Asian Infrastructure Investment Bank (AIIB)

People's Republic of China

Beijing-Tianjin-Hebei Low Carbon Energy Transition and Air Quality Improvement Project

Environmental Impact Assessment and Environmental Management Plan for Gas Transmission

- Associated Facility of the Project

Construction unit：Beijing Gas Group Co.,Ltd.

Compilation unit：TIWTE Environmental Technology Development (Tianjin) Co., Ltd.

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1 Introduction

1.1 Project background

China is now the world's largest exporterand manufacture, also the world's second-largest economy. Attributed to its energy-intensive growth in the past, , China has beenfacing critical challenges of environmental pollution. This by estimationwhich costs around 3-10% of its GDP , in which a large part arises from air pollution.To address such an obsolete and unsustainable growth model, the Chinese government has proposed a green development model which focuses on decoupling economic growth with resource oversupply as well as high carbon emissions with and environmental damage. Since then, green development has become a top priority in China's development policy.

Reducing coal consumption is at the heart of China's green development agenda. Being limited by natural resource reserves, China has relied heavily on coal to boost its economy. . However, coalis a polluting and unsustainable energy source, and pollutants from coal combustion have become the main source of air pollution. To improve air quality, it is urgent to replace coal with clean fuels such as natural gas and renewable energy. In 2012, the State Council promulgated new environmental air quality standards to reduce the concentration of six major atmospheric pollutants. In 2013, the National Comprehensive Plan of Action for the Prevention and Control of Air Pollution (CAAP, 2013-2017) was launched, outlining the most stringent air pollution control measures in China's history. In 2016, Plan 45 (2016-2020) began implementing mandatory targets for local air quality improvement. In 2018, the State Council announced a three-year action plan for the Blue Sky Campaign, requiring local governments to take measures to achieve more in air pollution control, and to promote clean energy use for heating in the winter in North China, accelerate the phase out of small coal-fired boilers and increase rail freight transport in and around the Beijing-Tianjin-Hebei region, the Yangtze River Delta, the Fenhe River and the Weihe River Plain. Air quality has generally improved over the past few years through strong interventions, but levels of air pollution remain high compared to OECD countries.

According to the Paris Agreement, carbon dioxide (CO2) emissions are expected to peak by 2030, as coal combustion is the single largest source of air pollution and CO. Global carbon emissions soared to record in 2018, which sets a remarkable milestone. This also underscored the need to accelerate and fasten climate change with stronger actions. Therefore, energy system transition is needed to meet growing demand while curtailing emissions to address climate change and air pollution.. The project aims to to replace coal with natural gas in the Beijing-Tianjin-Hebei region, which is expected to largely reduce carbon emissions upon completion. This is not in line with commitments from international community in fighting against climate change, but also comply with government's policy priority in reducing CO2 emissions and improving regional air quality. In light of its foreseeable benefits to the environment , this program has attained strong support from the central government.

Beijing-Tianjin-Hebei and its surrounding areas (such as Henan, Shandong, Shanxi and Liaoning provinces) are the key engines of economic development in China. Together, they face dual challenges of increasing energy supplies and tackling air pollution. Beijing-Tianjin-Hebei is a highly industrial area with high energy and pollution intensity. . It also has been experiencing poor air quality, mainly due to heavy reliance on coal in the energy mix , and concentration of heavy duty trucks as well as inadequate monitoring of environmental standards. Air pollution, especially high levels of PM 2.5 , can potentially lead to many negative health effects and increase the risk of cardiovascular disease, respiratory disease and ischemic heart disease. Children, patients and the elderly are most vulnerable to such adverse effects. With increasing public awareness of environmental protection and the frequent red warning of air pollution in the Beijing-Tianjin-Hebei region, coal reduction and resulting poor air quality have always been the core of environmental policy discussions among governments, academia and governments. Therefore, it is necessary to reduce coal consumption in the Beijing-Tianjin-Hebei region and switch from coal to natural gas for a more sustainable low-carbon development path, which will bring substantial environmental benefits for improving air quality and reducing carbon emissions.

According to the " Implementation Plan for the Construction of LNG Storage and Transportation System in Bohai Rim Region (2019-2022) ", the capacity f the LNG terminal is able to back up gas supply that to 5% of enterprises' demand for and 3 days of government's demand emergency gas storage capacity of local governments. At present, there are 2 LNG receiving stations in the Beijing-Tianjin-Hebei region, namely Tianjin floating LNG from CNOOC and Tianjin LNG from Sinopec, with a gasification capacity of 4300 ×

104 nm 3/d, and Tangshan LNG supply to the Beijing-Tianjin-Hebei region with a gasification capacity of 4200 × 104 nm 3/d . The expansion of the Tangshan LNG receiving station and Tianjin LNG receiving station from CNOOC is planned for 2022 with a total gasification capacity of 27900 × 104 nm 3/d . considering the radiation area of the send-out pipeline, the supply of the Beijing-Tianjin-Hebei region will be about 16978 × 104 Nm3/d in 2025, the demand of the Beijing-Tianjin-Hebei region will be 36885 × 104 Nm3/d in 2025, and the total supply capacity of the pipeline gas source will be 32452 × 104 Nm3/d.

With the development of national economy, the gap between China's natural gas resources and demand is becoming larger, and imported gas will increase year by year, especially in the Bohai Rim region where energy is relatively scarce while economy is well developed. With the increasing demand for energy, importing LNG will play an important role in optimizing China's energy structure, improving energy securiand addressing ecological environment conservation , and achieving sustainable economic and social development. The rated capacity of LNG receiving station is 5 Mt/year, equivalent to 6.937 billion cubic meters , which can replace 8,5 million tons of standard coal. This amounts to 272 Mt reduction of sulfur dioxide per year, 676.99 Mt reduction of soot peryear, 7.5 Mt043 reduction of carbon dioxide per year and 784.41Mt3 reduction of nitrogen oxides per year.

In this context, Beijing Gas Group Ltd. is convinced ends to develop this project. The completion of the project is expected to provide back up for gas supply as well as meet peak demand for the Beijing-Tianjin-Hebei region, which can effectively relieve the winter supply shortage in this region. , In the meanwhile, it can also promote pipeline interconnections, secure gas supply for the Bohai Sea region, reduce carbon emissions and improve air quality.

1.2 Working procedure

In accordance with the relevant requirements of the Environmental and Social Framework of the Investment Bank, the Environmental Protection Law of the People's Republic of China, the Environmental Impact Assessment Law of the People's Republic of China and the relevant provisions of the Administrative Regulations on Environmental Protection of Construction Projects No. 253 of the State Council Order, the Beijing Gas Group Limited Company commissioned the Environmental Science and Technology Development (Tianjin) Ltd. of Tianyuan to conduct environmental impact assessment on the project. After accepting the entrustment, the EIA unit has carried on the deep l analysis and research to the work result of the project in the early stage, has collected the relevant data extensively, the EIA unit is involved in the project in advance in the feasibility design, pays attention to the whole process risk management, attaches importance to the ecological sensitive area protection problem, has carried on the public participation investigation according to the relevant regulations of the country. The present report has been prepared on the basis of a synthesis of project-related thematic findings, expert advice and public participation.

The present report has been prepared in accordance with the requirements of the AIIB Framework for Environment and Society. According to China's " Environmental Impact Assessment Technical Guidelines ", " Environmental Impact Assessment Technical Guidelines for Atmospheric Environment ", " Environmental Impact Assessment Technical Guidelines for Surface Water Environment ", " Environmental Impact Assessment Technical Guidelines for Sound Environment " (HJ 2.4-2009), " Environmental Impact Assessment Technical Guidelines for Groundwater Environment ", " Environmental Impact Assessment Technical Guidelines for Soil Environment " (for Trial Implementation), " technical Guidelines for Environmental Risk Assessment of Projects, Regulations for Environmental Impact Assessment of Port Construction Projects and Technical Guidelines for Environmental Risk Assessment of Oil Spill on Water, etc. The methods of environmental impact assessment, such as data collection, status survey, remote sensing analysis, numerical simulation and analogy, were adopted.

The following environment-related technical results were mainly referenced and referenced during the preparation of the report :

(1) “Beijing Gas Tianjin Nangang LNG Emergency Reserve Project involves the Tianjin Municipality's Permanent Protection Ecological Zone (excluding Nature Reserves) Ecological Environment Impact Demonstration Report”, Tianjin Huanke Environmental Planning Technology Development Co., Ltd., July 2019;

(2) “Report on the Impact of the Outer Pipeline Crossing of Tianjin Nangang LNG Emergency Reserve Project on the Ecological Environment of Tianjin Beidagang Wetland

Nature Reserve", National Forestry and Prairie Bureau Survey Planning and Design Institute, April 2019;

(3) "Evaluation Report on the Impact of Beijing Gas-Tianjin Nangang LNG Send-out pipeline Passage Project on National Key Protected Wild Animals and Their Habitats", Tianjin Beidagang Wetland Nature Reserve, National Forestry and Prairie Bureau Survey Planning and Design Institute, July 2019 .

1.3 Compliance analysis with related planning

1.3.1 Compliance with local planning along the pipeline

According to the natural conditions along the terrain, geomorphology, geology, hydrology, earthquake and other social conditions such as transportation and electric power, and taking into account the urban development planning along the line and the constraints of nature reserves, water source protection areas, scenic spots, etc. Coordination with local planning and construction focuses on the safety of pipelines and local areas along the route, and handles the relationship between soil and water conservation, environmental protection and pipeline construction, protecting the environment and reducing land occupation.

The route of the send-out pipeline of the project has been fully communicated with the local planning department. The pipeline routing and site selection have obtained the consent of the Planning Department of the Tianjin Planning and Natural Resources Bureau, the Natural Resources Department of Hebei Province and the Beijing Municipal Planning and Natural Resources Committee. Comments, so this pipeline project is in line with local planning.

Table 1.3-1 Opinions and treatment of various planning departments

Sequence number	Administrative region	Approval department	Planning department comments
Tianjin			
1	Wuqing District	People's Government of Wuqing District	In principle, the line selection scheme of the project is agreed
2	Xiqing District	Xiqing Branch of Tianjin Bureau of Planning and Natural Resources	Agree in principle to the site selection scheme of the project
3	Jinghai District	Tianjin Jinghai District People's Government	Agree to your proposed project in principle
4	Binhai New Area	Binhai New Area Branch of Tianjin Bureau of Planning and Natural Resources	We agree that your company will carry out pre-planning and site selection work
Hebei Province			

Sequence number	Administrative region	Approval department	Planning department comments
5	Guangyang District	Langfang City Natural Resources and Planning Bureau	We agree to the Guangyang Section of the Project
6	Anji District	People's Government of Anji District	Agree in principle to the implementation of the project
7	Yongqing County	Yongqing County Bureau of Natural Resources and Planning	Agree in principle on the routing direction and valve chamber setting
Beijing			
8	Daxing District		

1.3.2 Compliance analysis of ecological protection red line planning

The project passes through Tianjin, Hebei and Beijing, and passes through 26 permanent ecological protection areas in Tianjin (including 15 forest belt types, 6 river types, 2 lake reservoir types, 2 park types, and 1 wetland type). There are 2 ecological red lines in Hebei, and there is no ecological red line crossing Beijing.

According to the Notice of the General Office of the General Office of the CPC Central Committee on Printing and Distributing Certain Opinions on Delineating and Strictly Observing the Red Line of Ecological Protection (Dongzi [2017] No. 2), Ecological Protection Red Line, Environmental Quality Bottom Line, Resource Utilization and Environment The requirements for the establishment of a technical guide for the entry of negative lists (Environmental Environmental Assessment [2017] No. 99), etc., have been approved by the Tianjin Municipal Government on August 14, 2019; the ecological red line of Hebei Province has been solicited. The opinions of the People's Government of Hebei Province, but due to the lack of specific control requirements in Hebei, no reply was sent. The red line area and the yellow line area traversed by this project are not prohibited development areas. Therefore, the control requirements of the ecological red line are not in conflict.

1.4 Project characteristics and main environmental issues and environmental impacts of concern

In the gas pipeline project, the transport medium is clean natural gas, and the environmental impact is mainly concentrated in the construction period. This evaluation combines the characteristics of the construction project, focusing on the environmental risk assessment along the ecological environment and operation period along the construction period. The main issues of concern are: the environmental impact of the project on the Beidagang Wetland Nature Reserve, the ecological red line, the environmental feasibility of the pipeline route and station site selection, the ecological environment during the construction period, the surface water environment impact and environmental protection measures, operation Risk prevention measures.

The main environmental impacts of this project are:

1) Ecological impact: The ecological environment impact of the project is mainly reflected in the construction period, which is characterized by trench excavation, pipeline crossing, and construction of the valve chamber of the station yard, which brings disturbance to the surface of the soil, changes in landform and damage to surface vegetation. Land use pattern change, loss of agriculture, forestry, planting industry; construction of temporary roads and other land occupation caused by soil erosion and surface vegetation damage. After evaluation, the impact of the project on the ecological environment is small, and the adverse impact is system acceptable.

2) Environmental impact of surface water: The rivers traversed by this project are mostly directional drilling construction, which has little impact on the water body. In addition, the excavated water body affects the water quality of the water, but the impact is short-lived. Therefore, the project The impact of construction on the surface water environment is small. The operation period has almost no impact on surface water. The station wastewater is used for greening and flushing roads in the station, and is not discharged, which has little impact on the surface water environment.

3) Atmospheric, noise, groundwater, solid waste, etc.: The exhaust gas in the station is mainly the exhaust gas of gas-fired air-conditioning, wall-hung boiler and boiler, and the unorganized gas of equipment and pipe valve parts; the noise contribution value of each station yard boundary can be It meets the Class 2 standards of Environmental Noise Emission Standards for Industrial Enterprises (GB12348-2008); the ecological red lines of Tianjin and Hebei that pass through the project have little impact on the surrounding environment through impact analysis; The solid waste generated by the project has been properly disposed of.he solid waste generated by the project has been obtained. Properly disposed of.

4) Environmental risk impact: The main types of accidents in this project are natural gas leakage, fire and explosion. The prediction indicates that the maximum tube inventory control node unit has a fracture accident and the maximum gas reservoir leakage in the station. Under the set prediction conditions, the maximum distance of methane toxicity end point concentration -1 is 230m, and the methane toxicity end point concentration is -2. The distance is 460m. Natural gas leaks can easily cause fires. Natural gas leaks instantaneously and is prone to incomplete combustion, which produces carbon monoxide. Due to the low sulfur content of this project, the concentration of SO2 pollutants generated by natural gas leakage combustion is limited (⊁10mg/m3), and SO2 pollutants will not increase significantly and exceed the standard. The prediction indicates that the maximum pipe inventory control node unit has the largest gas reservoir leakage accident in the event of a fracture accident. Under the set prediction conditions, the farthest distance of the CO toxicity endpoint concentration is 330m. The maximum distance for the end point concentration of CO toxicity of -2 is 660 m..

1.5 Main conclusions of the environmental impact report

The pipeline routing of this project has undergone repeated site surveys and economic and technical demonstrations of multiple schemes. The selected routes are generally in line with the urban development planning and land use planning along the route. The various processes are relatively advanced, and all kinds of pollutants can reach the standard discharge, and its environmental impact. Smaller, environmental risks can be prevented and controlled, pollution prevention measures are feasible, and ecological damages are temporary and recoverable, and compensated accordingly.

Therefore, after comprehensively strengthening supervision and management, strictly implementing the “three simultaneous” environmental protection system and conscientiously implementing various pollution prevention measures, ecological protection measures, risk control measures and emergency plans, the construction of this project is feasible from the perspective of environmental protection. .

2 General Provisions

2.1 Basis of preparation

2.1.1AIIB related requirements

（1）Definitions

•Client means the recipient of the Bank financing for a Project and any other entity responsible for implementation of the Project.

•Project means the specific set of activities for which the Bank financing is provided, as defined in the agreement governing such financing, regardless of the financing instrument or the source of such financing or whether the Project is financed in whole or in part by the Bank.

The Environmental and Social Framework comprises：

•Environmental and Social Policy (ESP). This comprises mandatory environmental and social requirements for each Project.

•Environmental and Social Standards. Three associated mandatory environmental and social standards (ESSs) set out more detailed environmental and social requirements relating to the following:

ESS 1：Environmental and Social Assessment and Management;

ESS 2：Involuntary Resettlement; and

ESS 3：Indigenous Peoples.

•Environmental and Social Exclusion List. The Bank will not knowingly finance a Project that involves activities or items specified in this list (Exclusion List).

Scope of Application：The ESP applies to all Projects. The Bank requires each Client to manage the environmental and social risks and impacts associated with its Project in a manner designed to meet the ESP and the applicable ESSs in accordance with the environmental and social management plan (ESMP), and environmental and social management planning framework (ESMPF), as applicable, required for the Project under this ESP and ESSs.

(2) Categories

The Bank assigns each proposed Project to one of the following four categories:

•Category A. A Project is categorized A if it is likely to have significant adverse environmental and social impacts that are irreversible, cumulative, diverse or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works and may be temporary or permanent in nature. The Bank requires the Client to conduct an environmental and social impact assessment (ESIA)or equivalent environmental and social assessment, for each Category A Project and to prepare an ESMP or ESMPF, which is included in the ESIA report for the Project. The ESIA for a Category A Project examines the Project's potentially negative and positive environmental and social impacts, compares them with those of feasible alternatives (including the "without Project" situation), and recommends any measures needed to avoid, minimize, mitigate, or compensate for adverse impacts and improve environmental and social performance of the Project.

•Category B. A Project is categorized B when: it has a limited number of potentially adverse environmental and social impacts; the impacts are not unprecedented; few if any of them are irreversible or cumulative; they are limited to the Project area; and can be successfully managed using good practice in an operational setting. The Bank requires the Client to conduct an initial review of the environmental and social implications of the Project. On the basis of this review, the Bank, in consultation with the Client, determines the appropriate instrument for the Client to assess the Project's environmental and social risks and impacts, on a case-by-case basis. The Bank may determine that an environmental and social assessment or another similar instrument is appropriate for the Project. The scope of the assessment may vary from Project to Project, but it is narrower than that of the Category A ESIA. As in the case of a Category A Project, the assessment examines the Project's potentially negative and positive environmental impacts and recommends any measures needed to avoid, minimize, mitigate, or compensate for adverse impacts and improve environmental performance of the Project.

•Category C. A Project is categorized C when it is likely to have minimal or no adverse environmental and social impacts. The Bank does not require an environmental and social assessment, but does require the Client to conduct a review of the environmental and social implications of the Project.

•Category FI. A Project is categorized FI if the financing structure involves the provision of funds to or through a financial intermediary (FI) for the Project, whereby the Bank delegates to the FI the decision-making on the use of the Bank funds, including the selection, appraisal, approval and monitoring of Bank-financed subprojects. The Bank requires the FI

Client, through the implementation of appropriate environmental and social policies and procedures, to screen and categorize subprojects as Category A, B or C, review, conduct due diligence on, and monitor the environmental and social risks and impacts associated with the Bank-financed subprojects, all in a manner consistent with this ESP. A Project categorized as FI is also subject to: (a) the Environmental and Social Exclusion List and applicable host country national laws for all the Bank-financed subprojects; and (b) the applicable ESSs for the Bank-financed subprojects that are classified as Category A subprojects (and if the Bank so determines, some or all of the Bank-financed subprojects that are classified as Category B subprojects).

(3) Environmental and Social Assessment

When the Bank has determined, in consultation with the Client, that the Project has potentially adverse environmental or social risks and impacts, it requires the Client:

•To conduct an environmental and social assessment relating to these risks and impacts, and design appropriate measures to avoid, minimize, mitigate, offset or compensate for them, all as required under ESS 1.

•If the Project would result in Involuntary Resettlement, to address this in the social section of the assessment report, complemented by more in-depth coverage, as required under ESS 2. The Client covers Involuntary Resettlement in a resettlement plan or resettlement planning framework (RPF), which is provided to the Bank as a freestanding document, an annex to the assessment report, or incorporated into the report as a recognizable element.

•If the Project would affect Indigenous Peoples, to address this in the social section of the assessment report, complemented by more in-depth coverage, as required under ESS 3. The Client covers impacts on Indigenous Peoples in an Indigenous Peoples plan or Indigenous Peoples planning framework (IPPF), which is as a freestanding document, an annex to the assessment report, or incorporated into the report as a recognizable element.

(4) Involuntary Resettlement.

Involuntary Resettlement.： Involuntary Resettlement covers physical displacement (relocation, loss of residential land or loss of shelter) and economic displacement (loss of land or access to land and natural resources; loss of assets or access to assets, income sources or means of livelihood)

The Bank screens each Project to determine whether or not it involves Involuntary Resettlement (which covers both physical and economic displacement, as defined in ESS 2). Where it is not feasible to avoid Involuntary Resettlement, the Client is required to ensure that resettlement activities are conceived and executed as sustainable development programs, providing sufficient resources to enable the persons displaced by the Project to share in Project benefits.

If the Project involves Involuntary Resettlement, the Bank requires the Client to prepare a resettlement plan or RPF (as applicable) that is proportional to the extent and degree of the impacts. The degree of impacts is determined by: (a) the scope of physical and economic displacement; and (b) the vulnerability of the affected people. The resettlement plan or RPF complements the broader coverage of social risks and impacts in the environmental and social assessment and provides specialized guidance to address the specific issues associated with Involuntary Resettlement, including land acquisition, changes in land use rights, displacement and need for livelihood restoration.

The Bank does not endorse illegal settlement; however, it recognizes that significant populations already inhabit both urban and rural land without title or recognized land rights in its countries of operation. Given this situation, the Bank requires the Client to ensure that

displaced persons without title to land or any recognizable legal rights to land, are eligible for, and receive, resettlement assistance and compensation for loss of non-land assets, in accordance with cut-off dates established in the resettlement plan, and that they are included in the resettlement consultation process.

Associated Facilities. Associated facilities (Associated Facilities) are activities that are not included in the description of the Project set out in the agreement governing the Project,but that the Bank determines, following consultation with the Client, are: (a) directly and materially related to the Project; (b) carried out or planned to be carried out, contemporaneously with the Project; and (c) necessary for the Project to be viable and would not be constructed or expanded if the Project did not exist.

Associated Facilities Controlled or Not Controlled by the Client. The Bank requires the Client, as part of its environmental and social assessment, to identify and assess the potential environmental and social risks and impacts of Associated Facilities, as follows:

•To the extent the Client controls or has influence over the Associated Facilities, the Bank requires it to take the following actions: (a) the Client is required to comply with the requirements of the ESP and ESSs with respect to such facilities, to the extent of its control or influence; and (b) if the Associated Facilities are financed by another multilateral development bank or bilateral development organization, the Bank may rely on the requirements of such other development partner in place of all or some of the requirements set out in the ESP and ESSs, provided that, in the Bank's judgment, such requirements do not materially deviate from what would otherwise be required under the ESP and ESSs.

•If the Client does not control or have influence over the Associated Activities, it identifies in the environmental and social assessment the environmental and social risks and impacts the Associated Facilities may present to the Project.

•The Client is required to demonstrate, to the Bank's satisfaction, the extent to which it does not exercise control or have influence over the Associated Facilities by providing details of the relevant considerations, which may include legal, regulatory and institutional factors.

(5) Involuntary Resettlement

1. Objectives: o avoid Involuntary Resettlement wherever possible; to minimize Involuntary Resettlement by exploring Project alternatives; where avoidance of Involuntary Resettlement is not feasible, to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-Project levels; to improve the overall socioeconomic status of the displaced poor and other vulnerable groups; and to conceive and implement resettlement activities as sustainable development programs, providing sufficient resources to enable the persons displaced by the Project to share in Project benefits.

2. Scope and Application: ESS 2 applies if the Project's screening process reveals that the Project would involve Involuntary Resettlement (including Involuntary Resettlement of the recent past or foreseeable future that is directly linked to the Project). Involuntary Resettlement covers physical displacement (relocation, loss of residential land or loss of shelter) and economic displacement (loss of land or access to land and natural resources; loss of assets or access to assets, income sources or means of livelihood) as a result of: (a) involuntary acquisition of land; or (b) involuntary restrictions on land use or on access to

legally designated parks and protected areas. It covers such displacement whether such losses and involuntary restrictions are full or partial, permanent or temporary.

3.Measure：If adverse environmental, social or economic impacts from Project activities involving loss of access to assets or resources or restrictions on land use that do not fall within the definition of Involuntary Resettlement are identified, such impacts are avoided, or when avoidance is not feasible, they are at least minimized, mitigated, or compensated for, through the environmental and social assessment under ESS 1. If these impacts are found to be adverse at any stage of the Project, the Client is required to develop and implement a management plan to restore the livelihoods of affected persons to at least pre-Project level or better.

4. Requirements: The Client is required to undertake the following actions in relation to the Project:

•Planning. Determine the required scope of Involuntary Resettlement planning, through a survey of land and assets, a full census of persons to be displaced, and an evaluation of socioeconomic conditions specifically related to Involuntary Resettlement risks and impacts. This establishes baseline information on assets, productive resources and status of livelihoods. Include consideration of customary rights, collective or communal forms of land tenure. Take gender into account in conducting the above. If Indigenous Peoples are affected, follow the requirements of ESS 3.

•Resettlement Plan. Prepare a resettlement plan elaborating on displaced persons' entitlements, income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget and time-bound implementation schedule. Involve affected persons in consultation on the resettlement plan and disclose the draft resettlement documentation in accordance with the Information Disclosure bullet below. The resettlement plan complements the broader coverage of social risks and impacts in the environmental and social assessment and provides specialized guidance to address the specific issues associated with Involuntary Resettlement, including land acquisition, changes in land use rights, including customary rights, physical and economic displacement, and potential design adjustments that may reduce resettlement requirements. In some cases, with the Bank's prior approval, resettlement actions may be part of an overall community development plan, where the Client takes special efforts to ensure people who are displaced receive appropriate benefits through such a plan. When displacement is only economic, prepare a livelihood restoration plan. Provide measures to be taken in case of disputes over compensation.

•Abbreviated Resettlement Plan. Where impacts on the entire displaced population are minor, or fewer than 200 people are displaced, the Client may, with the prior approval of the Bank, prepare an abbreviated resettlement plan, covering such elements as the Bank may specify. Impacts are considered “minor” if the affected people are not physically displaced and less than 10 percent of their productive assets are lost. Resettlement Planning Framework. If (a) the Project is likely to involve Involuntary Resettlement but consists of a program or series of activities whose details are not yet identified at the time the Project is approved by the Bank, or (b) in exceptional circumstances, duly justified by the Client, the Bank determines that the environmental and social assessment of identified Project activities involving Involuntary Resettlement may be conducted using a phased approach under paragraph 50 of the ESP: prepare an RPF. Prepare the resettlement plan or abbreviated resettlement plan, as described in the preceding bullets, as early as possible during development of the activities, in conformity with the RPF approved by the Bank.

•Proportionality. Ensure that the resettlement plan or RPF is proportional to the extent and degree of the impacts. The degree of impacts is determined by: (a) the scope of physical and economic displacement; and (b) the vulnerability of the persons to be displaced by the Project.

•Consultations. Carry out meaningful consultations with persons to be displaced by the Project, host communities and nongovernmental organizations, and facilitate their informed participation in the consultations. Consult with all persons to be displaced on their rights within the resettlement process, entitlements and resettlement options, and further participation process. Ensure their involvement in planning, implementation, monitoring and evaluation of the resettlement plan. Pay particular attention to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, Indigenous Peoples and those without legal title to land, and ensure their participation in consultations.

•Grievance Mechanism. Establish a suitable grievance redress mechanism to receive and facilitate resolution of the concerns of persons displaced by the Project and inform them of its availability. Scale the grievance mechanism to the risks and impacts of the Involuntary Resettlement. The grievance mechanism may utilize existing formal or informal grievance mechanisms, provided that they are properly designed and implemented, and determined by the Bank to be suitable for the Project; these may be supplemented, as needed, with Project-specific arrangements. Design the mechanism to address displaced persons' concerns and complaints promptly, using an understandable and transparent process that is gender-sensitive, culturally appropriate and readily accessible to all affected people. Include provisions to protect complainants from retaliation and to remain anonymous, if requested. Disclose reports on grievance redress and outcomes in accordance with the Information Disclosure bullet below.

•Social Support. Support the social and cultural institutions of persons displaced by the Project and their host population to address resettlement. Where Involuntary Resettlement risks and impacts are highly complex and sensitive, consider implementation of a social preparation phase to build the capacity of vulnerable groups to address resettlement issues, consisting of consultation with affected people and the host population before key compensation and resettlement decisions are made. The cost of social preparation is included in the resettlement budget.

•Livelihood Restoration. Improve, or at least restore, the livelihoods of all persons displaced by the Project through: (a) where possible, land-based resettlement strategies when affected livelihoods are land-based or where land is collectively owned; or cash compensation at replacement value for land, including transitional costs, when the loss of land does not undermine livelihoods; (b) prompt replacement of assets with assets of equal or higher value; (c) prompt compensation at full replacement cost for assets that cannot be restored; and (d) capacity building programs to support improved use of livelihood resources and enhance access to alternative sources of livelihood. Include transaction costs in determining compensation. Examine the opportunities for provision of additional revenues and services through benefit-sharing, as the nature and objectives of the Project may allow.

•Resettlement Assistance. Provide persons displaced by the Project with needed assistance, including the following: (a) if there is relocation, security of tenure (with tenure rights that are as strong as the rights the displaced persons had to the land or assets from which they have been displaced) of relocation land (and assets, as applicable), proper housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities and extension of Project benefits to host communities to facilitate the resettlement process; (b) transitional support and development assistance, such as land development, credit facilities, training or employment opportunities; and (c) civic infrastructure and community services, as required.

•Standards of Living. Improve the standards of living of the poor and other vulnerable groups displaced by the Project, including women, children and persons with disabilities, to at least national minimum standards, including access to social protection systems. In rural areas provide them with legal and affordable access to land and resources, and in urban areas provide them with appropriate income sources and legal and affordable access to adequate housing.

•Persons without Title or Legal Rights. Ensure that persons displaced by the Project who are without title to land or any recognizable legal rights to land, are eligible for, and receive, resettlement assistance and compensation for loss of non-land assets, in accordance with cut-off dates established in the resettlement plan. Include them in the resettlement consultation process. Do not include compensation to these people for the illegally settled land. Conduct land survey and census as early as possible in Project preparation to establish clear cut-off dates for eligibility and to prevent encroachment. If claims have been made by these displaced persons that are currently under administrative or legal review, develop procedures to address these situations.

•Negotiated Settlement. Develop procedures in a transparent, consistent and equitable manner if land acquisition or changes in land use rights are acquired through negotiated settlement under the Project, to ensure that those people who enter into negotiated settlements maintain the same or better income and livelihood status.

•Information Disclosure. Disclose the draft resettlement plan, including documentation of the consultation process, in the Project area, in a timely manner in accordance with paragraph 57 of the ESP, in an accessible place, and in a form and language(s) understandable to persons displaced by the Project and other stakeholders. Disclose the final resettlement plan, and any updates to affected persons and other stakeholders in the same manner. Disclose any RPF in the same manner. Regularly disclose updated environmental and social information, along with information on any relevant materialchanges in the Project.

•Implementation. Design and execute Involuntary Resettlement as part of the Project. Include the full costs of resettlement in the presentation of the Project's costs and benefits. For a Project with significant Involuntary Resettlement impacts, consider implementing the Involuntary Resettlement component of the Project as a stand-alone Project.

•Compensation and Entitlements. Pay compensation and provide other resettlement entitlements before any physical or economic displacement under the Project.

•Supervision. Closely supervise implementation of the resettlement plan throughout Project implementation.

•Monitoring. Using suitably qualified and experienced experts, monitor and assess resettlement outcomes under the Project, their impacts on the standards of living of displaced persons and whether the objectives of the resettlement plan have been achieved, by taking into account the baseline conditions and the results of resettlement monitoring. Disclose monitoring reports in accordance with the Information Disclosure bullet above. Consider the use of suitably qualified and experienced third parties to support monitoring programs.

2.1.2National laws on environmental protection

（1）Environmental Protection Law of the People's Republic of China (April 2014);

（2）Law of the People's Republic of China on Environmental Impact Assessment (December 2018);

（3）Law of the People's Republic of China on Prevention and Control of Water Pollution (2017 Revision) ;

（4）Law of the People's Republic of China on Prevention and Control of AtmosphericPollution (October 2018);

（5）Law of the People's Republic of China on Prevention and Control of Pollution from Environmental Noise (2018) (December 2018);

（6）Law of the People's Republic of China on the Prevention and Control of Environment Pollution Caused by Solid Wastes (2016 Revision) ;

（7）Law of the People's Republic of China on Water and Soil Conservation (March 2011);

（8）Marine Environment Protection Law of the People's Republic of China (2017 Revision);

（9）Land Administration Law of the People's Republic of China (August 2004);

（10）Fisheries Law of the People's Republic of China (August 2004);

（11）Forest Law of the People's Republic of China (January 2011);

（12）Agricultural Law of the People's Republic of China (January 2013);

（13）Urban and Rural Planning Law of the People's Republic of China (April 2015);

（14）Grassland Law of the People's Republic of China (June 2013);

（15）Wild Animal Conservation Law of the People's Republic of China (July 2016);

（16）Law of the People's Republic of China on the Administration of Sea Area (January 2001);

（17）Law of the People's Republic of China on Flood Control (2017 Amendment) ;

（18）Law of the People’s Republic of China on Work Safety (November 2011);

（19）Clean Production Promotion Law of the People's Republic of China (June 2002);

（20）Circular Economy Promotion Law of the People's Republic of China (October 2010);

（21）Energy Conservation Law of the People's Republic of China (October 2018);

（22）Emergency Response Law of the People's Republic of China (November 2017);

（23）Oil and Natural Gas Pipeline Protection Law of the People's Republic of China (October 2010).

（24）Law of the People's Republic of China on the Prevention and Control of Occupational Diseases (December 2018);

（25）Labor Law of the People's Republic of China (December 2018).

2.1.3Relevant national regulations and documents

（1）Opinions of the CPC Central Committee and the State Council on Accelerating the Construction of Ecological Civilization (No.12 [2015], CPC Central Committee) ;

（2）Notice on Further Strengthening of Environmental Impact Assessment Administration and Environmental Risk Prevention (No.77 [2012], State Environmental Protection Administration) ;

（3）Notice on the Effective Strengthening Risk Prevention and Strict Environmental Impact Assessment Administration (No.98 [2012], State Environmental Protection Administration) ;

（4）Notice of Issuing the Measures for the Administration of Contingency and plans and recordation for environmental emergency for Enterprises and Public Institutions (for Trial Implementation) (No.4 [2011], State Environmental Protection Administration)

（5）Measures on environmental emergency response management (The Ministry of Environmental Protection, June 2015) ;

（6）Three-Year Action Plan to Win the Battle for a Blue Sky (No. 22 [2018], State Council) ;

（7）Notice of the State Council on Issuing the Air Pollution Prevention and Control Action Plan (No. 37 [2013], State Council);

（8）Notice of the State Council on Issuing the Action Plan for Prevention and Control of Water Pollution (No. 17 [2015], State Council) ;

（9）Notice of the State Council on Issuing Soil Pollution Prevention and Control Action Plan (No. 31 [2016], State Council) ;

（10）Circular of the State Council on the Issuing of 13th Five-Year Plan for the Protection of Ecological Environment (No. 65 [2016], State Council) ;

（11）Notice of the State Council on the Issuing the Outline of the Plan for Ecological Protection in China (No. 151 [2016] of Environmental Ecology)

（12）Regulations on the Implementation of Water and Soil Conservation Law of the People's Republic of China (No. 130, [1993], State Council) ;

（13）Regulations of the People's Republic of China on the Protection of Basic Farmlands (2011.1) ;

（14）Regulations of the People's Republic of China on the Administration of River Courses (2017.3) ;

（15）Regulations of the People's Republic of China on Wild Plants Protection (1997.1) ;

（16）Regulations of the People's Republic of China on Nature Reserves (2017 revision) ;

（17）Regulations on the Safe Management of Hazardous Chemicals (No. 344, [2002], State Council, Revision 2013.12) ;

（18）Measures for the Administration of Permit for Operation of Dangerous Wastes (No. 408, [2004], State Council, Revision 2013.12) ;

（19）Directory of National Hazardous Wastes (Order No. 39 of the Ministry of Environmental Protection, 1 August 2016) ;

（20）Announcement on Issuing the Guidelines for environmental impact assessment of hazardous wastes in construction projects (Announcement No.43 [2010] of Ministry of Environmental Protection)

（21）Regulation on the Administration of Construction Project Environmental Protection (October 2017) ;

（22）Catalog of Guidance on Industrial Restructuring (Order No. 21 of the National Development and Reform Commission [2013]) ;

（23）Classified Administration Catalogue of Environmental Impact Assessment of Construction Projects (implemented on 1 September 2017), 18 April 2018, Decision on Amending certain content of Classified Administration Catalogue of Directory of Classification Management for Environmental Impact Assessment of Construction Projects;

（24）Measures for Public Participation in Environmental Impact Assessment (Order No. 4 of the Ministry of Ecology and Environment) ;

（25）Notice on coordinating the environmental impact assessment system and the emission permits system (EIA No.84 [2017] of the State Environmental Protection Administration) ;

（26） Notice on issuing Work Plan for the Prevention and control of volatile organic compounds during the 13th Five-Year Plan period (NO.121 [2017] of the State Environmental Protection Administration)

（27）Implementation Opinions on Tightening Interim and Ex-Post Regulation of Environmental Impact Assessment of Construction Projects (EIA No. 11 [2018] of the State Environmental Protection Administration) ;

（28）Notice on Strengthening Protection of Coastal Wetlands and Strict Control of Reclamation (No 24 [2018], State Council) ;

（29）Notice by the Ministry of Natural Resources on Further Clarification of Requirements for addressing the historical legacy of reclamation (Regulation No.7 [2018] of the Ministry of Natural Resources) ;

（30）Notice by the State Forestry Administration on forest land use issues related to oil and gas pipeline construction (No 105 [2010] the State Forestry Administration) ;

（31）Notice by the State Forestry Administration and the Ministry of Finance on issuing the Measures for Administration of National Public Forests (No1162 [2013] the State Forestry Administration)

（32）Notice by nine ministries and commissions including the National Development and Reform Commission of Issuing the Guiding Opinions on Strengthening the control of Resource environment ecological red line, (No.11662 [2016] on the Environment and Resources Issued by the National Development and Reform Commission).

2.1.4 Local regulations and documents

2.1.4.1 Tianjin

（1）Regulations of Tianjin Municipality on Environmental Protection 28 November

2017 Amendment) ;

（2）Regulations of Tianjin Municipality on the Administration of River Courses (effective October 1, 2011) ;

（3）A decision on Amending the regulations of Tianjin Municipality on Marine Environment Protection, (November 27, 2015)

（4）Regulations of Tianjin Municipality on the Prevention and Control of Atmospheric Pollution (1 March 2015) ;

（5）Regulations of Tianjin Municipality on the Prevention and Control of Water Pollution (1 March 2016) ;

（6）Administrative Measures of Tianjin Municipality on Prevention and Control of Pollution From Environmental Noise (No. 6 of the Tianjin Municipal People’s Government [2003]) ;

（7）Measures for the Administration of Environmental Protection of Construction Projects in Tianjin Municipality (No. 20 [2015] of the Tianjin Municipal People’s Government) ;

（8）Measures for the Prevention and Control of Hazardous Wastes Pollution in Tianjin Municipality (1 July 2004) ;

（9）Notice on the issuance of technical requirements for the standardization of pollution source sewage outlets. (No 57 [2007] of Tianjin Environmental Protection Supervision)

（10）Letter of issuing on Applicable zoning of Acoustic quality standard in Tianjin Municipality (New version) 》（Letter 590 [2015] of Tianjin Enviromentl Protection）

（11）Notice on the Issuing of the Clean Air Action Plan in Tianjin Municipality (No.35 [2013] of the Tianjin Municipal People’s Government) ;

（12）Decision of the Standing Committee of the Tianjin Municipal People's Congress to Ratify the Delineation of permanent ecological protection areas s (1 March 2014) ;

（13）Notice of the Tianjin Municipal People's Government on Issuing Provisions on Administration of Tianjin Municipality for the Permanent Ecological Protection Areas (No. 13 [2014] of the Tianjin Municipal People’s Government) ;

（14）Letter from the Municipal Environmental Protection Bureau on the Implementation of Special Emission Restrictions on Atmospheric Pollutants in Key Industries (Letter No 388 [2017] of Tianjin Enviromentl Protection,26 September 2017) ;

（15）Notice of the Municipal Environmental Protection Bureau on the Specific Requirements for the Implementation of coherence between the Environmental Assessment Document and the Emission Permit System (Note No22 [2018] of Tianjin Enviromentl Protection, 15 January 2018) ;

（16）Notice of the Tianjin Municipal People's Government on Issuing the Red Line for Ecological Protection of Tianjin Municipality (Tianjin Municipal People's Government, 3 September 2018).

（17）Letter on issuing the Implementation Plan for the Prevention and control of volatile organic compounds during the 13th Five-Year Plan period (Letter No 18 [2018] of Tianjin Enviromentl Protection).

（18）Notice of the Municipal Development and Reform Commission on the Issue of Plan for Protection of the Ecological Environment in Tianjin Municipality during the 13th Five-Year Plan period (Plan No. 335 [2017] of Tianjin Municipal Development and Reform Commission) ;

（19）Regulations of Tianjin Municipality on Wild Animals Protection (28 November 2017 Amendment) ;

（20）Regulations of Tianjin Municipality on the Protection of Wild Plants (24 May 2006).

2.1.4.2 Hebei, Langfang

（1）Notice of the People's Government of Hebei Province on the Issue of the Plan for the Protection of the Ecological Environment in Hebei Province during the 13th Five-Year Plan period (No 10 [2017] of Hebei Government) ;

（2）Notice of the Hebei Provincial People's Government of the CPC Hebei Provincial Committee on the Issue of <the work plan of Hebei Province on the Prevention and Control of Water Pollution (No. 28 [2015] of Hebei Province) ;

（3）Regulations of Hebei Province on Environmental Protection (1 May 2005) ;

（4）Regulations of Hebei Province on the Administration of Environmental Protection (March 2005) ;

（5）Regulations of Hebei Province on the Prevention and Control of Atmospheric Pollution (March 2016) ;

（6）Regulations of Hebei Province on Prevention and Control of Water Pollution(September 2018) ;

（7）Measures of Hebei Province for the Administration of Discharge Permits(March 2016) ;

（8）Regulations of Hebei Province on the Administration of Groundwater (March 2015) ;

（9）Regulations of Hebei Province on the Prevention and Control of Pollution by Solid Wastes (March 2015) ;

（10）Notice on issuing the division of Urban centralized drinking water source protection area (冀环控[2009]4号)

（11）Regulations of Hebei Province on the Protection of Terrestrial wildlife (September 2016) ;

（12）Notice of the General Office of the People's Government of Hebei Province on Issuing the Lists of wild plants under special state protection (August 2010)

（13）Water functional zoning in Hebei Province (No 127 [2017] of, 冀水资 January 2018) ;

（14）Notice of the People's Government of Hebei Province on the Issue of the " Red Line for Ecological Protection in Hebei Province " (冀政字 [2018] 23).

2.1.4.3 Beijing

（1）Regulations of Beijing Municipality on the Prevention and Control of Water Pollution (30 March 2018) ;

（2）Measures of Beijing Municipality for Water Conservation (Order No. 244 of the Beijing Municipal People's Government) ;

（3）Regulations of Beijing Municipality on the Prevention and Control of Atmospheric Pollution (Announcement No. 2 of the Beijing Municipal People's Congress, 30 March 2018) ;

（4）Measures of Beijing Municipality for the Prevention and Control of Pollution From Environmental Noise (No. 181) ;

（5）Notice of the Beijing Municipal People's Government on the issuance of measures for the control of atmospheric pollution for 2012-2020 (No. 10 [2012] of the Beijing Municipal People’s Government) ;

（6）Opinions of the Beijing Municipal People's Government on the implementation of the strictest water resources management system (No. 25 [2012] of the Beijing Municipal People’s Government) ;

（7）Measures of Beijing Municipality for the Administration of Automatic Monitoring of Fixed Pollution Sources (No 87 [2014] of 京环, 5 November 2014) ;

（8）Notice on issuing the Detailed Rules of accounting for total emission reduction of volatile organic compounds (VOCs) from industrial pollution sources in Beijing (For Trial Implementation) （京环发[2012]305号）；

（9）Notice of the Beijing Municipal People's Government on issuing the Action Plan of Beijing Municipality for Clean Air 2013-2017 （ No. 27 [2013] of 京政发）；

（10）Notice of the General Office of the Beijing Municipal People's Government on issuing Decomposition of Key Tasks of Beijing Municipality Clean Air Action Plan 2013-2017 (No. 49 [2013] of 京政办发) ;

（11）Measures of Beijing Municipality for the Administration of Construction Site (Order No. 247 of the Beijing Municipal People's Government, implemented on 1 July 2013) ;

（12）Notice on issuing the Special Plan of Beijing Municipality of Prevention and Control of Atmospheric Pollution in the 13th Five-Year Plan period (No.25 [2017] 京环发,September 4, 2017)

（13）Notice of the Beijing Municipal People's Government on the Issue of the Emergency Plan of Beijing Municipal for Heavy Air Pollution (2017 Revision) (No. 27 [2017] of 京政发, 11 September 2017) ;

（14）Notice on issuing the Special Action Plan for Dust Control on Construction Site in 2017 No.74 [2017] 京建发, March 8, 2017.

（15） Notice of the Beijing Municipal Bureau of Statistics and the Beijing Municipal Economic and Informatization Commission on the Issue of the Category of Beijing's “High-tech” Industry Activities (No. 32 [2017] of 京统, May 2017) ;

（16）Three-Year Action Plan of Beijing Municipality to Win the Battle for a Blue Sky (No. 22 [2018] of 京政, 7 September 2018) ;

（17）Catalog of prohibitions and restrictions on new industries in Beijing (2018 edition) (No.35 [2018] of 京政办, 6 September 2018) ;

（18）Notice of the Beijing Municipal People's Government on Issuing the Red Line of Beijing Ecological Protection (No. 18 [2018] of 京政, July 2018).

2.1.5Technical Guidelines and Related Standards

（1）Technical Guidelines for Plan Environmental Impact Assessment-General principles (HJ 2.1-2016) ;

（2）Technical Guidelines for Environmental Impact Assessment-Atmospheric Environment (HJ 2.2-2018) ;

（3）Technical Guidelines for Environmental Impact Assessment-Surface-water environment (HJ 2.3-2018) ;

（4）Technical Guidelines for Environmental Impact Assessment on the Sound Environment (HJ 2.4-2009) ;

（5）Technical Guidelines for Environmental Impact Assessment -Groundwater Environment (HJ 610-2016) ;

（6）Environmental Impact Assessment Technical Guidelines-Soil Environment (On Trial) (HJ 964-2018) ;

（7）Technical Guidelines for Environmental Impact Assessment-Ecological Impact (HJ19-2011) ;

（8）Technical Guidelines for Environmental Risk Assessment of Construction Projects (HJ 169-2018) ;

（9）Technical Specifications for Emergency Monitoring in Abrupt Environmental Accidents (HJ 589-2010) ;

（10）Identification of Major Hazard Installations for Hazardous Chemicals (GB 18218-2018) ;

（11）Classification method for environmental accident risk of an enterprise (HJ 941-2018) ;

（12）National Catalogue of Hazardous Wastes (effective 1 August 2016) ;

（13）Identification standards for solid wastes General rules (GB 34330-2017) ;

（14）Technical guidelines for the preparation of the Red Line for Ecological Protection, the Bottom Line for Environmental Quality, the Upper Line for Resource Utilization and the Negative List of Environmental Access (On Trial).

2.1.6Technical data

（1）Feasibility Study of Beijing Gas Group-Tianjin Nangang LNG Emergency Reserve Project -Specification of Pipeline Projects, China Petroleum Pipeline Engineering Co., Ltd., January 2019 ;

（2）Demonstration report on the related ecological environment impact of Tianjin permanent ecological protected area (excluding nature reserve), Tianjin Environmental Planning Science and Technology Development Ltd., July 2019 ;

（3）Beijing Gas Group-Tianjin Nangang LNG Emergency Reserve Project-Environmental Impact Assessment in the ecological environment of LNG pipelines crossing the Tianjin Beidagang Shidi Nature Reserve. , Academy of Forest Inventory and Planning (AFIP) April 2019 ;

（4）Report on Impact Assessment of Beijing Gas Group-Tianjin Nangang LNG Pipeline Crossing Project on National Priority Protected Wild animals and their Habitat of Tianjin Beidagang Shidi Nature Reserve, Academy of Forest Inventory and Planning (AFIP) July 2019 ;

2.2 Identification of environmental impacts and Screening

2.2.1Identification of environmental parameters

(1) Ecological environmental impacts

The ecological environmental impact of the pipeline project is mainly reflected in the construction period. The main parameters of the ecological impact are the disturbance to the soil surface layer, the landform change, the destruction of the surface vegetation, the loss of agriculture, forest and planting caused by the change of the land use during the periods of the excavation of the pipeline, pipeline crossing and the construction of the valve room of the station; Soil erosion and destruction of the surface vegetation during the construction period of the temporary roads.

There will be no new ecological impacts during the operation period, and the ecological environment affected by the construction will be gradually restored and reconstructed according to the corresponding environmental protection measures.

(2) Environmental impacts of surface water

Water environmental impacts are characterized as: 1) The impact of small and medium-sized river excavation on surface water environment during construction period; 2) Impact of hydrostatic test discharge on surface water environment ; 3) Impact of domestic sewage from construction workers on surface water environment.

(3) Environmental impacts of groundwater

The impact of pipeline projects during the construction and the operation periods is mainly manifested in the influence of the pipeline excavation on the shallow groundwater and the groundwater pollution from the sewage infiltration on site and the pipeline corrosion.

(4) Atmospheric environment

The atmospheric environmental impact is characterized as: 1) exhaust gas emissions from construction machinery; 2) Construction dust; 3) The impact of natural gas emissions under abnormal operating conditions.

(5) Sound environment

The impact of sound environment is characterized as: 1) the mechanical noise from construction equipments during construction period; 2) the mechanical noise generated by the pressurized equipments and gas transmission at various pipeline stations during the operation period.

(6) Environmental parameters of solid waste pollution

The environmental parameters of solid waste pollution are as follows: 1) spoil (slag) produced during construction period; 2) Waste mud; 3) Construction waste; 4) Domestic waste; 5) Pigging waste generated during the operation period.

(7) Social environment

Social environmental impacts are characterized as: 1) The impact on agricultural production along the pipeline during the construction period; 2) Influence of road crossing on the traffic during construction period; 3) The impact of construction on the living environment ; 4) Contribution to the employment and the economy along the pipeline; 5) Impact of the construction on landscape along the pipeline.

The identification of environmental impact parameters of this project is shown in Table 2.2-1

Table 2.2-1 Environmental Impact Identification of Pipeline Project

Construction stage	Construction activity	The content of Environmental impacts
Construction period	1. Construction of Station and Cut-off Valve Room	①Permanent occupation of land, changing the existing functions of land use; ②The original users of the expropriated land will be compensated according to the regulations.
	1.1 Construction equipments operation	Produce mechanical exhaust and mechanical noise.
	1.2 Daily life of construction workers	Domestic sewage, domestic solid waste.
	2 Pipe-laying	Temporary occupation of part of the land, affecting the

Construction stage	Construction activity	The content of Environmental impacts
		function or type of land use in the short term.
	2.1 Trench excavation and backfilling	①Destruction of soil, vegetation and visual landscape in the construction zone; In particular, the destruction of forest land along the pipeline is irreversible and the compensation plan for forest land needs to be proposed; ②Abandoned earthwork may be produced and the improper stacking may result in soil erosion and pollution of surface water or farmland; ③Dust is produced in transportation and reclamation operations.
	2.2 Raw Material Transportation	①Transport vehicles produce exhaust emissions, noise and dust; ②The temporary material yard occupies the land, and affects the function or type of land in the short term.
	2.3 Construction equipments operation	Produce mechanical exhaust and mechanical noise.
	2.4 Construction service road	Temporary occupation of part of the land, for the patrol roads that need to be retained will permanently change the original function of land use.
	2.5 Daily life of construction personnel	Domestic sewage, domestic solid waste.
	3. Construction crossing project	Temporary occupation of part of the land, short-term impact on the use of land functions or types, oily sewage generated by a small amount of construction machinary or equipments.
	3.1 River crossing	①The excavation type crossing will have a short-term effect on the river water quality, resulting in the increase of sediment content in river; ②Improper disposal of backfill or abandoned earthwork may result in the river siltation or soil erosion; ③Sludge excavated from the river bed, if improperly stacked or disposed of, may cause contamination of farmland or soil; ④Directional drilling through large rivers or rivers with potable water can result in a certain amount of waste mud. The improper stacking or treatment of the mud may cause pollution of the rivers crossing, or contamination of farmland or soil near the crossing point.
	3.2 Railway crossing	The probability of composite accident is extremely low due to the construction process such as jacking, box culvert, under-bridge excavation or directional.
	3.3 Highway crossing	The probability of composite accident is extremely low because of the use of pipe jacking construction technology
	4 Historic preservation	In the phase of the pipeline route selection, it avoids the places of interest on the ground. However if underground cultural relics are found in the construction, it shall stop the construction and report to the local cultural relics department in time.
	5 Pressure test, pigging	Wastewater discharge may have a certain impact on regional water environment in the short term. The wastewater must be discharged after the sedimentation and filtration.
Operation period	6 Normal operation of pipeline	——
	7 Station Yard	①Domestic sewage of station staff; ②When the production is abnormal, the natural gas discharged directly by the venting device during overpressure of the system and overhaul of the station; ③The domestic garbage produced by the staff at the station and the pipe pigging operation, as

Construction stage	Construction activity	The content of Environmental impacts
		well as a small amount of solid powder produced by the maintenance of the separator.
	8 Gas Pipeline Accident	①The influence of pipeline leakage on the environment and personnel on both sides of pipeline; ②Fire or explosion accidents caused by natural gas exposure to flames have an impact on the environmental air quality in the accident area, the densily populated area and the area of public concern on both sides of the pipeline.
	9 Processing station Accident	①The influence of leakage on the site and surrounding environment and personnel; ②Fire or explosion accidents caused by natural gas exposure to flames have an impact on the environmental air quality in the accident area, the densily populated area and the area of public concern on both sides of the pipeline.

Table 2.2-2 Identification of Environmental Impact Parameters for Pipeline Projects

Categories	Environmental components	Construction period			Operating period			Abnormal condition		
		pros	Cons	Sigificance	pros	Cons	Sigificance	pros	Cons	Sigificance
Natural Ecological environment	topography and geomorphology	-	Have	General	-	-	-	-	-	-
	Vegetation and soil erosion	-	Have	Obvious	-	-	-	-	Have	General
	Soil	-	Have	General	-	-	-	-	-	-
	Land use	-	Have	Obvious	-	Have	General	-	-	-
	Wild plant	-	Have	General	-	-	-	-	Have	General
	Wild animal	-	Have	General	-	-	-	-	Have	General
	Protected area	-	Have	General	-	-	-	-	Have	General
	Agriculture	-	Have	Obvious	-	-	-	-	Have	General
	Forestry	-	Have	Obvious	-	-	-	-	Have	General
Environmental quality	Surface water	-	Have	General	-	Have	General	-	Have	General
	Ground water	-	Have	General	-	Have	General	-	Have	General
	Air	-	Have	General	-	Have	General	-	Have	General
	Sound environment	-	Have	General	-	Have	General	-	Have	General
Social environment	Live in	-	Have	General	-	-	-	-	-	-
	Traffic transport	Have	Have	General	Have	-	General	-	-	-
	Social economy	Have	-	Obvious	Have	-	Obvious	-	Have	General
	Labour employment	Have	-	General	Have	-	General	-	-	-
	Landscape	-	Have	General	-	-	-	-	-	-

As can be seen from the above table, the environmental impact of this project is mainly caused by the construction process on the natural ecological environment (topography, vegetation, soil and soil erosion, flora and fauna and ecology, agriculture and land use) and the impact on the surrounding ecological environment and social environment under abnormal conditions.

2.2.2 Screening

The evaluation parameters are screened according to the contents, the identification and characterization of environmental impact parameters, and the degree of influence.

Table 2.2-3 Environmental Impact Assessment parameters for Send-out pipeline project

Evaluation components	Evaluation type	Evaluation parameter or object
Ecology	Ecological status survey Application of 3S	Nature reserves, water conservation areas, soil and land use, agriculture and soil erosion, flora, fauna and ecology, agriculture
Water environment	Investigation on Environmental Quality of Surface Water	PH, CODCR, ammonia nitrogen, SS, petroleum, permanganate index, total nitrogen, total phosphorus
	Investigation on Groundwater Quality	K +, Na +, Ca 2+, Mg 2+, CO 32-, HCO 3-, Cl-, SO 42-, pH, ammonia nitrogen, nitrate, nitrite, volatile phenols, cyanide, arsenic, mercury, chromium (hexavalent), total hardness, lead, fluorine, cadmium, iron, manganese, dissolved total solids, permanganate index, sulfate, chloride, total coliform bacteria, total petroleum total
air	Investigation on Air Quality	NMHC, total hydrocarbon
	Anticipated impact on Air quality	NMHC
Sound environment	Anticipated impact on Sound enviroment	Plant noise, LEQ (a)
Soil environment	Investigation on Soil Environmental Quality	Arsenic, cadmium, copper, lead, chromium (hexavalent), mercury, nickel, carbon tetrachloride, chloroform, chloromethane, 1, 1-dichloroethane, 1, 2-dichloroethane, 1, 1-dichloroethylene, cis-1, 2-dichloroethylene, trans-1, 2-dichloroethylene, dichloromethane, 1, 2-dichloropropane, 1, 1, 1, tetrachloroethane, 1, 1, 2, 2-tetrachloroethane, tetrachloroethylene, 1, 1, 1-trichloroethane, 1, 1, 2-trichloroethane, trichloroethylene, 1, 2, 3-chloropropane, chloroethylene, benzene, chlorobenzene, 1, 2-dichlorobenzene, 1, dichlorobenzene, ethylbenzene, styrene, toluene, m-xylene + p-xylene, o-xylene, nitrobenzene, aniline, 2-chlorophenol, benzo-[A] anthracene, benzo [A] pyrene, benzo [B] fluoranthene, benzo [K] fluoranthene, benzo [A, H] anthracene [1, 2, 3-CD] pyrene, naphthalene, petroleum hydrocarbons (C10-C40)

2.3 Grading and scoping

According to the relevant requirements of the AIIB Environmental and Social Framework, the AIIB's Environmental and Social Policy (ESP) and Environmental and Social Standards (ESS) will apply to the project. ESS1, Environmental and Social Assessment and Management, and ESS2, involuntary resettlement apply to the project. According to AIIB's

ESP, the project is classified as a category A considering the potential impact of the project's expectations on environmental and social risks. For category A projects, an environmental and social impact assessment (ESIA) of the project is required.

2.3.1Surface water environment

(1) Grading

According to the Technical Guidelines for Environmental Impact Assessment, Surface Water Environment (HJ 2.3-2018), the domestic sewage generated from the send-out pipeline station yard of this project is used for greening in the station. It is not direct but indirect discharge, thus resulting in Level III B for the surface water enviromental evaluation.

(2) Scoping

Considering that the domestic sewage generated by the send-out pipeline station is used for greening in the station. it is not directly discharged, thus the evaluation grade of the surface water environmental impact is 3B. It indicates that there is no need to set a specific evaluation scope. In the evaluation process, the effectiveness of the water pollution control, the impact mitigation measures and the environmental feasibility of sewage treatment facilities are evaluated accordingly.

2.3.2Groundwater environment

According to the requirements of "Technical Guidelines for Environmental Impact Assessment-Groundwater Environment " (HJ 610-2016), the grade of groundwater environmental impact assessment shall be determined according to the category of the construction industry and the level of Groundwater environmental sensitivity. For a line-type structre, the evaluation grade will be determined segmentedly according to the sensitivity of the groundwater environment involved and the location of the main station.

（1） Categorization of construction industry

Reference to the provisions of the Industry Categorization Table of the Subsurface Water Environmental Impact Assessment in the Technical Guidelines for Environmental Impact Assessment-Groundwater Environment (HJ 610-2016), Natural gas pipeline is in categorized as “Class III project”.

（2） The level of environmental sensitivity

In this project, the total length of the send-out pipeline is 229 km and there are 7 processing stations. The pipeline part and the stations do not involve the groundwater environment sensitive area such as the protection or quasi-protection zone used to supply drinking water nor other special protection zone of the grounwater source. Since there are decentralized drinking water source in the villages where are within the evaluation area of the pipeline, the groundwater sensitivity grade is "more sensitive ". Therefore, the evaluation grade of groundwater environmental impact is specified as Level III for the send-out pipeline which is categorized as “Class III project”.

（3） Scoping

According to the " Technical Guidelines for Groundwater ", the linear engineering should extend 200 m from both sides of the boundary as the scope of investigation and evaluation. The evaluation range of the station site is determined by using the method of look-up table, three-level evaluation ≤6Km2, combined with the hydrogeological conditions of the station site and the distribution of sensitive points near the station site, and finally determined: The evaluation range of the station site is 250 m upstream and 250 m lateral expansion of the wall, and 500 m extension of the downstream ; The pipeline extends 200 m from both sides of the boundary as the investigation and evaluation scope.

2.3.3Atmospheric Environment

(1) Grading

In this project, the maximum ground concentration (Cmax) of various contaminant from various sources and its occupancy rate (Pmax), and the farthest influence distance D10% corresponding to the ground concentration of various pollutant reaching the standard limit of 10% was calculated. The calcuations are according to discrimination in the evaluation grading (Section 5.3) in "Technical Guidelines for Environmental Impact Assessment-Atmospheric Environment" (HJ2.2-2018), using the pollution source in Engineering Analysis of the Project and the recommended estimation mode (AERSCREEN) of the “Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment” Appendix. According to the calculation results and the Table 2 of the evaluation grade discrimination in "Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment", the evaluation grade is determined. The specific calculation results and the main parameters used are shown in the section on atmospheric environmental impact prediction during the operation period of this report. The evaluation of the evaluation work level is shown in the table below.

Table 2.3-1 Discrimintation in Atmospheric evaluation & grading

Name of pollution source	Sequence number	Contaminant	Cmax (g g/m3)	Evaluation criteria (μg/m³)	PMAX (%)
Anci Distribution Station	Waste gas of water-jacket blast furnace	SO_2	0.138	500	0.00276
		NOX	2.88	200	1.44
		$PM_{2.5}$	0.516	450	0.115
ChengNanmo Station	Waste gas of water-jacket blast furnace	SO_2	0.202	500	0.004
		NO_X	1.71	200	0.853
		$PM_{2.5}$	0.348	450	0.077

According to the calculation results in theTable 2.3-1, the Pmax of Nox is the largest among various contaminants from various pollution sources, reaching 1.44%<10%. Based on the evaluation grade of Technical Guidelines for Environmental Impact Assessment-Atmospheric Environment (HJ2.2-2018), the evaluation grade of the atmospheric of this project is Grade II.

(2) Scoping

According to HJ 2.2-2018, the scope of the atmospheric environmental impact assessment of the project with Grade II is 5 km. Therefore, the evaluation scope is based on the receiving terminal, Anci distribution station and Chengnan terminal station as the center, the length of 5 km rectangular area and the pipeline on both sides of the 200 meters as the scope of the assessment of the atmospheric environment.

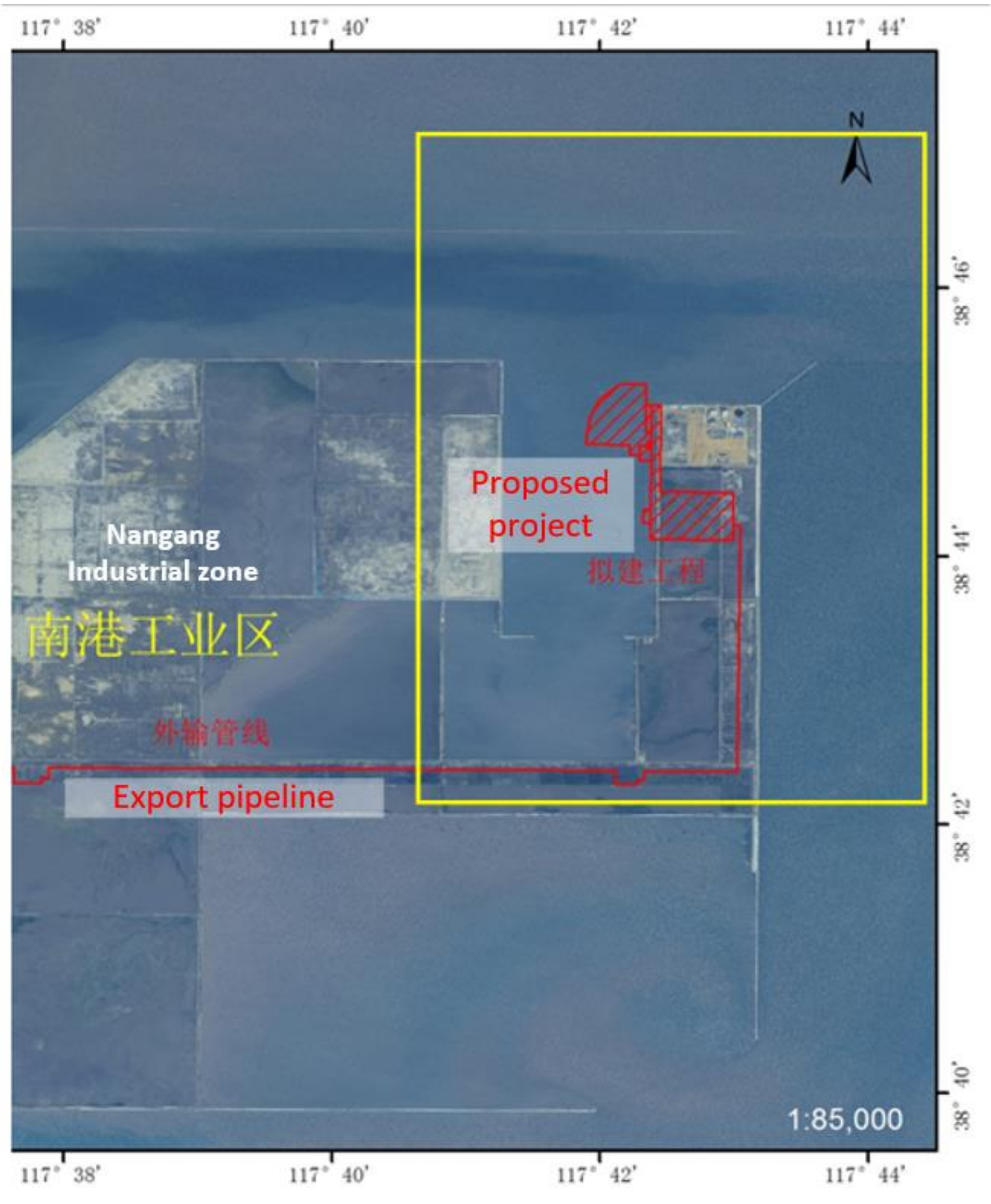


Figure 2.3-1 Schematic of Atmospheric Assessment Scope

2.3.4Sound environment

(1) Grading

The grade of sound environmental impact assessment of the project is determined according to the " Technical Guidelines for Environmental Impact Assessment-Sound Environment " (HJ 2.4-2009). The specific basis of the evaluation criteria is shown in table 2.3-2.

Table 2.3-2 Evaluation criteria for acoustic environmental assessment

Evaluation grade	Decision basis		
	Functional zoning of sound environment	Noise level increment of sensitive target within the scope	Number of affected populations
Level I	Category 0 or protected areas with special noise limitations	>5 dB (A)	Manifest
Level II	Categories 1 and 2	≥3 dB (A), ≤5 dB (A)	Increase more
Level III	Categories 3 and 4	Less than 3 dB (A)	Change little

The noise of send-out pipeline project during the construction phase mainly comes from construction machinery, and the noise during the operation phase mainly comes from separator. According to the on-site investigation, the sound environment quality of the area along the pipeline is good, and the villages along the pipeline are located 200m away from both sides of the pipeline. The evaluation grade of the sound environment assessment is level II.

(2) Scope of evaluation

Based on the relevant provisions of the Technical Guidelines for Environmental Impact Assessment-Sound Environment (HJ 2.4-2009) and the environmental characteristics around the processing stations along the pipeline, the scope of the sound environmental assessment during construction period shall be limited to the village or residential area within the range of 200 m on both sides of the pipeline, and the village or residential area within the range of 200 m of the plant boundary of each processing station during operation phase.

2.3.5Ecological environment

(1) Grading

The total length of the send-out pipeline is 229 km, the pipeline is set to cross the special and important environmental sensitive areas such as Beidaigang Wetland Nature Reserve, Tianjin Permanent Protection Ecological Region, Tianjin Ecological Red Line and Hebei Province Ecological Red Line. According to grading classification of Technical Guidelines for Environmental Impact Assessment-Ecological Impact (HJ19-2011), the evaluation grade is set as level I.

Table 2.3-3 Evaluation criteria for ecological environment assessment of the send-out pipeline projects

Influence area	Engineering footprint			Basic information of the project	Evaluation grade
Ecological	Area ≥20	Area 2 km ~20	Area ≤ 2	The total length of	Level I

sensitivity	km 2 Or more than 100 km in length	km 2 Or 50 km to 100 km in length	km 2 Or length ≤50 km	pipeline project is 229 km and the length is more than 100 km	
Special ecological sensitive area	Level I	Level I	Level I	It is set to cross Special and important environmental sensitive areas such as Beidaigang Wetland Nature Reserve, Tianjin Permanent Ecological Area, Tianjin Ecological Red Line and Hebei Province Red Line	
Important ecological sensitive area	Level I	Level II	Level III		
General area	Level II	Level III	Level III		

(2) Scope of evaluation

In this evaluation, the range of 500 m on each side of the pipeline is taken as the scope of the ecological environment assessment. For the sensitive objects, the scope is extended to the range of 5 km on each side, and the habitat condition within the range of 200 m around the processing station is evaluated.

2.3.6 Soil environment

According to the " Environmental Impact Assessment Technical Guidelines for Soil Environment " (pilot) (HJ 964-2018), the send-out pipeline project belong to other " Class IV Project".

2.3.7 Enviromental risk

2.3.7.1 Preliminary Assessment of Environmental Risk Potential

The fuel oil used in the transportation of the proposed project to transport LNG is mainly hydrocarbons. The chemical structure of the fuel oil is mainly composed of three series, namely alkanes group, cycloalkanes group and aromatic (group). There is a difference depending on the composition of the fuel oil. The physical properties of the fuel oil vary with its chemical composition, colors range from dark brown to dark green to black. Fuel oil with high sulfur content gives off a strong, pungent odor; The density of fuel oil is less than that of water. Fuel oil is insoluble in water, but soluble in organic solvents, such as benzene, flavor, ether, trichloromethane, carbon sulfide, carbon tetrachloride, etc., it can also be partially dissolved in alcohol.

Natural gas has a lower density than air, has a very low boiling point (-161.5 ° C), and is almost insoluble in water. The main component of natural gas is methane. In case of natural gas leakage and fire explosion, the fire will be extinguished only after the natural gas combustion is completed according to the actual accident of the transmission pipeline. There is no fire-fighting wastewater generated without water-extinguishing. Thus, the water environment quality and hydrological parameters are basically unaffected under normal production and accident conditions of this project.

(1) Analysis of Risk Characteristics of Hazardous Substances and Processing Systems

In accordance with the requirement of Appendix C, the Hazardous classification of Hazardous Substances and Processing Systems (P), in Technical Guidelines for Environmental Risk Assessment of Construction Projects (HJ 169-2018), the ratio of quantity of hazardous substances to critical mass (Q) and industry and production process (M) of the project are determined.

Combined with the characteristics of the project, the processing station and the pipeline between the two nodes that can be controlled are used as a functional unit.

①Ratio of quantity of hazardous substances to critical mass (Q)

Station yard: According to the engineering analysis, the maximum total quantity of station yard is 1.07 t, Q<1.

Pipeline: The pipeline of this project is designed according to the code of design of gas pipeline project (GB 50251-2015), and the cut-off valve chamber is arranged according to the regional classification. According to the calculation of natural gas on-line quantity in each pipe section, it is shown that the maximum total quantity Q of dangerous substances between the two cut-off valve chambers in this project is " Q≥ 100 " and 10≤Q< 100 .

The calculation process is as follows :

Station Yard :

There are no natural gas storage tanks in the project site (origin station, Nangang distribution station, Dachuzhuang distribution station, Jinghai Transmission station, Yongqing Transmission station, Anci distribution station, Chengnan terminal station). The natuarl gas flowline vlolume is the one in the pipeline. The natural gas flowline volume in the station is between 0.5 t and 10 t, which is less than 10 t (critical mass).

Table 2.3-4 Distribution of Hazardous Substances in Stations of this Project

Unit / Substance	Separator and filter	Metering skid	Pressure-regulating skid
Natural gas (t)	0.92	0.14	0.01

The hazardous substance involved in this project is natural gas, and the maximum total quantity of hazardous substances in the plant boundary and their ratio to critical mass are shown in the table below.

Table 2.3-5 Determination of site Q values for this project

Region	Name of hazardous substance	CAS	Maximum total amount (t)	Critical mass (t)	Q value of the hazardou substance
Station yard	Natural gas	74-82-8	1.07	10	0.107

As shown from the table above: Q<1 in station yard.

Pipeline :

In accordance with the Code for the Design of Gas Pipeline Engineering (GB 50251-2015), the cut-off valve chamber is arranged based on the regional classification. In this evaluation, the processing station and the pipeline between the two nodes that can be controlled are used as a functional unit, thus there are 17 functional units in total.

According to the calculation of natural gas on-line quantity in each pipe section, it is shown that the maximum total quantity Q of hazardous substances between the two cut-off valve chambers of this project is " 10 ≤ Q< 100 " and " Q ≥ 100 ".

Table 2.3-6 Risk Potential Classification of Pipeline Sections of this Project

Sequence number	Pipe section	Node distance (km)	On-Line Quantity	Critical	hazardous substance Q value		M value		P value	E value	Risk potential
1	First Stop ~0 # Reserved Valve Room	6.0	481.2	10	48.1	10≤ q< 100	10	M 3	P 3	/	/
2	Reserved Valve ~1# Valve Room	6.0	481.2		48.1	10≤ q< 100	10	M 3	P 3	/	/
3	Valve Room No. 1-South Port Distribution Station	12.6	1010.5		101.1	Q ≥ 100	10	M 3	P 2	/	/
4	South Harbour Transfer Station ~2 # Valve Room	32.7	2622.6		262.3	Q ≥ 100	10	M 3	P 2	/	/
5	Valve Room No. 2 ~ Da	17.0	1363.4		136.3	Q ≥ 100	10	M 3	P 2	E 3	III

	Qiu Zhuang Transfer Station										
6	Daqiuzhuang Branch Transmission Station to Jinghai Transmission station	16.1	1291.2		129.1	Q ≥ 100	10	M 3	P 2	E 3	III
7	Jinghai Transmission station~3# Valve Room	17.3	1387.5		138.7	Q ≥ 100	10	M 3	P 2	/	
8	Valve Room 3~ Valve Room 4	17.2	1379.4		137.9	Q ≥ 100	10	M 3	P 2	/	
9	Valve Room 4~ Valve Room 5	16.7	1339.3		133.9	Q ≥ 100	10	M 3	P 2	/	
10	Valve Room 5~ Valve Room 6	5.6	449.1		44.9	10≤ q< 100	10	M 3	P 3	/	
11	Valve Room 6~ Valve Room 7	11.3	906.3		90.6	10≤ q< 100	10	M 3	P 3	/	
12	Valve Room 7# ~8	12.0	962.4		96.2	10≤ q< 100	10	M 3	P 3	E 3	II
13	Valve Room 8~ Yongqing Transmission station	14.2	1138.8		113.9	Q ≥ 100	10	M 3	P 2	E 3	III
14	Yongqing Transmission station~9# Valve Room	9.8	528.6		52.9	10≤ q< 100	10	M 3	P 3	E 3	II
15	Valve Room No.9	15.9	857.6		85.8	10≤ q< 100	10	M 3	P 3	E 3	II
16	Secondary Transfer Station ~10# Valve Room	12.7	685.0		68.5	10≤ q< 100	10	M 3	P 3	E 3	II
17	Valve Room No.10-Nanbu Station	6.0	323.6		32.4	10≤ q< 100	10	M 3	P 3	E 3	II

②Industry and production process (M)

The M value of the oil and gas pipeline is 10 (M3) according to the requirements of Tbale C.1, industry and production process (M) in Appendix C, the Hazardous classification of Hazardous Substances and Processing Systems (P), of the Environmental Risk Assessment Guidelines for Construction Projects (HJ 169-2018).

③Hazardous classification of Hazardous Substances and Processing Systems (P)

According to the Technical Guidelines for Environmental Risk Assessment of Construction Projects (HJ 169-2018), Appendix C, Hazardous classification of Hazardous Substances and Processing Systems (P), the project Q value belongs to " Q≥ 100 ", and the value of 10≤Q< 100, M=10 belongs to M3, so the project Hazardous Classification of Hazardous Substances and Processing Systems (P) are classified as P2 and P3.

(2) Environment sensitive characteristic analysis

According to the Technical Guidelines for Environmental Risk Assessment of Construction Projects (HJ 169-2018), Appendix D, Classification of Environmental Sensitivity (E), the atmospheric environmental sensitivity of the LNG receiving terminal, station yard and the pipeline are low sensitivity (E3).

(3) Environmental Risk Potential Assessment

According to the harzard of hazardous substances and process systems involved in the construction project and the environmental sensitivity of the site, combined with the environmental impact pathways under the accident, the environmental risk level of the construction project is analyzed in a general way, and the environmental risk potential is determined according to the following table.

Table 2.3-7 Environmental Risk Potential Classification of Construction Projects

Environmental sensitivity (E)	Hazardous substances and process system hazards (P)			
	Extremely high hazard (P1)	High Hazard (p2)	Moderate Hazard (P3)	Minor hazard (P4)
Highly environmentally sensitive area (E1)	IV +	IV	III	III
Environmental sensitivity area (E2)	IV	III	III	II
Low environmental sensitivity area (E3)	III	III	II	I

According to the table above, the atmospheric environmental risk potential of the receiving station is III and that of the station is II and III.

2.3.7.2 Evaluation grading

According to the Technical Guidelines for Environmental Risk Assessment of Construction Projects (HJ 169-2018), the environmental risk potential is determined based on the hazards and environmental sensitivity of the substances and processing systems involved in the construction projects, and the evaluation level is determined according to the following table.

Table 2.3-8 Levels of evaluation work

Environmental risk potential	IV, IV +	**III**	**II**	I
Evaluation grade	**Level I**	**Level II**	**Level III**	Simple Analysis[a]
a: it is a relative detailed evaluation of the contents of the work, in the description of hazardous substances, environmental impact pathways, environmental hazard consequences, risk prevention				

measures and other aspects of the qualitative description. Note: The project site Q value is 0.107 . According to the Technical Guidelines for Environmental Risk Assessment of Construction Projects (HJ 169-2018), when Q<1, the environmental risk potential is I.

Based on the above identification results: the atmospheric environmental risk assessment of this environment is Level II;

2.3.7.3 Evaluation scope

Atmospheric Environmental Risk Assessment scope: A rectangular area 5 km from the receiving station boundary and a range of 200 m on both sides of the pipeline.

2.4 Evaluation criteria

2.4.1Environmental quality criteria

Table 2.4-1 List of environmental quality standards for terminals and receiving stations

Project	Standard number	Standard Name and Classification	Level
Seawater quality	GB 3097-1997	Standard for Water Quality of Seawater	Four-class
Surface water	GB 3838-2002	Standard for Environmental Quality of Surface Water	The water quality of Tianjin main canal and corridor main canal of the South-to-North Water Transfer Project is carried out by the send-out pipeline. Water quality of Grade III is carried out in the Great Qinghe River, Ziya River, South Canal and Hongnihe River aqueducts. The water quality of class IV is carried out by the single-flow river reducing, Zhongting and Yongding rivers ; Water environmental functional zoning or water functional zoning in the absence of forward channels, drainage channels, alkali river, transport east drainage channels, youth canals, port groups, small temples, such as the dry dry dry according to class IV water quality.
	SL 63-94	Standard for Quality of Surface Water Resources	River SS reference execution
	GB/T 14848-2017	Groundwater Quality Standards	Class III in Outgoing Pipeline Execution Table 1
Atmospheric environment	GB 3095-2012	Standard for Environmental Air Quality	Secondary
		Environmental air quality non-methane total hydrocarbon limit	Implementation of Non-methane Total Hydrocarbon in Yongqing Transmission station and Anji Transfer Station of

			Send-out pipeline
		Detailed Explanation of Comprehensive Emission Standard for Air Pollutants	Reference for other station characteristic pollutants in terminals, receiving stations and send-out pipelines
	GB 3096-2008	Sound Environmental Quality Standards	Terminal and receiving station to implement 3 types of standards Implementation of Class 1 standards along pipelines The surrounding area of the station shall carry out two types of standard traffic trunk and two sides of sound environment shall carry out four types of standard
	GB 18668-2002	Marine sediment quality	Three categories
Marine organism	GB 18421-2001	Standard for the Quality of Marine Life	Three categories
Soil	GB 36600-2018	Standard for Management and Control of Soil Pollution Risk in Construction Land for Soil Environmental Quality (Trial Implementation)	Table 1 Selection of Type II Land Use Risks

2.4.2 Pollutant discharge standard

2.4.2.1 Exhaust gas

Organized Waste Gas: The water jacket heating furnace of Anji Transfer Station implements the standards of Table 1 and Table 2 of the Standard for the Discharge of Air Pollutants from Industrial Kiln in Hebei Province (DB13/ 1640-2012) ; The water jacket heating furnace at the end of Chengnan Station implements the Beijing Municipal Standard for the Emission of Atmospheric Pollutants from Boiler (DB11/ 139-2015), which limits the emission concentration of air pollutants from the newly built boiler in Table 1 (April 1, 2017).

Waste gas without organization: the first station of the receiving station, the south port sub-transmission station, the daqiuzhuang sub-transmission station, the Jinghai Transmission station and the non-methane total hydrocarbon with non-organic characteristic pollutants shall implement the " Standard for Comprehensive Emissions of Atmospheric Pollutants " (GB 16297-1996), which means 4.0 mg/m3. The total non-methane hydrocarbon with non-organic characteristic pollutants in the plant boundary of Yongqing Transmission station and Anji Transmission Station shall be subject to the Standard for the Control of Volatile Organic Pollutants Emission from Industrial Enterprises in Hebei Province (DB13/ 2322-2016). The total non-methane hydrocarbon with non-organic characteristic pollutants in the plant boundary of Chengnan terminal station shall be subject to the emission limit of 1.0 mg/m3 of the waste gas and other pollutants from the production process in Table 3 of the Comprehensive Emission Standard for Atmospheric Pollutants (DB 11501-2017).

Table 2.4-2 Limits for Atmospheric Pollutants Emission Standards for Industrial Kiln (DB13/ 1640-2012) (Heating Furnace)

Sequence number	Contaminant	Maximum permissible emission concentration (mg/m3)
1	SO 2	400
2	NOX	400
3	Particulate matter	50

Table 2.4-3 Boiler Air Pollution Emission Standards (DB11/ 139-2015)

Sequence number	Contaminant	Concentration limits for new boilers as of 1 April 2017 (mg/m3)
1	SO 2	10
2	NOX	30
3	Particulate matter	5
4	Smoke blackness	Level 1

2.4.2.2 Waste water

The wastewater generated during the pipeline operation period of the project is mainly domestic sewage. The domestic sewage in the station is used for greening in the station after being treated by the septic tank and integrated sewage treatment facilities, and is not discharged, and the implementation of "Urban Wastewater Recycling Urban Miscellaneous Water Quality" (GB) /T18920-2002) Greening water standards.

2.4.2.3 Noise

(1) Noise during construction period

During the construction period, the emission limits of Environmental Noise Emission Standard (GB 12523-2011) shall be implemented.

Table 2.4-4 Noise Evaluation Criteria for Construction Plant Boundaries [Unit: DB (A)]

Construction stage	Main noise source	Daylight	Night
Earthwork, pile driving, structure, decoration	Bulldozers, excavators, loaders, pile drivers, concrete mixers, vibrators, chainsaws, cranes, elevators, etc.	70	55

(2) Plant noise during operation

The processing stations of the pipeline shall implement Category II standard limits of the Emisson standard for industrial enterprises noise at boundary (GB 12348-2008)

Table 2.4-5 Performance criteria for plant boundary noise assessment [unit: DB (a)]

Execution Location	Standard limit		Noise control standard
	Daylight	Night	
Station yard boundary	60	50	Environmental Noise Emission Standard for Industrial Enterprises (GB 12348-2008) Type 2

2.4.2.4 Solid waste

Solid wastes are classified and treated as required in accordance with the relevant provisions of the National Hazardous Wastes List (2016 Edition) and the General Criteria for Identification of Hazardous Wastes (GB 5085.7-2007).

(1) General solid waste treatment and disposal shall implement the "General Industrial Solid Waste Storage and Disposal Site Pollution Control Standards " (GB 18599-2001).

(2) Hazardous Solid Waste Disposal shall implement the Standard for pollution control on hazardous waste storage (GB 18597-2001).

(3) Announcement on the Amendment of 3 National Pollutant Control Standards for General Industrial Solid Waste Storage and Disposal Site Pollution Control Standards (GB18599-2001) (Provision of Environmental Protection Department Announcement No. 36 of 2013).

2.5 Evaluation focus and evaluation period

This evaluation focuses on the ecological environment, surface water environment and environmental risk assessment during the construction period.

2.6 Pollution Control and Environmental Sensitive Targets

2.6.1Pollution control target

(1) To control the discharge of pollutants from the stations along the line so that the environmental quality around the stations is not lower than the existing environmental functions.

(2) To control and mitigate soil and water loss caused by ditch excavation and temporary access road construction on surface vegetation and soil, especially to control the impact on hilly land and local eco-sensitive areas.

(3) To control the influence of river crossing construction along the road on surface water bodies, paying special attention to controlling the functions of type II and type III water bodies through large excavation to prevent surface water bodies and groundwater from being affected by construction activities.

(4) Control and mitigate the impact of ditch excavation on nature reserves, forest land and agricultural ecosystems along the pipeline, minimize deforestation and occupation of basic farmland, and implement vegetation and farmland restoration measures.

(5) Control and mitigate the impact of construction activities on the residents along the pipeline and around the site.

2.6.2Environment sensitive target

2.6.2.1 Main ecological sensitive target

The main eco-sensitive objectives within the scope of the project evaluation are shown in the table below.

Table 2.6-1 Primary Eco-environmental Protection Objectives Table 1 (Ecological Red Line)

Sequence number	Name	Administration Regions	Ecological involved Region Type	Red Line Name Involved	Traverse length
1	Tianjin permanent protection ecological region	Tianjin	River course	Red Line Area of Daqinghe River	484.6
				Daqinghe Yellow Line Area	260.5
2				Single-flow river reducing red line region	24128.2
				Single flow reducing yellow line region	3879.6
				Red Line Area of Middle Route of South-to-North Water Transfer	122
				Yellow Line Area of Middle Route of South-to-North Water Transfer	300
4				Southern Canal Red Line Area	255.1
				South Canal Yellow Line Area	206.1
6				Ziya River Red Line Region	145.7
				Ziya Yellow Line Area	227.4
7			Park	Duliu River Reduction Country Park	30734.3
8				Jinxi Country Park	9489.7
9			Lake reservoir	Huangyi District of Beidangang Reservoir	17238.6
10				Red Line Area of Wangqingtuo Reservoir	249.4
				Huangyi District of Wangqingtuo Reservoir	200.3
11			Forest belt	Baojin Expressway	214.3
12				Planning high speed	1297.0
13				Planning railway	97.9
14				Huangwan Railway	63.2
15				Jinbao High-speed Railway	226.7
16				Jincang High Speed	232.8
17				Jinjin Expressway	243.5

Sequence number	Name	Administration Regions	Ecological involved Region Type	Red Line Name Involved	Traverse length
18				Beijing-Shanghai high-speed	23786.8
19				Beijing-Shanghai high-speed railway	345.2
20				Beijing-Shanghai line	60.0
21				Li Gang Railway	180.3
22				Rongwu Expressway	741.2
23				Tangjin Expressway	25710.7
24				Northwest wind-proof sand-proof belt	21731.7
25				Coastal protection forest	3779.9
26				Peripheral Wedge-type Greenland in Central Urban Area	654.2
27			Wetland	East Diwa	8510.9
28	Hebei Ecological Red Line	Langfang City	Channel type	Alkali River Red Line Area	50
				Yongding River Red Line Area	45

Table 2.6-2 Objective Table 2 for Eco-environmental Protection of the Project

Sequence number	Environment Sensitive Destination Name	Affiliated administrative region	Level	Type	Relationship to Pipeline	Remark
1	Beidagang Wetland Nature Reserve	Tianjin	Provincial level	Wetland type	The total length of pipeline crossing is 31 km in Beidaigang Wetland Nature Reserve	Directional drilling method for crossing single stream and reducing river ; Laying in the protected area in parallel with the third line of PetroChina Port, Sinopec LNG and town high pressure pipeline
2	Basic farmland	Tianjin, Langfang City			Be distributed along the project line	

2.6.2.2 Main surface water body sensitive target

The main sensitive targets of the send-out pipeline of the project are: the main surface water sensitive targets of the corridor main canal (the supporting project of the South-to-North Water Transfer Project in Hebei Province), the permanent protection ecological region of Tianjin (the main canal of the Mid-North Water Transfer Project, the HongNi River of the Yellow River and the South-to-North Water Transfer Project, the south canal of the main river channel of the Yellow River Diversion and the Jijin Project, the Da-He River, and so on), and the ecological red line of Hebei Province (Yongding River and the Ziya River).

The sensitive areas of surface water environment and main rivers through the send-out pipeline of this project are shown in the following table.

