topping-up, repair or routine maintenance, at what frequency, or in what quantities. As a result, although the probability of original PCB oil use may be lower than for sealed capacitors or certain high-risk electrical equipment, the possibility of PCB cross-contamination through historical maintenance cannot be excluded.

The audit also identified important limitations. Due to the large scale of the Baku Metro network, with approximately 40.7 km of metro lines and numerous underground technical areas, it was not possible to inspect the entire project area during the audit phase. The inspection was therefore carried out using a sample-based approach, covering representative stations, technical areas,

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accessible equipment locations and selected infrastructure elements. In addition, there were no records of historical oil spills, leakage events, clean-up actions or the extent of existing contamination. Therefore, the audit could not fully determine whether contamination is present beneath equipment, within cable ducts, on tunnel surfaces, in drainage channels or in other inaccessible locations.

The audit found that the underground setting of the Baku Metro increases the environmental sensitivity of the project. Many items of legacy equipment are located in enclosed or semi-enclosed areas with limited ventilation, active electrical systems, groundwater inflow and tunnel drainage channels. If oil or hazardous substances are released during dismantling or handling, contamination may affect tunnel floors, ballast, drainage channels, absorbents, tools, PPE, containers or other materials. For this reason, equipment located near drainage channels, sumps, groundwater inflow points or wet tunnel sections should be treated as higher-priority for inspection and sampling.

The audit confirmed that the current assessment is preliminary where laboratory analysis has not yet been conducted. The absence of visible contamination is not proof that hazardous materials are absent. Similarly, the absence of documentation confirming PCB-free oil means that oil-filled equipment with unknown oil composition should remain classified as PCB-suspect. Any future dismantling, recycling, transfer or disposal must therefore be preceded by analytical confirmation, approved method statements and site-specific environmental and safety procedures.

The risk of PCBs being present in choke-transformer oils was assessed as Medium before laboratory testing. This rating reflects the combination of oil-filled legacy equipment, long service life, undocumented oil maintenance history and the lack of laboratory confirmation. The risk is not assessed as uniformly High because PCB oils were not normally expected to have been used as original insulating fluids in this equipment type. However, specific units may have a Medium/High or High priority where oil history is unknown, visible leakage or staining is present, the equipment is in poor physical condition, or the unit is located near drainage or groundwater-sensitive areas.

5.2 Recommendations

It is recommended that Baku Metro and the project implementation team apply a precautionary hazardous-materials management approach to all oil-filled drossel-transformers / choke-transformers until laboratory testing confirms that PCB concentrations are below the applicable threshold of **50 ppm**. No oil-filled equipment should be opened, drained, cut, dismantled, recycled, sold as scrap or transferred for disposal until the equipment has been inventoried, risk-screened and, where required, sampled and tested. Equipment with unknown oil history should be clearly labelled and managed as PCB-suspect.

A detailed equipment inventory should be completed before any dismantling works begin. The inventory should record the equipment type, manufacturer if available, year of manufacture or installation where known, line / station / tunnel section, operational status, estimated oil volume, physical condition, leakage status, proximity to drainage or groundwater inflow points, accessibility and proposed management route. The inventory should also include other legacy electrical and electronic equipment, such as control boxes, relay equipment, switch machines, tunnel telephones, old cables, cable ducts and electrical cabinets, for hazardous waste and e-waste classification.

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A risk-based PCB sampling program should be implemented. Considering the scale of the network and the number of oil-filled units, approximately **100 oil samples** should be collected and submitted for PCB analysis as a first-stage representative screening campaign. The sampling program should cover different metro lines, tunnel sections, stations, depots, equipment types, operating conditions and environmentally sensitive locations. Priority should be given to units with missing maintenance records, unknown oil topping-up history, visible leakage or staining, damaged seals, corrosion, poor physical condition, proximity to drainage channels or groundwater inflow areas, and equipment located in pilot or early decommissioning sections.

Sampling should be carried out only by trained and authorized personnel under approved method statements. Before sampling, equipment must be isolated, secured and confirmed safe by qualified electrical personnel. Each selected item should receive a unique identification number and be entered into a sampling register. Samples should be collected in clean appropriate containers, uniquely labelled, photographed, documented in a sampling log and accompanied by a chain-of-custody form from collection to laboratory delivery. Testing should be undertaken by an accredited or certified laboratory using recognized analytical methods.

If laboratory results confirm PCB concentrations at or above 50 ppm, the affected equipment and oils should be immediately classified as PCB-contaminated or PCB-containing hazardous waste. Works on the affected equipment should stop, the area should be isolated, the equipment should be labelled, and access should be restricted. A PCB register should be opened, linking each laboratory result to the exact equipment number, location, oil volume, photographs and proposed management route. PCB-confirmed oil, equipment, absorbents, sludge, contaminated PPE, tools and residues should not be mixed with used oil, scrap metal, e-waste or general hazardous waste.

A project-specific PCB Management Procedure should be prepared and approved before any further handling of PCB-suspect or PCB-confirmed equipment. The procedure should cover inventory, labelling, sampling, testing, classification, handling, PPE, spill prevention, secondary containment, temporary storage, controlled transport, emergency response, documentation, reporting and final disposal. If national PCB treatment capacity is not available, the project should identify legally authorized treatment or disposal options in accordance with national requirements and applicable international procedures, including Basel Convention principles for any transboundary movement.

The project should establish controlled temporary storage arrangements at depot level. PCB-suspect and PCB-confirmed materials should be stored on impermeable surfaces, in secure and access-controlled areas, with appropriate labels, secondary containment, spill kits and fire safety arrangements. Liquid waste and oil containers should be placed within secondary containment with capacity equal to at least 110% of the largest container volume. No hazardous waste, PCB-suspect material or oil-filled equipment should be stored in tunnels, platforms, escape routes, drainage channels, shafts or other underground operational areas.

The project should also strengthen spill prevention and drainage protection measures. Equipment located near tunnel drainage channels, sumps, groundwater inflow points or wet tunnel sections should be prioritized for inspection and sampling. If visible staining, oil residue, sludge, unusual odour or contaminated sediment is identified during future works, activities should stop in the affected area and further investigation, sampling and classification should be carried out. Contaminated absorbents, cleaning materials, sludge and wash residues should be treated as hazardous waste until classification confirms otherwise.

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Occupational health and safety controls should be applied before any inspection, sampling or dismantling works involving PCB-suspect equipment. These controls should include permit-to-work procedures, Lock-Out / Tag-Out, restricted access, ventilation where required, chemical-resistant gloves, coveralls, eye protection, respiratory protection where needed, spill response equipment and worker training. Workers should be instructed not to open, drain, cut or handle oil-filled equipment without an approved method statement and supervision by competent personnel.

Finally, the audit findings should be incorporated into the project Environmental Management Plan, Waste Management Plan, OHS Plan, Emergency Response Plan, Environmental Monitoring Plan and decommissioning method statements. The PIU and Supervision Consultant should verify that the corrective actions are implemented before physical dismantling begins. All laboratory results, inventories, labels, photographs, training records, waste transfer notes, disposal certificates, incident records and corrective actions should be maintained in an auditable file and summarized in project environmental monitoring reports.

Annex 2: Rapid Environmental Screening Checklist

Baku Metro Signaling Modernization and Operations Digitalization Project

Inspection location: _____

Metro line / station / tunnel section: _____

Type of area: ☐ Tunnel ☐ Station technical room ☐ Relay room ☐ Depot ☐ Cable corridor ☐ Workshop ☐ Other: _____

Equipment group inspected: _____

Date: _____

Auditor(s): _____

Baku Metro representative(s): _____

This checklist is adapted from the submitted rapid environmental screening questionnaire and modified for the specific conditions of the Baku Metro Project, including underground tunnels, stations, depots, technical rooms, cable routes, drainage systems, legacy signaling equipment, and oil-filled drossel-transformers / choke-transformers.

1. Equipment Identification and Age

Equipment type:

- ☐ Drossel-transformer / choke-transformer
- ☐ Trackside signaling junction / control box
- ☐ Relay equipment
- ☐ Switch machine / point machine
- ☐ Tunnel telephone
- ☐ Cable / cable duct
- ☐ Electrical cabinet / control panel
- ☐ Other: _____

Equipment year of manufacture / installation, if known: _____

Probability of PCB concern based on age and documentation:

- ☐ Before 1980 – higher concern
- ☐ 1980–1990 – possible concern
- ☐ After 1995 – lower concern
- ☐ After 2005 – very low concern
- ☐ Unknown year – treat as suspect until verified

Is the equipment included in an official inventory?