Table 2.6-3 Main environmental sensitive areas of surface water passing through the send-out pipeline of the project

Sequence number	Environment Sensitive Destination Name		Administrative district	Relationship to Pipeline
1	South-to-North Water Transfer Middle Route Langong Canal (Hebei Province South-to-North Water Transfer Project)		Langfang City	Crossing the culvert once on the northeast side of Wangma Village, Jiuzhou Town, Guangyang District, directional drilling, length 600m
	South-to-North Water Transfer Middle Line Tianjin Main Canal		Tianjin	Crossing the culvert in the south of Wangdao Village, Wangqingyu, Wuqing District, directional drilling, length 600m
2	Tianjin permanent protection ecological region	HongNi River (Yellow River Diversion and South-to-North Water Transfer)	Tianjin	Directional drilling through, directional drilling length 600 m
3		South Canal (Main River of YRDP)	Tianjin	Directional drilling through, directional drilling length 600 m
4		Duliujian river 1#	Tianjin	Directional drilling through, directional drilling length 650 m
5		Duliujian river 2#	Tianjin	Directional drilling through, directional drilling length 730 m
6		Daqinghe River	Tianjin	Directional drilling through, directional drilling length 1000 m
7		Ziya River	Tianjin	Directional drilling through, directional drilling length 600 m
8	Ecological Red Line Region of Hebei	Yongding River	Langfang City	Directional drilling through, directional drilling length 928 m
9		Jian river	Langfang City	Directional drilling through, directional drilling length 552 m

Table 2.6-4 Statistics table of main surface water bodies passing through the send-out pipeline of the project

Area along the line	River name	Water width	Traverse length	Water quality Target	Water body function	Traversing mode	Alternate note
Tianjin City	Duliujian river1	200	650	IV	Agricultural water	Directional drill	Tianjin permanent protection ecological
	Duliujian river 2	400	730	IV	Agricultural water	Directional drill	

	Daqinghe River	60	735	III	Agricultural water	Directional drill	region
	Ziya River	36	600	III	Drinking, agriculture	Directional drill	
	South Canal	20	1600	III	Drinking, agriculture, industry	Directional drill	
	Hongmud River	26	600	III	-	Directional drill	
	Forward channel	50	600	IV *	-	Directional drill	
	Drainage channel	76	600	IV *	-	Directional drill	
	Eastern drainage channel	24	50	IV *	-	Top pipe	
	Youth canal	25	50	IV *	-	Top pipe	
	Gang approach	29	50	IV *	-	Top pipe	
	Zhongting River	23	63	IV	-	Excavation	
Hebei Province	Yongding River	20	928	IV	-	Directional drill	Ecological Red Line Region of Hebei Province
	Alkali river	20	552	IV *	-	Directional drill	
	Xiao Miao Dong Gan	11	50	IV *	-	Top pipe	

Note: * Rivers are undemarcated in water functional zoning and are evaluated according to Grade IV water quality.

2.6.2.3 Main groundwater sensitive target

According to the guidelines, groundwater environmental protection is targeted at groundwater aquifers and aquifers that may be affected by construction projects and have value for the development and use of drinking water, centralized drinking water sources, decentralized drinking water sources and environmentally sensitive areas involving groundwater.

According to the field investigation and the sensitive target investigation, the wharf and receiving station of this project are located in the coastal intertidal zone (tidal flat), which is formed by land reclamation in the surrounding sea on tidal flat, and the underground water in the project construction area and the affected area is connected with seawater, which belongs to salty water, the water quality is poor, and is not suitable for drinking, and there is no sensitive point of groundwater drinking water environment. The pipeline does not cross the groundwater source protection area, but it crosses the Beidaigang Wetland Nature Reserve in Tianjin, which is listed as the target of groundwater protection. The villages involved in the evaluation of the Tianjin section, the residents use the water from their town water works, and do not use groundwater ; In the evaluation area of Hebei section, the village residents use more water to collect the village concentrated water supply wells, the well depth is about 300-

500 m, the deep confined water is used, and there is a stable and continuous weak permeable layer between the confined water and the upper layer diving, and the hydraulic connection is poor ; There are no villages in the evaluation area of Beijing section.

Therefore, this evaluation statistics the water wells within 200 m of the project's send-out pipeline, and the water source wells within 200 m of the project's send-out pipeline are shown in the following table.

Table 2.6-5 Statistics of groundwater protection targets within 200 m of the send-out pipeline of this project

Sequence number	Village	Water supply mode	Water supply population	Nearest distance between supply well and pipe	The direction of the well in the pipeline	Water supply well profile
Langfang City						
1	Nan Ren Ying Cun	Village concentration well	300	Well located 190 m upstream of groundwater	WW	There is a centralized well with a depth of 400 m and a water consumption of approximately 60 m3/d
2	Little	Village concentration well	500	The well is 130 m downstream of the groundwater	Ne	There is a centralized well with a depth of 150 m, a regional groundwater depth of about 30 m and a water consumption of about 100 m3/d

Note: Upstream and downstream of groundwater refers to the direction of groundwater or shallow water flow.

2.6.2.4 Major Cultural Relics Protection Units

This project does not deal with national and provincial key cultural relics.

2.6.2.5 Atmospheric environment sensitive target

The project statistics villages within 200 m on both sides of the send-out pipeline, as shown in Table 2.6-6~8.

2.6.2.6 Acoustic environment sensitive target

There are no acoustic sensitive targets in the evaluation area around the field of the send-out pipeline station . The acoustic sensitive targets around the pipeline are shown in Table 2.6-6~8.

Table 2.6-6 Statistics of distribution of sensitive targets within 200 m on both sides of pipeline

Sequence number	Sensitive destination name	Closest to pipe	Orientation	Number of households in the evaluation area	Population under evaluation	City of residence
1	Chang Liu Zhuang	110	SE	7	28	Tianjin
2	Xue Jia Fang Cun	41	S	1	4	Tianjin

Sequence number	Sensitive destination name	Closest to pipe	Orientation	Number of households in the evaluation area	Population under evaluation	City of residence
3	Yang Xiaozhuang	50	S	28	95	Tianjin
4	Shunmin Tun	35	S	130	410	Tianjin
5	Xin Zhuang Zi Cun	136	S	65	200	Langfang City
6	Jiu Jia Bao Cun	155	S	58	180	Langfang City
7	Nan Di Cun	140	N	16	55	Langfang City
8	Xiao Shen Zhuang Cun	141	N	21	60	Langfang City
9	West Zhangzhuang Village	95	E	8	25	Langfang City
10	Nan Ren Ying Cun	180	WW	4	13	Langfang City
11	Guan Dao Cun	120	SW	10	38	Langfang City
12	Heng Ting Cun	120	WW	15	48	Langfang City
13	Chai Wu Cun	120	Ne	16	50	Langfang City
14	Little	130	Ne	21	65	Langfang City
15	Xing Long Zhuang Cun	150	WW	18	60	Langfang City
16	Sui Shang Cun	160	Ne	6	20	Langfang City
17	Huo Tou Ying Cun	80	Ne	33	110	Langfang City
18	Miao Xiao Zhai Cun	170	WW	2	7	Langfang City

Table 2.6-7 Statistics on the distribution of sensitive targets within 2.5 km of the substation yard

Sequence number	Type	Sensitive destination name	Distance	Orientation	Number of households	Population	City of residence
1	Residential area	Little	450	E	150	500	Langfang City
2		Qian Nan Zhuang Cun	1580	Ne	800	3000	Langfang City
3		Hou Nan Zhuang Cun	2070	Ne	210	1100	Langfang City
4		Da Bei Shi Cun	1230	SE	720	2700	Langfang City
5		Chai Wu Cun	2320	SE	310	1000	Langfang City
6		Xiao Bei Shi Cun	2350	SE	180	600	Langfang City
7		Liu Yuan Cun	1930	SW	650	2100	Langfang City
8		Amber Ying Cun	2450	SW	200	700	Langfang

Sequence number	Type	Sensitive destination name	Distance	Orientation	Number of households	Population	City of residence
							City
9		Wang Ma Cun	1520	WW	670	2300	Langfang City
10		Zhao Ge Zhuang Cun	2860	Nw	120	450	Langfang City
11		Nan Shun Min Tun Cun	2050	N	350	1200	Langfang City
1	Educational institution	Nanzhuang Central Kindergarten Sub-garden	650	E	/	/	Langfang City
2		Nanzhuang Central Kindergarten	2100	E	/	/	Langfang City
1	Medical institution	Qiannan Zhuang Village Clinic	2310	Ne	/	/	Langfang City

Table 2.6-8 Statistics of distribution of sensitive targets within 2.5 km of Nanbu Station

Sequence number	Type	Sensitive destination name	Distance	Orientation	Number of households	Population	City of residence
1	Residential area	Nei Guan Zhuang Cun	935	N	150	500	Beijing
2		Dian Zi Cun	1100	N	280	900	Beijing
3		Sun Jia Ying Cun	1970	Ne	260	850	Beijing
4		Zhao Jia Yuan Cun	2490	Ne	100	350	Beijing
5		Huo Tou Ying Cun	1460	SE	620	2000	Langfang City
6		Small Firehead Battalion	1800	SE	60	200	Langfang City
7		Miao Xiao Zhai Cun	1130	SE	90	300	Langfang City
8		Wang Xiao Zhai Cun	2400	S	30	100	Langfang City
9		Tai Ping Zhuang Cun	1520	WS	30	100	Langfang City
10		Wang Hua Zhuang Cun	1510	Nw	35	120	Beijing
11		Zhao Jia Zhuang	1920	Nw	50	190	Beijing
12		Cypress Village	2000	Nw	60	210	Beijing
13		Lixian Home	1650	Nw	420	1500	Beijing
1	Educational institution	Lixian National School	1810	Nw	/	/	Beijing
2		Beijing Hui Min School (Lixian Branch)	1900	Nw	/	/	Beijing
1	Medical institution	Tenant Community Health Service Station	1380	N	/	/	Beijing

2.6.2.7 Environmental risk sensitive target

The pipeline evaluation scope is 200 m on both sides, and the targets of environmental risk sensitivity around the pipeline are shown in Table 2.6-6~8.

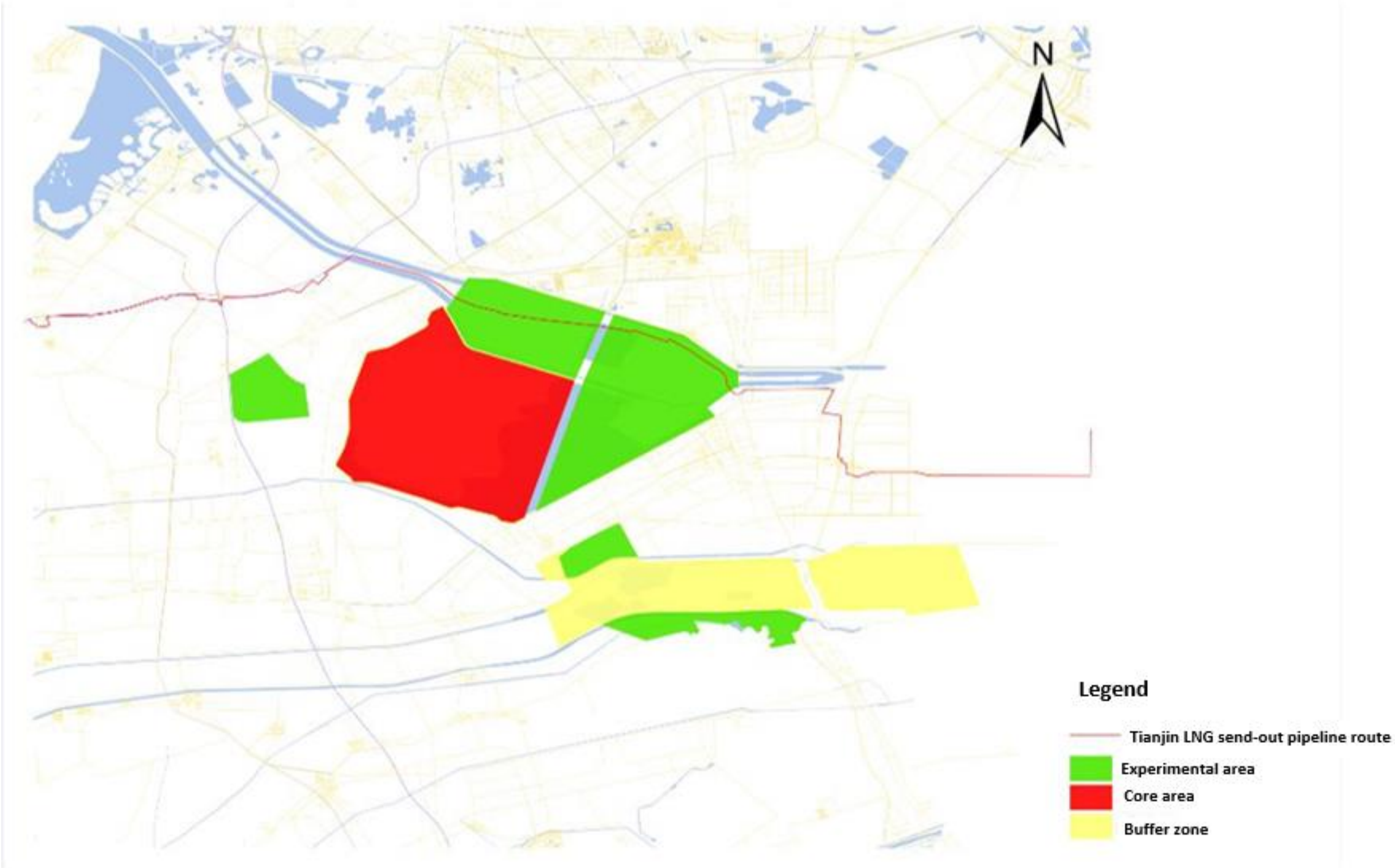

N
Legend
Tianjin LNG send-out pipeline route
Experimental area
Core area
Buffer zone

Figure 2.6-1 Schematic diagram of the relationship between the project and the Beidagang Wetland Reserve

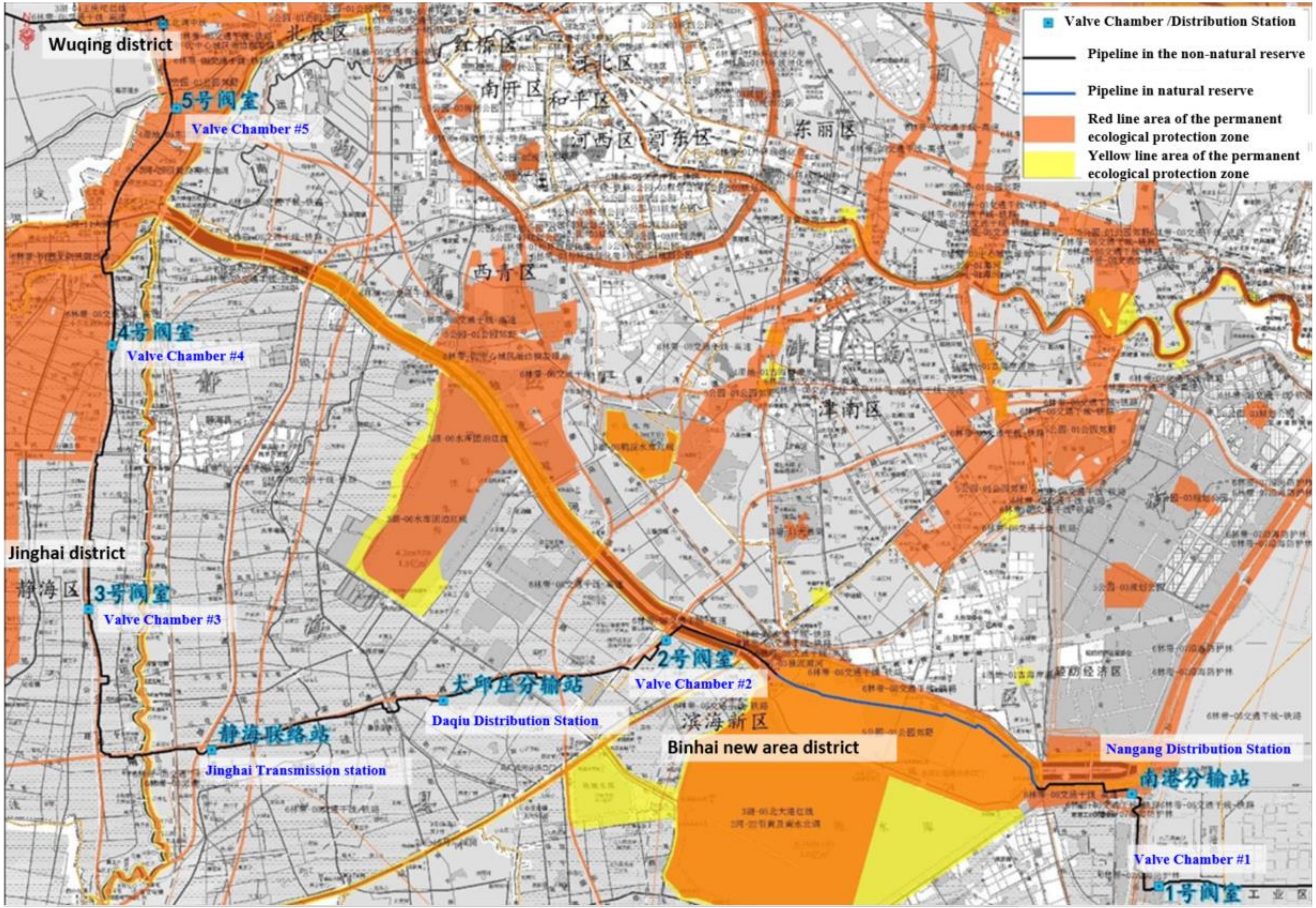


Figure 2.6-2 Positional relationship between the Tianjin section of the send-out pipeline and the permanent ecological protection zone

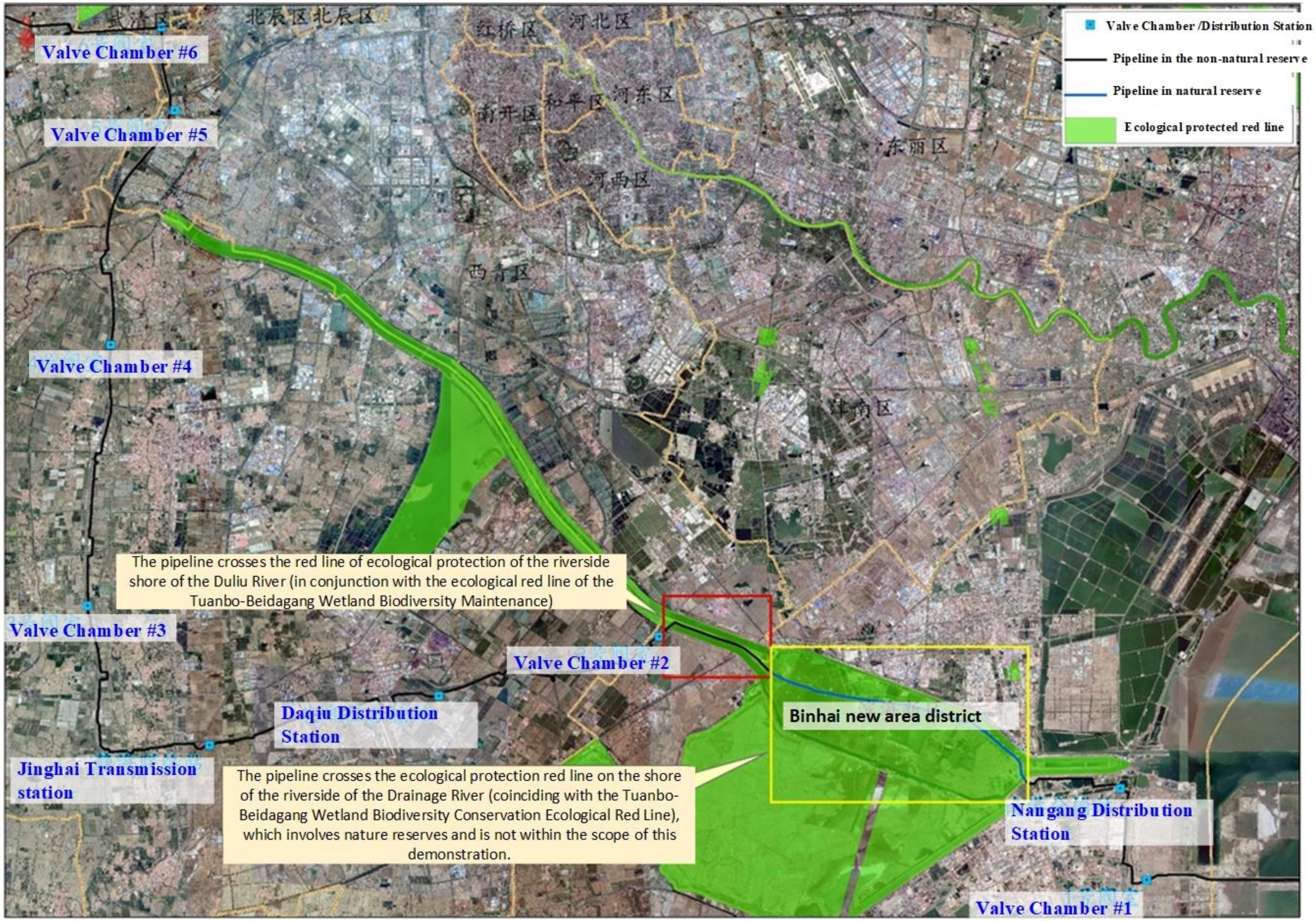


Figure 2.6-3 Relationship between Tianjin section of the send-out pipeline and ecological protectied red line

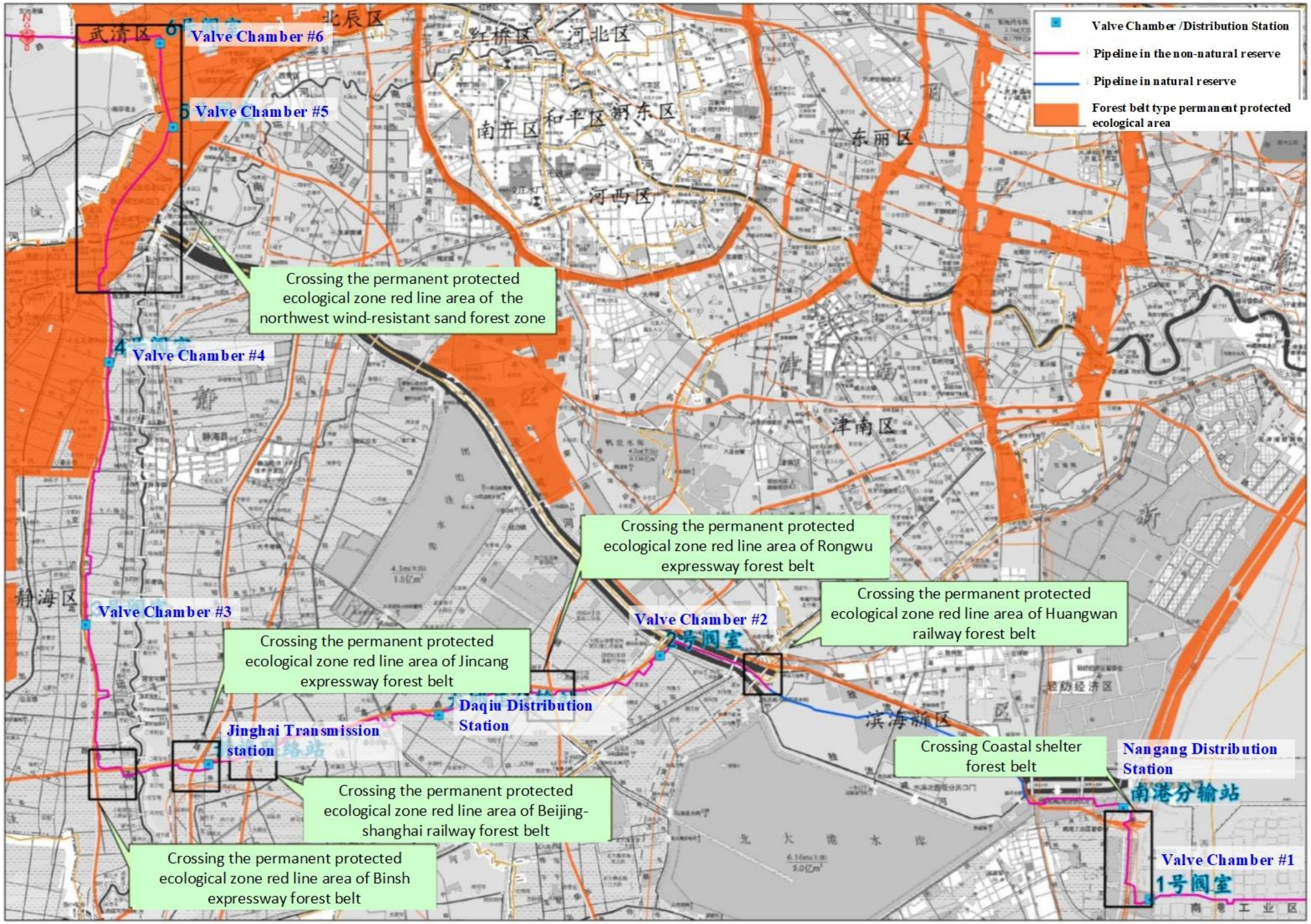


Figure 2.6-4 Positional relationship between the Tianjin section of the send-out pipeline and the permanent protected ecological area - forest belt

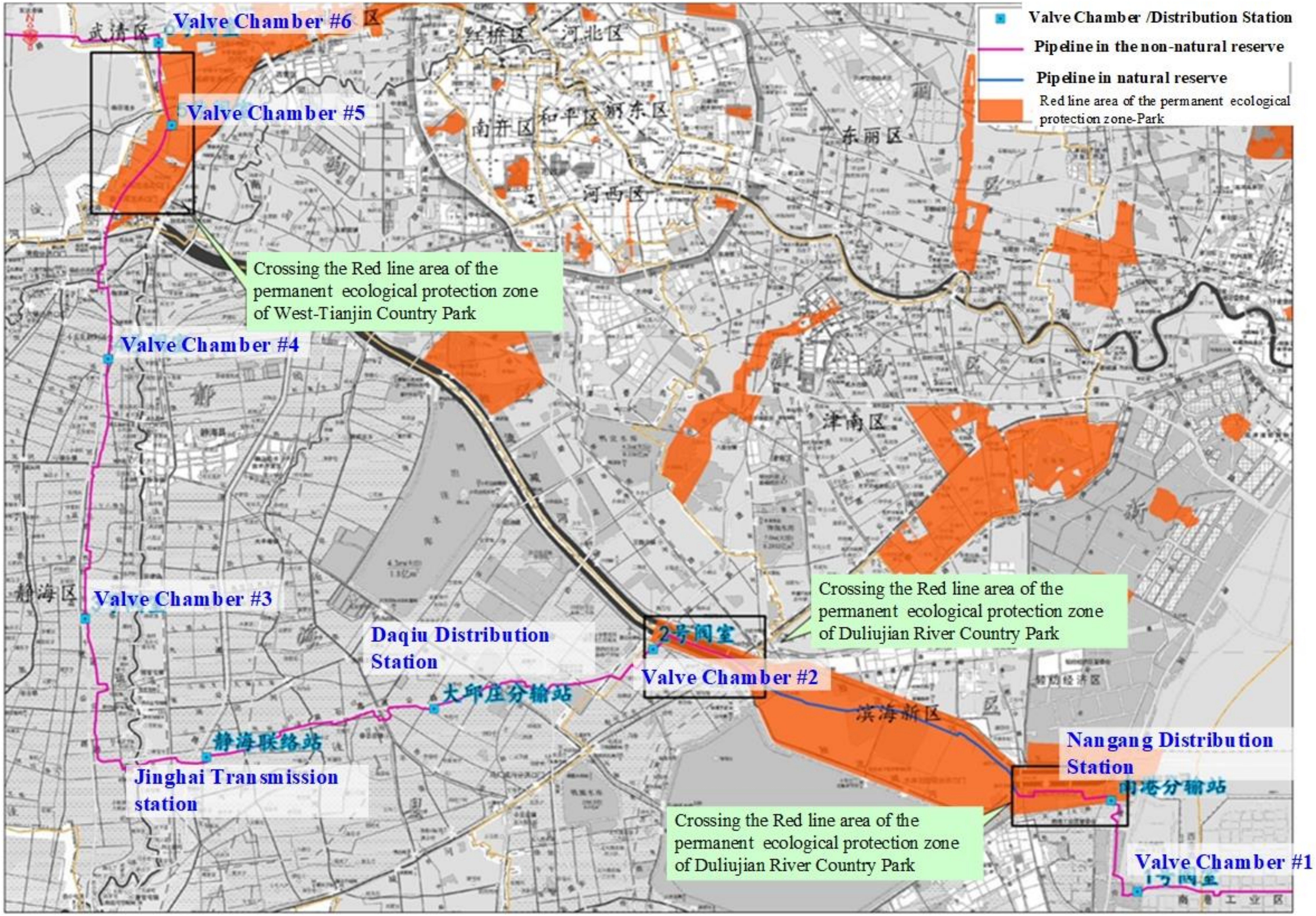


Figure 2.6-5 Positional relationship between the Tianjin section of the send-out pipeline and the permanent protected ecological area - park

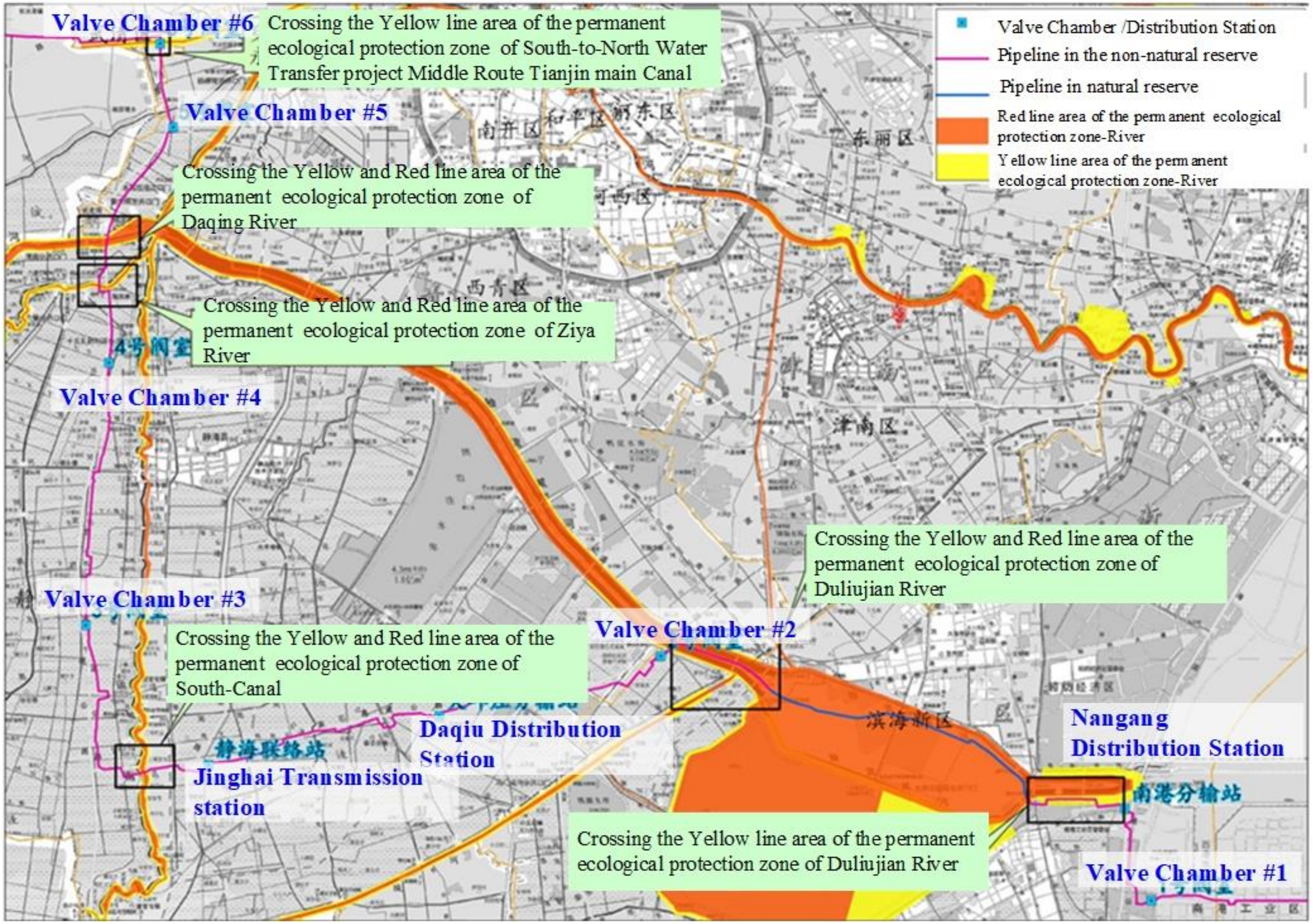

Valve Chamber #6
Crossing the Yellow line area of the permanent ecological protection zone of South-to-North Water Transfer project Middle Route Tianjin main Canal
Valve Chamber /Distribution Station
Pipeline in the non-natural reserve
Pipeline in natural reserve
Red line area of the permanent ecological protection zone-River
Yellow line area of the permanent ecological protection zone-River
Valve Chamber #5
Crossing the Yellow and Red line area of the permanent ecological protection zone of Daqing River
Crossing the Yellow and Red line area of the permanent ecological protection zone of Ziya River
Valve Chamber #4
Crossing the Yellow and Red line area of the permanent ecological protection zone of Duliujian River
Valve Chamber #3
Valve Chamber #2
Crossing the Yellow and Red line area of the permanent ecological protection zone of South-Canal
Daqiu Distribution Station
Nangang Distribution Station
Jinghai Transmission station
Crossing the Yellow line area of the permanent ecological protection zone of Duliujian River
Valve Chamber #1

Figure 2.6-6 Positional relationship between the Tianjin section of the send-out pipeline and the permanent protected ecological area - river

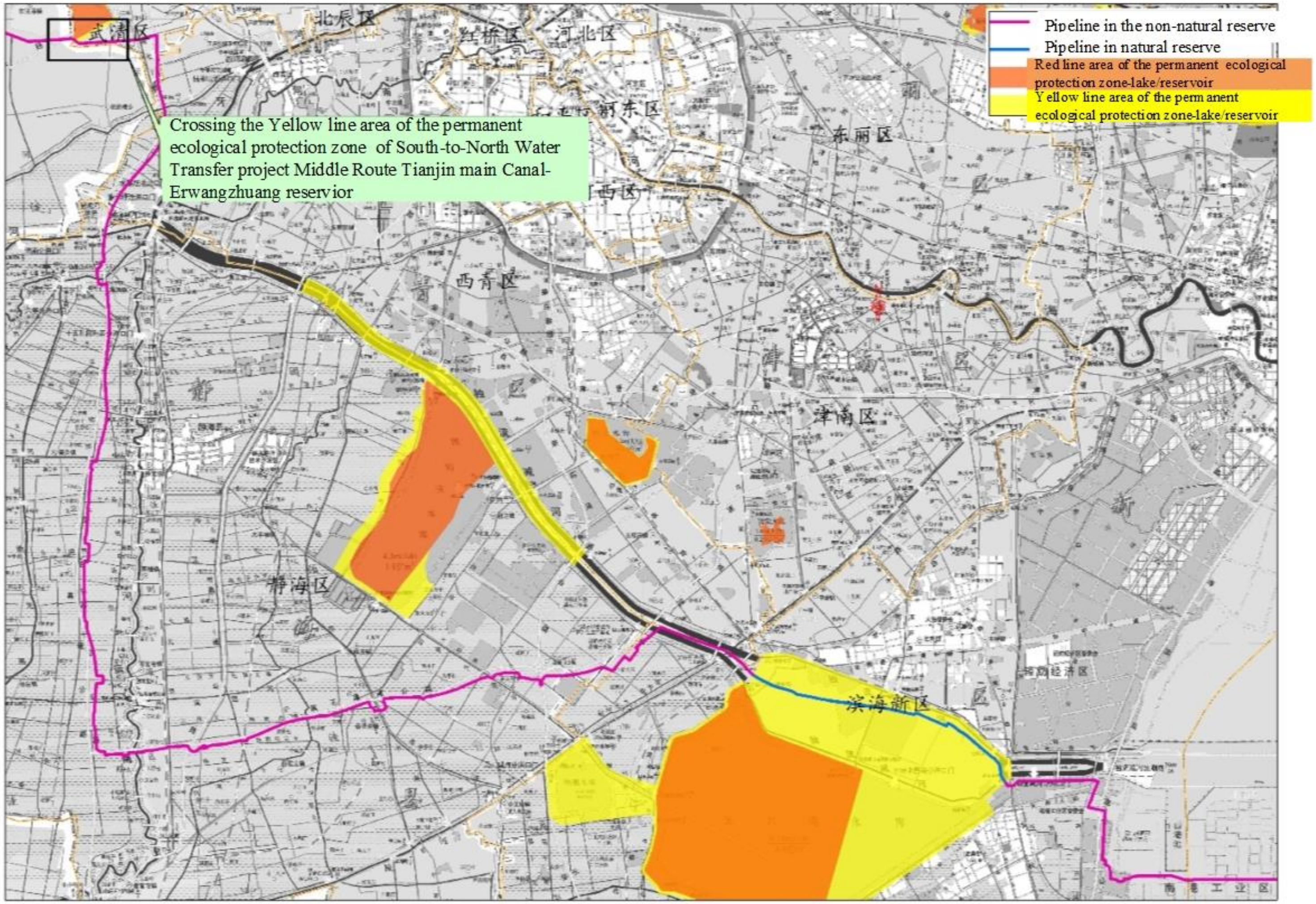


Figure 2.6-7 Positional relationship between the Tianjin section of the send-out pipeline and the permanent protected ecological area -lake and reservior

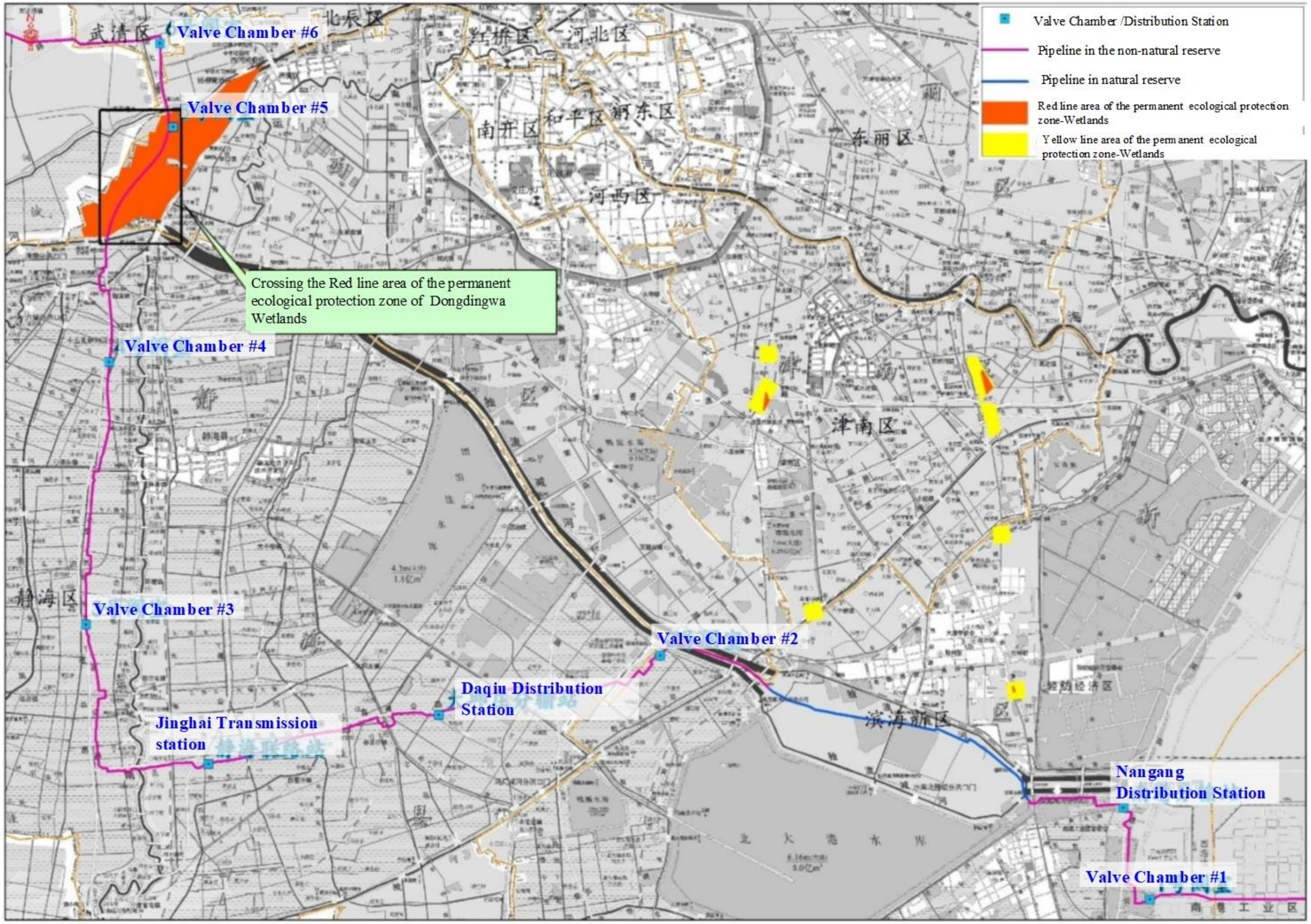
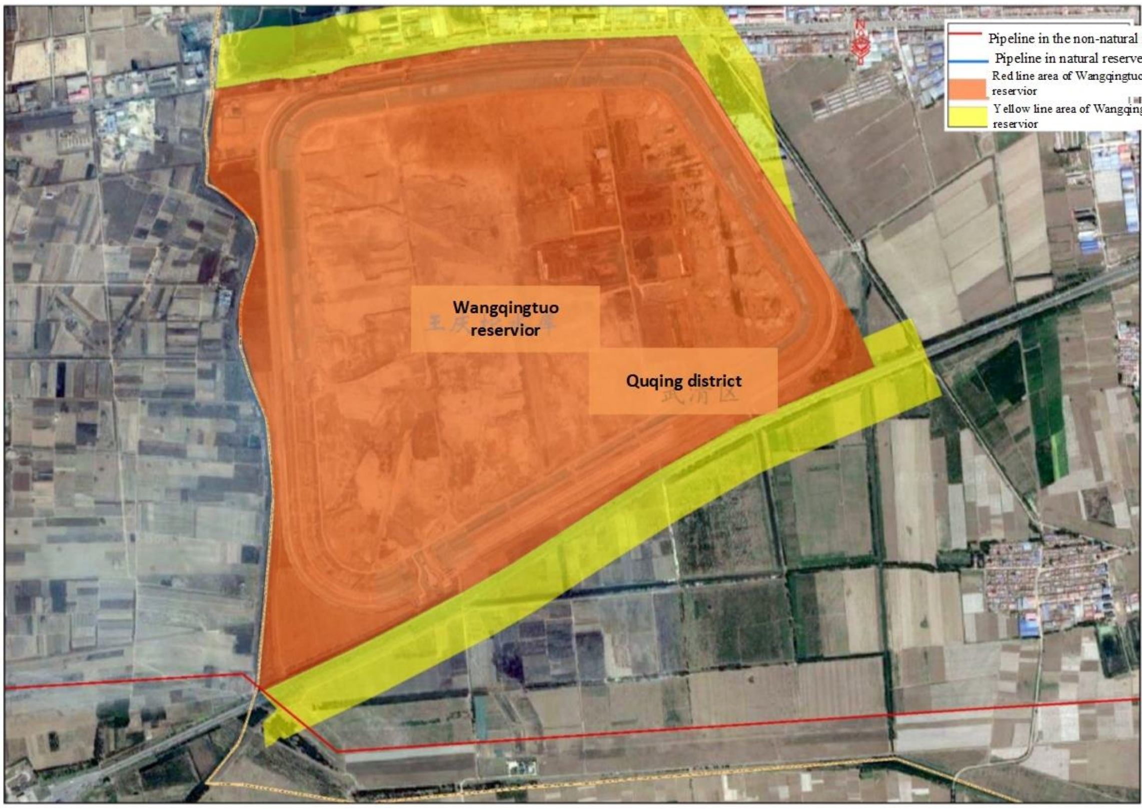

Valve Chamber /Distribution Station
Pipeline in the non-natural reserve
Pipeline in natural reserve
Red line area of the permanent ecological protection zone-Wetlands
Yellow line area of the permanent ecological protection zone-Wetlands
Valve Chamber #6
Valve Chamber #5
Crossing the Red line area of the permanent ecological protection zone of Dongdingwa Wetlands
Valve Chamber #4
Valve Chamber #3
Valve Chamber #2
Daqiu Distribution Station
Jinghai Transmission station
Nangang Distribution Station
Valve Chamber #1
武清区
北辰区
红桥区
河北区
南开区
和平区
河东区
东丽区
河西区
津南区
静海区
滨海新区

Figure 2.6-8 Tianjin section of the send-out pipeline and the permanent protected ecological area -wetlands



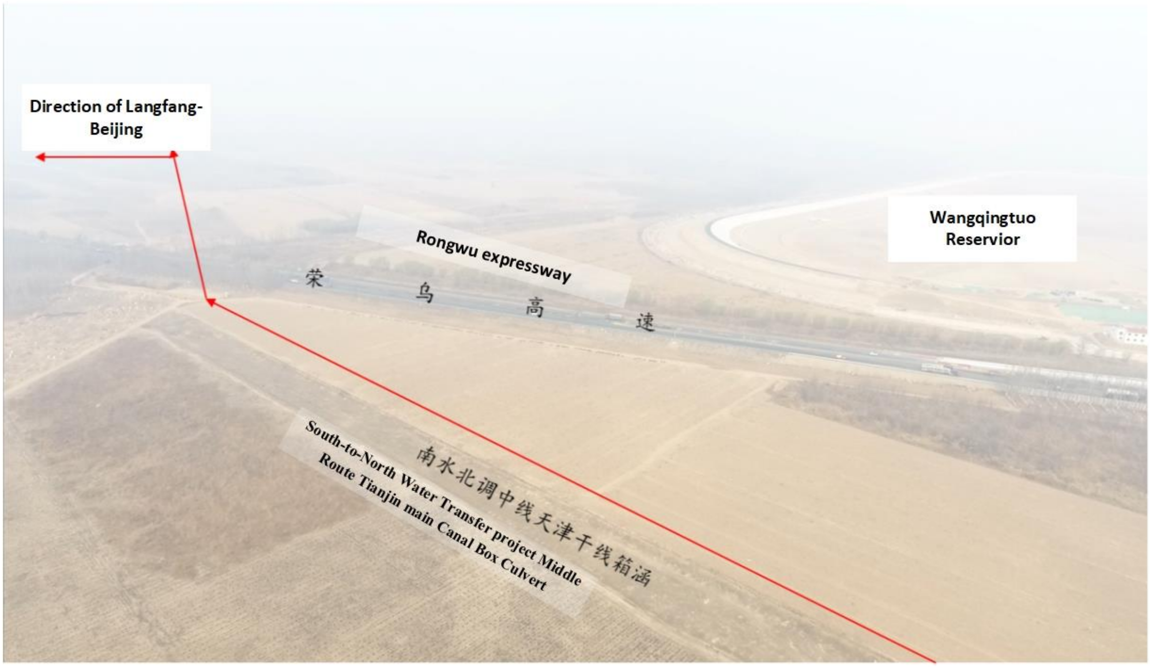
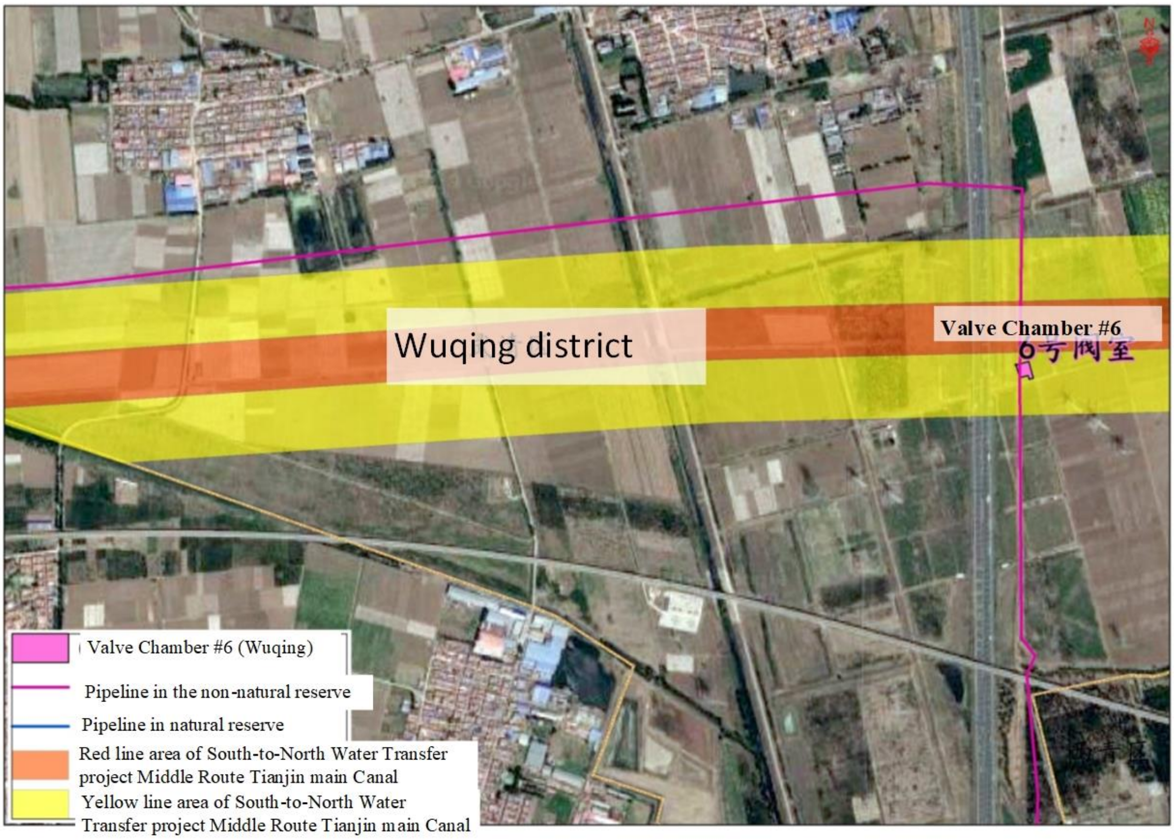


Figure 2.6-9 Positional relationship between project pipeline and permanent protection ecological area of Wangqingtuo Reservior



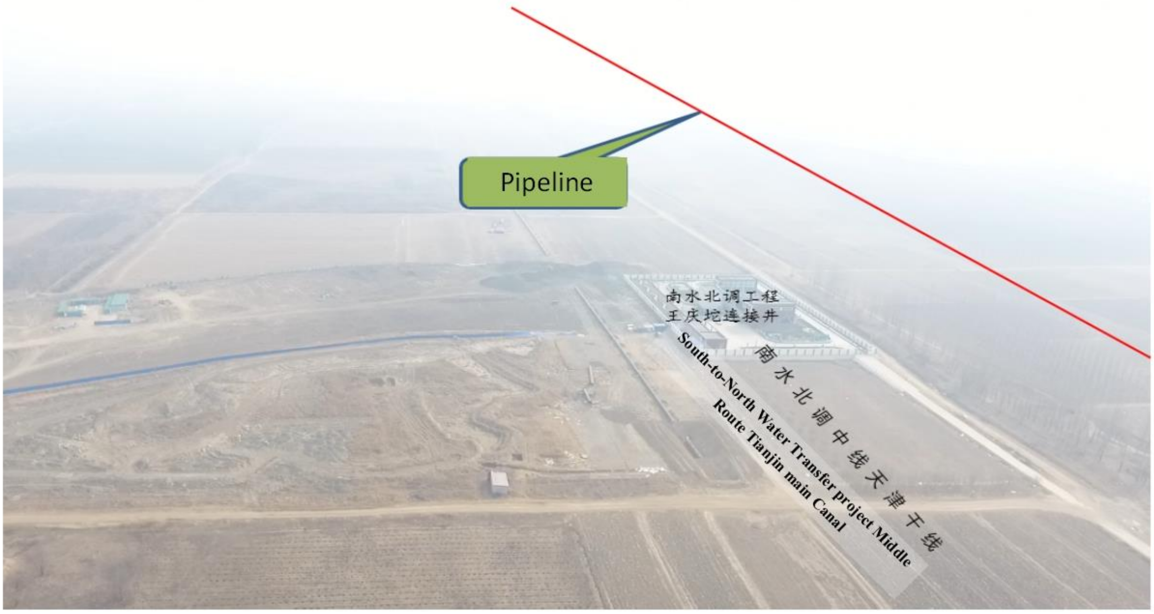


Figure 2.6-10 Positional relationship between project pipeline and permanent protection ecological area of South-to-North Water Transfer project Middle Route Tianjin main Canal

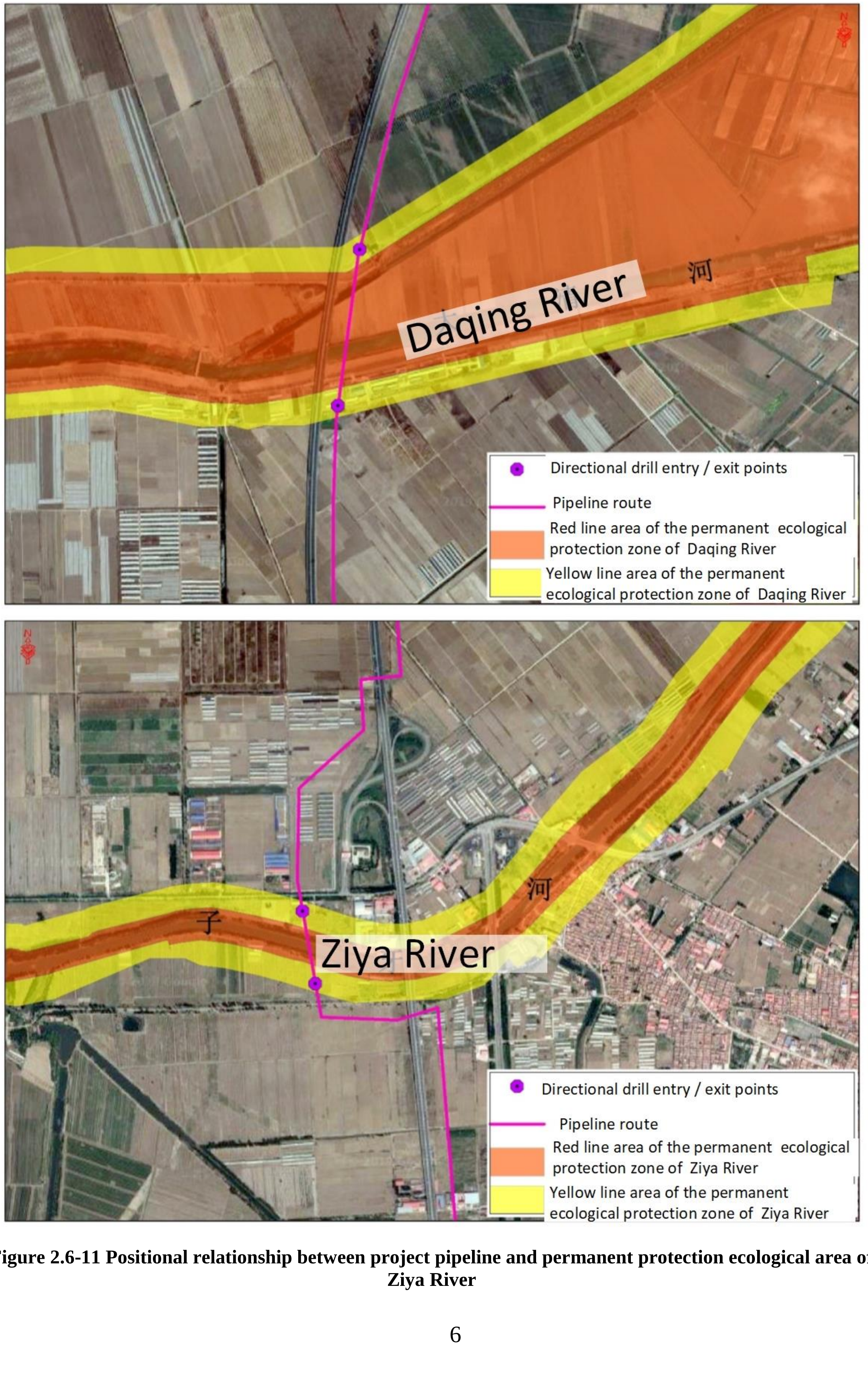


Figure 2.6-11 Positional relationship between project pipeline and permanent protection ecological area of Ziya River

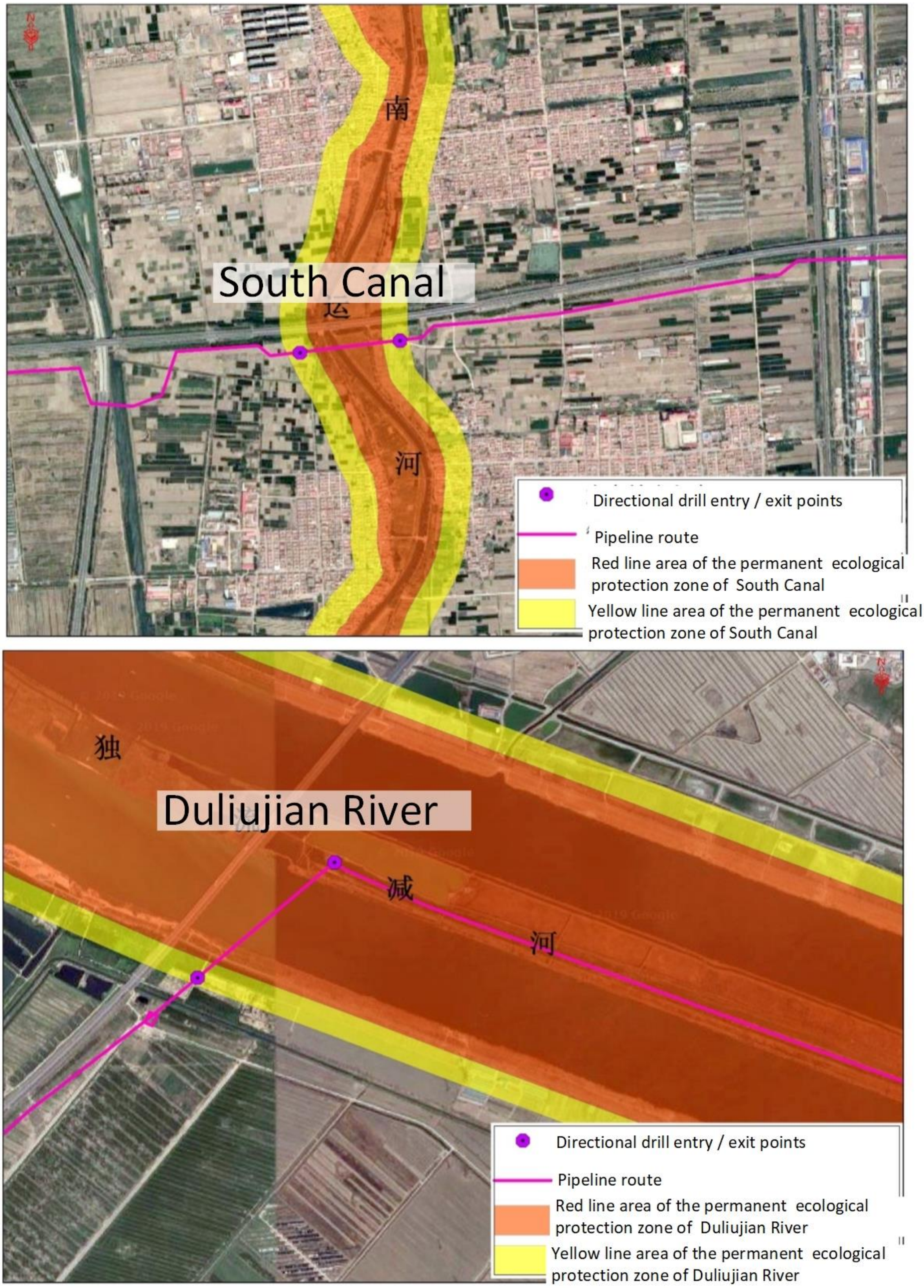


Figure 2.6-12 Positional relationship between project pipeline and permanent protection ecological area of Duliujian River

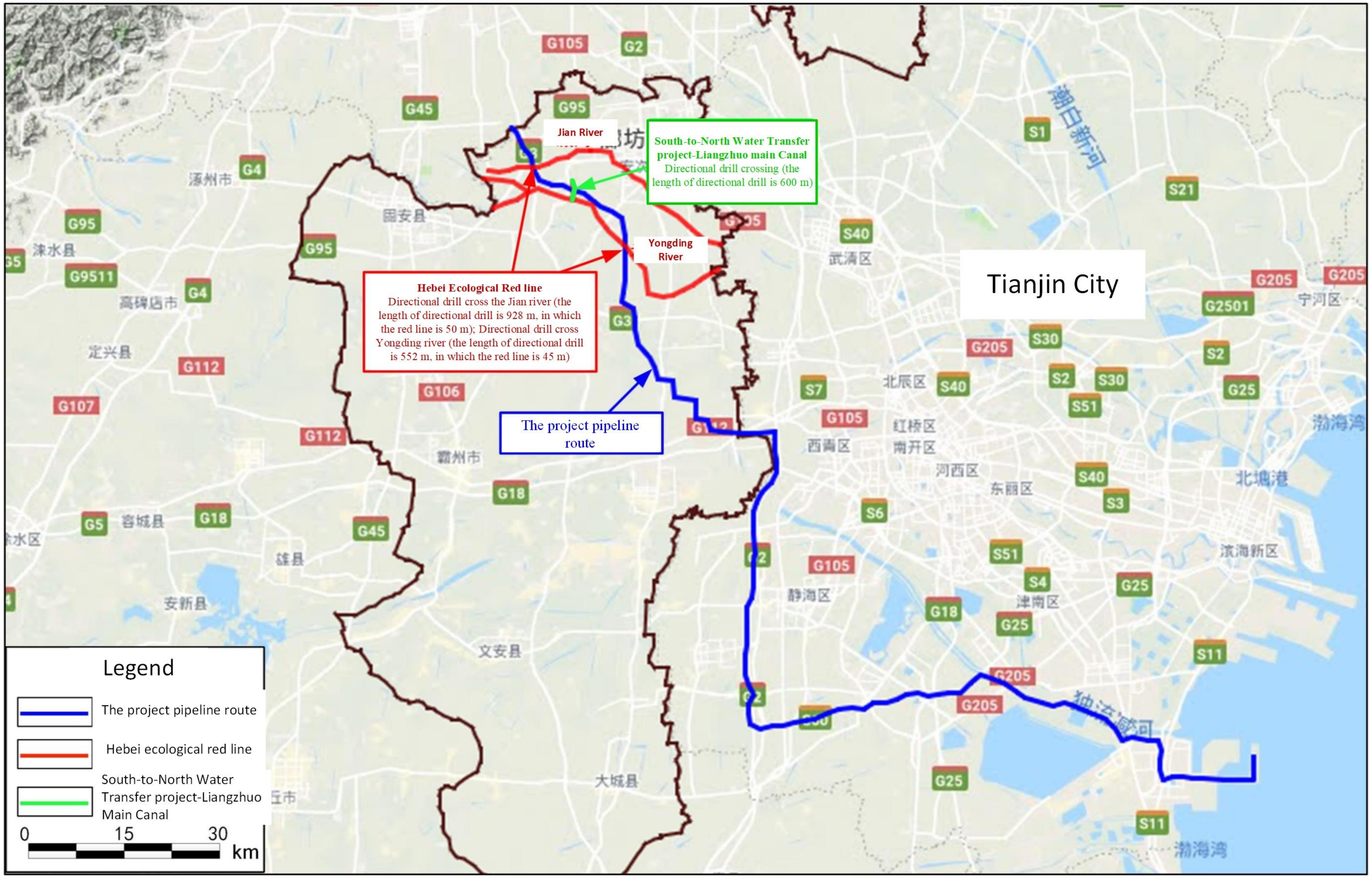


Figure 2.6-13 Relationship between the Hebei section of the send-out pipeline and the ecological protection red line of Hebei Province

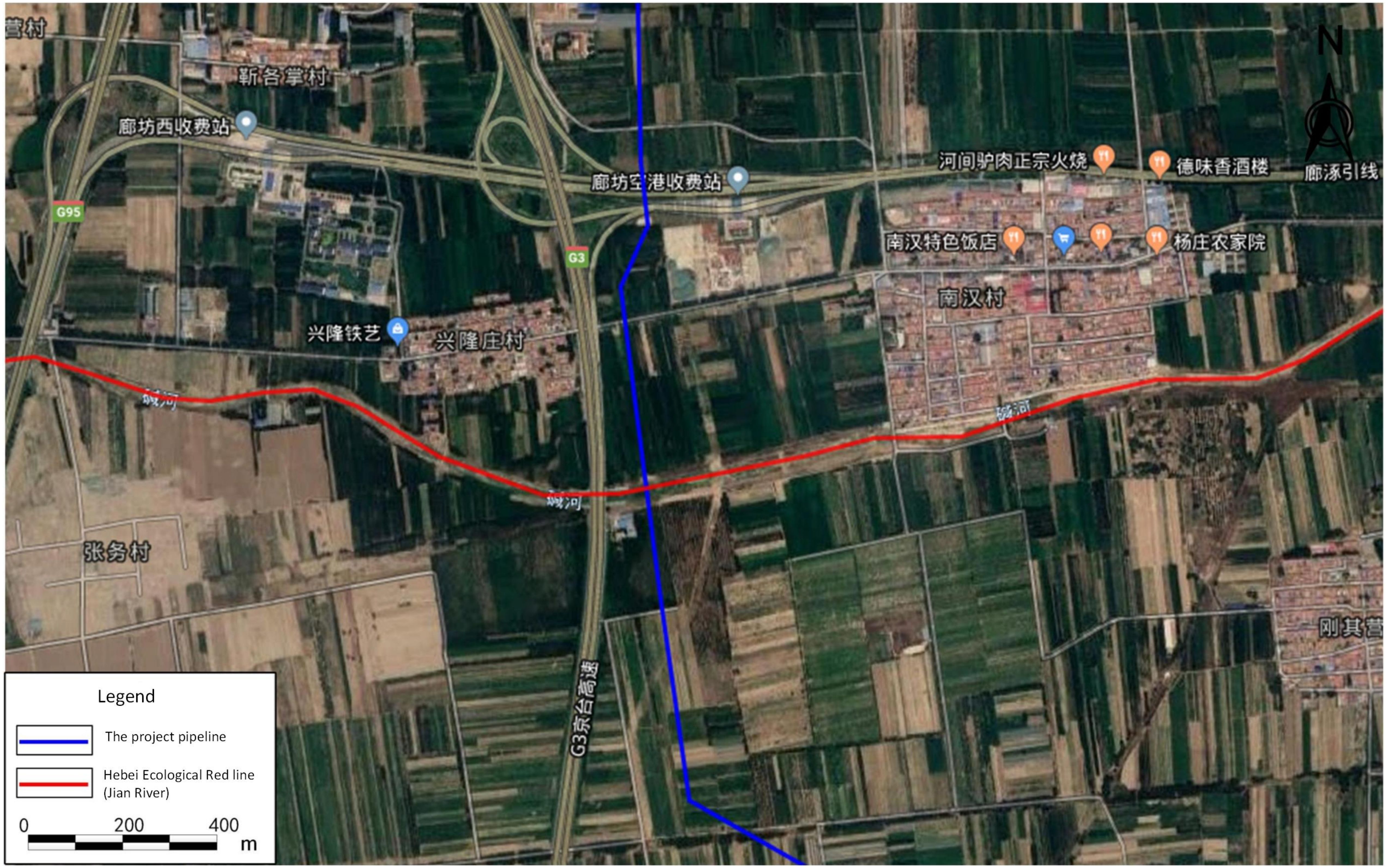


Figure 2.6-14 Relationship between the Hebei section of the send-out pipeline and the ecological protection red line (Jian River) of Hebei Province

Figure 2.6-15 Relationship between the Hebei section of the send-out pipeline and the ecological protection red line (Yongding River) of Hebei Province

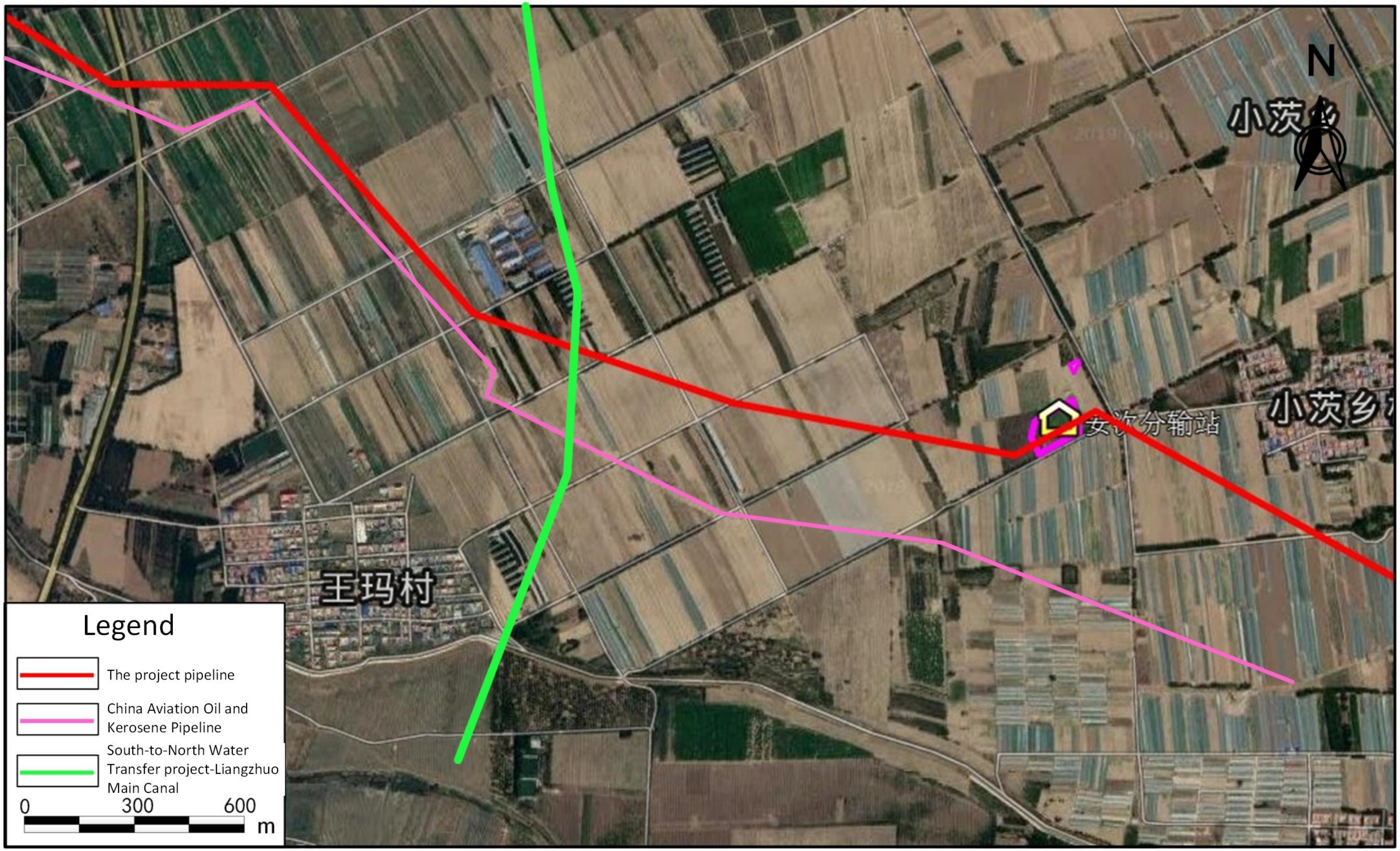


Figure 2.6-16 Relationship between the Hebei section of the send-out pipeline and the ecological protection red line (South-to-North Water Transfer project-Liangzhuo Main Canal) of Hebei Province

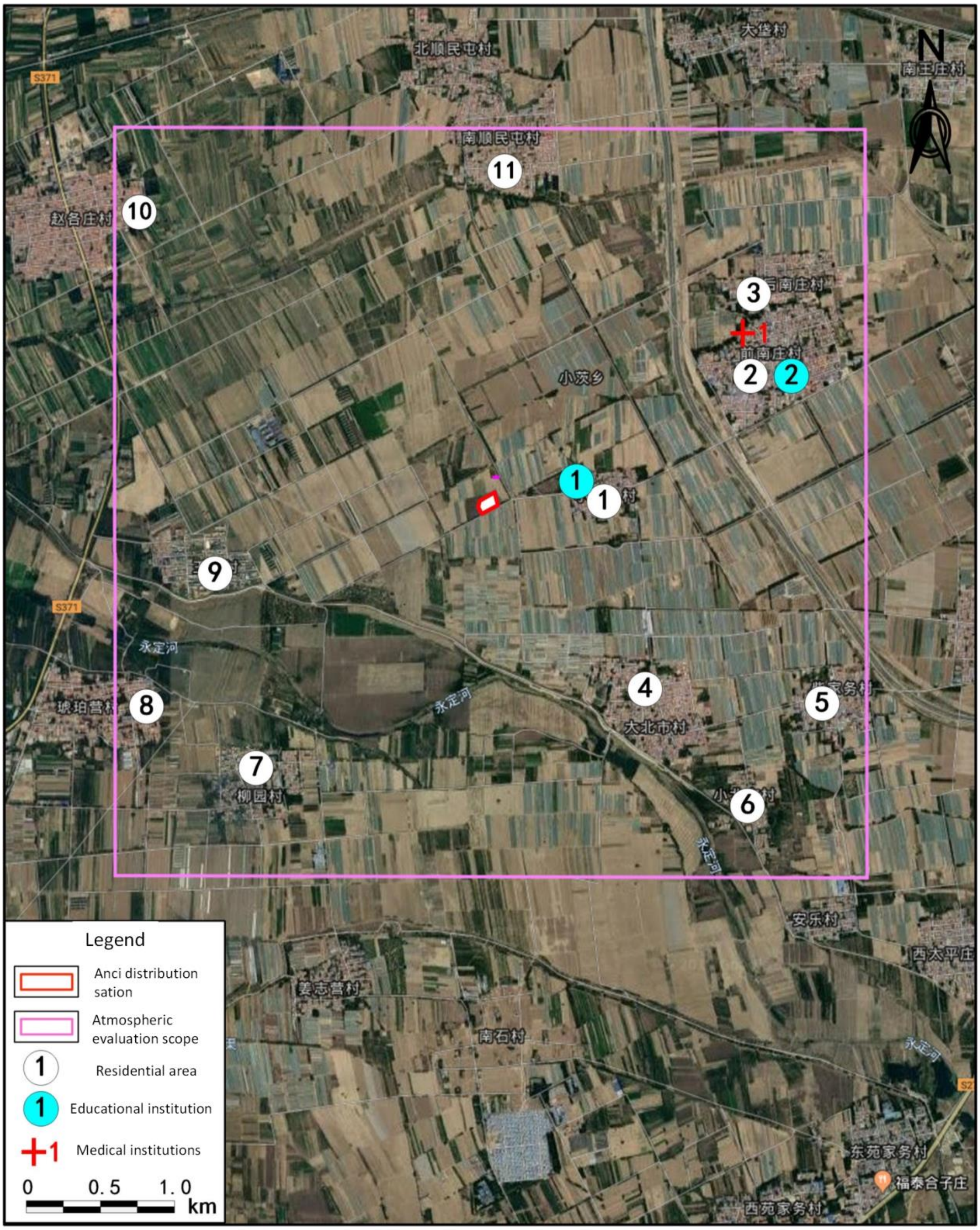


Figure 2.6-17 Anci distribution station atmospheric risk sensitive target map

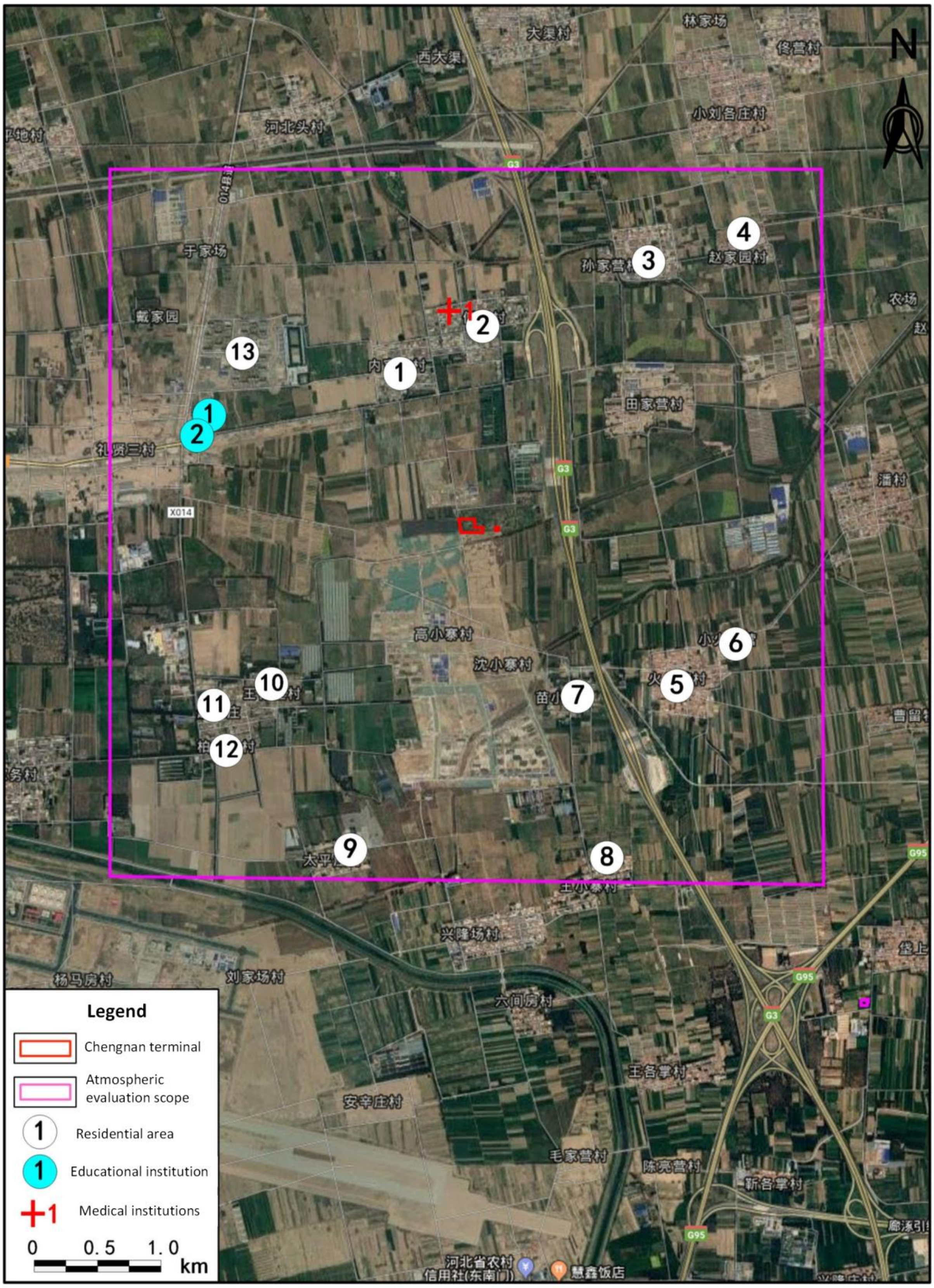


Figure 2.6-18 Chengnan terminal atmospheric risk sensitive target map

3 Analysis of Alternatives

3.1 With and Without Project Alternatives

(1) The existing LNG supply capacity cannot guarantee the demand of Beijing, Tianjin and Hebei province.

According to the "Implementation Plan for the Construction of LNG Storage and Transportation System in Bohai Rim Region (2019-2022)", the storage capacity of the LNG receiving terminal shall meet the demand of 5% of the gas enterprises and 3 days of emergency gas of local governments. At the moment, there are two LNG receiving terminals in the Beijing-Tianjin-Hebei region, namely Tianjin floating LNG from China National Offshore Oil Corporation (CNOOC) and Tianjin LNG from the China Petroleum and Chemical Corporation (Sinopec), with a gasification capacity of 4,300 × 104 Nm3/d. In addition, Tangshan LNG receiving terminal supplies to the Beijing-Tianjin-Hebei region with a gasification capacity of 4,200 × 104 Nm3/d. It is planned to expand the total gasification capacity for Tangshan LNG and Tianjin floating LNG from CNOOC to 27,900 × 104 Nm3/d in 2022. Considering the radiation area of the send-out pipeline, the supply to the Beijing-Tianjin-Hebei region will be about 16978 × 104 Nm3/d in 2025. In addition, considering the total supply capacity of all pipelines export to this region, it will be 32452 × 104 Nm3/d by then. However, the daily demand for high monthly average of the Beijing-Tianjin-Hebei region will be up to 36885 × 104 Nm3/d in 2025. Thus, the supply capacity is unable to guarantee the demand of the Beijing-Tianjin-Hebei region.

(2) The project is expected to largely enhance natural gas reserve and peak capacity in the Beijing-Tianjin-Hebei region.

In 2017, Beijing's natural gas consumption was about 162 × 108 Nm3, which is the largest among all cities in China and the second largest city in the world. The gas consumption in Beijing is expected to increase up to 210 × 108 Nm3 in2022, and 260 × 108 Nm3 in2030. Natural gas supply has become the core to secure Beijing’s energy supply.

At present, Beijing’s natural gas supply is facing severe challenges due to insufficient reserve capacity. Given this, heat supply shortage has become a critical issue which badly affects societal well-beings, in particular for occasions with serious malfunctions of upstream facilities and extreme weather. According to estimations, in 2017, the volume of peak demand (defined as the sum of the demand which exceeds annual average over all months) in Beijing accounts for 30% of the annual gas consumption. However, the usable capacity of gas storage in the surrounding Beijing-Tianjin-Hebei region was only about 27× 108 Nm3, which was far from meeting the peak demand in Beijing. Also most enterprise fail to meet the national requirements about keeping gas reserve capacity of at least 5%. In light of this, this project will help to largely enhance gas reserve capacity to meet peak demand in the Beijing-Tianjin-Hebei region. This is also well aligned with China's state-level energy policies.

The total consumption in Beijing-Tianjin-Hebei region will stably increase, mainly driven by development of downstream markets. According to the market analysis, the supply gap in 2023 can reach up to 1848× 104 Nm3/d in months with high gas demand, and increase to 4063 × 104 Nm3/d in 2035.

(3) This project is seen as an important move to optimize energy consumption mix, and promote energy conservation and emission reduction in the Beijing-Tianjin-Hebei region.

China will experience radial energy transition in the next five years and beyond. Clean and low-carbon energy is the core to address air pollution and mitigate climate change. However, being subjected to various economic and technical limitations of deploying renewable and storage technologies, scalable and flexible power resources are required to balance intermittency of the system. Gas power plants are characterized by high flexibility and fast ramping up, shutting down capability. Gas power has been proven to be effective in complementing wind and solar power, which helps to reduce the renewable curtailment in China and thus improve overall energy efficiency security of the power supply. Therefore, renewable development and gas supply should go hand in hand to facilitate China's clean energy transition.

Natural gas itself is an efficient, clean and low-carbon high-quality energy resource, rich in reserve and supply, relatively low-cost, easy to use and low in emissions. The thermal efficiency of natural gas for power generation and industrial combustion is normally 10% higher than that of coal. The efficiency of natural gas-based combined cooling, heat and power (CCHP) plant is nearly 2 times higher than that of coal-fired power generation. However, the CO_2 emission from gas is merely 59% of coal and 72% of fuel oil. The sulfur dioxide emission concentration of large gas-steam combined cycle unit is almost zero. The sulfur dioxide emission of industrial boiler is 17% of coal and 25% of fuel oil. Nitrogen oxide emission from large gas-steam combined cycle unit is 73% of ultra-low emission coal power unit and 20% of coal from industrial boiler. At the same time, compared with coal and fuel oil, natural gas has no dust emissions.

(4) The project will largely contribute to the interconnection of natural gas networks in Beijing-Tianjin-Hebei region and the whole country

According to statistics, the total length of the national natural gas pipeline reached 68,000 kilometers as of the end of 2017. The total gas transmission capacity was about 290 billion cubic meters per year, with key corridors that runs through the whole country and connects abroad, namely including the West-East Gas Transmission System, Shaanxi-Beijing System, Sichuan-East Gas Transmission System, and Southwest Pipeline network. However, due to the different ownership of natural gas pipelines and bad connections for regional network, so far the pipelines are not completely interconnected. This makes it difficult to secure supply for peak demand in critical moments.

In addition, most China's LNG receiving stations only supply gas for nearby regions, and only a small amount of gas is left for the national network system. Also the coastal transmission route has not yet formed. If the two pipelines can be used in parallel, they can complement each other to cover supply shortage from physical malfunctions. This can largely help secure gas for downstream users and thus enhanc pipeline emergency support capability.

3.2 Route and site selction analysis

In the process of site selection, according to the opinions of the government departments such as the Land and Resources Bureau and the Planning Bureau, combined with the detailed site survey and the existing pipelines, the pipeline routing and the site selection of the station has been fully demonstrated. This evaluation analyzes the rationality of routing from the macro-route of the pipeline and the route involving sensitive sections, and conducts feasibility analysis of the station site selection.

3.2.1Pipeline routing macro-comparison

There are 3 macro-comparison schemes, namely the west line, the mid-line and the east line plan:

West Line: The pipeline is in parallel with Sinopec LNG Pipeline in Tianjin Binhai New Area; and then it goes to the South. In Ganzhou, Huanghua city, it is in parallel with CNOOC Mengxi Coal Gas Pipeline to Caigongzhuang Town, Jinghai District, Tianjin; Afterwards, it then parallels with the Gangqing Third Line and enter Langfang City, Hebei Province. Then it turns to the north to the Chengnan Terminal. The total length of the pipeline is about 281km;

Mid-line: The pipeline is in parallel with Sinopec LNG Pipeline, Gangqing Line, Gangqing Double Line and Gangqing Third Line in Tianjin Binhai New Area. After crossing the Duliujian River Country Park, it will continue to be laid in parallel with Sinopec LNG Pipeline and Gangqing Third Line. In Yongqing County, Langfang City. After crossing the Yongding River in the northwest direction, it enters the Guangyang District of Langfang City, and then goes to the South Terminal in parallel with the G3 Jingtai Expressway. The total length of the pipeline is about 229km;

East Line: The pipeline route passes through Tianjin Binhai New Area-Ninghe County-Baoyu District-Wuqing District-Langfang Guangyang District-Beijing Daxing District to avoid the nature reserves in Tianjin and Huangzhou City. The total length of the pipeline is about 227km.

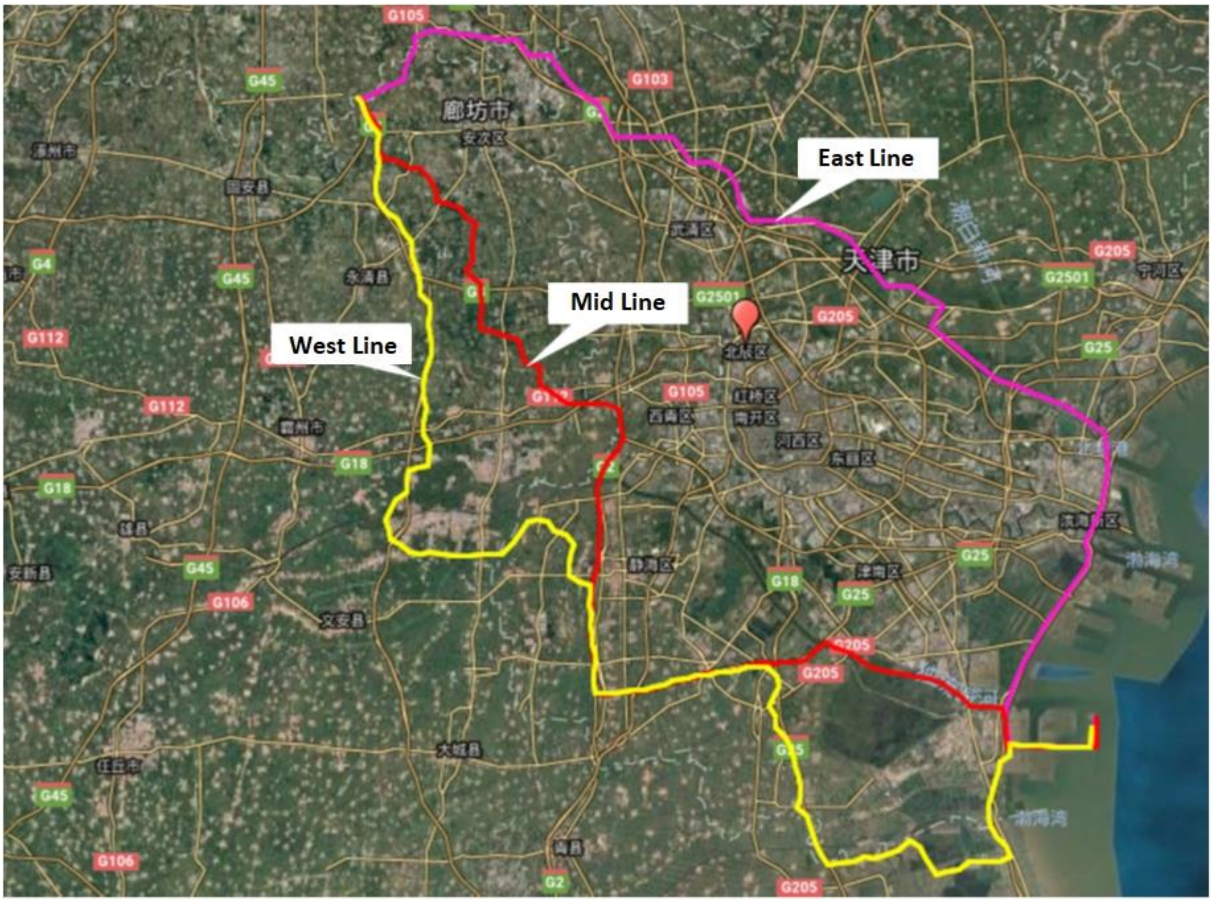


Figure 3.2-1 Pipeline comparison scheme

1) Route description

(1) West Line:

The West Line scheme is the recommended route for pre-feasibility study of the project. After exiting the first station of the receiving terminal, the pipeline will be connected to the Sinopec LNG pipeline in Tianjin Binhai New Area.

After exiting the Nangang Industrial Zone, it will enter the Huanghua City of Cangzhou City, In Huanghua City, it is laid in parallel with the CNOOC Mengxi coal gas pipeline to Caigongzhuang Town, Jinghai District, Tianjin. The route is generally U-shaped; In Jinghai District, it entered the vicinity of the Langya Expressway in Bazhou, Langfang City, Hebei Province in parallel with the Gangqing Third Line. Afterwards, it will be laid north along the Langyao Expressway to the Chengnan Terminal of Daxing District, Beijing. The pipeline runs through Tianjin Binhai New Area, Huangpu City, Cangzhou City, Hebei Province, Jinghai District, Tianjin, Wen'an County, Bazhou City, Hebei Province, Yongqing County, Guangyang District, Daxing District, Beijing, a total of 3 provinces/municipalities 8 County area. The line length is approximately 281km. The routing scheme considers interconnection with Sinopec LNG pipeline and PetroChina Shaanxi-Beijing pipeline.

Along the pipeline, the land is dominated by fish (water) ponds and plain drylands. The pipeline can rely on the roads such as G25 National Highway, S60 Binshi Expressway, G202 Beijing-Shanghai Expressway, Langya Expressway, G18 Rongwu Expressway, G3 Jingtai Expressway, S371 Provincial Highway, S273 Provincial Highway, and other national and provincial trunk roads. The roads at the township level and below are staggered, the population density is low, and the transportation and social support conditions are good.

The scheme includes large and medium-sized river crossings such as Yongding River, Beipai River, Ziyaxin River, and Jiedi River. The pipelines in Huanghua City, Cangzhou City pass through contiguous saline-alkali ponds, and the maximum crossing length of a single pond is bout 4 kilometers.

(2) Mid-line:

After the first stop from the LNG receiving terminal, the pipeline will be paralleled by several natural gas pipelines such as LNG Pipeline, Gangqing Line, Gangqing Double Line and Gangqing Third Line in Tianjin Binhai New Area. After crossing the Duliu River Country Park, it will continue to be laid in parallel with Sinopec LNG Pipeline, Gangqing Double Line and Gangqing Third Line, and then enter the Jinghai District of Tianjin. The pipeline will be separated from the Gangqing Line and the Gangqqing Line in Jinghai District, but it will be still laid in parallel with Sinopec LNG Pipeline and Gangqing Third Line. It will enter the Guangyang District of Langfang City after crossing the Yongding River in the northwest direction along the county boundary in Yongqing County, Langfang City. After that, it will go north to the Chengnan terminal with the G3 Jingtai Expressway. The pipeline passes through Tianjin Binhai New Area, Jinghai District, Xiqing District, Wuqing District, Yongqing County, Anci District, Guangyang District, Langfang City, Hebei Province, Daxing District, Beijing, a total of 3 provinces/municipalities, 8 counties, pipelines The total length is about 229km. The routing scheme considers interconnection with Sinopec LNG Pipeline, CNOOC Mengxi Coal Gas Pipeline, and CNPC Sino-Russian East Line Natural Gas Pipeline.

The land along the pipeline is dominated by plain dry land and sporadic distribution of small fish (water) ponds. The pipeline can rely on the roads such as G25 National Highway, S60 Binshi Expressway, G202 Beijing-Shanghai Expressway, Langya Expressway, G18 Rongwu Expressway, G3 Jingtai Expressway, S371 Provincial Highway, S272 Provincial Highway, S273 Provincial Highway and other high-speed and national and provincial trunk roads. The roads at the township level and below are staggered, the population density is low, and the transportation and social support conditions are good.

The scheme involves a large and medium-sized river crossing (directional drilling through the Duliujian River, Yongding River, Daqing River, etc.).

(3) East Line:

After the pipeline exits from the first station, it will be in parallel with the Sinopec LNG pipeline in Tianjin Binhai New Area; it will be laid north along the S11 provincial road on the east side of the Duliujian River Country Park. In the northwest direction near Xingang No. 8 Road, the pipeline passes through the S30 Beijing-Tianjin Expressway through the Dongli District, Beichen District and Wuqing District of Tianjin, then folds to the west, and lays along the junction of Guangyang District of Langfang, Hebei Province and Daxing District of Beijing to the Chengnan terminal. The pipeline runs through Tianjin Binhai New Area, Dongli District, Beichen District, Wuqing District, Guangyang District of Langfang City, Hebei Province, and Daxing District of Beijing. It has a total of 3 provinces/municipalities in 6 counties and districts with a total length of 227km. The routing scheme considers interconnection with CNPC's Sino-Russian East Line natural gas pipeline.

The land along the pipeline is dominated by fish (water) ponds and plain drylands. The pipeline can rely on the roads such as S11 Haibin Expressway, S50 Jinjin Expressway, S105 Tianjin Avenue, S215 Provincial Road, S204 Provincial Road, S30 Beijing-Tianjin Expressway, S103 Jinhan Highway, S231 Provincial Highway, S323 Provincial Highway, etc. The roads at the township level and below are staggered, the population density is high, and the transportation and social support conditions are good.

There are large and medium-sized waters along the route including Haihe River, Huabei River, Yongding New River, Beitang Sewage River, Jintang Canal, Longfeng River and North Canal and in total 11. In addition, the scheme will cross the continuous reservoir.

2) Natural geographical condition

(1) topography, landform and surface vegetation

There are not much different of the topography and surface vegetation distribution among the three schemes. The landforms are dominated by plains and water networks, and the surface vegetation is mainly corn, rice and woodland.

Water network: mainly distributed in Tianjin Binhai New Area, Jinghai District, Dongli District and Huanghua City, Cangzhou City, Hebei Province. It is a continuous water (fish) pond with a grid-like distribution, and the water depth along the line is about 1.0m~1.5m. The deepest part is about 2.00m, and the thickness of the underwater mucky silty clay is about 0.5m~1.0m.

Plain: It can be subdivided into two types. One is formed by land reclamation. Most of the surface has been leveled. Locally distributed pits, puddles and mounds are scattered. In some areas, there are gravel distribution, mostly wasteland. It is mainly distributed around the Nangang Industrial Zone in Tianjin Binhai New Area; the other is the alluvial plain, mainly distributed in Tianjin, Hebei Province and Beijing. The terrain is slightly undulating, with local ditches and water (fish) ponds. Vegetation development along the line is mainly based on forest land and cultivated land. The groundwater depth is about 1.00m~1.50m, and the seasonal variation is about 0.50m~1.00m.

(2) Engineering geological conditions

There are no big differences of the engineering geological conditions among the three schemes. The water network area is mainly composed of silt and mucky silty clay. The plain area is mainly composed of silty clay, silt, silty sand and artificial filled soil.

(3) Meteorological conditions

The three routes are basically the same in latitude and longitude, and the climate is not much different. They belong to the eastern monsoon region, and the warm temperate coastal semi-humid continental monsoon climate. They have certain marine climatic characteristics, four distinct seasons, moderate heat and cold, long winter and summer, short spring and autumn. The winter is cold and dry, the spring is dry and rainy, the summer is hot and rainy, and the autumn is warm and change.

3) Environmentally sensitive areas, town planning areas, mining areas, etc.

(1) Environmentally sensitive areas

After preliminary investigation, the west-line will route through the ecological red line areas such as Beipai River, Ziyaxin River, Jiedi River, Guanyangchang Reservoir and Nandagang Ecological Wetland; the mid-line plan will cross the Beidagang Wetland Biodiversity to maintain the ecological protection red line. The east-line plan will not cross the ecological red line area.

(2) Situation of urban planning areas along the line

According to the previous research, there are no urban planning area within the region where the west-line and the mid-line will go through. The east-line plan needs to cross the Tianjin town planning area, where the population is dense.

(3) Mineral crushing along the line

After on-site investigation, preliminary judgments, the three schemes do not involve the situation of mineral overmolding.

4) Difficulties in construction and special construction sites

Common problems of the three schemes: After the pipeline exits from the first station of the receiving terminal, it is laid in parallel along the established Sinopec LNG pipeline in Tianjin Nangang Industrial Zone for about 19km. Due to the constraintion of space, construction measures must be taken to protect the built pipeline; Due to the high groundwater level, special construction methods such as precipitation, stabilization and support are needed. In addition, the construction difficulties and special sections of each of the three schemes include:

West Line Scheme: It takes about 21km to cross the water area of Beidagang Wetland Reserve and Nandagang Wetland Reserve. It contains several large continuous ponds. The maximum length of a single pond is more than 4 kilometers. It needs to adopt precipitation and stability. Special construction methods such as pipe and support, the roads in the local sections are poorly supported and the construction is difficult.

Mid-line plan: When crossing the Duliu River Country Park, it will be laid in parallel with a number of in-service natural gas pipelines. The space in the east and west of the park will be tight. For the first part of the local space, a plan should be made during construction to avoid damage to the built pipeline; Consider the impact of water flow flushing on the pipeline during the flood season of Duliujian River, and the pipeline should adopt anti-scouring and steady-tube construction measures.

Eastern route plan: Pipeline route crosses Tianjin urban and rural planning area, with large demolition and high difficulty in demolition; and a large number of high-speed highways or provincial highways or high-speed laying along the line, special construction methods such as directional drilling are required.

5) Traffic and social support

The three schemes are all economically developed plain areas. There are many high-speed, national highways, provincial highways and pipelines in parallel or intersecting. The county and township highways are also criss-crossed, and the traffic support is good, with little difference.

6) Opinions of local government departments

According to on-site reconnaissance and integration with relevant local departments, the east line plan involves urban-rural planning area crossing, where the housing and population are intensive. Thus local governments do not agree with the routing plan; the west line plan and the mid-line plan involve environmental sensitive area crossing, among which The western route involves many eco-red line crossings such as Beipai River, Ziyaxinhe River, Jiedi River, Guanyangchang Reservoir and Nandagang Ecological Wetland. The local environmental protection bureau does not recommend this route; the mid-line scheme will cross the Beidaogang wetland ecology. The red line requires special environmental assessment and flood control evaluation.

7) Pipeline safety operation management

From the aspect of safe operation management of pipelines, the west line scheme is located outside the township planning area, but involves long-distance pond crossing, which is inconvenient for pipeline operation and maintenance; the east line scheme involves the crossing of densely populated areas, which poses hidden dangers to the pipeline's ontology safety; The mid-line scheme is located outside the township planning area and has convenient transportation to facilitate the safe operation and management of the pipeline.

8) Main civil engineering quantities and advantages and disadvantages of each route

The main civil engineering quantities and advantages and disadvantages of each scheme are shown in the table below.

Table 3.2-1 Comparison of main quantities of route plan

Sequence number	Project			East Line Scheme	Midline scheme	Western route scheme	Contrast results
1	Pipe length	Total length of line (km)		227	229	281	East Line Scheme Excellent
		By geomorphology	Plain (km)	196	180.8	210	Midline scheme
			Water network (km)	31	48.2	71	East Line Scheme Excellent
2	Span across	Rail (M/S)		780 / 9	780 / 9	780 / 9	Quite
		High Grade Highway (M/F)		2980 / 34	2080/ 26	3620 / 41	Midline scheme
		Large water crossing (m/a)		12500 / 11	1550 / 2	1800 / 2	Midline scheme
		Medium water crossing (m/a)		3400 / 5	2050/ 3	1100 / 2	Western route scheme
3	Length of Difficult Section (km)			66.8	47.7	70.3	Midline scheme
4	Length of National and Provincial Nature Reserves Passed (km)			18	30	37	East Line Scheme Excellent
5	Crossing environment sensitive area condition			Crossing the Northern Canal, Yongding New River and other Tianjin ecological red lines	Crossing the Yangtze River and High Speed Forest Belt and other Permanent Protected Ecological Areas and the North Dagang Wetland Nature Reserve	Cross the ecological red line areas such as Beipiao River, Ziyexin River, , Guanyangchang Reservoir and Nandaigang Ecological Wetland	Crossing sensitive areas such as ecological red lines
6	Road engineering	Construction road (km)	New	70.2	73.52	87.2	East Line Scheme Excellent
			Alteration and expansion	24.9	25.0	30.9	East Line Scheme Excellent
7	Earthwork	Earthwork section (km)		159	229	197	East Line Scheme Excellent
		Earthwork (104 m3)		450	439.9	1467	Midline scheme

Sequence number	Project		East Line Scheme	Midline scheme	Western route scheme	Contrast results
8	Hydraulic protection	Masonry Protection (104 m3)	7.5	6.8	10	Midline scheme
9	Occupied land	Permanent land requisition (M2)	5972	5927	7138	Midline scheme
		Temporary footprint (104 M2)	672	618	832	Midline scheme
10	Important compensation	Relocation Compensation (104 M2)	18.1	4.2	22.83	East Line Scheme Excellent
		Compensation for Green Seedlings (104 M2)	68	77	60	East Line Scheme Excellent
		Compensation for fruit trees (104 m2)	18	16	15	Western route scheme

Table 3.2-2 Comparison of main advantages and disadvantages of route plan

Advantages and disadvantages	Western route scheme	Midline scheme	East Line Scheme
Advantage	The transportation is developed, which is convenient for construction entry and operation maintenance. The population density along the lines is the lowest in the three programmes and the removal amount along the lines is small.	Short circuit length and low investment ; The transportation is developed, which is convenient for construction entry and operation maintenance. Many parallel pipelines have been built on the whole line, forming a corridor, the difficulty of approval is small ; The information of the planning area, sensitive area and mining area along the line can be used for reference. Station yard, valve room, etc. can be built together with already built pipeline, convenient joint operation.	Short circuit length and low investment ; The transportation is developed, which is convenient for construction entry and operation maintenance. Less environmental sensitive points are passed along the line and less difficult sections are constructed.
Defect	The longest line length and high investment ; Through Yongqing County Planning District, Langfang Linkong Economic Zone and residential resettlement area, the route is limited ; Local space is limited, the construction of the water network section along the line and the high underground water level section need to take measures to ensure the safety of the existing pipeline,	The parallel pipeline section is limited by space, which makes the construction difficult. The ecological red line across the wetland in Beida Harbor needs to be evaluated and coordinated. The local space is limited, and corresponding measures should be taken during the construction of the water network section along the line and the high underground water level section.	Crossing the urban and rural planning area of Binhai New Area, the removal amount is large and the coordination difficulty is high, which is not conducive to maintaining the integrity of urban planning ; Some sections have not been built in parallel, and coordination work has increased.

Advantages and disadvantages	Western route scheme	Midline scheme	East Line Scheme
	the construction is difficult ; The number of sensitive points crossing the border is large and the environmental impact is great.		

9) Recommended scheme

Through the comparison, considering the various influencing factors, the natural conditions, town planning areas and mining areas along the three schemes are basically the same.

The length of the east-line scheme is short, but the pipeline crosses the urban planning area and has a high population density, which is not conducive to maintaining the planning integrity of the city and the safe operation of the pipeline;

The west-line has passed through many ecological red line areas such as Beipai River, Ziyaxin River, Jiedi River, Nandagang Reservoir and Li Ertan Wetland, and it is difficult to apply for approval. The maximum crossing length of a single pond is more than 4 kilometers. The construction difficulty is high;

The mid-line scheme is recommended by the Tianjin Planning Institute. The local government departments initially agree on the routing direction, and the length of the line is short, which is convenient for joint operations.

Based on the above factors, the mid-line plan is recommended.

3.2.2 Recommended Routing Parallel with Other Pipes

The pipelines of this project are in line with the established pipelines. Therefore, in accordance with the requirements of the design standards, in order to make full use of the results and existing facilities of the in-service pipelines, the pipeline of this project is laid in parallel with several in-service pipelines in different administrative divisions. This is convenient for management, and can reduce the initial investment and construction difficulty, and save investment. The pipeline of this project is laid in parallel with Sinopec LNG Pipeline, Mengxi Coal Gas and Gangqing Third Line in Tianjin Binhai New Area, Jinghai District, Xiqing District, Wuqing District, and in parallel with Sino-Russian East of Langfang City.

Line and Mengxi coal gas in Yongqing County, Anci District. The total length of 187km in parallel, accounting for about 82% of the total length of the pipeline.

Table 3.2-3 Concurrency of the Works to Other Existing Pipelines

S.N	Administrative divisions	Parallel range	Length (km)	Parallel active pipeline
1	Binhai New Area	Receiving Station First Station-No.2 Valve Room	57	Sinopec LNG Pipeline, Gangqing Third Line
2	Binhai New Area, Jinghai District	Valve Room #2-Valve Room 4	65	Sinopec LNG Pipeline, Gangqing Third Line, Monxi Coal Gas Production
3	Jinghai District, Xiqing District, Wuqing District	Valve Room No.4-Jinji Boundary	33	Sinopec LNG Pipeline
4	Yongqing County	Yongqing Anjie Yongqing Branch Transportation Station	10	Sino-Russian eastern Line
5	Anci District	Yongqing Transfer Station-Anji Transfer Station	22	Muncy coal gasification
	Total		187	

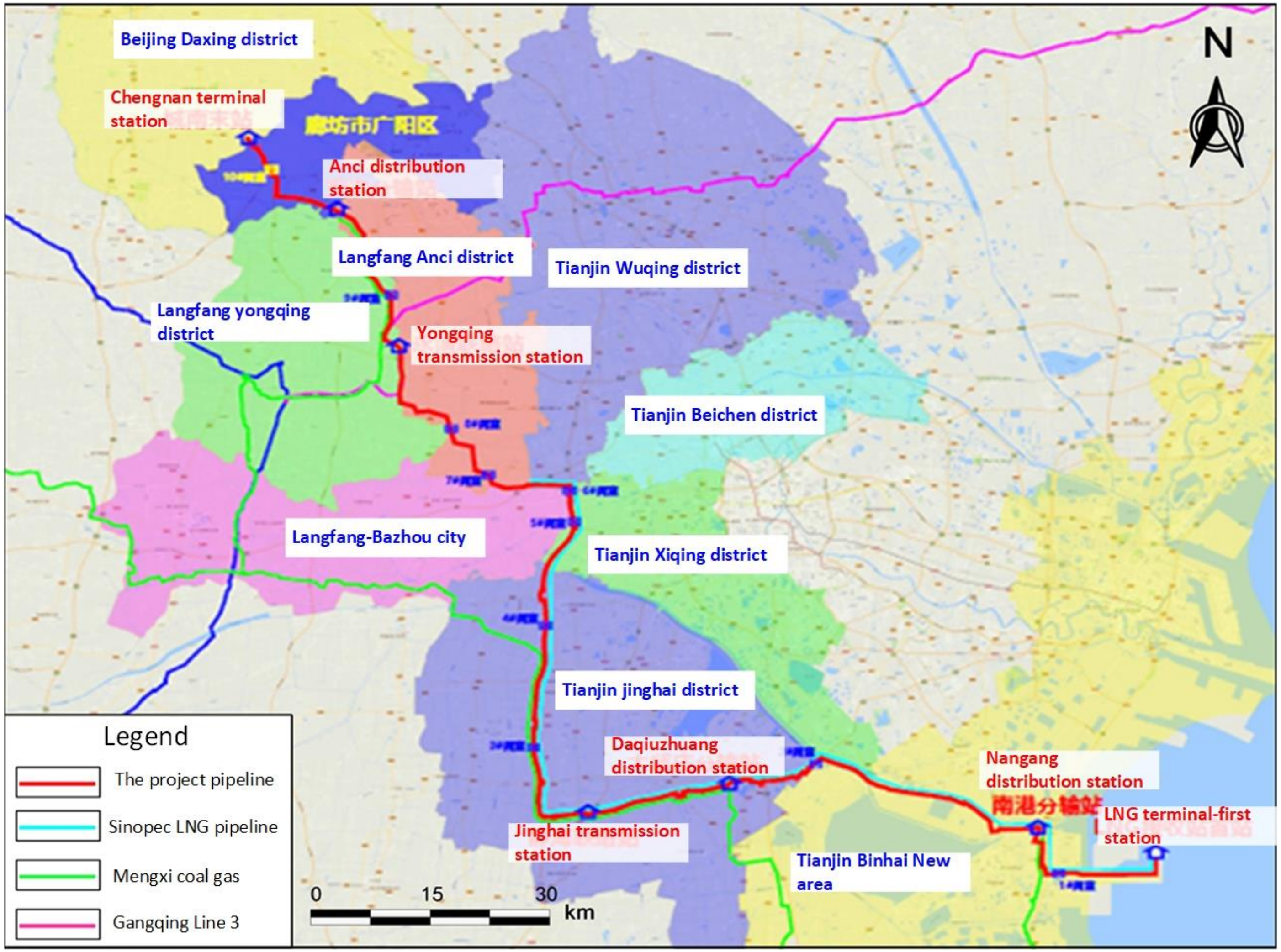


Figure 3.2-2 Parallel diagram of this project with other pipelines

3.2.3 Feasibility analysis of pipeline routing through environmentally sensitive areas

3.2.3.1 Macro-route selection of Tianjin Beidagang Wetland Nature Reserve section

In order to fully demonstrate the pipeline routing across the Beidagang Wetland Nature Reserve section, a large number of optimization and comparison was carried out on the route selection of this section. A total of four macro routing schemes were selected for the comparison, among which scheme 1, scheme 2 and scheme 3 are completely passing round the Tianjin Beidagang Wetland Nature Reserve. However, they will go through densely populated areas. There are frequent people and traffic, and many buildings, which are the factors affecting pipeline safety. The pipeline operation has potential risks to personnel safety. For scheme 4, there are obvious advantages in the gas supply market, the feasibility of pipeline construction and support conditions, environmental risks and social stability such as demolition, pipeline operation risks, engineering investment and economic. The line routing comparison scheme is shown in the figure below.

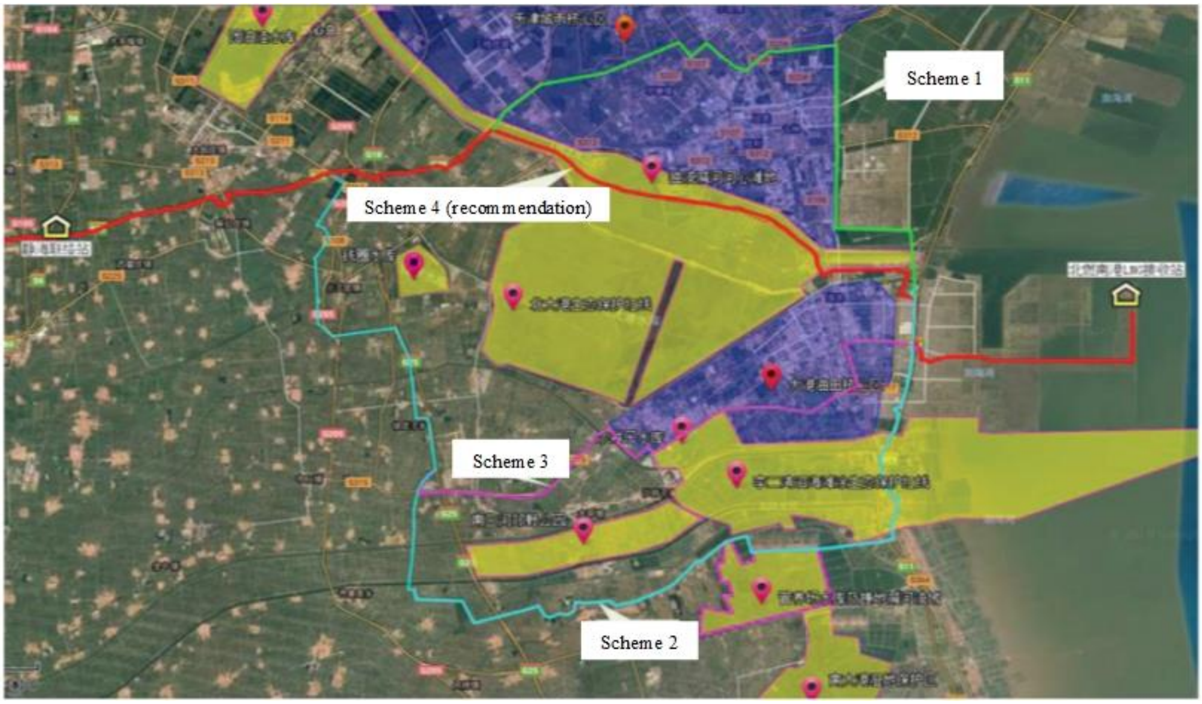


Figure 3.2-3 The route comparison diagram of the project in the wetland protection section of Beidagang

1) Description of the scheme

(1) Scheme 1

Although the scheme completely avoids the Beidagang Wetland Nature Reserve, the high-impact areas along the line are densely distributed and the regional level is high. The urban development status does not allow the passage of high-pressure long-distance pipelines.

Due to the dense population, the risk of pipeline failure is high. Accidents will result in more serious casualties; at the same time, the probability of third-party damage along the pipeline will increase, leading to an increase in the probability of pipeline failure; In addition, the passage of pipelines from developed regions will be detrimental to the development of cities, which will impose certain restrictions on urban planning and increase the amount of demolition projects along the route. Therefore, as the scheme passes through the commercial developed areas, the flow of people and traffic is frequent, the buildings are numerous, and the municipal supporting facilities in the green belt of the trunk road are densely covered. The pipelines in the area are difficult to operate and maintain, and there are various factors affecting pipeline safety. The risk is greater. Therefore, this scheme is not operational.

(2) Scheme 2

The Beidagang Wetland Nature Reserve has reserved a north-south construction corridor along the S11 coastal high-speed center in the buffer zone, which is about 600m wide. However, at present, the corridor has been occupied by oilfield gathering pipelines, Mengxi coal gas, urban high-pressure pipelines, power cables, photovoltaic power plants, private houses, planned highways and planned Bohai Intercity Railways. There is no space for pipelines. In addition, the routing scheme has various landforms along the line, and the continuous large-area waters traverse more, and the local part passes through the edge of the continuously distributed villages, mainly in the third-level and fourth-level areas, with a high population density and high distribution of high-impact areas. While increasing the probability of pipeline failure, the pipeline operation has a potential risk to personnel safety, which increases the operational risk of the pipeline to a certain extent, and is not conducive to the planning and later development of villages along the line. Therefore, this scheme is also difficult to implement.

(3) Scheme 3

Although the scheme completely avoided the Beidagang Wetland Nature Reserve, the pipeline inevitably passed through the core area of Dagang Oilfield, with dense gathering and transportation pipelines, many industrial facilities, and large compensation for house demolition. All these factors which are not conducive to social stability. The section of the pipeline passing through the southern edge of the core area of Dagang Oilfield is the planning area of Dagang Oilfield, and the planning department does not agree that the pipeline will pass. In addition, in densely populated areas, pipeline operations have a high potential risk to personnel safety, and limited space available along the line. The current state of urban construction does not allow large-caliber high-pressure pipelines to pass. Therefore, the scheme is also not practically reliable.

(4) Scheme 4

Scheme 4 is a route that crosses the Beidagang Wetland Nature Reserve. The route passes through the corridor where the high-pressure pipeline has been formed in the experimental area of the protected area. It is parallel with a number of established oil and gas pipelines, and the terrain is simple. The species is sparsely populated, and the regional level is dominated by the first-level region. Compared with other schemes, the advantages of Scheme 4 are obvious. The use of existing high-pressure pipeline corridors greatly reduces the impact on the future planning of the adopted area, with the shortest line length, reducing land use and environmental disturbances; The pipeline is sparsely populated, there is no high-impact area, and the pipeline risk level is low; the human activities and mechanical construction around the pipeline are less, which is conducive to the safe operation of the pipeline.

In summary, Scheme 4 has obvious advantages in responding to pipeline construction objectives, strengthening space utilization, maintaining social stability, reducing operational risk and economic optimization, and is the optimal solution.

Table 3.2-4 Routing comparison of pipeline crossing through the wetland protection section of Beidaigang

Comparison content	Scenario One	Scenario II	Scenario Three	Scenario Four
Gas supply market	Distribution of Pipe Road Routing According to Target Market and Intake Point	The pipeline bypasses to Huangqin City, Cangzhou City, the passing area is not in conformity with the planned distribution market direction of the project	The pipeline bypasses the south side of Dagang Oilfield, and the passing area is not in conformity with the planned distribution market direction of the project	Distribution of Pipe Road Routing According to Target Market and Receiving Point
Feasibility and Supporting Condition of Pipeline Construction	The pipeline passes through the developed area of the city, without the high pressure pipeline corridor as the backing, the area grade is high, disadvantageous to the	Pipeline parallel to CNOOC Mengxi coal gas pipeline, but from the buffer zone through the gap, dense structures, no access space	The pipeline runs parallel to the Jinhua line, but the area along the line is of high grade, the buildings are dense and there is	The use of the formed pipeline corridor, parallel laying with multiple pipelines, has no impact on the planning, less land use

	city planning		no passage space	
Environmental risk and social stability such as demolition and demolition	Along the densely populated, large removal, not conducive to social stability	Along the densely populated, large removal, not conducive to social stability	Along the densely populated, large removal, not conducive to social stability	No human habitation along the line Housing, no demolition. High consequence area
Pipeline operation risk	High regional level, the probability of pipeline damage by third party increased ; High population density, serious consequences of pipeline failure and high overall risk	High regional level, the probability of pipeline damage by third party increased ; High population density, serious consequences of pipeline failure and high overall risk	High regional level, the probability of pipeline damage by third party increased ; High population density, serious consequences of pipeline failure and high overall risk	Low regional level, the probability of pipeline damage by third party is lower ; Low population density, low pipeline failure, low overall risk
Engineering Investment and Economic Analysis	Line length approximately With 66.8 km, the removal volume is large, the number of highway crossings is large, and the total cost is high	The length of the line is about 91.7 km, the continuous water section passes through much, the construction is difficult and the overall cost is high	The length of the line is about 74.1 km, the oil field gathering and conveying pipeline is dense, the construction is difficult and the overall cost is high	The length of the line is about 51.6 km, the length of the line is the shortest, the topography is simple, the crossing project is few, the construction difficulty is low, the total cost is low
Comparison result				Recommendation scheme

3.2.3.2 Crossing route selection of the section of Tianjin Beidagang Wetland Nature Reserve

According to the macro-route comparison results of the Beidagang Wetland Nature Reserve section, the pipeline of this project cannot avoid crossing the Beidagang Wetland Nature Reserve. Therefore, the route route through the Beidagang Wetland Nature Reserve is again selected.

1) Routing direction description

Restricted by the Tianjin urban area and the Dagang oil construction plan, the project is routed in the Dinghe River Country Park in the Binhai New Area of Tianjin via the Beidagang Wetland Ecological Red Line. There are two schemes for routing in the Duanjiang River section of Tianjin Binhai New Area, which can be used as a comparison. The routing directions of the two schemes are shown in the following figure.

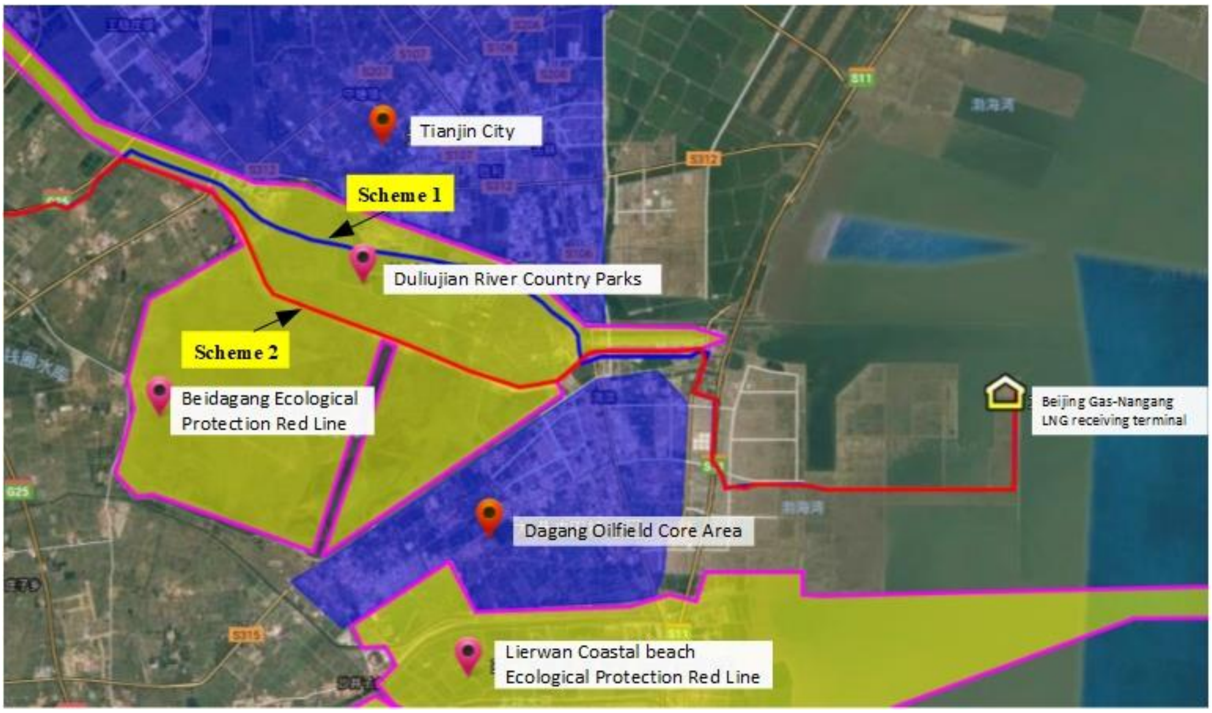


Figure 3.2-4 Tianjin Binhai New Section Routing Comparison Scheme

Scheme 1: Passing through the middle of the Duliu River Country Park, passing through the established oil and gas pipeline pipe corridor, and paralleling the construction of the China Petroleum Port Qingsan Line, Sinopec LNG, and urban high-pressure pipelines; The location of the pipeline and the marked piles are obvious. There is no big change in the buried depth of the pipeline. There is no obvious erosion mark, but the vegetation recovery above the pipeline is not very good. It is also obvious that the construction operation belt has water in some sections. According to the situation of the dike and the river-flat, the scouring of the river is not obvious, and there has not been a large flood in recent years. There are no houses and other buildings in the river-flat.

Scheme 2: The pipeline from the north side of the Duliujian River South Embankment is laid along the dike. The pipeline intersects with the established oilfield gathering pipeline multiple times or in parallel.

(1) Scheme 1

The first pipeline starts from the north side of Tianjin Nangang Industrial Zone. The pipeline is first laid along the south side of the south bank of the river, and then enters the country park inside the eastern end of the Duliu River Country Park. Qingsan Line, Sinopec LNG, and urban high-pressure pipelines were laid in parallel, crossing the Duliu River Country Park; after passing through the Duliu River in the west end of the park, it was laid along the G25 Changshen Expressway. The total length of the pipeline is about 30.2km. The landform along the line is mainly plain and water network landforms, and reservoirs and small rivers are distributed along the line.

There are a number of established pipelines in the Duoli River Country Park passing through the pipeline. The existing pipeline locations and sign piles are more obvious. There is no major change in the buried depth of the pipeline. There is no obvious erosion trace, but the vegetation recovery above the pipeline is not very Well, it is also obvious that the construction work belt has water in some areas. According to the situation of the site dam and the river beach, the scouring of the river is not obvious, and there has not been a large flood in recent years. There are houses and other buildings in the river beach.

Figure 3.2-5 Current status of river flats in the Duliujian river country park

(2) Scheme 2

The scheme 2 pipeline starts at the north side of Tianjin Nangang Industrial Zone, passes through the S217 Haibin Avenue, and is laid west along the river bank of the north side of the river dynasty, and overlaps with the scheme one route near the G25 Changshen Expressway. The total length of the pipeline is about 31.2km. The landform along the line is mainly river beach, and some small reservoirs, rivers and dams are distributed locally.

The riverside beaches on the north side of the rivers have better vegetation coverage in the west, mainly grassland and low-lying trees; there are few vegetations in the east, mainly wasteland, and sporadic new seedlings are distributed. It has repeatedly crossed the Dagang oilfield gathering pipeline and river dam along the route.

Figure 3.2-6 Landform of the north side of the south bank of the river embankment (west)

Figure 3.2-7 Landform the north side of the south bank of the river embankment (east)

2) Environmentally sensitive areas, town planning areas, mining areas, etc.

(1) Environmentally sensitive areas

After preliminary investigation, the routes of both schemes are located in the Beidagang Wetland Nature Reserve, which belongs to the scope of the ecological red line of Beidagang Wetland. According to the requirements of the “Regulations on the Management of Wetlands Protection”, the experimental area should be managed as a nature reserve. According to the "Regulations on the Nature Reserve of the People's Republic of China (Revised in 2017)", "No production facilities shall be built in the core area and buffer zone of the nature reserve. In the experimental area of the nature reserve, no pollution environment or damage shall be built. Production facilities for resources or landscapes; for other projects, the pollutant discharge shall not exceed the national and local standards for pollutant discharge." The construction and operation of long-distance natural gas pipelines does not involve environmental pollution, and the restoration of landforms will be carried out after construction is completed. Vegetation restoration, if necessary, will increase appropriate hydraulic protection and soil and water measures, without causing damage to resources or destruction of landscape production facilities.

(2) Situation of urban planning areas along the line

According to the preliminary investigation, the two schemes have not passed through the urban and rural planning areas.

(3) Mineral crushing along the line

After on-site investigation and preliminary judgment, neither of the two schemes involved mineral crushing.

The environmentally sensitive areas and social constraints involved in the pipeline along the project are shown in the figure below.

Figure 3.2-8 The main environmentally sensitive areas and social constraints of the Beidagang wetland

3) Pipeline crossing situation

Scheme 1: Including the large river crossing 2 times, that is, the river crossing through Duliujian River; the small river crossing 3 times; the pond crossing 5 times; the railway crossing 2 times; the road crossing 4 times; the river embankment road crossing 2 times.

Scheme 2: including large river crossings 3 times; small river crossing 5 times; railway crossing 2 times; road crossing 4 times; river embankment road crossing 2 times.

4) Construction difficulties and special construction areas

The common problems of the two schemes are that some sections along the road need to adopt special construction methods such as precipitation, pipe stabilization and support due to high groundwater level. In addition, the construction difficulties and special locations of the two schemes are as follows :

Scheme 1: The pipeline shall be laid in parallel with several existing pipelines in the Duliujian River Country Park. For local restricted areas, construction measures shall be taken to protect the existing pipelines from damage.

Scheme 2: The pipeline is laid along the south bank of the river. Some areas along the line are tight, and in many places, levees, dikes, artificial ponds and landscape parks have been built along the banks of the Duliujian River. Special construction methods such as pipe jacking and directional drilling are required; In the limited area, the plan should be formulated during construction to avoid damage to the south bank of the river, and take into account the impact of water flow flushing on the pipe along the river bank. The pipe should adopt anti-scouring and steady pipe construction measures.

5) Transport and social support

The two schemes are developed by the nearby road network, with better social support conditions and better traffic conditions.

6) Opinions of local governments

According to the site survey and the opinoins of local governments, both schemes pass through environmentally sensitive areas. One of the schemes will cross the Duliujian river country park and conflicts with the current planned reservoir construction; Scheme 2 will be laid along the north side of the Duliujian River South embankment, and the consent of the local planning department is initially obtained.

7) Management aspects of safe operation of pipelines

From the aspect of pipeline safety operation management, both schemes are located outside the town planning area, and there are relatively few human activities and third party mechanical construction activities along the pipeline. These are conducive to the safe operation of natural gas pipeline ; here are many high-speed roads, railways, etc. along the route of the two schemes, and the transportation is convenient, which facilitates the later management and regular maintenance of the pipeline.

8) Main quantities and advantages and disadvantages of each route scheme

The main engineering quantities and advantages and disadvantages of each trending scheme are shown in the table below.

Table 3.2-5 Table 3.2-5 Comparison of main quantities of the route plan

<table>
<tr><th>S.N</th><th colspan="3">Project</th><th>Scenario One</th><th>Scenario II</th><th>Contrast results</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Pipe length</td><td colspan="2">Full line length (km)</td><td>30.2</td><td>31.2</td><td>Scheme optimum</td></tr>
<tr><td>By geomorphology</td><td>Water network (km)</td><td>30.2</td><td>31.2</td><td>Scheme optimum</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Span across</td><td colspan="2">Rail (M/S)</td><td>160 / 2</td><td>160 / 2</td><td>Quite</td></tr>
<tr><td colspan="2">High Grade Highway (M/F)</td><td>240 / 3</td><td>240 / 3</td><td>Quite</td></tr>
<tr><td colspan="2">Levee Road (M/F)</td><td>160 / 2</td><td>160 / 2</td><td>Quite</td></tr>
<tr><td colspan="2">Large water crossing (m/a)</td><td>1550 / 2</td><td>3600 / 3</td><td>Scheme optimum</td></tr>
<tr><td>3</td><td colspan="3">Length of Difficult Section (km)</td><td>12.4</td><td>26.7</td><td>Scheme optimum</td></tr>
<tr><td>4</td><td colspan="3">Length of National and Provincial Nature Reserves Passed (km)</td><td>30</td><td>30</td><td>Quite</td></tr>
<tr><td></td><td colspan="3">Impact on Wetland Protection Areas</td><td>Along the existing pipe corridor, and in the experimental area of the protected area, the impact on the protected area is small</td><td>There are about 8 km pipeline laying adjacent to the core area boundary of the protected area, which will affect the protected area greatly during the construction period</td><td>Scheme optimum</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Road engineering</td><td rowspan="2">Construction road (km)</td><td>New</td><td>12.8</td><td>12.8</td><td>Quite</td></tr>
<tr><td>Alteration and expansio</td><td>5.6</td><td>5.6</td><td>Quite</td></tr>
</table>

S.N	Project		Scenario One	Scenario II	Contrast results
		n			
6	Earthwork	Earthwork section (km)	30.2	31.2	Scheme optimum
		Earthwork (104 m3)	42	44	Scheme optimum
7	Hydraulic protection	Masonry Protection (104 m3)	0.5	0.5	Quite
8	Occupied land	Permanent land requisition (M2)	660	690	Scheme optimum
		Temporary footprint (104 M2)	130	140	Scheme optimum
9	Important compensatio n	Relocation Compensation (104 M2)	0.6	0.5	Scheme second-best
		Compensation for Green Seedlings (104 M2)	3.7	5.4	Scheme optimum
		Compensation for fruit trees (104 m2)	0.2	0.2	Quite

Table 3.2-6 Comparison of advantages and disadvantages of line comparison schemes

Project	Scheme One	Scheme 2
Advantage	Parallel pipeline has been built, forming a corridor, small impact on the environment ; Along the planning area, sensitive area, mining area and other information can basically use the existing pipeline results ; The road is well supported for construction entry and operation maintenance ; It has little influence on land use and planning in later stage ; There are less human activities and mechanical construction around the pipeline, which is conducive to the safe operation of the pipeline.	The river and other water areas have less crossing and shorter crossing length ; The terrain is flat, the site is wide and the construction difficulty is low ; The road is well supported for construction entry and operation maintenance ; It has little influence on land use and planning in later stage.
Defect	The Duliujian River Country Park is located in the ecological red line of Beidaigang Wetland. The high pressure pipeline built in the middle of the Dugu River Subtraction Country Park may exist in some space restricted areas to increase the difficulty of construction.	Crossing the ecological red line of the wetland in Beida Harbor ; Close to the core area of wetland protection area, the impact on wetland is great. There are many facilities such as river dam and landscape park along the Henan coast, which need special protection measures, and it is difficult to cross. It is more difficult to cross the existing oil collection and transportation pipeline on the Henan coast. During the flood period, the risk of pipeline being washed is high, and measures for protection against scour and stabilization of river banks should be formulated. Being close to the river bank, the water conservancy department shall meet the requirements for its spacing and limit the long-term expansion of the bank ; It has certain influence on the flood discharge port of the river.

Project	Scheme One	Scheme 2
Comparison result	Scheme 1, in the parallel protected area, several pipelines such as the third line of Zhongpetroleum-port, the LNG of Sinopec and the high-pressure pipeline of the town have been laid. Second, laying along the boundary of the core area of the protected area will have a certain negative impact on the life of the protected area during the construction period, which is greater than that of the first plan. Therefore, the environmental impact of the proposed project is considered acceptable from the perspective of environmental protection.	

9) Recommendation

By comparison, the natural conditions, urban planning areas and mining areas along the two schemes are basically the same. Taking into account all the factors mensioned above, it is suggested that the first scheme is the pipeline route of the Duliujian River section in Binhai New Area.

3.2.3.3 Rational Routing Analysis of Tianjin Permanent Protection Ecological Region

The pipeline of this project will pass through the permanently protected ecological area in Tianjin, covering 27 permanent protected ecological areas (including 16 forest belts, 6 river courses, 2 park types, 1 wetland type, 1 lake reservoir type) . The LNG gas pipeline of this project has a distance of 67900 m in the permanently protected ecological area after the overlap is deducted.

1） Basic information of permanent protection ecological area through

The permanent ecological protection areas covered by this project are :

(1) Types of rivers :

Duliujian River: 24128.2 m across the Red Line (17253 m in Beidagang Wetland Nature Reserve) and 3879.6 m in the Yellow Line area. Temporary occupation of the Red Line Area 14.22 Ha (excluding the temporary occupation of the Beidagang Wetland Nature Reserve Section), Yellow Line Area 12.66 Ha.

South Canal: 255.1 m across the red line area and 206.1 m across the yellow line.

Daqinghe River: Through the red line area 484.6 m, yellow line area 260.5 m.

Ziya River: 145.7 m across the red line, 227.4 m across the yellow line area

Middle Route of South-to-North Water Transfer: 122 m across the Red Line ; Crossing the Yellow Line area 300 m, occupying the Yellow Line area 0.1084 Ha permanently (overlaping with the northwest wind-resistant sand forest belt and the Beijing-Shanghai high-speed forest belt), temporarily occupying the Yellow Line area

0.75 Ha.

(2) Reservoir:

Wangqingtuo reservoir: through the red line area 249.4 m, through the yellow line area 200.3 m, temporarily occupied the yellow line area 0.5 ha.

(3) Wetland :

East Diwa: 8510.9 m across the Red Line, covering a permanent area of 0.1687 Ha (Overlapping the northwest wind-resistant sand forest belt and the Jinxi Country Park), temporarily occupying the Red Line Area 21.11 Ha.

(4) Parks :

Duliujian River Country Park: 30734.3 m across the Red Line (17253 m in the nature reserve, not within the scope of this demonstration), permanently occupy the Red Line Area 2.6641 HA, temporarily occupy the Red Line Area 30.21 HA (excluding temporary occupation of the Beidaigang Wetland Nature Reserve).

Jinxi Country Park: 9489.7 m across the Red Line, 0.1687 HA (overlapping with the northwest windbreak Sarin Belt and East Dianwa Wetland) will be permanently occupied, and 23.96 HA will be temporarily occupied.

(5) Forest belts :

Wedge-shaped green space around the city center: 654.2 m across the red line area, temporarily occupy the red line area 0.02 ha.

Wedge green area around the central city: 654.2m across the red line and 0.02ha temporarily occupied the red line.

Northwest wind-resistant sand belt: 21731.7m crossing the red line area, permanently occupying the red line area 0.2751ha (0.1687ha overlaps with Dongdianyu wetland and Jinxi country park, 0.1084ha overlaps with the South-North Water Transfer Middle Line Yellow Line and Beijing-Shanghai Expressway), temporary Occupy the red line area 50.63ha.

Coastal shelterbelt: 3779.9m crossing the red line area and 8.79ha temporarily occupying the red line area.

Baojin high-speed shelterbelt belt: 214.3m across the red line area and 0.48ha temporarily occupied the red line area.

Huangwan Railway Shelterbelt: 63.2m crossing the red line area, temporarily occupying the red line area 0.16ha,

Jinbao high-speed railway shelterbelt: 226.7m crossing the red line area, temporarily occupying 0.57ha of the red line area,

Jinyu high-speed shelterbelt: 232.8m across the red line, temporarily occupying 0.42ha of the red line area,

Jinjin high-speed shelterbelt: crossing the red line area of 243.5m, temporarily occupying the red line area of 0.53ha,

Beijing-Shanghai high-speed shelterbelt: 23786.8m across the red line, permanent land occupation of 0.277ha (0.1084ha overlaps with the northwest wind-resistant sand belt and the north line of the South-North Water Transfer Middle Line), temporarily occupying 60.38ha of the red line area.

Beijing-Shanghai high-speed railway shelterbelt: 345.2m crossing the red line area, temporarily occupying the red line area 0.86ha,

Beijing-Shanghai line shelterbelt: 60.0m crossing the red line area, temporarily occupying the red line area 0.01ha,

Ligang Railway Shelterbelt: 180.3m crossing the red line area, temporarily occupying 0.45ha of the red line area,

Rongwu high-speed protective forest belt: crossing the red line area 741.2m, temporarily occupying the red line area 1.72ha,

Tangjin high-speed shelterbelt: 25710.7m across the red line area, temporarily occupying the red line area 66.09ha,

Plan high-speed shelterbelt: 1297m across the red line area and 2.71ha temporarily occupy the red line area.

Plan railway shelterbelt belt: 97.9m across the red line area and 0.24ha temporarily occupied the red line area.

2) Compliance analysis with the requirements related to the management of permanent protected ecological areas in Tianjin

In accordance with the decision of the Standing Committee of the Tianjin Municipal People's Congress on the approval of the delimitation of the permanent ecological protection area, the ecological red line protection area covered by this project is the first-grade river (Duliujian River, the south canal, the Grand Qinghe

River, the Ziya River), Water transfer river (the central line of the South-to-North Water Transfer Project), the lake reservoir (Beidaigang Reservoir, it belongs to nature reserve but not in the scope of this demonstration), wetland (East Dianwa), country park (Jinxi Country Park and Dugu River Country Park), forest belt (northwest windbreak resistance Sarin belt, coastal shelterbelt and trunk traffic forest belt).

In accordance with the "Resolution of the Standing Committee of the Tianjin Municipal People's Congress on Further Strengthening the Management of the Ecological Region for Permanent Protection", the construction of ecological protection projects, major infrastructure and major livelihood security projects in permanent protection ecological areas shall be carried out by experts from the relevant administrative departments in charge of environmental impact assessment, protection and restoration programs after the approval of the Municipal People's Government.

This project belongs to the gas pipeline project and bears the heavy responsibility of gas supply in the Beijing-Tianjin-Hebei region. It is a major livelihood project that needs to be built. In the design, the principle of avoiding the ecological red line and occupying the ecological red line as little as possible; In the construction, strengthening the protection and restoration of the temporarily occupied forest land and farmland, and adopting comprehensive restoration measures after the completion of the construction. The project as a whole complies with the relevant management regulations for permanent protection of ecological regions.

3) Rationality analysis of routing

This project route is the recommended route after multiple comparisons in the feasibility study stage. This scheme is an optimal routing scheme based on the site survey and research and the opinions of the planning department. The pipeline in the Tianjin section is completely parallel with the Sinopec LNG pipeline and some sections of the parallel Mengxi coal gas pipeline, which can be constructed along the existing pipe corridor to minimize the impact on the ecological environment.

In the process of line selection, the project has reasonably avoided ecologically fragile and sensitive areas. The project pipeline is long (229 km in length and 155 km in Tianjin section). The east-west direction passes through the middle line of the South-to-North Water Transfer Project and the Beijing-Shanghai Expressway. It is laid south along the east side of the Beijing-Shanghai Expressway. After passing the

Binshi Expressway, it will be laid along the south side of the Binshi Expressway. All types of permanently protected ecological areas except for mountain types distributed in the line range, or distributed in north-south or east-west distribution, are inevitably involved.

3.2.3.4 Analysis of rationality of routing of Hebei ecological red line

The project pipeline passes through three districts and counties of Anci District, Yongqing County and Guangyang District in Langfang City, Hebei Province, and passes through the alkali river and Yongding River ecological red line in Guangyang District. According to the eco-red line of the alkali river and Yongding River in Langfang City, the range is east-west and Anyang District and Guangyang District. The pipeline route of the project is generally north-south. Therefore, it is inevitable to cross the ecological red line of Hebei Province. The route optimization is only in Xinglongzhuang South and Dongyuan Housework. In the north of the village, the liquefied drilling method is used to cross the Alkaline River and the Yongding River ecological red line. The ecological red line of the crossing is about 20m. The length of the directional drilling of the project is 600m. The distance between the access points and the river bank is more than 200m. The directional drilling depth is from the river. The bottom of the scouring line is about 10m. The construction of this project has little impact on the eco-red line of the Alkali River and the Yongding River. Therefore, the route recommended by the project to cross the ecological red line of Hebei is feasible.

3.2.3.5 Optimization and Adjustment Analysis of Engineering Through Important Sensitive Area

In the EIA stage, the design of some sections of the feasibility study design route was optimized and adjusted, which reduced the impact of project construction on environmentally sensitive areas. The main optimization adjustments are described below.

1) Optimized adjustment of directional drilling engineering in Ziya River

The original design of the project has a length of about 400m, and its entry and exit points are located in the yellow line area of the permanent protection ecological zone of Ziya River. The length of the directional drill is increased to 600m by the evaluation agency. The soil points are adjusted to the yellow line area to reduce the impact on the permanent protected ecological area of Ziya River. The specific engineering optimization adjustment is shown in the figure below.

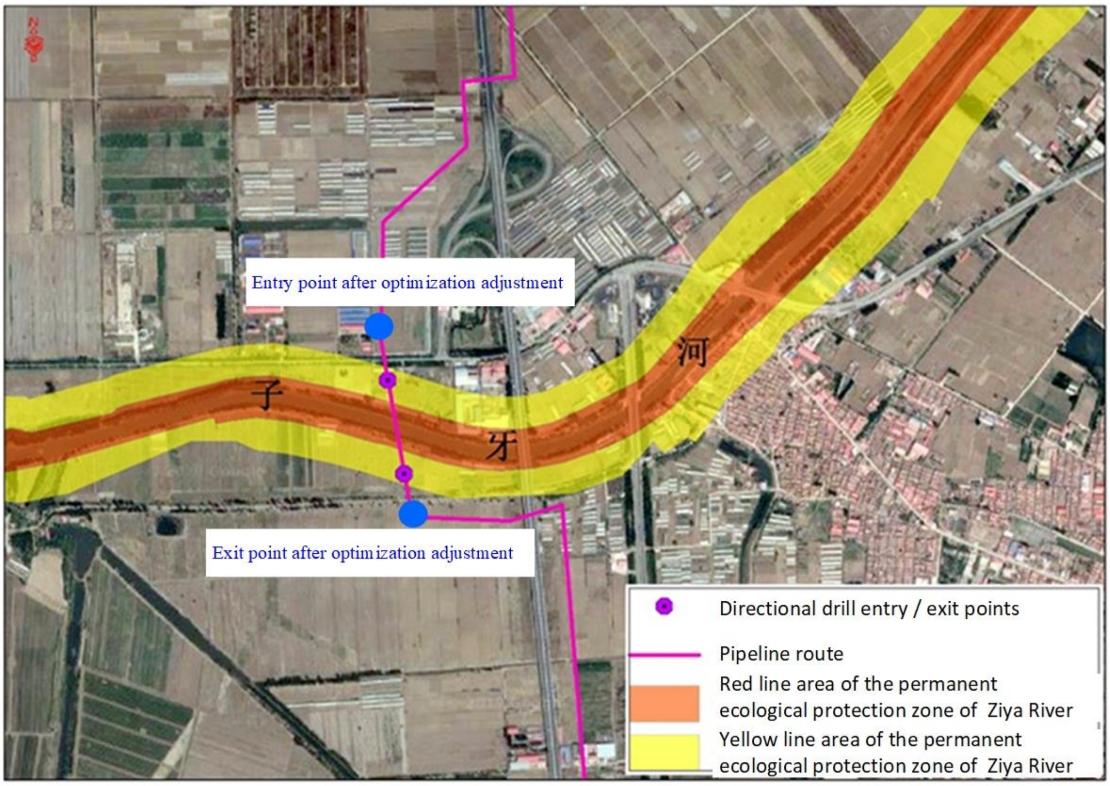


Figure 3.2-9 Optimizing and Adjusting Diagram of Ziya Directional Drilling Project

2) Optimization and Adjustment of Directional Drilling Project in South Canal

The length of directional drilling in the south canal of this project was about 400 m, and its exit points are all located in the yellow line area of the permanent protection ecological area of the south canal. The specific engineering optimization adjustment is shown in the following figure.

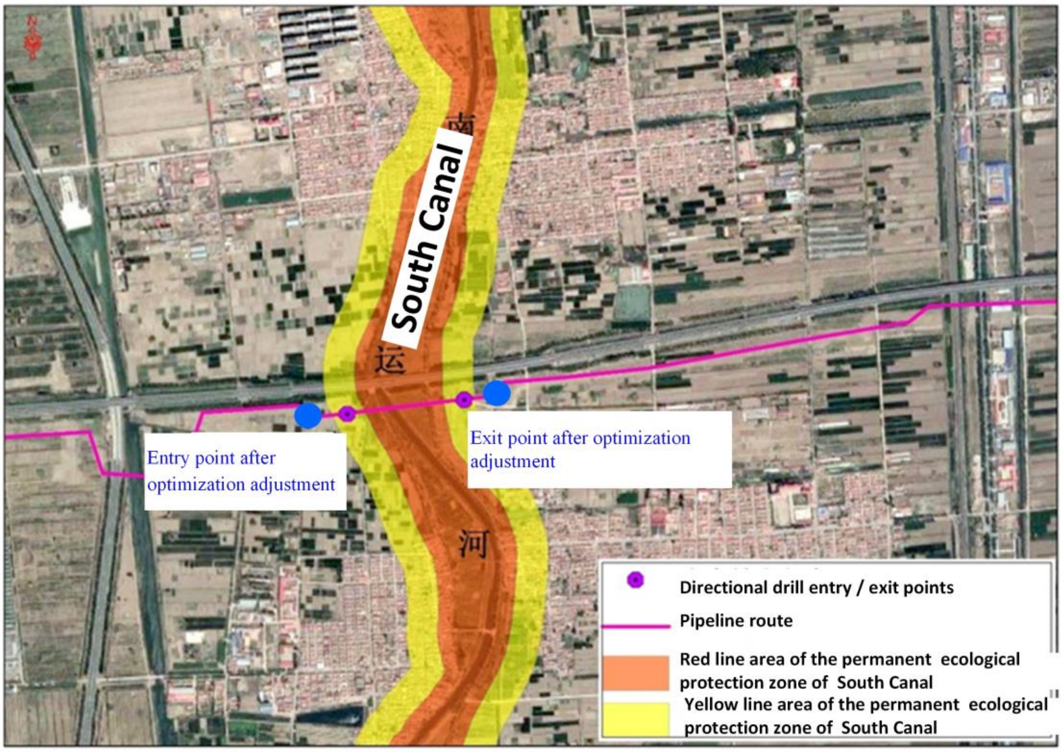


Figure 3.2-10 Optimization and Adjustment of Directional Drilling Project in South Canal

3) Optimization and Adjustment of Directional Drilling Project for Duliujian River

The length of the directional drilling of the project is about 900 m, and the excavated sites are all located in the yellow line area of the permanent ecological protection area of the river . The length of the directional drilling is increased to 1200 m, and the excavated site is adjusted out of the yellow line area to reduce the influence on the permanent ecological area of the Duliujian River. The specific engineering optimization adjustment is shown in the following figure.

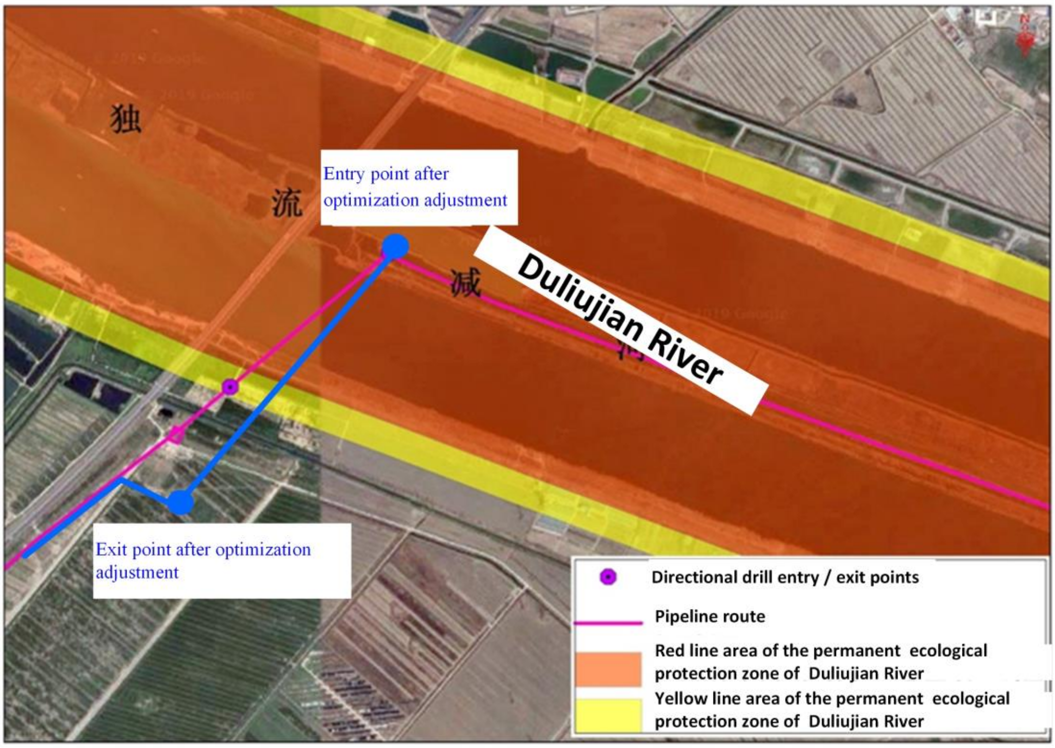


Figure 3.2-11 Optimizing and Adjusting Diagram of Directional Drilling Engineering for Single Flow Reduced River

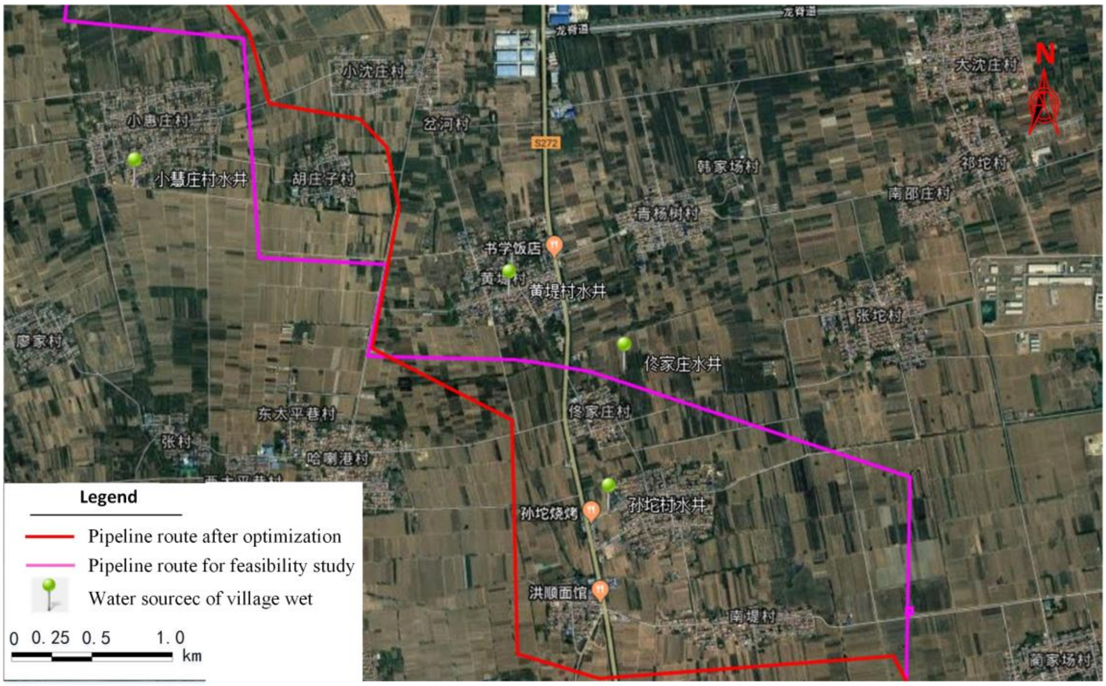


Figure 3.2-12 Optimizing and Adjusting Chart 1 of the Project for the Near Groundwater Source Section

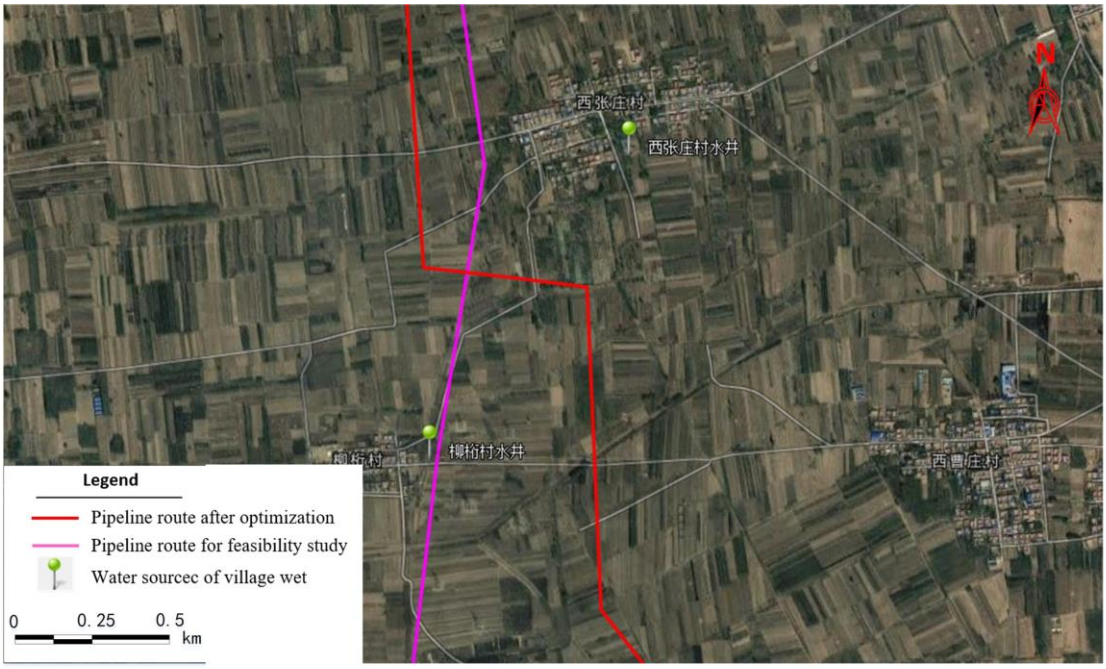


Figure 3.2-13 Optimizing and Adjusting Chart 2 of the Project for the Near Groundwater Source Section

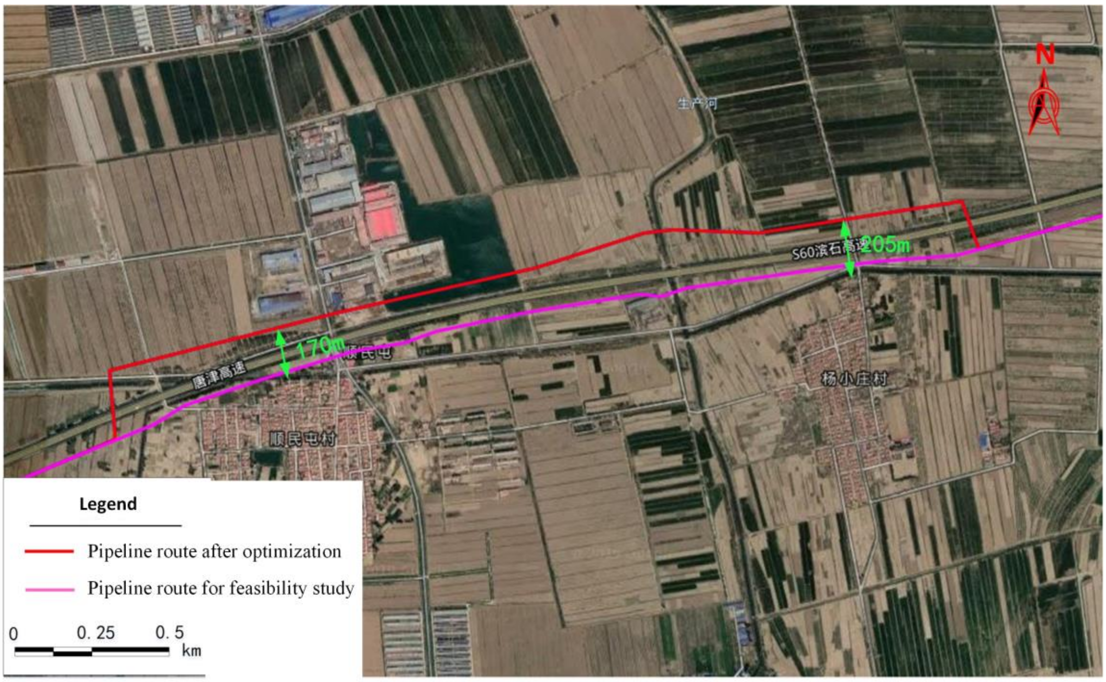


Figure 3.2-14 Optimal adjustment of the project to the village segment at close range

3.2.4Feasibility Analysis of Site Location

3.2.4.1 Site selection principle

1) Site selection Strict implementation of current national regulations and related regulations.

2) Lack of cultivated land and fertile land, making full use of wasteland and inferior land.

3) The site should meet the requirements of route routing, and adapt to the process design process. It should not be placed in sensitive areas such as nature reserves, water source protection areas, and scenic spots.

4) Comply with relevant local urban construction planning and other relevant policies and regulations.

5) Have good social support conditions and safe production environment, and the site should have sufficient environmental capacity.

6) Site selection should minimize the demolition of residential buildings, overhead power lines and communication cables.

7) The site should have suitable topographical and geomorphic conditions, which is convenient for the vertical and rainwater design of the station. It should avoid the areas with bad engineering geology and natural disasters.

8) The site should have sufficient land area and land area that may be expanded.

3.2.4.2 Rational Analysis of Site Location

There are 7 gas transmission stations in the project. The land acquisition of the project site has been approved by the local planning department and is in line with the local urban development plan. The site selected by each station does not involve environmentally sensitive areas such as nature reserves, drinking water source protection areas, scenic spots, etc. According to the acoustic environment. As well as the results of environmental air impact assessment, the stations in the operation period have little impact on the sensitive targets outside the station. From the perspective of environmental protection, the site selection is reasonable.

4 Engineering overview

4.1 Project introduction

The entire pipeline of the project is 229km long, passing through Tianjin, Hebei and Beijing provinces, 8 districts and counties. It starts from the first station of LNG receiving station of Beifang South Port of Tianjin Binhai New Area, and the end point is Chengnan Terminal Station of Daxing District, Beijing. The designed transmission volume is 6000×104Nm3/d, the design pressure is 10Mpa, and the pipe diameter is 1219mm and 1016mm. The project is equipped with 7 process stations and 10 shut-off valve rooms, all of which are monitoring valve rooms. Another reserved room for the valve room is located in Nangang Industrial Park. After the completion of the project, the LNG loading capacity is 170×104t/a, and the maximum gasification external transmission capacity is 6000×104Nm3/d.

Table 4.1-1 List of Site Construction Sites for Send-out pipeline Process Stations

Sequence number	Station yard	Position	Remark
1	Receiving station header	Tianjin Binhai New Area Nangang LNG Terminal	Interworking point with Sinopec LNG to reserve interworking function at receiving station
2	Nangang Transfer Station	Hangzhou Road, Tianjin Binhai New Area, Haiphong Road and the East and South Side of the North Crossing Port Road	Yinbao station
3	Daqiuzhuang Branch Transmission Station	Da Qiu Zhuang Zhen Guan Keng Cun Xi Bei Bei, Jinghai District, Tianjin City	Unattended
4	Jinghai Transmission station	Xi Zhai Zhuang Zhen He Xin Cun Bei Yuan, Jinghai District, Tianjin City	CNOOC Mengxi Coal Preparation Gas Interworking Point and Construction of CNOOC Mengxi Coal Preparation Gas Static Sea Transportation Station
5	Yongqing Transmission station	Bei Gu Zhuang Zhen Nan Ren Ying Cun, Yongqing County, Langfang City, Hebei Province	Interworking point with Sino-Russian East Line, and CY-47# Valve Room of Sino-Russian East Line
6	Anji Transmission Station	Yang Wu Xiang Xiao Ci Cun Xi Qu, Anji District, Langfang City, Hebei Province	
7	Nanami Station	Li Xian Zhen Nei Guan Zhuang Cun Nan Bei, Daxing District, Beijing City	Yin Bao station, and North Fucheng Nangao A station Linjian

Table 4.1-2 List of Site for Line Engineering Construction of this Project

Sequence number	State	City	County	Length (km)	Subtotal (km)

Sequence number	State	City	County	Length (km)	Subtotal (km)
1	Tianjin	Tianjin	Binhai New Area	63	155.5
2			Jinghai District	73.5	
3			Xiqing District	10	
4			Wuqing District	9	
5	Hebei Province	Langfang City	Anji District	30	73
6			Yongqing County	27	
7			Guangyang District	16	
8	Beijing	Beijing	Daxing District	0.5	0.5
Total (km)					229

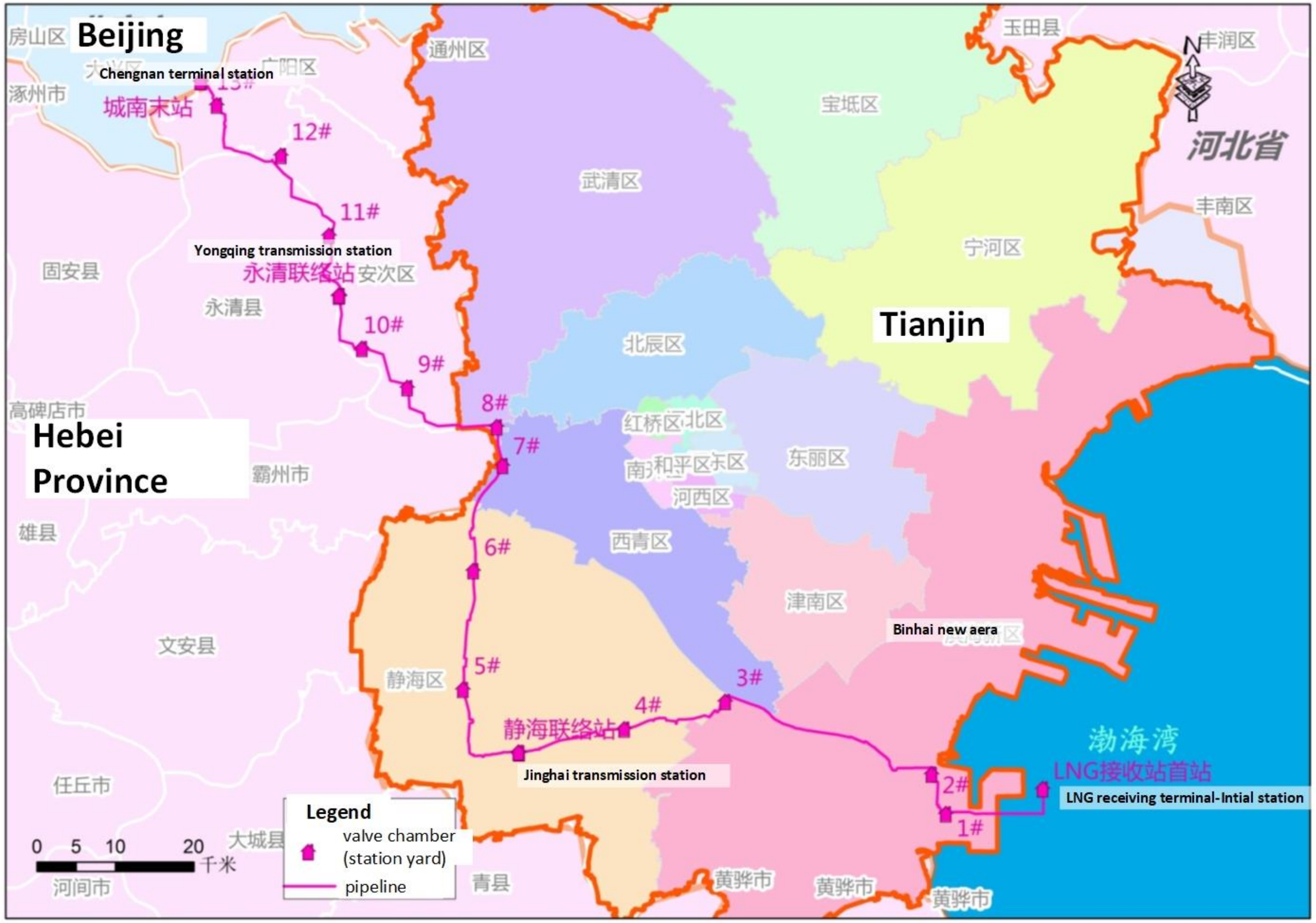


Figure 4.1-1 Pipeline route map

4.2 Pipeline Route

4.2.1 Routing Scheme

The pipeline follows the direction starting from Beiran Nangang LNG First Stop of Receiving Station, paralleling the existing Sinopec Nangang LNG send-out pipeline, to Wangqingtuo Town, Wuqing District, Tianjin City, and then to the northwest to Yongqing Distribution Station, and then to the northwest to Chengnan Terminal Station. The macro direction of the pipeline is from southeast to northwest, passing by Binhai New District, Jinghai District, Xiqing District, Wuqing District of Tianjin City, Anci District, Yongqing County, Guangyang District of Langfang City, Hebei Province, and Daxing District of Beijing City. There are 8 counties (cities, districts) in 3 cities and provinces, with a total length of 229km.

4.2.1.1 Description of Route in Tianjin

(1) Route in Binhai New Area District

The pipeline starts from Beiran Nangang LNG First Stop of Receiving Station, lays along the existing Sinopec Nangang LNG send-out pipeline, to Hongqi Road in about 4.2km to the south, along the north side of Hongqi Road in 13km to the west and then crosses the Hongqi Road by turning north after crossing the Haifang road, then cross the S11 Binhai Expressway to the west, then to the north for about 3km on the west side of the S11 Binhai Expressway and then turn west to Haifang Road. Then, it lays along the east side of the Haifang Road for 1.7km to the north and crossing Haifang Road to the west, and then crossing the Duliujianhe Country Park in parallel with the PetroChina Qingsan Line, Sinopec LNG Line, and the urban high-pressure pipeline. The pipeline reaches the G25 Changshen Expressway, and then to the south along the south side of the S60 Binshi Expressway in about 3.2km, it ends in the Jinghai District of Tianjin. The pipeline in Binhai New District is about 63km long.

(2) Route in Jinghai District

The pipeline lays from the northwest of Changliuzhuang, along the south side of the S60 Tangjin Expressway to the Jinghai District. The pipeline lays along S60 Expressway to the west for about 33.8km, then to the G2 Beijing-Shanghai Expressway and then to the north pass through the S60 Tangjin Expressway. After laying about 34.7km north along the east side of the G2 Beijing-Shanghai Expressway, it will enter the Xiqing District of Tianjin. The pipeline is about 73.5km long in the Jinghai District.

(3) Route in Xiqing District

After the pipeline passes through the Daqing River on the east side of the G2 Beijing-Shanghai Expressway and enters the Xiqing District, it will continue to be laid along the east side of the G2 Beijing-Shanghai Expressway to the northeast for about 10km, then turn north into the Wuqing District, Tianjin City. The pipeline is about 10km long in the Xiqing District.

(4) Route in Wuqing District

After entering the southeast of Zhaojialiu Village along the east side of the G2 Beijing-Shanghai Expressway, the pipeline will enter the Wuqing District. It will continue to be laid along the east side of the G2 Beijing-Shanghai Expressway to the north for about 4km, then turn west to the G2 Beijing-Shanghai Expressway, and then pass through the South Daogouzi Village and South Wang Erdian Village. Then it will be laid about 5km to the northwest and cross the G18 Rongwu Expressway to enter the Anci District, Langfang City, Hebei Province. The pipeline is about 9km long in Wuqing District.

4.2.1.2 Description of Route in Langfang City, Hebei Province

（1）Route in Anci District

The pipeline enters from Wuqing District, Tianjin City into Anci District, Langfang City, Hebei Province. The total length of the pipeline in the Anci District is about 30km and is divided into two parts. The first part is laid from the southeast to the northwest in the farmland, passing through Donggugang Town, Geyucheng Town and Tiaohetou Village, and then enters Yongqing County. The length of first part is about 24km. It will set up 7# Valve Chamber on the east side of Mochagang Village, Donggugang Town and 8# Valve Chamber on the east side of Nandi Village, Geyu Town. The second part starts from Yongqing County, and then goes northward to Mengxi Coal to Gas into Yangshuiwu Town. The length of second part is about 6km. It will set up Anci Distribution Station on the west side of Xiaocixiang Village, near the Mengxi Coal to Gas last station of Langfang.

（2）Route in Yongqing District

The pipeline enters Yongqing County from Anci District and enters Anci District again from south to north via Lancheng Town, Bieguzhuang Town, and Hancun Town. The total length in Yongqing County is about 27km. The route in Yongqing County will basically paralleled to the planned pipeline. About 10km in the vicinity of Bieguzhuang Town, the pipeline parallels to the China-Russia East Line and will set up Yongqing Transmission station on the east side of the 47# Valve Chamber of the China-Russia East Line. About 16km in the vicinity of Hancun Town, the pipeline parallels to Mengxi Coal to Gas and will set up 9# Valve Chamber on the south side of Hengting Village.

（3）Route in Guangyang District

The total length of the pipeline in Guangyang District is about 16km. It starts from Anci District and pass westward through Jiuzhou Town, and will be laid in the farmland on the north side of the Yongding River Area. It will get Gaoxinzhuang Village and then go to the north along the G3 Jingtai Expressway and will enter Daxing District, Beijing City near Gaoxiaozhai Village. It will set up 10# Valve Chamber on the west side of Fashang Village, Jiuzhou Town.

4.2.1.3 Description of Route in Daxing District, Beijing City

The pipeline enters the Daxing District, Beijing City to the northeast of Gaoxiaozhai Village, and extends about 0.5km northward to the end at the Chengnan Terminal Station, in the south side of the village. The length of the pipeline in Daxing District, Beijing City is about 0.5km.

4.2.2Pipeline Laying

4.2.2.1 Pipeline laying in general sections

（1）Pipe trench depth

①The buried depth of the pipeline in general sections should not be less than 1.2m. For the sections that may be scoured by floods, the buried depth should be appropriately increased.

②In water network and fishpond crossing sections the pipeline should be buried below the dredging depth not less than 1.2m.

③The small river crossing sections are designed in 50 years return period flood condition. The depth of pipe trench should be determined according to the scouring or dredging situation. The pipeline should be buried no less than 1m below the scouring line, and the buried depth of the pipeline should not be less than 2.5m. In no scouring or dredging water areas, the buried depth of the pipeline should not be less than 2.5m, and should meet the requirements of the Water Authority Department. This project adopts concrete cover protection for small rivers and trenches to prevent third-party mechanical damage caused by river dredging.

（2）Pipeline slope

The slope of the pipeline trench shall be determined according to the pilot excavation or the physical and mechanical characteristics of the soil such as the internal friction angle, cohesion, humidity and density. In the case of poor hydrogeological conditions, the trench slope shall be determined by pilot excavation. The soil structure of the trench slope shall not be agitated or destroyed during mechanical excavation.

According to the results of the geotechnical investigation of the route, it is recommended that the pipeline trench slope of the general sections are 1:0.67, and of the water network sections and the river crossing sections are 1:1.5.

（3）Work belt width

According to the pipeline trench forming regulations mentioned above, considering the landform characteristics of this section, combined with the actual situation of the large pipe diameter, the belt width of the D1219mm pipe in general sections are 28m, in the water network and river crossing sections are 45m, in the more than 5m dredging depth sections are 50m, and in areas occupied by economic crops, forest land and protected areas should be reduced as much as possible, are 24~26m. The belt width of D1016mm pipeline in general sections are 26m, in the water network and river crossing sections are 43m, in the more than 5m dredging depth sections are 48m, and in areas occupied by economic crops, forest land and protected areas should be reduced as much as possible, are 22~24m.

（4）Trench excavation and backfilling

The pipeline trench will be excavated mechanically in general sections, and will be excavated manually in some special sections. The distribution of underground facilities should be surveyed before the trench is excavated. It should be confirmed that there are no other underground facilities, and there is sufficient operation space by excavating mechanically. While the exact location of the underground facilities could be determined, the trenches shall be excavated manually within 3m by two sides of the underground facilities, and should supply necessary protection to the underground facilities excavated. For important underground facilities, it should obtain the consent of the property rights department before excavation and shall excavate under its supervision if necessary.

When excavating pipe trenches in farmland areas, the surface layer of cultivated soil and the bottom layer of raw soil should be strictly layered. The excavated earthwork should be protected in case of soil erosion.

The trench backfill should be more than 300mm above the ground to compensate for the soil settlement. The covering soil should be consistent with the centerline of the trench, and its width should be the same with the width of the opening in the trench, and should be made in Trapezoid. Ground facilities along the pipeline such as retaining walls, fields, drains, and access roads which are damaged during construction should be restored after the backfill.

The trench backfilling should be carried out in combination with the water and soil conservation scheme. For the sections with no superelevation backfilled soil, the trench compaction backfilling by layers should be adopted, and the layered thickness should not be more than 0.3m.

（5）Pipeline steering treatment

The horizontal and vertical steering of large-diameter pipelines of this project can be handled by elastic installation, cold-bending bends and pre-heated bends according to the specific conditions. The main principles are as follows:

①elastic installation

According to the implementation situation of the Shaanxi-Beijing Line 4 pipeline and the West Line 2 pipeline with the same caliber and the same landform type, when the horizontal or vertical rotation angle of the pipeline in the flat and wide section of the construction site is small (about 1°～8°), the design can adopt elastic installation, the radius of curvature of the elastic installation should be not less than 1000D; the elastically bending sections with vertical and downward concave should still meet the deformation condition requirement under the self-weight of the pipe.

Between the adjacent reverse elastic bending sections and between the elastic bending section and the artificial bending pipe, a straight pipe section connection should be adopted, and the length of the straight pipe section is not less than the outer diameter of the steel pipe. The elastic bending should not be used while the corners occur simultaneously in the plane and the longitudinal direction.

When elastic laying is used, the radius of curvature of the curve is generally not less than 1000 times the outer diameter of the steel pipe.

②When the elastic installation was impossible, the cold-bending bends should be used. The radius of curvature: pipeline with diameter D1219mm. The maximum bending angle of each pipe (if is 12m) should not exceed 7° (R=50D); the pipe with diameter D1016mm, each pipe (if is 12m) The maximum bending angle must not exceed 10° (R=40D).

When terrain conditions permit and are economical, multiple cold-bending bends connections may be considered during construction to change the route direction (maximum no more than three). There should be at least 2m long straight pipe sections on each side of the cold-bending bends section of each field.

③When the cold-bending bends are not satisfied, the hot bending bends are adopted, and the radius of curvature of the hot bending bends is at least 6 times the pipe diameter (R=6D). There should be not less than 0.5m long straight pipe sections at both sides of hot bending bends. The minimum use angle for the diameter 1219mm hot-bending bends is 8°, and for the diameter D1016mm hot-bending bends is 11°. It is made every 3° a step, and fine-tuning trench can be used for fitting and installation during construction for 1.5° deviation. The hot bending is made of longitudinal submerged arc welding steel pipe.

（6）Pipe cleaning and pressure test

The newly built pipeline shall be cleaned, calipered and pressure tested by following the "Code for Construction and Acceptance of Oil and Gas Transmission Pipeline Engineering" (GB 50369-2014). For this project, the diameter of the pipe, the size and weight of the cleaning and measuring device are large, the water pressure and test pressure are high, and the control of pressure test and drainage is important for engineering quality control.

The construction company needs to study the construction process seriously, a complete pipeline cleaning and pressure test construction organization plan should be formulated before the construction, and the water source for the pressure test water and the drainage site after the pressure test should be coordinated in advance.

Pipeline laying in special sections

This project considered the topography, geomorphology, geological (hydrological) conditions and surrounding disturbances along the route, and proposed corresponding technology scheme for the special areas where the pipeline passes: the water crossing section, the high groundwater level section, and the parallel laying section with the in-service pipeline.

（1）Pipeline laying in the water area section

The pipeline crosses the water network section in Binhai New District, Jinghai District and Wuqing District, and passes through sporadic ponds and small rivers for 11.614km in total. Some sections mentioned above are covered with water all year round, construction equipment and materials are difficult to enter, and trench excavating and fitting are difficult.

The main ways of crossing the continuous water area sections include cofferdam excavating crossing, water excavating crossing, directional drilling crossing, pipe jacking crossing, and tunnel crossing. The length of the large and medium-sized water areas is generally more than 1000m, which exceeds the pipe jacking capacity. Therefore, it is not recommended to use pipe jacking. The shield tunneling has a large amount of engineer quantity, high investment, complicated construction process and long cycle, which is not suitable for this project. Excavation crossing using special equipment such as underwater dredgers or high-pressure water jetting and then backfilled is not recommended since it needs special construction equipment, large working face, long construction period, and high investment. Coffering excavation is the most commonly used waterway crossing method, suitable for various geological conditions, and has advantages like no large equipment, short construction period and low risk. Directional drilling crossing is superior to pipe jacking crossing and tunnel crossing in investment, environmental protection and construction period. It also can effectively reduce the compensation cost of aquaculture ponds. The stratum of this project is mainly silt and silty clay, which is suitable for directional drilling.

The project uses directional drilling to pass through large and medium-sized rivers and small-sized river. Other waters area crossing sections are mainly located in Tianjin Binhai New District, Jinghai District, Wuqing District, etc. where the water depth is shallow and the traffic is convenient. It is generally recommended to use cofferdam excavation crossing if the water conservancy department agrees.

It will use two-sides cofferdam or one side cofferdam depending on different situations.

Generally, if it is far away from the current road, both sides of the pipeline need to be built with cofferdams to block water and drain. Therefore, the two-sides cofferdam is adopted. Some following measures should be attention to the two-sides cofferdam:

①Use riprap or bagged soil as the cofferdam foundation.

②According to the site conditions and geological conditions, it is recommended to construct in winter, using the cofferdam section diversion and support excavation to isolate the surface water in the working area from the outside. In the meantime, pave the steel pipe row or steel plate on the way for construction machinery, increase the surface bearing capacity to meet the traffic and operation requirements of mechanical equipment.