- ☐ Yes ☐ No ☐ Partly ☐ Unknown

Remarks:

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2. Nameplate and Documentation Review

Nameplate available and readable:

☐ Yes ☐ No ☐ Partly

Information recorded from nameplate:

Manufacturer: _____

Type / model: _____

Serial number: _____

Year: _____

Oil type indicated: _____

Oil volume indicated: _____

Look for direct PCB-related labels:

- ☐ Askarel
- ☐ Aroclor
- ☐ Pyralene
- ☐ Clophen
- ☐ Sovol
- ☐ Sovtol
- ☐ PCB
- ☐ Chlorinated dielectric fluid
- ☐ No PCB-related label observed
- ☐ Nameplate unreadable / not accessible

Soviet / Russian designations to check:

- ☐ СОВОЛ / SOVOL
- ☐ СОВТОЛ / SOVTOL
- ☐ Трихлордифенил / Trichlorodiphenyl
- ☐ Трихлордифенилоксид / Trichlorodiphenyl oxide
- ☐ None observed
- ☐ Not checked / inaccessible

If any PCB-related label is present, the equipment shall be classified as PCB-containing until confirmed otherwise.

Remarks:

3. PCB and Oil-Containing Equipment

Does the equipment contain oil or dielectric fluid?

☐ Yes ☐ No ☐ Unknown

Estimated oil volume: _____

PCB testing records available:

☐ Yes ☐ No ☐ Not applicable

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Oil maintenance / topping-up records available:

☐ Yes ☐ No ☐ Incomplete ☐ Unknown

Is the type of oil added over the years documented?

☐ Yes ☐ No ☐ Partly

Any equipment suspected of containing PCBs above 50 ppm?

☐ Yes ☐ No ☐ Unknown

Visible oil leakage or staining:

☐ Yes ☐ No ☐ Minor staining ☐ Not accessible

Condition of seals / casing / fittings:

☐ Good ☐ Damaged ☐ Corroded ☐ Leaking ☐ Not accessible

Is sampling recommended?

☐ Yes ☐ No

Reason for sampling recommendation:

- ☐ Unknown oil history
- ☐ Old equipment
- ☐ Visible leakage / staining
- ☐ Located near drainage channel / sump
- ☐ Poor physical condition
- ☐ Representative equipment type
- ☐ Early decommissioning location
- ☐ Other: _____

Remarks:

4. Location and Environmental Sensitivity

Equipment / area located in:

- ☐ Tunnel
- ☐ Station technical area
- ☐ Relay room
- ☐ Depot
- ☐ Workshop
- ☐ Cable corridor
- ☐ Near passenger area
- ☐ Other: _____

Proximity to drainage channel / sump / groundwater inflow area:

- ☐ Directly adjacent
- ☐ Within 5 m
- ☐ More than 5 m

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- ☐ Not applicable
☐ Unknown

Groundwater or water inflow observed nearby:

- ☐ Yes ☐ No ☐ Signs of moisture only

Risk of oil entering tunnel drainage if leakage occurs:

- ☐ Low ☐ Moderate ☐ High

Ventilation condition in inspection area:

- ☐ Good ☐ Limited ☐ Poor ☐ Not assessed

Access constraints:

- ☐ Safe access available
☐ Restricted access
☐ Confined / narrow space
☐ Near active metro operations
☐ Night access only
☐ Other: _____

Remarks:

5. Surface Contamination and Residues

Evidence of oil staining on floor / concrete / ballast / equipment base:

- ☐ Yes ☐ No ☐ Not accessible

Evidence of oily residue, sludge or contaminated sediment:

- ☐ Yes ☐ No ☐ Not accessible

Stained drainage channel or cable duct observed:

- ☐ Yes ☐ No ☐ Not applicable

Unusual odour observed:

- ☐ Yes ☐ No

Signs of historical spill or leakage:

- ☐ Yes ☐ No ☐ Unknown

Need for confirmatory sampling of surface residue / sludge / sediment:

- ☐ Yes ☐ No

Remarks:

6. Waste Management Conditions

Waste or obsolete equipment stored at the inspected location:

☐ Yes ☐ No

Type of waste observed:

- ☐ Scrap metal
- ☐ Cable waste
- ☐ E-waste
- ☐ Oil-contaminated waste
- ☐ Used absorbents / rags
- ☐ Packaging
- ☐ Batteries / lamps
- ☐ Unknown waste
- ☐ Other: _____

Waste segregation adequate:

☐ Yes ☐ No ☐ Not applicable

Hazardous and non-hazardous waste mixed:

☐ Yes ☐ No ☐ Not applicable

Waste stored in tunnel / platform / drainage area / escape route:

☐ Yes ☐ No

Waste containers labelled:

☐ Yes ☐ No ☐ Not applicable

Disposal / transfer records available:

☐ Yes ☐ No ☐ Not applicable

Certified waste contractor identified:

☐ Yes ☐ No ☐ Unknown

Remarks:

7. Temporary Storage and Spill Control

Is a designated temporary storage area available at depot or approved facility?

☐ Yes ☐ No ☐ Not checked

Storage surface:

- ☐ Impermeable
- ☐ Concrete but damaged
- ☐ Soil / unprotected surface
- ☐ Not applicable

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Secondary containment available for liquid waste / oil-containing equipment:

☐ Yes ☐ No ☐ Not applicable

Secondary containment capacity adequate, minimum 110% of largest container:

☐ Yes ☐ No ☐ Not verified

Spill kits available and functional:

☐ Yes ☐ No ☐ Not applicable

Firefighting equipment available nearby:

☐ Yes ☐ No ☐ Not applicable

Access control for hazardous waste / PCB-suspect area:

☐ Yes ☐ No ☐ Not applicable

Remarks:

8. Water, Drainage and Groundwater Protection

Drainage system present near inspected area:

☐ Yes ☐ No

Drainage system functional and unobstructed:

☐ Yes ☐ No ☐ Not assessed

Oil-water separator present, if applicable:

☐ Yes ☐ No ☐ Not applicable

Any evidence of oily water discharge:

☐ Yes ☐ No

Any waste, cable, equipment or materials stored in drainage channel:

☐ Yes ☐ No

Need for water / sediment sampling:

☐ Yes ☐ No

Remarks:

9. Asbestos and Other Legacy Materials

Suspected asbestos-containing materials observed:

☐ Yes ☐ No ☐ Not assessed

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Possible asbestos location:

- ☐ Cable penetration sealing
- ☐ Wall / floor panels
- ☐ Roofing / sheet material
- ☐ Thermal insulation
- ☐ Unknown material
- ☐ Other: _____

Material damaged or deteriorating:

- ☐ Yes ☐ No ☐ Not applicable

Risk of disturbance during project works:

- ☐ Low ☐ Moderate ☐ High ☐ Not applicable

Management / removal plan available:

- ☐ Yes ☐ No ☐ Not applicable

Remarks:

10. Occupational Health and Safety Conditions

Electrical hazards observed:

- ☐ Yes ☐ No

Low-hanging / damaged / unsupported cables observed:

- ☐ Yes ☐ No

Confined-space conditions present:

- ☐ Yes ☐ No

Poor lighting:

- ☐ Yes ☐ No

Slip / trip / fall hazards:

- ☐ Yes ☐ No

Work near active metro operations:

- ☐ Yes ☐ No

Need for Lock-Out / Tag-Out before any intervention:

- ☐ Yes ☐ No

Need for permit-to-work:

- ☐ Yes ☐ No

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PPE required for inspection / sampling:

- ☐ Safety helmet
- ☐ Gloves
- ☐ Chemical-resistant gloves
- ☐ Eye protection
- ☐ Respiratory protection
- ☐ Safety footwear
- ☐ High-visibility clothing
- ☐ Other: _____

Remarks:

11. Emergency Preparedness and Access Control

Emergency response plan available for the inspected area:

- ☐ Yes ☐ No

Emergency exits / access routes unobstructed:

- ☐ Yes ☐ No

Area fenced / locked / access-controlled:

- ☐ Yes ☐ No ☐ Not applicable

Warning signs installed:

- ☐ Yes ☐ No ☐ Not applicable

Communication with OCC / dispatch available:

- ☐ Yes ☐ No ☐ Not checked

Emergency contact information displayed:

- ☐ Yes ☐ No

Remarks:

12. Overall Risk Rating

Overall risk rating for inspected equipment / area:

- ☐ Low – No significant hazardous material, contamination or safety issue identified; standard waste and OHS controls are sufficient.
- ☐ Moderate – Potential hazardous material, oil leakage, e-waste, drainage interaction or OHS issues identified; corrective actions required before dismantling or transfer.
- ☐ High – PCB-suspect oil-filled equipment, visible leakage, drainage contamination risk, unsafe handling conditions or major OHS hazard identified; detailed investigation and approved management procedures required before works proceed.