③According to the geological and traffic conditions, it is recommended to use the balanced ballast bag to stabilize the pipeline in the whole section. If the geological conditions change during the actual construction, may use the concrete block to stabilize the pipeline.

④Take protective measures such as steel sheet piles or plank support for the existing pipelines that may be affected by the trench excavation.

If one side can make use of the original or renovated bank or dam to meet the needs of water-retaining, drainage and access road, the one side cofferdam excavation method is adopted, and there are some following measures below:

①Use riprap or bagged soil as the cofferdam foundation in soft soil sections. The water network sections could use the bagged soil as the cofferdam foundation or none-foundation according to different geological conditions.

② According to the site and geological conditions, it is recommended to construct in winter, and use the segmental diversion and support excavation for the water network sections where the tidal flat and the trench are difficult to form, and use the open drainage and excavation for the water network sections with better geological conditions. In the meantime, pave the steel pipe row or steel plate on the way for construction machineries, increase the surface bearing capacity to meet the traffic and operation requirements of mechanical equipment.

③According to the geological and traffic conditions, it is recommended to use the balanced ballast bag to stabilize the pipeline in the whole section. If the geological conditions change during the actual construction, may use the concrete block to stabilize the pipeline.

④Take protective measures such as steel sheet piles or plank support for the existing pipelines that may be affected by the trench excavation.

（2）Pipeline laying in reclamation areas

The pipeline at the exit section of Nangang Wharf of Binhai New District in Tianjin is located in the reclamation areas. The reclamation area is filled by newly deposited sediment as landfilling materials which comes from the offshore sea. The special physical properties, mechanical properties and short solidification time of the filling sand results to low bearing capacity of the stratum and large ground settlement. The water content of the stratum is high, the groundwater level is high, the formation of the trench is difficult, and the water in the trench is serious.

In the landfilling areas, the machine is difficult to enter and the pipe trench is not easy to form. For the landfilling areas, as well as other areas with high groundwater level, it should be considered to construct in the winter as much as possible to facilitate the entry of the machine and the formation of the trench. In addition, some necessary drainage measures should be taken during the excavation to prevent the water seepage in the trench and soil creeping or collapsing.

Considering the situation mentioned above, according to the actual soil characteristics in the site, the following measures could be taken during pipeline construction:

①For the relatively stable soil sections, the construction can be carried out by open drainage.

②For the sand-soil sections where the trench wall is easy to collapse, the construction can be carried out by dewatering the well outside the trench first, and then excavating the pipeline trench.

③For the silt sections where the soil is extremely unstable and the trench is difficult to form, the construction can be carried out by using continuous steel sheet piles to support, and well point precipitation to excavate the trenches.

④In order to prevent the pipeline from floating up due to groundwater immersion, it is possible to use balanced ballast bags or soil bags to stabilize the pipe and other measures.

（3）Seismic active fault zone pipeline laying

After the completion of the seismic safety assessment, the pipeline inspection and design shall be carried out according to the relevant contents.

（4）Parallel pipeline laying

The pipeline is in line with the existing pipelines in some sections. Therefore, by following the requirements of the design standards, in order to make full use of the results data and facilities of the existing pipelines, the pipeline is laid in parallel with several existing pipelines in different administrative divisions. It’s convenient for management and can reduce the initial investment, make the construction easy, and save investment. The pipeline is laid in parallel with Sinopec LNG Pipeline, Mengxi Coal to Gas and Gangqing Line 3 in Binhai New District, Jinghai District, Xiqing District, Wuqing District of Tianjin City, and is laid in parallel with China-Russia East Line and Mengxi Coal to Gas in Yongqing County, Anci District of Langfang City. The total parallel length is 187km.

Table 4.2-1 Parallel situations between new pipeline and other in-service pipelines

Serial Number	Administrative division	Parallel range	Lenth km	Parallel with in-service pipeline
1	Binhai New District	First Stop of Receiving	57	Sinopec LNG Pipeline, Gangqing

		station -2# Valve Chamber		Line 3
2	Binhai New District, Jinghai District	2#Valve Chamber-4# Valve Chamber	65	Sinopec LNG pipeline, Gangqing Line 3, Mengxi Coal to Gas
3	Jinghai District, Xiqing District, Wuqing District	4#Valve Chamber-Jinyu Border	33	Sinopec LNG pipeline
4	Yongqing County	Yongqing Anci Border-Yongqing Distribution Station	10	China-Russia East Line
5	Anci District	Yongqing Distribution Station -Anci Distribution Station	22	Mengxi Coal to Gas
	Total		187	

（5）Intersect and parallel with other buried pipelines, optical (electrical) cables

In order to save the land, the new pipeline will be laid by using existing pipeline corridors and other public facilities. Due to the shallow depth of other buried pipelines and optical (electrical) cables, the pipeline and construction equipment are heavy, and it is likely to cause damage to other pipelines and optical (electrical) cables during the construction process. In order to ensure safety, necessary protective measures must be taken to facilitate the passage of large machinery, to ensure that the safety and normal operation of the existing pipelines and other facilities are not affected. The specific laying requirements are as follows:

①When access roads for materials and equipment crosses other buried pipelines and optical (electric) cables, thick steel plates or steel pipe bridges shall be set up to facilitate the passage of large machinery.

②When the new pipeline crosses other buried pipelines or metal structures, the vertical clearance should not be less than 0.3m. When the new pipeline crosses the power cables and communication cables, the vertical clearance should not be less than 0.5m.

③The construction company should obtain the permission of the relevant administrative department and sign the safety production management agreement before construction, and termly report the progress of the construction to its administrative department.

（6）Laying in parallel with high voltage lines

The pipeline route is limited by local planning and distribution of villages and towns, so the pipeline will be laid in parallel with overhead power supply lines in some sections.

The pipelines paralleling with high-voltage lines should follow the following principles:

①Verify the voltage level of the high-voltage lines in the parallel laying section, and set a safet distance which should meet the requirement of "Code for design of 66kV or under overhead electrical power transmission line" (GB50061-2010) and "Code for design of 110kV~750kV overhead transmission line" (GB50545-2010). The parallel spacing is generally not less than 1.0 times the distance between transmission poles.

②Parallel spacing in pipeline laying restricted areas should meet the minimum distance specified by the standard, and if necessary, should negotiate specific protection measures with the power department to avoid mutual influence.

③ The grounding electrode protection of the high-voltage line should be strengthened during the pipeline construction. Under no circumstances the pipeline and the high-voltage line tower grounding electrode should not be connected together. It should negotiate with the power department to change the grounding electrode direction if the safety spacing between the pipeline and high-voltage line grounding electrode can't meet the requirement.

④When the pipeline crosses the high-voltage line, the intersection angle should be greater than 30° as much as possible. If it cannot be satisfied and intersect at a small angle, drainage measures should be taken according to the specific conditions.

⑤ When the pipeline is constructed near the high-voltage line, the safety insulation measures of the construction personnel and construction equipment should be strengthened during the construction to avoid danger. Construction personnel should wear insulated shoes and gloves, or operate on insulation pads. The welded pipes must be grounded when welding pipes near high-voltage lines. It should not use large-scale machines, and construction work must be stopped during thunderstorms.

⑥ In order to ensure the long-term operation safety of the pipeline, it is recommended to test the stray current in the site and take drainage measures as needed.

⑦Before the construction, it should be coordinated with the power supply management department, and combined with the requirements of the power department for design and organization.

（7）Laying in disastrous and unfavorable geological sections

It should be confirmed that the pipeline is sufficient to cross disastrous and unfavorable geological sections according to the geological disaster assessment results.

4.2.3Pipeline Crossing

4.2.3.1 River crossing

（1）Large and medium-sized river crossings

There are 2 large-sized river crossings and 3 medium-sized river crossings with a crossing length of 4315m. The statistics of large and medium-sized river crossings are shown in the table below.

Table 4.2-2 Statistics of large and medium-sized river crossings

Serial Number	River Name	Crossing position	Water width（m）	Crossing length（m）	Way of crossing
1	Duliujian River 1#	Tianjin Dagang District	200	650	Directional drilling
2	Duliujian River 2#	Tianjin Dagang District	400	730	Directional drilling
3	Daqinghe	Tianjin Jinghai District	60	735	Directional drilling
4	Advance Canal + South Canal	Tianjin Jinghai District	60+30	1600	Directional drilling
5	Drainage channel	Tianjin Jinghai District	76	600	Directional drilling
Total				4315	

（2）Small river and ditch crossings

There are a total of 41 small-sized river and ditch crossings in the project, of which 2 are small directional drilling crossings, 4 are pipe jacking crossings , and the rest are all large excavation crossings. The main small river and ditch crossings are shown in the table below.

The buried depth of the pipeline should be below 1.0m of the scouring line when river and ditch small crossing by excavation, and the original appearance of the river bank should be restored. Masonry or grass bags should be used for bank slope protection if necessary. In addition, appropriate stabilizing measures should be considered to prevent the pipeline from floating. For the main canal crossing if it is difficult to excavate or the water conservancy department does not allow it, should consider changing the way of crossing to pipe jacking or directional drilling.

The crossing position of the pipeline should be negotiated with the relevant departments in detail to ensure crossing work successfully.

Table 4.2-3 Statistics of main small river crossing

Serial Number	Name	Crossing position	Water width （m）	Crossing length （m）	Way of crossing
1	Ziya River	Tianjin Jinghai District	36	600	Directional drilling
2	Yongding River	Langfang Anci District	45	928	Directional drilling
3	Yundongpai Main Channel	Tianjin Jinghai District	24	50	Pipe jacking
4	Qingnian Channel	Tianjin Jinghai District	25	50	Pipe jacking
5	Gangtuan Irrigation Channel	Tianjin Jinghai District	29	50	Pipe jacking
6	South Canal	Tianjin Jinghai District	20	600	Directional drilling
7	East Xiaomiao Main Channel	Langfang Anci District	11	50	Pipe jacking
8	Zhongting River	Tianjin Xiqing District	23	63	Excavation
9	Jian River	Langfang Guangyang District	20	552	Directional drilling
10	Unkown River		36	50	Excavation
11	Unkown River		5	45	Excavation
12	Unkown River		10	50	Excavation
13	Unkown River		10	50	Excavation
14	Unkown River		8	48	Excavation
15	Unkown River		10	50	Excavation
16	Unkown River		31	71	Excavation
17	Unkown River		21	61	Excavation
18	Unkown River		25	65	Excavation
19	Unkown River		20	60	Excavation
20	Unkown River		15	55	Excavation
21	Unkown River		24	64	Excavation
22	Unkown River		24	64	Excavation
23	Unkown River		20	60	Excavation
24	Unkown River		20	60	Excavation
25	Unkown River		29	69	Excavation
26	Unkown River		20	60	Excavation
27	Unkown River		27	67	Excavation
28	Unkown River		23	63	Excavation
29	Unkown River		21	61	Excavation
30	Unkown River		23	63	Excavation
31	Unkown River		16	56	Excavation
32	Unkown River		30	70	Excavation
33	Unkown River		9	49	Excavation
34	Ditch		6	46	Excavation

Serial Number	Name	Crossing position	Water width （m）	Crossing length （m）	Way of crossing
35	Ditch		10	50	Excavation
36	Ditch		6	46	Excavation
37	Ditch		6	46	Excavation
38	Ditch		25	65	Excavation
39	Ditch		15	55	Excavation
40	Ditch		12	52	Excavation
41	Ditch		40	80	Excavation

4.2.3.2 Road crossing

There are 214 road crossings in total. Among them, there are 15 expressway crossings, 22 Class 2 and above road crossings, and 12 Class 3 and Class 4 road crossings. 4 road crossings use small directional drilling as small river crossings, and other crossings use reinforced concrete casing. There are 165 road crossings in Class 4 and below, 101 crossings of which adopt pipe jacking, and 64 crossings adopt excavation and plate cover.

The main roads along the pipeline (referring to expressways, class roads) are shown in the following table.

Table 4.2-4 Statistics of main highway

Serial Number	Road Name	Crossing Position	Highway Grade	Way of Crossing	Crossing Length/m
1	Haigang Road	Binhai New District	Class 1	Mechanical pipe jacking	80
2	Zaijian Road	Binhai New District	Class 1	Mechanical pipe jacking	80
3	Hongqi Road	Binhai New District	Class 1	Mechanical pipe jacking	80
4	S11 Binhai Expressway	Binhai New District	Highway	Mechanical pipe jacking	80
5	Chuangye Road	Binhai New District	Class 2	Mechanical pipe jacking	60
6	Binhai Expressway	Binhai New District	Class 1	Mechanical pipe jacking	80
7	Haijing Avenue	Binhai New District	Class 1	Mechanical pipe jacking	80
8	S106 Jinqi Road	Binhai New District	Class 2	Mechanical pipe jacking	60
9	G205 Jinnao Road	Binhai New District	Class 1	Mechanical pipe jacking	80
10	G205 Jinwang Line	JInhai District	Class 1	Mechanical pipe jacking	80
11	G18 Rongwu Road	JInhai District	Highway	Mechanical pipe jacking	80
12	S311 Gangjing Road	JInhai District	Class 2	Mechanical pipe jacking	60
13	S213 Jingwang Road	JInhai District	Class 2	Mechanical pipe jacking	60
14	S114 Jinwang	JInhai District	Class 2	Mechanical	60

Serial Number	Road Name	Crossing Position	Highway Grade	Way of Crossing	Crossing Length/m
	Road			pipe jacking	
15	X626 County Road	JInhai District	Class 3, Class 4	Mechanical pipe jacking	60
16	S6 Jincang Expressway	JInhai District	Highway	Mechanical pipe jacking	80
17	G105 Jingfu Road	JInhai District	Class 1	Small directional drilling	600
18	G104 Jingfu Line	JInhai District	Class 1	Small directional drilling	600
19	S60 Binshi Expressway	JInhai District	Highway	Mechanical pipe jacking	80
20	Ziya Fast Road	JInhai District	Class 1	Small directional drilling	600
21	S116 Jingwen Line	JInhai District	Class 2	Mechanical pipe jacking	60
22	X616 Jingtai Line	JInhai District	Class 3, Class 4	Small directional drilling	600
23	South Jingba Line	JInhai District	Class 3, Class 4	Mechanical pipe jacking	30
24	G2 Jinghu Expressway	JInhai District	Highway	Mechanical pipe jacking	80
25	S310 Jingba Road	JInhai District	Class 2	Small directional drilling	600
26	G2 Jinghu Expressway	JInhai District	Highway	Mechanical pipe jacking	80
27	G2 Jinghu Expressway	Xiqing District	Highway	Mechanical pipe jacking	80
28	X448 County Road	Xiqing District	Class 3, Class 4	Mechanical pipe jacking	30
29	G18 Rongwu Expressway	Xiqing District	Highway	Mechanical pipe jacking	80
30	G2 Jinghu Expressway	Wuqing District	Highway	Mechanical pipe jacking	80
31	G18 Rongwu Expressway	Wuqing District	Highway	Mechanical pipe jacking	80
32	X709 Mayang Lineg	Anci District	Class 3, Class 4	Mechanical pipe jacking	30
33	G112 Jintong Road	Anci District	Class 1	Mechanical pipe jacking	80
34	Made Line	Anci District	Class 3, Class 4	Mechanical pipe jacking	30
35	Yunhua Road	Anci District	Class 3, Class 4	Mechanical pipe jacking	30
36	S272	Anci District	Class 2	Mechanical pipe jacking	60
37	G3 Jintai Expressway	Yongqing County	Highway	Mechanical pipe jacking	80
38	X755 Donggao Line	Yongqing County	Class 3, Class 4	Mechanical pipe jacking	30
39	Hangu Line	Yongqing County	Class 3, Class 4	Mechanical pipe jacking	30
40	Hangu Line	Yongqing	Class 3, Class 4	Mechanical	30

Serial Number	Road Name	Crossing Position	Highway Grade	Way of Crossing	Crossing Length/m
		County		pipe jacking	
41	Hangu Line	Yongqing County	Class 3, Class 4	Mechanical pipe jacking	30
42	S273	Yongqing County	Class 2	Mechanical pipe jacking	60
43	S371	Yongqing County	Class 2	Mechanical pipe jacking	60
44	X754 Wuyu Line	Guangyang District	Class 3, Class 4	Mechanical pipe jacking	30
45	G3 Jintai Expressway	Guangyang District	Highway	Mechanical pipe jacking	80
46	SL77	Guangyang District	Class 2	Mechanical pipe jacking	60
47	G3 Jintai Expressway	Guangyang District	Highway	Mechanical pipe jacking	80
48	G95 Mizhuo Expressway	Guangyang District	Highway	Mechanical pipe jacking	80
49	G3 Jingtai Expressway	Guangyang District	Highway	Mechanical pipe jacking	80

4.2.3.3 Railway Crossing

There are a total of 9 railway crossings in this project, 4 of which pass under the railway roadbed and 5 pass under the railway viaduct. At this stage, there is not a clear response from railway administrative department after consultation with them about the present method, which use top box culvert or the top casing crossing. 4 pipelines passing under the railway roadbed tentatively adopt top box culvert crossing, 5 pipelines passing under the railway bridge adopt excavation and plate cover. Railway crossings are shown in the following table.

Table 4.2-5 Statistics of railway crossing

Serial Number	Name	Crossing Lenth（m）	Way of Crossing	County area	Remarks
1	Nangang Railway 1	100	Top box culvert	Binhai New District	Changed according to the opinion of the Planning Bureau
2	Nangang Railway 2	120	Top box culvert	Binhai New District	Changed according to the opinion of the Planning Bureau
3	Nangang Railway 3	80	Excavation + cover	Binhai New District	Newly built, passed under the railway bridge
4	Nangang Railway 4	80	Excavation + cover	Binhai New District	Pass under the railway bridge
5	Suhuang Railway	80	Excavation + cover	Binhai New District	Pass under the railway bridge
6	Beijing-	80	Excavation +	Jinghai	Pass under the railway

Serial Number	Name	Crossing Lenth（m）	Way of Crossing	County area	Remarks
1	Nangang Railway 1	100	Top box culvert	Binhai New District	Changed according to the opinion of the Planning Bureau
2	Nangang Railway 2	120	Top box culvert	Binhai New District	Changed according to the opinion of the Planning Bureau
3	Nangang Railway 3	80	Excavation + cover	Binhai New District	Newly built, passed under the railway bridge
	Shanghai high-speed railway		cover	District	bridge
7	Jinpu Railway	80	Top box culvert	Jinghai District	
8	Jinbao Railway	80	Excavation + cover	Xiqing District	Pass under the railway bridge
9	Jinba Railway	80	Top box culvert	Anci District	

4.2.4Auxiliary Works

（1）pipeline block valve chamber

According to the "Code for Design of Gas Transmission Pipeline Engineering" GB50251, the pipeline block valve is set up. There are 10 valve chambers in this project, all of which are monitoring valve chambers, and one valve chamber is reserved. Statistics are shown in the table below.

Table 4.2-6 Station Valve Chamber schedule

Serial Number	Mileage (km）	Spacing（km）	Regional Class	Valve Chamber Type	Location
First Stop of Receiving Station	0.0	——	Class 3	——	Nangang LNG Terminal, Binhai New District, Tianjin
0# Reserved Valve Chamber	6.0	6.0	Class 3	——	East side of 1# Valve Chamber of Sinopec LNG send-out pipeline in Nangang Industrial Park, Binhai New District, Tianjin
1# Valve Chamber	12	6.0	Class 3	Class B Monitoring Valve Chamber	East side of Nangang Gas 2# Gate Station, Nangang Industrial Park, Binhai New District, Tianjin
Nangang Distribution Station	24.6	12.6	Class 3	——	Southeast of the intersection of Haiphong Road and Beichuangang Road, Hangzhou Lane, Binhai New District, Tianjin
2# Valve Chamber	57.3	32.7	Mainly Class 1	Class B Monitoring Valve Chamber	Northeast side of Changliuzhuang Village, Zhongtang Town, Binhai New District, Tianjin
Daqiuzhuang	74.2	17.0	Class 3	Class B Monitoring	Northwest side of Guankeng Village, Daqiuzhuang Town,

Serial Number	Mileage (km）	Spacing（km）	Regional Class	Valve Chamber Type	Location
Distribution Station				Valve Chamber	Jinghai District, Tianjin
Jinghai Transmission station	90.3	16.1	Class 3	——	North side of Hexin Village, Xidizhuang Town, Jinghai District, Tianjin
3# Valve Chamber	107.6	17.3	Class 3	Class B Monitoring Valve Chamber	West side of Xichangtun Village, Chenguantun Town, Jinghai District, Tianjin
4# Valve Chamber	124.8	17.2	Class 3	Class A Monitoring Valve Chamber	West side of Liujiaying Village, Duliu Town, Jinghai District, Tianjin
5# Valve Chamber	141.6	16.7	Class 3	Class B Monitoring Valve Chamber	Northeast of the intersection of Jinghu Expressway and Rongwu Expressway, Xinkou Town, Xiqing District, Tianjin
6# Valve Chamber	147.2	5.6	Class 3	Class B Monitoring Valve Chamber	South side of Daogouzi Village, Wangqingtuo Town, Wuqing District, Tianjin
7# Valve Chamber	158.4	11.3	Class 3	Class B Monitoring Valve Chamber	East side of Mochangang Village, Donggugang Town, Anci District, Langfang City, Hebei Province
8# Valve Chamber	170.4	12.0	Class 3	Class B Monitoring Valve Chamber	East side of Nandi Village, Geyucheng Town, Anci District, Langfang City, Hebei Province
Yongqing Transmission station	184.6	14.2	Class 3	——	East side of Nanrenying Village, Bieguzhuang Town, Yongqing County, Langfang City, Hebei Province
9# Valve Chamber	194.4	9.8	Class 3	Class B Monitoring Valve Chamber	South side of Hengting Village, Hancun Town, Yongqing County, Langfang City, Hebei Province
Anci Distribution Station	210.3	15.9	Class 3	——	West side of Xiaocixiang Village, Yangshuiwu Town, Anci District, Langfang City, Hebei Province
10# Valve Chamber	223.0	12.7	Class 3	Class B Monitoring Valve Chamber	West side of Fashang Village, Jiuzhou Town, Guangyang District, Langfang City, Hebei Province
Chengnan Terminal Station	229.0	6.0	Class 3	——	South side of Neiguanzhuang Village, Lixian Town, Daxing District, Beijing

（2）Pipeline marker

The pipeline marker post set up in this project are: milepost, corner pile, crossing pile, intersection pile, structural pile and encrypted pile. There are 5903 marker post and 113 warning signs along the project.

The pipeline marking strip for excavation and laying shall be set at 500mm above the top of the pipeline. The D1219 pipeline marking strip has a width of 1.5m and a total length of 172.61km. The D1016 pipeline marking strip has a width of 1.2m and a total length of 44.62km.

（3）Access roads and accompanying roads

The project is located in Beijing, Langfang and Tianjin which are littoral developed areas. There are many Expressway, national and provincial highways, and county-level roads in this area. The existing roads in the area can basically meet the needs of future operation and maintenance, so new accompanying roads are not necessary. The accompanying roads are only refurbished in some poor road condition areas so that the road conditions meet the needs of pipeline construction and operation management.

Vehicle transportation mainly relies on existing roads and construction work belts. However, there are no parallel main roads on both sides of the pipeline in some local sections. When the construction vehicle enters the construction site, it is necessary to build a certain length of access road, or to widen and strengthen some rural dirt roads and small bridges. In some bad condition sections, to build temporary bypass roads are necessary.

The access road width is 4.5m. The construction method is to level by a bulldozer, backfill the plain soil and compact (the solidity should be over 90%), and in some areas, it can also be reinforced with gravel cushion. Reinforced concrete circular culvert with 1m diameter should be pre-embedded in the access road crossing ditch sections. The land occupation for the access road should be temporary, the original topography and landform should be restored after the construction.

The newly built access road is 73.52km, and the rebuilt access road is 25km.

4.3 Station Works

4.3.1Station Settings

There are 7 gas transmission stations, which are First Stop of Receiving Station, Nangang Distribution Station, Daqiuzhuang Distribution Station, Jinghai Transmission station, the Yongqing Transmission station, Anci Distribution Station and Chengnan Terminal Station. The First Stop of Receiving Station will be built with the Beiran Nangang LNG Receiving Station together, other six are newly built stations. There are 10 block valve chambers in total, including a Class A monitoring valve chamber and 9 Class B monitoring valve chambers. And there is another reserved space for valve chambers in Nangang Industrial Park. The statistics of station setting are shown in the table below.

Table 4.3-1 Statistics of Station Setting

Station &Valve Chamber No.	Mileage (km)	Spacing(km)	Valve Chamber Type	Location	Remarks
First Stop of Receiving Station	0.0	——	——	Nangang LNG Terminal, Binhai New District, Tianjin	Interconnection with Sinopec LNG, reserved interconnection function at the receiving station
Nangang Distribution Station	24.6	12.6	——	Southeast of the intersection of Haifang Road and Beichuangang Road, Hangzhou Lane, Binhai New District, Tianjin	Yinbao Station
Daqiuzhuang Distribution Station	74.2	17.0	——	Northwest side of Guankeng Village, Daqiuzhuang Town, Jinghai District, Tianjin	Non-attended
Jinghai Transmission station	90.3	16.1	——	North side of Hexin Village, Xidizhuang Town, Jinghai District, Tianjin	CNOOC Mengxi Coal-to-Gas Interconnection Point, near the Jinghai Distribution Station of CNOOC Mengxi Coal-to-Gas
Yongqing Transmission station	184.6	14.2	——	East side of Nanrenying Village, Bieguzhuang Town, Yongqing County, Langfang City, Hebei Province	Interconnection with the China-Russia East Line, near CY47# Valve Chamber of the China-Russia East Line
Anci Distribution Station	210.3	15.9	——	West side of Xiaocixiang Village, Yangshuiwu Town, Anci District, Langfang City, Hebei Province	
Chengnan Terminal Station	229.0	6.0	——	South side of Neiguanzhuang Village, Lixian Town, Daxing District, Beijing	Yinbao Station, near the Nangao A Station of Beiran City

4.3.2Station General Scheme

4.3.2.1 First Stop of Receiving Station

First Stop of Receiving Station is located in the Tianjin Nangang LNG Receiving Station, and the process equipment area is set in the station. The design of the general scheme should be considered by the Receiving Station.

4.3.2.2 Nangang Distribution Station

（1）Station location

Nangang Distribution Station is located on the southeast side of the intersection of Haifang Road and Beichuangang Road, Hangzhou Lane, Binhai New District, Tianjin City. The site location is a pond where is low. According to the site investigation, the site location is about 15m lower than the west road. Due to the requirements of the route and process system, the station can only be set up here. Therefore, the station needs lots of landfilling, and the access road relies on the west side road.

Figure 4.3-1 Layout of Nangang Distribution Station Area

（2）General layout

The station is divided into three areas: office area, production area and venting area. The office area and the production area are separated by wrought iron fence. The venting area is arranged separately on the east side of the station near the north side of the dirt road. Among them, the office area is located on the west side of the site area, and the comprehensive duty room, comprehensive equipment room and domestic sewage treatment device are set up. The production area is located on the east side of the site area, and the process equipment area and the heating furnace area are set up. The venting area is set on the east side of the site area separately and located at the windward side of the field with the minimum wind frequency.

2.5m high solid wall is used around the station. The partition wall between the office area and the production area is 1.8m high wrought iron fence, and 1.8m high steel mesh fence is used around the venting area.

The vertical design adopts a flat slope, and the slope of the site is 0.5%. Since the location of the site is about 15m lower than the west road and the site is located in the pond, the site needs to be partially dredged and largely landfilled. The earthwork volume in this station is about: Fill: 200000m3 (of which gravel is 30,000 m3, and plain soil is 170,000 m3). Excavation: 20000 m3.

Organized drainage for rainwater is adopted in the station. After collecting rainwater from the road inside the station, it is discharged into the natural ditches near the station. The rainwater flow in the station is: building roof→site→road→external drainage ditch→pond in the south side of the station.

The greening of the station site focuses on the office area, it will plant plants which are rich in ornamental and common evergreen trees, shrubs and turf. The venting area will be paved with gravel.

（3）Road and masonry works

The road in the station adopts the urban concrete pavement. The main road is 6m wide and it’s turning radius is 9m. The secondary road is 4m wide and it’s turning radius is 12m. The road outside the station is 6m wide as the suburban concrete pavement.

The station entrance and exit is set on the north side wall at the northwest corner of the site, nearby the comprehensive duty room. A 6m wide wrought iron gate is set at the partition wall of the office area and the production area, and a 1.5m wide evacuation door is set at the northeast corner of the production area.

In order to facilitate daily operation and equipment maintenance, some areas like process equipment area is paved with 80mm thick square bricks, and a 2m wide sidewalk is set at an appropriate position between the equipment area and the fire passage. Other open spaces in the production area are paved with graded gravel.

4.3.2.3 Daqiuzhuang Distribution Station

（1）Station location

The Daqiuzhuang Distribution Station is located on the northwest side of Guankeng Village, Daqiuzhuang Town, Jinghai District, Tianjin City, and on the south side of S60 Tangjin Expressway. The site location is cultivated land which is flat and open, and the land status is forest land. The south side of the site is adjacent to a water ditch, and the south side of the water ditch is adjacent to a cement road which the access road relies on.

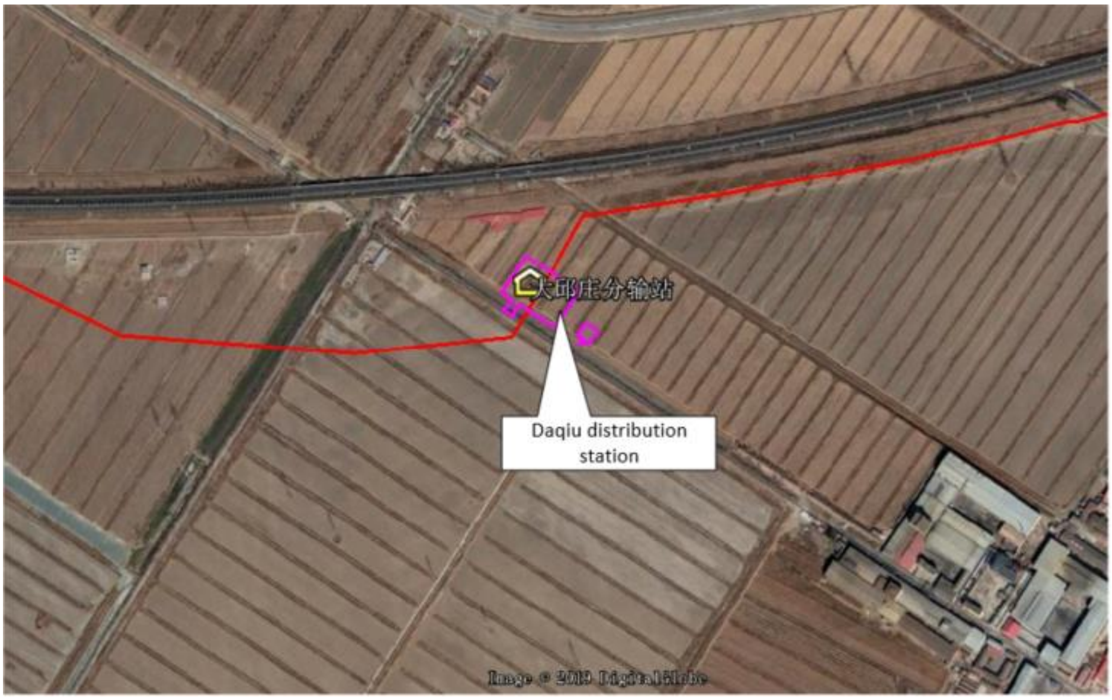


Figure 4.3-2 Daqiu Zhuang Distribution Station Regional layout

（2）General layout

This station is an unattended station, and it is divided into two areas: production area and venting area. The production area includes comprehensive equipment room, process equipment area and heating furnace area. The venting area is set separately on the east side of the site and located at the windward side of the field with the minimum wind frequency.

2.5m high solid wall is used around the station, 1.8m high steel mesh fence is used around the venting area.

The vertical design adopts a flat slope, and the slope of the site is 0.5%. Since the location of the site is a bit lower than the south road, the site needs to be partially dredged and landfilled. The earthwork volume in this station is about: Fill: 120000m3, Excavation: 5000 m3.

Organized drainage for rainwater is adopted in the station. After collecting rainwater from the road inside the station, it is discharged into the southside natural ditches. The rainwater flow in the station is: building roof→site→road→external drainage ditch→southside natural ditches.

Only surrounding areas of comprehensive equipment room are greening, and the surrounding areas of the process equipment area are paved with gravel. The venting area is paved with gravel.

（3）Road and masonry works

The road in the station adopts the urban concrete pavement. The main road is 6m wide and it’s turning radius is 9m. The secondary road is 4m wide and it’s turning radius is 12m. The road outside the station is 6m wide as the suburban concrete pavement.

The station entrance and exit is set on the south side wall of the site, nearby the comprehensive equipment room. A 1.5m wide evacuation door is set at the northeast corner of the production area.

In order to facilitate daily operation and equipment maintenance, some areas like process equipment area is paved with 80mm thick square bricks, and a 2m wide sidewalk is set at an appropriate position between the equipment area and the fire passage. Other open spaces in the production area are paved with graded gravel.

4.3.2.4 Jinghai Transmission station

（1）Station location

Jinghai Transmission station is located on the north side of Hexin Village, Xidizhuang Town, Jinghai District, Tianjin City, and on the east side of Sinopec Tangguantun Distribution Station, and interconnected with CNOOC Mengxi Coal to

Gas Jinghai Distribution Station (proposed). The site is flat and the land status is farmland. There is a rural cement road on the west side of the site.

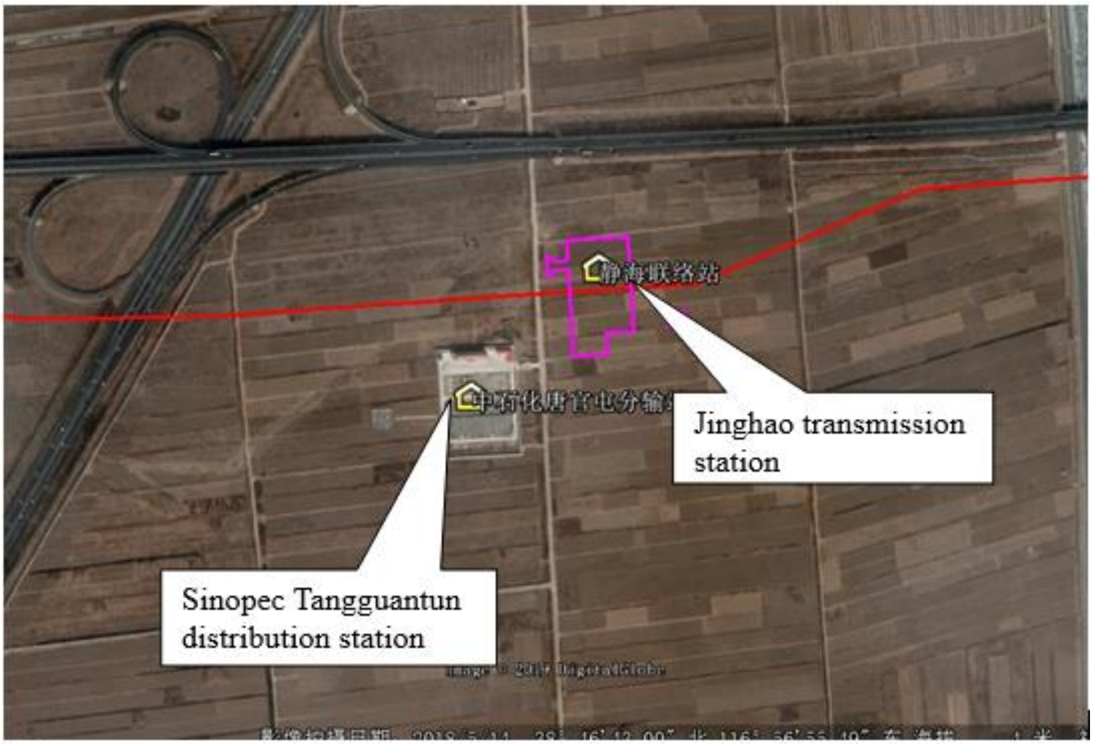


Figure 4.3-3 Jinghai transmission Station Regional layout

（2）General layout

The station includes three areas: office area, production area and venting area. The office area and the production area are separated by wrought iron walls, and the venting area is separately set on the east side of the station. Among them, the office area is located on the north side of the site, including the comprehensive duty room, comprehensive equipment room and domestic sewage treatment device. The venting area is separately set on the east side of the site, and located at the windward side of the field with the minimum wind frequency.

2.5m high solid wall is used around the station. The partition wall between the office area and the production area is 1.8m high wrought iron fence, and 1.8m high steel mesh fence is used around the venting area.

The vertical design adopts a flat slope, and the slope of the site is 0.5%. The earthwork volume in this station is about: Fill: 17000m3. Excavation: 10000 m3.

Organized drainage for rainwater is adopted in the station. After collecting rainwater from the road inside the station, it is discharged into the natural ditches near the station. The rainwater flow in the station is: building roof→site→road→external drainage ditch→natural ditches.

The greening of the station site focuses on the office area, it will plant plants which are rich in ornamental and common evergreen trees, shrubs and turf. The production area and venting area will be paved with gravel.

（3）Road and masonry works

The road in the station adopts the urban concrete pavement. The main road is 6m wide and it’s turning radius is 9m. The secondary road is 4m wide and it’s turning radius is 12m. The road outside the station is 6m wide as the suburban concrete pavement.

The station entrance and exit is set on the west side wall of the site, nearby the comprehensive duty room. A 6m wide wrought iron gate is set at the partition wall of the office area and the production area, and a 1.5m wide evacuation door is set at the northeast corner of the production area.

In order to facilitate daily operation and equipment maintenance, some areas like process equipment area is paved with 80mm thick square bricks, and a 2m wide sidewalk is set at an appropriate position between the equipment area and surrounding roads. Other open spaces in the production area are paved with graded gravel.

4.3.2.5 Yongqing Transmission station

（1）Station location

Yongqing Transmission station is located in Nanrenying Village, Bieguzhuang Town, Yongqing County, Hebei Province. It is on the east side of China-Russia Pipeline CY47# Valve Chamber and interconnected with China-Russia East Line CY47# Valve Chamber. The site is flat and the current land status is farmland and orchard. On the west side of the site, there is a rural cement road which can be relied upon. The newly built road and the extension road of the station is about 1km, which is connected to the rural cement road on the west side of the station.

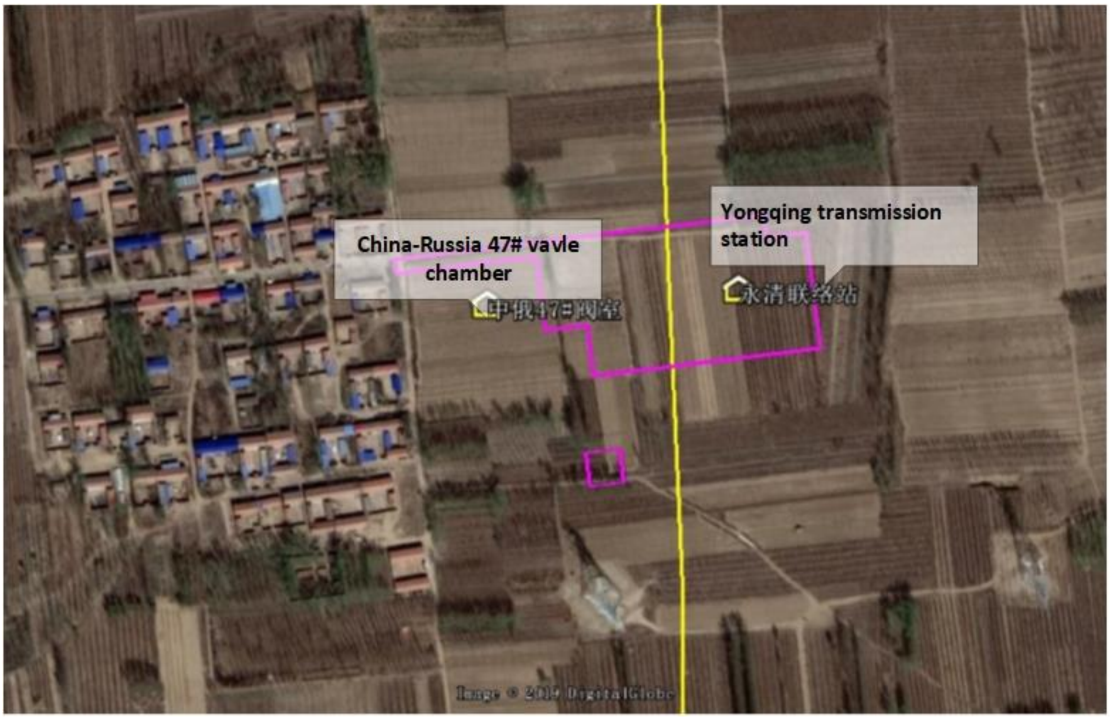


Figure 4.3-4 Yongqing transmission Station Regional layout

（2）General layout

The station includes three areas: office area, production area and venting area. The office area is located on the east side of the site, with a comprehensive duty room, comprehensive equipment room and domestic sewage treatment device. The production area is located on the west side of the site, including the process equipment area and the heating furnace area. The venting area is separately set on the south side of the site, and located at the windward side of the field with the minimum wind frequency.

2.5m high solid wall is used around the station, and 1.8m high steel mesh fence is used around the venting area.

The vertical design adopts a flat slope, and the slope of the site is 0.5%. The earthwork volume in this station is about: Fill: 18400m3. Excavation: 11300 m3.

Organized drainage for rainwater is adopted in the station. After collecting rainwater from the road inside the station, it is discharged into the natural ditches near the station. The rainwater flow in the station is: building roof→site→road→external drainage ditch→natural ditches.

The greening of the station site focuses on the office area, it will plant plants which are rich in ornamental and common evergreen trees, shrubs and turf. The venting area will be paved with gravel.

（3）Road and masonry works

The road in the station adopts the urban concrete pavement. The main road is 6m wide and it's turning radius is 9m. The secondary road is 4m wide and it's turning radius is 12m. The road outside the station is 6m wide as the suburban concrete pavement. The newly built road and the extension road of the station is about 1km, which is connected to the rural cement road on the west side of the station.

The station entrance and exit is set on the north side of the site, and a 1.5m wide evacuation door is set at the south side of the production area.

In order to facilitate daily operation and equipment maintenance, some areas like process equipment area is paved with 80mm thick square bricks, and a 2m wide sidewalk is set at an appropriate position between the equipment area and surrounding roads. Other open spaces in the production area are paved with graded gravel.

4.3.2.6 Anci Distribution Station

（1）Station location

The Anci Distribution Station is located on the west side of Xiaocixiang Village, Yangshuiwu Township, Anci District, Langfang City, Hebei Province. The site is flat and forest land currently, and the land status is general farmland. There is a dirt road on the south side of the site which is connected with a cement road on the east side of the village. It can be used as access road.

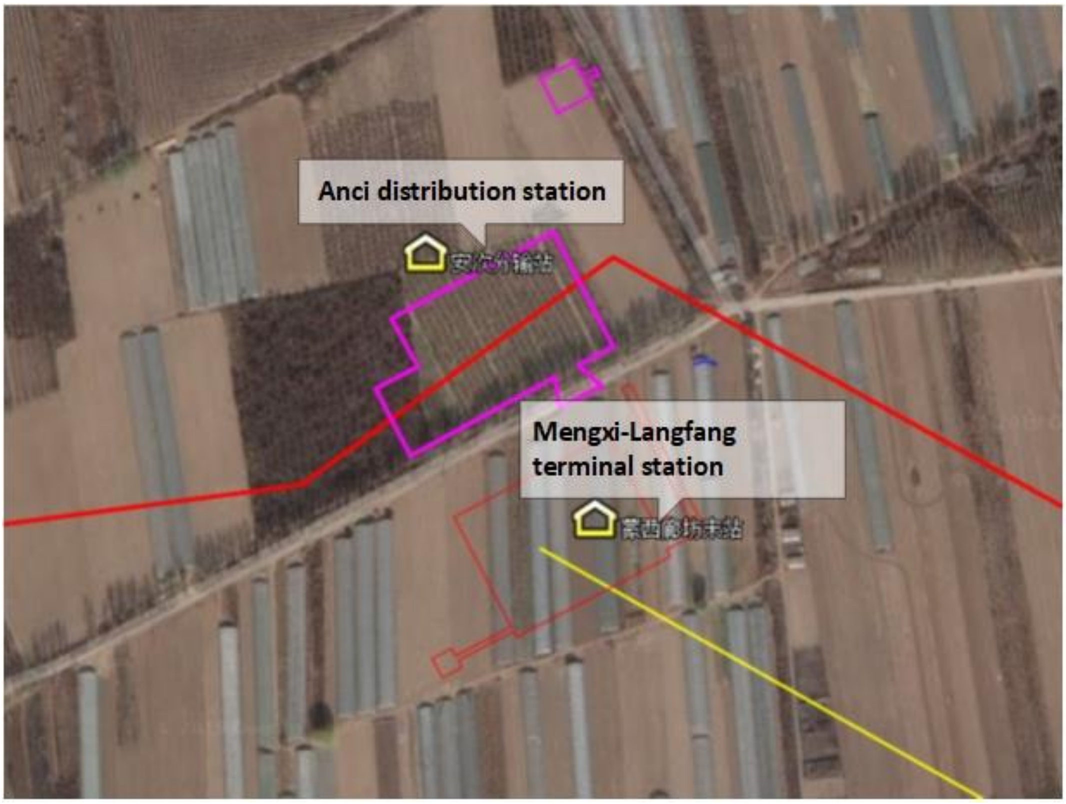


Figure 4.3-5 Anci distribution Station Regional layout

（2）General layout

The station includes three areas: office area, production area and venting area. The office area is located on the east side of the site, and is equipped with a comprehensive duty room, comprehensive equipment room and domestic sewage treatment device. The production area is located on the west side of the site, including the process equipment area and the heating furnace area. The venting area is separately set in the northeast direction of the site and located at the windward side of the field with the minimum wind frequency.

2.5m high solid wall is used around the station, 1.8m high steel mesh fence is used around the venting area.

The vertical design adopts a flat slope, and the slope of the site is 0.5%. The earthwork volume in this station is about: Fill: 15000m3, Excavation: 8000 m3.

Organized drainage for rainwater is adopted in the station. After collecting rainwater from the road inside the station, it is discharged into the natural ditches nearby. The rainwater flow in the station is: building roof→site→road→external drainage ditch→natural ditches nearby.

The greening of the station site focuses on the office area, it will plant plants which are rich in ornamental and common evergreen trees, shrubs and turf. The venting area will be paved with gravel.

（3）Road and masonry works

The road in the station adopts the urban concrete pavement. The main road is 6m wide and it’s turning radius is 9m. The secondary road is 4m wide and it’s turning radius is 12m. The road outside the station is 6m wide as the suburban concrete pavement. The newly built road and the extension road of the station is about 1km, which is connected to the rural cement road on the west side of the station.

The station entrance and exit is set on the south side of the site, and a 1.5m wide evacuation door is set at the south side of the production area.

In order to facilitate daily operation and equipment maintenance, some areas like process equipment area is paved with 80mm thick square bricks, and a 2m wide sidewalk is set at an appropriate position between the equipment area and surrounding roads. Other open spaces in the production area are paved with graded gravel.

4.3.2.7 Chengnan Terminal Station

（1）Station location

The site is located in Lixian Town, Daxing District, Beijing City, and is adjacent to the west side of Chengnan High-voltage A Station.

The location of the proposed site is in a local cemetery which is flat and planted with trees. The north side of the site is Hengyi Road, Xinhang Chengdong District, the east side is the planned Zongyi Road, Xinhang Chengdong District, and the west side is the 5m wide asphalt road. The venting area is located on the east side of Zongyi Road, Xinhang Chengdong District. The existing drainage ditch on the south side of the site can be used as a rainwater outlet for the station. And it can be connected to the planned urban roadside municipal rainwater pipe network in the future. 25 graves need to be moved, 1 private house and about 400m wall need to be demolished.

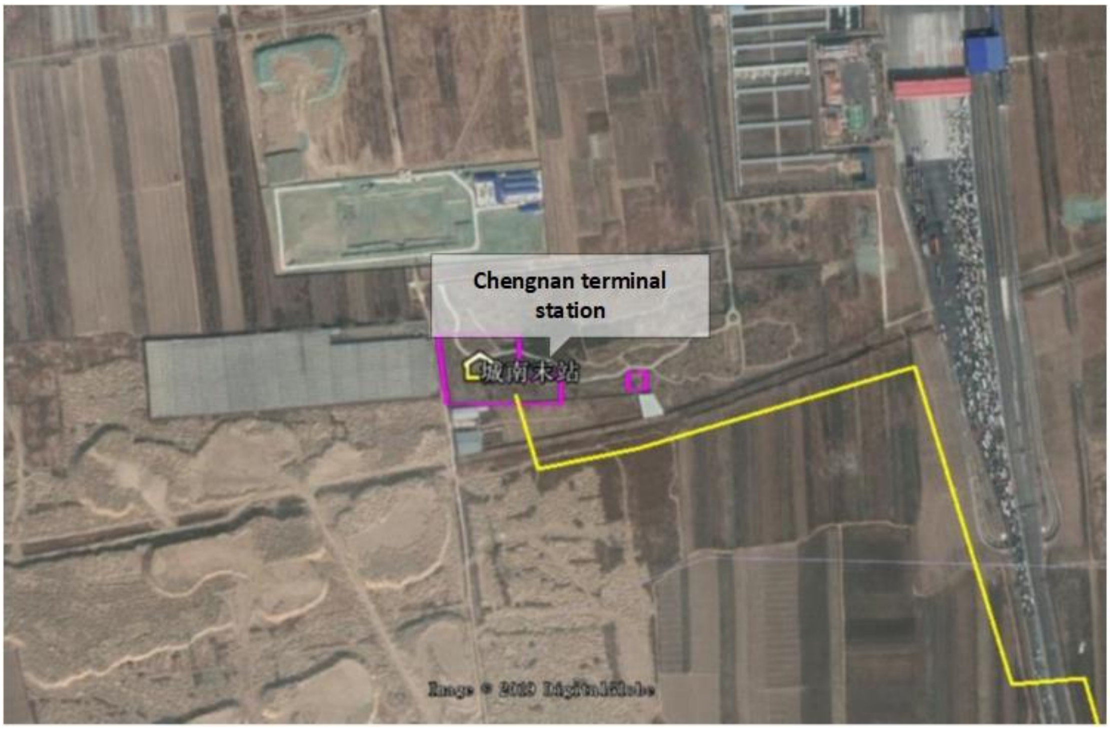


Figure 4.3-6 Chengnan terminal Station Regional layout

（2）General layout

The general layout of Chengnan Terminal Station is divided into two areas: station area and venting area. The station area is on the west side and south side of Chengnan High-voltage A Station. It is located in the west side of Zongyi Road, Xinhang Chengdong District, and is equipped with process equipment area, comprehensive building, boiler room, fire water storage tank and rain water storage tank.

The venting area is separately set on the east side of the Zongyi Road, Xinhang Chengdong District, which is located at the windward side of the field with the minimum wind frequency.

2.5m high solid wall is used around the station, 2.5m high steel mesh fence is used around the venting area.

The vertical design adopts a flat slope, and the slope of the site is 0.5%. The earthwork volume in this station is about: Fill: 20000m3, Excavation: 13000 m3.

Organized drainage for rainwater is adopted in the station. After collecting rainwater from the road inside the station, it is discharged into the southside natural ditches or planned road drainage network. The rainwater flow in the station is:

building roof→site→road→external drainage ditch→southside natural ditches/ municipal pipe network.

The greening of the station site focuses on the comprehensive building area, it will plant plants which are rich in ornamental and common evergreen trees, shrubs and turf. The venting area will be paved with gravel.

（3）Road and masonry works

The road in the station adopts the urban concrete pavement. The main road is 6m wide and it's turning radius is 9m. The secondary road is 4m wide and it's turning radius is 12m. The road outside the station is 6m wide as the suburban concrete pavement.

The station entrance and exit is set on the west side of the site, connecting the existing cement road. A 1.5m wide evacuation door is set at the east side of the production area.

In order to facilitate daily operation and equipment maintenance, some areas like process equipment area is paved with 80mm thick square bricks, and a 2m wide sidewalk is set at an appropriate position between the equipment area and the fire passage. Other open spaces in the production area are paved with graded gravel.

4.3.2.8 Valve Chamber

There are 10 block valve chambers in this project, which are all monitoring valve chambers. The monitoring valve chamber includes Class A monitoring valve chamber and Class B monitoring valve chamber. The Class A monitoring valve chamber is equipped with a valve group area, a skid mounted room and an venting standpipe. The Class B monitoring valve chamber is equipped with a valve group area, an integral foundation and an venting standpipe. A 2.5m high solid wall is set surrounding valve chambers and the entrance and exit is 4m wide. The road outside the valve chambers is equipped with a 4m wide grade gravel road.

4.4 Utility Works

4.4.1Water Supply And Drainage

4.4.1.1 Water supply

Chengnan Terminal Station, Nangang Distribution Station, Jinghai Transmission station, Yongqing Transmission station and Anci Distribution Station all need a living water supply system. The small amount of production water and cleaning water for the production facilities can rely on the living water supply system.

The Daqiuzhuang Distribution Station is unattended and does not have a water supply system.

4.4.1.2 Water supply source

The water source of Chengnan Terminal Station and Nangang Distribution Station is from the municipal water supply. A water supply pipe is introduced into the station from the nearby municipal planning road, and the total water meter is metered and directly supplied to each water point in the station.

The water sources of Yongqing Transmission station, Jinghai Transmission station and Anci Distribution Station are supplied by the self-contained water source wells of the station. The water volume, water pressure and water quality should meet the requirement of the project.

4.4.1.3 Drainage

The Chengnan Terminal Station, Nangang Distribution Station, Jinghai Transmission station, Yongqing Transmission station and Anci Distribution Station all need a living drainage system. The Daqiuzhuang Distribution Station is unattended and does not have a drainage system.

The drainage will be combined with sewage and waste in Chengnan Terminal Station and Nangang Distribution Station. The domestic sewage will be treated by the outdoor septic tank and discharged into the municipal drainage network. The domestic sewage of Jinghai Transmission station, Yongqing Transmission station and Anci Distribution Station will be treated by the outdoor septic tank and discharged to the outdoor integrated sewage treatment equipment. They are used for greening and flushing the road in the station after treatment, and will not be discharged.

4.4.2Heat Supply

The station boiler uses natural gas as fuel. The natural gas is filtered, regulated, metered and then sent to the boiler room. The gas pressure to the boiler room is 5~10kPa. An Electromagnetic Valve (Normally Open) and a Quick Block Valve are set on the gas supply pipe of the boiler room, and a gas alarm is installed in the boiler room. When there is a gas leak in the room, the gas alarm will make sound and light alarm and the Electromagnetic Valve will close the gas supply.

4.4.3Heating, ventilation and air conditioning

The comprehensive duty room of Nangang Distribution Station, Jinghai Transmission station, Yongqing Transmission station and Anci Distribution Station all use a radiator heating system. The return water is provided by the gas boiler, and the water temperature is 80/60 °C. For the up-supply and up returning double-pipe remote system, each set of radiator water supply pipe is equipped with a high-resistance two-way thermostatic control valve.

The electric heating system is used in the integrated equipment rooms Nangang Distribution Station, Jinghai Transmission station, Yongqing Transmission station, Anci Distribution Station and Daqiuzhuang Distribution Station.

The boiler room in the comprehensive building and the comprehensive equipment room of Chengnan Terminal Station adopts the radiator heating system. The heat source is provided by the gas boiler, and the water temperature is 85/60 °C. For the up-supply and up return double-pipe remote system, each set of radiator water supply pipe is equipped with a high-resistance two-way thermostatic control valve.

In general, it adopts natural ventilation. When some rooms emit harmful gas such as flammable and explosive gas or rooms generate a large amount of residual heat, if natural ventilation does not meet the requirements, mechanical ventilation is adopted.

4.4.4Anticorrosion

The exposed pipelines and equipment in the stations and valve chambers are protected by acrylic polyurethane coating system. The buried pipelines and facilities in the stations and valve chambers are protected by 3LPE or solventless liquid epoxy coating + polypropylene cold-wound system. After the flange gasket and bolt nut are installed, The organic thermoplastic coating is used for protection. The buried valve (including the gas-liquid linkage valve) in the station and other buried parts of the different components are made of viscoelastic anti-corrosion tape system (with matching polypropylene anti-corrosion tape) for anti-corrosion. The buried pipeline in the station adopts the forced current method for regional cathodic protection.

4.4.4.1 Automatic control

The automatic control system for the pipeline uses computer-based monitoring and data acquisition system (SCADA). The production and operation parameters of the pipeline will be transmitted to the "Beijing Gas Control Center" through the data communication system. The dispatch control center will centrally monitor, control and manage the production and operation of each station of the gas pipeline, and receive important parameter related to the gas pipeline. The control center monitors the stations and valve chambers separately by establishing a computer control system. The station control system and the monitoring valve chamber RTU can control and operate the process equipment of the station under the authorization of the dispatch control center. The operation control of the dispatch control center to the station includes at least: station ESD command, normal start of the station, normal shutdown of the station, etc.

The pipeline full-line monitoring valve chamber transmits data to the upstream and downstream stations through the communication equipment, and uploads data to the control center through the communication route of the upstream and downstream stations.

4.4.5Communication

This project mainly adopts optical communication mode, and the optical communication system speed grade is STM-4. A set of 622 Mbit/s optical communication equipment was set up at Nangang Distribution Station, Daqiuzhuang Distribution Station, Jinghai Transmission station, Yongqing Transmission station, Anci Distribution Station, and Chengnan Terminal Station separately. The SCADA data is transmitted to Chengnan Terminal Station via the optical communication system, and the dedicated digital circuit is leased at the Chengnan Terminal Station to transmit the SCADA data of each station to Beijing Operation and Dispatch Center.

The SCADA alternate transmission mode of each station is consistent with the alternate communication mode of the LNG receiving station, that is, the leased special line digital circuit is used to transmit the data to the Beijing dispatching room.

4.4.6Labor quota

Relies on this project Beijing Gas Group established natural gas sales branch, LNG receiving station branch, and pipeline branch, have 274 employees in total, of which:

Natural gas sales branch: set up business department, sales department, verification and measurement center, etc., a total of 40 people

LNG receiving station branch: set up operation department, technical department, engineering department, maritime department, commodity inspection department, etc., a total of 150 people, including 30 administrative personnel, 110 production operators at the receiving station, and 10 maintenance personnel. The operating shift system adopts four shifts and three operating systems. The main operation management and production are handled by the production operation dispatching department, and the various departments of the receiving station are located inside of the receiving station.

Pipeline branch: set up engineering department, technical department, operation and maintenance department, safety and environmental protection department, etc., a total of 84 people, including 15 people in headquarters, 5 people at First Stop of the Receiving Station, 10 people at Jinghai Transmission station, 10 people at Yongqing Transmission station, 44 people at Chengnan Terminal Station (including 34 repair workers). The operating shift system adopts four shifts and three operating systems, and the operation management and production are mainly in charged by the operation and maintenance department.

The natural gas sales branch, the LNG receiving station branch (non-operating maintenance personnel), and the pipeline branch (non-operating maintenance personnel) all rent office and accommodation in the Economic Development Zone MSD. At the receiving station, 90 people work in the daytime and 10 people are on night shift. (may add up to 30 external staff to work).

4.5 Pipeline Gas Transportation Process

4.5.1Gas Source

The pipeline gas source is imported LNG

4.5.2Gas Source Component And Physical Characteristics

Table 4.5-1 Natural gas component of Beiran Nangang LNG pipeline

Component	Unit	Lean solution		Rich solution
methane (CH4)	mol%	99.86		87.74
ethane (C2H6)	mol%	0.04		7.81
propane (C3H8)	mol%			2.83
isobutane (i-C4H10)	mol%			0.53
n-butane (n-C4H10)	mol%			0.62
isopentane (i-C5H12)	mol%			0.08
n-pentane (n-C5H12)	mol%			0.03
nitrogen (N2)	mol%	0.1		0.36

4.5.3Other Design Parameters

（1）Standard status

The standard state of the gas is a pressure of 0.101325 MPa and a temperature of 20 °C.

（2）Supply pressure and temperature

The design pressure of the send-out pipeline is 10MPa. Under the design distribution capacity, in order to ensure that the temperature of the Chengnan Terminal Station is not lower than 0 °C, according to the calculation, the exit temperature of First Stop of the Receiving Station is not lower than 20 °C.

（3）Setting of pipeline peak shaving and transporting days

The annual transporting days of the pipeline are 365, which are consistent with the receiving station. The total guarantee days are 62, among them, emergency security days are 5, and the peak shaving days are 57.

4.5.4Station Process

4.5.4.1 First Stop of Receiving Station

The station is located in the Beiran Nangang LNG receiving station. The design pressure is 10MPa, and the designed maximum daily output is 6000×104Nm3/d. The main function is ball-sending and communicating with the send-out pipeline, and other parts are considered by the Beiran Nangang LNG receiving station.

4.5.4.2 Nangang Distribution Station

The design pressure is 10MPa, and the maximum distribution is 80×104Nm3/h. The main functions are filtration, metering, pressure regulation, venting and sewage.

4.5.4.3 Daqiuzhuang Distribution Station

The design pressure is 10MPa, and the maximum distribution is 400×104Nm3/d (peak volume 25×104Nm3/h). The main functions are filtration, metering, pressure regulation, venting and sewage.

4.5.4.4 Jinghai Transmission station

The design pressure is 10MPa, and the maximum distribution is 1400×104Nm3/d. The main functions are filtration, metering, pressure regulation, venting and sewage. The send-out pipeline is interconnected with the Mengxi Coal to Gas pipeline at Jinghai Transmission station.

4.5.4.5 Yongqing Transmission station

The design pressure is 10MPa, and the maximum distribution is 3600×104Nm3/d. The main functions are ball-collecting, ball-sending, filtering, metering, regulating, venting and sewage. The send-out pipeline is interconnected with the China-Russia East Line at the Yongqing Transmission station.

4.5.4.6 Anci Distribution Station

The design pressure is 10MPa, and the maximum distribution is 35×104Nm3/h. The main functions are filtration, heating, metering, pressure regulation, venting and sewage.

4.5.4.7 Chengnan Terminal Station

The station is to receive gas from Anci Distribution Station, and distribute gas to the downstream town, the designed distribution is 3600×104Nm3/d, and the design pressure is 10MPa. The main functions are collecting, filtering, heating, metering, regulating, and distributing.

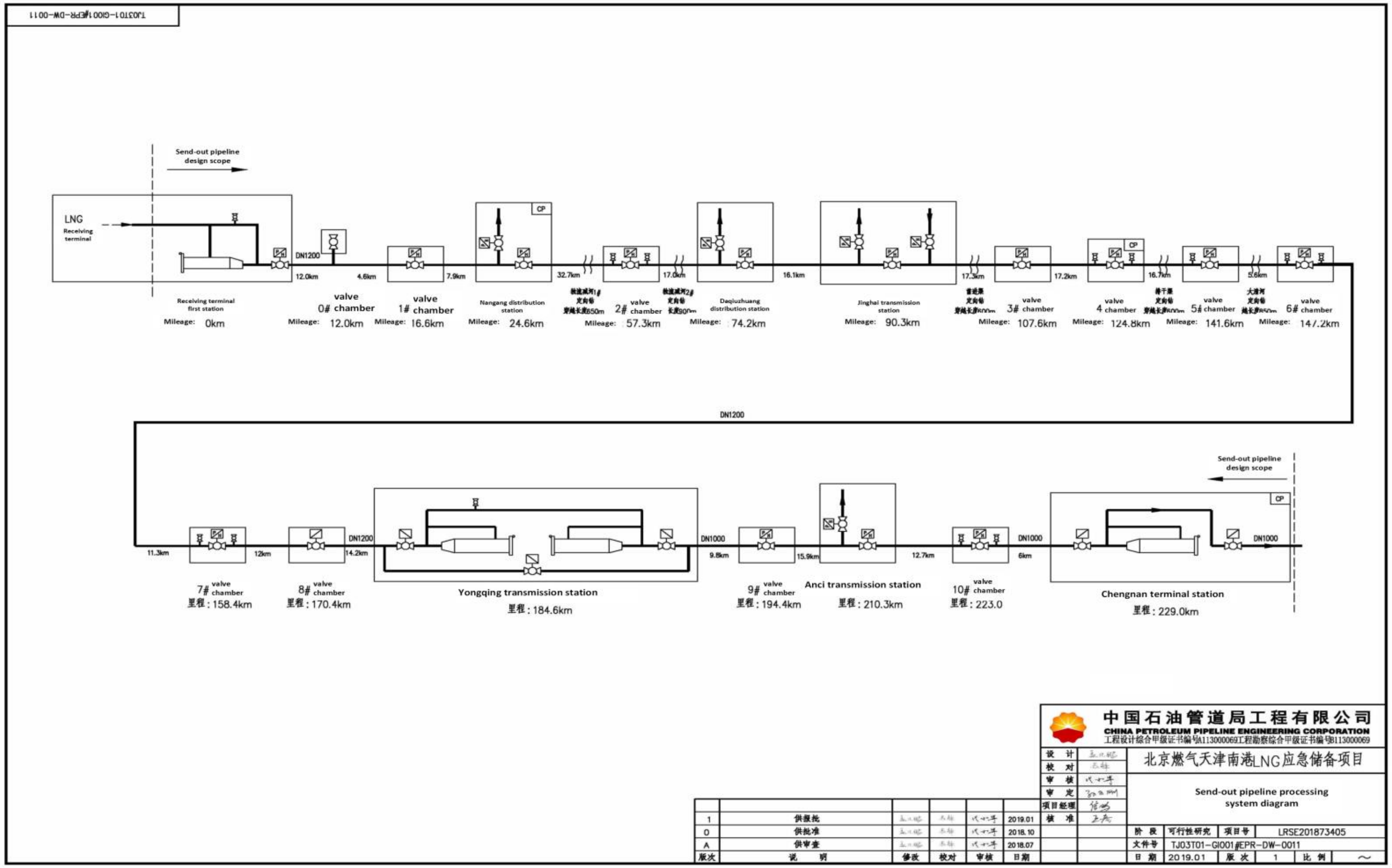


Figure 4.5-1 Send-out pipeline process flow chart

4.6 Land Occupation

4.6.1Permanent Land Use

The total land use for the project is 11.45 hectares, of which the land area is about 11.28 hectares.

Table 4.6-1 List of permanent land use by provinces, cities (counties) Unit: hectare

Serial Number	Areas	Areas in total	Station (including venting area)	Valve Chamber (including venting area)	Maintenance team	accompanying roads	Other land	Remarks
一	Tianjin City	6.193	4.8978	0.8932			0.402	
二	Hebei Province	3.9311	3.0366	0.6965			0.198	
三	Beijing City	1.3305	1.3289				0.0016	
		11.4546	9.2633	1.5897			0.6016	

Table 4.6-2 Various types of permanent land use list Unit：m2

Serial Number	Function	Land Area				Affiliated to the county
		Sub-Total	Within the center line of the fence (including venting area)	Outside the center line of the fence (access road, slope protection, etc.)	Other land	
一	Station (including venting area)					
1	Nangang Distribution Station	26641	11950	14691		Binhai New District, Tianjin
2	Daqiuzhuang Distribution Station	8615	6966	1649		Jinghai District, Tianjin
3	Jinghai Transmission station	13722	11630	2092		Jinghai District, Tianjin
4	Yongqing Transmission station	18760	13380	5380		河北省廊坊市永清县
5	Anci Distribution Station	11606	9880	1726		河北省廊坊市安次区
6	Chengnan Terminal Station	13289	11794	1495		北京市大兴区
二	Valve Chamber (including venting area)					
1	1# Monitoring Valve Chamber	1747	1072	675		Binhai New District, Tianjin（Sea area section）
2	2# Monitoring Valve Chamber	1686	1600	86		Binhai New District, Tianjin

Serial Number	Function	Land Area				Affiliated to the county
		Sub-Total	Within the center line of the fence (including venting area)	Outside the center line of the fence (access road, slope protection, etc.)	Other land	
3	3# Monitoring Valve Chamber	1042	960	82		Jinghai District, Tianjin
4	4# Monitoring Valve Chamber	1686	1600	86		Jinghai District, Tianjin
5	5# Monitoring Valve Chamber	1687	1600	87		Xiqing District, Tianjin
6	6# Monitoring Valve Chamber	1084	988	96		Wuqing District, Tianjin
7	7# Monitoring Valve Chamber	1730	1600	130		Anci District, Langfang City, Hebei Province
8	8# Monitoring Valve Chamber	1721	1600	121		Anci District, Langfang City, Hebei Province
9	9# Monitoring Valve Chamber	1743	1600	143		Yongqing County, Langfang City, Hebei Province
10	10# Monitoring Valve Chamber	1771	1600	171		Guangyang District, Langfang City, Hebei Province
三	Others					
1	Three piles of land use	4020			4020	Tianjin City
		1980			1980	Hebei Province
		16			16	Beijing City

4.6.2Temporary Land Use

The total amount of temporary land use for this project is 671.66hm2, which is mainly used for pipeline construction.

Table 4.6-3 List of temporary land use by provinces, cities and counties Unit：hectare

Serial Number	Project Name / Area	Pipeline Construction	Material yard	Others	Sub-Total
	Total	633.5	5.07	33.09	671.66
I	Tianjin City Sub-Total	435.4	3.11	22.47	460.97
1	Binhai New District	176.4	1.26	9.1	186.76
2	Jinghai District	205.8	1.47	10.62	217.89
3	Xiqing District	28	0.2	1.44	29.64
4	Wuqing District	25.2	0.18	1.3	26.68
II	Langfang City Sub-Total	196.8	1.46	10.55	208.8
1	Anci District	64.4	0.46	3.32	68.18
2	Yongqing County	97.3	0.73	5.27	103.3
3	Guangyang District	35.1	0.27	1.95	37.32
III	Beijing City Sub-Total	1.3	0.5	0.07	1.87
1	Daxing District	1.3	0.5	0.07	1.87

4.7 Main Construction Scheme and Schedule

4.7.1Construction Scheme

4.7.1.1 Pipeline construction

First of all, we must measure the alignment, clean the construction site, level the work belt, and build the access road (so that the construction personnel, vehicles, pipes, etc. could enter the construction site). The pipeline will be transported to the site after anti-corrosion insulation, and then be installed, assembled and welded, non-destructive tested, field jointed and anti-corrosion leak detected. After completion of pipeline trench excavation, railway crossing, road crossing, river crossing and other basic work, it will finish pipeline setting, section pressure test, station connection, pipeline pigging, cathodic protection, completion acceptance.

4.7.1.2 Precessing station construction

First of all, we will clean the site, then install the process equipment and build the corresponding auxiliary facilities.

After the completion of the above-mentioned works, the pipeline trench will be backfilled, the site will be cleaned, the landform and the surface vegetation will be restored, the site will be greened and completed.

The construction process of pipeline construction is shown in Figure 4.7-1.

Figure 4.7-1 Pipeline construction process

4.7.1.3 Construction work belt cleaning

Before the pipeline construction, the construction work belt needs to be cleaned and leveled so that the construction personnel, vehicles and machinery can pass, and then the trench excavation can be carried out. Considering the topography and geomorphology along the route, and using the design and construction of the existing gas pipeline as a reference, combined with the current domestic construction machinery and equipment requirements, the pipeline construction work belt width is determined according to different topography: the belt width of the D1219mm pipe in general sections are 28m, in the water network and river crossing sections are 45m, in the more than 5m dredging depth sections are 50m, and in areas occupied by economic crops, forest land and protected areas should be reduced as much as possible, are 24~26m. The belt width of D1016mm pipeline in general sections are

26m, in the water network and river crossing sections are 43m, in the more than 5m dredging depth sections are 48m, and in areas occupied by economic crops, forest land and protected areas should be reduced as much as possible, are 22~24m.

4.7.1.4 Large excavation crossing construction

（1）When the pipeline passes through farmland, grassland, woodland and other local roads, it will be constructed by large excavation. After the pipeline is installed, it will restore the ground and pavement immediately in original status. There is no protective casing when excavating.

The pipelines are mainly laid underground. The depth of the pipeline top cover is not less than 1.2m and is greater than the maximum frozen soil depth. The bottom of the stone section should be over-excavated by 0.2m, and the fine soil should be backfilled to 0.3m above the pipeline top. When the pipeline passes through large and medium-sized rivers, the pipeline top should be buried at least 1.0m below the stable layer of the riverbed in 100 years flood return period. The depth of pipeline should be 1.5m for farmland, cultivated land, and areas prone to third-party damage. The schematic diagram of the excavation operation of the general section is shown in Figure 4.7-2.

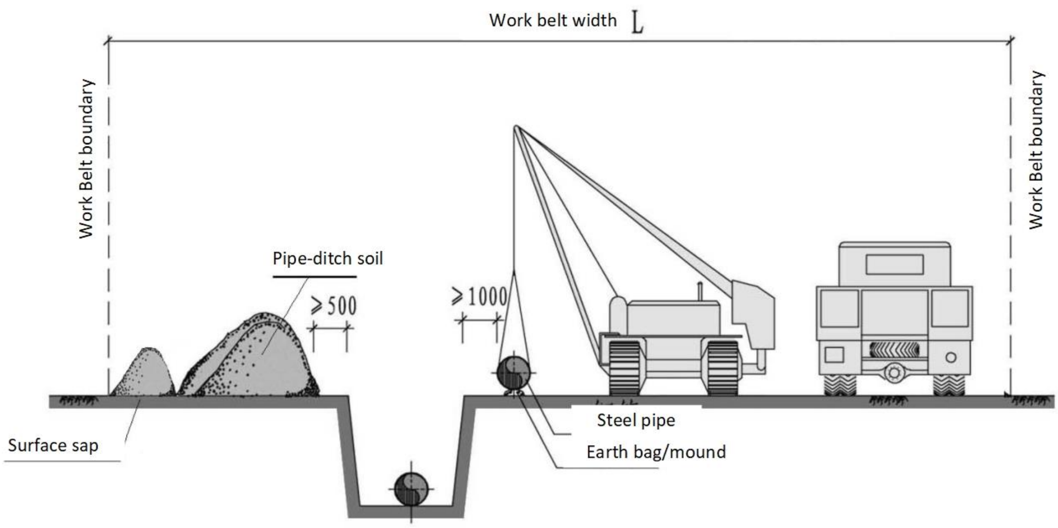


Figure 4.7-2 Schematic diagram of pipeline excavation in general area

In farmland, grassland, forest land, etc., the mature soil (topsoil) and the raw soil (subsoil) are piled up separately, and the trenches are filled with raw and mature soil orderly to protect the tilth layer., There should be a natural settlement allowance above the trench after backfilling (0.3m above the ground), and the excess earthwork will be nearly leveling.

（2）River excavation crossing construction

Large excavation construction methods are adopted in shallow and small rivers, as well as general agricultural or drainage trenches. Large excavation construction are generally carried out in dry seasons. Small rivers, trenches, ponds or fish ponds crossing shall be adopted by cofferdam diversion trench excavation, or by direct trench excavation after precipitation. The bank slopes of the trenches shall be protected by stone pitching and slope protection measures; The pipeline is buried in a stable layer below the riverbed scouring line.

The cofferdam diversion trench excavation method is to dig the diversion trench first, divert or closure the river from the cofferdam to the diversion trench, and then excavate the trench in the river channel mechanical or manually. The distance between the intercepting dams at both ends is set according to the construction operation, and is generally not less than 45m. It should ensure the safe burial depth of the pipeline and ensure that the pipeline passes through the stable layer of the riverbed when crossing the river. The schematic diagram of the construction section of the cofferdam diversion trench excavation method is shown in the figure below.

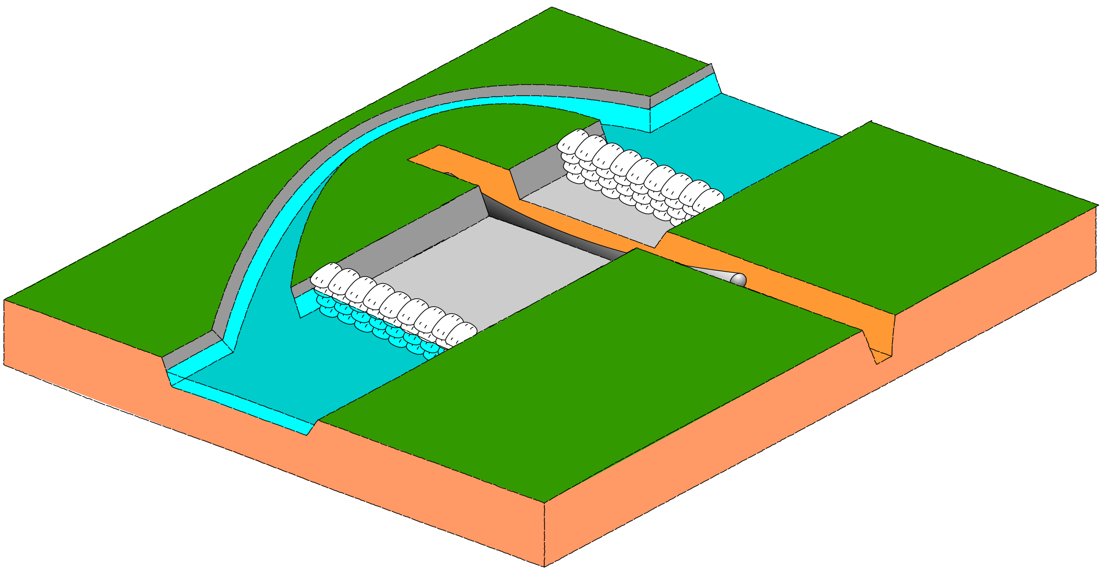


Figure 4.7-3 Schematic diagram of construction section of cofferdam diversion trench excavation method

4.7.1.5 Pipe jacking construction

When crossing the expressway, railway and main roads, it will adopt horizontal hole drilling machine or jacking method. The top of the casing is not less than 1.2m from the road and railway road, and not less than 0.5m from the bottom of the roadside trench. Some provincial and sub-county asphalt roads should take the traffic flow into account, and may cross by pipe jacking.

The pipe jacking construction technology is a relatively mature construction technology for non-excavation laying pipelines domestic and overseas. It could be divided into muddy water balance method, earth pressure balance method and artificial digging jacking method. Domestic currently, construction methods which are mainly adopted is to use a large thrust jack to directly press the prefabricated casing into the soil layer, and then use manual or mechanical excavation to remove the stone and residual soil. It could be mainly divided into surveying setting-out, excavating work pits, laying guide rails, installing hydraulic jacks, lifting concrete prefabricated pipes, excavating soil, pipe jacking, re-excavating soil, re-pipe jacking, completion acceptance, etc. The schematic diagram of the pipe jacking construction process is shown in the figure below.

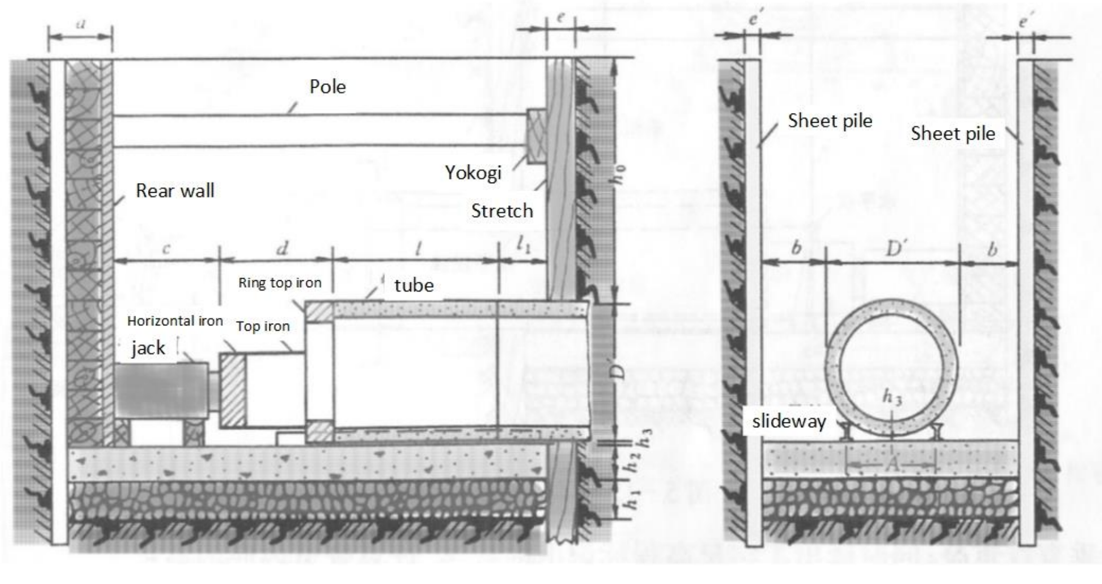


Figure 4.7-4 Schematic diagram of jacking construction structures and facilities

The sectional diagrams of construction methods for road crossing and railway crossing are shown in the following figure.

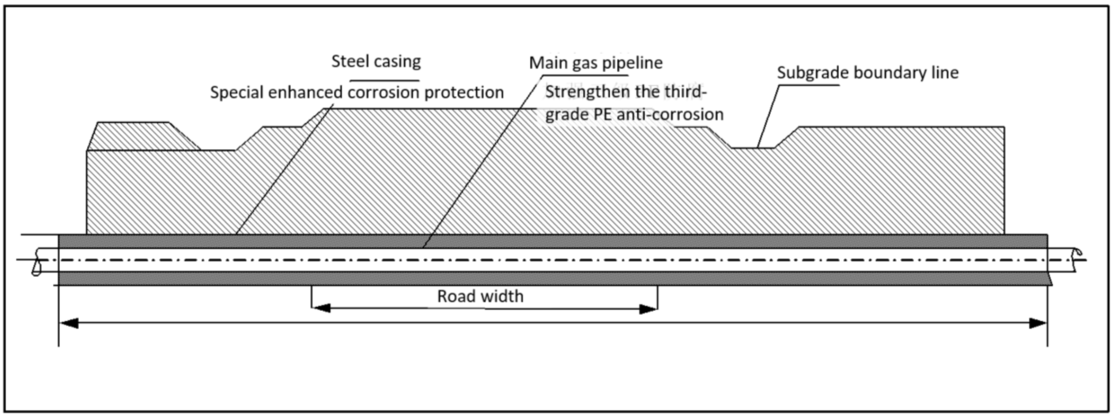


Figure 4.7-5 Sectional diagram of construction method for road crossing

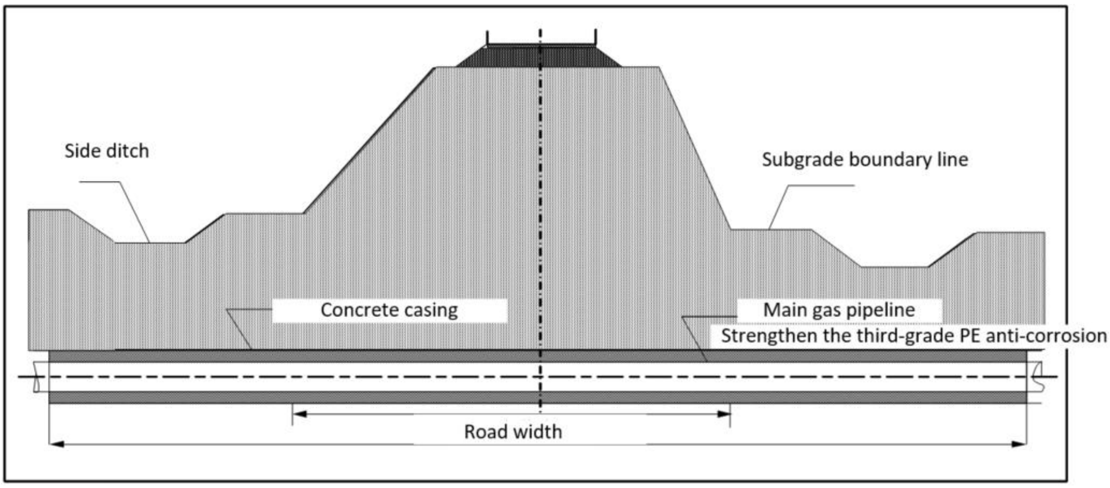


Figure 4.7-6 Sectional diagram of construction method for railway crossing

4.7.1.6 Directional drilling

（1）Directional drilling crossing river construction Process

The use of directional drilling for pipeline crossing construction is generally divided into three stages:

In the first stage, the rig is installed on the side of the entry point. The rig will Start from the entry point, go along the designed route, in a curve from the entry point to the exit point which will be a guiding curve for the pre-expanded and towed line.

In the second stage, the guild hole is reamed, and the drilled hole is often smaller than the diameter of the towed line. In order to make the drilled hole reach 1.3 to 1.5 times the diameter of the towed line, a reamer is required to expand the guild hole to the desired diameter from the exit point to the entry point.

The third stage is that the underground hole passes through the pre-expanded hole. After getting the towing request, the drill pipe, the reamer, the towed joint and the installed pipeline are connected in turn. And then drag the pipeline while expanding back to the entry point from the exit point.

The section diagram of the directional drilling crossing the river construction process is shown in the figure below.

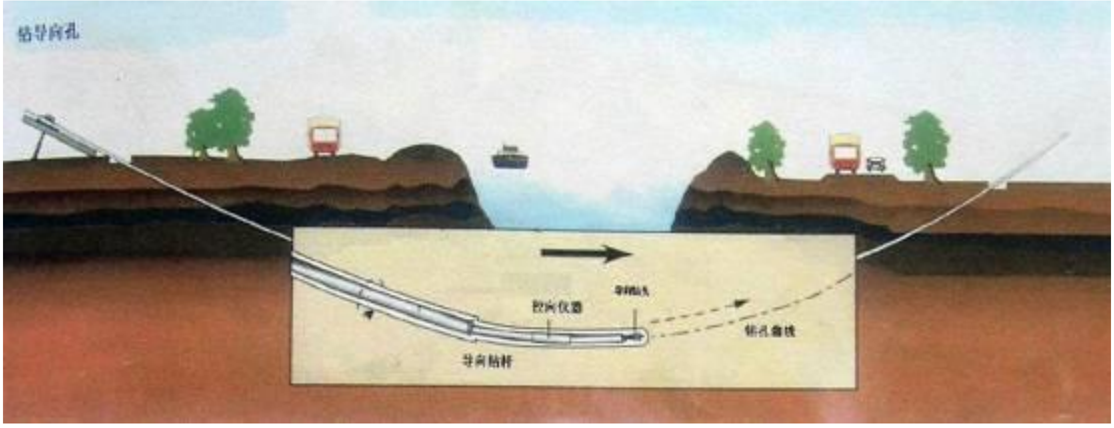


Figure 4.7-7 Sectional diagram of drill guide hole in direction construction

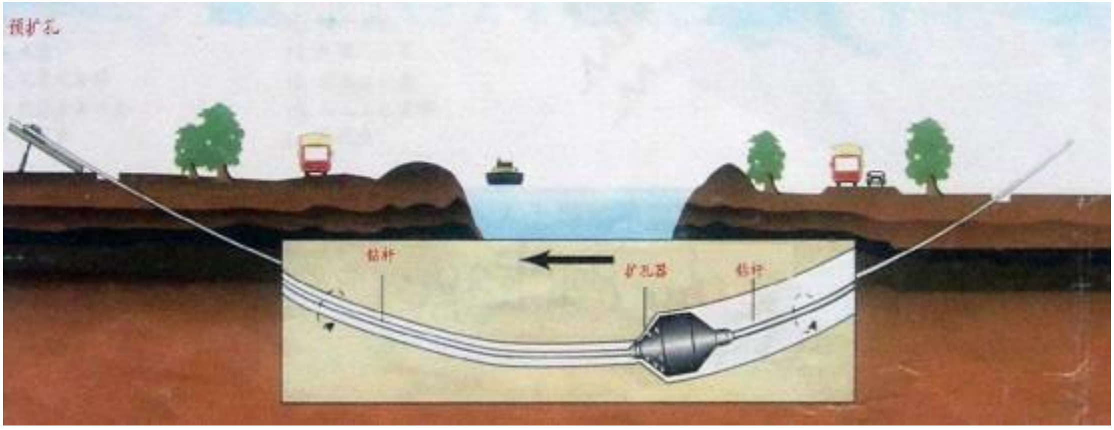


Figure 4.7-8 Sectional diagram of pre-expanded hole in directional drilling construction

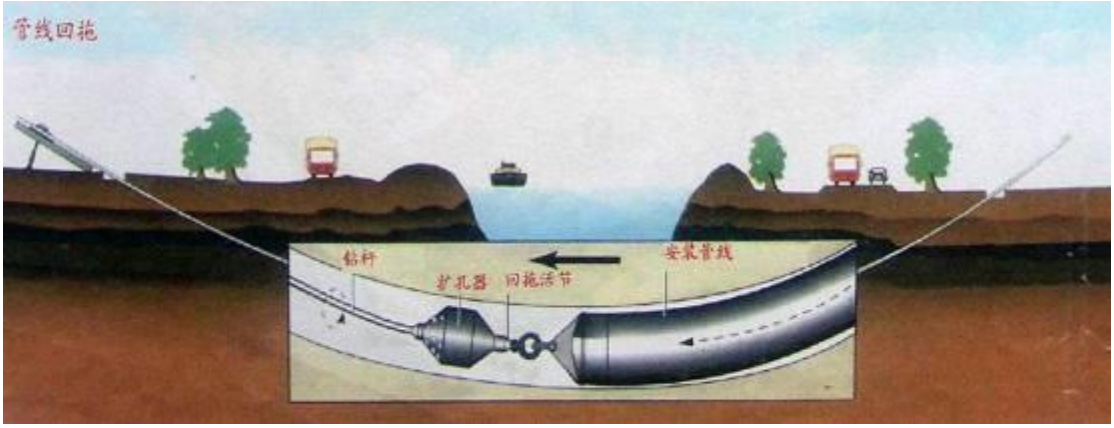


Figure 4.7-9 Sectional diagram of pipeline towing in directional drilling construction

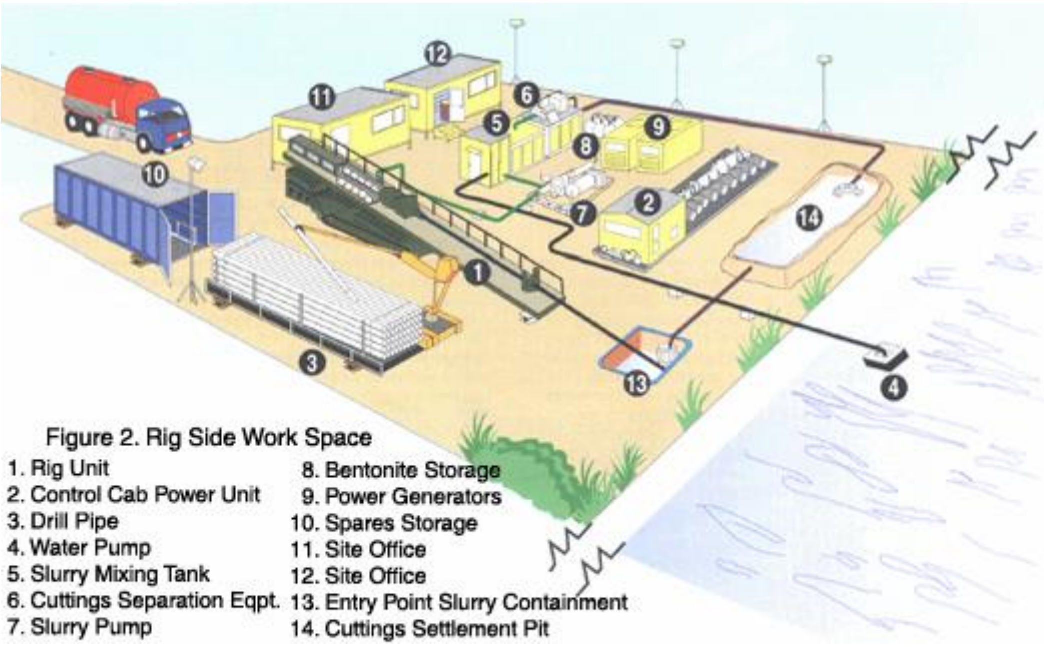


Figure 4.7-10 Schematic diagram of Rig Side Work Space

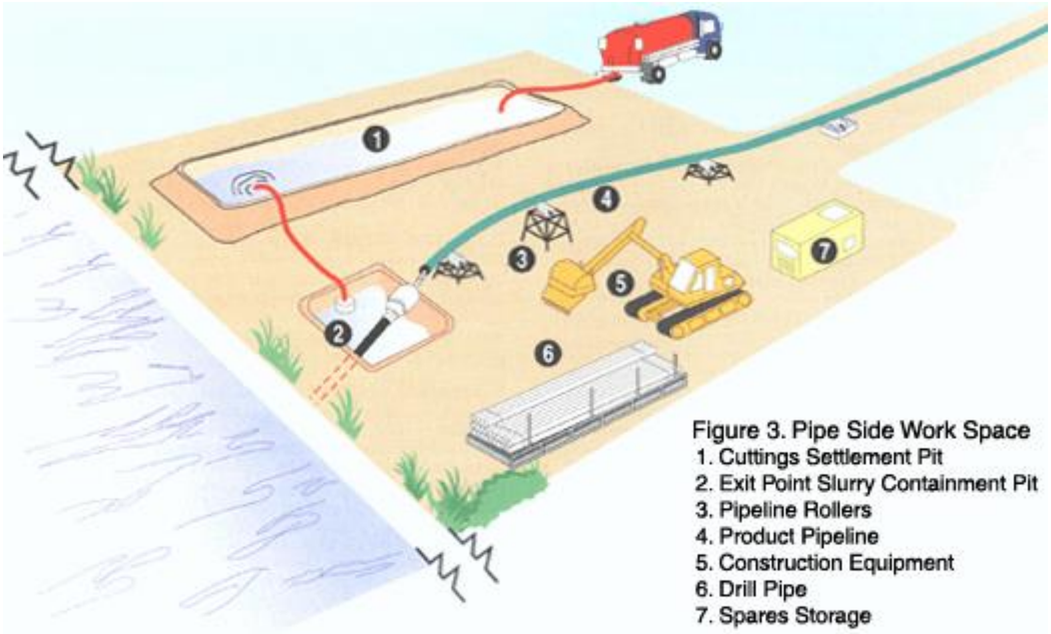


Figure 4.7-11 Schematic diagram of Pipe Side Work Space

Directional drilling can be constructed all year round without seasonal restrictions. It has advantages like short construction period, good engineering quality, river navigation and flood control unaffected, buried depth guaranteed, aquatic life and water quality of river unaffected. However, directional drilling construction will also cause some environmental problems, including the temporary land occupation for the construction site; Cutting settlement pit and slurry containment pit at the construction site may leak polluted water; waste mud and cuttings will also be produced after construction.

Construction schedule

The overall construction period of the project will take about 44 months (including the construction preparation period).

5 Engineering Analysis

5.1 Analysis of Environmental Impact Factors

5.1.1Analysis of environmental impact factors during construction period

The main impact of water environment during construction period mainly occurs during port engineering and dredging engineering works. Agitation results in suspended sediment, causing turbid water body and reduced water quality, thus impacting the seawater quality and marine lives. The direct impact of work platform, berthing dolphin and mooring dolphin is damaging the living environment of benthos and bury the habitat of berthos. During construction period, the main pollution factor of marine environment is SS.

During engineering construction period, the main pollutants discharged to environment include the domestic sewage and domestic waste caused by construction personnel, construction waste water, dust from working, mechanical smoke & dust, and construction noise etc.

From the above, the main links of pollutant occurrence during construction period include: Construction of port engineering, dredging engineering and water intake-outlet engineering; construction of dock's upper structure; dust from working, exhaust of machineries, paint-spray emissions, construction noise, and solid wastes etc. However, such pollutions are only temporary, which will disappear along with the completion of engineering construction, and normally no permanent pollution effect will occur.

(I) Ecological environment impact analysis

During engineering construction period, the impact of ecological envionrment is mainly reflected in the following aspects,

(1) Cleanup of construction work area, road construction, and pipe trench excavation

① Cleanup of construction work area and excavation of pipe trench

Low-mountain and hilly areas: In order to cleanup the construction work area in low-mountain and hilly areas, firstly, all the woods in this range will be felled. Then at the rock sector, it will be necessary to explode roks for pavement and explode out the pipe trench; during its construction period, it will not only cause larger damage to the vegetation of the work area, but also will cause certain amount of abandoned dregs. If these abandoned dregs are not properly treated, it will cause water loss and soil erosion.

Plain: The plain area where the pipeline passes through is mainly farm land, and the soil body disturbance caused by pipe trench excavation will change the soil's structure, composition, and physicochemical property characteristics etc., which will further impact the erosion condition of soil, recovery of vegetation, and growth of crops.

In this project, the pipelines are laid mainly in a trench-buried manner. Pipe trench excavation will cause disturbance and damage to the soil and vegetation in the scope of entire construction work area, and the damage of vegetation will be serious especially in the rang of about 5m of pipe trench excavation;Plain: the soil body disturbance caused by pipe trench excavation will change the soil's structure, composition, and physicochemical property characteristics etc., which will further impact the erosion condition of soil, recovery of vegetation, and growth of crops.

During the laying of pipeline, some abandoned earthwork will also occurr, which will have certain impact upon ecological environment; besides, abandoned stonework will also occur during the levelling of construction work area of mountaineous sector , and it may easily cause water loss and soil erosion if the abandoned stonework is not properly piled up.

② Build construction access road and pipeline road

In this project, no pipeline road is arranged, and to build construction access road is one of the main activities impacting ecological environment. Such process will normally damage the soil structure and physiochemical property of topsoil, destructing large amount of vegetation, and destroy the living evnironment of animals, thus creating large amount of biological blackspots. Therefore, it's necessary to sufficiently utilize the existing road as much as possible during construction period; for some sectors like plain area and loess hill area without country road connected to the pipeline location, it's possible to temporarily build certain length of construction access road to meet construction requirement at adequate location.

In the someloess hill areas with poor road & traffic conditions where this project passes through, it's necessary to build certain amount of construction access roads in order to facilitate pipeline construction, as well as future operation and maintenance.

Among them, some of the pipeline roads can be converted from the construction access roads by constructing the pavement after the construction task is completed, so as to save the engineering investment.

(2) Crossing engineering

① Crossing of rivers

When crossing large-and-intermediate scale rivers, under the precondition that the geological condition of river bed meets the process condition of directional-drilling construction, the crossing construction process with directional-drilling shall be the first choice; if the geological condition can not meet the precondition of directional-drilling process, try as much as possible to adopt crossing mode of pipe-jacking, so as to avoid impacting the water quality of rivers.

When cross the rivers and diteches with small water volume, crossing can be achieved by adopting pipe trench excavation with cofferdam diversion or pipe trench burying with direct excavation. The impact of crossing rivers with large-scale excavation is mainly reflected as increasing the sediment content, thus the content of suspended solids in river will increased, and the water quality of river will be impacted; after pipe trench backfilling, if excessive earthwork and stonework are not properly treated, it may cause water loss & soil erosion or river channel blockage.

② Crossing of gullies and ditches

In this project, the pipelines will pass through small amount of gullies and ditches, adopting the mode of large-excavation trench-burying for crossing. After backfilling of pipe trench, it may possibly cause water loss and soil erosion if excessive earthwork is not properly disposed. Therefore, it's necessary to attach importance to the soil and water conservation work of that area. Regarding crossing ditches, after pipeline construction is completed, it's necessary to immediately restore the the orginal apperance of ditches and protect the pipelines in a hydraulic protection manner such as flow surface etc. to protect the pipeline.

③ Crossing of highway and railway

In this project, crossing of highway is conducted by jacking-pipe and crossing of railway is conducted by culvert box jacking. During construction with adopted process, there will be little influence on environment, except for generating small amount of spoils.

(3) Land occupation of the project

The land occupation of the project is divided into permanent land-occupation and temporary land-occupation, in which temporary land-occupation mainly includes the construction of construction work area, stock yard, and construction access road; and permanent land-occupation mainly includes lands occupied by stations, valve rooms and Three Piles (i.e. milage piles, corner steel sheet piles, and marking piles) etc. In this project, the total area of permanent land usie is 11.45 hectares, in which the stations and valve rooms account for 10.853 hectares and others like the Three Piles (i.e. milage piles, corner steel sheet piles, and marking piles) etc. accounts for 0.6016 hectares; the total area of temporary land use is 671.66 hectares, in which the construction work area accounts for 633.5 hectares, pipeline storage yard accounts for 5.07 hectares, and others account for 33.09 hectares. Permanent land use will change the nature of land use, impacting the environment to some extent. Temporary land use will impact the environment during construction period, and the impact can be reduced to the minimum by ecological-restoration of temporary land-occupation after completion of project.

(II) Waste gas

The construction waste gas mainly comes from the flowing dust generated from ground excavation and driving of construction machineries and transportation vehicles, as well as from the fume discharged from construction machineries (disel engine).

Because the process of excavation and pipeline burying is conducted sector by sector with shorter construction period, less flowing dust will be generated in the process of excavation under the condition of strengthened management.

Apart from excavation construction, during the construction of pipeline with large machineries such as directional-drilling and pipe-jacking crossing etc., because equipment like disel engine is used, small amount of combustion fume will ge generated, and the main pollutants are SO2, NO2 and CmHn etc. Because the amount of waste gas is less and all the construction sites are in the field, it's helpful for the diffusion of air, meanwhile, the waste gas pollution source is intermittent and flowing, therefore, it has less environment impact for local areas.

(III) Waste water

(1) Waste water of pipeline pressure test

Pressure-test by sector is conducted for pipeline engineering in order to test the strength and tightness of pipelines, and the medium of pressure test is clean water, subject to high-point pressure gauge. Test pressure of normal land sector: The pressure of strength test is 1.25 times of designed pressure, holding stable pressure for 4 hours. The pressure of tightness test is 1.1 times of designed pressure, holding stable pressure for 4 hours. For pipelines crossing large-and-intermediate river, railway, second-class highway and above, and express highway, pressure test shall be conducted separately; the pressure of strength test is 1.5 times of designed pressure, holding stable pressure for 4 hours; and the pressure of tightness test is 1.1 times of designed pressure, holding stable pressure for 4 hours.

Clean water is normally for pressure-test water; the pressure-testing pipe sector is normally divided according to location class combined with topography, normally no not exceeding 32km. Pressure-test water can be reused, with reusing rate above 50%, and the maximum sector-wise discharge volume of pressure-test waste water from Φ1219 and Φ1016 pipelines are respectively around 1.86x 10^4m3 and 1.29 x 10^4m3.

Normally, the bid-sections of pipeline construction bid-invitation are not crossing provinces or cities, with length between 70km～80km respectively. The main pollutants of pressure-test waste water after pigging are suspended solids, which can be recycled and used for agricultural irrigation and road spray water ,or discharged after choosing adequate locations; and the waste water of pressure test is prohibited to be discharged into surface water body with the function of drinking water. In this project, the discharge volume of pressure-test waste water is 12.53 x 10^4m3.

(2) Construction domestic water

① Pipeline construction

According to the analogized investigation with the construction period of western sector, No. 2 western line, the discharge rate of domestic sewage, COD, and ammonia nitrogen are respectively 26m^3/km,7.8kg/km, and 0.78kg/km of pipeline construction at normal sector,therefore, the discharge volume of domestic sewage, COD, and ammonia nitrogen during construction period of this project will respectively be 5954m3, 1.79t,and 0.18t.

② Arrangement of construction camps

During the construction period of this project, office and accomodation areas are not arranged in the construction camps near the concentrated residence area, and peripheral private residences will be rented. Construction camps are normally selected at flat ground and gentle-slope land of gentle and spacious topography. During the levelling of construction camp, it will damage the original aboveground vegetation; during the arrangement of construction camp, it will increase the amount of water loss and soil erosion of original ground surface; during the dismantling of temporary facilities after the completion of construction, it will cause exposure of ground surface, resulting in quite serious water loss and soil loss in short period of time. Construction camps are in the category of temporary land occupation, the construction of camps will not damage topography and landforms, and original vegetation can be completely restored after the completion of project. Among various construction activities, construction camps have less adverse effect on ecological environment.

According to previous experience, for renting peripheral private residences instead of arranging construction camps during construction period, the domestic sewage mainly relies on local domestic sewage treatment system; if needing to arrange construction camps, temporary dry latrine should be arranged, and domestic sewage and excrement & urine can be used as farm manure after simple treatment in septic tank. Therefore, the domestic sewage during construction period has less impact on the environment along the line.

(IV) Solid wastes

The solid wastes generated during construction period are mainly domestic wastes, abandoned slurries, engineering abandoned soils, abandoned dregs, and construction wastes.

(1) Domestic wastes

According to analogized investigation, the rate of domestic waste generated during the pipeline construction of ordinary sector is 0.35t/km, and the amount of domestic wastes generated by the construction personnel of this project during construction project will be around 80.15t.

(2) Abandoned slurry

In this project, compound slurry needs to be used for directional-drilling construction, whose main composition is bentonite, containing slight amount of Na2CO3, slightly alkaline, with poor permeability for soil. During construction, the slurry can be reused; After the completion of construction, the remaining slurry (about 40% of total amount of slurry) can be collected in the slurry pit after pH adjustment to neutral; with permission of local environmental-protection authoriteis, such slurry can be buried into anti-seepage slurry pit on-the-spot after curing treatment, covered with

40cm of cultured soil, ensuring to restore original landforms.

(3) Abandoned soil and dregs of engineering

During construction period, the earthwork and stonework mainly comes from pipe trench excavation, crossing & spanning, and building construction access road & gas-transmission process stations. During the construction of this project, the amount of earthwork and stonework shall be adjusted by various types of construction process sectors, and balanced according to the landform units and different construction processes; try as much as possible to realize the balance between various types of construction processes and the earthwork & stonework of various bid-sectors.

① When excavating in the farming area, the mellow soil (surface cultured soil) and immature soil (subsoil) shall be separately piled; when backfilling pipe trench, immature soil and mellow soil shall be backfilled in sequence, so as to protect the cultivation layer. After backfilling, natural settling margin shall be reserved above the pipe trench (higher than ground by 0.3~0.5m), and excessive earthwork shall be levelled nearby.

② Large excavation of cofferdam shall be constructed in dry season, and the engineering work quantity of cofferdam will be small, with lower standard. During excavation, cofferdam needs to be built at the upstream and downstream of river; earth material shall be taken from the pipe trench of work area on both sides of river; after the completion of construction, the cofferdam shall be dismantled, and the soil used for cofferdam shall be restored to the pipe trench of work area on both sides of river, without abandoned earthwork.

③ When crossing express highway and classified highway in a manner of pipe-jacking, excessive earthwork will be generated. This portion of excessive earthwork mainly includes soil and gravel, which can be used as filling stuff of local country road construction or slope protection of road, without abandonded earthwork.

④ Because some abandoned soils and abandoned dregs will generated when crossing large-and-intermediate rivers with directional-drilling, such abondoned soils and abandoned dregs can be used for backfilling of nearby pipelines, construction of stations and valve rooms, and road construction etc.

⑤ Balance of excavation and backfilling shall be basically realized for gas-transmission stations, without stockyard of abandoned soil and abandoned dregs, and new soils and sand & stone materials shall be obtained by commercial procurement.

In this project, the volume of excavation & filling earthwork and stonework is 2.88 cubic meters, balanced in excavation and backfilling, without abandoned earthwork and stonework.

(4) Construction wastes

Construction wastes mainly include the waste welding rods generated in welding work, waste anti-corrosion materials generated in anti-corrosion work, as well as the waste concrete generated during construction etc.

(V) Noise

The noise source mainly comes from construction machinery, such as excavator, electric welding machine, and directional-drilling machine etc., with intensity at 85~105 dB (A).

5.1.2Analysis of environmental impact factors during operation period

Because gas-transmission pipelines are buried underground, adopting enclosed transmission, and anti-corrosion treatment is conducted for the pipeline, there will be no discharging of pollutants under normal conditions. In this project, under normal conditions, the pollutant source is mainly the waste water, waste gas, solid waste and noise source generated from various process stations.

(I) Waste gas

In this project, under normal condition of the outward-transmission pipeline, the waste gas is mainly the discharging of waste gas from water-jacket heating furnace of stations.

In this project, water-jacket heating furnaces are adopted as the heating equipment of natural gas at Anci Distributing Station and Chengnan Terminal Station.

In Anci Distributing Station, 2 sets of water-jacket furnaces are arranged , with single load of 2500kW and total gas consumption of 88.66 x 10^4Nm3/a; at Chengnan Terminal Station, 3 sets of water-jacket furnaces are arranged at Chengnan Terminal Station, with single load of 3000KW and total gas consumption of 48.2 x 10^4Nm3/a. In Anci Distrubuting Station, 1 of the furnace needs to be running for 350 days a year (including 5 days of emergency heating-supply ensurance) and the other furnance needs to be running for 5 days under the condition of emergency heating supply ensurance. In Chengnan Terminal Station during winter (winter is considered as 90 days), 1 furnace needs to be running for 90 days (ncluding 5 days of emergency heating-supply ensurance), and the other 2 furnances needs to be running for 5 days under the condition of emergency heating supply ensurance.

(II) Waste water

In this project, except that no manpower quota is arranged at the Daqiuzhuang Distributing Station for the outward-transmission pipeline, newly-added manpower quota of 10 persons are respectively added to the other 6 stations, considered as 3 persons in each station per day; the waste water generated during the operation period of pipeline is mainly domestic sewage; the domestic sewage in station is treated by septic tank and can be used for in-station landscaping or road flushing after treatment by sewage treatment facilities, without outward discharging.

(III) Solid wastes

The solid wastes generated in each station mainly comes from the waste dregs and domestic wastes during maintenance of separators and pigging operation.

(IV) Noise

The main noise source of each process station is mainly the separators and venting systems of each station, and the noise of venting system will only occur under emergency condition.

(V) Environmental risk accident

During operation, large amount of natural gas may be discharged into atomospheric environment because of misoperation, or equipment/valve losing control, and the total hydrocarbon will pollution the atomospheric air; once fire explosion occurs because of leaked natural gas, large amount of CO2 and small amount of CO, SO2 and NxO etc. will be generated, thus polluting the environmental air nearby the pollution accident and harming the population nearby. However, the automation level designed in this project is very high; once above-mentioned condition happens, the emergency cut-off valve will quickly close, thus avoiding leakage of large amount of natural gas.

5.2 Estimation of pollution source strength

5.2.1Estimation of pollution source strength during construction period

Table 5.2-1 List of producing and discharging condition of main pollutants during construction period of outward-transmission pipeline project

Type of Pollution	Pollution Source	Discharge Amount	Discharge Mode	Main Pollutants	Discharging Direction
Waste Gas	Flowing dust of vehicle driving and ground excavation construction	Small amount	Intermittent	Dust	Environmental air

	Exhaust of construction machineries and transportation vehicles	Small amount	Intermittent	SO2, NO2, particles, and CmHn	Environmental air
Waste Water	Domestic sewage of construction personnel	5954m^3	Intermittent	COD:300mg/L, ammonia nitrogen: 30mg/L； COD 1.79t, ammonia nitrogen 0.18t	Based on local domestic sewage treatment system or temporary dry latrine
	Drainage of pipeline pigging and pressure-test	Maximum: 1.86 x 10^4m^3/1.29 x10^4m^3	Intermittent	Small amount of iron rust and sediment	After settling and filtering, it can be recycled for agricultural irrigation and road spray water, or it can be discharged
Solid wastes	Domestic wastes	80.15t	Intermittent		Collected and treated by local environmental sanitation department
	Construction wastes	45.8t	Intermittent	Iron debris, abandoned concrete, and waste welding rods etc.	Some of them can be recycled, and others, after collection, will be consigned to local garbage station for treatment
	Waste slurry	538.5m^3	Intermittent	Bentonite, small amount of Na_2CO_3, and additives	Dried and buried on-the-spot, with vegetation restoration
Noise	Noise of construction machinery and transportation vehicle	85～105dB(A)	Intermittent	Noise	Environmental air

5.2.2Estimation of pollution source strength during operation period

5.2.2.1 Estimation of atmospheric pollution strength

Under normal condition of the outward-transmission pipeline, the waste gas is mainly the discharging of waste gas from water-jacket heating furnace of stations.

In this project, water-jacket heating furnaces are adopted as the heating equipment of natural gas at Anci Distributing Station and Chengnan Terminal Station.

In Anci Distributing Station, 2 sets of water-jacket furnaces are arranged, with single load of 2500kW and total gas consumption of 88.66 x 104Nm3/a; at Chengnan Terminal Station, 3 sets of water-jacket furnaces are arranged at Chengnan Terminal Station, with single load of 3000KW and total gas consumption of 48.2 x 104Nm3/a. In Anci Distrubuting Station, 1 of the furnace needs to be running for 350 days a year (including 5 days of emergency heating-supply ensurance) and the other furnance needs to be running for 5 days under the condition of emergency heating supply ensurance. In Chengnan Terminal Station during winter (winter is considered as 90 days), 1 furnace needs to be running for 90 days (ncluding 5 days of emergency heating-supply ensurance), and the other 2 furnances needs to be running for 5 days under the condition of emergency heating supply ensurance.

According to experience, around 14 Nm3 of fume is produced from burning 1Nm3 of natural gas. The waste gas discharging concentration is assessed hereby. For the discharging concentration of NOx, according to the experience of design institutions, normally the discharging concentration of NOx is 70 mg/m^3; considering that the atmospheric standard of Beijing is stricter, the discharging concentration of NOx can be reduced to below 30mg/m^3 after communication with heating-furnace supplier and adopting measures like using improved burners etc. Therefore, in this assessment, the discharging concentration of NOx for Anci Distributing Station of Hebei Province is calculated on the basis of 70 mg/m^3, and the discharging concentration of Chengnan Terminal Station of Beiing is calculated on the basis of 30 mg/m^3 because of technical improvement. For the discharging concentration of particles, 0.14 kg of smoke dust will be discharged for the burning of every 1000 cubic meters of natural gas according to the discharging factor of pollutants from oil and gas fuels in Training Materials for Occupational Qualification Registration of Environmental Impact Assessment Engineer - Social Area Type (Published by China Environmental Science Press) ; while the discharging of smoke dust was not counted in the Coefficient Manual of National Pollution Source Census because it was deemed that the content of smoke dust from natural gas burning was minor. In this assessment, the discharging concentration of particles for Anci Distributing Station of Hebei Province is calculated on the basis of 10 mg/m^3, and the discharging concentration of Chengnan Terminal Station of Beiing is calculated on the basis of 5 mg/m^3 because of technical improvement.For the producing concentration of SO_2, according to the natural gas quality analysis report provided by the Owner, the content of H_2S is 0.569 ppm at very low concentration. As conservatively estimated in this assessment, referring to the quality requirement of National Standard - Natural Gas (GB 17820-2018) that the natural gas to enter into long-distance transmission pipeline must meet the quality requirement of Class-A gas (The content of total sulfure is Class-A natural gas shall be ≤20mg/m^3)， therefore SO2 producing concentration of this project is 2.86mg/m^3.

The waste gas produced after burning will be discharged from the chimney of 15 meters high in the station.

Pollutants SO_2, NO_x and particles of this project: Anci Distributing Station shall execute the standard in Table 1 and Table 2 of Discharging Standard of Atomospheric Pollutants from Industrial Furnace (DB13/1640-2012), i.e. SO_2 and NO_x of 400mg/m^3 and particles of 50mg/m^3;Chengnan Terminal Station shall execute the provisions in Table 1 - Discharging Concentration Limit of Atmospheric Pollutants for Newly-Built Boilers in Discharging Standard of Boiler's Atomospheric Pollutants (DB11/139-2015) OF Beijing, i.e. SO_2 of 10mg/m^3, NOx of 30mg/m^3 and particles of 5mg/m^3.

Therefore, the waste gas produced in this project can be discharged up-to-grade. See the following table for the discharging condition of waste gas in this project.

Table 5.2-2 Discharging Condition of Waste Gas Pollutants during Operation Period of this Project

Pollution Source	Quantity (set)	Natural gas consumption amount (m3/h)	Total amount of fume (m3/h)	NOx Discharging Rate (kg/h)	Smoke Dust Discharging Rate (kg/h)	SO2 Discharging Rate (kg/h)	NOx Pollutant Concentration (mg/m3)	Smoke Dust Pollutant Concentration (mg/m3)	SO2 Pollutant Concentration (mg/m3)	Chimney			Discharging Frequency	Discharging Condition
										Height (m)	Inner Diameter (m)	Outlet Temperature ℃		
Heating Furnace of Anci Distributing Station	1 set	105.68	1478	0.1035	0.0148	0.0042	70	10	2.86	15	0.5	220	8400h	Normal condition
Heating Furnace of Chengnan Terminal Station	1 set	223.38	3124	0.0937	0.0156	0.0089	30	5	2.86	15	0.6	220	2160h	Normal condition

5.2.2.2 Estimation of water pollution source strength

Except that no manpower quota is arranged at the Daqiuzhuang Distributing Station for the outward-transmission pipeline, newly-added manpower quota of 10 persons are respectively added to the other 6 stations, considered as 3 persons in each station per day; the waste water generated during the operation period of pipeline is mainly domestic sewage; the domestic sewage in station is treated by septic tank and can be used for in-station landscaping or road flushing after treatment by sewage treatment facilities, without outward discharging.

The domestic water quota for personnel of the project is 75L (cap·d), the domestic sewage discharge amount of each station is 0.06m3/ (cap·d), main pollutants are COD and ammonia nitrogen etc., and the concentrations of COD and ammonia nitrogen are respectively 300mg/L and 500mg/L. Therefore, each station needs to discharge domestic sewage at the amount of 63m3/a, containing COD and ammonia nitrogen respectively at 0.018t/a and 0.003t/a. Therefore, total amount of domestic sewage needed to be discharged for this project is 378m3/a, with COD and ammonia nitrogen respectively of 0.018t/a and 0.018t/a. The domestic sewage in station will be treated by septic tank, and will be used for in-station landscaping after treatment by integrated sewage treatment facility, without outward discharging.

5.2.2.3 Estimation of noise source strength

The main noise source of each process station is mainly the separators and venting systems of each station, and the noise of venting system will only occur under emergency condition. See the following table for the quantity of main noise sources and normal sound-level strength.

Table 5.2-3 Main Noise Source and Sound-Level Strength of Process Stations in Outward Transmission Engineering of the Project

S.N.	Station	Condition	Main Noise-Generating Equipment	Quantity (set)		Acoustic Power Level (dB)	Height of Sound Source (m)	Remark
				Running	Standby			
1	Nangang Distributing Station	Normal condition	Filter separator	2	0	75	2	Outdoor
2		Abnormal condition	Venting vertical pipe	1	0	100	15	Outdoor
3	Daqiuzhuang Distributing Station, Jinghai Transmission station, and	Normal condition	Filter separator	1	1	75	2	Outdoor
4		Abnormal condition	Venting vertical pipe	1	0	100	15	Outdoor

S.N.	Station	Condition	Main Noise-Generating Equipment	Quantity (set)		Acoustic Power Level (dB)	Height of Sound Source (m)	Remark
				Running	Standby			
	Anci Distributing Station							
5	Yongqing Transmission station and Chengnan Terminal Station	Normal condition	Filter separator	3	1	75	2	Outdoor
6		Abnormal condition	Venting vertical pipe	1	0	100	15	Outdoor

5.2.2.4 Estimation of solid wastes

The solid wastes generated in each station mainly comes from the waste dregs and domestic wastes during maintenance of separators and pigging operation.

(1) Domestic wastes

Domestic wastes are calculated on the basis of 1.0kg/person·day, therefore, the producing amount of domestic wastes in stations will be 6.3t/a, which will be regularly cleaned-up and transported out by environmental sanitation department.

(2) Pigging and ball-recovery operation

Pigging will be conducted 1~2 times per year, the whole-line pigging unit is manually operated and pigging balls are enclosed. The amount of solid wastes produced during pigging is minor; for process station with ball-recovery unit, 15kg of waste residues will be produced during each time of pigging operation. For regular cleaning-up, the environmental sanitation department will clean-up and transport out, with minor impact on environment.

In this project, there are 2 stations with ball-recovery units, therefore, waste residues of 0.06t/a will be produced during pigging operation.

(3) Maintenance dust of separators

According to analogized investigation, the freqncy of maintenance for separators is normally once per year, and the producing amount of waste residues is around 5kg. In this project, there are 7 stations, and the producing amount of waste residue is around 0.035t/a, which are regularly cleaned-up and transported out by environment sanitation department, with minor impact on environment.

See Table 5.2-4 for the solid wastes produced in planned outward transmission engineering of the project and disposal modes.

Table 5.2-4 List of Solid Wastes produced in Planned Outward Transmission Engineering of the Project and Disposal Modes

S. N.	Name of Pollution Source	Main Composition	Discharge Amount (t/a)	Type	Treatment and Direction
1	Domestic wastes	-	6.3	Ordinary solid wastes	Regular cleaning-up and out-transportation
2	Waste residue of pigging	Dust and ferric oxide powder	0.06	Ordinary solid wastes	Discharged into blowdown tank and regularly cleaning-up & out-transportation
3	Maintenance of separators	Dust	0.035	Ordinary solid wastes	

6 Baseline of Enviromental and Social Conditions

6.1 Natural Environment

6.1.1Meteorology

(1) Temperature

The average annual temperature in the project area is 12.1 ℃, with the highest average temperature of 12.9 ℃ and the lowest average temperature of 11.6 ℃. The extreme maximum temperature was 40.3 degrees Celsius (13 June 1988) and the extreme minimum temperature was 20.3 degrees Celsius (31 January 1979). The average temperature in January was -4.9 ℃. The average temperature in July was 26.3 degrees Celsius. The average temperature is slightly higher in autumn than in spring.

(2) Precipitation

The average precipitation days is 55 days in a year, and the average annual precipitation is 593.6 mm. Precipitation mainly concentrates in June to September, and the average precipitation is 491.5 mm, accounting for 84% of the total precipitation. Seasonal and monthly precipitation is concentrated in summer, autumn is more than spring, winter is the least. July has the largest precipitation of the year, with an average of 232.2 mm in a calendar year. The lowest rainfall was recorded in January, with a calendar year average of 3.2 mm.

(3) Fog

There are 14.2 days over a year with a visibility less than 1 km, which happen mostly in winter.

(4) Wind

Dagang area is located in the monsoon climate zone. Winter and summer are controlled by different air masses, forming different wind directions. The normal wind direction of the sea area is S direction with a frequency of 11. 97% , and sub-normal wind direction is E direction with the frequency of 11. 08% ; The strong wind direction is in the E direction with the measured maximum wind speed is 19.7 m/s, and the next strong wind direction is ENE direction with the maximum wind speed measured is 17.5 m/s. The average annual wind speed in the region was 4.43 m/s, and the maximum winds come from E of 6.51 m/s. The area has more NW wind in winter, SE wind in summer and SW wind in spring and autumn. The main cause of strong wind is cold wave in winter and spring. Typhoons occur less frequently.

(5) Humidity

The averaged absolute humidity in Dagang area is 11. 3% over the years. The averaged relative humidity is 65% , the maximum relative humidity 69% (1990), and the minimum 60. 5% (1988). The largest annual averaged relative humidity is in July and August with a value of 80%, and the lowest humidity is from January to May with a value of 57%.

The pipelines are in the eastern monsoon region. It has a warm temperate coastal semi-humid continental monsoon climate with a certain sea climate characteristics. The winter is cold with snows; the spring is dry and windy; the summer has a high temperature, humidity, and precipitation concentration ; the autumn is crisp and sunny. The main meteorological data along the line are shown in the table below:

Table 6.1-1 Statistics of main meteorological data along the route

Place	Temperature (℃)			Wind			Annual average Precipitation (mm)	Max Frozen soil Depth (cm)
	Extreme maximum	Extreme minimum	Annual average	Maximum frequency wind direction	Minimum frequency wind direction	Max Wind speed (m/s)		
Binhai New Area			12.6	Northwest		31	566	
Jinghai District			12.4	South Southwest		25	552.5	
Xiqing District			12.2	South Southwest		33	549.4	
Wuqing District	39.9	－22.0	11.6	SW	Northwest		666	72
Anci District	40.2	－29.2	11.5	North North West	West		509	60
Yongqing County	39.1	－29.4	10.9	North North West	West		690	70
Guangyang District	40.2	-25.5	11.9	North North West			554.9	70
Daxing District	41.9	-17.0	11.6	South South West			556	

6.1.2Hydrology

(1) Tides and tidal currents

Dagang area experiences irregular semidiurnal tides with two tides in a day. There are two spring tides and two neap tides in one month. According to the investigation of Qikou located to the southern boundary of Dagang District in Tianjin City in 1985, the duration of ebb tide was 7 hrs 20 mins and the duration of high tide was 5 hrs 5 mins. The mean high water level was 1.92 m and the mean low water level was 0.52 m. The average spring tide difference is 1.81 m, and the average small tide difference is 1.02 m. The ebb tide flows to southeast while flood tide flows to northwest.

(2) Sea ice

The coastal area in Tianjin has an ice age 3 months in each year, and from mid-January to mid-February is the glacial maximumThe fixed ice width along the coast is generally within 500 m with the thickness of 10-25 cm and the maximum of 40 cm ; The range of drift ice is 20~30 km, with the thickness of 10~25 cm and the outer line within the 10~15 m isobath. The direction of ice flow is mostly in SE~NW direction, and the flow velocity is about 30 cm/s with the maximum value of 100 cm/s.

(3) River

The pipeline is located in the eastern part of the North China Plain and lies in the middle and lower reaches of the Haihe River Basin. The main rivers passing through the pipeline from southeast to northwest are Dugu River, Zhao Lianzhuang Township Second Drainage, Youth Canal, Production River, Yundong Drainage, Chengglory Canal, South Canal, Gang Tuan River, Ziya River, Daqing River, Zhongting River, Xiaomiao Donggan, Yongding River and so on. Most of the rivers are perennial rivers with water, which is affected by rainfall. The dry season is from mid-November to mid-March of the following year, and the flow is small; The flood season is from mid-June to mid-September of each year, and the flow is huge.

6.1.3Geology

The geological structure in Tianjin is complex, with the Ninghe-Baoyu fault as the boundary, the northern part is the Yinshan zonal tectonic system, and the mountainous area is controlled by the secondary Yanshan settlement belt. The piedmont plain is formed between the Jixian fault and the Ninghe-Baoyu fault. The Tangshan uplift of the east-west distribution and the compression and torsion fractures of the Xinhuaxia system, as well as the existence of the front and west wing reflex arcs of the eastern wing reflex arc of the Luhelan type structure and the Malanyan character structure. The southern part of the Xinhuaxia tectonic system runs through the north and south, and is a series of north-north-eastward uplift depressions and tectonic faults. From the west to the east, there are the Jizhong depression, the Jixian uplift, the Huanghua depression and a series of NE-trending faults. . The Tianjin section of the project is located in the Ninghe-Baoyu fault. It is a Class I tectonic unit in the Taipei section of the North China quasi-district, and the II-level tectonic unit is located in the North China fault zone. It is divided into two Grade III tectonic units in the Huanghua depression and the Jixian uplift.

Hebei province is divided into three distinct zones from north to south. Along the northern edge of the Kangbao storage field, which is about 42° N line, is a qualitative change boundary: to the north is the pre-Mesozoic Canine Ocean and to the south lies the continent. The main tectonic line and modern geomorphic trend are different along the central line of latitude 40°. The north side of the mountain range is the Yanshanian mountain, and the direction of the mountain and the main tectonic line are near east and west. To the south, the vast and flat North China Plain lies side by side with the towering Taihang Mountains to the NNE and SSW.

6.1.4Earthquake

According to the " China Earthquake Peak Acceleration Zoning Map " (GB 18306-2015), combined with the results of the intermediate edition of seismic safety assessment, the peak earthquake acceleration along the project is shown in the following table.

Table 6.1-2 Characteristic periodic values of the response spectra of the basic ground motion peak acceleration and the basic ground motion acceleration along the line

Provinces	City (County)	Peak acceleration	Response spectrum characteristic period	Remark
Beijing	Daxing District	0.20	0.40	Fifty year probability of exceeding 10%
Hebei Province	Guangyang District, Langfang City	0.20	0.40	Fifty year probability of exceeding 10%
	Langfang Yongqing County	0.15	0.40	Fifty year probability of exceeding 10%
	Langfang Anji District	0.15	0.40	Fifty year probability of exceeding 10%
Tianjin	Wuqing District	0.15	0.40	Fifty year probability of exceeding 10%
	Xiqing District	0.15	0.40	Fifty year probability of exceeding 10%
	Jinghai District	0.15	0.40	Fifty year probability of exceeding 10%
	Binhai New Area	0.20	0.40	Fifty year probability of exceeding 10%

6.1.5Topography and geomorphology

Tianjin is located in the transitional zone from Yanshan Mountain to Binhai Plain. The northern mountainous area belongs to Yanshan Mountain, the southern plain is part of North China Plain, and the southeast is near Bohai Bay. The topography is high in the north and low in the south: from the northern mountains to the southeast coastal plain the highest peak is Jiuding Mountain with the elevation of 1078.5 m, and the lowest is Dagu mouth of the coastal zone with the elevation of zero. The main geomorphic units passing by the pipeline are water network and plain, and the surface conditions are mostly farmland, fish pond, forest land, orchard, etc.

Water network: mainly distributed in the front section of Tianjin Binhai New Area, Jinghai District and Xiqing District, mainly for continuous fish ponds distributed in a grid pattern. The length of the water network in Tianjin is 48.2 km, accounting for 30% of the total length of the pipeline in Tianjin.

Plain: about 70% of the pipeline passing through Tianjin is plain, mainly alluvial plain, coastal alluvial plains and Coastal alluvial low plains. The topography is low and slightly undulating with local ditches and fish ponds. The southeast of coastal zone has salt flats and wetlands, and the soil salinity is serious ; Vegetation development along the remaining areas is mainly forest land and arable land. The other part is formed by artificial reclamation, and most of the surface area has been leveled. There are earth pits, water puddles and earth mounds distributed locally. Gravels are in individual areas, mostly wasteland, mainly in the section of the Beijng Gas-Nangang LNG terminal.

Langfang City is mostly in the depressed area. With the subsidence of the earth's crust, the ground is gradually filled up by Quaternary sediments, resulting in the large subsidence of the boundary strata. The topography of the city is relatively flat and monotonous, with the plain as the main. The general elevation is between 2.5-30 meters, and the average elevation is about 13 meters above sea level.

Beijing is surrounded by mountains in west, north and northeast. Southeast is a gently sloping toward the Bohai Sea. The elevation of the Beijing Plain is 20-60 meters. In Langfang City, Hebei Province and Daxing District, Beijing, the main pipeline passing along the area is alluvial flood plain area, which is a typical North China Plain landform. It is a flat and open landform, with mostly dry land, maize, cotton, wheat and so on.

6.2 Social environment profile

6.2.1General Situation of Tianjin Binhai New Area

Tianjin Binhai New Area includes advanced manufacturing industrial zone, Linkong Industrial Zone, Binhai Hi-tech Industrial Development Zone, Linang Economic Zone, Nangang Industrial Zone, Seaport Logistics Zone, Binhai Tourism Zone, Zhongxin Tianjin Eco-city, the nine largest industrial functional areas in the central business district and the fifth largest comprehensive trade port in the world throughput-Tianjin Port.

Tianjin Binhai New Area has a planned area of 2270 km 2 and a coastline of 153 km, with a resident population of 2,980,000 . Tianjin Binhai New Area has a good ecological environment and abundant resource reserves, with water surface, wetland more than 700 km^2 ; Saline-alkali wasteland of 1200 km^2 is available for development ; The total petroleum resources in the Bohai Sea area have been proved to be more than 10,100,000,000 tons and natural gas reserves 193,700,000,000 m3.

After many years of development, Tianjin Binhai New Area has developed many advantages, such as open advantage, complete industrial support, abundant scientific and technological resources. The GDP of Tianjin Binhai New Area increased by 6.0% in 2017. Among them, the primary industry declined by 0.3 percent, the secondary industry increased by 1.7 percent and the tertiary industry increased by 11.5 percent. The three industrial structures are 0.2 : 51.2 : 48.6 . The value-added ratio of the tertiary industry increased by 2.7 percentage points, and the economic structure was further optimized.

6.2.2Overview of South Port Industrial Zone

Located as a world-class petrochemical industry and port comprehensive functional area, Tianjin Nangang Industrial Zone is a demonstration base for the new industrial petrochemical industry, a national energy reserve base and a pilot unit for Tianjin recycling economy. The planned area is 200 km2, with an increase of 20,94 billion RMB in 2018.

The Nangang Railway is scheduled to open at the end of June 2020, with the completion of the Haibin Expressway and the construction of the Jinshi Expressway (Tianjin Section). The primary trunk road network of the park has been basically formed, and a hundred kilometers of roads have been opened to traffic. Six general bulk cargo berths of 20,000 ton class, one general berth of 70,000,000 ton class, seven liquid chemical terminals of 50,000,000 ton class, one LNG terminal of 10,000,000 ton class and eight working vessel berths have been put into use, and the 100000 ton class navigation channel has been officially opened to the public. Key public works, such as China Electric Power and Co-generation and Industrial Gas in Liquid and Air, have started construction. The Seawater Desalination Project has completed detailed design and is ready for construction. At present, the park has 480000 kV • A power supply capacity of 50000 tons/day water supply and distribution center, with 790000 tons/day steam supply capacity, 200000 cubic meters/day air supply capacity, 2500 cubic meters/day sewage treatment capacity.

Has gathered Sinopec, PetroChina, CNOOC, Bohua, Shell, BP, Shabik, Hensmail, graceful, FCL, Oldfield, Veolia, Akzo Nobel and other leading domestic and foreign enterprises. Sinopec LNG, Shell Lubricating Oil, graceful catalyst and other 25 projects have been completed and put into production, and China Sha polycarbonate, Bohua and Akzo Nobel peroxide, BP lubricating oil and other 14 projects are under construction.

Nangang Industrial Zone adheres to the concept of " low-carbon development, green development and circular development ", and focuses on the construction of ecological parks with the coordinated development of economic society and ecological civilization. Strict access to the project, forming a comprehensive system of project access indicators. Build an environment monitoring and early warning system to monitor the environmental quality and trend of the park. Constructing safety supervision system and emergency management system of chemical industrial park. Implement closed management. Nangang Industrial Zone is the first chemical industrial park in China to implement " Responsibility Concern ", and has signed the " Global Charter for Responsibility Concern ".

6.2.3Overview of other regions

Jinghai District is the municipal district of Tianjin, is one of the coastal open areas approved by the State Council. The northeast and southeast of Jinghai are adjacent to Xiqing District and Dagang District of Tianjin, the northwest border with Bazhou City of Hebei Province, the west and southwest border with Wen'an County and Dacheng County of Hebei Province, and the south is Qingxian County and Huangyi City of Hebei Province. Jinghai District is 40 km from Tianjin, 80 km from Tianjin New Port, 60 km from Tianjin Binhai International Airport and 120 km from Beijing.

Xiqing District is located in the southwest of Tianjin, adjacent to Hongqiao District in the east, and across the river from Jingliu County in the south. It borders Wuqing District and

Bazhou in Hebei Province in the west and Ziya River in the north. By the end of 2016, the population size has grown steadily. At the end of the year, the resident population of the district was 857,700, an increase of 113,000 from the end of the previous year, a year-on-year increase of 1.3%. At the end of the year, the registered population was 406,100, an increase of 17,600 from the end of the previous year, an increase of 4.5%. There are several industrial parks in Lingqing Creative Industry Park, Saida Industrial Park and Zhongbei Town Industrial Park in Xiqing District.

Wuqing District is a municipal district under the jurisdiction of Tianjin Municipality and is located in the northwest of Tianjin. It is connected to Tongzhou District of Beijing and Xianghe County of Langfang City, Hebei Province. It is adjacent to Beichen District, Xiqing District of Hebei Province and Bazhou City of Hebei Province. It borders Tianjin Baodi District and Ninghe County in the east, and Langfang in Hebei Province in the west. The city of Anci District borders. Located at the center of the two municipalities directly under the Central Government of Beijing and Tianjin, it is known as the “Beijing-Tianjin Corridor” and “Beijing-Tianjin Pearl”. It is the meeting point of the three provinces and cities of Beijing, Tianjin and Hebei, and is an important core of the national “Beijing-Tianjin-Hebei coordinated development” strategy. District and bridgehead.

Langfang City, a prefecture-level city in Hebei Province, is located in the east-central part of Hebei Province . It is located between Beijing and Tianjin. Jurisdiction Guangyang, Anji two districts, big factory, Xianghe, Yongqing, Gu'an, Wen'an, big city six counties and Langfang Economic and Technological Development Zone, in charge of three rivers, Bazhou two county-level cities.

Daxing District is a subordinate district of Beijing. It is located in the south of Beijing, 13 kilometers from the city center. It is the nearest suburb to the Beijing area. It was one of the first batch of satellite cities in the capital approved by the State Council in 1984. In 2016, it was listed as the second batch of national new urbanization comprehensive pilot areas.

7 Survey and evaluation of current environmental status

7.1 Survey and evaluation of current atmospheric environmental quality

7.1.1Regional ambient air quality status

According to the relevant provisions of the 《Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment》 (HJ2.2-2018), the compliance with the ambient air quality in the administrative area where the project is located was judged based on the monitoring data and conclusions of 《Bulletin of Environmental Status in Tianjin in 2017》, 《Bulletin of Environmental Status in Beijing in 2017》, and 《the Environmental Quality Summary in Langfang City in 2017》.

7.1.1.1 Status of ambient air quality in Tianjin

(1) Ambient air quality status

According to the Bulletin of Environmental Status in Tianjin in 2017, the city's ambient air quality status: the annual average concentration of sulfur dioxide (SO2) is 16 μg/m3, which is lower than the national annual average concentration standard (60 μg/m3); The annual average concentration of nitrogen (NO2) is 50 μg/m3, which is 0.25 times higher than the national annual average concentration standard (40 μg/m3); the annual average concentration of inhalable particulate matter (PM10) is 94 μg/m3, which is 0.34 times higher than the national average standard concentration (70 μg/m3); the average concentration of fine particles (PM2.5) is 62 μg/m3, which exceeds the national annual average concentration standard (35 μg/m3) by 0.77 times; The 95th percentile of the 24-hour average concentration of carbon monoxide (CO) is 2.8 mg/m3, which is lower than the 24-hour average concentration standard (4 mg/m3); the 90th percentile of the maximum 8-hour average concentration of ozone (O3) is 192 μg/m3, exceeding the maximum 8-hour average concentration standard (160 μg/m3) by 0.20 times.

The project covers four districts in Tianjin: Wuqing District, Binhai New Area, Xiqing District and Jinghai District. The ambient air quality status is shown in the table below.

Table 7.1-1 Air quality monitoring results of various districts in Tianjin involved in this project

District	The concentration of pollutants					
	PM2.5	PM10	SO2	NO2	CO	O3
Wuqing District	61	88	19	48	2.8	202
Binhai New Area	63	92	16	49	2.6	189
Xiqing District	63	94	15	51	3.1	166

Jinghai District	70	105	16	46	2.6	191
Standard value	35	70	60	40	4	160
Compliance	Excess	Excess	Meet the standard	Excess	Meet the standard	Excess
Maximum excess multiple	1	0.5	-	0.28	-	0.26

Note: For SO2, NO2, PM10 and PM2.5, values in the table are the average concentration; for CO, values are the 95th percentile of the 24-hour average concentration; for O3, values are the 90th percentile of the maximum 8-hour average concentration. Units of other pollutants are μg/m3, except for CO (mg/m3).

According to statistics, the average concentration of fine particulate matter (PM2.5) in the various districts of Tianjin in this project is 61-70 μg/m3, which exceeds the national annual average concentration standard (35 μg/m3); The annual average concentration of particulate matter (PM10) is 88-105 μg/m3, which exceeds the national annual average concentration standard (70 μg/m3); the annual average concentration of sulfur dioxide (SO2) is 15-19 μg/m3, which is lower than the national annual average concentration standard (60 μg/m3); the annual average concentration of nitrogen dioxide (NO2) is 46-51 μg/m3, which exceeds the national annual average concentration standard (40 μg/m3); the 95th percentile of 24-hour average concentration of carbon monoxide (CO) is 2.6-3.1 mg /m3, which is lower than the 24-hour average concentration standard (4 mg/m3); The 90th percentile of daily maximum 8-hour average concentration of ozone (O3) is 166-202 μg/m3, which exceeds the daily maximum 8-hour average concentration standard (160 μg/m3) by 0.20 times.

(2) Evaluation of the target area in the project

According to the relevant provisions of "Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment" (HJ2.2-2018) mentioned in 6.4.1.2, "urban environmental air quality meets the standards means all of the six pollutants in the assessment index of urban environmental air quality standards are all up to standard for urban environmental air quality should meet the standards. In the districts and counties in the project, except for the corresponding concentrations of sulfur dioxide (SO2) and carbon monoxide (CO), which meet the requirements of the Class II standard of Ambient Air Quality Standard (GB3095-2012), other basic factors are exceeded the standard. Therefore, the ambient air quality in Tianjin in 2017 was judged to be out of compliance.

7.1.1.2 Status of ambient air quality in Beijing

(1) Ambient air quality status

According to the 《Bulletin of Environmental Status in Tianjin in 2017》, the city's ambient air quality status is: the annual average concentration of fine particulate matter (PM2.5) in the city is 58 μg/m3, which is 20.5% lower than the previous year, exceeding the national standard by 0.66 times. The annual average concentration of sulfur dioxide (SO2) is 8 μg/m3, which is 20.0% lower than the previous year, reaching the national standard; the annual average concentration of nitrogen dioxide (NO2) is 46 μg/m3, which is 4.2% lower than the previous year, exceeding the national standard by 0.15 times; the average annual concentration of inhalable particulate matter (PM10) is 84 μg/m3, which is 8.7% lower than the previous year and 0.20 times higher than the national standard.

The 95th percentile of the 24-hour average concentration of carbon monoxide (CO) in the city was 2.1 mg/m3, which is 34.4% lower than the previous year, reaching the national standard; the 90th percentile of the maximum 8-hour sliding average concentration of the ozone (O3) daily was 193 μg/m3, which was 3.0% lower than the previous year and 0.22 times higher than the national standard. The ozone concentration is higher in May-September, and the over-standard mainly occurs in the afternoon to evening in spring and summer.

The project only covers Daxing District in Beijing. According to the annual average concentration of major pollutants in various districts of Beijing published in the "Gazette", the relevant data of Daxing District is extracted and analysed according to the "Environmental Air Quality Standards" (GB3095-2012). See the table below for details.

Table 7.1-2 Summary of the annual average concentration of major pollutants in Daxing District in 2017

No.	Evaluation effects	Evaluation index	Units	Concentration	Standard	Status	Super standard multiple
1	PM2.5	Annual average	μg/m3	61	35	Non-compliance	0.63
2	SO2	Annual average	μg/m3	9	60	compliance	/
3	NO2	Annual average	μg/m3	51	40	Non-compliance	0.28
4	PM10	Annual average	μg/m3	103	70	Non-compliance	0.24

(2) Evaluation of the target area in the project

According to the relevant provisions of "Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment" (HJ2.2-2018) mentioned in 6.4.1.2, "urban environmental air quality meets the standards means all of the six pollutants in the assessment index of urban environmental air quality standards are all up to standard for urban environmental air quality should meet the standards. Therefore, the environmental air quality in Daxing District in 2017 was judged to be out of compliance.

7.1.1.3 Ambient air quality status in Langfang City

(1) Ambient air quality status

① ambient air quality in urban area of Langfang

In 2017, the situation of air quality in Langfang City (excluding sand and dust) is as follows: the annual average concentration of PM10 is 102 μg/m3, the average annual concentration of PM2.5 is 60 μg/m3, and the annual average concentration of SO2 is 14 μg/m3. The average concentration was 48 μg/m3, the 95th percentile of the daily CO average concentration was 2.9 mg/m3, and the 90th percentile of the maximum 8-hour sliding average concentration of O3 was 207 μg/m3. The concentration of SO2 and CO reached the secondary standard in the Ambient Air Quality Standard (GB3095-2012), and the concentrations of PM10, PM2.5, NO2 and O3 exceeded the standard, exceeding by 0.46 times, 0.71 times, 0.20 times and 0.29 times respectively. The air quality composite index is 6.61.

② Environmental air quality in the urban areas of Langfang

In 2017, the situation of the ambient air quality of all counties in Langfang (excluding sand and dust) is as follows: the concentration of the SO2 and CO reached the secondary standard of Environmental Air Quality Standard (GB3095-2012); NO2 concentration reached the second-class standard in Dachang County, Xianghe County, Wen'an County, Gu'an County, and exceeded the standard in Sanhe City, Yongqing County, Dacheng County and Bazhou City; the concentration of PM10, PM2.5 and O3 exceeded the standard.

The project covered Yongqing County of Langfang City, and the concentration of SO2 and CO in the county reached the second standard of “Environmental Air Quality Standard” (GB3095-2012); the concentrations of NO2, PM10, PM2.5 and O3 exceeded the standard.

Table 7.1-3 Air quality monitoring results in various districts of Langfang City

District, county	Pollutants concentration					
	PM2.5	PM10	SO2	NO2	CO	O3
Urban area（Guangyang、Anci）	60	102	14	48	2.9	207
Yongqing County	62	116	13	42	3	193
Standard	35	70	60	40	4	160
Status	compliance	Non-compliance	compliance	Non-compliance	compliance	Non-compliance
Super standard multiple	0.77	0.66	-	0.2	-	0.29

Note: For SO2, NO2, PM10 and PM2.5, values in the table are the average concentration; for CO, values are the 95th percentile of the 24-hour average concentration; for O3, values are the 90th percentile of the maximum 8-hour average concentration. Units of other pollutants are μg/m3, except for CO (mg/m3).

(2) Evaluation of the target area in the project

According to the relevant provisions of "Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment" (HJ2.2-2018) mentioned in 6.4.1.2, "urban environmental air quality meets the standards means all of the six pollutants in the assessment index of urban environmental air quality standards are all up to standard for urban environmental air quality should meet the standards. Therefore, the environmental air quality of Langfang City in 2017 was judged to be out of compliance.

7.1.2Monitoring and evaluation of the status of ambient air in send-out pipelines

7.1.2.1 Monitoring points and monitoring items

(1) Monitoring points

Specific monitoring points: 7 stations; the first station measures 4 points, 1 of the upwind direction and 3 of the downwind direction; the other stations are set at the site;

At the same time, the monitoring data of the annual routine factors of the environmental monitoring stations in the project area are collected.

(2) Monitoring cycle

Continuous monitoring for 7 days; daily monitoring time is 02, 08, 14, 20 hours.

(3) Monitoring items

Monitoring: non-methane total hydrocarbons, total hydrocarbons;

Monitoring and observation of meteorological conditions such as wind direction, wind speed, temperature and pressure at each monitoring point.

(4) Monitoring and analysis methods

Sampling and analysis methods for atmospheric pollutants are carried out in accordance with the requirements of the fourth edition of the Air and Exhaust Gas Monitoring and Analysis Methods.

Table 7.1-4 Atmospheric Status Monitoring Points and Monitoring Items

No.	Monitoring points	Geographic coordinate	Monitoring points	Monitoring items

1	The first receiving station	38°44'37.40"N；117°43'2.48"E	4 points: 1 of the upwind direction and 3 of the downwind direction	non-methane total hydrocarbons, total hydrocarbons
2	Nangang substation	38°45'18.84"N；117°33'30.21"E	1 point at the site	non-methane total hydrocarbons, total hydrocarbons
3	Daqiuzhuang substation	38°48'20.20"N；117°6'7.59"E	1 point at the site	non-methane total hydrocarbons, total hydrocarbons
4	Jinghai transmission station	38°46'46.39"N；116°56'57.50"E	1 point at the site	non-methane total hydrocarbons, total hydrocarbons
5	Yongqing transmission station	39°18'22.04"N；116°41'2.02"E	1 point at the site	non-methane total hydrocarbons, total hydrocarbons
6	Anci substation	39°28'3.47"N；116°35'54.15"E	1 point at the site	non-methane total hydrocarbons, total hydrocarbons
7	Chengnan Station	39°33'5.91"N；116°28'36.63"E	1 point at the site	non-methane total hydrocarbons, total hydrocarbons

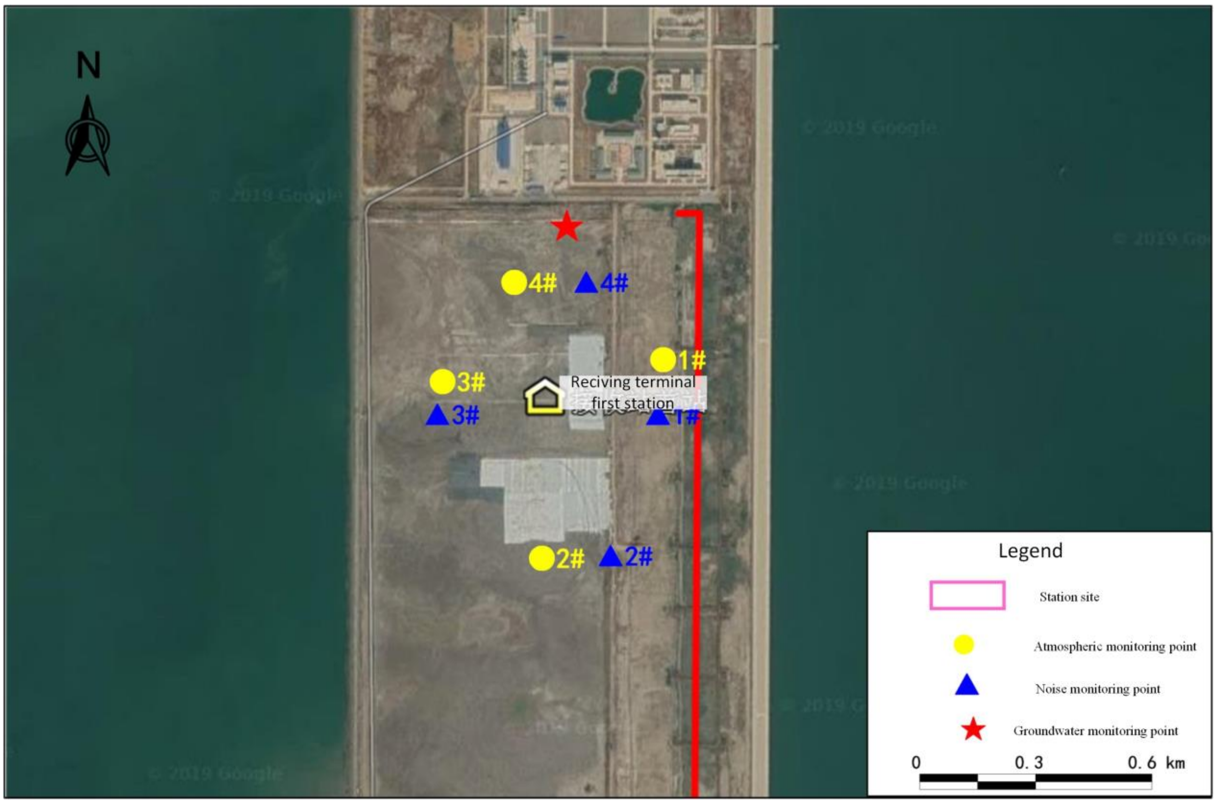


Figure 7.1-1 Atmospheric, noise, groundwater monitoring points at the first station of the receiving station

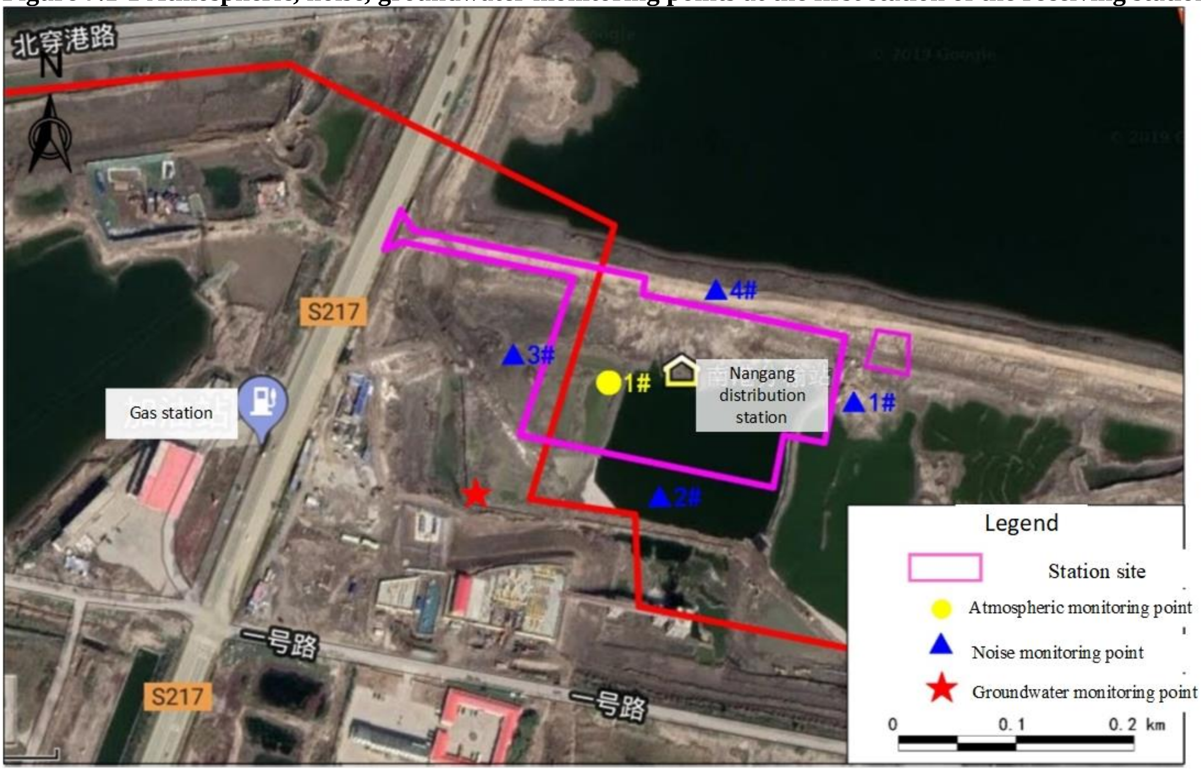


Figure 7.1-2 Atmospheric, noise and groundwater monitoring points at Nangang Substation

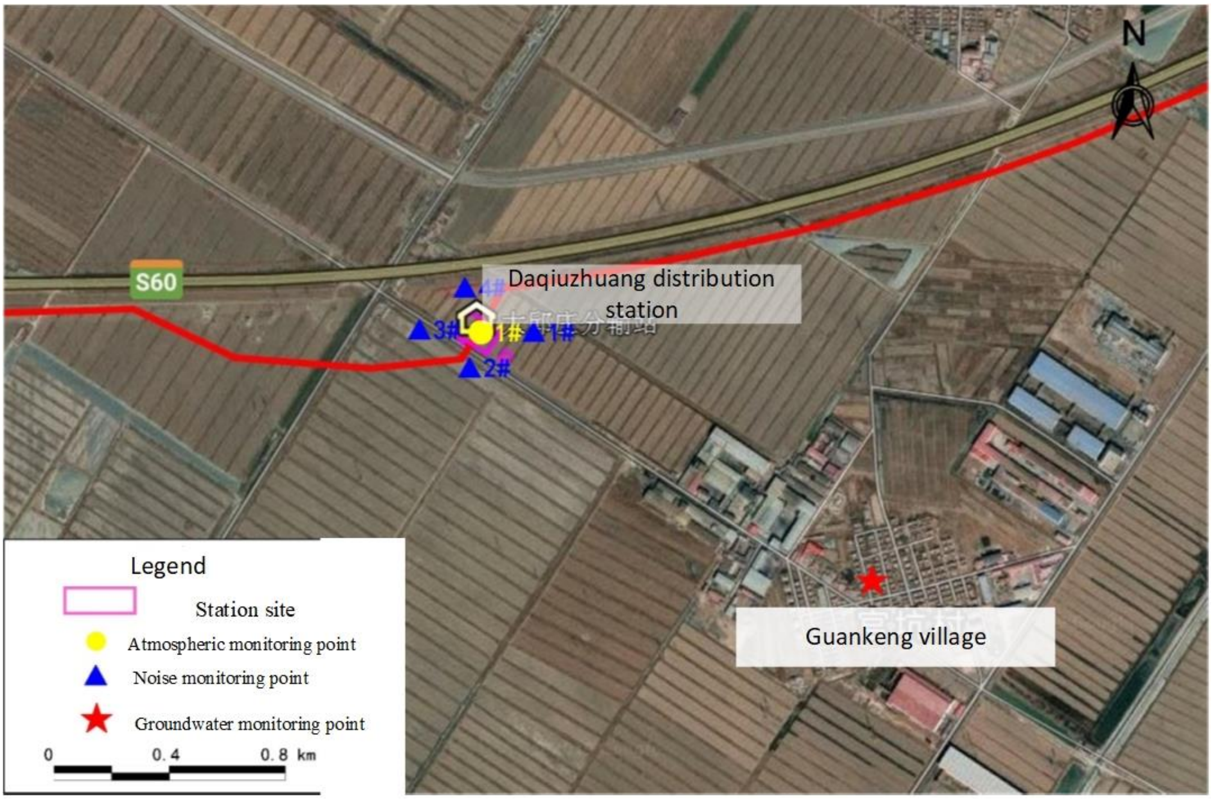


Figure 7.1-3 Atmospheric, noise, groundwater monitoring points at Daqiu Zhuang Substation

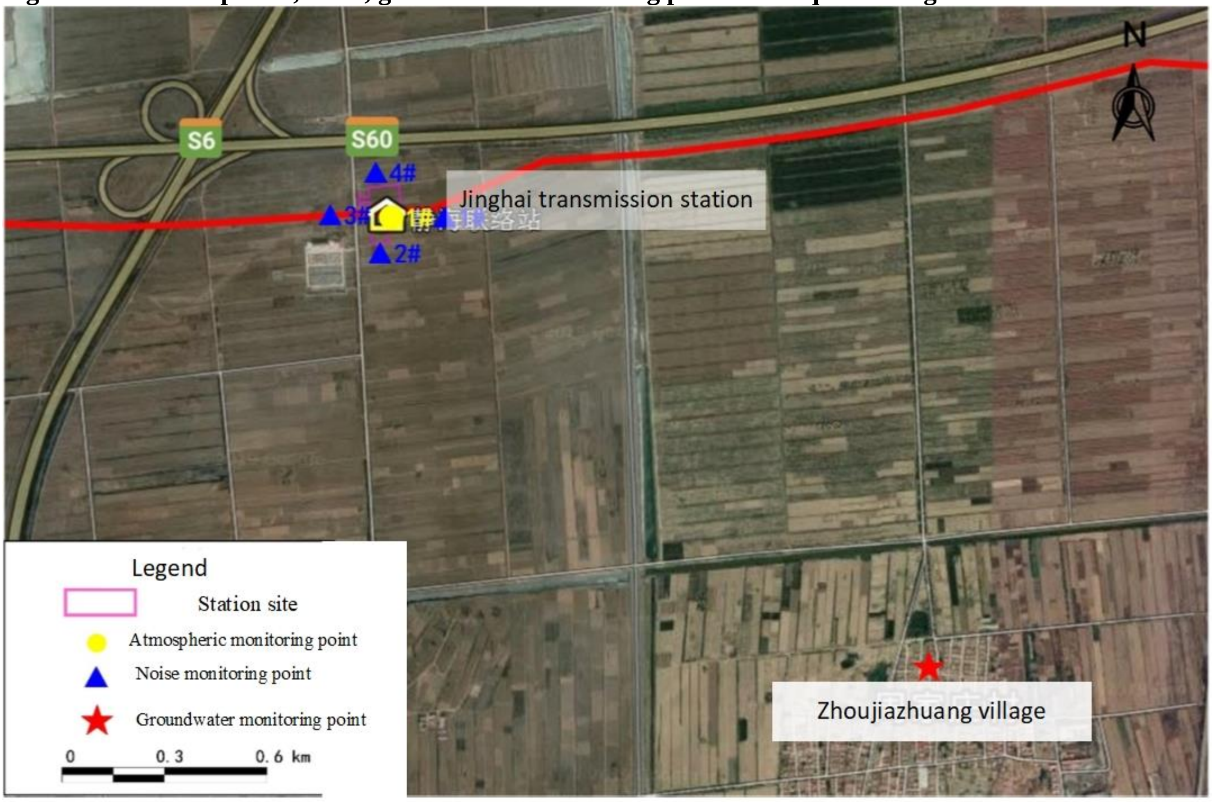


Figure 7.1-4 Atmospheric, noise and groundwater monitoring points of Jinghai Transmission station

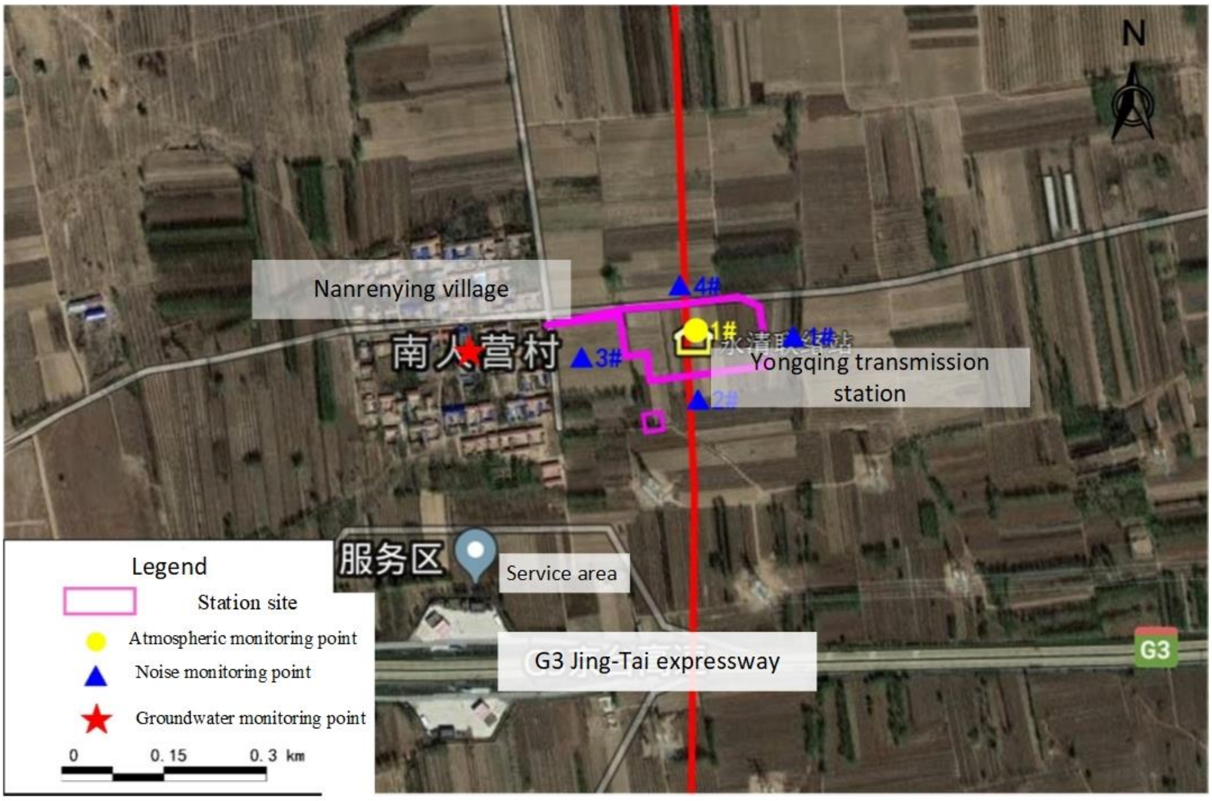


Figure 7.1-5 Atmospheric, noise and groundwater monitoring points of Yongqing Transmission station

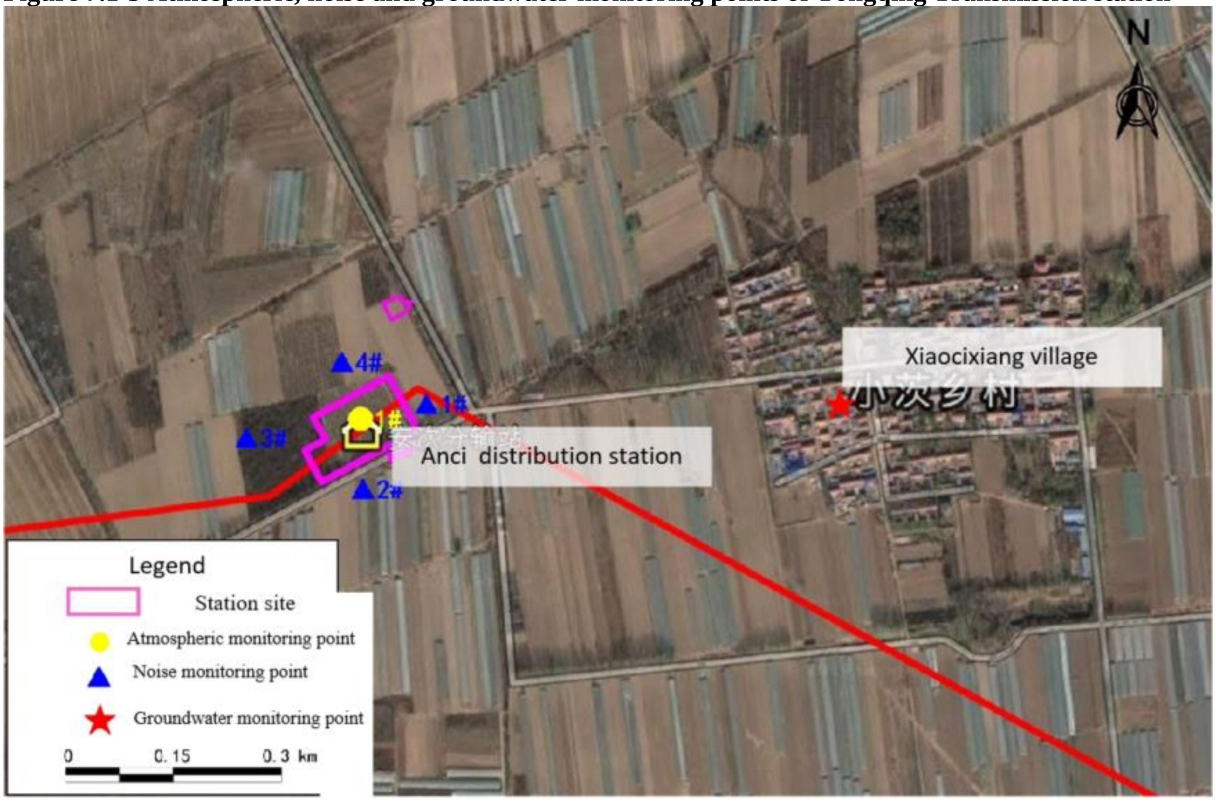


Figure 7.1-6 Atmosphere, noise, groundwater monitoring points at Anci substation

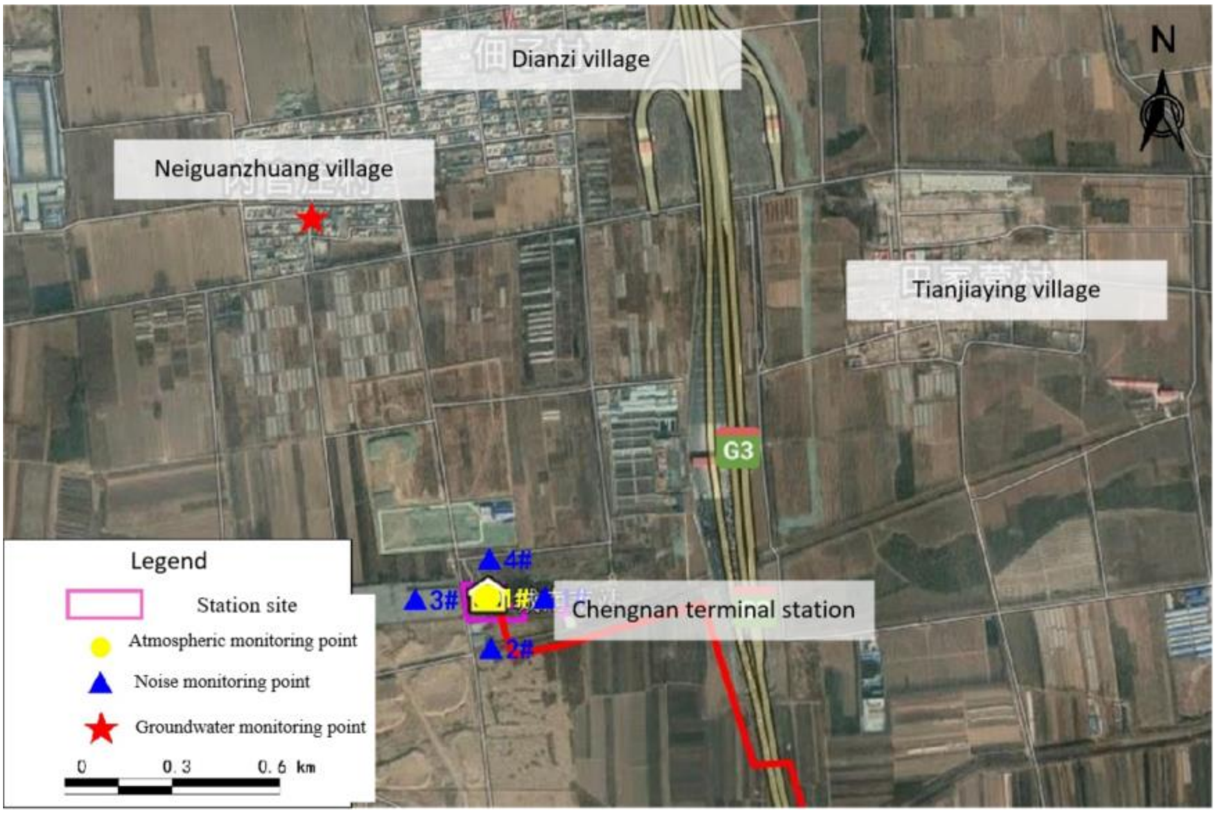


Figure 7.1-7 Atmospheric, noise, groundwater monitoring points at the end of the city

7.1.2.2 Sampling and analysis methods

The specific methods of sampling and analysis are shown in the table below.

Table 7.1-5 Monitoring methods for atmospheric pollutants

Pullants	Methods	Source	lowest detection limit （mg/m3）
Total hydrocarbons	《Ambient air; total hydrocarbon, methane and non-methane total hydrocarbon determination; direct injection-gas chromatograph》	HJ 604-2017	0.06
non-methane total hydrocarbons	《Ambient air; total hydrocarbon, methane and non-methane total hydrocarbon determination; direct injection-gas chromatograph》	HJ 604-2017	0.07

7.1.2.3 Statistics and evaluation of monitoring results

The meteorological data and monitoring and evaluation results during the monitoring of characteristic pollutants at the boundary of the plant are shown in the following table.

Table 7.1-6 Meteorological data of routine pollutant monitoring in the process station

Monitoring points		Date	T（℃）	P（kpa）	Wind direction	Wind speed（m/s）
The first receiving station	upwind direction 1#	2019.6.6-6.12	24.3-35.2	99.8-100.5	Southeast/ northwest	1.6-5.2
	downwind direction 2#					
	downwind direction 3#					
	downwind direction 4#					
Nangang substation		2019.6.6-6.12	23.7-34.6	99.8-100.4	Southeast/ northeast	1.7-4.9
Daqiuzhuang substation		2019.6.6-6.12	18.7-34.3	99.8-100.7	Southeast/ northeast	1.9-4.5
Jinghai transmission station		2019.6.6-6.12	18.4-33.7	99.7-100.8	Southeast/ northeast	1.7-3.7
Yongqing transmission station		2019.5.24-5.31	16.4-34	99.7-100.6	South/north	1.4-3.9
Anci substation		2019.5.24-5.31	17.8-34.6	99.7-100.8	South/north	1.1-3.8
At the end of the south station		2019.5.24-5.31	17.3-33.7	99.7-100.8	South/north	1.2-3.9

Table 7.1-7 Statistical results of monitoring atmosphere status in the process station Unit: mg/m3

Evaluation effects	Monitoring points		Concentration range	Detection rates %	over-limit ratio %	Maximum/ standard%	Standard limit
total hydrocarbons	The first receiving station	upwind direction 1#	1.93-2.78	100	——	——	——
		downwind direction 2#	2.04-2.77	100	——	——	
		downwind direction 3#	2.27-2.99	100	——	——	
		downwind direction 4#	2.21-3.14	100	——	——	
	Nangang substation		1.46-2.44	100	——	——	
	Daqiuzhuang substation		1.72-3.88	100	——	——	
	Jinghai transmission station		1.5-3.04	100	——	——	
	Yongqing transmission station		2.21-2.93	100	——	——	
	Anci substation		1.61-2.64	100	——	——	
	Chengnan Station		1.62-2.8	100	——	——	
non-methane total hydrocarbons	The first receiving station	upwind direction 1#	0.39-0.89	100	0	44.5	Hourly average：2.0
		downwind direction 2#	0.52-0.84	100	0	42	
		downwind direction 3#	0.61-0.94	100	0	47	
		downwind direction 4#	0.49-0.88	100	0	44	
	Nangang substation		0.42-0.9	100	0	45	
	Daqiuzhuang substation		0.26-0.99	100	0	49.5	
	Jinghai transmission station		0.55-0.99	100	0	49.5	

	Yongqing transmission station	0.48-1.00	100	0	50	
	Anci substation	0.51-0.88	100	0	44	
	Chengnan Station	0.19-0.74	100	0	37	

It can be seen from the above table that the concentration of total hydrocarbons and non-methane total hydrocarbons in the sites of the project is low, and the monitoring concentrations of non-methane total hydrocarbons at each monitoring site are not exceeding the standard, which can meet requirements for the 1-hour average concentration standard limit for non-methane total hydrocarbons in “Comprehensive emission standards for air pollutants”.

7.2 Monitoring and evaluation of acoustic environment status

7.2.1 Monitoring and evaluation of acoustic environment status near send-out pipelines

7.2.1.1 Monitoring points

In order to understand the sound environment quality around the proposed project site, this survey evaluates the use of on-site monitoring methods for three villages within 500m of each station: 1 point was set up in each village for monitoring, including Nanrenying Village (village near Yongqing Station, 39°18'21.46 "North; 116°40'47.15" East), Xiaozi Village (village near Anci Station, 39°28'4.74" north; 116°36'21.94" East), and Neiguanzhuang Village (village near Chengnan Station, 39° 33'39.44"North; 116°28'19.61"East).

7.2.1.2 Monitoring time and frequency

The sampling time and frequency are carried out in accordance with the requirements of the Acoustic Environmental Quality Standard (GB3096-2008). The monitoring is carried out continuously for 3 days, and each time during the daytime and nighttime monitoring, including at night after 22 o'clock.

7.2.1.3 Survey results and evaluation of acoustic environment status

The statistics and evaluation results of the monitoring status of the acoustic environment are shown in the table below.

Table 7.2-1 Statistical results of acoustic environment quality monitoring results Unit: dB(A)

Monitoring point	Daytime		Night	
	Monitoring results	Compliance analysis	Monitoring results	Compliance analysis
Nanrenying village	51-53	Compliance	41-43	Compliance
Xiaozi village	50-52	Compliance	41-42	Compliance
Neiguanzhuang village	51-52	Compliance	40-43	Compliance
Standard limit（category 1）	55		45	

It can be seen from the above table that the acoustic environment of the villages near the proposed stations is of good quality, and the acoustic environment at night and in the daytime meets the requirements of the Class 1 standard limits in the Acoustic Environmental Quality Standard (GB3096-2008).

7.2.2 Investigation and evaluation of noise status at the site boundary of the station yard

7.2.2.1 Monitoring plan

In order to understand the current situation of the atmosphere of the existing process site, the noise monitoring points are set around the boundary of the seven stations. The location of specific monitoring points is shown in the figure below.

Monitoring period: continuous monitoring for 3 days, once every day.

The detailed monitoring time of each monitoring point is shown in the table below.

Table 7.2-2 List of Noise Monitoring Time of Process Station Boundary

Monitoring point	Geographic coordinates	Monitoring time
The first receiving station	38°44'37.40"N；117°43'2.48"E	2019/05/23~2019/05/25
Nangang substation	38°45'18.84"N；117°33'30.21"E	2019/05/23~2019/05/25
Daqiuzhuang substation	38°48'20.20"N；117° 6'7.59"E	2019/05/23~2019/05/25
Jinghai transmission station	38°46'46.39"N；116°56'57.50"E	2019/05/23~2019/05/25
Yongqing transmission station	39°18'22.04"N；116°41'2.02"E	2019/05/25~2019/05/27
Anci substation	39°28'3.47"N；116°35'54.15"E	2019/05/25~2019/05/27
Chengnan Station	39°33'5.91"N；116°28'36.63"E	2019/05/25~2019/05/27

7.2.2.2 Statistics and evaluation of monitoring results

Monitoring statistical results are shown in the table below.

Table 7.2-3 Statistical results of noise monitoring at the boundary of the plant Unit: dB(A)

Monitoring point		Daytime		Night	
		Monitoring results	Compliance analysis	Monitoring results	Compliance analysis
The first receiving station	Factory boundary east 1#	55-56	Compliance	45-46	Compliance
	Factory boundary South 2#	55	Compliance	45-46	Compliance
	Factory boundary west 3#	55-56	Compliance	45	Compliance
	Factory boundary north 4#	54	Compliance	45	Compliance
Nangang substation	Factory Boundary East 1#	55-56	Compliance	45	Compliance
	Factory	55-56	Compliance	45-46	Compliance

Monitoring point		Daytime		Night	
		Monitoring results	Compliance analysis	Monitoring results	Compliance analysis
	boundary South 2#				
	Factory Boundary East 3#	55	Compliance	45	Compliance
	Factory boundary north 4#	55	Compliance	45	Compliance
Daqiuzhuang substation	Factory boundary east 1#	51-54	Compliance	47	Compliance
	Factory boundary South 2#	52-55	Compliance	47-48	Compliance
	Factory boundary west 3#	49-51	Compliance	47-48	Compliance
	Factory boundary north 4#	48-52	Compliance	46	Compliance
Jinghai transmission station	Factory boundary east 1#	50-51	Compliance	46	Compliance
	Factory boundary South 2#	51-54	Compliance	47	Compliance
	Factory boundary west 3#	52-54	Compliance	48-49	Compliance
	Factory boundary north 4#	54-57	Compliance	48-49	Compliance
Yongqing transmission station	Factory boundary east 1#	51-54	Compliance	42-43	Compliance
	Factory boundary South 2#	52-53	Compliance	41-44	Compliance
	Factory boundary west 3#	50-52	Compliance	40-42	Compliance
	Factory boundary north 4#	50-52	Compliance	40-42	Compliance
Anci substation	Factory boundary east 1#	51-52	Compliance	41-43	Compliance
	Factory boundary South 2#	51-52	Compliance	41-44	Compliance
	Factory boundary west 3#	51	Compliance	42-44	Compliance
	Factory boundary north 4#	50-52	Compliance	40-42	Compliance

Monitoring point		Daytime		Night	
		Monitoring results	Compliance analysis	Monitoring results	Compliance analysis
Chengnan Station	Factory boundary east 1#	52-53	Compliance	41-43	Compliance
	Factory boundary South 2#	51-53	Compliance	40-42	Compliance
	Factory boundary west 3#	50-51	Compliance	40-41	Compliance
	Factory boundary north 4#	52-53	Compliance	39-41	Compliance
Standard limit（category 2）		60		50	

It can be seen from the above table that the noise monitoring results of the existing gas station yards are between 48~56 dB (A), and the nighttime monitoring results are between 39~49 dB (A), which can meet the requirements of the Class 2 standard limits in the Noise Emission Standard (GB12348-2008) in industrial boundary environment. The results show the acoustic environment quality is good in the existing gas station yards.

7.3 Survey and evaluation of current status of surface water environment

7.3.1 Status monitoring

7.3.1.1 Monitoring points

The rivers with drinking water function, water source protection area and high water level were selected to monitor the current situation of surface water environmental quality. The specific monitoring points and monitoring time are shown in the following table.