Main reason for rating:

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Immediate action required:

- ☐ No immediate action
- ☐ Label equipment
- ☐ Restrict access
- ☐ Install spill containment
- ☐ Collect sample
- ☐ Stop work
- ☐ Notify PIU / HSE
- ☐ Prepare corrective action
- ☐ Other: _____

Safety Rules During Inspection

During the inspection, the following actions are prohibited unless a specific approved method statement and safety permit are in place:

- ☐ Opening transformer or choke-transformer hatches
- ☐ Unscrewing plugs or valves
- ☐ Draining or transferring oil
- ☐ Touching oil, oily residues or stained materials without appropriate PPE
- ☐ Heating, welding, cutting or grinding near oil-filled or PCB-suspect equipment
- ☐ Moving, dismantling or selling suspect equipment as scrap
- ☐ Discharging any liquid, sludge or wash water into tunnel drainage
- ☐ Entering restricted tunnel or technical areas without Baku Metro authorization

If PCBs are suspected, the equipment must be marked:

“SUSPECTED PCB EQUIPMENT — DO NOT OPEN”

Annex 3: List of Participants

“Bakı Metropoliteninin” QSC-nin işarəvermə sistemlərinin modernləşdirilməsi və əməliyyatların rəqəmsallaşdırılması layihəsi üzrə ictimai görüş

Təşkilatçı: “Bakı Metropoliteni” Qapalı Səhmdar Cəmiyyəti

Ünvan: Bakı şəhəri, Nəsimi rayonu, Azadlıq prospekti küç, 22

Tarix: 12.05.2026

No	Ad, Soyad	Ərazi	Təşkilat / Qurum	Vəzifə	Əlaqə nömrəsi/email	İmza
1.	Sizacə Həsərov		Baş Müfəttişlik	Müfəttiş		[Signature]
2.	Əbdullayev Fəxrəddin		Azərbaycan	Söbə rəisi		[Signature]
3.	Quliyev Niyazi		IRX	xidmət rəisi		[Signature]
4.	İbrahimov Əlqismət		IRX	Baş mühəndis		[Signature]
5.	Məmmədov Bəxtiyar		Kommunikasiya departamenti	İDŞ rəisi		[Signature]
6.	Hafiz Qay, kor		tranzit			[Signature]
7.	İrəqli Karıladze		ADB	Consultant		[Signature]
8.	Mustafayev Emil		IRX	Söbə rəisi		[Signature]
9.	İsmədov Rəşad		MDX	Rəis müdri		[Signature]
10.	Anar Nuriyev		IRX	IRX HİK 30 d/2		[Signature]

Baku Metro Signalling Modernization and Operations Digitalization Project – Initial Environmental Examination

11.	Günel Hüseynova	JMSTD	söbə rəisi		
12.	Nərimin Həsəbli	JMSTD	rep. rəhbər		
13.	Günay Quliyeva	JMSTD	JMST rəhbər		
14.	Kanan Məmmədova	Azcon H	HSE		
15.	Məmməd Bayramov	IRX	distansiya rəisi		
16.	Məmmədov Fəhri	IRX	distansiya rəisi		
17.	Bəqirli Şəkran	IRX	söbə rəisi		
18.	İsmayilov Əmir	IRX	dist. rəisi		
19.	Düliyəv Nərimin	IRX	dist. rəisi		
20.	Zeynəlov Rəşad	IRX	dist. rəisi		
21.	Səhbazov Əmir	YX	Mühafiz		
22.	Əbdullayev Qeyhün	YX	əllətaxassıs		
23.	Həsənov Fərid	IRX	B. el. mex		
24.	Fəxrəzadə Yusif	IRX	el. mex		
25.	Məmmədov Bərkən	IRX	B. el. mex		