Table 7.3-1 Arrangement of surface water monitoring points along the pipeline

No.	River name	City/County	Construction method
1	Duliujian River 1#	Tianjin Dagang District	Directional Drill
2	Duliujian River 2#	Tianjin Dagang District	Directional Drill
3	Daqing River	Tianjin Jinghai District	Directional Drill
4	Qianjin Canal	Tianjin Jinghai District	Directional Drill
5	Drainage Canal	Tianjin Jinghai District	Directional Drill
6	Ziya River	Tianjin Jinghai District	Directional Drill
7	Yongding River	Langfang City-Anci District	Directional Drill
8	Yundong Drainage Canal	Tianjin Jinghai District	Pipe Jacking
9	Youth Canal	Tianjin Jinghai District	Pipe Jacking
10	Gangtuanyin River	Tianjin Jinghai District	Pipe Jacking
11	Xiaomiao Donggan	Langfang City-Anci District	Pipe Jacking
12	South Canal	Tianjin Jinghai District	Directional Drill
13	Alkali River	Langfang City-the source part of Xinglongzhuang	Directional Drill
14	Hongnihe Water Diversion Canal	Tianjin Beidagang Wetland Reserve	

15	Zhongting River	Tianjin City	

7.3.1.2 Monitoring items, time and frequency

Monitoring items: pH, CODCr, ammonia nitrogen, SS, petroleum, permanganate index, total nitrogen, total phosphorus.

Monitoring time: May 24-26, 2019.

Monitoring frequency: continuous monitoring for three days, once a day.

7.3.1.3 Monitoring and analysis methods

The method of pollutant analysis is carried out in accordance with the requirements of the National Standards for Water Quality Analysis Methods (Fourth Edition) and the Environmental Quality Standard for Surface Water (GB 3838-2002). The specific methods and sources are shown in the table below. The collection, storage and transportation of samples are carried out in accordance with standard methods. The methods and sources of contamination analysis are shown in the table below.

Table 7.3-2 Analysis methods of surface water pollutants

No.	Test index	Detection limit (mg/L)	Test method
1	pH	0.1unit	Glass electrode method
2	Visible object	——	direct observation
3	CODcr	0.05	volumetric method
4	ammonia nitrogen（mg/L）	0.02	pectrophotometry
5	CODMn	0.05	volumetric method
6	petroleum	0.05	infrared spectrophotometry
7	TN	0.07	flow injection
8	TP	0.01	ammonium molybdate spectrophotometry

7.3.2 Monitoring results and evaluation of surface water environment status

The evaluation method used in this evaluation is the standard index method, and the calculation formula is:

$$P_i = \frac{C_i}{C_s}$$

Where: P_i - a single index;

C_i - monitoring concentration of water quality parameter i (average value), mg /l;

C_s - the standard value of water quality parameters, mg / l;

For pH, the formula for the single standard index is:

$P_i = (7.0 - pH_i)/(7.0 - pH_{sd})$ When $pH_i \leqslant 7.0$;

$P_i = (pH_i - 7.0)/(pH_{su} - 7.0)$ When $pH_i > 7.0$.

Where: P_i - pH standard index; pH_i - pH measured value;

pH_{sd} - the lower limit of the pH in the standard; pH_{su} - the upper limit of the pH in the standard.

When the single standard index is greater than 1, it indicates that the water quality exceeds the standard. The larger the index, the more serious the exceeding standard.

Monitoring data and analysis results of the monitoring section are shown in the table below.

Table 7.3-3 Results of monitoring data for Class III water monitoring sections Unit: mg/L, pH is dimensionless

Sampling location		pH	SS	CODCr	NH4+-N	COD Mn	Petro	TN	TP
Daqing River	Upstream 1	8.31	5.0	15.09	0.13	4.19	<0.05	0.58	0.06
	Upstream 2	8.16	3.0	17.83	0.20	4.19	<0.05	0.53	0.07
	Upstream 3	8.09	10.5	14.65	0.15	3.89	<0.05	0.29	0.08
	Downstream 1	8.21	<0.5	16.59	0.13	3.89	<0.05	0.52	0.08
	Downstream 2	8.09	12.5	15.89	0.13	4.19	<0.05	0.53	0.08
	Downstream 3	8.08	8.5	13.79	0.23	3.89	<0.05	0.34	0.07
Hongnihe Water Diversion Canal	Upstream 1	8.08	4.5	17.74	0.56	5.62	<0.05	0.69	0.18
	Upstream 2	8.05	3.5	18.72	0.51	5.3	<0.05	0.67	0.15
	Upstream 3	7.89	1.5	17.25	0.51	4.69	<0.05	0.54	0.15
	Downstream 1	8.03	5.0	17.98	0.86	5.87	<0.05	0.93	0.19
	Downstream 2	7.98	9.0	16.95	0.38	5.68	<0.05	0.56	0.17
	Downstream 3	8.04	<0.5	14.35	0.59	4.38	<0.05	0.65	0.16
South Canal	Upstream 1	8.17	<0.5	18.54	0.29	4.58	<0.05	0.73	0.09
	Upstream 2	7.98	<0.5	16.75	0.13	5.32	<0.05	0.52	0.05
	Upstream 3	8.19	3.5	18.32	0.25	4.25	<0.05	0.84	0.08
	Downstream 1	8.18	6.5	16.70	0.26	4.29	<0.05	0.51	0.08
	Downstream 2	8.15	10.0	18.53	0.28	4.68	<0.05	0.63	0.08
	Downstream 3	8.16	4.5	16.45	0.27	4.23	<0.05	0.92	0.07
Ziya River	Upstream 1	8.07	6.5	18.09	0.17	3.89	<0.05	0.34	0.07
	Upstream 2	8.05	2.0	17.29	0.16	3.73	<0.05	0.28	0.06
	Upstream	7.98	4.0	17.23	0.16	3.73	<0.05	0.34	0.06

	3								
	Downstream 1	8.09	4.0	18.32	0.16	4.04	<0.05	0.26	0.05
	Downstream 2	8.02	10.0	15.51	0.16	3.58	<0.05	0.29	0.05
	Downstream 3	8.01	9.5	15.02	0.15	4.04	<0.05	0.29	0.05
Evaluation standard（category III）		6～9	30	20	1	6	0.05	1	0.2

Table 7.3-4 Analysis results of monitoring data for Class III water body (Pi value)

Sampling location		pH	SS	CODCr	NH4+-N	CODMn	Petro	TN	TP
Daqing River	Upstream 1	0.66	0.17	0.75	0.13	0.70	/	0.58	0.32
	Upstream 2	0.58	0.10	0.89	0.20	0.70	/	0.53	0.33
	Upstream 3	0.55	0.35	0.73	0.15	0.65	/	0.29	0.40
	Downstream 1	0.61	/	0.83	0.13	0.65	/	0.52	0.40
	Downstream 2	0.55	0.42	0.79	0.13	0.70	/	0.53	0.39
	Downstream 3	0.54	0.28	0.69	0.23	0.65	/	0.34	0.37
Hongnihe Water Diversion Canal	Upstream 1	0.54	0.15	0.89	0.56	0.94	/	0.69	0.90
	Upstream 2	0.53	0.12	0.94	0.51	0.88	/	0.67	0.75
	Upstream 3	0.45	0.05	0.86	0.51	0.78	/	0.54	0.75
	Downstream 1	0.52	0.17	0.90	0.86	0.98	/	0.93	0.95
	Downstream 2	0.49	0.30	0.85	0.38	0.95	/	0.56	0.85
	Downstream 3	0.52	/	0.72	0.59	0.73	/	0.65	0.80
South Canal	Upstream 1	0.59	/	0.93	0.29	0.76	/	0.73	0.43
	Upstream 2	0.49	/	0.84	0.13	0.89	/	0.52	0.26
	Upstream 3	0.60	0.12	0.92	0.25	0.71	/	0.84	0.39
	Downstream 1	0.59	0.22	0.84	0.26	0.72	/	0.51	0.38
	Downstream 2	0.58	0.33	0.93	0.28	0.78	/	0.63	0.40
	Downstream 3	0.58	0.15	0.82	0.27	0.71	/	0.92	0.37
Ziya River	Upstream 1	0.54	0.22	0.90	0.17	0.65	/	0.34	0.36
	Upstream 2	0.53	0.07	0.86	0.16	0.62	/	0.28	0.28
	Upstream 3	0.49	0.13	0.86	0.16	0.62	/	0.34	0.31
	Downstream 1	0.55	0.13	0.92	0.16	0.67	/	0.26	0.25

	Downstream 2	0.51	0.33	0.78	0.16	0.60	/	0.29	0.27
	Downstream 3	0.51	0.32	0.75	0.15	0.67	/	0.29	0.23
Over limit rate		0	0	0	0	0	0	0	0
Evaluation standard (category III）		6～9	30	20	1	6	0.05	1	0.2

Table 7.3-5 Results of Monitoring Data for Section IV Water Monitoring Section Unit: mg/L, pH is dimensionless

Sampling location		pH	SS	CODCr	NH4+-N	CODMn	Petro	TN	TP
Duliujian river 1#	Upstream 1	8.15	2.0	16.78	0.45	7.54	<0.05	0.71	0.14
	Upstream 2	8.15	2.5	19.23	0.40	7.85	<0.05	0.69	0.12
	Upstream 3	8.22	0.5	17.53	0.41	7.54	<0.05	0.68	0.11
	Downstream 1	8.21	17.0	18.69	0.26	7.54	<0.05	0.41	0.09
	Downstream 2	8.18	7.5	18.92	0.34	7.24	<0.05	0.59	0.11
	Downstream 3	8.08	2.5	16.82	0.48	8.15	<0.05	0.79	0.11
Duliujian river 2#	Upstream 1	8.09	3.0	18.31	0.37	5.68	<0.05	0.70	0.11
	Upstream 2	8.19	11.5	16.73	0.34	5.34	<0.05	0.69	0.10
	Upstream 3	8.15	5.5	17.68	0.40	5.31	<0.05	0.76	0.12
	Downstream 1	8.16	6.0	17.42	0.39	5.79	<0.05	0.80	0.12
	Downstream 2	8.15	2.5	19.56	0.41	5.69	<0.05	0.64	0.12
	Downstream 3	8.11	8.5	16.53	0.37	5.28	<0.05	0.72	0.10
Gangtuanyin River	Upstream 1	8.18	<0.5	18.63	0.10	3.58	<0.05	0.68	0.18
	Upstream 2	8.12	2.0	18.96	0.10	4.04	<0.05	0.71	0.07
	Upstream 3	8.07	<0.5	15.32	0.09	3.81	<0.05	0.53	0.06
	Downstream 1	8.18	<0.5	18.09	0.12	3.73	<0.05	0.65	0.08
	Downstream 2	8.07	<0.5	17.23	0.12	3.89	<0.05	0.65	0.08
	Downstream 3	8.06	1.5	14.83	0.12	3.43	<0.05	0.65	0.05
Alkali River	Upstream 1	8.73	7.0	18.96	0.15	5.14	<0.05	0.59	0.08
	Upstream 2	8.71	15.0	13.28	0.15	5.26	<0.05	0.37	0.08
	Upstream 3	8.65	5.5	16.42	0.15	5.71	<0.05	0.58	0.07
	Downstream 1	8.46	4.5	14.32	0.16	5.79	<0.05	0.45	0.08
	Downstream 2	8.68	7.0	15.38	0.21	5.41	<0.05	0.45	0.07
	Downstream 3	8.74	7.0	17.53	0.16	5.41	<0.05	0.56	0.07
Drainage Canal	Upstream 1	8.79	1.5	16.21	0.22	4.29	<0.05	0.56	0.08
	Upstream 2	8.79	5.0	18.20	0.17	4.62	<0.05	0.56	0.10
	Upstream 3	8.63	1.0	16.37	0.19	4.11	<0.05	0.55	0.09
	Downstream 1	8.63	2.0	15.43	0.22	4.35	<0.05	0.87	0.09
	Downstream 2	8.52	7.0	17.52	0.21	4.31	<0.05	0.83	0.09
	Downstream 3	8.82	5.0	18.32	0.20	4.48	<0.05	0.31	0.09
Qianjin Canal	Upstream 1	8.12	1.0	15.62	0.39	5.29	<0.05	0.53	0.13
	Upstream 2	8.11	4.0	18.50	0.43	5.36	<0.05	0.49	0.11
	Upstream 3	8.06	12.5	13.60	0.38	5.11	<0.05	0.59	0.11
	Downstream 1	8.07	5.5	17.83	0.38	5.21	<0.05	0.42	0.12
	Downstream 2	8.08	1.0	17.23	0.41	5.12	<0.05	0.58	0.13
	Downstream 3	8.16	8.5	14.53	0.34	5.16	<0.05	0.54	0.08
Youth Canal	Upstream 1	8.06	<0.5	16.38	0.18	7.24	<0.05	0.50	0.08
	Upstream 2	8.05	<0.5	13.79	0.13	6.78	<0.05	0.38	0.05
	Upstream 3	7.96	<0.5	10.34	0.17	7.09	<0.05	0.83	0.07
	Downstream 1	8.14	2.0	17.23	0.17	6.63	<0.05	0.52	0.07
	Downstream 2	8.01	14.0	10.34	0.29	6.63	<0.05	0.90	0.06
	Downstream 3	7.95	<0.5	15.51	0.16	7.31	<0.05	0.26	0.10

Xiaomiao Donggan	Upstream 1	8.64	3.5	12.06	0.14	5.18	<0.05	0.27	0.08
	Upstream 2	8.76	<0.5	17.23	0.14	5.12	<0.05	0.56	0.10
	Upstream 3	8.82	9.5	14.69	0.13	5.56	<0.05	0.64	0.07
	Downstream 1	8.73	1.0	17.23	0.16	7.24	<0.05	0.38	0.09
	Downstream 2	8.79	<0.5	17.23	0.15	5.79	<0.05	0.68	0.08
	Downstream 3	8.67	5.0	18.32	0.13	5.56	<0.05	0.62	0.08
Yongding river	Upstream 1	8.83	<0.5	22.40	0.15	4.34	<0.05	0.63	0.07
	Upstream 2	8.63	3.0	18.09	0.18	5.33	<0.05	0.60	0.09
	Upstream 3	8.48	4.5	16.37	0.15	4.72	<0.05	0.50	0.10
	Downstream 1	8.87	2.5	24.12	0.16	4.72	<0.05	0.61	0.06
	Downstream 2	8.57	4.0	17.23	0.15	5.71	<0.05	0.52	0.06
	Downstream 3	8.66	4.0	21.54	0.16	4.80	<0.05	0.72	0.08
Yundong Drainage River	Upstream 1	7.80	2.5	16.71	0.83	5.69	<0.05	0.88	0.19
	Upstream 2	8.13	7.0	14.32	0.76	5.38	<0.05	0.83	0.17
	Upstream 3	8.04	2.5	13.21	0.52	5.36	<0.05	0.63	0.11
	Downstream 1	7.96	7.0	15.63	0.89	5.24	<0.05	0.92	0.08
	Downstream 2	8.11	1.5	16.38	0.62	5.84	<0.05	0.72	0.10
	Downstream 3	7.98	12.0	14.77	0.39	5.71	<0.05	0.51	0.12
Evaluation standard（category IV）		6～9	60	30	1.5	10	0.05	1.5	0.3

Table 7.3-6 Analysis results of Class IV water body monitoring data (Pi value)

Sampling location		pH	SS	CODCr	NH4+-N	CODMn	Petro	TN	TP
Duliujian River 1#	Upstream 1	0.58	0.03	0.56	0.30	0.75	/	0.47	0.45
	Upstream 2	0.58	0.04	0.64	0.27	0.79	/	0.46	0.41
	Upstream 3	0.61	0.01	0.58	0.27	0.75	/	0.45	0.37
	Downstream 1	0.61	0.28	0.62	0.17	0.75	/	0.27	0.31
	Downstream 2	0.59	0.13	0.63	0.23	0.72	/	0.39	0.38
	Downstream 3	0.54	0.04	0.56	0.32	0.82	/	0.53	0.36
Duliujian River 2#	Upstream 1	0.55	0.05	0.61	0.25	0.57	/	0.47	0.38
	Upstream 2	0.60	0.19	0.56	0.23	0.53	/	0.46	0.33
	Upstream 3	0.58	0.09	0.59	0.27	0.53	/	0.51	0.40
	Downstream 1	0.58	0.10	0.58	0.26	0.58	/	0.53	0.41
	Downstream 2	0.58	0.04	0.65	0.27	0.57	/	0.43	0.38
	Downstream 3	0.56	0.14	0.55	0.25	0.53	/	0.48	0.34
Gangtuanyin River	Upstream 1	0.59	/	0.62	0.07	0.36	/	0.45	0.60
	Upstream 2	0.56	0.03	0.63	0.07	0.40	/	0.47	0.22
	Upstream 3	0.54	/	0.51	0.06	0.38	/	0.35	0.20
	Downstream 1	0.59	/	0.60	0.08	0.37	/	0.43	0.25
	Downstream 2	0.54	/	0.57	0.08	0.39	/	0.43	0.27
	Downstream 3	0.53	0.03	0.49	0.08	0.34	/	0.43	0.16
Alkali River	Upstream 1	0.87	0.12	0.63	0.10	0.51	/	0.39	0.27
	Upstream 2	0.86	0.25	0.44	0.10	0.53	/	0.25	0.26
	Upstream 3	0.83	0.09	0.55	0.10	0.57	/	0.39	0.24
	Downstream 1	0.73	0.08	0.48	0.11	0.58	/	0.30	0.27

	Downstream 2	0.84	0.12	0.51	0.14	0.54	/	0.30	0.24
	Downstream 3	0.87	0.12	0.58	0.11	0.54	/	0.37	0.24
Drainage Canal	Upstream 1	0.90	0.03	0.54	0.15	0.43	/	0.37	0.28
	Upstream 2	0.90	0.08	0.61	0.11	0.46	/	0.37	0.32
	Upstream 3	0.82	0.02	0.55	0.13	0.41	/	0.37	0.31
	Downstream 1	0.82	0.03	0.51	0.15	0.44	/	0.58	0.29
	Downstream 2	0.76	0.12	0.58	0.14	0.43	/	0.55	0.31
	Downstream 3	0.91	0.08	0.61	0.13	0.45	/	0.21	0.30
Qianjin Canal	Upstream 1	0.56	0.02	0.52	0.26	0.53	/	0.35	0.43
	Upstream 2	0.56	0.07	0.62	0.29	0.54	/	0.33	0.37
	Upstream 3	0.53	0.21	0.45	0.25	0.51	/	0.39	0.37
	Downstream 1	0.54	0.09	0.59	0.25	0.52	/	0.28	0.40
	Downstream 2	0.54	0.02	0.57	0.27	0.51	/	0.39	0.43
	Downstream 3	0.58	0.14	0.48	0.23	0.52	/	0.36	0.28
Youth Canal	Upstream 1	0.53	/	0.55	0.12	0.72	/	0.33	0.28
	Upstream 2	0.53	/	0.46	0.09	0.68	/	0.25	0.16
	Upstream 3	0.48	/	0.34	0.11	0.71	/	0.55	0.24
	Downstream 1	0.57	0.03	0.57	0.11	0.66	/	0.35	0.22
	Downstream 2	0.51	0.23	0.34	0.19	0.66	/	0.60	0.21
	Downstream 3	0.48	/	0.52	0.11	0.73	/	0.17	0.34
Xiaomiao Donggan	Upstream 1	0.82	0.06	0.40	0.09	0.52	/	0.18	0.27
	Upstream 2	0.88	/	0.57	0.09	0.51	/	0.37	0.32
	Upstream 3	0.91	0.16	0.49	0.09	0.56	/	0.43	0.23
	Downstream 1	0.87	0.02	0.57	0.11	0.72	/	0.25	0.31
	Downstream 2	0.90	/	0.57	0.10	0.58	/	0.45	0.27
	Downstream 3	0.84	0.08	0.61	0.09	0.56	/	0.41	0.25
Yongding river	Upstream 1	0.92	/	0.75	0.10	0.43	/	0.42	0.25
	Upstream 2	0.82	0.05	0.60	0.12	0.53	/	0.40	0.30
	Upstream 3	0.74	0.08	0.55	0.10	0.47	/	0.33	0.33
	Downstream 1	0.94	0.04	0.80	0.11	0.47	/	0.41	0.19
	Downstream 2	0.79	0.07	0.57	0.10	0.57	/	0.35	0.21
	Downstream 3	0.83	0.07	0.72	0.11	0.48	/	0.48	0.27
Yundong Drainage River	Upstream 1	0.40	0.04	0.56	0.55	0.57	/	0.59	0.63
	Upstream 2	0.57	0.12	0.48	0.51	0.54	/	0.55	0.57
	Upstream 3	0.52	0.04	0.44	0.35	0.54	/	0.42	0.37
	Downstream 1	0.48	0.12	0.52	0.59	0.52	/	0.61	0.27
	Downstream 2	0.56	0.03	0.55	0.41	0.58	/	0.48	0.33
	Downstream 3	0.49	0.20	0.49	0.26	0.57	/	0.34	0.40

Over limit rate	0	0	0	0	0	0	0	0
Evaluation standard （category IV）	6～9	60	30	1.5	10	0.05	1.5	0.3

It can be seen from the above table that the monitoring factors such as pH, CODCr, ammonia nitrogen, SS, petroleum, permanganate index, TN and TP in the water quality of each monitoring point have not exceeded the standard value and can meet the environmental quality standard of surface water (GB 3838-2002) Class III and Class IV standard limits.

7.4 Survey and evaluation of current ecological status of inland areas

7.4.1Evaluation method

The investigation and evaluation of the current status of the ecological environment is based on the combination of on-site investigation and satellite remote sensing image interpretation, and evaluates the ecological environment status of the evaluation area and the project disturbance area.

7.4.1.1 Remote sensing interpretation

First, landsat-8 satellite images and related data in this region are used, including landsat-8 satellite images (15m resolution) of July 2018 and June 2018 in the project area, the SPOT images and QB images (at 2.5m and 0.61m resolution) of project areas from 2016 to 2018, China vegetation map at 1:1000000, topographic maps at 1:50 000, ecological function zoning maps and other relevant images; Based on the analysis of these data and the natural and social situation of each city, the situation of land use, vegetation and sensitive targets around the project areas are roughly judged to find out the difficult points. Then the field investigation is carried out to further evaluate the status of ecological environment quality such as land use type, vegetation type, soil type and protection status of sensitive targets, so as to determine the habitat composition of fuzzy points in remote sensing images. Finally using GIS software, satellite images and 1:50000 topographic map, pipe route map and other related datum are corrected. By the artificial visual interpretation,topography of surrounding areas, water system, traffic, sensitive target data are digitally evaluated. Finally after extracting the data of vegetation, soil erosion in evaluated areas, the various classification statistical figures are generated. On the basis of various data and charts, the assessment of regional ecological environment situation of quantitative and qualitative evaluation is given.

7.4.1.2 Evaluation method of ecosystem integrity

The evaluation method combines landscape ecology theory and other relevant methods to assess ecological system integrity of evaluated areas. Taking the land use type as the landscape unit, the paper analyzes and compares the structure, function and stability of each landscape unit with the method of landscape ecology, so as to provide the basis for the macroscopic and overall evaluation of the project.

At present, the method of calculating the important value of vegetation in traditional ecology is mostly used to determine the advantage of a certain patch type in the landscape, known as the dominance value (Do) which is calculated by three parameters: density (Rd), frequency (Rf) and landscape proportion (Lp). The calculation formula of landscape ecology is as follows:

Density (Rd) = (number of plaque I/total number of plaques) ×100%

Frequency (Rf) = (number of quadrats in plaque I/total quadrats) ×100%

Landscape proportion (Lp) = (area of patch I/total area of sample land) ×100%

Dominance (Do) =0.5×[0.5×(Rd+Rf)+Lp]×100%

The density and landscape proportion can comprehensively reflect the connectivity degree of a certain kind of patch in the landscape system. The frequency can reflect the distribution uniformity of a certain patch in the landscape system. The landscape proportion can reflect the relative area of a patch in the landscape system. Three parameters of density, frequency and landscape proportion can be concluded the dominance value, as one kind of patch dominance value is significantly higher than other kinds of patches of dominance value, it is concluded that this type of patch is mode of landscape system so that ecological characteristics of landscape system is dominated by the ecological characteristics of this type of mold. If a particular area of the landscape system recognize green areas as its model, it shows that the region has a better ecological integrity.

7.4.1.3 Method of sample investigation

GPS was used to determine the location of the calibration quadrat, and the community is investigated by the method of Braun-Blanquet sampling method, with seting up the arbor community samples in 10x10m^2, bushy aspects 5x5m^2, herb samples in terms of 2x2m^2 (tall herbal) or 1x1m^2 (small herbaceous). The plant number, height and DBH of tree layer are investigated and recorded. The species, number, height, abundance and coverage of shrub layer and herb layer are investigated and recorded. Photographs of quadrat communities are taken.

7.4.1.4 Soil erosion

The evaluation scope of this project focuses on two types of hydraulic erosion areas. The main investigation methods are as follows:

The investigation on the status quo of soil erosion is based on the analysis of vegetation, terrain and other factors in the evaluation area. According to vegetation coverage, slope and other indicators and the classification and classification standards of soil erosion (sl190-2007), the soil erosion in this area is classified and evaluated, and the erosion amount of primary surface soil is estimated, and the soil erosion status map of the evaluation area is drawn.The area and soil erosion modulus of each area are substituted into the evaluation model of soil erosion status, and the amount of soil erosion and the total amount of soil erosion in the evaluated areas are calculated. The grading standards of soil erosion intensity are shown in the table below.

Table 7.4-1 Grading criteria for soil erosion intensity

<table>
<tr><td colspan="7">Hydraulic erosion intensity classification</td></tr>
<tr><td>Level</td><td>Average erosion modulus［t/(km2·a)］</td><td colspan="5">Average loss of thickness（mm/a）</td></tr>
<tr><td>Microdegree</td><td>＜200，＜500，＜1000</td><td colspan="5">＜0.15，＜0.37，＜0.74</td></tr>
<tr><td>Mild</td><td>200，500，1000-2500</td><td colspan="5">0.15,0.37，0.74-1.9</td></tr>
<tr><td>Moderate</td><td>2500-5000</td><td colspan="5">1.9-3.7</td></tr>
<tr><td>Strong</td><td>5000-8000</td><td colspan="5">3.7-5.9</td></tr>
<tr><td>Extremely strong</td><td>8000-15000</td><td colspan="5">5.9-11.1</td></tr>
<tr><td>Acute</td><td>＞15000</td><td colspan="5">＞11.1</td></tr>
<tr><td colspan="7">Note: The thickness coefficient of the loss of this table is calculated according to the dry density of soil 1.35g/cm3, and the local soil can be calculated according to the dry density of the soil</td></tr>
<tr><td colspan="7">Soil erosion intensity surface erosion (sheet erosion) grading standard</td></tr>
<tr><td colspan="2">Land slope grade</td><td>5-8</td><td>8-15</td><td>15-25</td><td>25-35</td><td>＞35</td></tr>
<tr><td rowspan="4">Non-cultivated land cover（%）</td><td>60-75</td><td rowspan="3">Mild</td><td rowspan="2">Mild</td><td>Mild</td><td rowspan="2">Moderate</td><td>Moderate</td></tr>
<tr><td>45-60</td><td rowspan="2">Moderate</td><td>Strong</td></tr>
<tr><td>30-45</td><td rowspan="2">Moderate</td><td>Moderate</td><td>Extremely strong</td></tr>
<tr><td>＜30</td><td>Moderate</td><td rowspan="2">Strong</td><td rowspan="2">Extremely strong</td><td rowspan="2">Acute</td></tr>
<tr><td colspan="2">Sloping land</td><td>Mild</td><td>Moderate</td></tr>
</table>

Evaluation model of soil erosion status:

$$W_S = \sum_{i=1}^{n} M_{si} \cdot f_i$$

$$Ms = Ws/F$$

Where: Ws -- total amount of soil erosion in the desired area(t)

Msi -- soil erosion modulus (t/km2·a)

fi -- area (km2) corresponding to soil erosion modulus Msi(km2)

Ms -- average soil erosion modulus in the desired area (t/km2·a)

F -- total area of evaluated area (km2) $F=\sum_{i=1}^{n} fi$

7.4.2Ecological function regionalization and main ecological problems

7.4.2.1 National ecological function regionalization

According to the National Ecological Function Regionalization (revised version) (Ministry of environmental protection, 2015), the national terrestrial ecosystem service functions are divided into three categories: ecological regulation, product supply and human settlement. The pipeline runs through the two categories of product supply and human settlement. According to the importance of ecosystem service function, it can be divided into 9 ecological function types. The areas crossed by the pipeline respectively involve the functional area of preventing agricultural products and the functional area of human settlement. There are two ecological functional areas in haihe plain agricultural products supply area and Beijing-Tianjin-Hebei metropolitan group.

7.4.2.2 Ecological function zoning of Tianjin

The proposed pipeline will go through Binhai new area, Jinghai district, xiqing district and wuqing district, and the ecological function zoning map of Tianjin will be superimposed on the project. See the following table for the ecological function areas of the pipeline crossing the area. The pipeline involves 1 ecological zone, 3 ecological sub-zones and 5 ecological functional zones.

Table 7.4-2 Tianjin Ecological Functional Zone with Pipeline Crossing

Ecological area	Ecological subregion	Ecological functional area	Major environmental issues	Service function	Protection and development
Beijing-Tianjin-Tangshan Town and Suburban	I-9-4 Tianjin Binhai chemical industry	Tanggu chemical industry and sea freshwater aquaculture ecological	The water pollution is serious; the land reclamation, the construction of	Wetland	Protect the marine environment from land-based pollution, reduce the pollution generated by the upstream and then

Agro-ecological Zone	and fisheries ecological sub-region	functional zone	Yantian and the Xiuhuan Highway will reduce the tidal flat, and the tidal flat will be lost; the marine fishing industry will be too strong.。		discharge the sea; limit marine fishing; strengthen coastal zone management and raise fishermen's awareness of protecting sea resources.
	I-9-1 Agro-ecological sub-region of Beijing-Tianjin-Tangcheng suburb	Gang Tuan group biodiversity conservation and water conservation ecological functional area	Upstream water drastically reduces the shrinkage of wetland area; water pollution	Wetland protection, water conservation, biodiversity conservation, hydrological storage	Strengthen wetland conservation management; establish various types of protected areas
	I-9-1 Agro-ecological sub-region of Beijing-Tianjin-Tangcheng suburb	Highly sensitive ecological functional area in dry farming and soil salinization in southern China	The degree of soil salinization is high; the irrigation and drainage conditions are poor; the lack of water seriously restricts the development of agricultural production in this area	Agricultural production	Encourage the cultivation of drought-tolerant and salt-tolerant economic crops; develop and use shallow and brackish economic crops; develop and utilize shallow brackish water; change soil and alkali; pay attention to rational use of chemical fertilizers and pesticides to prevent soil pollution.
	I-9-3 Tianjin central city ecological sub-region	Suburban comprehensive development and soil pollution control ecological function area	The population is dense and there are many factories. The “three wastes” have large emissions and serious pollution.	Social production	Strengthen the sewage treatment level and pollutant discharge, comprehensively develop agriculture, forestry, animal husbandry and fishery, and build a modern food production base.
	I-9-1 Agro-ecological sub-region of Beijing-Tianjin-Tangcheng suburb	Wang Qingyu agricultural fruit ecological function area	Irrigation water sources and water quality are not guaranteed, and soil comprehensive fertility and potential are relatively low.	Agricultural production, fruit production	Planting drought-tolerant forests mainly can be used to grow grape and other fruit trees in areas with well irrigation conditions, but attention should be paid to increasing organic fertilizer, improving soil, and improving soil water retention and fertility.

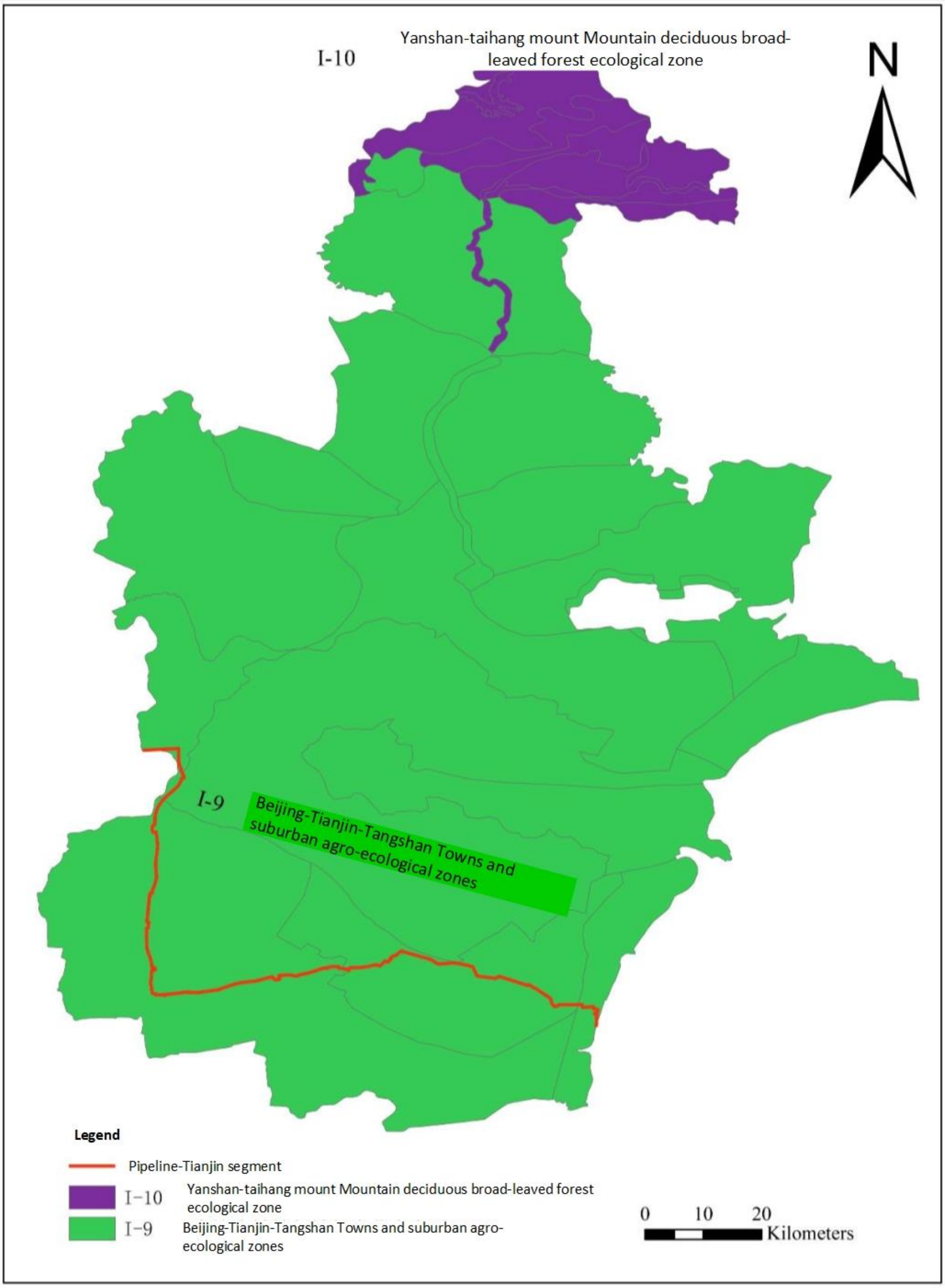


Figure 7.4-1 Pipeline and Tianjin Ecological Zone Map

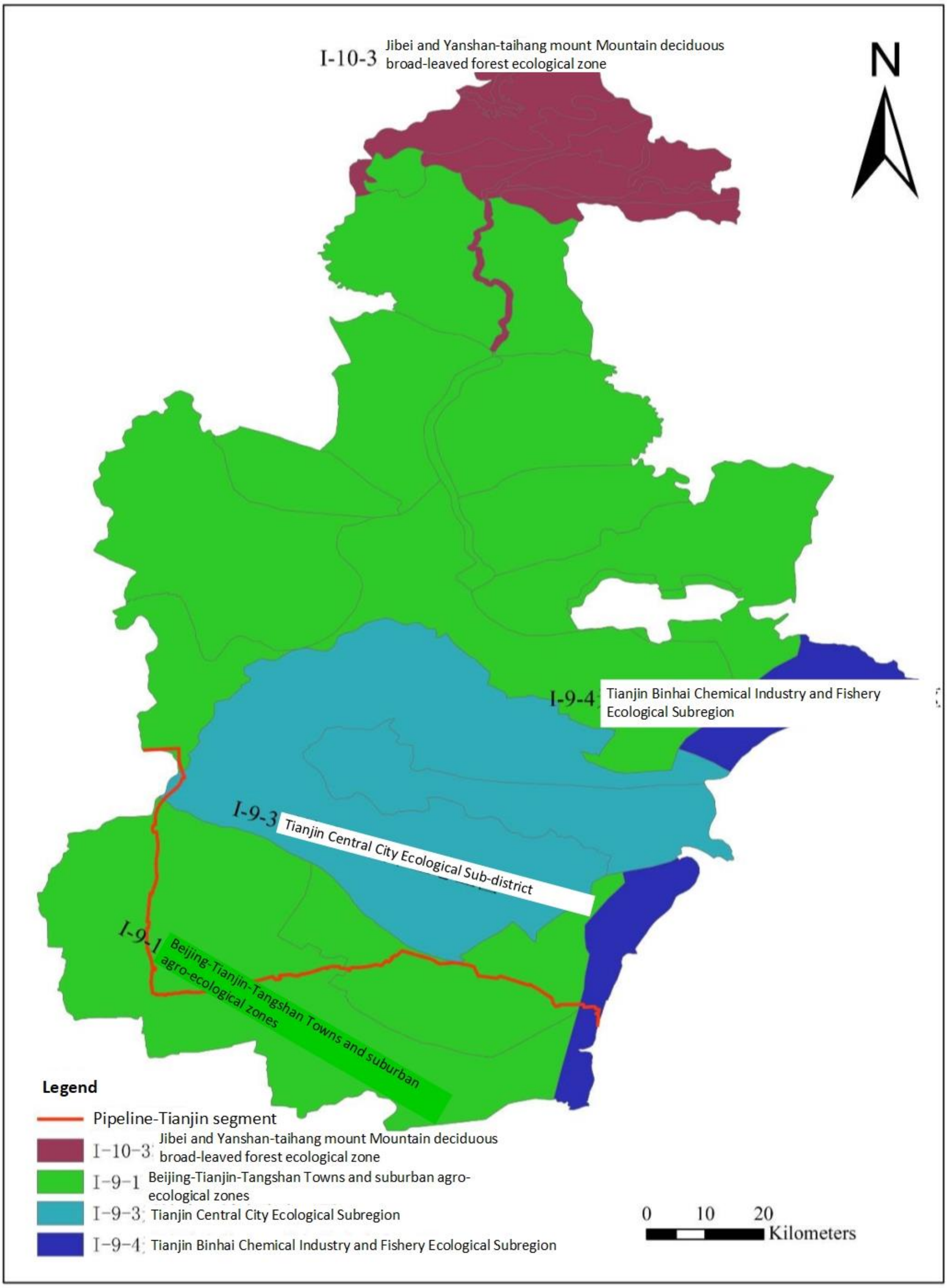


Figure 7.4-2 Pipeline and Tianjin Ecological Sub-area

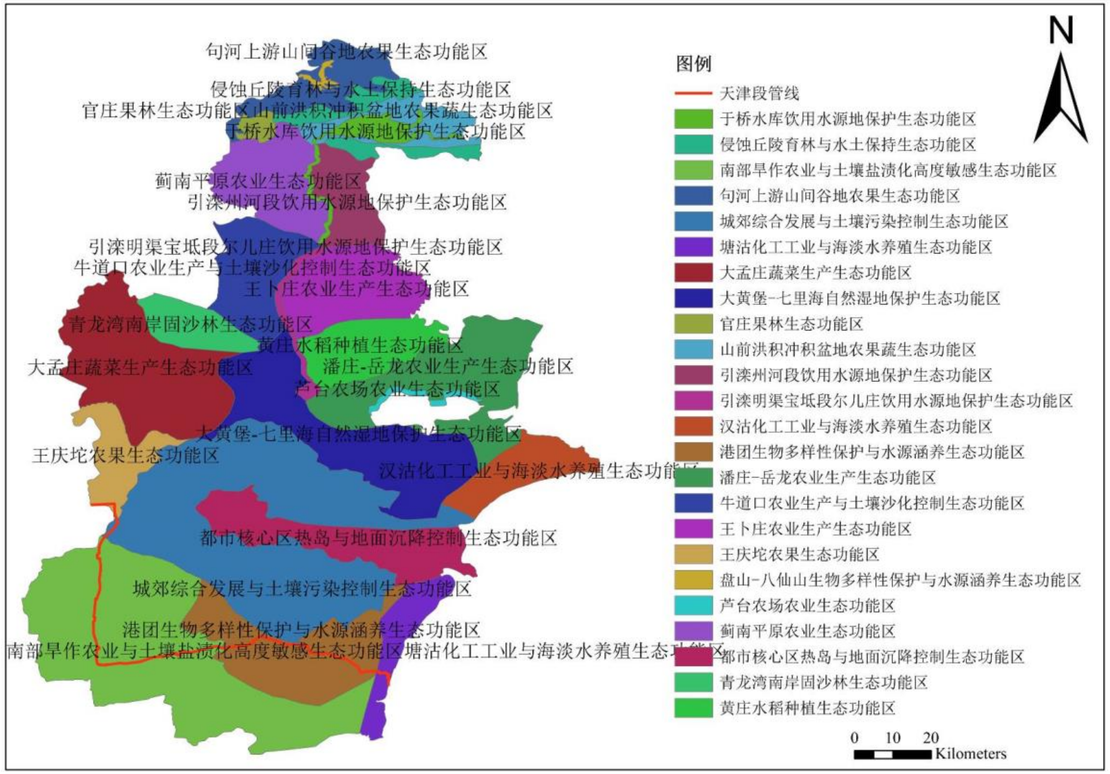


Figure 7.4-3 Pipeline and Tianjin Ecological Functional Area Map

7.4.2.3 Marine function zoning of Tianjin

The Marine functional zoning map of Tianjin is superimposed on this project, and see the following table for the Marine functional areas that pipelines cross. The pipeline involves two Marine functional areas.

Table 7.4-3 Tianjin Marine Functional Zone with Pipeline Crossing

Functional area name	Functional area type	Management requirements	
		Sea area management	Marine environmental protection
Tianjin port Nangang port shipping Area	Port shipping area	To ensure the safety of transportation, it is suitable for seas for ports and seas for navigation, to ensure the safety of industrial water intake, and to ensure the safety of port shipping, it is compatible with oil and gas. It is allowed to moderately change the natural attributes of the sea area. The port project encourages the use of jetties and structures. The docks and storage areas can be reclaimed for land reclamation. It should be gradual, economical, intensive, and optimized. To ensure the management requirements of flood control and control, it is forbidden to construct construction and structures that impede flood discharge within the scope of the single-flow and river-reducing conductors, and to ensure the safety of flood discharge.	Safeguard the water depth conditions and hydrodynamic environment at the forefront of the port area; strengthen supervision and prevent various types of risk accidents such as oil spills; waste and sewage must reach standard. The quality of seawater is not inferior to the four categories of standards, the quality of marine sediments and the quality of marine organisms are not inferior to the three categories of standards. The Nangang industry in the district and the eastern waters of the urban area (about 2.6km wide) are buffered waters adjacent to the agricultural and fishery areas and protected areas. The seawater quality, marine sediment quality and marine biological quality are not inferior to the second-class standard.
Nangang industrial and urban sea area	Industrial and urban sea area	To ensure the use of the sea in Nangang's industrial and urban construction, it is compatible with oil and gas and adopts the sea. It is allowed to moderately change the natural attributes of the sea area, scientifically arrange the sea time series, save intensive use of the sea, optimize the reclamation sea level design and shoreline layout, moderately increase the public pro-coastal section, and strengthen dynamic monitoring and tracking management. The embankment reconstruction and landscape restoration will be carried out. The deployment of constructed wetlands will be considered in the park, and an ecological isolation corridor will be built.	Strictly control the impact on adjacent marine special protection areas and agricultural and fishery areas, properly deploy marine environmental monitoring stations; implement waste, sewage treatment and reuse of water, it is necessary to discharge the sea to reach standard discharge on east side, and need to carry out deep drainage argument. Quality of seawater is not inferior to the three categories of standards, and the quality of marine sediments and the quality of marine organisms are not inferior to the second category. South side and east side should be constructed according to plane layout of project construction. It is strictly forbidden to discharge and natural inflow to the adjacent

			functional area.

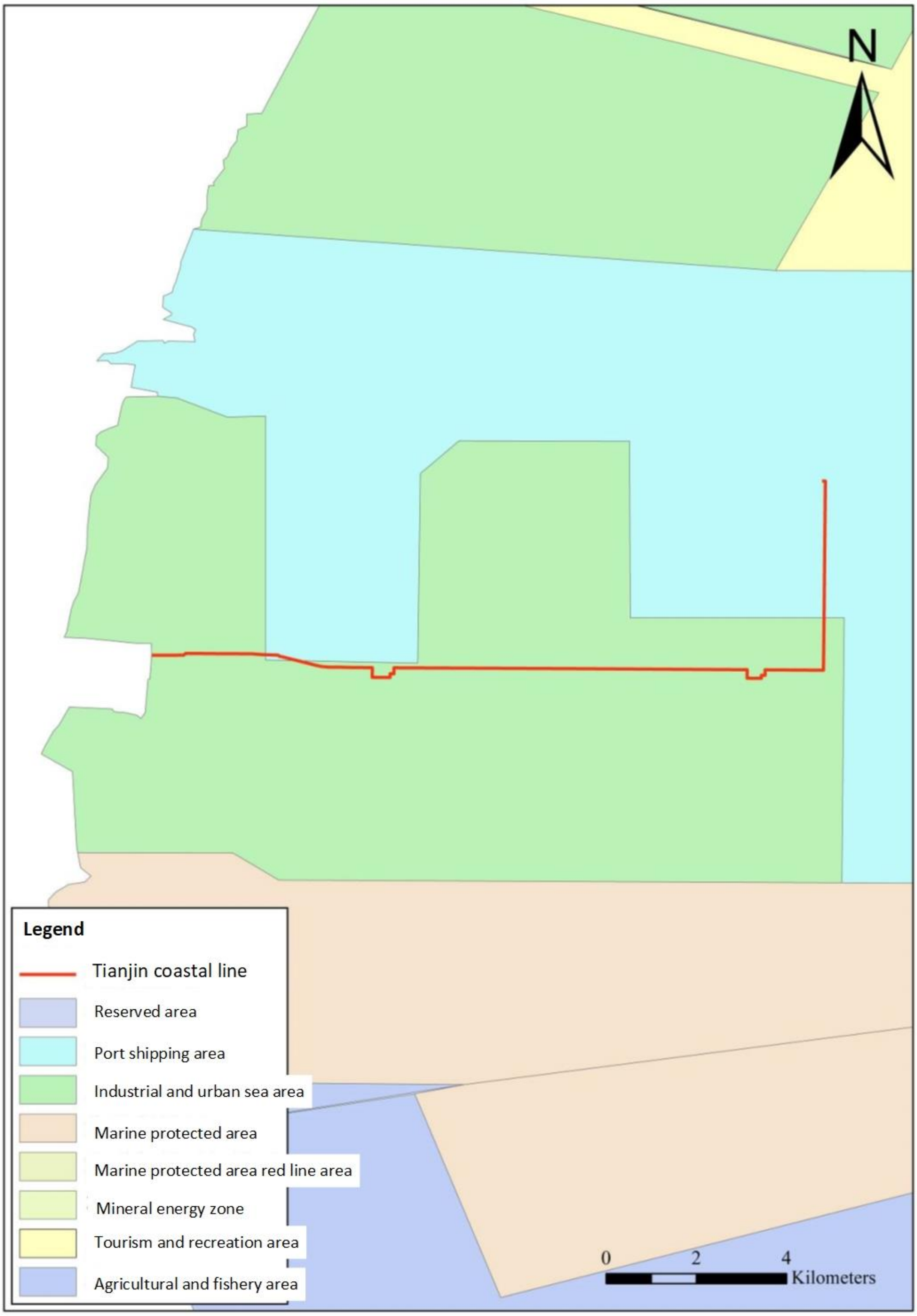


Figure 7.4-4 Pipeline and Tianjin ocean functional zone map

7.4.2.4 Ecological function regionalization in Hebei province

The proposed pipeline will go through Anji district, Yongqing county and Guangyang district of Langfang city. The ecological function zoning map of Hebei province will be superimposed on this project.The pipeline involves 1 ecological zone, 1 ecological sub-zone and 1 ecological functional zone. The ecological functional areas of the pipeline crossing the region are shown in the following table.

Table 7.4-4 Ecological Functional Area of Pipeline Crossing (Hebei Province)

Ecological area	Ecological subregion	Ecological functional area	Major environmental issues	Service function	Protection and development
Beijing-Tianjin-Tangshan town and suburban agro-ecological zone	I-9-1 Agro-ecological sub-region of Beijing-Tianjin-Tang suburb	Soil desertification control ecological function zone along the Yongding River in Langfang	Soil desertification is serious, and agricultural non-point source pollution in the southwest is serious	Desertification control and flood storage	Implementing the conversion of farmland to forests and grasslands; developing ecological industries; Construction and storage of flood storage areas

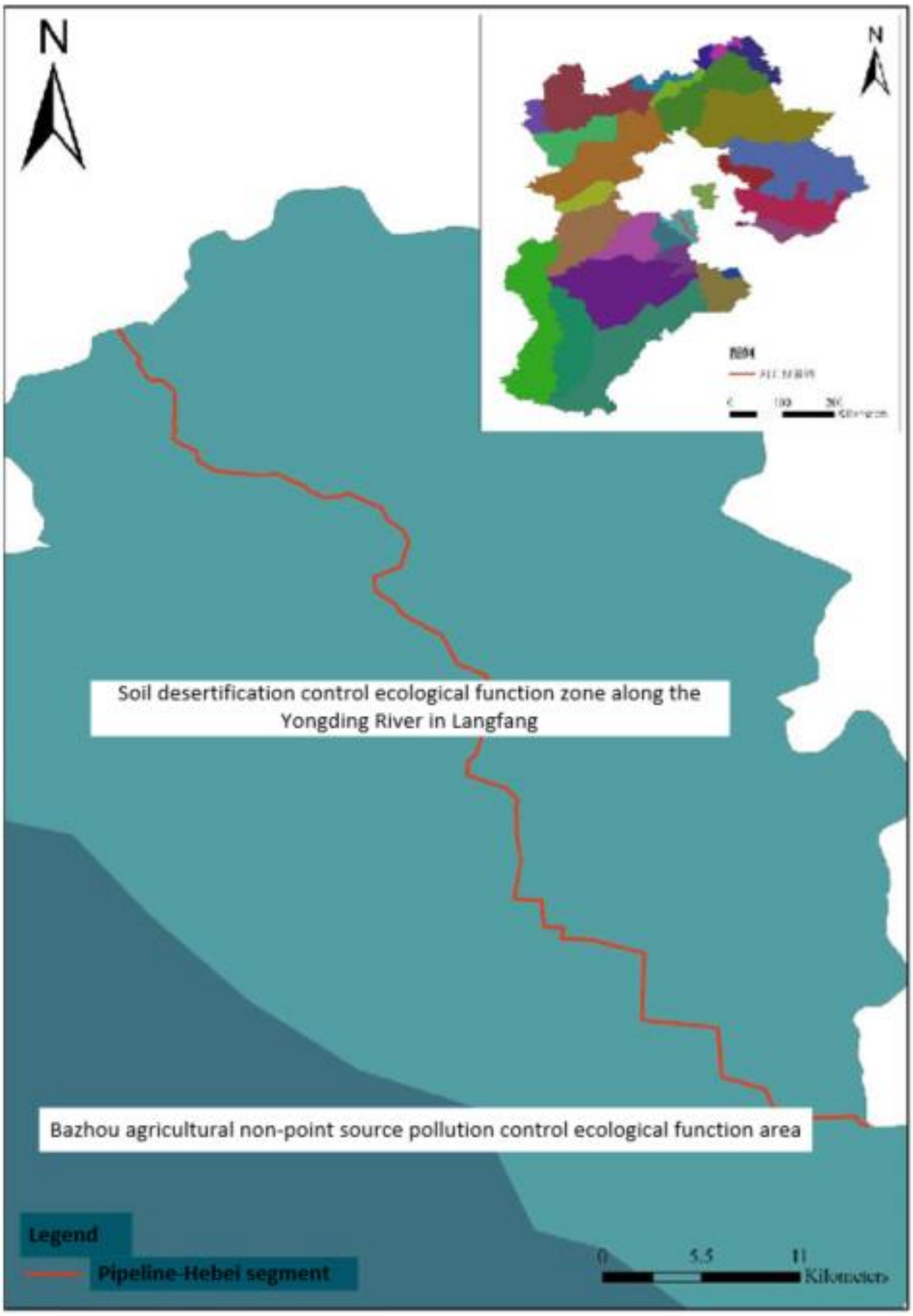


Figure 7.4-5 Location relationship between pipelines and ecological function zones in Hebei Province

7.4.2.5 Ecological function zoning of Beijing

The proposed pipeline passes through Lixian Town, Daxing District, Beijing, and superimposes the “Beijing Ecological Functional Zoning Map” with the project. The pipeline involves 1 ecological zone, 1 ecological sub-region and 1 ecological functional zone. The ecological function area of the pipeline crossing area is shown in the table below.

Table 7.4-5 Ecological Functional Zone of Pipeline Crossing (Hebei Province)

Ecological area	Ecological subregion	Ecological functional area	Major environmental issues	Service function	Protection and development
Beijing-Tianjin-Tangshan town and suburban agro-ecological zone	I-9-1 Agro-ecological sub-region of Beijing-Tianjin-Tang suburb	Sand prevention and sand fixing area in the lower reaches of Yongding river	Soil desertification is serious, and agricultural non-point source pollution in the southwest is serious;	Sand prevention and sand fixation	Afforestation, construction of shelterbelt system, transition of secondary forests, reduction of sand dust generation and migration, and fundamental prevention of sand fixation

Figure 7.4-6 Location relationship between pipelines and ecological function zones in Beijing

7.4.3Ecosystem integrity assessment

7.4.3.1 Ecosystem type

The whole pipeline is located in the north China plain, and the farmland ecosystem is the main one along the pipeline, followed by the town/village ecosystem, and the water and wetland ecosystem.

①Farmland ecosystem

The pipeline is located in the north China plain, and the farmland ecosystem is distributed throughout the whole line. Due to the strong interference of human activities, farmland ecosystem has more cultivated vegetation and lower biodiversity. The cultivated vegetation is mainly crops which include winter wheat, rice, corn, etc., while the cash crops are mainly vegetables.

The farmland ecosystem within the evaluation range is mainly distributed in the farmland and garden crossed by the pipeline, with an area of 173.08km^2, accounting for 75.58% of the total area of the evaluation range.

The animals in the farmland ecosystem are mainly common animals, such as birds, magpies, rodents, such as mice, rattusnorvegicus and so on.

③Water and wetland ecosystem

The water and wetland ecosystem within the evaluation scope are mainly distributed in the river and pond water surface crossed by pipelines, with an area of 17.17km^2, accounting for 7.50% of the total area of the evaluation scope.

The natural vegetation of water body and wetland ecosystem is mainly secondary herbaceous vegetation and reed, most of which are distributed in Dagang nature reserve of Tianjin, and a few in fields and on the Banks of rivers. Animal species mainly include amphibians, reptiles, and wetland birds.

②Town/village ecosystem

The urban/village ecosystem is an artificial ecosystem with rural/urban population as the core, associated organisms as the main biome, and construction facilities as the important habitat environment. The area within the evaluation range is 3.14km2, accounting for 1.37% of the total area of the evaluation range.

The vegetation in this ecosystem is mostly artificial plants, and the animal species are mostly common rodents and common birds.

7.4.3.2 Ecosystem integrity evaluation

The calculation results of each index within the scope of pipeline evaluation are shown in the following table.

Table 7.4-6 Current Status Statistics of Landscape Types along the Pipeline (500m on Both Sides)

Landscape type	Area （km^2）	Plaque sample	Number of plaques (i)	Rf	Lp	Rd	Do
Farmland landscape	172.02	49	774	100	75.12	44.52	73.73
Garden landscape	1.06	19	33	39	0.46	1.88	10.44
Forest landscape	10.06	38	142	78	4.39	8.15	23.71
Meadow landscape	3.05	22	27	45	1.33	1.57	12.19
Road landscape	11.83	49	183	100	5.17	10.50	30.25
Industrial landscape	10.39	41	150	83	4.54	8.62	25.29
Territorial waterslands cape	17.17	49	373	100	7.50	21.48	34.16
Residential landscape	3.14	22	44	45	1.37	2.51	12.44
Other landscape	0.27	8	14	17	0.12	0.78	4.43
Total	229	49	1739		100	100	

According to the calculation results of various landscape indexes in the evaluation area, the density (Rd) and landscape proportion (Lp) of farmland landscape are relatively large, followed by water landscape. It can be seen that the connection degree of farmland is the best, followed by water landscape, which is in line with the social situation of plain agriculture along the route. The landscape along the pipeline is greatly affected by human activities, and the water landscape is basically artificial ditch. The frequency (Rf) of farmland landscape, road landscape and water landscape is 100. It can be seen that the uniformity of landscape along the pipeline is good. By further comparison of the dominant value, the dominant value of farmland landscape was the largest, followed by the water landscape, indicating that the dominant ecological feature within the evaluation area was farmland landscape.

In general, the evaluation area constitutes a land use pattern mainly composed of farmland landscape, water landscape, road landscape and other types embedded therein, presenting a relatively stable artificial ecosystem. From this perspective, the evaluation area is completely disturbed by human activities.

7.4.4Status of land use

The landform along the pipeline is mainly alluvial plain, followed by coastal accumulation plain.

The land use forms in the areas along the route are mainly agricultural land, construction land and unused land, among which agricultural land is the main one. In agricultural land, arable land accounts for the largest proportion, with a small number of woodland and garden. Construction land includes residential land, industrial and mining land, and transportation land. The unused land is mainly water area and water conservancy facilities and other land.

The pipeline length of the project is 229km. Combined with the results of this remote sensing interpretation, in the evaluation area (about 229km^2) located on 500m sides of the pipeline, the main land use type is cultivated land, with an area of 63.1km2, accounting for 75.11% of the total area of the evaluation area, which is basically irrigated land and widely distributed in the evaluation area. Second are water area and water conservancy facilities land, with an area of 5.96km^2, accounting for 7.09% of the total evaluation area, mainly for canals. The percentage of transportation land in the total area of the evaluation area is 5.17%, mainly for highway land. The forest land area is 3.69km^2, accounting for 4.4% of the total evaluation area. It is mainly composed of poplar trees, which are distributed in residential areas, roads, farmland and rivers.

The specific statistics are shown in the table below.

Table 7.4-7 Statistical Table of Land Use Status along the Pipeline (500m on Both Sides)

Land use type	Area（km^2）	Percentage of total area（%）
Arable land	172.02	75.11
Woodland	11.12	4.86
Grassland	3.05	1.33
Territorial waters	16.25	7.09
Urban and rural areas, industrial and mining, residents and other construction land	25.35	11.07
Unutilized land	1.23	0.54
Total	229	100

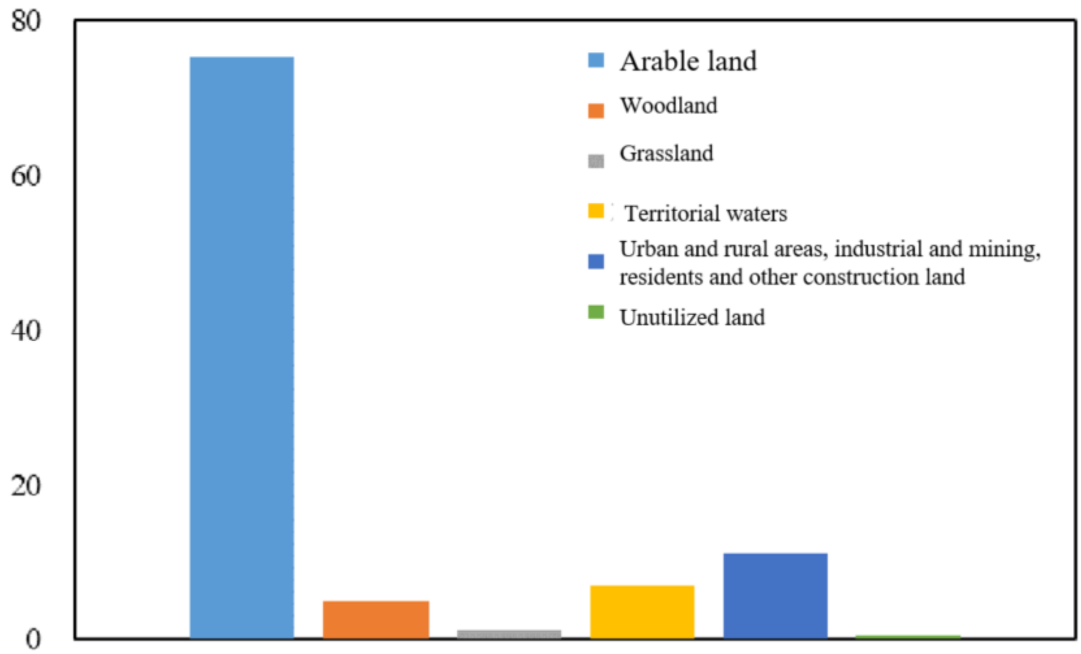


Figure 7.4-7 Statistics on current status of land along the pipeline (500m on both sides)

7.4.5Status of vegetation

7.4.5.1 Overview of vegetation in the assessment area

The proposed pipeline is located in the temperate monsoon climate zone, and its zonal vegetation is deciduous broad-leaved forest in the warm temperate zone, belonging to the flora of north China. Because of the north China plain where agricultural development has a long history with high degree of development, developed urbanization, serious human interference, basically there is no zonal vegetation along the route.

Due to the suitable natural conditions, the area along the pipeline is planted with a large area of crops, mainly winter wheat, rice, corn, etc. Cash crops are mainly vegetables. There is less patches of plantation vegetation, distributed like belt or line in farmland, river bank, roadside, forming a forest network. In addition, there are sporadic distribution of fruit forests, mainly including apples, jujube, peach, pear and so on.

The natural vegetation is mainly secondary herbaceous vegetation and reed, most of which are distributed in the Dagang nature reserve of Tianjin, with a few scattered in the field and river Banks

7.4.5.2 Result and analysis

The evaluation area on 500m sides of the project's external transmission pipeline is about 229km^2, and the area with vegetation is about 68.64km^2, accounting for

81.71% of the total area of the evaluation area, including artificial vegetation and natural vegetation. Artificial vegetation occupies 97.87% of the vegetation area, and natural vegetation occupies 2.13% of the vegetation area. Vegetation-free area accounted for 18.29% of the total area of the evaluation area.

The proposed pipeline is located in the north China plain, along which agriculture is mainly developed. Therefore, the vegetation area in the evaluation area is mainly artificial vegetation area where wheat and cotton are the main irrigated crops, accounting for about 75.12% of the total area and distributed in contiguous patches. The artificial poplar forest area is about 10.06km^2, accounting for 4.39% of the total area. It is mainly distributed along the farmland, residential areas, roads and rivers. The area of fruit forest is about 1.06km^2, accounting for 0.46 % of the area with vegetation in this section. It is mainly distributed near residential areas in plain areas, and the patch area of both is small. At the same time, a small number of grass meadows dominated by carex and reed wetland meadows were also distributed, accounting for 1.33% and 0.4 % of the total area of the evaluation area, respectively.

In addition, the area of other areas in the evaluation area is 41.87km^2, mainly water area and water conservancy facilities land, with an area of about 5.96km^2, accounting for 7.09% of the total area of the evaluation area. Transportation land accounts for 5.17% of the total area of this section. Other types are relatively small.

Table 7.4-8 Current status table of vegetation types along the pipeline (500 m on both sides)

Vegetation types		Area(km^2)	Area percentage%	Number of patches	Average size(km^2)
Artificial vegetation area	Wheat and cotton as main crops	172.02	75.12	774	0.222
	Artificial poplar forest	10.06	4.39	142	0.071
	Apple-dominated orchard	1.06	0.46	33	0.033
Natural vegetation area	Grass meadow dominated sedge	3.05	1.33	27	0.112
	Reed wetland meadow	0.93	0.40	14	0.068
Other areas	Other areas	41.87	18.29	750	0.056
Total		229	100	1739	0.132

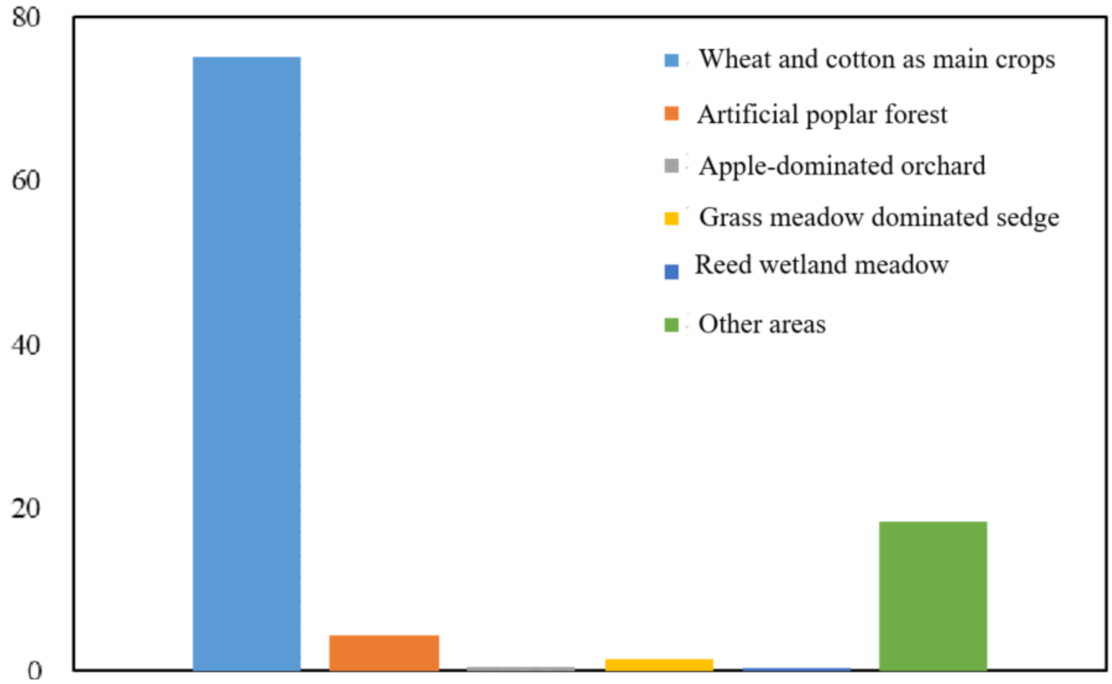


Figure 7.4-8 Current status of vegetation types along the pipeline (500m on both sides)

7.4.5.3 Site survey and vegetation sample survey

The pipe-laying area is the north China plain, and the farmland ecosystem is the main one along the route, while the forest ecosystem is few and scattered. This evaluation conducted field survey along the route and selected representative areas for vegetation quadrate survey. Based on the field recording points, the remote sensing image interpretation mark is established and the main points are selected for feature description.

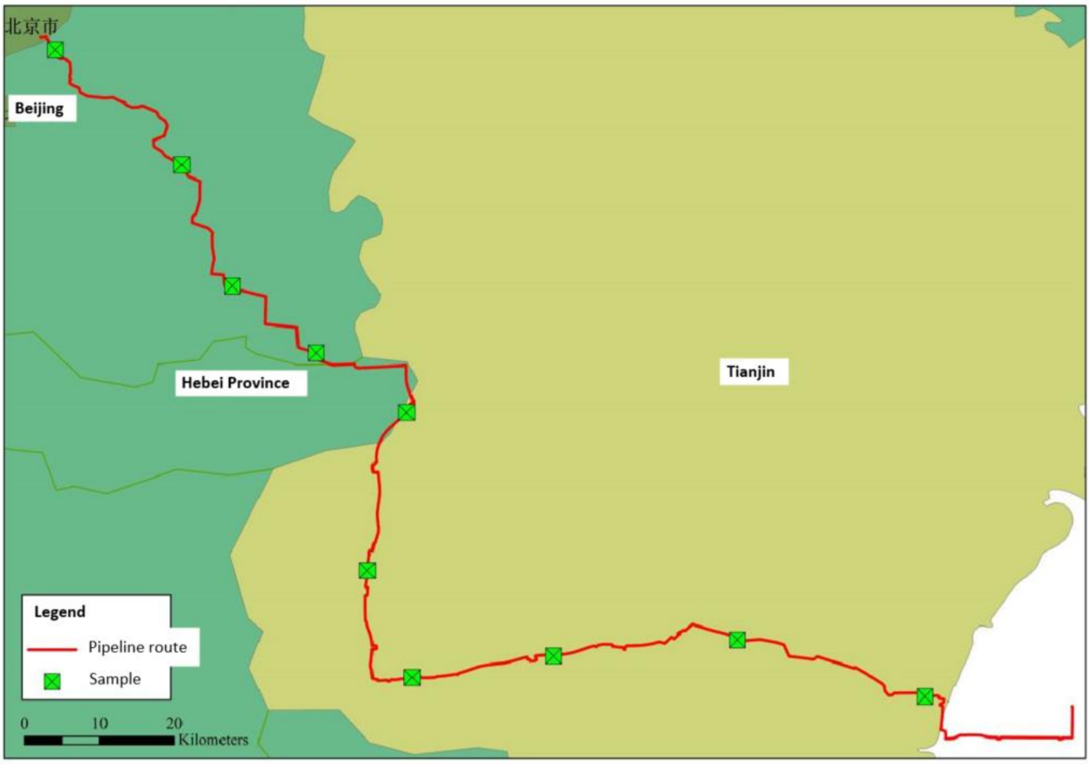


Figure 7.4-9 Sample square point distribution map

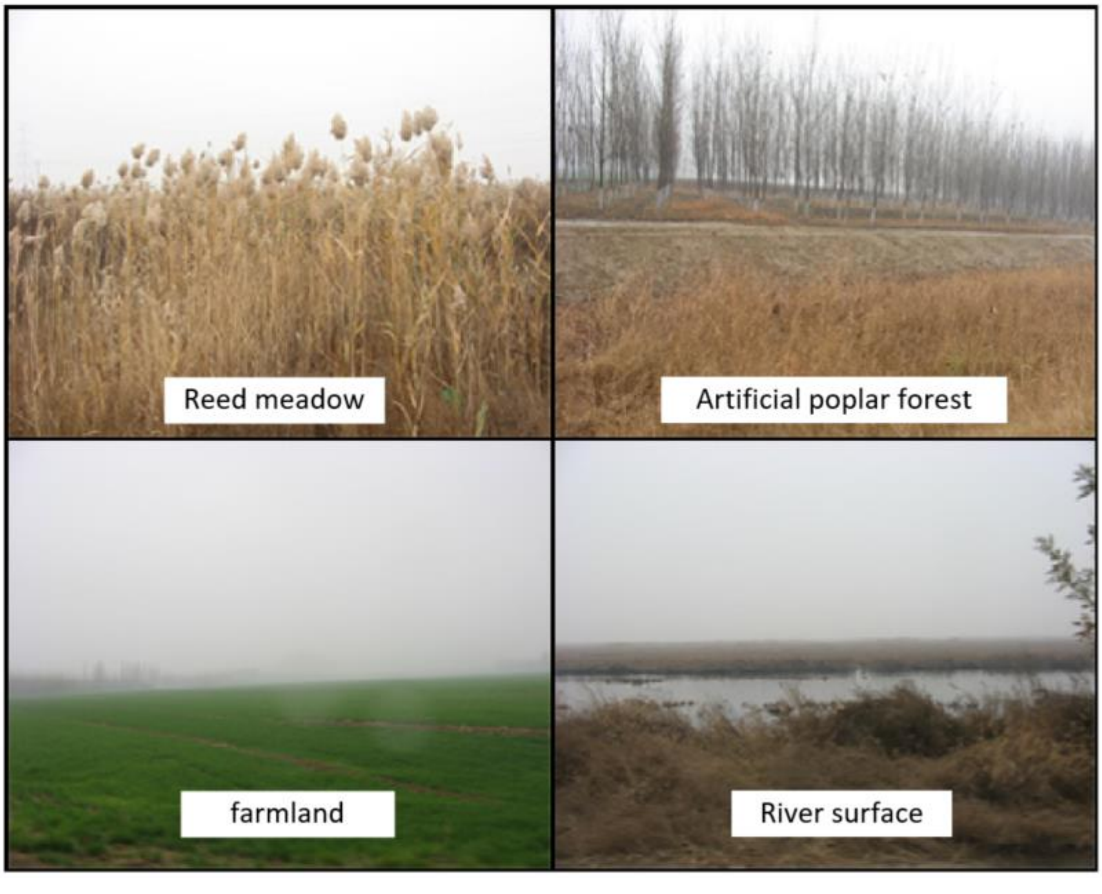


Figure 7.4-10 Photographed on the spot

Valerian herb swamp

Valerian + Suaeda Meadow

Suaeda

Poplar forest

Eucalyptus forest

Figure 7.4-11 Scene along the pipeline

7.4.6Soil erosion status

According to remote sensing interpretation results, the average erosion modulus in the evaluation area along the pipeline is 366.5t/km^2·a, and the total erosion amount in the evaluation area is 83,900 t/a.

Soil erosion area is about 187.43m^2, accounting for 81.84% of the total area of the evaluation area, in which micro-erosion is the main factor with about 1776km^2, accounting for 76.86% of the total area of the evaluation area, mainly for farmland area; Slight erosion is the second, accounting for 4.86% of the total area. Moderate erosion mainly occurred in bare land area, accounting for about 0.13% of the total area. In addition, the erosion-free area is about 41.57km^2, accounting for 18.15% of the total area.

Table 7.4-9 Statistics table of soil erosion status of 500m sides of pipeline

The intensity of erosion	Area (km^2)	Area percentage(%)	Erosion modulus (t/km^2·a)	Erosion (10000t/a)	Percentage of erosion(%)
Micro degree of erosion	176.00	76.86	399	7.02	83.67
Slight erosion	11.12	4.86	1138	1.26	15.08
Moderate erosion	0.30	0.13	3490	0.10	1.25
Erosion-free area	41.57	18.15	/	/	/
Total	229.00	100.00	366.5	8.39	100

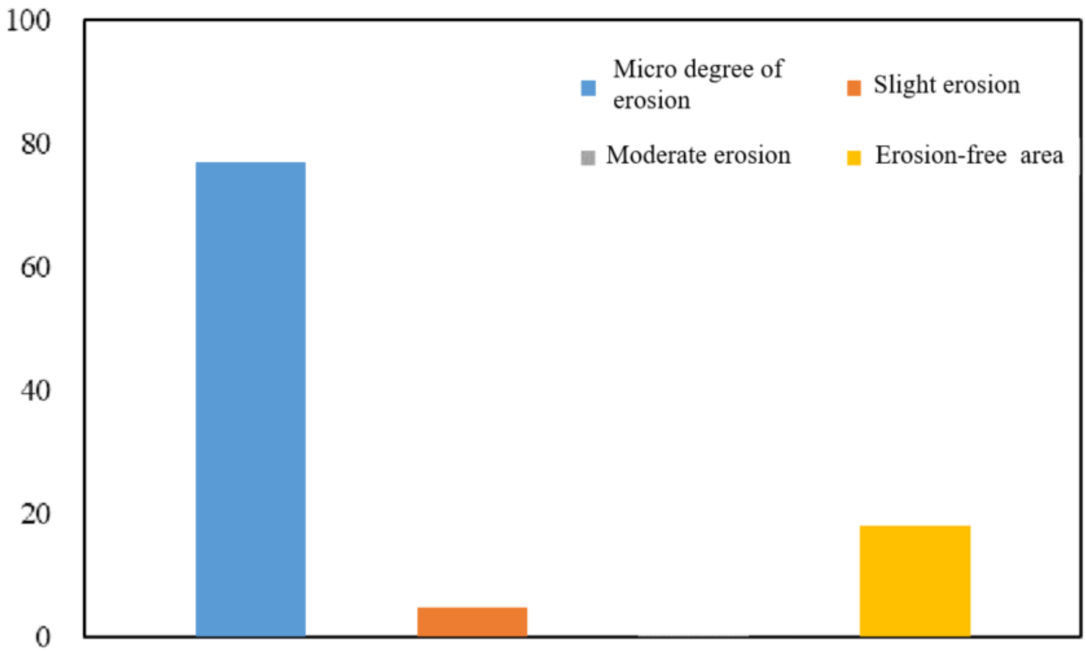


Figure 7.4-12 Statistical diagram of soil erosion along the pipeline (500m on both sides)

7.4.7 Wild animals survey

According to the survey results of the ecological environment in the scope of the proposed pipeline, the surface vegetation along the pipeline is mostly artificial vegetation, mainly farmland. The human activities are frequent, and the rare wild animals and plants are mainly distributed in the surrounding protected areas. Through field investigations, interviews and access to literature, the main wildlife species along the pipeline are listed on the survey.

There are two ecologically sensitive targets distributed within 5km along the two sides of the pipeline, namely Tianjin Beidagang Wetland Nature Reserve and Tianjin Ancient Coast and Wetland Nature Reserve. Among them, Tianjin Beidagang Wetland Nature Reserve mainly protects the wetland ecosystem and its biodiversity including birds and other wild animals, rare and endangered species resources, which are close to the pipeline; Tianjin Ancient Coast and Wetland Nature Reserve mainly protects and studies the sea-land transition and coastal wetland ecosystem and the geological landscape that can not be regenerated.

Through field investigations, interviews and literature review, the main common wildlife species along the pipeline are listed in the survey list below.

Table 7.4-10 Table 7.4-10 List of major wildlife in the project area

Number	Affiliated subjects	Species	Latin name	Protection level	Main distribution of project areas
Birds					
1	Ciconiidae	White stork	Ciconia ciconia	I	Tianjin Ancient Coast and Wetland Nature Reserve
2	Ciconiidae	White Spoonbill	Platalea leucorodia	II	Tianjin Ancient Coast and Wetland Nature Reserve
3	Ciconiidae	Oriental stork	Ciconia boyciana	I	Tianjin Beidagang Wetland Nature Reserve
4	Ciconiidae	Black stork	Ciconia nigra	I	Tianjin Beidagang Wetland Nature Reserve
5	Ciconiidae	Pied Harrier	Circus melanoleucos	II	Tianjin Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve
6	Ciconiiformes	white crane	Grus leucogeranus	I	Tianjin Beidagang Wetland Nature Reserve
7	Ciconiiformes	White-naped Crane	Grus vipio	II	Tianjin Beidagang Wetland Nature Reserve
8	Ciconiiformes	Great Bustard	Otis tarda	I	Tianjin Beidagang Wetland Nature Reserve
9	Ciconiiformes	Red-crowned crane	Grus japonensis	I	Tianjin Beidagang Wetland Nature Reserve
10	Ciconiiformes	Grey crane	Grus grus	II	Tianjin Beidagang Wetland Nature Reserve
11	Ciconiiformes	Demoiselle Crane	Anthropoides virgo	II	Tianjin Beidagang Wetland Nature Reserve

Number	Affiliated subjects	Species	Latin name	Protection level	Main distribution of project areas
12	Lariformes	Relict Gull	Larus relictus	I	Tianjin Beidagang Wetland Nature Reserve
13	Passeriformes	Lark	alauda arvenisis		Grasslands, arid plains, loach and swamps
14	Falconiformes	Eastern Marsh Harrier	Circus spilonotus	II	Tianjin Beidagang Wetland Nature Reserve
15	Falconiformes	Eastern Imperial Eagle	Aquila heliaca	I	Tianjin Ancient Coast and Wetland Nature Reserve
16	Falconiformes	Marsh Harrier	Circus aeruginosus	II	Tianjin Ancient Coast and Wetland Nature Reserve
17	Falconiformes	Hen Harrier	Circus cyaneus	II	Tianjin Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve
18	Falconiformes	Goshawk	Accipiter gentilis	II	Tianjin Ancient Coast and Wetland Nature Reserve
19	Falconiformes	Upland Buzzard	Buteo hemilasius	II	Tianjin Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve
20	Falconiformes	Red-footed Falcon	Falco vespertinus	II	Tianjin Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve
21	Falconiformes	Kestrel	Falco tinnunculus	II	Tianjin Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve
22	Falconiformes	Golden Eagle	Aquila chrysaetos	I	Tianjin Ancient Coast and Wetland Nature Reserve
23	Falconiformes	Common Buzzard	Buteo buteo	II	Tianjin Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve
24	Falconiformes	Sparrowhawk	Accipiter nisus	II	Tianjin Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve
25	Falconiformes	Pallas's Fish-eagle	Haliaeetus leucoryphus	I	Tianjin Ancient Coast and Wetland Nature Reserve
26	Falconiformes	Eagle	Milvus korschun	II	Tianjin Ancient Coast and Wetland Nature Reserve
27	Pelecaniformes	Pelagic Cormorant	Phalacrocorax pelagicus	II	Tianjin Beidagang Wetland Nature Reserve
28	Pelecaniformes	Pelagic Cormorant		II	Tianjin Beidagang Wetland Nature Reserve
29	Strigiformes	Short-eared Owl	Asio flammeus	II	Tianjin Beidagang Wetland Nature Reserve
30	Anseriformes	White-fronted Goose	Anser albifrons	II	Tianjin Beidagang Wetland Nature Reserve
31	Anseriformes	Whooper Swan	Cygnus cygnus	II	Tianjin Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve

Number	Affiliated subjects	Species	Latin name	Protection level	Main distribution of project areas
32	Anseriformes	Greylag Goose	Anser anser	II	Tianjin Ancient Coast and Wetland Nature Reserve
33	Anseriformes	Tundra Swan	Cygnus columbianus	II	Tianjin Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve
34	Anseriformes	Mute Swan	Cygnus olor	II	Tianjin Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve

Wild plants survey

According to the survey results of the ecological environment in the scope of the proposed pipeline, the surface vegetation along the pipeline is mostly artificial vegetation, mainly farmland. The human activities are frequent, and the rare wild animals and plants are mainly distributed in the surrounding protected areas. Through field investigations, interviews and access to literature, the main wildlife species along the pipeline are listed on the survey.

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Through field investigations, interviews and literature review, the main common wildlife species along the pipeline are listed in the survey list below.

7.5 The investigation and evaluation of groundwater environment status

7.5.1 Geological and hydrogeological conditions of the target area

7.5.1.1 Geology

<1> Tianjin part

The strata are listed according to geological time from the old to the new, which are the Great Wall, Jixian and Qingbaikou systems of the Meso-and Neoproterozoic Era; the Cambrian and Ordovician systems of the Paleozoic Era; the Carboniferous and Permian systems of the Upper Paleozoic Era; the Triassic, Jurassic and Cretaceous systems of the Mesozoic Era; the Paleogene, Neogene, and Quaternary systems of the Cenozoic Era.

In this evaluation of the groundwater environment, the strata of Quaternary system in the target area will be mainly introduced. The Quaternary system is restricted and influenced by the uplifting as well as the depression of base. The thickness of the Quaternary system is approximate 260-460m. The thickness of the uplifting zone is small and that of the depression zone is large. The thickest place is located in the Wuqing Depression in the northern section of the western line, which is followed by the Qikou Depression in the east of Taiping Village on the southern line. The smaller thickness appears in the the Chenguantun-Zhongwang of Jinghai County and the Haogezhuang-Lingtingkou of Baodi District. The strata of the Quaternary system are divided into four basic stratigraphic units from the bottom up, namely: Yangliuqing, Diaolou, Tanggu and Tianjin Formation. Since the objective of this evaluation is shallow groundwater, the geological overview of the first part of the Tianjin Formation in the evaluation area is mainly introduced which the depth of the bottom plate is 0 to 4 m. The lithology is mainly yellow-grey-brown grey cohesive soil, partially silt soil, and seaside is covered by silt soil.

In this area, the 20m deep stratum along the pipeline can be divided into 4 layers by its genetic age, and mainly are the Q_4 strata of the Holocene Series. From the strata involved in the scope of this evaluation, here we mainly introduce the stratigraphic lithology of the artificial fill layer (Q_4^{ml}), the first continental layer (Q_4^{3al}) and the first marine layer (Q_4^{2m}). Details are shown below:

1)Ninghe~Jinghai part

(1) The artificial fill layer（Q_4^{ml}）

This layer is artificially stacked and mainly composed of plain fill and can be commonly found in this area. The thickness is 0.8~1.8m, and the difference in thickness among each part is not significant. The burial depth of the bottom is nearly

0.8~1.8m. The bottom level is -0.65~ 9.66m, and it is composed of taupe, uneven, loose, mainly clayey, silty clay, containing impurities, finely crushed gravel and roots.

(2) The first continental layer (Q43al)

This layer is composed of sediments deposited from the riverbed and the floodplain, and the thickness increases from north to south.

The first sub-layer is composed of cohesive soil: the colour is yellow-brown to grey-yellow; the soil is relatively uniform and plastic with a small amount of rust stain spots; the thickness is 1.2~5.3m, and the depth of the bottom is 2.4 ~ 6.4m. The second sub-layer silt: the colour is yellow ash ~ grey yellow; the soil is slightly dense, uneven, with a small amount of clay stripes and rust staining; the thickness is 1.6 ~ 4.8m; the burial depth of the bottom is 3.5 ~ 6.4m; the layer of silt in the Baodi and Wuqing areas is thin, with a thickness of 1.5 ~ 3m, but the thickness of silt of this layer in Duliu town, Jinghai county reaches 4.8 m, and shallowly buried.

(3) The first marine layer (Q_4^{2m})

This layer has sediments from shallow marine deposits, which is mainly composed of silt and silty clay, and its thickness get smaller from north to south. The first sub-layer, clay: layer thickness is 1 ~ 6.3m; the burial depth of the bottom is 7 ~11.2m; bottom level -8 ~ 2.78m; contains grey, uneven, containing mica, sand sticky, thin layer of silty clay.

2)Jinghai to Dagang part

(1) The artificial fill layer（Q_4^{ml}）

The Jinghai-Dagang part is mainly filled with soil, and the Nangang Industrial district is mainly composed of filling soil. The thickness of the filling soil of Jinghai to Dagangsu is 0.5~1.8 m, the burial depth of the bottom is 0.5~1.8 m, and bottom level is -0.55~1.87m. It is taupe, uneven, loose, mainly composed of cohesive soil and silty clay, small gravel and roots. The thickness of filling soil in the Nangang Industrial district is 1.4 ~ 4 m, and the thickness gradually increases from west to east.

(2) The first continental layer (Q43al)

Generally this layer is evenly distributed in the target area, with a thickness of 1.3~5.3 m and a burial depth of 4.5~6 m. It is mainly composed of the upper cohesive soil and the lower silt layer; due to the fact that the Nangang Industrial district is land reclamation, this layer is missing in many areas in this region. The first sub-layer is mainly cohesive soil, and the thickness is 1.3~5.3 m; the burial depth of the bottom is 2.8~6.4m with a bottom level -4.62 ~ -0.53m; grey yellow - yellow brown, plastic, rust stain, with a thin layer of silt; the soil is uneven, and the part in the eastern Dagang area contains organic components. The second sub-layer is with silt; the thickness is 1.7~3.3m, and burial depth of the bottom is 4.9~ 6.1m, with burial depth of the bottom -4.02 ~ 2.23m. Colour of this sub-layer is grey, wet, dense, containing mica.

(3) The first marine layer (Q_4^{2m})

This layer is sedimentary of coastal marine deposit, with a thickness of 10~16 m, and the thickness increases from west to east. The Jinghai area is mainly filled with clay, silty clay and silt, but the Dagang area to Nangang industrial area is mainly composed of silt or silty clay and powder clay. The first sub-layer is cohesive soil: the thickness is 2.7 ~ 5.5 m and the burial depth of the bottom is 9~14.3 m with a bottom level -9.3 ~ ~7.1m; It is yellow grey and brown grey, and contains mica, organic matter, humus, a small number of layered shells. It shows soft to flow plasticity, and medium to high compression.

The second sub-layer, silt and silty clay: the thickness is 2.5~13m, burial depth of the bottom 5.3~20m, bottom level -17.5 ~ -7.38m, grey-based, soft~flow plastic, with a thin layer of silt Contains shells, organic matter, and high compressibility. The thickness of the powder layer at the Dagangzi tooth new river is about 3.2m, the burial depth of the bottom is 8.1m, and the bottom level is -5.43m. It is slightly dense and contains organic matter, mica and a small amount of shells.

<2> Hebei part

Since the Cenozoic, the elevation of the North China plain has been in a downward trend, which results in thick deposition of the Cenozoic with a thickness about 5,000 to 6,000 m. Specially, the thickness of the Quaternary is about 400 to 550 m.

This project is located in Langfang which includes Yongqing county, Anci and Guangyang district. From the bottom up, the strata are the Early Pleistocene, the Middle Pleistocene, the Late Pleistocene and the Holocene series. Here we describe the strata of the Quaternary system as follows:

1）The Early Pleistocene（Q1）

The burial depth of the bottom is nearly 400～550m，and the thickness is 130～150m. It is mainly brown-red, grey-green thick clay and sandy clay, and hard. Mostly medium and coarse sand aquifer. Fine sand aquifer around the area of Baiyangdian.

2）The Middle Pleistocene（Q_2）

The burial depth of the bottom is nearly 270-400m，with a thickness of 180～220m. The upper part is mainly brownish yellow and brown ash sandy clay. Poor sorting. Fine and medium sand aquifer. The lower reddish brown sandy clay is mainly composed of high viscosity. Mainly powder and fine sand aquifer.

3）The Late Pleistocene（Q_3）

The burial depth of the bottom is nearly 90～180m，with a thickness of 7～144m. Good sorting and mainly fine sand aquifer.

4）The Holocene（Q_4）

The burial depth of the bottom is nearly 20～36m. It is grey, grey to yellow clay sand and sandy clay. Mainly loose fine sand and fine sand aquifer. Good sorting.

<3> Beijing part

The project is located along a pipeline with a length of only 500m in Beijing. The stratum of the project is mainly composed of artificial silt, newly sedimentary soil and the Quaternary system which is alluvial-caused sandy silt, silt, silty clay and heavy silty clay. We will describe the strata from the top down as follows:

(1) The artificial fill layer

One layer of soil filling which is mainly sandy silt, yellow-brown, loose, slightly wet, with a small amount of ash, uneven soil.

(2) New sedimentary layer

Two layers of silt: brownish yellow, medium dense, wet, mainly quartz, feldspar, containing mica flakes, partially intercalated silty clay, clayey silt, sandy silt, this layer is sandwiched with sandy silt 21 interlayer and silty clay 22 lens body.

Twenty one layers of sandy silt: brownish yellow, medium dense, slightly wet, containing mica flakes, iron oxide, and some parts of the phase change into silt.

Twenty two layers of silty clay: brownish yellow, plastic to hard plastic, wet, containing a small amount of mica flakes, local phase change into heavy silty clay to clay.

(3) The sedimentary of the Quaternary system

Three layers of silty clay to heavy silty clay: brown to grey, plastic, wet, and partially transformed into clay.

Thirty one layers of silt: greyish yellow, medium dense, wet, mainly quartz, feldspar, containing mica flakes.

7.5.1.2 Hydro-geology

<1> Tianjin part

Because the characteristics of groundwater are affected by geological structure, lithology, weather and topography, the genetic type, water-rich, distribution and burial conditions of groundwater are often different. According to the properties of the aqueous medium, the conditions of groundwater occurrence, hydrodynamic characteristics, and water yield property and water-permeable properties are different as well. The Tianjin aquifer group is divided into five small groups according to the burial depth of the aquifer, and they are the I, II, III, IV, and V aquifer sub-groups. The pipeline area is mainly located in the salt water area. Therefore, the II and III aquifer groups are mainly exploited, and meanwhile the exploitation volume of the IV and V aquifer groups also accounts for a considerable proportion. There is a small amount of all-fresh water distribution area in the northern area, and the groundwater exploitation method is generally mining both of I and II aquifer groups. Since the objective of this evaluation is mainly shallow groundwater, the hydrogeological overview of the I aquifer group will be introduced.

1) Water yield property of groundwater

The I aquifer group is the first aquifer group under the surface, mainly phreatic water, micro confined water or shallow confined water. The depth of the its bottom boundary is generally within 70m. The stratigraphic age is the Holocene and the Upper Pleistocene ($Q_h + Q_p^3$). The lithologic structure is a plurality of lithological interphase structures or a two-layer structure with a fine upper and lower coarse. This group includes shallow freshwater and salt water subgroups. Affected by seawater invasion, it forms a boundary near the Baoji fault. The north belongs to the whole freshwater area, and the south belongs to the salt water area. The first aquifer group in the whole freshwater area is composed of fresh water. The salt water area is mainly composed of salt water. Under the dilution of fresh water such as rivers and lakes, the upper part of the salt water body in some areas has desalinated into fresh water. In this case, the group will form two subgroups in vertically direction: the upper part as fresh water and the lower part as salt water.

The I aquifer group is thicker in Baigutun-Gaocun of Wuqing and Wuqing, Baodi, Baigutun -Yuelongzhuang of Ninghe county. The thickness of aquifer is 10~40m, and that in Tangguantun of Jinghai county is generally larger than 25m. It is thinner in the eastern part of the southern pipeline in Dagang, the western pipeline in area between Baiguantun-Jinghai county to Chenguantun line in Wuqing district, and generally less than 10m. The lithology of the aquifer is mainly composed of fine sand, and the silt aquifer is located in the southeastern Mapengkou, Tangjiahe, northern Gaocun, areas around Hebei and Linting. In Baiguyu ~ Yuelongzhuang area, aquifer is better water-rich, mainly medium water-rich, and single well water inflow equals 500 ~ 1000m^3 / d. Some places is well rich with water and single well water inflow equals 1000~ 3000m^3 /d. The Baigutun-Dunliuzhen, places around Tangguantun, and the Zhuangzizi-Tangjiahe mainly is weak water-rich, and the single well water inflow is only 100-500m^3/d. The western pipeline in the Jinghai which is southern of Duliu town is in the transition zone between medium and low water-rich. The southern part of the Machang river is a very weak water-rich area, and single well water inflow is less than 100m^3/d.

2)The recharge, runoff and discharge condition of groundwater

The shallow groundwater is buried shallow, and its recharge conditions are complicated. The main sources of recharge are atmospheric precipitation, river leakage, lateral runoff and infiltration recharge from irrigation water. The runoff conditions of the shallow groundwater get worse from the mountain front plain to the southern plains, and mainly through evaporation, artificial exploitation and deeper flow. The former is the main runoff method.

3)Water yield property of the aquifer group

The thickness of the I water group is larger in the Baiguyu-Gaocun part of Wuqing, Wuqing, Baodi, Baiguyu-Yuelongzhuang of Ninghe county along the northern pipeline, and that of the aquifer is 10~40m. That of the southern evaluation area in the Tangguantun area of Jinghai county is generally greater than 25m. It is small in the eastern part of the southern pipeline in Dagang, the western pipeline in area between Baiguantun-Jinghai county to Chenguantun line in Wuqing district, and generally less than 10m. The lithology of the aquifer is mainly composed of fine sand, and silt aquifer is located in the southeastern Mapengkou, Tangjiahe, northern Gaocun, places around Hebei and Linting. In addition, the aquifer in parts of Wangqingtuo ~ Duliu, Taiping Village ~ Xinzhuang are very poor.

In the northern part of the evaluation area, namely Baiguyu-Yuelongzhuang, the aquifer is water-rich, mainly medium water-rich, and the single well water inflow is 500-1000m^3/d. Some places is well water-rich, and the single well water inflow is 1000-3000m^3/d. The Baigutun-Dunliuzhen, areas around of Tangguantun, and the Zhuangzizi-Tangjiahe are mainly weak water-rich, and the single well water inflow is 100~500m^3/d. The western pipeline in the Jinghai, south of Duliu town is in the transition zone between medium and weak water-rich. The southern section of the Machang river is a very weak water-rich area, and the single well water inflow is less than 100m^3/d.

4)Chemical properties of water

The salinity of the first aquifer group varies greatly, from less than 1g/L for fresh water to more than 50g/L for brine. Fresh water is only found in parts of the northern line such as Yuelongzhuang town and region in the north of Sicundian. The salinity along the most of north of engineering line Liangtou town in Jinghai county is between 1 and 21 g/L. The salinity along the east of Zhongwang town is generally greater than 5g/L, and most of them are above 10g/L. The chemical types of groundwater are diverse. In Jinghai county is Cl·SO_4-Na type water and in Dagang area is Cl-Na. That in the freshwater area in the north are HCO_3-Ca·Mg·Na, HCO_3·SO_4·Cl-Na·Ca·Mg, etc. The brackish water area is mainly HCO_3·Cl-Na·Mg type, and the pH value is between 7.1 and 8.26 . The closer to the surface river or the northern freshwater area, the lower salinity of the water.

5)Groundwater burial depth and dynamic characteristics

The water level of the I aquifer group is 1~6m, and the lowest point is located in the area of Duliu town in Jinghai county and the eastern mouth of north of Heilangkou in Baodi district. It forms a small-scale light underground cone of depression area. The water level is about 5m in the area of Duliu town in Jinghai and about 4m in the eastern mouth area.

The northern pipeline is close to or partially belongs to the whole freshwater area. The groundwater recharge conditions are relatively good. The groundwater dynamics in the whole freshwater area are significantly affected by precipitation and artificial exploitation. The period of high water level is basically consistent with the peak precipitation, and from November to December there are time lags. Affected by artificial exploitation, the low water level almost coincidently happens at the beginning of June, and the annual water level fluctuated by 1 to 2.5 m. The water level dynamics was controlled by precipitation. Generally, the annual water level of dry years decreased significantly, while during wet years, the water level can be restored. Its dynamic characteristics are represented by infiltration-runoff-artificial exploitation type. Most of the pipelines are in the salt water area of the southern plains. The groundwater in the first aquifer group is mainly recharged by atmospheric precipitation, and discharge is based on evaporation and the deeper flow. The current exploitation volume is small, and the groundwater level dynamics are mostly in a natural state, which is basically consistent with the meteorological cycle. The peak precipitation and high-volume exploitation period have no significant influence on the water level dynamics. The high water level often appears in March and April after the unfreezing, while the low water level appears in the October to December, and the variation is small mostly with in the range of 0.5 to 1.5 m. Its dynamic belongs to the infiltration-evaporation type. It should be pointed out that in the area of Duliu Town in Jinghai, due to the increase of the difference in water head between the first aquifer group and the second aquifer group, the deeper flow from the first aquifer group increases and its dynamics becomes infiltration-flow-evaporation.

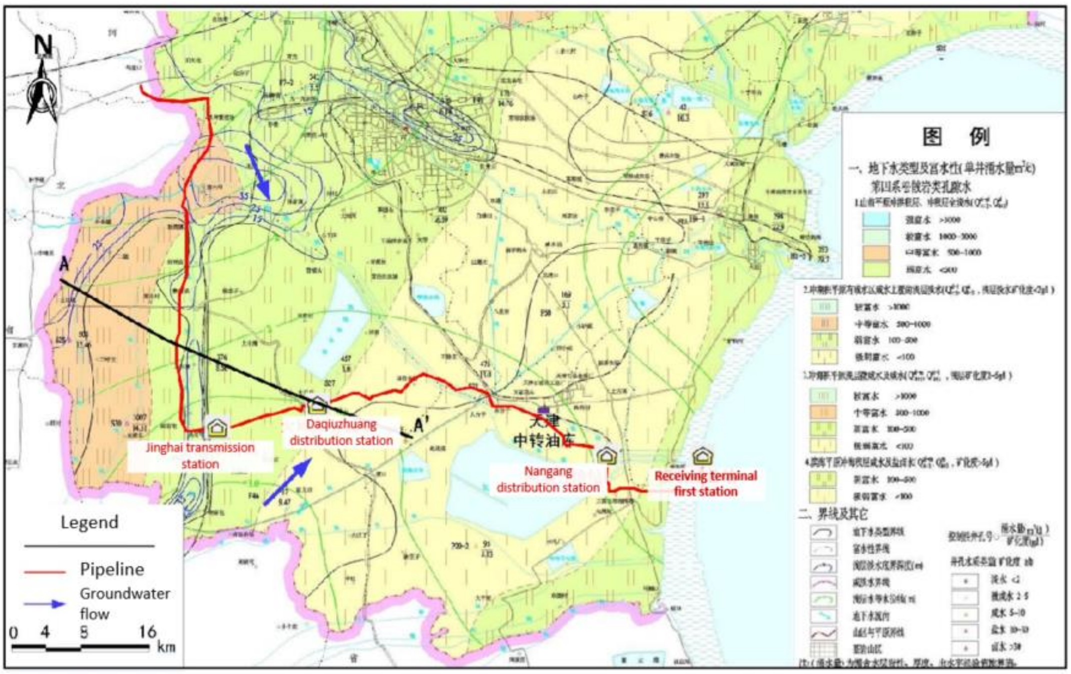

Figure 7.5-1 The Hydro-geologic map of the Tianjin part of this project

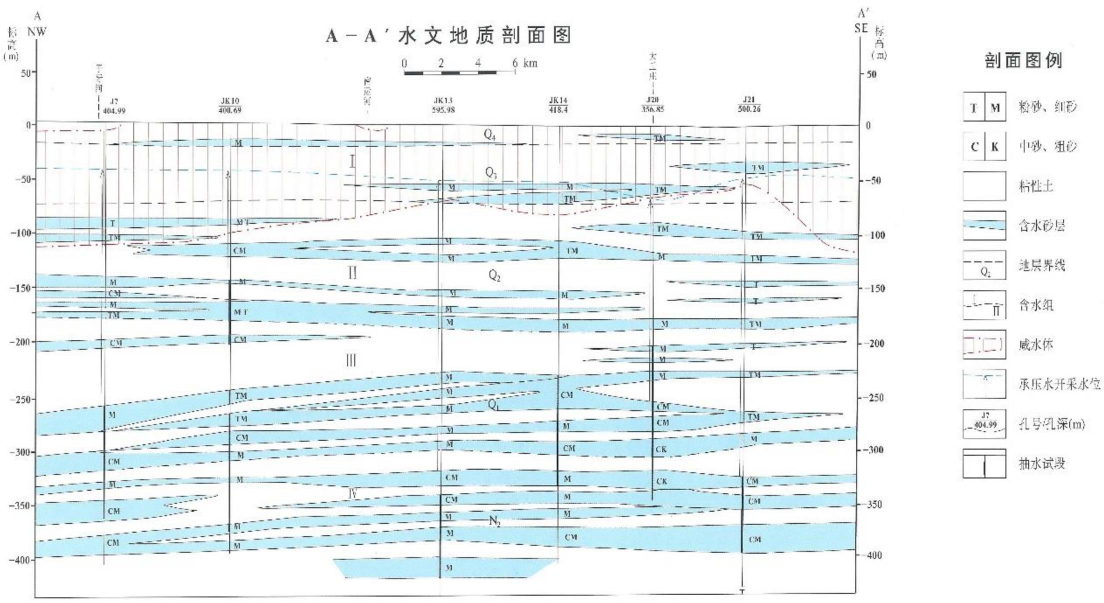

Figure 7.5-2 The Hydrogeological Profile of the Tianjin part of this project

<Hebei – Beijing part>

The area where the pipeline passes is located in the middle of the North China Plain, belonging to the Bohai depression area. It has been in the subsidence area for a long time since the Cenozoic. Since the Quaternary, sediments with thickness of several hundred meters have been deposited, such as continental sediments and land-sea interaction loose deposits. The surface layer is the Quaternary alluvial yellowish brown, brown silty clay and fine sand layer. The groundwater is mainly composed of surface phreatic water and deep confined water. The recharge sources of the groundwater are atmospheric precipitation and river runoff. The upper shallow groundwater aquifer is mainly composed of fine sand and silt. The groundwater level is generally more than 10m, mainly discharge through evaporation on the surface, artificial exploitation. The type of water is light fresh water and brackish water.

1) Groundwater type

The groundwater type in this area is loose rock pore water of the Quaternary. According to the spatial distribution and hydraulic connection characteristics of the water medium, it can be divided into shallow groundwater and deep groundwater. The shallow groundwater is phreatic water and micro-contained water, and the deep groundwater is confined water.

The part of the pipeline from Dongpugang town to Yongqing is located in the water-rich zone. The shallow groundwater is rich with water of 100-500 m^3/d. The shallow freshwater and upper saline water are closely related to atmospheric precipitation. The hydraulic connection is of the same type of groundwater dynamics, and there is a stable aquifer between the salt water body in the salt water area and the underlying deep confined water (the salt water floor is buried 55~110m deep), so the water above the floor of the salt water in salt water area is considered as a phreatic water group. The buried depth of the shallow aquifer group is 55 ~110 m. It includes the upper part of the first and the second aquifer groups, and is mainly used for agricultural irrigation. The upper part of the lithology of the aquifer is mostly silt and the lower part is fine sand. Generally there is no good confining bed, and the groundwater is a type of phreatic water and micro-contained water. The water level is greatly affected by artificial exploitation and precipitation. Since the beginning of agricultural irrigation, the water level will drop sharply. When the rainy season comes in July and August, the irrigation will stop and the water level can be quickly restored.

The pipeline from the Yongqing Transmission station to the southern part of the Chengnan Station is located mainly in the relatively water-rich area. The shallow groundwater is water-rich with 500-1000 m^3/d, of which the Anji sub-transmission station to the Baijiawu area is in the good water-rich zone. Shallow groundwater is with water more than 100 ~ $500m^3/d$. The groundwater mainly exists in the pores of the Quaternary loose sand layer, which belongs to the pore water of the Yongding River alluvial plain. The lithology of the northwestern aeration belt is dominated by sub-sand and silt, and the southeastern region is mainly composed of mild clay and clay. The lithology of the aquifer is mainly dominated by medium sand with a small amount of gravel. The thickness of the aquifer is between 40 and 50 m. The lithology of the aquifer in the Guangyang part is mainly dominated by medium sand, followed by fine sand.

2)Hydrogeology status of aquifer groups

The project is located in the salt water area, and according to the hydrogeological conditions of the project site, the salinity of the first aquifer group in the survey area is between 1-3g/L, which belongs to the brackish water distribution area. The buried depth of the first aquifer group is 40m. In this survey, the first aquifer group in the project was discussed as a shallow aquifer group, and the remaining II-IV aquifer group was discussed as a deep-water group.

(1) The first aquifer group

The bottom plate of this aquifer group is gentle, and the burial depth of the bottom plate is 30~60 m. The total freshwater area is $277.9km^2$, and the salt water area is $145.7km^2$. The top of the salt water body is buried at a depth of 7 ~ 32.5 m, and the weighted average thickness is 16.60 m. The aquifer group changes from sand with gravel to medium, medium fine and fine sand from west to east. The thickness changes from 30m to less than 5m, and the weighted average thickness is 8.53m; the thickness of the single layer gets thinner, the level of aquifer changes from less to more, and the hydrogeological conditions tend to be complicated; the unit water inflow is 10~5.5~2.5m^3/h·m respectively; the water depth changes from deep to shallow; the salinity changes from less than 1g/L to 2~3g/L, from the whole freshwater area to the salt water area, the water chemical type ranges from HCO_3-Na·Mg type to HCO_3·Cl-Na·Mg type or C1·HCO_3-Na·Mg type.

(2) The II aquifer group

The bottom plate of this aquifer group reflects base structure slightly, and the depth of the bottom plate is 150~160m. Hydrogeological conditions have significant changes in the horizontal direction. The size of aquifer particles from north to southeast changes from coarse to fine, which changes from fine-medium sand to fine sand and fine silt; the thickness of the sand layer gets thinner, and the level of the layer gets less; the water-rich property gets weaker, and the unit water inflow decreases from 15 to 10/h to less than 5 m^3/h; the salinity changes from less than 0.5 g/L to 1 to 2 g/L; the type of water chemistry is from HCO_3-Na·Mg to Cl·HCO_3-Na·Mg.

(3) The III aquifer group

The shape of bottom plate of this group clearly inherits the base structure, and its burial depth is 330~380m. We can find how the hydrogeological conditions change from northwest to southeast: the aquifer particles changes from coarse and thin, that is from the fine sand with gravel gradually changes to medium fine and fine sand; the thickness of the aquifer decreases from 50m to 30m; the thickness of single layer decreases, and the level of the layer increases; the unit water inflow is reduced from 15 ~ 10 m^3/h·m to 10 ~ 5 m^3/h·m; the salinity is generally about 0.5 g/L; the water chemical type is from HCO^3-Na to HCO^3·C1-Na type.

(4) The IV aquifer group

The IV aquifer group is confined water, and the bottom plate is buried under about 600 m. The lithology of the aquifer is significantly different in the north and south. It is north of Datun-Xiaowang Guzhuang, mainly for the micro-weathered or moderately weathered gravel sand and coarse sand, with a thickness of 55~70m, and the unit water inflow is 5～10m^3/h • m. The burial depth of water level is 40~45m, south of Datun-Xiaowang Guzhuang. The lithology of the aquifer is mainly fine sand and fine silt; the thickness is 55~70m; the unit water inflow is <5 m^3/h·m, and the burial depth of water level is 45 ~65m.

The aquifer group has been developed in recent years, providing a new source of water for urban life and industrial production.

3) Groundwater level dynamics

(1) Shallow groundwater

The change of shallow groundwater level is decided by atmospheric precipitation and artificial exploitation, and the water level shows a slowly decreasing trend for many years. According to the monitoring data from the Langfang Exploration Institute of Hebei Province Environmental Geological Survey, the average water level of shallow groundwater in the range of 614km^2 around Langfang city in the five years from 2006 to 2010 decreased by 3.12m, with an annually average decrease of 0.62m, except for the eastern part of the city (with salt water area) which shows a slightly increase. The water level in the north, west and south shows decrease, and the water level dropped more than 4m. The area was in the Economic and Technological Development Zone, Baijiawu and Kyushu.

At the end of 2010, the burial depth of water level shows changes: taking the urban built-up area as the center, the groundwater level anti-cone of depression is formed. The water level in the city center is 2~4m deep, and gradually deepens to 4~6m, 6~8m, 8~10m. The west and the north are >10m, and the west of Wanzhuang and the Kyushu and Baijiawu areas are buried 15 to 20m deep.

(2) Deep groundwater

According to the monitoring data of Langfang Investigation Institute, the deep groundwater decreased by an average of 4.31m (0.86m every year) during the five years from 2006 to 2010 for 614km^2 area around Langfang. Except for urban built-up area and its surrounding 42km^2 area which water level increases slightly, groundwater level of the rest of the area all showed a decline trend. The area of where groundwater level decreased accounts for more than 90% of the total area, and that in the Economic and Technological Development zone showed the greatest decrease (13.30m in five years), flowed by Daguying area (11.73m in five years) .

The distribution of water depth in the end of 2010: the groundwater level of the deep groundwater gradually deepened from the periphery to the center of the Langfang cone of depression, and the burial depth gradually changed from 20~30m to >70m. The groundwater flows from the periphery of cone of depression to its center. Taipingzhuang has the smallest burial depth of 29.94m in the western of cone of depression and the water level in the center is 73.65m.

4) Groundwater recharge, runoff and discharge conditions

Shallow groundwater is mainly recharged by atmospheric precipitation and lateral runoff, and its discharge is dominated by agricultural exploitation and phreatic evaporation. The deep groundwater is mainly recharged by lateral runoff, and the recharge source is located in the northwest mountainous and mountain front areas. Due to over-exploitation for many years, a large-scale cone of depression in water level has been formed in this area, which has changed the original natural flow field of groundwater. That deep groundwater flows from the edge of depression cone to its center, and the discharge depends mainly on artificial exploitation.

The monitoring analysis of many years shows that the deep groundwater does not show hydraulic connection with upper aquifer group.

7.5.2 A investigation on the status of groundwater environment in send-out pipelines

7.5.2.1 Status of groundwater artificial exploitation and utilization

To know the groundwater environmental protection objectives and its environment status along the pipeline of the project, a comprehensive investigation was conducted on the groundwater utilization near the pipeline of the project. The groundwater exploitation and utilization status and environmental protection objectives are shown below.

The villages in Tianjin which are involved this evaluation, the residents used water from local water plants, not from groundwater; the village residents in Hebei evaluation project uses local village's centralized water supply wells, and the well depth is around 300-500m which was exploited from deep confined water; there is no village within the Beijing evaluation project.

The water use of residents along the pipeline is shown in the table below.

Table 7.5-1 A investigation on the status of groundwater environment in send-out pipelines

No.	Village	Water supply	Population of residents	The closest distance between the water supply well and the pipeline（m）	Location of wells along the pipeline	Overview of water supply wells
Tianjin						
1	Changliu county	Village concentration well	2300	750	SE	A concentrated well with a depth of 350m and a groundwater depth of about 30m. The water consumption is about 400m3/d
2	Yangxiao village	Water plant of Xiqiaozhuang town	500	2500	S	Depth of well: 400m
3	Shunmintun		1300		S	
Langfang						
4	Yushuyuan village	Village concentration well	200	215	N	A concentrated well with a depth of 300m and a groundwater depth of about 20m. Water consumption is about 40m^3/d
5	Xinzhuangzi village	Water plant of Geyu town (Maliu Village)	700	2100	N	Depth of well: 400m
6	Jiujiabao village		600			
7	Suntuo village	Village concentration well	1500	630	E	A concentrated well with a depth of 500m， and a groundwater depth of about 20m. Water consumption is about 300m^3/d
8	Huangti village	Village concentration well	2000	710	E	A concentrated well with a depth of 500m. The water consumption is about 400m^3/d
9	Xiaohuizhuang village	Village concentration well	1000	1050	W	A concentrated well with a depth of 450m. Water consumption is about 200m^3/d
10	Liuxing village	Village concentration well	100	560	W	A concentrated well with a depth of 400m. Water consumption is about 20m^3/d
11	Xizhangzhuang village	Village concentration well	400	720	E	A concentrated well with a depth of 400m. Water consumption is about 70m^3/d

No.	Village	Water supply	Population of residents	The closest distance between the water supply well and the pipeline（m）	Location of wells along the pipeline	Overview of water supply wells
Tianjin						
12	Nanrenying village	Village concentration well	300	190	W	A concentrated well with a depth of 400m. Water consumption is about 60m^3/d
13	Guandao village	Village concentration well	400	280	W	A concentrated well with a depth of 300m. Water consumption is about 70m^3/d
14	Hengting village	Water plant of Hancun town (North Zhaojia village)	1100	2400	W	A concentrated well with a depth of 500m. Burial depth of groundwater 50m
15	Xiyuanjiawu village		1000			
16	Nanjiawuzhuang village		800			
17	Xitaipingzhuang village	Village concentration well	800	1000	W	A concentrated well with a depth of 600m. Burial depth of groundwater 20m. Water consumption is about 150m^3/d
18	Chaijiawu village	Village concentration well	700	210	E	A concentrated well with a depth 300m. Water consumption is about 120m3/d
19	Xiaozi village	Village concentration well	500	130	NE	A concentrated well with a depth 150m. Burial depth of groundwater 30m，Water consumption is about 100m^3/d
20	Xinglongzhuang village	Well of Nanchangdao village	600	1300	W	A concentrated well with a depth 400m. Burial depth of groundwater 50m
21	Zhanshang village	Well of Nanchangdao village and local area	1000	770	NE	A concentrated well with a depth 400m，Burial depth of groundwater 60m
22	Huotouying village	Well of Baijiawu village	1500	2500	NE	A concentrated well with a depth 400m，Burial depth of groundwater 50m
23	Miaoxiaozhai village	Village concentration well	300	550	W	A concentrated well with a depth 400m. Water consumption is about 100m^3/d
Beijing						
24	Dianzizhuang	Village concentration well	900	1300	N	A concentrated well with a depth 400m，Burial depth of groundwater 40m. Water consumption is about 200m^3/d
25	Neiguanzhuangvillag	Village concent	500	1200	N	A concentrated well with a depth 400m. Water

No.	Village	Water supply	Population of residents	The closest distance between the water supply well and the pipeline（m）	Location of wells along the pipeline	Overview of water supply wells
Tianjin						
	e	ration well				consumption is about 100m^3/d

7.5.2.2 A survey to the groundwater pollution source

The target area is a plain, and the villages along the area are densely populated with concentrated agriculture. The main sources of pollutants are domestic and agricultural pollution, and a few areas exist industrial pollution.

1) Agricultural pollution sources

It mainly exists in agriculturally developed areas with poor environmental protection. The use of regional pesticides and chemical fertilizers causes pollutants infiltrating into the vadose zone or aquifer with rainwater and polluting local groundwater.

There are small and medium-sized farms in some areas of the pipeline. Livestock manure and other garbage are piled up in open space without anti-seepage measures. Pollutants penetrate into the ground with rainwater and pollute groundwater.

2) Sources of living pollution

Such pollution sources are mainly caused by the unreasonable disposal of rural domestic garbage and domestic wastewater. Undisposed domestic sewage directly enters the shallow groundwater through the groundwater runoff, which may affect the deep groundwater and cause pollution.

3) Industrial pollution sources

No industrial pollution sources were found near the gas pipelines. The form of industrial pollution mainly includes industrial wastewater that may pollute groundwater by infiltrating into the ground or entering surface water bodies which are closely related to groundwater.

7.5.2.3 Monitoring and evaluation of groundwater environmental quality status

<1> Monitoring of groundwater environmental quality status

1)The location of monitoring stations

This project is about how the wastewater generated during the construction period of gas pipeline influences groundwater quality and how the sewage leakage from monitoring stations during operation period impacts on groundwater quality. To understand the status of groundwater environment quality around the project area and provide primary data for groundwater environmental impact analysis or prediction, the groundwater environmental monitoring stations are set up in special locations such as gas transmission stations and densely populated areas along the pipelines. According to the <Technical Guidelines for Environmental Impact Assessment--Groundwater Environment> (HJ610-2016): "The three-level evaluation project should have no less than three water quality monitoring stations for aquifers, and the number of aquifers which have drinking water development and utilization value and may be affected by the construction of project should be within 1 ~2". Therefore, the status of groundwater environmental quality evaluation has set up 16 groundwater quality monitoring wells in gas stations and along the pipeline to monitor the groundwater level.

The arrangement of monitoring stations considers both the function of the drinking water well, the form of water supply (distributed, centralized water supply), the characteristics of groundwater and the hydraulic connection between the well and the pipeline. The representativeness of the hydrogeological conditions is also considered. The groundwater monitoring stations of this project is described as follows, and some parts of the pipeline have no monitoring station or are far away from the monitoring.

1) Station: The first station of the accepting station and the other villages nearest to the gas station are equipped with stations. Therefore, 7 stations in total.

2) Pipeline: Nantai village, Huotouying village, Xinglongzhuang village, Dongyuan Jiawu village, Hengting village, Yujiazhuang village, Xinzhuangzi village, Yangxiaozhuang village, Changliuzhuang. Therefore, 9 stations in total.

2) Monitoring frequency and time

The monitoring frequency is in accordance with the requirements of the <Technical Guidelines for Environmental Impact Evaluation—Groundwater

Environment> (HJ610-2016). The frequency of water quality monitoring for the three-level evaluation is one phase. Groundwater level and water quality monitoring should be carried out at least once during the evaluation period. The groundwater level and water quality monitoring time of this project is May 24-27, 2019.

3) Monitoring items

According to the characteristics of groundwater of this project, the groundwater quality monitoring items are mainly composed of three parts:

(1) Basic components of water chemistry: K^+, Na^+, Ca^{2+}, Mg^{2+}, CO_3^{2-}, HCO_3^-, Cl^-, SO_4^{2-};

(2) Basic water quality items: pH, ammonia nitrogen, nitrate, nitrite, volatile phenols, cyanide, As, Hg, Cr^{6+}, total hardness, Pb, F, Ge, Fe, Mn, dissolved total solids, permanganate index, sulfate, chloride, total coliform, total number of bacteria;

(3) Special pollution item in this project: petroleum.

4) Monitoring and analysis methods

The groundwater monitoring method of this project is carried out according to the relevant regulations in the <Technical Specifications for Groundwater Environmental Monitoring> (HJ/T164-2004). Groundwater level monitoring and sampling manually measures the water level two times using steel tape, rope and other measuring tools to measure the vertical distance from the fixed point of the wellhead to the groundwater surface. When the difference between two measured values of two consecutive static water levels is less than ±1cm/10m, the two measured values and their mean values will be recorded into our "Groundwater Sampling Record Form"; the groundwater quality sampling method uses water samples collected from the wells and is carried out after sufficient pumping. The amount of pumped water should not be less than 3 times of the volume of the wellbore water. It should be below 0.5m of groundwater surface to ensure that the water sample can represent the groundwater quality. For closed production wells, the pumping water is taken from the pump outlet pipe of the pumping station.

The groundwater quality testing method of this project is carried out according to the methods specified in the <Sanitary Standards for Drinking Water> (GB/T 5750-2006) and the <Groundwater Quality Standards> (GB 14848-2017).

Table 7.5-2 Analysis method of the pollutants in groundwater

No.	Items	Detection limits/mg/L	Test methods
1	K	0.1	Inductively coupled plasma atomic emission spectrometry
2	Na	0.1	Inductively coupled plasma atomic emission spectrometry
3	Ca	0.1	Inductively coupled plasma atomic emission spectrometry
4	Mg	0.1	Inductively coupled plasma atomic emission spectrometry
5	SO^4	0.005	Iodometric method
6	pH	0.1 (no unit)	Glass electrode method
7	CO_3	1	Determination of carbonate by titration
8	HCO_3	2	Determination of bicarbonate by titration
9	Cl	0.01	Determination of chloride by silver titration
10	NO_3	0.01	UV spectrophotometry
11	Total alkalinity	0.5	Calculation
12	Total hardness	0.005	Iodometric method
13	Mn	0.003	Inductively coupled plasma atomic emission spectrometry
14	NH^4-N	0.02	Nessler reagent colorimetry
15	NO_2	0.001	Diazo coupling spectrophotometry
16	F	0.2	Ion selective electrode method
17	Fe	0.01	Inductively coupled plasma atomic emission spectrometry
18	As	0.001	Atomic fluorescence spectrometry
19	Hg	0.00004	Atomic fluorescence spectrometry
20	Phenol	0.0003	Spectrophotometry
21	CN	0.001	Isonicotinic acid-pyrazolone colorimetry
22	Cr	0.001	ICP plasma emission spectrometry
23	Pb	0.001	ICP-MS plasma emission mass spectrometry
24	Cd	0.0001	Graphite furnace atomic absorption spectrophotometry
25	COD_Mn	0.05	Volumetric method
26	oil	0.05	Infrared spectrophotometry
27	Total solubility solid	2	Dry weight method
28	Total coliform *ρ（B）/（MPN/100mL）	No	Multi-tube fermentation
29	Total number of bacteria *ρ（B）/（CFU/mL）	No	Plate counting method

5）Evaluation method

The single factor index (P_i) method is employed in this project for groundwater quality evaluation. If P_i >1，then the concentration or value of the evaluated item is over than groundwater quality standard value, and a higher value of P_i indicates a more serious situation of pollution. The calculation of P_i can be categorized into two different situations.

（1）For items with a standard value P_i is calculated by:

$$P_i = \frac{C_i}{C_{si}}$$

Where P_i is standard index of the i^th^ evaluated item， C_i is the measured concentration of the i^th^ item（mg/L）； C_{si} is the standard value of the i^th^ item（mg/L）。

（2）For items within a range, such as pH, P_i is calculated by：

$$P_{pH} = \frac{7.0 - pH}{7.0 - pH_{sd}} \quad pH \leq 7.0$$

$$P_{pH} = \frac{pH - 7.0}{pH_{su} - 7.0} \quad pH \geq 7.0$$

Where P_{pH} is the standard index of pH; pH is measured value of pH； pH_{sl} is the lower bound of pH in water quality regulation; pH_{sl} is the upper bound of pH in water quality regulation

We refer to “Form 1” of the third type standards released by《Groundwater Quality Standard》（GB 14848-2017）, for petroleum item, we refer to《Surface Water Quality Standard》（GB3838-2002），see Table 7.5-3 for more details.

Table 7.5-3 Groundwater quality standard

No.	Name of pollutants	unit	Standard value	Source of standard
1	pH	/	6.5-8.5	《Groundwater Quality Standard》GB/T14848-2017 type Ⅲ
2	Total hardness	mg/L	≤450	
3	COD_{Mn}, Permanganate index	mg/L	≤3	
4	Ammonia nitrogen	mg/L	≤0.5	
5	Fluoride	mg/L	≤1	
6	chloride	mg/L	≤250	
7	Sulfate	mg/L	≤250	
8	Nitrate nitrogen	mg/L	≤20	
9	Nitrite nitrogen	mg/L	≤1	
10	Cyanide	mg/L	≤0.05	
11	Cr^{6+}	mg/L	≤0.05	
12	Volatile phenol	mg/L	≤0.002	
13	Total coliform	(CFU/100ml)	≤3	
14	Fe	mg/L	≤0.3	
15	Mn	mg/L	≤0.1	
16	Cu	mg/L	≤1	
17	Zn	mg/L	≤1	
18	Pb	mg/L	≤0.01	
19	Hg	mg/L	≤0.001	

No.	Name of pollutants	unit	Standard value	Source of standard
20	As	mg/L	≤0.01	
21	Total solubility solid	mg/L	≤1000	
22	Na	mg/L	≤200	
23	Petroleum	mg/L	≤0.05	《Surface Water Environmental Quality Standard》（GB3838-2002）

<2> Results of monitoring and evaluation

From monitoring results, all groundwater monitoring stations set up in this project, the monitoring items except the total coliform, total number of bacteria, , F, total hardness, Cl and SO4 have different levels of over-standard phenomenon. The monitoring factors can meet the type III water quality standard limit requirements in the <Groundwater Quality Standard> (GB/T14848-2017), and the characteristic pollutant petroleum can meet the type III standard in the <Surface Water Environmental Quality Standard> (GB3838-2002). Limit requirements.

The main reason for the occurrence of the total number of colonies and the total coliform bacteria exceeded was caused by the unreasonable treatment of rural domestic garbage and domestic wastewater. According to the on-site investigation, the groundwater drinking water wells in the villages are mostly distributed around the houses, close to the toilets, livestock sheds and other facilities. Because the drinking water wells have no anti-seepage measures, the well depth is shallow, and the untreated domestic sewage passes through the groundwater runoff. Channels directly entering the well supply are prone to breeding bacteria, so the total number of bacteria exceeds the standard and is related to the source of domestic pollution.

The phenomenon of fluoride exceeding the standard is related to the local hydrogeological conditions. The sampling depth of the groundwater is shallow, and the fluoride in the project passes through the area. The total dissolved solids, total hardness, Cl and SO4 are mainly in the villages in Tianjin, which is mainly due to the proximity of the ocean and the shallow groundwater

Table 7.5-4 The monitoring results of groundwater status

Items	Zhoujiazhuang	Guanken Village	Nangang	Shouzhan	Nanrenying	Xiaozixiang	Neiguanzhuang	Nantai village	Huotouvillage	Xinglongzhuang village	Dongyuanjiawu village	Hengting village	Tongjiazhuang village	Xinzhuangzi village	Yangxiaozhuang village	Changliuzhuang
K	1.2	1.1	1.6	1.6	0.4	0.4	0	1.6	0	0.2	0.3	0.4	0	0	1	1
Na	434.4	430.1	453	453.8	275.8	118.8	127.4	455.5	122.8	128.2	105.3	118.7	151.4	150.5	432.6	436.3
Ca	10.4	11.1	11.2	11.6	24.6	10.3	54.2	11.2	52.8	51.6	8.9	10.4	5.4	5.3	10.8	11.1
Mg	5.3	5.2	4	4	29.3	2.1	54.3	4.1	52.6	54.6	1.8	2.6	1.3	1.2	5.2	5.3
SO_4	300.3	302.4	302.6	304.5	102.1	60.1	52.7	311	51	51.4	54.3	58.8	59.8	60	309.1	294.1
pH	8.46	8.45	8.49	8.5	8.1	8.33	7.8	8.49	7.72	7.85	8.35	8.25	8.43	8.49	8.39	8.38
CO_3	4.8	1.8	2.4	3.6	0	0	0	2.4	0	0	0	0	5.4	4.8	1.2	1.8
HCO_3	310	312.4	328.3	328.3	497.9	198.9	629.7	326.5	621.2	643.8	177	202	278.3	273.4	319.1	319.7
Cl	355.2	316.2	337.8	338.2	230.4	56.7	62	336.1	61.3	64.2	50.3	57.4	48.6	48.6	315.5	318.7
NO_3	0.64	0.3	1.11	1.51	0.27	5.51	0.57	1.04	0.72	1.22	3.95	5.56	0.74	<0.05	0.74	0.52
Total alkalinity	271.7	259.2	273.2	275.2	390.4	163.1	516.5	271.7	509.4	528	145.1	165.6	237.2	232.2	263.7	265.2
Total hardness	446.9	49	44.5	45.5	485.4	34	358.8	45	348.3	353.3	29.5	457.9	19	18	48.5	463.9
Mn	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
NH_4-N	0.09	<0.02	0.04	0.05	0.08	0.02	0.04	0.07	0.09	0.09	0.06	<0.02	<0.02	0.05	<0.02	<0.02
NO_2	0.017	0.006	0.017	0.018	0.005	0.004	0.004	0.016	0.003	0.003	0.0014	0.004	0.005	0.009	0.007	0.007
F	2.02	1.94	2.1	2.02	2.55	0.56	1.04	2.1	1.17	1.08	0.52	0.68	2.65	2.76	2.1	2.1
Fe	0.06	0.06	0.13	0.14	0.03	<0.01	<0.01	0.13	0.02	<0.01	0.1	0.01	0.03	0.03	0.09	0.08
As	0.002	0.001	0.002	0.002	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.002	0.002	0.001	0.001
Hg	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004

Phenol	0.0004	0.0004	0.0001	0.0003	0.0003	0.0002	0.0002	0.0002	0.0006	0.0006	0.0004	0.0005	0.0005	0.0006	0.0006	0.0008
CN	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cr	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cd	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
COD_Mn	1.69	1.68	2.09	1.92	1.25	0.82	1.67	2.15	0.9	1.66	1.08	2	1.35	0.94	1.87	1.88
Oil	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total solubility solid	1266.6	1224.1	1276.75	1281.45	911.55	347.85	665.45	1285.15	651.1	672.1	309.4	349.3	411.05	407.1	1234.95	1228.15
Total coliform	No	2	23	23	No	No	No	No	No	No	No	No	No	No	2	No
Total number of bacteria	3	8	360	290	No	No	No	240	No	No	No	No	11	19	10	43
Depth of sampling(m)	5	5.5	4.5	4.5	6.5	6	12	5	11.5	13	8	6.5	6	4.5	5.5	6

Table 7.5-5 The monitoring results of groundwater status

Items	Zhoujiazhuang	Guanken village	Nangang	Shouzhan	Nanrenying	Xiazixiang	Neiguanzhuang	nantai village	Huotouying village	Xinglongzhuangvillage	Dongyuanjiawu village	Hengting village	Tongjiazhuang village	Xinzhuangzi village	Yangxiaozhuang village	Changliuzhuang
SO_4	1.20	1.21	1.21	1.22	0.41	0.24	0.21	1.24	0.20	0.21	0.22	0.24	0.24	0.24	1.24	1.18
pH	0.73	0.73	0.75	0.75	0.55	0.67	0.40	0.75	0.36	0.43	0.68	0.63	0.72	0.75	0.70	0.69
Cl	1.42	1.26	1.35	1.35	0.92	0.23	0.25	1.34	0.25	0.26	0.20	0.23	0.19	0.19	1.26	1.27
NO_3	0.03	0.02	0.06	0.08	0.01	0.28	0.03	0.05	0.04	0.06	0.20	0.28	0.04	/	0.04	0.03
Total hardness	0.99	0.11	0.10	0.10	1.08	0.08	0.80	0.10	0.77	0.79	0.07	1.02	0.04	0.04	0.11	1.03
Mn	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
NH_4-N	0.18	/	0.08	0.10	0.16	0.04	0.08	0.14	0.18	0.18	0.12	/	/	0.10	/	/
NO_2	0.02	0.01	0.02	0.02	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
F	2.02	1.94	2.10	2.02	2.55	0.56	1.04	2.10	1.17	1.08	0.52	0.68	2.65	2.76	2.10	2.10

Items	Zhoujia zhuang	Guanken village	Nan gang	Shou zhan	Nanre nying	Xiazi xiang	Neiguan zhuang	nantai village	Huotouying village	Xinglongzh uangvillage	Dongyu anjiawu village	Hengting village	Tongjia zhuang village	Xinzh uangzi village	Yangxia ozhuang village	Changli uzhuang
Fe	0.20	0.20	0.43	0.47	0.10	/	/	0.43	0.07	/	0.33	0.03	0.10	0.10	0.30	0.27
As	0.20	0.10	0.20	0.20	/	/	/	0.20	/	/	/	/	0.20	0.20	0.10	0.10
Hg	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Phenol	0.20	0.20	0.05	0.15	0.15	0.10	0.10	0.10	0.30	0.30	0.20	0.25	0.25	0.30	0.30	0.40
CN	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Cr	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Pb	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Cd	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
COD_Mn	0.56	0.56	0.70	0.64	0.42	0.27	0.56	0.72	0.30	0.55	0.36	0.67	0.45	0.31	0.62	0.63
Oil	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	1.27	1.22	1.28	1.28	0.91	0.35	0.67	1.29	0.65	0.67	0.31	0.35	0.41	0.41	1.23	1.23
Total coliform	/	0.67	7.67	7.67	/	/	/	/	/	/	/	/	/	/	0.67	/
Total number of bacteria	0.03	0.08	3.60	2.90	/	/	/	2.40	/	/	/	/	0.11	0.19	0.10	0.43

*：This table show results for items required in standards and detected items, "/" means the concentration/value is less than detection limits

7.6 Soil environmental status investigation and assessment

7.6.1Montoring point setting

In this project, one monitoring point was set for each station as well as the 4# valve chamber, and in toal, 8 points were set. One group soil sample was collected in each point with a sampling depth of 0.2 m and 0.8 m.

7.6.2Monitoring frequency and monitoring time

Monitoring phase 1, sampling once at each monitoring point.

7.6.3Monitoring project and method

The monitoring project is about basic factor and characteristic pollution factor like total petroleum hydrocarbon in Soil environmental quality Risk control standard for soil contamination of development land (GB36600-2018).

The pretreatment and analysis of soil samples can be refered to The Technical Specification for soil Environmental monitoring (HJ/T166-2004) and Soil environmental quality Risk control standard for soil contamination of development land (GB36600-2018). The analysis method of the monitoring project is shown in the table below.

Table 7.6-1 The analysis method of soil monitoring project

Numer	Item	Method basis	The detection limit
1	pH	Method for determination of soil pH NY/T1377-2007	/
2	Cu	Solid Waste–Determination of metals–Inductively coupled plasma mass spectrometry (ICP-MS) HJ766-2015	0.92 mg/Kg
3	Ni	Solid Waste–Determination of metals–Inductively coupled plasma mass spectrometry (ICP-MS) HJ766-2015	1.2 mg/Kg
4	Cd	Solid Waste–Determination of metals–Inductively coupled plasma mass spectrometry (ICP-MS) HJ766-2015	0.01 mg/Kg
5	Pb	Solid Waste–Determination of metals–Inductively coupled plasma mass spectrometry (ICP-MS) HJ766-2015	0.51 mg/Kg
6	As	Soil quality—Analysis of total arsenic contents—Atomic fluorescence spectrometry GB/T22105.2-2008	1 mg/Kg
7	Hg	Soil quality—Analysis of total arsenic contents—Atomic fluorescence spectrometry GB/T22105.1-2008	0.0005mg/Kg
8	Cr6+	Solid waste-Determination of chromium(VI)-1,5-Diphenylcarbohydrazide spectrophotometric method GB/T15555.4-1995	0.02mg/kg

9	Chloromethane	Soil and Sediment—Determination of Volatile Organic Compounds by Purge and Trap Gas Chromatography/Mass Spectrometry Method HJ 605-2011	0.05mg/kg
10	Vinyl chloride		
11	1,1- Dichloroethene		
12	Dichloromethane		
13	Cis-1,2-dichloroethylene		
14	Dichloroethane		
15	Trans-1,2-dichloroethylene		
16	Chloroform		
17	1,1,1- Trichloroethane		
18	CCl4		
19	C6H6		
20	1,2- Dichloroethane	Soil and Sediment—Determination of Volatile Organic Compounds by Purge and Trap Gas Chromatography/Mass Spectrometry Method HJ 605-2011	0.05mg/kg
21	Trichloroethylene		
22	1,2- Dichloropropane		
23	Toluene		
24	1,1,2- Trichloroethane		
25	Tetrachloroethylene		
26	Chlorobenzene		
27	Ethylbenzene		
28	1,1,1,2-Tetrachloroethane		
29	Para-xylene		
30	O-xylene		
31	Styrene		
32	1,1,2,2-Tetrachloroethane		
33	1,2,3- Trichloropropane		
34	P-dichlorobenzene		
35	O-dichlorobenzene		
36	Nitrobenzene	Soil and sediment - Determination of semivolatile organic compounds- Gas chromatography /Mass spectrometry US EPA8270D-2014	0.1mg/kg
37	Aniline		
38	2- chlorophenol	Soil and sediment—Determination of phenolic compounds —Gas chromatography (HJ703-2014)	0.1mg/kg
39	Naphthalene	Soil and Sediment–Determination of polycyclic aromatic hydrocarbon by Gas chromatography (HJ 805-2016)	0.05mg/kg
40	Chrysene		
41	Benz[a]anthracene		
42	Benzo[b]fluoranthene	Soil and Sediment–Determination of polycyclic aromatic hydrocarbon by Gas chromatography (HJ 805-2016)	0.05mg/kg
43	Benzo[k]fluoranthene		
44	Benzo[a]pyrene		
45	Indeno[1,2,3-cd]Pyrene		
46	Dibenzo(a,h)hydroquinone	Soil and Sediment–Determination of polycyclic aromatic hydrocarbon by Gas chromatography (HJ 805-2016)	0.02mg/kg
47	Petroleum hydrocarbon	TPH Determination by Gas chromatography ISO 6703:2011	20mg/kg

7.6.4Monotoring results statistics and evaluation

It can be seen from the following table that all the monitoring factors have not exceeded the standard value in the soil underground with a depth of 20 cm and 80 cm at the site of each station of the project, which meet the requirements of the second type of land use screening value (Table 1) in Soil environmental quality Risk control standard for soil contamination of development land and the monitoring factors of soil pollution risk (test) (GB36600- 2018). The quality of the soil environment is good.

Table 7.6-2 Monitoring results of soil environmental status unit：mg/kg，heavy metal：10^{-6}

Serial number	Monitoring factor	Initial receiving station		Nangang substation		Daqiu village substation		Jinhai interface location		Yongqing interface location		Anci substation		South city last station		4#valve chamber	
		20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm
1	Cr (Hexavalent)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
2	Ni	25.3	25.9	32.9	34.5	23.4	23.4	31.8	32.9	23.4	21.8	19.1	18.3	24.1	20.8	27.5	27.0
3	Cu	20.5	20.8	43.3	45.7	18.9	19.0	35.2	34.8	19.1	16.7	14.3	12.4	21.0	20.7	23.3	22.9
4	Cd	0.108	0.108	0.140	0.149	0.124	0.114	0.229	0.203	0.129	0.083	0.103	0.082	0.120	0.137	0.145	0.143
5	Pb	22.2	24.0	24.6	25.5	23.2	22.9	33.4	32.7	22.4	19.1	20.7	18.1	22.8	23.3	31.1	31.6
6	As	9.61	9.63	8.16	8.68	9.71	10.1	11.1	11.6	7.39	7.08	5.98	5.19	8.71	7.23	8.46	8.83
7	Hg	0.021	0.029	0.021	0.024	0.045	0.031	0.039	0.036	0.022	0.019	0.011	0.009	0.025	0.033	0.030	0.026
8	CH3Cl	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
9	CHCl3	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
10	CCl4	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
11	1,1-Dichloroethane	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
12	1,2-Dichloroethane	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
13	1,1-Dichloroethene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
14	Cis-1,2-dichloroethylene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
15	Trans-1,2-dichloroethylene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
16	CH2Cl2	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
17	1,2-Dichloropropane	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L

Serial number	Monitoring factor	Initial receiving station		Nangang substation		Daqiu village substation		Jinhai interface location		Yongqing interface location		Anci substation		South city last station		4#valve chamber	
		20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm
18	1,1,1,2-Tetrachloroethane	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
19	1,1,2,2-Tetrachloroethane	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
20	Tetrachloroethylene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
21	1,1,1-Trichloroethane	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
22	1,1,2-Trichloroethane	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
23	Trichloroethylene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
24	1,2,3-Trichloropropane	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
25	Vinyl chloride	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
26	C6H6	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
27	C6H5 Cl	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
28	1,4-Dichlorobenzene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
29	1,2-Dichlorobenzene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
30	Ethylbenzene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
31	Styrene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
32	Toluene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L

Serial number	Monitoring factor	Initial receiving station		Nangang substation		Daqiu village substation		Jinhai interface location		Yongqing interface location		Anci substation		South city last station		4#valve chamber	
		20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm	20cm	80cm
33	Paraxylene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
34	o-Xylene	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L	0.05L
35	Nitrobenzene	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L
36	Naphthalene	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L
37	Aniline	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L
38	2-Chlorophenol	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L
39	Chrysene	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L
40	Benz[a]anthracene	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L
41	Benzo[b]fluoranthene	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L
42	Benzo[k]fluoranthene	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L
43	Benzo[a]pyrene	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L
44	Indeno[1,2,3-cd]Pyrene	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L	0.1L
45	Dibenzo(a,h)hydroquinone	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L	0.02L
46	Petroleum hydrocarbon	20L	20L	20L	20L	20L	20L	20L	20L	20L	20L	20L	20L	20L	20L	20L	20L

8 Environmental Impact Prediction and Evaluation During Construction Period

8.1 Atmospheric environmental impact analysis during construction period

The construction waste gas pollution sources mainly come from ground excavation, backfilling, earth and stone dumping and fugitive dust (dust) generated by transportation vehicles, and construction machinery (diesel engine) and exhaust gas emitted by transportation vehicles. The main pollutants in the exhaust gas are SO2, NO2, CmHn, etc. . These pollutants will cause a certain degree of pollution to the ambient air, but this pollution is short-term and will cease to exist after the project is over. This analysis mainly uses the construction experience and monitoring results of similar projects, and analyzes the impact of the construction period on the atmospheric environment along the line and the station.

8.1.1 Analysis of the impact of dust (dust)

The fugitive dust (dust) of this project is mainly produced in three parts: construction activities such as ground cleaning, excavation, landfill, earth and stone stacking in trenches and stations, as well as fugitive dust (dust) generated during vehicle transportation. The fugitive dust (dust) pollution generated during construction mainly depends on the construction operation mode, material stacking and wind power. The wind is the most influential factor. With the increase of wind speed, the pollution degree and dusting range of construction fugitive dust (dust) It will also be enhanced and expanded.

The pipeline cleaning and excavation, excavation, landfill and earthwork stacking are carried out in stages, and the construction time is short. The fugitive dust (dust) generated in the operation belt is discharged from unorganized surface sources and is constructed in plains and hills. According to the actual site survey of similar projects: in the case of high winds, the dust concentration of the wind at the construction site can reach 3mg/m3 at 1m, 1.53mg/m3 at 25m, and the TSP concentration in the range of 60m downwind. However, due to the construction process being segmented, the construction time is short. Under the conditions of strictly implementing the operation system of layered excavation, layered backfilling, avoiding long-distance construction, engineering measures and biological measures, in general, the pipeline Dust pollution in construction operations is short-lived, and the impact will not be great. The atmospheric protection targets are less affected by construction dust during the pipeline construction period.

Dust pollution will also occur during the transportation of the automobile during the construction phase. The amount of dust, particle size, etc. are related to various factors, such as road conditions, vehicle speed, load capacity, weather conditions, etc. The weather conditions such as wind speed and wind direction directly affect the transmission direction and distance of the dust. Due to the short dusting time generated during the transportation of automobiles and the rapid landing of dust, the scope of influence is mainly concentrated on both sides of the transport road, and the distance between the atmospheric protection targets and the construction site is more than 60m, so the degree and scope of the impact of the vehicle transportation dust on the surrounding ambient air Smaller, the impact time is also shorter. If hardened roads are used, roads are sprinkled with water to suppress dust, vehicles are not overfilled, and airtight or covered measures are taken, the impact of transport dust on ambient air can be greatly reduced.

There are fewer sensitive targets within 60m of the construction site, as long as reasonable management, control of the working area, appropriate water spray of the mound, cover of the mound and building materials, metal plates, and stoppage of windy days are adopted, and construction dust is sensitive to surrounding targets. The impact can be minimized.

8.1.2 Analysis of the influence of construction machinery exhaus

During the construction period, in the construction of large-scale machinery such as directional drilling and pipe-crossing, the transportation of automobiles and pipelines will generate combustion fumes due to the use of diesel engines and other equipment. The main pollutants are SO2, NO2, CmHn and so on. However, due to the small amount of exhaust gas and the construction site are in the wild, it is conducive to the diffusion of air, and the source of exhaust gas pollution has intermittent and fluidity, so the environmental impact on local areas is relatively light.

8.2 Acoustic environmental impact assessment during the construction period of the send-out pipeline

8.2.1Acoustic environmental impact assessment on the send-out pipeline

8.2.1.1 Construction noise source

The impact of engineering analysis on the noise environment is mainly caused by construction machinery and transportation vehicles. In addition, in the mountainous and river valley rock sections, blasting methods are used to repair the roads and widen the original mountain roads and trenches. Will produce strong noise.

As the project progresses in each construction section, different mechanical equipments will be used, such as excavators for trenching, transport vehicles for piping, welders and generators for welding, and straws for pipelines entering the trenches. Machines, bulldozers are used for backfilling. These constructions are all daytime operations. The construction machinery is used alternately according to the construction content, and moves with the construction position. The pipeline construction is a construction section every 60km, and the operation period is about 20d. These constructions are all daytime operations, and the construction machinery is alternately used according to the construction contents, and moves with the construction position.

The construction site is selected on the side where the traffic is convenient and the site is open. The construction period depends on the construction method and the length of the crossing and the geological conditions. The construction time of each project is generally between 20 and 40 days. Mainly generators, directional drilling machines and mud pump noise.

According to the analysis of the main equipment selected by the analogy survey and on-site survey monitoring and project feasibility study report, the noise source construction machinery with equipment up to 85dB(A) is: excavator, pipelayer, electric welder, directional drilling machine , bulldozers, concrete mixers, cutting machines, stone transport vehicles, etc.

Table 8.2-1 Noise values of main construction machinery

Sequence number	Noise source	Noise intensity B)	Sequence number	Noise source	Noise intensity B)
1	Excavator	92	6	Concrete mixer	95
2	Pipe hanger	88	7	Concrete dumper	90
3	Electric welder	85	8	Concrete vibrator	105
4	Directional drill	90	9	Cutting machine	95
5	Dozer	90	10	Diesel generator	100

Usually, there are many different types of construction machinery working on the construction site at the same time. Their radiation levels will be superimposed, and the intensity increment will vary depending on the type, quantity and relative distribution distance of the noise source. The predicted values of construction noise as a function of distance attenuation are shown in the table below.

Table 8.2-2 Unit of attenuation of construction noise with distance: DB (a)

Distance	10	20	40	80	100	200	400	800	1000
Excavator	80	74	68	62	60	54	48	42	40
Pipe hanger	76	70	64	58	56	50	44	38	36
Electric welder	73	67	61	55	53	47	41	35	33
Directional drill	78	72	66	60	58	52	46	40	38
Dozer	78	72	66	60	58	52	46	40	38
Concrete mixer	83	77	71	65	63	57	51	45	43
Concrete dumper	78	72	66	60	58	52	46	40	38
Cutting machine	83	77	71	65	63	57	51	45	43
Diesel generator	88	82	76	70	68	62	56	50	48
Concrete vibrator	93	87	81	75	73	67	61	55	53

In the line construction, the excavator is used for a long time, the noise intensity is high, and the duration is long, while other construction machinery such as concrete shock rods, concrete mixers, concrete dump trucks, cutting machines, bulldozers, etc. are generally used intermittently, and The construction time is short, so the construction noise of the excavator basically reflects the influence level of pipeline construction noise. The main noise sources for directional drilling and pipe jacking construction are directional drilling machines and diesel generators. The source strength is 90dB(A)～100dB(A). Generally, during daytime construction, the construction period is 20～40d. Acoustic noise reduction.

It can be seen from the calculation results that the main machinery does not exceed the noise limit of 75dB(A) of the construction site boundary at the time of

40m, and the distance is not more than 200m at night if it does not exceed the standard of 55dB(A) at night. .

There are many villages and settlements within 200m of this project pipeline, but they are mainly concentrated outside the range of 40m (35m from the pipeline of Tianjin Shunmin Village). And the construction is generally during the day, and with the end of the construction period, the impact will also end. Therefore, the noise impact during pipeline construction is acceptable.

8.2.1.2 Influence of construction machinery on close-range noise protection targets on both sides of pipelines

Engineering construction machinery concrete mixer, concrete dumper, cutting machine and diesel generator are basically used in station construction, directional drilling through large rivers, etc., the frequency of use is low, the excavator uses the highest frequency, therefore, the excavator is the representative to illustrate the project. Noise impact during construction period. According to the calculation results, the noise level of the equipment during the construction period is gradually weakened outward along the construction pipeline. The noise level of the excavator other than the sound source is less than 54dB (A). The acoustic environment of the noise protection target within 200m on both sides of the pipeline will be affected by construction noise during the construction period, and the noise level will increase to different extents, and the noise value will exceed the standard limit. However, the construction noise is short-lived and dispersive, and is generally constructed during the day without affecting the nighttime acoustic environment. Therefore, the general construction noise has little impact on the lives of the surrounding residents.

To prevent impact on sensitive points at close range, take the following measures:

(1) Arrange the construction time reasonably. When formulating the construction plan, avoid a large number of high-noise equipment construction at the same time. The high-noise construction time is scheduled during the day, and the construction amount is reduced or not at night. Construction is prohibited at night when the pipeline passes through close-range residential areas within 40m.

(2) Reasonably arrange the construction site to avoid arranging a large number of power machinery and equipment at the same place to avoid excessive local sound level.

(3) Establish a temporary sound barrier, and a single-sided sound barrier may be established according to the situation during the construction process.

(4) Pipeline transportation and hoisting should be arranged during the daytime. When the construction workshop passes through the villages and towns, whistling is prohibited.

8.2.1.3 The impact of station construction and large crossings on surrounding villages

The noise of the station construction and pipeline construction has similar effects on the surrounding. The main machinery does not exceed the noise limit of 70dB(A) of the construction site boundary during the 100m; and if it does not exceed the standard of 55dB(A) at night, The distance is far more than 200m. However, according to the survey, the construction of the station near the distance from the village will have different degrees of noise impact. Communication and compensation should be done with the residents to avoid night construction.

The large-scale cross-over construction site is large, with many noise sources and relatively long noise duration. The large-scale cross-over project is continuous construction day and night. According to the survey, there is no protection target such as residential concentration area within 40m of the large-scale crossing project. The construction site will affect the surrounding residents due to construction noise. It is recommended to wear a fixed noise machine away from the residential building as far as possible across the construction site, and reasonably move the noise source travel route to avoid nighttime strong noise equipment (such as excavators, bulldozers, loaders, cranes, diesel generators), if necessary A single-sided sound barrier can be established as appropriate to communicate with local residents.

8.3 Surface Water Environmental Impact Assessment During Construction Period

The influence of construction period on surface water quality mainly occurs in the process of river crossing construction . According to the hydrologic, geological and environmental characteristics of rivers along the road, directional drilling and large excavation are adopted. The directional drilling method passes below the riverbed, and the water quality of the river will not be affected directly. Large excavation and other construction methods have a certain impact on river water quality.

8.3.1Analysis of main wastewater sources and effects during construction period

The waste water during pipeline construction mainly comes from the domestic sewage produced by the construction workers and the waste water discharged after the pipeline is installed.

(1) Domestic sewage

Construction personnel rent houses nearby, do not set up construction camps during the construction of domestic sewage mainly rely on the local sewage treatment system. The directional drilling crossing point shall be provided with temporary dry latrine for the construction camp, and the domestic sewage and excrement shall be treated simply by the septic tank and used as farm manure. Therefore, the impact of domestic sewage on the environment along the construction period is relatively small.

(2) Pipe cleaning, pressure testing and drainage

During construction period, pipeline cleaning and pressure testing are carried out in sections, the main pollutants are suspended substances. In order to save water and avoid waste of water resources, the waste water of cleaning pipe and pressure test can be reused (utilization rate can be up to 50%).

According to the experience of other pipeline construction in China, this part of wastewater will not affect the water quality of the affected water. However, due to the large displacement and short drainage time, it is necessary to do a good collection and discharge management and drainage work, as far as possible to avoid drainage caused local soil loss and pollution.

The environmental assessment requires that the discharge of pressure test water from clear pipes into categories II, III or drinkable waters be prohibited. Prior to the discharge of the pressure test water in the pipeline, the consent of the local ecological environment authority shall be obtained and the discharge shall be carried out in accordance with its requirements.

8.3.1.1 Influence of Different Construction Methods on Surface Water Environment

(1) Effect of Directional Drilling on Surface Water Environment

Directional drilling is a kind of crossing construction method with less environmental impact . Pipeline crossing surface water should be given priority, especially in environmentally sensitive areas.

In the river crossing construction of this project, 7 large, medium and small rivers cross by directional drilling.

1) Introduction of Construction Method of Directional Drilling

Directional drilling is an advanced method of pipeline crossing construction. Directional drilling through the pipeline hole below the river bed, more than 10 meters from the river bed, with the advantages of not destroying the river bank, not disturbing the river bed and so on. Because directional drilling passes through the construction site, it is required that the " buried point " and " excavated point " be located on the outside of the bank, and the directional drilling technology will pass at 10m-20m under the river bed, which will not affect the embankment project, the river water temperature, the water conditions and the water environment. The construction will only temporarily destroy the soil layer on both sides of the embankment, and after the construction is completed, the original appearance of the embankment will not adversely affect the embankment ; During construction period and operation period, the river landscape remained unchanged ; The large water area pipeline is usually buried below the riverbed, and the construction process will not affect the dykes on both sides of the river channel, nor will it affect navigation and ship anchoring, will not obstruct the main river flow, will not disturb the river hydrology, water conditions, water quality and related water conservancy facilities, and will not affect the water environment.

In the process of crossing, slurry pools should be set up at the buried site and the excavated site, and the size of slurry pools should be designed according to the amount of mud needed for directional drilling across the river length. From the construction site of the existing projects, the slurry pools are provided with anti-seepage membrane, resulting in a smaller leakage probability, generally the slurry pool to achieve safe landfill, will not affect surface water bodies.

2) Main effect of directional drilling construction

a) During construction, the soil layer on both sides of the embankment will be temporarily damaged ;

b) Contamination spills or leaks from cuttings sedimentation tanks and mud collection tanks may contaminate water bodies ;

c) A certain amount of solid waste (mainly waste mud and cuttings) will be produced after the completion of construction ;

d) Domestic sewage and domestic garbage produced during construction.

3) Measures taken

For the purpose of this project, in order to minimize the impact of directional drilling construction on water crossing, the following environmental protection measures must be implemented during the construction process :

a) It is prohibited to discharge all pollutants into the water body.

b) Prevent domestic sewage and domestic waste from entering the river directly.

c) No filling or storage of oil storage tanks for construction machinery shall be allowed in the feet of two external dykes passing through the river, and no cleaning of construction machinery, vehicles and sewage shall be allowed in the main stream and overflow areas of the river.

d) Strengthen the maintenance of the equipment to prevent oil spills in the water.

e) The slurry pool shall be set up in accordance with the regulations, and its volume shall be considered as 30% surplus to prevent rainwater from flushing and overflowing.

f) After the completion of construction, the waste mud is separated and cured, and a treatment agreement can be signed with the local people (usually referred to the local villagers for treatment) ; Can also remain in the mud pool, after curing buried soil to restore planting ; The separated sewage can be transported and discharged after the treatment reaches the standard ; Waste cuttings are used to build dykes and restore sites, etc.

g) Construction of excess earthwork may be used for the berm along the coast and may not be disposed of at will.

h) After the completion of construction, the original appearance of the site should be restored and buried as soon as possible to reduce soil erosion.

i) The bottom and sides of the slurry pool shall be covered with PVC material to prevent the infiltration of sewage. After the construction is finished, the remaining slurry pH is adjusted and collected as waste in the mud pit . With the consent of the local environmental protection department, after solidification treatment, it is buried in the impervious mud pool, covered with 40 cm of tillage soil, to ensure the restoration of the original topography, or to be sent to the designated garbage dump site of the local environmental protection department for disposal.

After taking the above measures, directional drilling has little effect on surface water environment.

(2) Analysis on the Influence of Large Excavation on Surface Water

1) Construction analysis of large excavation

Large excavation method is adopted for small river crossing.

The large excavation crossing mode is suitable for the river with shallow water, less water and wider river-overflow beach. The diversion channel is excavated on one side of the river, and then the channel channel is excavated . Concrete blocks are added to the pipe section to stabilize the pipe. After the completion of the construction, the riverbed will be stabilized by the restoration of covered soil.

For medium and small river ditch excavation, usually in the non-flood season. In the process of construction, a straw bag cofferdam is usually used to stop water at both ends of the river, then a large excavation is carried out, and the original riverbed is restored after the pipeline passes.

For small rivers with large water volume, the cofferdam diversion excavation method is adopted . For reservoirs, the cofferdam is pumped first and then excavated . During the construction, the riverbed is temporarily damaged when the trench is laid in the riverbed.

2) Influence of large excavation construction on water environment

During the excavation and crossing construction, the water quality of the river will be affected in a short time. The main manifestations are :

a. Impact on rivers

During the construction period, the excavation will have a short-term impact on the river water quality, mainly to increase the sediment content in the river water. However, this effect is local, after a certain distance of the river flow, the water quality of the river will be restored to its original state due to sediment deposition, and the original riverbed shape will be restored after the construction, which will not have a significant impact on the water function and water quality.

According to the results of field investigation, there are less seasonal rivers along the dry season, and one of them has a short effect on the water quality of the river during the dry season, and the other is the temporary damage to the riverbed caused by the excavation operation . The excavation depth is usually 1.5 m below the designed scour line . after the restoration of overlying soil, the riverbed stability measures will not affect the riverbed and water environment.

For small rivers and ditches with large water volume, the cofferdam diversion excavation method is adopted . During construction, the channel is temporarily damaged when the channel is excavated and laid in the riverbed. During the construction period, the excavation of the river will have a short-term effect on the water quality of the river . During the process of the cofferdam diversion, the suspended matter content in the river may increase, the setting of the diversion ditch will destroy the vegetation in some catchment areas and increase the sediment flowing into the river . However, this effect is local . the original riverbed shape is restored, and it will not affect water function and water quality. In the process of diversion excavation of the cofferdam, a certain amount of silt and soil will be produced, and part of the backfill shall be processed in time.

b. Impact analysis on aquatic organisms and downstream agricultural water use

During the process of construction, the excavation activities may obstruct and influence the inherent hydrologic laws of the water area . The excavation will cause the groundwater to seep sideways in the direction of the pipe ditch, may form water flow along the pipe ditch, cause the groundwater level in the surrounding area to drop or obstruct the underground undercurrent on both sides of the pipe ditch . if the construction period is in the irrigation season, the cofferdam will be used to guide the flow of the construction, subsection construction will not stop the water, in addition, the construction of small rivers is shorter, usually 3-5 days, the impact is short-term and partial.

According to the site survey and local fisheries bureau, the large excavation mode of the project construction of the river crossing section of the " three field " distribution of fish.

c. Impact analysis on soil and water loss

During the construction, the diversion and temporary protection works shall be carried out to effectively prevent flood erosion and reduce soil erosion.

In conclusion, when the excavation method is adopted, the construction unit shall take full account of the function and type of surface water in the selection of the line and the crossing point of the river for the project, and minimize the impact of surface water quality during the construction.

d. Environmental measures taken

During the crossing construction, as long as the following measures are taken to strengthen the management, the pipeline construction will have little impact on the river. The main environmental protection measures to be taken in large excavation crossing construction are as follows :

- When construction is carried out by excavation method, the construction unit shall take fully into account the functions and types of surface water in the selection of the lines for this project and the selection of crossing points for river channels, and obtain the approval of the water conservancy department, planning department, agricultural department and environmental protection department to minimize the impact of surface water quality during construction.
- The construction unit shall strengthen the environmental management during the construction period, and the excavation of pipes and ditches, the construction of temporary roads, the crossing of rivers and canals shall avoid the rainy season, so as to reduce soil erosion and the impact on aquatic ecosystems ;
- Construction must be selected in dry season ;
- Strict construction organization, optimize construction plan and shorten construction time as much as possible ;
- Strictly implement the relevant provisions in local river management ;
- To prohibit the discharge of all pollutants into the water body ;
- It is strictly prohibited to discharge pipeline test water into the river ;
- It is strictly prohibited to build construction camps and construct temporary toilets at the foot of the outer dykes of the two river banks ;
- It is prohibited to clean construction machinery and transport vehicles in rivers and near shore ;
- The discharge of sewage and solid waste into rivers is strictly prohibited ;
- No filling or storage of oil storage tanks for construction machinery shall be allowed in the two levees crossing the river, and no cleaning of construction machinery or vehicles shall be allowed in the main stream and floodplain areas. Machinery equipment if there is oil leakage phenomenon to timely clean the scattered

oil ;

• -After the completion of the construction, the original riverbed of the construction section shall be restored to its original appearance as far as possible, and the excess earth and rock may be piled evenly on the backwater side of the bank slope of the river crossing area after the backfill of the pipe trench, compacted or used for the construction of the dam ; It is necessary to pay attention to the cleaning work of the cofferdam soil after the completion of construction to avoid blocking the river course.

In order to protect surface water and minimize the impact of large excavation construction on water crossing, the relevant provisions of the Law of the People's Republic of China on Water Pollution Prevention and Control and local river management shall be strictly implemented during the process of crossing construction to minimize the impact on hydraulic facilities, and the relevant environmental protection requirements and corresponding protection measures for large excavation construction methods shall be strictly implemented.

8.3.1.2 Influence of Pipeline Laying on Surface Water Environment

During the construction, such activities as land excavation, construction site leveling, temporary land occupation and abandoned earthwork stacking will not only destroy the local vegetation and soil, but also affect the local surface runoff, causing some small ditches water flow is not smooth, or even blocking or changing the flow direction, so that local hydrological conditions change, drainage capacity is reduced, but this effect is temporary.

(1) In the process of pipeline excavation, if the excavated soil and rock can not be backfilled in time, rain will wash into the nearby water body and affect the water quality.

(2) If the construction materials are not well managed, they will be washed into the nearby water body by rainwater, which will affect the water area.

(3) If the construction waste slag and the domestic garbage of the construction personnel are not handled properly, they will be piled up at will and washed into the nearby water body by rainwater, which will affect the water quality.

Through the above analysis, through the construction of waste slag, construction personnel proper disposal of domestic garbage ; Strict management of construction material stacking, timely filling and excavation stone ; To strengthen the construction management of river crossing, the degree of water environmental impact in the process of construction has been reduced to a minimum.

8.3.2Impact evaluation of project construction on sensitive targets of surface water

The main sensitive targets of surface water for the project are: main canal of Langdang (supporting project of Hebei Province), main canal of Tianjin (middle line of the South-to-North Water Transfer Project), Hongdai River (Yellow River and South-to-North Water Transfer Project), south canal (main channel of the Yellow River Diversion Project), Tianjin permanent protection ecological region (Duliu River Reduction, Daqinghe River, Ziya River and so on), ecological red line of Hebei Province (Yongding River and Alkali River). The construction method of directional drilling and jacking pipe is mainly adopted, and its crossing mode is shown in the following table.

Table 8.3-1 Passage modes for main surface water sensitive targets

Area along the line	River name	Water width	Traverse length	Water quality target	Water body function	Traversing mode	Alternate note
Day Jin City	Single flow river reduction 1	200	650	IV	Agricultural water	Directional drill	Tianjin permanent protection ecological region
	Duliujian river 2	400	730	IV	Agricultural water	Directional drill	
	Daqinghe River	60	735	III	Agricultural water	Directional drill	
	Ziya River	36	600	III	Drinking, agriculture	Directional drill	
	South Canal	20	1600	III	Drinking, agriculture, industry	Directional drill	
	Hongmud River	26	600	III		Directional drill	
	Tianjin Main Canal in the Middle Route of South-to-North Water Transfer	/	600	II	Drinking	Directional drill	South-to-North water Transfer
Hebei Province	Yongding River	45	928	IV	A.	Directional drill	Ecological Red Line Region of Hebei Province
	Alkali river	20	552	IV	A.	Directional drill	
	Corridor main canal of middle route of South-to-North Water Transfer	/	600	II	Drinking	Directional drill	South-to-North water Transfer

According to the analysis of the influence of directional drilling on surface water environment in the preceding chapter, the project passes through the sensitive area of surface water environment by directional drilling, and the distance between the entry point and the riverbank is more than 200 m. The influence on water quality and ecosystem is very small, and the environmental impact is acceptable.

8.4 Evaluation of Land Ecological Impact during Construction Period

8.4.1Prediction and Analysis of Land Use Impact

By using GIS technology, the land use type data of the main project of the proposed pipeline are superimposed with the land use status map drawn by the remote sensing survey.

8.4.1.1 Engineering footprint type

The types of land use occupied by the main works within 12 m of each side of the pipeline are shown in the table below.

Table 8.4-1 Statistics of Occupancy and Disturbance for Construction Scope (12m on both sides)

Footprint type	Temporary footprint HM2	Permanent footprint (HM2)		
		Station yard	Valve chamber	Three pile
Cultivated land	436.57	9.21	1.68	0.60
Forest land	22.65	0	0	0
Grassland	10.57	0	0	0
Waters	42.63	0	0	0
Urban and rural areas, industrial and mining, residents and other construction land	31.75	0	0	0
Unused land	5.43	0	0	0
Total	549.60	9.21	1.68	0.60

As can be seen from the table, the permanent floor area of the main project of the proposed pipeline is about 11.49 hm2.

The temporary occupation and disturbance area of pipeline works is about 549.6 hm2. In the disturbed area, the disturbed area of pipeline construction is about 436.57 hm2, which accounts for 79. 44% of the disturbed area. The disturbed area of water area and water conservancy facilities is 42.63 Hm2, accounting for 7. 76% of the temporary disturbed area of pipeline ; The disturbed area of forest land is about 22.65 hm2, which accounts for 4. 12% of the temporary disturbed area of pipeline. The disturbance area of other land use types is smaller.

8.4.1.2 Permanent Occupancy Impact Analysis

The proposed project will occupy 100% of the total land area under permanent occupation.

The largest permanent floor area is the station yard, followed by the valve room, because the permanent occupation of the facilities required by the project is scattered along the area, each project units occupy a smaller area, and distributed along the line. Therefore, the permanent occupation of the main pipeline works in this section has little impact on the existing land use situation along the line.

In the design of the project, the route direction is effectively connected with the local land use master plan, so as to minimize the impact on the land use master plan and realize the economical and intensive use of land. The land area of each project unit shall be designed in accordance with the provisions of the Land Use Indicators for Petroleum and Natural Gas Projects (No. 7) and the Land Self-Stopping Letter (2013) No. 378 from the Office of the Ministry of Land and Resources (2013).

The cultivated land occupied by the project shall strictly implement the state provisions on compensation for the occupied farmland and temporary land reclamation. The occupation of cultivated land shall be supplemented by the method of paying the land reclamation fee and entrusting the reclamation according to the principle of " taking up one and making up one " and the prescribed standards of the province where the pipeline is located ; Temporary land shall be reclaimed in time after completion of construction. In the process of project implementation, the spirit of relevant land requisition compensation documents of the state and the province where the pipeline is located shall be strictly implemented, compensation fees for land requisition shall be paid in accordance with the provincial government is prescribed standards, and the legitimate rights and interests of the peasants who have been expropriated shall be effectively safeguarded.

The cost of land reclamation, land reclamation funds and compensation for land requisition have been fully included in the project budget estimates.

Before the construction, the local procedures for compensation for land requisition and their costs shall be carried out carefully, and the balance of land occupation and compensation in the disturbed areas along the project shall be solved with the local government ; At the same time, the environmental protection measures contained in this report will be implemented during construction and operation to minimize the impact of permanent works occupation on land use along the route.

In the early stage of the project, the pre-assessment of land has been carried out, and the land use indicators and the balance plan of land use have been reported to the Land Resources Department of the provinces and autonomous regions.

8.4.1.3 Impact Analysis of Temporary Occupancy

In the process of pipeline and station construction, the construction service road, material field, crossing the project construction site and pipeline construction operation zone temporarily occupy the land, generally only in the construction phase causes the temporary change of land use along the line, most of the land used in a short period after the completion of construction (1-2 years) can restore the original use function.

1) Construction work area

Most of the temporary land occupied by the pipeline project is in the process of the pipeline excavation and burying, because the pipeline construction is carried out in sections and the construction time is short, each section of the pipeline from construction to soil re-covering is about three months, after the completion of the pipeline laying, most of the land use in this section can be restored to the original use state.

Because the near side of the pipeline (about 5000000) can no longer plant deep root plants, in general, this area can plant the herb with underdeveloped root system to improve the landscape and prevent soil erosion, so the temporary land occupation of the pipeline will have a greater impact on the forest land, occupying about 22.65 hm2 of the forest line, accounting for 4. 12% of the total temporary land area.

2) Materials stacking yard, construction site and construction access road

After the completion of construction, most of the material stacking sites and construction sites will restore their original land properties, and will not have a great impact on regional land use.

The pipeline construction service road belongs to the temporary project, after the completion of construction, most of the original land use property can be restored, part of the construction service road will be maintained as a rural road or pipeline maintenance convenience, although the original land use property has been changed, but because the retained construction service road is less, will not have a greater impact on regional land use.

The construction service road is usually arranged according to the specific construction section, each section covers an area of 30-45 days, the construction service road is mainly based on the existing county and township roads, and the newly-built roads are basically within 7 meters on both sides of the pipeline, which covers an area as shown in the main project occupation type table of each section. During the construction period, the crops in the construction area will be removed and shoveled, and the construction service road will be compacted ; After the completion of construction, the cultivated land occupied by the construction service road can be restored to its original planting. The main impacts of construction service road on the ecological environment along the road during construction period are :

1) Temporary land occupation will destroy the surface vegetation crops, which will reduce the crop season ;

2) During the process of construction, the compaction of vehicles increases the compactness of the soil in the land area, which is disadvantageous to the development and growth of crop root system after the land retillage.

3) In the dry weather, the vehicle drifts dust, so that both sides of the road surface cover of crops dust, light and role of the reduced, affecting the growth of crops ; Rain weather, construction vehicles in and out of the construction site, the dirt on the construction pavement will affect the road surface cleaning, dry will produce dust pollution ;

4) The construction of the construction service road of the river crossing section will destroy the vegetation of the embankment or the grass outside the dike. Due to the poor soil quality, it is difficult to recover vegetation after vegetation destruction in a short time . After the completion of construction, the necessary artificial vegetation restoration and tending measures should be implemented in such important areas as river embankment.

In short, temporary works will affect the use of land along the short-term, after the completion of construction, with the implementation of ecological compensation or ecological restoration measures, the impact will gradually decrease or disappear.

8.4.2Prediction and Analysis of Vegetation Impact

The influence of pipeline construction on vegetation mainly has two aspects: direct impact and indirect impact, which are construction occupation, destruction of human activities, pollution of three wastes, etc. The indirect effect is the change of soil and groundwater environment caused by construction activities, which results in soil erosion and desertification, and indirectly affects the growth of plants.

8.4.2.1 Analysis on the effect of engineering land occupation on vegetation

In the process of pipeline construction, the excavation ditch area will turn out the subsoil, so that the soil structure almost completely changes. Vegetation in the excavation area was destroyed, and vegetation on both sides of the pipeline was damaged and affected to varying degrees.

In the area of 2.5 m on both sides of the canal ditch, the vegetation will be seriously damaged, the original vegetation components will disappear and the root system of the plant will be completely destroyed. In the range of 2.5-5000000 on both sides of the ditch, vegetation damage is more serious due to the rolling, trampling and stacking of various mechanical, vehicle and personnel activities in excavation construction. In the range of 5-7000000 on both sides of the ditch, the degree of vegetation damage is relatively low due to less mechanical, vehicle and personnel activities.

The main distribution of forest resources along the pipeline is artificial forest land, during the construction will lead to a certain number of artificial forest destroyed. Although there will be no serious soil erosion during this period, more obvious corridors may be formed from the landscape.

According to the distribution of the damaged plantation, the total number of patches and the average area are relatively small, so the corridor formed by the pipeline crossing through each patch will not have obvious effect on the artificial forest ecosystem in the region, and the influence scope is limited to the construction area.

8.4.2.2 Biomass loss caused by floor space during construction period

By using GIS technology, the operation zone and vegetation type map of pipeline construction are superimposed and treated.

1) Influence of Pipeline Construction Zone on Vegetation

According to the statistics of vegetation damage along the pipeline, the area of vegetation disturbed and destroyed along the pipeline is 180.35 hm2. From the view of biomass loss, pipeline construction will result in one-time biomass loss of 1236.09 t, permanent biomass loss of about 157.86 t/a. See the table below.

Considering that the forest belts in this area are soon covered by shallow root plants, the biomass is greatly reduced than before, but the overall impact on regional ecological environment is not great.

Table 8.4-2 Statistics of vegetation damage in construction area (12 m on both sides)

Vegetation type	Area HM2	Average biomass T/hm2	One-time loss amount T)	Permanent loss T/A
Artificial poplar forest	412.85	52	21468.42	4472.59
Wheat + cotton as main crop	24.14	4.96	119.75	A.
Apple-dominated fruit tree forest	2.55	17.78	45.37	9.45
Mossy grass	7.33	0.15	1.10	A.
Reed wetland meadow	2.22	2.96	6.58	A.
Other Regions	100.50			
Total	549.60	A.	21641.23	4482.04

Note: Crop and forest biomass such as wheat is derived from China Statistical Yearbook 2014 ; Reed biomass from such people as Jia Qingyu research reed ; The temporary occupied and disturbed area of pipeline construction is 12 m on each side of the pipeline.

2) Impacts of ancillary works on vegetation

The ancillary works of this section of pipeline are the construction of station yard and valve chamber . There are 6 stations and 10 valve chambers along the pipeline.

The loss of vegetation area 11.46 hm2 and loss of biomass 56.84 t were caused by the permanent occupation of the pipeline. Because they are permanent, the loss of vegetation is relatively large ; Because the vegetation can not be recovered in the building-covered area, the loss should be reasonable and suitable for the surrounding vegetation greening of the ancillary facilities after the completion of the construction, so as to compensate for the permanent loss caused by land occupation.

8.4.2.3 Analysis on the Influence of Construction Pollutant Discharge on Vegetation

According to the engineering analysis, the pollution during the construction of the project mainly comes from dust, waste gas from various machinery and vehicles, production and domestic sewage discharged during the construction process, and solid waste such as production and domestic waste.

1) Effects of fugitive dust and waste gas on vegetation

The dust and waste gas in the development and construction of the project is one of the factors that affect the growth of the vegetation, and the effect of dust is the main factor. The dust accumulated on the plant surface is in the form of dry dust and mud film, which results in the obstruction of stomata on the plant surface, resulting in the decrease of gas exchange, the increase of leaf temperature, the decrease of photosynthesis, the yellowing and drying of leaves, and the production of plant dry matter is affected.

In general, the long-term settlement of the particles with low concentration in a large range does not adversely affect the natural ecosystem . Only when the settling rate of the particles is very high will it cause ecological problems. The area passed by the project is mainly located in the plain area, with good diffusion conditions and abundant rainfall, which is conducive to the scouring and settling of atmospheric particles. Due to the short construction time and dispersed construction site in the pipeline construction, the dust concentration is low and the duration is short.

2) Effect of construction wastewater on vegetation

During the whole operation period of pipeline construction, domestic sewage is produced, and most of the construction camps rely mainly on local houses, which will not be scattered ; Due to the short operation period and the dispersed construction personnel in each section, the production of less, will not have a bad impact.

3) Effects of construction wastes on vegetation

In pipeline engineering, pipeline corrosion prevention is an indispensable important process and the main protection measures to prevent accidents. In the construction site of pipeline anticorrosion treatment, inevitably some anti-corrosion materials scattered in the environment, soil and vegetation have a certain impact. Construction wastes and household wastes such as plastic bags and mineral water bottles will cause white pollution and affect soil . In the windy season, plastic bags will be blown on plants, not only affect the landscape, but also affect plant growth. As long as the construction process management and the environmental publicity and education of the construction personnel are strengthened, this effect can be eliminated, so as to minimize or even not.

8.4.2.4 Effect of Construction Personnel Activities on Vegetation

The man-made activities mentioned here refer to the disturbance and destruction of the surface soil and natural vegetation in the desert area, the disturbance and destruction of the fragile arid desert ecosystem due to the obvious increase of human activities, the disturbance and destruction of the surface soil and natural vegetation in the desert area and the marginal area, the level of primary productivity and the increase of soil and water loss. Therefore, the disturbance scope should be minimized during the construction process, the original soil environment and vegetation should be protected, unnecessary ecological damage and disturbance should be avoided and local desertification should be induced.

8.4.3Impact Analysis on Agriculture, Forestry and Animal Husbandry

8.4.3.1 Impact on agriculture

1) Impact Analysis of Occupying Basic Farmland

The cultivated land occupied by the project along the pipeline is mainly irrigated land . The protection rate of the basic farmland along the pipeline is 87% . The total area of basic farmland temporarily occupied is about 478.15 hm2.

According to Article 15 of the Regulations on the Protection of Basic Farmland, " After the basic farmland protection zones have been demarcated according to law, no unit or individual may change or occupy them. The site selection of key construction projects such as national energy, transportation, water conservancy and military facilities cannot avoid the basic farmland protection zones . Those who need to occupy the basic farmland, involving the conversion of agricultural land or the requisition of land, must obtain the approval of the State Council . "

Article 16 " Where the basic farmland is occupied with the approval of the State Council, the local people's government shall revise the general plan for land use in accordance with the approval documents of the State Council and add the same amount and quality to the basic farmland. The occupying unit shall, in accordance with the principles of occupation and reclamation, be responsible for the reclamation of arable land equal to the quantity and quality of the basic farmland occupied ; If the cultivated land that is not subject to conditions for reclamation or reclamation does not meet the requirements, the cultivated land reclamation fee shall be paid in accordance with the provisions of the provinces, autonomous regions and municipalities directly under the Central Government.

The units occupying the basic farmland for the proposed project shall, in accordance with the requirements of the local people's governments at or above the county level, use the soil of the basic farmland cultivation layer occupied for the soil improvement of newly reclaimed land, inferior land or other cultivated land.

Since the construction unit and the design unit have considered the compensation fee for the land requisition for the permanent project, it can be concluded that the permanent project will have a relatively small impact on the environment of the basic farmland along the line under the precondition of solving the coordination work of local basic farmland.

2) Impact Analysis on Agricultural Production

During the pipeline construction, including the station yard construction, the gas pipeline construction and the construction of the service road construction period, the current season can not plant crops, and will destroy the construction of existing crops on the ground, these will cause some economic losses. Maintenance of pipelines will also affect agricultural income.

For permanent occupation, crop productivity on these lands will be permanently lost during pipeline service due to changes in the nature of the original land and use.

During the normal operation of the pipeline, there is little effect on agricultural production. However, because deep root crops can not be planted within 5 meters on both sides of the pipeline, there will be some loss to areas that were originally economic crops with deep roots. For permanent land use, changes in the original land use function will have a certain impact on agricultural production.

During the decommissioning period, the impact on agricultural production is gradually reduced, and the full restoration of crops and other fruit trees will take about 2-3 years.

According to the preliminary calculation, the area of crop loss caused by this pipeline project is about 38.15 hm2, among which the irrigated crops mainly consist of wheat and cotton, and the remaining fruit trees mainly consist of apples. The economic loss of crops caused by the project construction was about 555600 yuan, of which 236900 yuan was lost.

Table 8.4-3 Statistics of loss from pipeline to agricultural production

Loss type	Crop loss area HM2	Crop yield T/hm2	Unit output value of crops Million yuan/ton	Total loss value of crops Ten Thousand Yuan
Disposable	24.14	4.96	0.14	16.76
Permanent	9.97	4.96	0.14	6.92
Subtotal	34.11	A.	A.	23.69
Loss type	Area lost from fruit tree (HM2)	Unit yield of fruit (kg/hm2)	Fruit unit output value Yuan/kg	Total fruit loss Ten Thousand Yuan
Disposable	A.	16784.12	4.7	A.
Permanent	4.04	16784.12	4.7	31.87
Subtotal	4.04	16784.12	4.7	31.87
Total	38.15	A.	A.	55.56

Note: Data on unit yield and unit output value of crops and fruit trees are derived from China Statistical Yearbook 2014.