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26.	Kicibayov Rəşad		IRX	B. el. mex.		IRX
27.	Nigar Sabanova		RKD	Aparıcı mühəndisi		IRX
28.	Rəsulov Elçin		ITX	Aparıcı mühəndisi		IRX
29.	Yaqubov Novruz		ETX	Sahib rəisi		IRX
30.	Bayramov Elmar		ETX	marfeyor		IRX
31.	Quluyev Kamal		ETX	elek. mex.		IRX
32.	Sübhənov Musa		DMTM	Mühəndis		IRX
33.	Bəyqulu Elmir		DMTM	Mühəndis		IRX
34.	Həsənov Elvin		DMTM	Mühəndis		IRX
35.	Nəvruzov Arif		DMTM	B. El. mexan.		IRX
36.	Hüseynov Rəşad		T.O.X	Usta		IRX
37.	Rəşid Əliyev		IRX	Aparıcı mühəndisi		IRX
38.	Əliyev Səmuradlı		IRX	B. el. mexan.		IRX
39.	Məhəlibəyov Tünhən		RKD	Mühəndis		IRX
40.	Elçin Tahirzadə		IRX	B. el. mex.		IRX

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41.	Alahverdizov Ramin	IRX	B.d. mex.		
42.	Vardizov Featuron	"Zilind-SIDIP	Reg. Koodol.		
43.	Hassimov Ilham	SEMB-1 (y/x)	B.d. mex		
44.	Safiyev Elshir	IRX	B.d. mex		
45.	Bagirov Sadi	IRX	B.d. mex		
46.	Huseynov Astin	IRX	B.d. mex.		
47.	Xalilov Elsan	IRX	B.d. mex		
48.	Dzaboy Rovson	IRX	B.d. mex		
49.	Mammadzade Namin	IRX	B.d. mexanix		
50.	Vahidov Zaurat M.	IRX	B.d. mex.		
51.	Ishod Elvin	Kommunikatsiya	Turnalist		
52.	Mammadova Elmar	IRX	texnolog		
53.	Naguyeva Arzu	IRX	texnolog		
54.	Mazidov Makhmedul	Kommunikatsiya	Fotograf		
55.					

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Below is the English version of the participant attendance list from the uploaded handwritten public hearing register for the **Baku Metro Signaling Modernization and Operations Digitalization Project**.

No.	Full Name	Area	Organization / Institution	Position	Contact number / email	Signature
1	Sena Aliyeva	—	Azerenergy	Customer / Client	050-238-06-02	Signed
2	Abdulkhayr Jabbarov	—	Azerenergy	Head of Department	050-222-53-49	Signed
3	Gulgun Niyazi	—	IRX	Respondent / Specialist	050-223-7790	Signed
4	Shakina Hajiyevea	—	IRX	Chief Specialist	050-246-73-54	Signed
5	Mammadov Bakhtiyar	—	Communications Department [unclear]	Head of Service / Department	050-654-5089	Signed
6	Haji Ogtay	—	Inventory [unclear]	—	003416535 [unclear]	Signed
7	Tarikhli Kari / Bachar [unclear]	—	ADB	Consultant	995599927940	Signed
8	Mustafayeva Emil	—	IRX	Head of Department	050-263-34-88	Signed
9	Ismayilov Rifat	—	MTX	Deputy Head	050-248-89-00	Signed
10	Iman Nuriyev	—	IRX	Chairperson / Head	055-884-4507	Signed
11	Emel Aliyeva	—	MSS	Head of Department	050-660-95-43	Signed
12	Nemat Huseynli / Hasabli	—	MSS		-	Signed
13	Olkay Quliyeva	—		Trade Union / Department	-	Signed
14	Khanim Mammadzade	—	Azercell / Azer	HSE	050-400-10-13	Signed
15	Mammad Bayramov	—	IRX	Security / Protection	050-265-9333	Signed
16	Mammadov Sabin	—	IRX	Head of Department	050-274-8919	Signed
17	Bagirli Sultan	—	IRX	Head of Department	050-228-8220	Signed
18	Ismayilov Emin	—	IRX	Depot / Station Head	050-675-72-15	Signed

Baku Metro Signalling Modernization and Operations Digitalization Project – Initial Environmental Examination

No.	Full Name	Area	Organization / Institution	Position	Contact number / email	Signature
19	Quliyev Namiq	—	IRX	Electrical Head / Engineer	050-228-82-16	Signed
20	Zeynal Rüstəm	—	IRX	Head / Specialist	050-228-02-15	Signed
21	Shahbazov Emil	—	YX	Engineer	050-783-00-98	Signed
22	Abdullayeva Gulnar	—	YX		051-816-53-46	Signed
23	Hasanov Farid	—	IRX	Senior Electrical Mechanic	050-251-48-62	Signed
24	Qorox / Qorxmaz Zaur [unclear]	—	IRX	Electrical Mechanic	051-255-15-15	Signed
25	Mammadov / Olamadov Soyun [unclear]	—	OIRX / IRX [unclear]	Senior Electrical Mechanic	050-551-1124	Signed
26	Kichibayov Rovshan	—	SIX [unclear]	Senior Electrical Mechanic	050-246-21-12	Signed
27	Nigar Babayeva	—	RKD	Operations Specialist	050-866-50-73	Signed
28	Rasulov Elchin	—	ITX	Senior Officer / Specialist	055-860-37-41	Signed
29	Hasanov Novruz	—	ETX	Site Manager / Section Head	050-246-92-29	Signed
30	Bayramov Elman	—	ETX	Mechanic	070-288-53-20	Signed
31	Quliyev Kamran	—	ETX	Technical Mechanic	010-514-14-39	Signed
32	Sultanov Musa	—	DMTM	Engineer	070-966-66-02	Signed
33	Hajiyev Ahmed	—	DMTM	Engineer	055-446-22-23	Signed
34	Hasanov Elvin	—	DMTM	Engineer	051-427-66-66	Signed
35	Nacmeddinov Arif [unclear]	—	DMTM	Senior Electrical Mechanic	051-480-66-69	Signed
36	Huseynov Raciq	—	SQA.X / YQA.X [unclear]	Foreman	050-280-95-43	Signed
37	Rashid Parviz / Aziz [unclear]	—	SAX [unclear]	Welder	050-488-12-8 0	Signed
38	Imraz Rahman	—	IRX	Senior Electrical Mechanic	055-513-33-06	Signed

Baku Metro Signalling Modernization and Operations Digitalization Project – Initial Environmental Examination

No.	Full Name	Area	Organization / Institution	Position	Contact number / email	Signature
39	Malikov Jumshud / Jushan [unclear]	—	RKD	Manager / Head	051-818-05-07	Signed
40	Elchin Tahirov	—	IRX	Senior Electrical Mechanic	055-820-2507	Signed
41	Mahmudov Ramin	—	IRX	Senior Electrical Mechanic	070-980-30-60	Signed
42	Valiyev Fidail / Fədayi [unclear]	—	“Ziya-Şöbə” / Department [unclear]	Head of Department	050-538-73-51	Signed
43	Hasanov İlham	—	ŞEMB / YX [unclear]	Senior Electrical Mechanic	050-920-18-00	Signed
44	Qatıyev Mustafa	—	IRX	Senior Electrical Mechanic	051-865-90-16	Signed
45	Bagirov Sadi	—	IRX	Senior Electrical Mechanic	050-565-50-53	Signed
46	Hüseynov Asim	—	—	Senior Electrical Mechanic	077-271-27-44	Signed
47	Khalilov Elshan	—	IRX	Senior Electrical Mechanic	010-246-62-04	Signed
48	Qazibey Rovshani / Rovshan [unclear]	—	IRX	Senior Electrical Mechanic	051-250-33-53	Signed
49	Mammadov Nariman	—	IRX	Senior Electrical Mechanic	050-559-38-64	Signed
50	Valiyev Rauf M.	—	Communications [unclear]	Senior Electrical Mechanic	051-753-10-10	Signed
51	Ibad Elvin	—	—	Repairman / Technician	051-331-78-98	Signed
52	Mammadalina Elmar [unclear]	—	IRX	Technologist	055-750-59-66	Signed
53	Nagiyeva Aysu	—	IRX	Technologist	055-862-37-77	Signed
54	Mashadiyev Vugar	—	—	Photographer	055-827-40-22	Signed

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