8.4.3.2 Impact on forestry

When pipeline passes through forest land, the width of construction operation zone should be controlled to reduce the loss of forest land resources ; At the end of construction, deep-rooted plants or crops will not be able to be planted along the road or in the proximal area, and the disturbed areas outside this area will be able to restore their original land use functions in the short term. The loss of biomass can be compensated to some extent by the corresponding measures of vegetation restoration after the pipeline is covered with soil.

According to statistics, the total area of forest land resource occupied by pipeline is about 412.85 hm2, and according to the average forest accumulation of 79 m3/hm2 in the whole country, the forest loss caused by pipeline construction is 32615 m3.

In addition, because deep root plants are forbidden to be planted within 5 meters on both sides of the pipeline, the loss of forest land caused by pipeline construction will suffer some losses during the operation period besides the construction period.

8.4.4Analysis of Effects on Wild Animals

During the construction period, the excavation, rolling and trampling of the ditch and roadbed will damage the vegetation resources of the ground to different degrees, which will lead to the destruction of the animal habitat, and the noise from the construction operation will frighten the wild animals and force them to move to the new environment ; Temporary occupation of construction camp and stacker yard, permanent occupation of valve room, station yard, marking pile etc. will result in some loss of wildlife habitat.

Table 8.4-4 Effects of works on wildlife

Animal group	Mode of influence
Amphibian	Water pollution, habitat destruction, rolling of vehicles during construction
Creeping class	The killing and killing of construction personnel, the change of food source migration, water pollution, habitat destruction, the rolling of vehicles during construction.
Birds	The influence of construction lighting, noise alarm, habitat destruction, air pollution, killing and killing of construction personnel, changes of food source migration.
Beast	Threat of construction vehicles, noise alarm, habitat destruction, air pollution, killing and killing of construction personnel, changes in food source migration.

8.4.4.1 Analysis of Effects on Amphibious and Reptile Animals

Amphibians mainly distributed in the evaluation of freshwater waters (rivers, ponds, lakes, reservoirs) near the main species: Bufo dorsalis, Chinese Toads, and so on.

The reptiles in the evaluation area mainly include webless gecko, yellow ridge snake, red chain snake, grassland sand lizard, mountain lizard, lizards, etc.

During the construction of the project, the site cleaning and leveling, the excavation and backfilling of pipes and ditches, the installation and construction of large mechanical equipment, and the transportation and stacking of pipes will have a certain impact on amphibians and reptiles in the construction area. However, due to the amphibian and reptile species are the most common species in the evaluation area, although the construction has some influence on the individual body, it will not have obvious influence on the whole population category and quantity.

With the end of the construction period, vegetation restoration and habitat restoration will gradually restore their habitat, so there will be no obvious impact on amphibians and reptiles.

8.4.4.2 Analysis of Effects on Birds and Animals

The species and quantity of birds are the most in the vicinity of the wetland nature reserves such as Beidagang Wetland Nature Reserve, Tianjin Ancient Coast and Wetland Nature Reserve within 5 km of the pipeline. State II key conservation animals: white spoonbills, big swans, small swans, warthog swans, hawkshawk, bromehawk, pine sparrow hawk, brown tail hawk, big bird, hairy foot, vulture, white tail roller, swimming red falcon, demoiselle crane, needle tail sand cone, carved owl, longitudinal grain small owl, long-eared owl, long-eared owl, short-eared owl, etc. Many others are common. Birds of prey nest on trees or rocks far away from disturbance, birds nest in the bush, ducks and chickens reproduce on the ground, during the construction of the project birds are easy to choose an unaffected suitable habitat to survive and settle.

The influence of pipeline construction activities on birds is mainly manifested in the following aspects :

1) In the process of construction, when the pipeline passes through the forest land, the construction site will form the interference corridor in the forest land, which will affect the migration and foraging of wild animals, and the noise of construction will affect the habitat of wild animals, especially the blasting of tunnel construction, which will cause a certain degree of terror to the birds living nearby, during the blasting birds will flee the construction site and fly to the surrounding hidden safety area. Such as construction at night, lighting will also affect the habitat of birds, even affect the migration of migratory birds ; Stacked domestic waste and waste also have an impact on the survival of wild birds.

2) During the construction of the project, the possible killing of wild birds by the construction personnel will affect the species and quantity of birds and even the existence of rare wild animals.

3) During the construction period, the breeding season of wild birds will affect the reproduction of wild birds. However, construction period is usually only 2-4 months, as long as the management is strengthened, the impact of the project on birds is controlled.

Therefore, the project construction should choose the appropriate construction period, construction site, avoid the migration of birds, migration routes and rest places, to reduce the impact on birds.

8.4.4.3 Analysis of Effects on Mammals

The vegetation types in the evaluation area are relatively simple, and the distribution of vegetation is different in different areas . The animals in the evaluation area are mostly small mammals . Rodents (chipmunk, rock squirrel, Daur yellow mouse, Chinese zokor, etc.), carnivores (mongoose, skunk, mongoose, civet, dog badger, pig badger, etc.) and rabbit orders (monkshoals, etc. This kind of animals adapt to many habitats, the adaptability to environmental changes is strong, can avoid the construction disturbance area, so the construction has less impact on it. The barrier of construction section may cause some animals to lose the passage of migration for a while, but the current situation investigation does not find that there is an important animal passage in the evaluation area, and the pipeline relies on the existing road, human interference always exists ; At the same time, pipeline construction is generally carried out in sections, construction activities will indeed cause damage to animal habitats in the construction area, damage to natural vegetation in the construction area, and some wild animals will lose a small amount of foraging, habitat and activity area, but because the construction area of the entire ecosystem is not a large proportion, and in a certain construction section, generally only 1-3 months, construction can gradually return to normal, so, the pipeline construction will not affect the survival and population of mammals in the evaluation range.

In the course of construction, the publicity and education of the construction personnel should be strengthened to prevent the occurrence of such phenomena as indiscriminate hunting and so on, so as not to affect the population of some wild animals.

8.4.4.4 Analysis on the impact of rare and endangered animals

The pipeline passes along the area which has the national level key protection wildlife, mainly distributes in the nature reserve core area and the buffer zone, as follows :

Beidagang wetland is a relay station on the migratory route of East Asian birds, where a large number of waterfowl migrate and multiply each year. Among them, there are 6 kinds of birds which belong to Grade I protection of the country, namely, Oriental White Stork, Black Stork, Red-crowned Crane, White Crane, Great bustard, Flock ; There are 17 species of protected birds of Class II of the country, including cormorant, swan, swan, white goose, grey crane, white pillow crane, demoiselle crane, red falcon, red foot falcon, white belly roller, white tail roller, sparrow hawk, general wilting, big yan, short ear etc. Most of the above bird species are migratory birds, spring and autumn migration two seasons each year, stay in the Beidaigang wetland.

The pipeline is far from its core area, the nearest distance to its buffer is about 110 m, and the nearest distance to its experimental area is about 70 m. If the construction period is during the migration and residence of birds in spring and autumn, the noise of construction affects the habitat of wild animals. Most birds are alert and timid, hearing and vision are very developed, good at running or soaring, can avoid the construction activity area, so construction activities on the nature reserve of birds less impact. During construction period, construction personnel should be prevented from indiscriminate hunting and other acts, in addition, the construction period should avoid birds migration stay in the spring (April-May) autumn (September-November) two seasons.

8.4.5Impact Analysis on Soil Environment

The influence of this project on soil is mainly caused by the construction of pipeline, valve chamber and station on soil pressure and disturbance.

In the early stage of exploration, the footprint of exploration personnel and the pressure of exploration equipment are small. During the construction stage of valve chamber and station yard, if the site is flat on site, the filling and excavation of soil are concentrated in the interior of the construction site and have little influence on the exterior of the site.

From the land occupation situation, except the valve room, station yard for permanent land requisition, most other temporary land occupation, temporary land occupation in 2-3 years after the end of the project can restore its original use function. However, due to the rolling of heavy construction machinery, trampling of construction personnel and disturbance of soil mass, the physical and chemical properties and fertility level of cultivated soil or natural soil along the construction line are affected and the surface vegetation restoration is further affected. This effect is expected to last for 2-3 years and will gradually disappear over time, eventually bringing the yield and quality of crops back to their original levels. These are as follows :

1) Disturb the soil layer and destroy the soil structure

Soil structure is formed after a long period of history . Excavation and backfilling of pipes and ditches will destroy soil structure. In particular, the aggregate structure in the soil, once destroyed, must take a long time to recover, the impact on the farmland soil is greater, the farmland soil tillage layer is to ensure the agricultural production foundation, the depth is generally 15 cm-25 cm, is the crop root system growth and the developed level. In addition to the direct damage to the excavated part of the pipeline, the excavation and stacking of the two sides will destroy the farmland, and the mixing and disturbance of the soil will also change the nature of the original farmland layer. Therefore, in the whole construction process, the impact on the soil tillage layer is the most serious.

2) Mixing soil layers and changing soil texture

Soil texture varies greatly from topography to soil formation conditions, and even if the same soil profile is the same, the surface soil texture is different from that of the bottom layer. The excavation and backfilling of the gas transmission pipeline must mix the original soil layer, reduce the soil water storage and fertilizer conservation capacity, easy to be affected by wind erosion, thus affecting the soil development, vegetation restoration ; In the farmland area, it will reduce the tillage performance of the soil, affect the growth of crops, and lead to the decline of crop production.

3) Affecting soil nutrients

Soil configuration is the combination of soil layers in soil profile. The characteristics and physical and chemical properties of different soil layers differ greatly. As far as nutrients are concerned, the topsoil layer is far better than the core soil layer, and its organic, total nitrogen, available phosphorus and potassium contents are high, the compactness and porosity are moderate, and the cultivability is strong. The construction will inevitably disturb the original soil configuration, which will affect the soil nutrient status, and seriously deteriorate the soil properties, and affect the vegetation on it, even difficult to recover.

According to the statistics, the influence of pipeline engineering on soil nutrients is closely related to soil physical and chemical properties. Under the measures of layered stacking and soil covering, the organic matter in soil will be reduced by 30-40% , soil nutrients by 30- 50% , and total nitrogen will be reduced by 43% , phosphorus by 40% and potassium by 43% . This indicates that the pipeline engineering has obvious influence on soil nutrients even when the protective measures such as layered stacking and layered soil covering are carried out in the pipeline construction process . In fact, it is difficult to ensure strictly the layered soil stacking and layered soil covering in the pipeline construction process, so the effect of pipeline construction on soil nutrients is more obvious, and the land biomass production is reduced.

4) Influence of soil compactness

The backfill after pipeline laying is difficult to restore the original soil compactness, mechanical compaction during construction, personnel trampling and so on will affect the soil compactness. Soil layer is too loose, easy to cause soil erosion, soil is too tight, and will affect crop growth.

5) Soil pollution

During the construction process, construction waste, domestic waste, welding slag, waste coating and other wastes will be produced. These solid wastes may contain substances that are difficult to break down and, if not properly managed, backfill will affect soil quality. In farmland, soil tillage and crop growth will be affected. In addition, during the construction process, the fuel leakage of all kinds of machinery and equipment may also affect the soil along the line.

With the completion of construction, soil quality will be gradually restored by taking certain measures. The influence of pipeline on soil during operation and decommissioning is small.

In summary, the pipeline changes the soil structure and soil nutrient status, but through some measures, soil quality will be gradually restored.

8.4.6Prediction and Analysis of Soil Erosion

8.4.6.1 Analysis of Soil Erosion Factors

The soil erosion of the proposed pipeline project mainly occurred during the construction period. The excavation of the pipe ditch, the formation of the construction service road, the leveling and hardening of the valve chamber in the station yard will destroy the original relatively stable geomorphology, make the soil structure loose, lose the surface vegetation in the working area, produce some bare ground, induce or aggravate the damage of soil erosion ; Crossing rivers, railways and highway pipelines will produce mud or spoil soil and increase soil erosion.

In general, the influence of soil erosion during construction period will be basically eliminated after construction. After surface restoration during the operation period, new soil erosion will not occur as long as the corresponding soil and water conservation measures are strictly implemented.

8.4.6.2 Soil erosion prediction method

1) Forecast Period

The construction of the proposed pipeline is carried out in sections, and the construction period of each section of the pipeline is relatively short. The soil and water loss period of this project is divided into construction period and operation period . The soil and water loss of pipeline construction is mainly concentrated in construction period. The forest land occupied can restore shallow root plants near the pipeline, and other areas can be planted. Therefore, the prediction period of soil and water loss in this evaluation varies according to the duration of disturbance of different construction projects . Within each municipal government area, the excavation of the pipe trench and the smooth construction of the construction road shall be about 2 months, and the construction disturbance time of the valve room in the station yard shall be about 1 month.

2) Erosion modulus

Based on the analysis results of climatic and soil characteristics, engineering disturbance mode and soil erosion status in the area along the line, and referring to the environmental impact assessment codes and relevant research results of the relevant projects, this project presents the possible values of soil erosion modulus for different construction contents, such as pipe trench excavation, cross-river gully flushing, construction service road construction and so on.

8.4.6.3 Soil erosion prediction results

Based on the above engineering disturbance area, disturbance time and erosion modulus, the soil erosion amount during construction period is calculated, mainly hydraulic erosion. Because the pipe trench excavation and construction service road construction in the pipeline construction content are calculated according to each side of the pipeline 12m operating band range.

During the construction of the whole project, the disturbed soil area was 549.6hm2. Under the premise of not taking any soil and water conservation measures, the erosion amount was 18415.5t, and the new erosion amount was 16354.86t compared with the soil erosion before the disturbance. The newly added amount accounts for the pipeline evaluation. The total amount of erosion in the district is 19.4% of the 500m on both sides of the pipeline. Combined with the construction method, degree and scope of the construction, the above-mentioned soil erosion mainly occurs in the disturbed construction area along the construction of the project. For the area along the line, the amount of new soil erosion is not large.

Table 8.4-5 Statistics of soil erosion during construction period

Construction content	Disturbance area HM2	Erosion modulus T/km2.a	Duration Month (s)	Amount of erosion T)	Increased erosion T)
Trench excavation	549.6	2000	2	18320	16306
Station yard and valve chamber construction	11.46	1000	1	95.5	49.8
Total	561.06	/	/	18415.5	16354.86

8.5 Analysis and Evaluation of Groundwater Environmental Impact during Construction Period

8.5.1Analysis and Evaluation of Groundwater Environmental Impact on General Pipeline

During the laying process, the depth of excavation determines the degree of influence on groundwater environment. Due to the small underground water depth in local area, pipe ditch construction may reveal groundwater, disturb shallow aquifer and increase the turbidity of groundwater, but due to the short construction time and the small impact of sediment, only a few meters in the vicinity of the pipeline, the impact on groundwater is minimal, and the pipeline construction can be resumed normal.

Domestic sewage of construction personnel: The domestic sewage produced by pipeline construction personnel is about 75 L/person • D, the main pollutants of construction domestic wastewater are COD, NH3-N and SS. In areas along the pipeline, construction camps may not be set up in densely populated areas where houses are rented nearby. Domestic sewage mainly depends on the local sewage treatment system during the construction period when renting houses ; Temporary dry latrines or mobile latrines shall be provided if construction camps are required, and domestic sewage and dung shall be used as farm manure after simple treatment by septic tanks. Therefore, the impact of domestic sewage on the groundwater environment along the construction period is small.

Construction wastewater: mainly includes construction machinery maintenance and washing wastewater, the main pollutants are COD, SS and petroleum. The resultant construction waste water shall be treated uniformly and shall not be discharged into the nearby ditch or urban sewage pipe network until it reaches the standard of inspection ; When the construction camp needs to be set up, the construction production unit shall set up sewage treatment facilities according to the corresponding environmental protection requirements, such as oil separation pools, collect the wastewater for centralized treatment, so as to prevent the production wastewater from directly discharging polluted groundwater without treatment. Therefore, the construction wastewater has little effect on groundwater.

Test pressure wastewater: clean water is usually used for test pressure water . The pollutants are mainly suspended substances . After test pressure is finished, the water is treated . After testing, it can be used for agricultural irrigation and road watering. Therefore, the effect of pressure test wastewater on groundwater is small.

8.5.2 Analysis and Evaluation of Groundwater Environmental Impact on River Crossing

The large and medium-sized water area of this project passes through 5 places, the accumulative crossing length is 3600 m. A total of 41 small cross, of which 2 are small directional drill through, 4 are top pipe through, the rest are large excavation through. The impact of each crossing mode on groundwater environment during construction is described below.

1) Directional drilling: Directional drilling is the process of drilling, reaming, clearing and so on by directional drilling machine, and then the pipeline is towed back,

so the river directional drilling is divided into four parts, namely the process of drilling guide hole, the process of pre-reaming hole, the process of pipeline backing and the process of geomorphic recovery after the completion of construction. Mud should be used to treat directional drilling . After drilling, the mud will return to the ground with the mud. The directional drilling construction of this project requires the use of compounding mud, its main component is bentonite, contains a small amount of Na_2CO_3, is weak alkalinity, the permeability of soil is poor, the mud can be reused in the process of construction, the remaining mud (about 40% of the total slurry) after the construction is pH adjusted to be neutral and collected as waste in the mud pit, which is acceptable by the local environmental protection department . after curing, the soil is buried in the impermeable slurry pool, covering 40 cm of tillage soil to ensure the original topography is restored.

When directional drilling construction, the pipeline burying depth is usually 20 m below the riverbed, and the minimum is not less than 6 m. During the construction process, the original groundwater flow field is changed slightly during the drilling process, because the groundwater level will not be reduced due to non-drainage. The pipeline is buried underground during the operation period, because the gas pipeline adopts the anticorrosion measures, it will not affect the groundwater under normal conditions ; In the case of accident, the gas overflow in the pipeline after the pipeline rupture will not affect the groundwater because the natural gas is insoluble in water and the density is smaller than air.

2) Large excavation crossing: This method is suitable for shallow river, small water flow, wide floodplain and not suitable for directional drilling across the river construction mode. The cofferdam shall be set up as required, and the water flow in the cofferdam shall be drained immediately after completion of the cofferdam. The method can make the surface water turbidity and increase the sediment content in the cofferdam water drainage stage and the cofferdam dismantlement stage when crossing the river, but because the groundwater usually exists in the pores and fissures, it has a certain filtering and adsorption effect on the sediment, so it has little effect on the water quality of sensitive targets of the downstream groundwater. The method of cofferdam diversion excavation will increase the groundwater recharge on both sides of the diversion channel, increase the groundwater level on both sides of the channel to a certain extent.

8.5.3Analysis and Evaluation of Groundwater Environmental Impact in Gas Transmission Station

This project has 7 process stations. The influence of construction period on groundwater mainly shows that construction waste water or domestic sewage which is not treated during construction period has an effect on groundwater quality under the condition of accident. The groundwater depth in the station area is deeper. In the case of accident, the construction wastewater or domestic sewage will be adsorbed and filtered by particles in the process of permeability through the air-entrapped zone. In the process of construction, the discharge of construction waste water can be strictly controlled to reduce or prevent the impact of construction on groundwater.

The influence of station construction on groundwater is relatively small.

8.6 Analysis of Soil Environmental Impact during Construction Period

(1) Effect of Site Land Smoothness on Soil

During the construction period, the soil around the working area will be severely compacted due to mechanical rolling and trampled by the construction personnel, the topsoil in some construction areas will be removed, and the topsoil in other areas may be filled, so that the soil topsoil after the completion of the construction will lack the fertility of the original soil and is not conducive to plant growth and vegetation restoration.

The construction of road system and buildings will increase a lot of impermeable ground, which will have some influence on local hydrological and meteorological factors. The construction of the project will inevitably result in a certain range of vegetation damage, excavation of earthwork so that the surface exposed, very easy to cause soil erosion or wind erosion.

The disturbance of soil layer caused by construction changes soil structure and density. The destruction of vegetation will increase the absorption of solar energy from bare surface and change the reflectivity of solar energy, which will result in the change of ground heat balance in the construction affected area.

(2) Effect of Pipeline Construction on Soil Environment

The influence of pipeline construction on soil environment is the part of burying ground, which needs to dig and fill the surface soil . The effects on soil environment are as follows :

1) Local destruction of soil structure

The formation of soil structure takes a long time . Soil structure is an important index of soil quality, especially the aggregate structure is an important index of soil quality . The higher the proportion of the aggregate structure, the better the soil quality, once the aggregate structure is destroyed, the longer it takes to recover, and the more difficult. In the process of construction, the excavation and filling of the land can easily destroy the granular structure and interfere with the natural forming process of the granular structure. During the construction process, mechanical rolling and human trampling will have bad effects on soil structure.

2) Partially destroy the soil layer and change the soil texture

In the process of soil formation, the soil surface layer is humus layer, the middle layer is eluvial deposit layer and the bottom layer is soil parent layer. In the process of pipeline excavation and backfilling, disturbance and destruction will occur to the original layer of soil, which will cause mixing of different layers and different texture of soil, especially after the mixed layer of soil will affect the growth and yield of crops.

3) A certain influence on the soil compactness of excavation zone

In the construction machinery operation, the rolling of the mechanical equipment and the trampling of the construction personnel increase the compaction degree of the soil and affect the water circulation in the soil in a short time.

4) Loss of soil nutrients in excavated areas

In the soil profile, the soil surface layer (humus layer, tillage layer) is much better than the core soil layer in terms of nutrient status. The construction work disturbed the original soil structure, changed the soil properties, affected the soil nutrient status, and affected the plant growth.

According to the relevant data at home and abroad, the influence of pipeline project on soil nutrients is closely related to the physical and chemical properties of soil itself and the construction operation mode. Under the measures of layered soil stacking and layered soil covering, the soil organic matter decreased by 30% ~ 40% , soil nutrient decreased by 30% ~ 50% , and total nitrogen decreased by about 43% , phosphorus decreased by 40% and potassium decreased by 43% . Therefore, in practical operation, it is necessary to strengthen the construction management and requirements of the construction team to carry out layered stacking and layered covering of the excavated surface soil to avoid the loss of various nutrients in the soil.

5) Effects of Construction Waste on Soil Environment

The waste materials in pipeline construction are the waste of the process such as heat preservation and corrosion protection. If these solid wastes are not cleared and transported in time, they may remain in the soil, which will affect the soil cultivation and the growth of crops in the recovery period. Therefore, the construction requirements should be strictly regulated, the solid waste during construction period must be cleared and transported after completion of construction.

6) Effects on soil organisms

Because of the physical and chemical properties of the soil and the changes of the soil configuration, the habitats of microorganisms, protozoa and other arthropods, annelids and mollusks in the soil are changed. The ecological balance of soil organisms will be restored soon after the completion of the construction because the influence width of the construction zone is 26~34000000 and the whole evaluation area is banded.

In short, the construction of the pipeline project has changed the environmental conditions of the soil and will eventually affect the restoration of surface vegetation, especially the production of crops, resulting in lower yields.

8.7 Effect Analysis of Solid Waste during Construction Period

Solid waste sources during the construction of the project's send-out pipeline: domestic waste generated by construction personnel, waste mud and construction waste, etc.

8.7.1Environmental Impact Analysis of Waste Mud

(I) Source of waste mud

The waste mud of this project comes from the directional drilling construction process. The mud used in directional drilling through construction has the properties of hole forming and hole protecting wall, which can clean up cuttings, transfer power, reduce drilling resistance and drag back. The pipeline crossing construction of this project produces 538.5 m3 of mud.

(II) Components of mud

The mud used in directional drilling mainly consists of bentonite and water, and some additives are added. Bentonite is a kind of natural and special clay with high expansibility and strong viscosity . It is non-toxic and pollution-free. It is adopted in the West-to-East Gas Pipeline Project and the East Sichuan Gas Pipeline Project.

(III) Mud preparation

1) Bentonite and water shall be compounded into aqueous slurry used in construction . A small amount of soda ash shall be added according to the water quality . The pH value of water shall be about 9.0 , and 2-3 kg additives shall be added in 1m3 water according to the soil conditions, construction pipe diameter and construction length.

2) A special mud allocation area shall be set up in the field to prepare the mud in a special mud mixing and compounding tank . The prepared mud shall be stored in a metal structure mud tank and shall not overflow into the environment.

3) In order to reduce environmental pollution and ensure the supply of mud effectively, a mud recovery and treatment system is installed at the construction site so that the mud can be reused.

(IV) Use and waste of mud

During drilling and reaming, cuttings and impurities are filtered out from the mud returned from drilling and can be reused. The mud consumption is the biggest in the process of pipeline tow back, the whole drilling hole should be filled with mud before tow back . In the first half of the pipeline tow back process, the pipeline gradually enters the hole and is squeezed by the pipeline. Therefore, before the pipeline can be towed back, the abandoned mud pits should be excavated and seepage-proof measures should be taken to prepare the abandoned mud.

After the pipeline is successfully towed back, the waste mud will flow into the pre-excavated abandoned mud pit and the backhaul channel . The residual mud will not be recovered and reused after the completion of construction . After the approval of the local environmental protection department, the amount of dry mud will be less after the solidification treatment. Waste slurries are required to be outside the protected area and their location is subject to the consent of local environmental authorities.

(V) Environmental Impact Analysis of Waste Mud

1) Test results of waste mud leachate

a. Source of Waste Mud Analysis Sample

The analysis sample is taken from the waste slurry pool of directional drilling construction site of Sichuan Gas East Pipeline Project.

b. Analytical method

Samples collected were tested and analyzed in accordance with the Technical Specification for Identification of Hazardous Wastes (HJ/T 298-2007), the Technical Specification for Sampling of Industrial Solid Wastes (HJ/T20) and the Standard for Identification of Hazardous Wastes (GB 5085).

c. Detection result

From September 15 to 16, 2007, the environmental monitoring station of Sinopec Southwest Branch inspected the sample advance. The criteria refer to the First Level Standard for Identification of Hazardous Wastes-Identification of Leaching Toxicity (GB/T 5085.3-2007) and the Integrated Sewage Discharge Standards (GB 8978-1996). The results are shown in the table below.

Table 8.7-1 Testing Results of Waste Mud Leachate from Horizontal Directional Drilling

Monitoring project	Measured value (mg/L)	GB/T 5085.3-2007 Standard Value (MG/L)	GB 8978-1996 Standard Value (MG/L)
Ph value	9.10		Six to 9
CODCR	49		60
Petroleum	0.25		5
Chloride	128.6		
Hexavalent chromium	Not checked out	5	0.5
Copper	0.35	100	0.5
Lead	Not checked out	5	1.0
Zinc	0.15	100	2.0
Cadmium	Not checked out	1	0.1
Iron	0.132		
Mn	Not checked out		2.0
Arsenic	Not checked out	5	0.5
Mercury	Not checked out	0.1	0.05

According to the Standard Identification of Hazardous Wastes for Leaching Toxicity (GB 5085.3-2007), the solid waste is considered a hazardous waste with leach toxicity if the content of any of the hazardous components in the solid waste leachate exceeds the standard limit.

As can be seen from the test data in the table above, none of the dangerous components in the leachate of this waste mud analysis sample exceeds the standard limit, so the directional drilling waste mud belongs to Class II general industrial solid waste.

2) Environmental Impact Analysis of Waste Mud

The buried and excavated sites of directional drilling construction of this project are selected on the outside of the embankment and are convenient for construction. Due to the low dry weight of waste mud and the general industrial solid waste of Class II, the impact on the soil environment is small, the local environment of the construction site will not have obvious adverse effects, and the abandoned mud pool is far from the river bank area, so the abandoned mud pool has little impact on the environment.

In order to reduce the generation of solid waste in this project and reduce the impact of solid waste discharge on the surrounding environment, the whole process management and control of the use and disposal of waste mud shall be carried out during the construction process, as follows :

(1) The construction site shall be provided with a special slurry distribution area, and the mud shall be prepared in a special mud mixing and allocation tank . The prepared mud shall be stored in a metal structure mud tank and shall not overflow into the environment.

(2) Prior to the construction, the slurry pools shall be excavated separately near the burial sites on both banks. The location of the slurry pool should be closer to the burial site, and suitable for permanent storage of mud, as little as possible occupy cultivation areas, arable land and so on. The topsoil of each slurry pool is stacked separately to restore the original topography.

(3) During the construction period, after filtering out the cuttings and impurities from the mud returned from the drilling hole, reuse them as much as possible and reduce the amount of waste mud produced.

(4) Strict operation rules during construction and rational operation parameters shall be formulated to prevent accidents such as slurry running during construction.

(5) After the completion of construction, the waste mud shall be cleaned or dried, and the surface of the slurry pool shall be restored to its original appearance by using the surface soil of the slurry pool.

(6) The middle route of the south-to-north water transfer, the Yellow River and the south-to-north water diversion, the south-to-north water diversion, the south-to-north water diversion and the south-to-north water transfer, the alkali river and the Yongding river belong to the ecological red line area. The original surface soil of the

slurry pool is covered at the top of the slurry pool, and at least 40 cm thick surface soil is guaranteed to be the original soil.

8.7.2Environmental Impact Analysis of Domestic Waste

The total amount of domestic waste generated by construction personnel during the construction period of this project is 80.15 t . After collecting it in sections and sections, it will be disposed of on the basis of local functional departments, with less environmental impact.

8.7.3Environmental Impact Analysis of Construction Waste

The construction waste mainly includes waste welding rod in welding operation, waste anticorrosion material in anticorrosion operation and waste concrete in construction process. The total amount of construction waste generated by the project construction is about 45.8 t. The construction waste is partly recyclable and the remaining waste is treated by the local sanitation department. All construction wastes are effectively treated and disposed of, with little environmental impact.

In summary, the solid waste generated during the construction period of the proposed project will be treated separately and will not be discharged. In the case of strict implementation of the above measures, solid waste during construction period will not adversely affect the environment and will be accepted by the environment.

9 Environmental Impact Prediction and Evaluation During Operation Period

9.1 Forecast and analysis of atmospheric environmental impact during operation period

9.1.1Meteorological characteristics of pollution in the assessment area

(1) Representative analysis of meteorological data

The surface meteorological data used in this project are derived from the statistical results of major meteorological data of the Tianjin Dagang District Meteorological Station in recent years. Dagang Meteorological Station is a national general meteorological observatory with geographical coordinates of 117° 28′ E, 38° 51′ N, and an altitude of 2.2m. The distance between the station and the project is about 24km. The station is close to the site, and its terrain and underlying surface conditions are similar to the site. Hence, the meteorological data has a good representative.

(2) Statistics of long-term meteorological factors of Dagang station

① Climatic characteristics

Tianjin is an area with warm temperate semi-humid continental monsoon climate with four distinct seasons, windy springs with drought and less rain; hot summers with concentrated rainwater; cool autumn with moderate warm and cold; cold winter, with dry and less snow.

② Statistics of long-term meteorological element

The statistics of long-term meteorological elements are shown in the table below.

Table 9.1-1 Statistics results of long-term main meteorological elements of Dagang Meteorological Station

Items	Value
Annual average wind speed (m/s)	2.3
Maximum wind speed (m/s)	11.7
Annual average temperature (℃)	13.4
Extreme maximum temperature (℃)	39.4 (Time of appearance: 5/7/2010)

Extreme minimum temperature (℃)	-15.2 (Time of appearance: 5/1/2010)
Annual average relative humidity (%)	59
Annual average precipitation (mm)	590.4
Annual average sunshine hours (h)	2346.6

(3) Frequency statistics of long-term wind

According to the long-term meteorological data, the dominant wind direction of the evaluation area is E-ESE-SE wind, and the sum of occurrence frequency of the three wind directions is 39.6%. The evaluation zone has a static wind frequency of 10.6%.

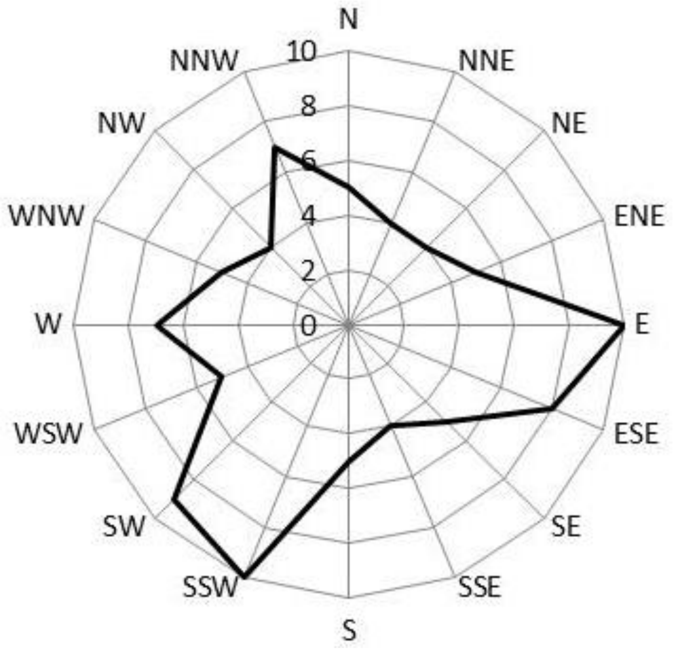

Figure 9.1-1 Rose map of long-term annual average wind frequency of Dagang Station

9.1.2Pollution source parameters

Table 9.1-2 The atmospheric pollution source parameters of the project under normal working conditions

Source of pollution	Altitude of exhaust tube bottom (m)	Height of exhaust tube (m)	Outlet diameter of exhaust tube (m)	0utlet temperature ℃	Exhaust emissions (Nm^3/h)	Annual emission hours (h)	Emissions condition	Pollutant emission rate (kg/h)		
								NO_x	Smoke	SO_2
Anci Sub-transmission Station	0	15	0.6	220	1478	8400	Normal	0.1035	0.0148	0.0042
Chengnan Terminal Station	0	15	0.6	220	3124	2160	Normal	0.0937	0.0156	0.0089

9.1.3Choice of atmospheric diffusion mode

The atmospheric evaluation level of this project is second level, and the atmospheric diffusion mode can be analyzed by the prediction result of the estimation model (AERSCREEN) recommended by the Environmental Impact Assessment Technical Guidelines (HJ2.2-2018) . No further evaluation and prediction are needed.

9.1.4Main parameters and schemes of the mode

The main calculation parameters and schemes in the estimation mode operation are shown in the table below.

Table 9.1-3 Parameter selection of atmospheric estimation mode for this project

Station name	Parameters		Value
Anci Sub-transmission Station	City/rural schemes	City/rural	Rural
		Population (city scheme)	/
	Maximum ambient temperature (℃)		40.2
	Minimum ambient temperature (℃)		-29.2
	Land use type		Cultivated
	Regional humidity condition		Arid
	Consider terrain or not	Consider terrain	Not consider
		Resolution of terrain data (m)	/
	Consider or not	Consider shoreline fume	Not consider
		Shoreline distance (m)	/
		Shoreline direction (°)	/
Chengnan Terminal Station	City/rural schemes	City/rural	Rural
		Population (city scheme)	/
	Maximum ambient temperature (℃)		41.9
	Minimum ambient temperature (℃)		-17.0
	Land use type		Cultivated
	Regional humidity condition		Arid
	Consider terrain or not	Consider terrain	Not consider
		Resolution of terrain data (m)	/
	Consider or not	Consider shoreline fume	Not consider
		Shoreline distance (m)	/
		Shoreline direction (°)	/

Table 9.1-4 The surface parameter value of atmospheric estimation mode of this project

Sector	Season	Albedo	BOWEN	Surface roughness
Anci Sub-transmission Station	Winter	0.6	1.5	0.01
	Spring	0.14	1.0	0.03
	Summer	0.2	2.0	0.2
	Autumn	0.18	2.0	0.05
Chengnan Terminal Station	Winter	0.6	1.5	0.01
	Spring	0.14	1.0	0.03
	Summer	0.2	2.0	0.2
	Autumn	0.18	2.0	0.05

9.1.5Evaluation factor

Outer pipeline: SO2, NOX and particulate matter.

9.1.6Evaluation content

Predict the ground concentration distribution of NO_2, SO_2 and PM_{10} discharged from the water jacket furnace in the Anci sub-transmission station and the Chengnan Terminal Station, and evaluate the its compliance or not.

9.1.7Evaluation criteria

The atmospheric environmental quality evaluation standard for NOx is 0.25mg/m3 (hourly average) , for SO2, it is 0.50mg/m3 (hourly average) , and the PM2.5 hour concentration evaluation standard refers to 3 times of the daily average concentration standard, i.e. 0.225. Mg/m3. Evaluation standard for non-methane total hydrocarbons is 2.0 mg/m3.

9.1.8Pollutant emissions accounting

The Anci sub-transmission station is located in Hebei Province and the Chengnan Terminal Station is located in Beijing. Therefore, the pollutant discharge calculation of this project is divided into Hebei and Beijing.

1.1.1.1. Hebei Anci sub-transmission station

Table 9.1-5 Air pollutants organized emissions accounting of Anci sub-transmission station

NO.	Emission port number	Pollutants	Accounting emission concentration /(mg/m3)	Accounting emission rate of single outlet/(kg/h)	Accounting annual emissions /(t/a)
Main emission port					
1	Water jacket heating furnace exhaust	NOX	70	0.1035	0.8566
		Smoke	10	0.0148	0.1224
		SO2	2.86	0.0042	0.0350
Sum of main emission port		NOX			0.8566
		SO2			0.1224
		Smoke			0.0350
Total organized emissions					
Total organized emissions		NOX			0.8566
		SO2			0.1224
		Smoke			0.0350

9.1.8.1 Beijing Chengnan Terminal Station

Table 9.1-6 Air pollutants organized emissions accounting of Chengnan Terminal Station

NO.	Emission port number	Pollutants	Accounting emission concentration /(mg/m3)	Accounting emission rate of single outlet/(kg/h)	Accounting annual emissions /(t/a)
Main emission port					
1	Water jacket	NOX	30	0.0937	0.2024
		Smoke	5	0.0156	0.0337

	heating furnace exhaust	SO2	2.86	0.0089	0.0193
Sum of main emission port		NOX			0.2024
		SO2			0.0193
		Smoke			0.0337
Total organized emissions					
Total organized emissions		NOX			0.2024
		SO2			0.0193
		Smoke			0.0337

9.1.9Results of prediction and analysis

The predicted results of the station exhaust gas are listed in Table 9.1-7. It can be seen from the table below that, the maximum contribution of the NO2, SO2, and PM10 hourly concentrations in the water jacket furnace at the Anci sub-transmission station and the Chengnan Terminal station accounts for the ratio to their environmental standard is less than 1.44%, 0.04%, and 0.115%, respectively. It can be seen that the pollutants emitted by this project have little impact on the regional atmospheric environmental quality.

Table 9.1-7 Atmospheric prediction results under normal working conditions in station area

Distance (m)	Anci sub-transmission station						Chengnan Terminal station					
	NO2		PM10		SO2		NO2		PM10		SO2	
	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)
10	4.66E-04	2.33E-01	8.34E-05	1.85E-02	2.23E-05	4.46E-03	3.04E-04	1.52E-01	6.20E-05	1.38E-02	3.60E-05	7.20E-03
50	2.66E-03	1.33E+00	4.76E-04	1.06E-01	1.27E-04	2.54E-02	1.71E-03	8.53E-01	3.48E-04	7.70E-02	2.02E-04	4.04E-02
100	1.89E-03	9.45E-01	3.39E-04	7.53E-02	9.04E-05	1.81E-02	1.31E-03	6.56E-01	2.67E-04	5.90E-02	1.55E-04	3.10E-02
150	1.38E-03	6.90E-01	2.48E-04	5.51E-02	6.61E-05	1.32E-02	9.81E-04	4.93E-01	2.01E-04	4.46E-02	1.16E-04	2.32E-02
200	1.26E-03	6.30E-01	2.26E-04	5.02E-02	6.04E-05	1.21E-02	7.97E-04	3.99E-01	1.63E-04	3.62E-02	9.46E-05	1.89E-02
250	1.43E-03	7.15E-01	2.56E-04	5.69E-02	6.82E-05	1.36E-02	7.03E-04	3.51E-01	1.44E-04	3.19E-02	8.33E-05	1.67E-02
300	1.47E-03	7.35E-01	2.63E-04	5.84E-02	7.02E-05	1.40E-02	6.17E-04	3.09E-01	1.26E-04	2.80E-02	7.31E-05	1.46E-02
350	1.46E-03	7.30E-01	2.62E-04	5.82E-02	6.98E-05	1.40E-02	6.34E-04	3.17E-01	1.29E-04	2.87E-02	7.49E-05	1.50E-02
400	1.52E-03	7.60E-01	2.73E-04	6.07E-02	7.29E-05	1.46E-02	6.43E-04	3.21E-01	1.31E-04	2.91E-02	7.59E-05	1.52E-02
450	1.50E-03	7.50E-01	2.70E-04	6.00E-02	7.19E-05	1.44E-02	6.34E-04	3.17E-01	1.30E-04	2.89E-02	7.54E-05	1.51E-02
500	1.46E-03	7.30E-01	2.62E-04	5.82E-02	6.98E-05	1.40E-02	6.90E-04	3.45E-01	1.41E-04	3.12E-02	8.15E-05	1.63E-02
550	1.41E-03	7.05E-01	2.52E-04	5.60E-02	6.72E-05	1.34E-02	7.03E-04	3.51E-01	1.44E-04	3.19E-02	8.34E-05	1.67E-02
600	1.35E-03	6.75E-01	2.41E-04	5.36E-02	6.43E-05	1.29E-02	7.07E-04	3.54E-01	1.45E-04	3.21E-02	8.38E-05	1.68E-02
650	1.28E-03	6.40E-01	2.30E-04	5.11E-02	6.13E-05	1.23E-02	7.03E-04	3.51E-01	1.44E-04	3.19E-02	8.34E-05	1.67E-02
700	1.22E-03	6.10E-01	2.19E-04	4.87E-02	5.84E-05	1.17E-02	6.94E-04	3.47E-01	1.42E-04	3.15E-02	8.23E-05	1.65E-02
750	1.16E-03	5.80E-01	2.08E-04	4.62E-02	5.55E-05	1.11E-02	6.81E-04	3.41E-01	1.39E-04	3.09E-02	8.08E-05	1.62E-02
800	1.11E-03	5.55E-01	1.98E-04	4.40E-02	5.29E-05	1.06E-02	6.69E-04	3.34E-01	1.36E-04	3.02E-02	7.90E-05	1.58E-02
850	1.06E-03	5.30E-01	1.89E-04	4.20E-02	5.05E-05	1.01E-02	6.51E-04	3.26E-01	1.33E-04	2.95E-02	7.70E-05	1.54E-02
900	1.01E-03	5.05E-01	1.81E-04	4.02E-02	4.82E-05	9.64E-03	6.34E-04	3.17E-01	1.29E-04	2.87E-02	7.49E-05	1.50E-02
950	9.66E-04	4.83E-01	1.73E-04	3.84E-02	4.62E-05	9.24E-03	6.13E-04	3.06E-01	1.26E-04	2.79E-02	7.28E-05	1.46E-02
1000	9.27E-04	4.64E-01	1.66E-04	3.69E-02	4.43E-05	8.86E-03	5.96E-04	2.98E-01	1.22E-04	2.70E-02	7.06E-05	1.41E-02
1050	8.90E-04	4.45E-01	1.59E-04	3.53E-02	4.25E-05	8.50E-03	5.79E-04	2.89E-01	1.18E-04	2.62E-02	6.85E-05	1.37E-02
1100	8.53E-04	4.27E-01	1.53E-04	3.40E-02	4.08E-05	8.16E-03	5.61E-04	2.81E-01	1.15E-04	2.55E-02	6.64E-05	1.33E-02
1150	8.22E-04	4.11E-01	1.47E-04	3.27E-02	3.93E-05	7.86E-03	5.44E-04	2.72E-01	1.11E-04	2.47E-02	6.43E-05	1.29E-02
1200	7.92E-04	3.96E-01	1.42E-04	3.16E-02	3.78E-05	7.56E-03	5.27E-04	2.64E-01	1.08E-04	2.39E-02	6.23E-05	1.25E-02
1250	7.60E-04	3.80E-01	1.36E-04	3.02E-02	3.63E-05	7.26E-03	5.10E-04	2.55E-01	1.04E-04	2.31E-02	6.04E-05	1.21E-02
1300	7.28E-04	3.64E-01	1.30E-04	2.89E-02	3.48E-05	6.96E-03	4.93E-04	2.46E-01	1.01E-04	2.25E-02	5.85E-05	1.17E-02

Distance (m)	Anci sub-transmission station						Chengnan Terminal station					
	NO2		PM10		SO2		NO2		PM10		SO2	
	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)
1350	7.00E-04	3.50E-01	1.25E-04	2.78E-02	3.34E-05	6.68E-03	4.80E-04	2.40E-01	9.80E-05	2.18E-02	5.68E-05	1.14E-02
1400	6.77E-04	3.39E-01	1.21E-04	2.69E-02	3.24E-05	6.48E-03	4.67E-04	2.34E-01	9.50E-05	2.11E-02	5.51E-05	1.10E-02
1450	6.56E-04	3.28E-01	1.18E-04	2.62E-02	3.14E-05	6.28E-03	4.50E-04	2.25E-01	9.20E-05	2.05E-02	5.35E-05	1.07E-02
1500	6.30E-04	3.15E-01	1.13E-04	2.51E-02	3.01E-05	6.02E-03	4.37E-04	2.19E-01	8.95E-05	1.99E-02	5.20E-05	1.04E-02
1550	6.08E-04	3.04E-01	1.09E-04	2.42E-02	2.91E-05	5.82E-03	4.27E-04	2.14E-01	8.70E-05	1.94E-02	5.06E-05	1.01E-02
1600	5.89E-04	2.95E-01	1.06E-04	2.36E-02	2.82E-05	5.64E-03	4.16E-04	2.08E-01	8.50E-05	1.89E-02	4.92E-05	9.84E-03
1650	5.70E-04	2.85E-01	1.02E-04	2.27E-02	2.73E-05	5.46E-03	4.05E-04	2.02E-01	8.25E-05	1.84E-02	4.79E-05	9.58E-03
1700	5.48E-04	2.74E-01	9.82E-05	2.18E-02	2.62E-05	5.24E-03	3.94E-04	1.97E-01	8.05E-05	1.79E-02	4.67E-05	9.34E-03
1750	5.30E-04	2.65E-01	9.50E-05	2.11E-02	2.53E-05	5.06E-03	3.84E-04	1.92E-01	7.80E-05	1.74E-02	4.54E-05	9.08E-03
1800	5.14E-04	2.57E-01	9.20E-05	2.04E-02	2.45E-05	4.90E-03	3.74E-04	1.87E-01	7.65E-05	1.70E-02	4.43E-05	8.86E-03
1850	5.03E-04	2.52E-01	9.01E-05	2.00E-02	2.40E-05	4.80E-03	3.65E-04	1.83E-01	7.45E-05	1.66E-02	4.32E-05	8.64E-03
1900	4.87E-04	2.44E-01	8.72E-05	1.94E-02	2.33E-05	4.66E-03	3.54E-04	1.77E-01	7.25E-05	1.61E-02	4.20E-05	8.40E-03
1950	4.69E-04	2.35E-01	8.41E-05	1.87E-02	2.24E-05	4.48E-03	3.47E-04	1.74E-01	7.05E-05	1.57E-02	4.11E-05	8.22E-03
2000	4.63E-04	2.32E-01	8.30E-05	1.84E-02	2.21E-05	4.42E-03	3.38E-04	1.69E-01	6.90E-05	1.54E-02	4.00E-05	8.00E-03
2050	4.44E-04	2.22E-01	7.96E-05	1.77E-02	2.12E-05	4.24E-03	3.29E-04	1.65E-01	6.70E-05	1.49E-02	3.90E-05	7.80E-03
2100	4.36E-04	2.18E-01	7.82E-05	1.74E-02	2.09E-05	4.18E-03	3.23E-04	1.62E-01	6.60E-05	1.47E-02	3.83E-05	7.66E-03
2150	4.31E-04	2.16E-01	7.72E-05	1.72E-02	2.06E-05	4.12E-03	3.17E-04	1.59E-01	6.45E-05	1.44E-02	3.76E-05	7.52E-03
2200	4.24E-04	2.12E-01	7.60E-05	1.69E-02	2.03E-05	4.06E-03	3.10E-04	1.55E-01	6.35E-05	1.41E-02	3.68E-05	7.36E-03
2250	4.08E-04	2.04E-01	7.32E-05	1.63E-02	1.95E-05	3.90E-03	3.02E-04	1.51E-01	6.15E-05	1.37E-02	3.58E-05	7.16E-03
2300	3.95E-04	1.98E-01	7.08E-05	1.57E-02	1.89E-05	3.78E-03	2.94E-04	1.47E-01	6.00E-05	1.34E-02	3.49E-05	6.98E-03
2350	3.81E-04	1.91E-01	6.83E-05	1.52E-02	1.82E-05	3.64E-03	2.88E-04	1.44E-01	5.85E-05	1.30E-02	3.41E-05	6.82E-03
2400	3.74E-04	1.87E-01	6.69E-05	1.49E-02	1.79E-05	3.58E-03	2.82E-04	1.41E-01	5.75E-05	1.28E-02	3.34E-05	6.68E-03
2450	3.64E-04	1.82E-01	6.52E-05	1.45E-02	1.74E-05	3.48E-03	2.75E-04	1.38E-01	5.60E-05	1.25E-02	3.26E-05	6.52E-03
2500	3.57E-04	1.79E-01	6.39E-05	1.42E-02	1.70E-05	3.40E-03	2.70E-04	1.35E-01	5.50E-05	1.22E-02	3.20E-05	6.40E-03
Maximum concentration and rate	2.88E-03	1.44E+00	5.16E-04	1.15E-01	1.38E-04	2.76E-02	1.71E-03	8.53E-01	3.48E-04	7.70E-02	2.02E-04	4.04E-02
Distance of Maximum	24		24		24		49		49		49	

Distance (m)	Anci sub-transmission station						Chengnan Terminal station					
	NO2		PM10		SO2		NO2		PM10		SO2	
	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)	Downwind concentration (mg/m3)	Ratio to standard (%)
concentration from source （m)												
Evaluation criteria	0.20		0.45		0.5		0.20		0.45		0.5	

9.1.10 Compliance analysis

(1) Compliance analysis of organized exhaust gas

Under normal working conditions, the organized exhaust gas from Anci sub-transmission station heating furnace can meet the "Emission Standard for Air Pollutants in Industrial Furnace and Kiln" (DB13/1640-2012) , and the organized exhaust gas from Chengnan Terminal station heating furnace can meet the “Comprehensive Emission Standards of Atmospheric Pollutants” (DB11501-2017) . The organized exhaust gas of this project reaches the emission standards.

Table 9.1-8 Organized compliance demonstration

Source of pollution	Pollutant concentration of NOx (mg/m3)	Pollutant concentration of smoke (mg/m3)	Pollutant concentration of SO2 (mg/m3)	Emission concentration of NOx (mg/m3)	Emission concentration of smoke (mg/m3)	Emission concentration of SO2 (mg/m3)	Name of criteria	Compliance or not
Anci sub-transmission station heating furnace	70	10	2.86	400	400	50	“Emission Standard for Air Pollutants in Industrial Furnace and Kiln” (DB13/1640-2012)	Compliance
Chengnan Terminal station heating furnace	30	10	2.86	100	10	20	“Comprehensive Emission Standards of Atmospheric Pollutants” (DB11501-2017)	Compliance

(2) Compliance analysis at the factory boundary

According to the calculation results, the maximum emission concentration of the project can meet the requirements of comprehensive emission standards for air pollutants (GB16297-1996) . The unorganized emission of this project meets the standards at the factory boundary.

Table 9.1-9 Unorganized compliance demonstration

Pollutant	Emission concentration (μg/m3)	Monitoring limit of unorganized concentration at factory boundary (mg/m3)	Source of criteria	Compliance or not
SO2	0.5154	0.4	Integrated emission standards for atmospheric pollutants (GB16297-1996)	Yes
NOx	22.7111	0.12		Yes
Particulate matter	1.8141	1.0		Yes

9.1.11 Atmospheric environmental protection distance

According to the "Technical Guidelines for Environmental Impact Assessment - Atmospheric Environment" (HJ2.2-2018) and the prediction results of the AERSCREEN model, among the emission pollutants of the project: the concentration at the factory boundary is lower than the concentration limit, the average hourly concentration at the factory boundary is lower than the environmental quality concentration limit. Therefore, the atmospheric environmental protection distance is not required for this project.

9.1.12 Summary

The atmospheric environmental protection distance is not required for this project. The maximum contribution of the NO2, SO2, and PM10 hourly concentrations in the water jacket furnace at the Anci sub-transmission station and the Chengnan Terminal station accounts for the ratio to their environmental standard is less than 1.44%, 0.04%, and 0.115%, respectively. The pollutants emitted by this project have little impact on the regional atmospheric environmental quality.

9.2 Prediction and analysis of impact on surface water environment during operation period

9.2.1Water pollution sources and emissions

There are 10 new employees in each station of the project. The domestic sewage generated is pretreated by the septic tank. After being treated by the integrated sewage treatment device, it is used for greening and flushing the road in the station, and is not discharged.

9.2.2Analysis of the Influence of Pipeline on Surface Water Environment

Under normal working conditions, since the gas pipeline is a fully enclosed system, the pipeline adopts a combination of anti-corrosion layer and cathodic protection. The transported natural gas will not be related to the river water passing through, and has no effect on crossing the river. At the same time, when the pipeline crosses the river, it is buried in the stable layer below the riverbed design scouring line. If a rupture accident occurs, the leaked natural gas will leak into the atmosphere through the surface water, which will have certain impact on the atmospheric environment.

9.2.3Analysis of the impact of the project on the South-to-North Water Transfer project and the River-type Ecological Red Line

The project involves the permanent protection area of river types which mainly are the Duliujian River, the South Canal, the Ziya River, the Hongni River and the Daqing River, and the Jian River and Yongding River in the ecological red line of Hebei Province. Besides, the project that passes through The South-to-North Water Transfer Project is mainly the Langzhuo main canal and Tianjin main canal. According to the "Water Function Zoning of Tianjin Hai River Basin" and the water function zoning of Hebei Province, the project pipeline mainly involves the industrial, agricultural and landscape entertainment functions of these rivers.

This project crosses the south-to-north water transfer and the river project in the ecological red line mainly uses the top pipe or directional drilling way to cross, does not touch the water body, and has little influence on the water body. During the construction period and operation period, it will not affect the flow direction and flow of rivers and other surface water bodies, and will not affect the safety of the regional water system. There is no behavior that damages the water system protection.

(1) Impact assessment of water function during construction period

The mud pool at the directional drilling construction site may leak and contaminate water. According to the construction site of the existing project, the mud pool has been treated with anti-seepage treatment, and there is a certain margin, and generally no leakage of polluted water bodies will occur. According to engineering analysis, waste mud will also be produced after construction. The mud used in the construction is non-toxic and has no harmful ingredients. The disposal of waste mud is generally carried out by landfilling and restoring the soil after natural drying in different places, which has little effect on the surrounding environment and water quality.

(2) Impact assessment of water function during operation period

The pipeline directional drilling crosses the river channel, does not change the source and destination of the existing channel water, and does not affect the normal use function of the water delivery channel, also does not affect the water quality and has high safety. Hence, it has no effect on the water function during the operation period.

During the construction period, the project pipeline is in the floodplain in the middle of the Duliujian river, and after investigation and calculation, the beach area of the river that involves in the excavation construction area of the project is 15.75 hectares. There is a driving effect on the aquatic animals and wild animals in the and reeds during the construction period, which keep the fish away from the construction site, so that the fish density in the construction area is significantly reduced. This approach will also result in a significant increase in sediment in the water, which will reduce fish growth, hatchability, larval survival and predation efficiency. After the completion of the construction, it does not affect whether the water environment quality reaches the corresponding target value of the water function zone.

9.2.4Summary

In summary, the scope of the temperature drop caused by the cold water discharge of the proposed project during the operation period and the maximum impact range of residual chlorine will not reach the South Port, and will not affect the environmentally sensitive protection targets of the open sea; the remaining wastewater will be separated and treated. Therefore, the operational period of the proposed project has little impact on the surrounding seawater environment and can be accepted by the environment.

Under normal operating conditions during the operation period, the gas pipeline is a fully enclosed system, and the transported natural gas will not be related to the river water body that the pipeline passes through. The impact of the project on the surface water environment is small.

9.3 Prediction and evaluation of acoustic environmental impact during operation period

The main sound sources are separators, gas collection pipes, pressure regulating systems, etc. Therefore, this evaluation mainly predicts the noise level at the factory boundary after the project is put into production.

9.3.1Analysis of main noise sources during operation period

The noise equipment in each station of the project is shown in the following table. The main noise source under normal working conditions is the separator of each station. The noise is venting noise under abnormal conditions. The number of main noise sources and the general sound level intensity can be seen in the following table.

Table 9.3-1 List of major noise sources under normal and abnormal conditions of each station

NO.	Station	Condition	Main noise equipment	Amount		Sound power level (dB)	Sound source height （m)	Remarks
				Operating	Reserve			
1	Nangang Sub-transmission station	Normal	Filter separator	2	0	75	2	Outdoor
2		Abnormal	Venting stand pipe	1	0	100	15	Outdoor
3	Daqiuzhuang Sub-transmission Station, Jinghai Connection Station, Anci Sub-transmission Station	Normal	Filter separator	1	1	75	2	Outdoor
4		Abnormal	Venting stand pipe	1	0	100	15	Outdoor
5	Yongqing Connection Station, Chengnan Terminal Station	Normal	Filter separator	3	1	75	2	Outdoor
6		Abnormal	Venting stand pipe	1	0	100	15	Outdoor

9.3.2Content of prediction and evaluation

Under normal and abnormal conditions, predict the noise source of each station that affect the acoustic environment and the noise value at the factory boundary. The noise emission at the factory boundary should meet the standard, and the distribution and the extent of the affected population in the acoustic environment functional zones of different categories should be given after the completion of the project.

9.3.3Prediction mode

This predicting calculation uses the industrial noise prediction model recommended in the Technical Guidelines for Environmental Impact Assessment (HJ 2.4-2008) .

9.3.4Prediction point setting

This evaluation mainly predicts and evaluates the noise value at the factory boundary and the noise value of the noise sensitive point within the range of 200m. The predicted points are set as follows:

1) Factory boundary prediction point is set at intervals of 5m on the project boundary.

2) Grid prediction point is set in units of 10m×10m in the range of 200m outside the boundary of each station.

3) Noise sensitive points within 200m of the factory boundary.

9.3.5Predicting and evaluating results

In the station of the project, except Nanqrenying Village near the Yongqing Connection Station, which is 110m away from the station yard, all other stations are residential areas within 400m.

(1) Normal working condition

The prediction results of the factory boundary noise (evaluated by the predicted value) of the project site are shown in the following table. The distribution of the sound level lines is shown in the following figure.

Table 9.3-2 Noise prediction results of Yongqing connection station boundary under normal working conditions Unit: dB(A)

Station	Prediction point	Prediction time period	Contribution	Standard limit	Compliance or not
Yongqing transmission station	East factory boundary	Daytime	29.3	60	The noise prediction values at daytime and nighttime boundary are all meet the standard
		Nighttime	29.3	50	
	South factory boundary	Daytime	38.6	60	
		Nighttime	38.6	50	
	West factory boundary	Daytime	42.9	60	
		Nighttime	42.9	50	
	North factory boundary	Daytime	42.4	60	
		Nighttime	42.4	50	

The 110m west of Yongqing Transmission station is Nanrenying Village. The predicted contribution value of the noise is 27.2dB(A) , the daytime prediction value is 53dB(A) , and the night-time prediction value is 43dB(A) . Therefore, it satisfies the class 1 standard of the Acoustic Environment Quality Standard (GB 3096-2008) (55dB (A) in the daytime and 45dB (A) in the nighttime) .

Under normal working conditions, the maximum contribution of noise at the factory boundary is 42.9dB(A) , and the noise at the boundary both in the daytime and nighttime can meet the Class 2 standard of the Environmental Noise Emission Standard for Industrial Enterprises Boundary (GB 12348-2008) .

Table 9.3-3 Noise prediction results at the factory boundary of other stations under normal working conditions Unit: dB(A)

Station	Prediction point	Prediction time period	Contribution	Standard limit	Compliance or not
Nangang sub-transmission	East factory boundary	Daytime	37.8	60	The noise prediction values
		Nighttime	37.8	50	

Station	Prediction point	Prediction time period	Contribution	Standard limit	Compliance or not
station	South factory boundary	Daytime	42.6	60	at daytime and nighttime boundary are all meet the standard
		Nighttime	42.6	50	
	West factory boundary	Daytime	30.9	60	
		Nighttime	30.9	50	
	North factory boundary	Daytime	35.1	60	
		Nighttime	35.1	50	
Daqiuzhuang sub-transmission station	East factory boundary	Daytime	34.0	60	The noise prediction values at daytime and nighttime boundary are all meet the standard
		Nighttime	34.0	50	
	South factory boundary	Daytime	33.2	60	
		Nighttime	33.2	50	
	West factory boundary	Daytime	32.3	60	
		Nighttime	32.3	50	
	North factory boundary	Daytime	41.6	60	
		Nighttime	41.6	50	
Jinghai connection station	East factory boundary	Daytime	31.9	60	The noise prediction values at daytime and nighttime boundary are all meet the standard
		Nighttime	31.9	50	
	South factory boundary	Daytime	31.6	60	
		Nighttime	31.6	50	
	West factory boundary	Daytime	39.4	60	
		Nighttime	39.4	50	
	North factory boundary	Daytime	30.1	60	
		Nighttime	30.1	50	
Anci sub-transmission station	East factory boundary	Daytime	30.4	60	The noise prediction values at daytime and nighttime boundary are all meet the standard
		Nighttime	30.4	50	
	South factory boundary	Daytime	36.5	60	
		Nighttime	36.5	50	
	West factory boundary	Daytime	34.0	60	
		Nighttime	34.0	50	
	North factory boundary	Daytime	34.4	60	
		Nighttime	34.4	50	
Chengnan Terminal staion	East factory boundary	Daytime	43.6	60	The noise prediction values at daytime and nighttime boundary are all meet the standard
		Nighttime	43.6	50	
	South factory boundary	Daytime	42.3	60	
		Nighttime	42.3	50	
	West factory boundary	Daytime	33.4	60	
		Nighttime	33.4	50	
	North factory boundary	Daytime	35.5	60	
		Nighttime	35.5	50	

Under normal working conditions, the maximum contribution of noise at each boundary is 43.6dB(A) , and the noise at the factory boundary of the daytime and nighttime can meet the Class 2 standard of the Environmental Noise Emission Standard for Industrial Enterprises Boundary (GB 12348-2008) .

(2) Abnormal working condition

Under abnormal working conditions, when the system overpressure is vented, the noise value exceeds 60dB(A) in the range of 15m around the ground of the venting facility; the noise value exceeds 55dB(A) in the range of 48m; the noise value exceeds 50dB in the range of 80m (A) In the range of 152m, the noise value exceeds 45dB (A) ; in the range of 269m, the noise value exceeds 40dB (A) . System overpressure venting will have a greater impact on the quality of the surrounding acoustic environment. However, since the system overpressure venting is accidental noise, the duration is short and the frequency is low, and the nearest acoustic environment sensitive target around each station is the nearest to Nanrenying Village, which is 110m away from Yongqing Station. Therefore, the impact of abnormal working conditions on the surrounding residents is small.

Table 9.3-4 Impact range of incident noise under abnormal working condition

NO.	Noise value dB(A)	Distance (m)
1	＞60	15
2	＞55	48
3	＞50	80
4	＞45	152
5	＞40	269

9.4 Impact assessment of terrestrial ecology during operation period

9.4.1Analysis of the impact on agricultural production

For the permanent land occupation, the crop productivity on these lands will be permanently lost during the pipeline service period due to changes in the original land and utilization properties.

During the normal operation of the pipeline, there is basically no impact on agricultural production. However, due to the inability to grow deep root crops within 5 m of both sides of the pipeline, there will be some loss for areas that were originally deep root economic crops. For permanent land occupation, due to the change of the original land use function, it will have a certain impact on agricultural production.

During the decommissioning period, the impact on agricultural production will gradually weaken, and the complete restoration of crops and other fruit trees will take 2-3 years.

9.4.2Analysis of the impact on the soil

The impact on the soil during normal operation of the pipeline is small, mainly due to the residue and sewage discharged from the pigging, which may have certain impact on the soil. Therefore, as long as the recycling work is done at the time of pigging, the impact on the soil environment can be minimized. In addition, the analogy survey shows that during the operation of the pipeline, the surface soil temperature is 1 °C-3 °C higher than the adjacent area, the evaporation amount is increased, and the soil moisture is reduced.

In short, the laying of pipelines has changed the soil structure and soil nutrient status, but by taking certain measures, the soil quality will gradually recover.

9.4.3Analysis of the impact on vegetation

According to the ecological theory, the vegetation damage along the pipeline is temporary and generally terminated after construction. According to the analysis of the natural conditions such as soil and climate in the area where the pipeline passes, after the construction is completed, the surrounding plants gradually invade and begin to resume the succession process. To restore vegetation cover, measures to artificially plant trees and grasses can speed up the recovery process, restore herbaceous vegetation needs 2-3 years, restore shrub vegetation needs 3-5 years, and restore tree vegetation will take 10-15 years.

It should be pointed out that the meaning of recovery is not to completely restore the vegetation composition and relative quantity ratio before the original construction, but only to the state composition approximation, the species diversity index value is similar, but still reduced.

9.4.3.1 Impact on vegetation under normal operating conditions

Under normal conditions during the operation period, the area where the pipeline passes is in a normal state, and the growth of surface vegetation and crops gradually returns to normal.

For example, in the pipeline that has been completed for 2-3 years, the area where the natural gas pipeline is laid underground has better surface vegetation restoration and the degree of landscape damage is very low. This proves that the pipeline has the least impact on the ecological environment and the smallest impact, which is a clean transportation mode. Therefore, it can be considered that during normal gas transmission, the pipeline has no adverse effect on the surface vegetation.

9.4.3.2 Impact on vegetation under abnormal (accident) operating conditions

Accidents caused by poor quality of engineering, omissions in management, natural factors (earthquake, flooding) and man-made damage, may cause damage and breakage to gas pipelines, which can lead large amounts of natural gas to leak and cause fires. The possibility of an accident exists, but as long as prevention is done, the probability of an accident can be reduced, and the caused damage can be reduced.

If the gas leaks, most of it will spread out quickly. In the absence of open flames, there will be no fire and no harm to the ecological environment. If there is a fire source, it may cause a fire and explosion event, which may cause a forest fire, resulting in a large-scale destruction of vegetation and will have a major impact on the ecological environment.

9.4.4Impact on various environmentally sensitive areas

Under normal operating conditions of pipelines, there is basically no impact on various environmentally sensitive areas. Under accident conditions, there is a potential risk of fire and explosion. If the pipe wall ruptures and the natural gas leaks during the operation of the pipeline, a fire and explosion accident will occur in the event of an open fire, which will have a certain impact on the surrounding environment.

Therefore, after the pipeline is completed and put into use, the inspection of the environmentally sensitive sections should be strengthened to avoid fires and explosions. At the same time, the operating unit should formulate an effective emergency plan for fire prevention and flood prevention during the operation period. Relevant departments such as fire protection, environmental protection, and water affairs should be in contact timely and report the accident situation so that relevant departments can quickly take effective measures to reduce the accident hazard and reduce the damage to the environment in various environmentally sensitive areas.

9.4.5Analysis of the impact on wildlife

Compared with the construction period, the impact on wildlife during operation period is small. Although deep root plants can no longer be planted along the pipeline, according to the site investigation, the terrestrial vegetation affected by the project is a common species, with wide growth range and strong adaptability. There is no plant population disappearance or extinction caused by local vegetation habitat destruction. It has little effect on plant growth.

After the completion of the pipeline project, with the restoration of vegetation and the disappearance of construction effects, the living environment of the animals will be restored. Some of the animals that have temporarily left will return to their original habitats, and the impact on animal activities caused by pipeline construction will gradually disappear. Because the noise generated by the station is small and far from the surrounding wildlife habitat, it will not affect the activities of wildlife.

9.4.6Impact on the ecological red line

9.4.6.1 Analysis of the impact of the project on the ecological protection red line of Hebei Province

(1) The relationship of locations between the project and the red line of ecological protection in Hebei Province

According to the notice of the People's Government of Hebei Province on the release of the “Red Line of Ecological Protection in Hebei Province" (Ji Zheng Zi [2018] No. 23) , the red line of ecological protection in Hebei Province has been officially demarcated. The proposed project mainly crosses the red line of ecological protection of riverside lakeside zone in Hebei Plain, and specifically crosses the red line of Yongding River ecological protection red line and alkali river ecological protection red line. The relationship between the proposed project and its location is shown in the figure and the location map of Hebei ecological red line.

(2) Analysis of the Impact of the Project on the Red Line of Ecological Protection in Hebei Province

The ecological protection red line that the proposed project traverses belongs to the river ecosystem and has the function of flood storage.

The project intends to adopt the directional drilling method to cross the above ecological red line area, and the directional drilling entry and exit points are both outside the red line. The directional drilling construction method is basically no disturbance to the water body. In addition, the mud in the construction process is stored in the anti-seepage mud pool. After solidification, it covers at least 40cm of cultivated soil, restores the original landform and vegetation, and does not affect the flood storage function of the river ecosystem, and thus has a very small impact on the red line area.

The project is a gas pipeline. Under the normal working condition during the operation period, it will not affect the red line area. At the same time, the project adopts engineering measures such as increasing wall thickness, strengthening anti-corrosion and testing to ensure pipeline safety, and strengthen management during the operation period. It can be seen that under the premise of implementing the above measures, it will not damage the flood regulation and storage function of the ecological red line area during the construction period and operation period, and the impact is within the acceptable range.

9.4.6.2 Analysis of the impact of the project on Tianjin permanent protection ecological zone and ecological red line

(1) The relationship of locations between the project and Tianjin's permanent protection ecological zone and ecological red line

According to the notice of Tianjin People's Government on issuing the "Tianjin Ecological Protection Red Line" (Jin Zheng Fa [2018] No. 21) , the Tianjin Ecological Protection Red Line has been officially demarcated. In accordance with the resolution of the Standing Committee of the Tianjin People's Congress on further strengthening the management of the permanent protection of ecological areas in the city, the Tianjin Permanent Protection Ecological Zone and the Ecological Protection Red Line are implemented together to define the permanent protection ecological zone. In accordance with the national regulations, the red line of ecological protection shall be strictly implemented, and the protection and management system of the national ecological protection red line shall be strictly implemented; if there are differences in protection and management regulations, protection and management shall be implemented in accordance with the strictest management and control standards. Since the control requirements of the Tianjin Eco-Red Line have not been introduced and the permanent protection of the ecological area includes the content of the ecological red line, this evaluation focuses on the impact on the Tianjin permanent protection ecological area.

The project has passed through 26 permanent ecological protection areas in Tianjin (including 15 forest belt types, 6 river channel types, 2 lake reservoir types, 2 park types, and 1 wetland type) . The relationship of locations between the project and the Tianjin ecological red line is shown in the attached figure.

(2) Analysis of the impact of the project on Tianjin's permanent ecological protection zone

The project crosses the permanent ecological protection zone of Tianjin, involving forest belts, rivers, lakes, wetlands and country parks. During the construction process, 196.5 hectares land is temporary occupied in the ecological area, and 3.1098 hectares is permanent occupied. During the construction of the project, the pipe trunking and directional drilling shall be used in the construction of the trunk line and the river crossing section, which will not disturb the occupied land and will not change the use of the land space, and will not directly disturb and destroy the water environment and water quality; In the general area, the open excavation is used to strictly control the width of the working belt. After the temporary land occupation, all the land use types are restored, and the environmental impact is further reduced by adopting ecological protection and restoration measures. The permanent land occupation of the project in the permanent protection of ecological areas will take the balance of compensation, and the supplementary land will be fully greened without reducing the area of the ecological area.

Therefore, under the circumstances of fully implementing ecological protection measures, risk prevention and emergency measures, and strengthening management, the impact of the construction and operation of this pipeline project on Tianjin's permanent ecological protection zone is acceptable.

9.5 Analysis and evaluation of impact on groundwater environmental during operation period

9.5.1 Analysis and evaluation of impact on groundwater environment during pipeline operation period

During the operation period, the pipeline is buried in the underground. The medium transported by the gas pipeline is natural gas. It is a pure methane gas that does not contain sulfur or water. No wastewater is generated during the operation. Natural gas volatilizes under normal conditions and has no adverse effect on groundwater quality. Even if the pipeline is broken, it will not enter the groundwater to cause pollution; In addition, the pipeline anti-corrosion design strictly follows the relevant regulations, and the pipeline is protected by the combination of external anti-corrosion layer and cathodic protection, so it will not affect the groundwater.

9.5.2Analysis and evaluation of the impact on groundwater environment during the operation period of the station

A total of 7 process stations were set up along the project.

1) Environmental impact of groundwater pumping at the station

The water source of the Chengnan Terminal Station and the Nangang Sub-transmission Station of the Project is intended to be municipal water supply. The water sources of Yongqing Connection Station, Jinghai Connection Station and Anci Sub-transmission Station are to be supplied by the self-contained water source wells of the station. The water volume, water pressure and water quality should be satisfied for the use of this project.

According to the water survey within the scope of the project evaluation, the depth of the wells for the residents to use the groundwater is about 300-500m. There are 10 people in the Yongqing Connection Station, the Jinghai Connection Station and the Anci Sub-transmission Station. The water consumption is very small. It has little impact on the aquifer flow field of deep groundwater around the station site and on regional groundwater.

2) Impact of station drainage on groundwater environment

The drainage of the Chengnan Terminal Station and the Nangang sub-transmission Station of the project will be combined with sewage and waste. The domestic sewage will be treated by the outdoor septic tank and discharged into the municipal drainage network.

The domestic water of Jinghai Connection Station, the Yongqing Connection Station and the Anci Sub-transmission Station are treated by the outdoor septic tank and discharged to the outdoor integrated sewage treatment equipment. After treatment, they are used for greening and flushing the road in the station, and are not discharged.

The main impact on the groundwater during the operation period of the station is the impact of domestic sewage on the surrounding groundwater. The main pollutants in domestic sewage are ammonia, nitrogen and phosphorus. However, the amount of domestic sewage produced by the project is small, and the time in the septic tank and the regulating tank is short. Therefore, the domestic sewage generated by the project has little impact on the surrounding groundwater.

In order to better protect the groundwater environment in the region, the construction unit is required to carry out anti-seepage treatment on the septic tank and the sewage pool. At the same time, the daily management should be strengthen. When the sewage leaks, the wastewater should be temporarily taken out and after the waste water is drained, the sewage wastewater storage facilities needs to be maintained; the dry sand is adopted and laid in the leaking sewage, which can adsorb the pollutants and then collect and treat uniformly.

After adopting the various measures proposed in the environment impact assessment, it has little impact on the surrounding groundwater environment during the construction period and operation period in the project site.

During the operation period, as the benefits of groundwater environmental protection measures are gradually exerted, the pipelines are buried in groundwater and have almost no adverse effects on groundwater. The station is equipped with sewage treatment measures, the amount of sewage is small, and the ground is hardened. Therefore, it will not affect the groundwater under normal circumstances.

9.6 Analysis of the impact on soil environmental during operation period

The transportation material of this project is natural gas with almost no pollution to the soil. Under the normal operation conditions, it does not touch the soil during the operation period. Even if a leakage accident occurs, the influence of natural gas on the soil is small.

9.7 Analysis of impact on solid waste during operation period

Closed gas transmission process is used in the pipeline during the operation period. The solid waste in the operation period mainly comes from the waste residue and domestic waste produced by the maintenance of separator and the self-cleaning operation.

9.7.1Environmental impact analysis of waste residues in pipe cleaning operations

There is very little solid waste generated during the operation of the pipeline. It is mainly caused by impurities in the natural gas to the inner wall of the pipeline. The main components are iron oxide powder and dust. It belongs to general solid waste, and about 15kg of waste residue will be produced during the pipe cleaning operation in the process station every time, which has the ball collecting device. The station with the ball collecting device in this project is the Yongqing Connection Station and the Chengnan Terminal Station. The waste is transported to the site designated by the local environmental protection department for landfill, which has less impact on the environment.

9.7.2Environmental impact analysis of separator maintenance dust

In the maintenance of the station separator, the dust is discharged by its own pressure. The waste to be removed must be introduced into the sewage tank. The annual production of waste residue is about 5kg per station. The main component is dust, which belongs to general solid waste. There are 7 stations in the project, and the amount of waste generated is about 0.035t/a. It is regularly cleaned and transported to landfills with little impact on the environment.

9.7.3Environmental impact analysis of domestic waste

The garbage at each station site is collected centralized and relying on local functional departments for paid disposal, which has less impact on the environment。

In summary, the solid waste generated during the operation period of the proposed project is reasonably disposed according to its nature. It has little impact on the surrounding environment and can be accepted by the environment.

10 Environmental Risk Assessment

10.1 Purpose of the evaluation

(1) Purpose of the evaluation

The purpose of the environmental risk assessment is to analyze and predict the potential risk and harmful factors of the construction project, the unexpected events or accidents that may occur during the construction and operation of the construction project (generally excluding man-made damage and natural disasters) , the leakage of toxic, harmful and inflammable and explosive substances, which cause the personal safety and environmental impact and damage caused. Proposing reasonable and feasible preventive, emergency and mitigation measures is to make the level of the accident rate, loss and environmental impact of the construction project acceptable.

(2) Evaluation focus

The proposed project is a liquefied natural gas terminal and receiving station, as well as pipeline and station works . The main transportation and storage of liquefied natural gas are flammable. Failure to take effective measures, in the event of an explosion or leakage, will inevitably endanger the safety of the surrounding population and the environment of the coastal waters. Therefore, the focus of this risk evaluation is as follows :

① Risk identification and source item analysis should be carried out according to the concrete situation of the proposed project.

② The proposed project includes a LNG receiving station and a terminal . LNG is a flammable substance, and the risk of fire is high.

③ Quantitatively predicting the influence of marine oil spill accidents on marine environment in marine transportation engineering.

10.2 Rating and scope of evaluation

See section 2.3 Rating Scale and Scope.

10.3 Risk identification

10.3.1 Material risk identification involved in the proposed project

The main substance at risk of the proposed project is liquefied natural gas.

10.3.2 Material risk identification

The main material involved in the proposed project is natural gas, which belongs to Class I-B fire hazard according to the Standard of Oil and Gas Engineering Design Fire Protection Code (GB 50183-2015) .

The process of this project includes LNG marine transportation, unloading, storage, etc. The LNG storage and transportation process is different from the petrochemical plant production process under high temperature and high pressure. The operation conditions are mild, but there are still many potential risk factors for the project due to its large reserves and easy volatilization. According to the analogical investigation and statistics of the accident, combined with the analysis of the process of the project, the main risks are fire, explosion and fuel oil and natural gas leakage at the receiving station and terminal of the project. The main components of natural gas contain more than 99. 8% methane (mol %) , and the sulfur content is very low. When the natural gas leakage accident occurs, the fire and explosion will be accompanied by CO secondary pollutants, CO is a toxic and harmful substance.

10.3.2.1 Natural gas hazard characteristic

(1) Flammability

Natural gas belongs to category A B fire hazard. Only a small amount of ignition energy in the air will burn, so there is a greater risk of fire.

(2) Explosive

Natural gas and air constitute a mixture of gases, its concentration in a certain range, when fire occurs. The explosive limit range of natural gas (methane) is 5.3-15 (%V/V) . The wider the limit range of natural gas explosion concentration, the lower the lower the lower the concentration, the greater the material explosion risk.

(3) Toxicity

Natural gas is a hydrocarbon mixture, a low toxic substances, but long-term exposure can lead to neurasthenia syndrome. Methane is a simple asphyxiation gas, high concentration of oxygen asphyxia caused by poisoning. Dizziness, respiratory acceleration and movement disorder occur when the concentration of methane in the air reaches 25% ~ 30%.

(4) Thermal expansion

The volume of natural gas expands with the increase of temperature. If the station container is exposed to the sun or near the high temperature heat source, the medium inside the container expands due to the increase of internal pressure due to thermal expansion. This thermal expansion and contraction often damage storage containers, resulting in media leakage. Natural gas storage containers can also cause external pressure instability at low temperatures.

(5) Electrostatic charge aggregation

Although the electrostatic charge mainly occurs in the transportation, flow, loading and unloading of natural gas, but compressed gas from the nozzle or breakage of the high-speed jet, due to strong friction, will also generate static electricity. The harm of electrostatic discharge is mainly electrostatic discharge. If the spark energy produced by electrostatic discharge reaches or exceeds the minimum ignition energy of combustible material, it will immediately cause combustion and explosion.

(6) Diffusibility

The leakage of natural gas not only affects the normal transmission of pipelines, but also pollutes the surrounding environment and even causes people to be poisoned, and more seriously increases the risk of fire and explosion. When the pipeline system is not sealed properly, natural gas can easily leak, and can spread around with the wind, meet open flame is very easy to cause fire or explosion. The hazard characteristics of natural gas are shown in Table 10.3-1.

Table 10.3-1 Hazardous characteristics of natural gas

Critical temperature (℃)		-79.48	Combustion heat（kJ/kmol)	884768.6
Critical pressure (bar)		46.7	LFL（%V/V)	4.56
Standard boiling point (℃)		-161.5	UFL（%V/V)	19.13
Melting point (℃)		-182.5	Molecular weight（kg/kmol)	16.98
Maximum radiant energy kW/m^2		200.28	Maximum burning rate（kg/m^2.s)	0.13
Explosion	Upper limit	5.0	Risk of combustion explosion	1.8

limit %（v)	Lower limit	14.0	Hazard class	Class 2.1 flammable gases
Density（kg/m^3)		0.7407（In Standard State)		

10.3.2.2 CO hazard characteristic

In case of the leakage accident of the proposed project, the secondary pollutants associated with the fire or explosion at high temperature are mainly CO. The hazard characteristics of CO are shown in Table 10.3-2.

Table 10.3-2 Physical and chemical properties and hazard characteristics of CO

ID	Chinese name	CO	CAS	630-08-0	RTECS No.	FG3500000
	English name	Carbon monoxide	Molecular weight	28	UN No.	1016
	Molecular formula	CO			Dangerous goods number	21005
Physicochemical properties	Appearance and character	Colorless odorless odor				
	Solubility	Be slightly soluble in water, soluble in most organic solvents such as ethanol, benzene, chloroform, etc				
	Melting point（℃)	-205	Relative density (water = 1)	1.25（0℃）	Combustion heat（kJ/mol)	285.624
	Boiling point（℃)	-191.5	Relative density (air = 1)	0.97	Saturated vapor pressure（kPa)	No data
	Combustibility	Flammable	Critical temperature (℃)	-140.2	Critical pressure（MPa)	3.50
Flash point（℃)	＜-50	Ignition temperatur(℃)	610	Combustion (decomposition) product	Carbon dioxide	
Fire rating	Class A	Lower limit of explosion（V%)	12.5	Upper limit of explosion（V%)	74.2	
Stability	Stable	Contraindication	Strong oxidant	Polymerization hazard	Unpolymerized	
Hazard class	Class 2.1 flammable gases	Packing mark for dangerous goods	2	Packaging category	O52	
Hazard characteristic	An inflammable and explosive gas can be mixed with air to form an explosive mixture, which can cause combustion explosion in the presence of open flame and high heat					
Fire extinguishing method	Cut off the gas. If the gas source cannot be cut off immediately, the burning gas shall not be extinguished. Cool the container with water spray and, if possible, move it from the fire to the open.					
Storage and transport considerations	Store in a cool, airy, flammable gas storage room. Stay away from the fire, and the heat. The temperature should not exceed 30℃. Should be stored separately with oxidant, alkali, edible chemicals, avoid mixing storage. Use explosion-proof lighting, ventilation facilities. Do not use mechanical equipment and tools that can spark easily. The storage area shall be equipped with emergency handling equipment for leakage.					
Health hazard	Carbon monoxide binds to hemoglobin in the blood and causes tissue hypoxia. Acute poisoning: mild poisoning, headache, tinnitus, palpitations, vomiting, weakness, blood carboxyhemoglobin concentration can be above 10%; In addition to the above symptoms, the skin mucous membrane showed fuchsia, rapid pulse, irritability, gait instability, shallow to moderate coma, blood carboxyhemoglobin concentration can be					

<table>
<tr><td></td><td colspan="2">more than 30%; In severe patients with deep coma, miosis, myotonia, frequent convulsions, fecal incontinence, shock, and severe myocardial injury, blood carboxyhemoglobin can be more than 50%. Chronic effects: Whether chronic poisoning can be caused and cardiovascular effects are uncertain.</td></tr>
<tr><td>First aid</td><td colspan="2">Remove quickly from site to fresh air when inhaled.Keep your airway open.If breathing is difficult, give oxygen. When the breath is stopped, artificial respiration and chest compressions are performed immediately. See a doctor.</td></tr>
<tr><td rowspan="5">Protective measures</td><td>Engineering protection</td><td>Closed production process, enhance ventilation; Safe shower and eye washing facilities available.</td></tr>
<tr><td>Respiratory system protection</td><td>When the air concentration exceeds the standard, wear a self-suction filter gas mask (semi-mask) . In case of emergency rescue or evacuation, it is recommended to wear air respirator, carbon monoxide filter self-rescuer.</td></tr>
<tr><td>Eye protection</td><td>No special protection is required</td></tr>
<tr><td>Protective clothing</td><td>Wear appropriate protective clothing.</td></tr>
<tr><td>Other</td><td>Smoking is strictly prohibited at work. Pre-employment and regular medical examinations are carried out. Avoid high concentrations of inhalation. Access to restricted space or other high concentration areas shall be supervised.</td></tr>
<tr><td>Leakage disposal</td><td colspan="2">Quickly evacuate the leaking contaminated area personnel to the upper wind and immediately isolate 150m, strictly restricting access. Cut off the fire. It is suggested that emergency personnel wear self-contained positive pressure respirator and anti-static work clothes. Cut off the source as much as possible. Reasonable ventilation, accelerated diffusion. Spray water is diluted and dissolved. A large amount of waste water produced by the construction of a dike or excavation. If possible, send the air leakage exhaust fan to the open area or install a suitable sprinkler to burn. The pipeline can also be used to guide the furnace, concave ground burning. The leaking container shall be handled properly, repaired and inspected before use.</td></tr>
</table>

10.3.3 Production system hazard identification

10.3.3.1 Hazard identification of pipeline facilities

Leakage or fracture of buried natural gas pipelines may be caused by soil corrosion, stray current corrosion, material defects and weld defects, natural disasters, third-party damage and other factors.

10.3.3.2 Hazard identification of pipeline station facilities

Improper selection or aging damage to the valve, flange, gasket, etc. of the station may cause gas leakage. When the equipment such as pigging, separation, filtration, etc. is overpressured due to abnormal reasons, if the safety relief device fails, it will cause gas leakage due to overpressure. The compressor leaks due to seal damage.

When the accident gas needs to be discharged in the system, the flare is vented. Once the combustion system fails, the gas in the pipeline is directly discharged into the atmosphere. If the gas diffusion conditions are not good, when these gases are mixed with the air to reach the explosion limit, there will be a danger of explosion.

10.3.4 Identification of material transfer pathways

The natural gas leaked from this project and the CO produced after combustion are gaseous pollutants. These pollutants enter the atmosphere and cause damage to the atmospheric environment around the project through atmospheric diffusion.

10.3.5 Risk identification results

(1) This project is transporting purified natural gas, which belongs to Class I-B fire hazard according to the Standard of Oil and Gas Engineering Design Fire Protection Code (GB 50183-2015) . The main types of accidents are natural gas leakage, fire explosion.

(2) The content of methane in the main component of natural gas is over 99. 8% (mol %) . The total sulfur content in the gas source is very low, and the concentration of SO2 pollutants produced by natural gas leakage combustion is limited (10 10 mg/m3) . In the event of leakage accident in the pipeline and station yard of this project, the fire and explosion of the leaking natural gas in the presence of open flames or high temperature heat energy will be accompanied by secondary CO pollutants, which are toxic and harmful substances.

This evaluation focuses on the environmental risk of CO associated with natural gas leakage and incomplete combustion of natural gas.

10.4 Risk Accident Scenario Analysis

10.4.1 Risk accident scenario setting

Because this project involves toxic, harmful and inflammable and explosive substances, this evaluation has confirmed that the potential hazards are fire explosion and toxic substance leakage through the analysis of main dangerous pipe sections, fire explosion index and analogical investigation and analysis results.

10.4.2 Maximum credible accident and its source term analysis

10.4.2.1 Screening of the Most Trusted Accidents of Atmospheric Environmental Risk

According to the definition in the Technical Guidelines for Environmental Risk Assessment of Construction Projects (HJ 169-2018) , the most credible accidents are those that cause the most serious hazards among all accidents occurring within a given probability range, based on empirical statistical analysis.

Considering that the environmental risk impact of the project is mainly secondary to the environment after the explosion fire accident, the maximum credible accident selection mainly considers the population distribution along the pipeline controllable nodes of the project and the natural gas online quantity and peripheral sensitivity. The maximum credible accident setting of the proposed pipeline is shown in the following table.

Table 10.4-1 Setting for Maximum trusted incident

No.	Position	Accident site	Accident overview	Select Reason
1	Pipeline	South Harbour Transfer Station ~2 # Valve Room	Due to the third party reason, if the pipeline is broken, the natural gas is leaking, and the mixture is easy to explode.	The longest pipe section, the largest on-line quantity of natural gas

10.4.2.2 Probability of the Most Trusted Accident of Atmospheric Environmental Risk

The maximum probability of a credible accident is referred to in Appendix E of *the Environmental Risk Assessment Guidelines for Construction Projects* (HJ 169-2018) .

Table 10.4-2 Leak Probability Table for Quantitative Risk Assessment of Major Hazard Sources

Part type	Leakage mode	Leakage probability
Pipe with internal diameter ≤ 75mm	Leakage aperture 10% aperture	5.0×10^{-6}/（m•a)
	Full pipe diameter leakage	1.0×10^{-6}/（m•a)
Pipe with inner diameter≤150 mm and >75mm	Leakage aperture 10% aperture	2.0×10^{-6}/（m•a)
	Full pipe diameter leakage	3.0×10^{-6}/（m•a)
Pipe with inner diameter>150 mm	Leakage aperture 10% aperture (max 50 mm)	2.4×10^{-6}/（m•a)
	Full pipe diameter leakage	1.0×10^{-7}/（m•a)

The pipeline diameter of this project is φ1219 and φ1016, and the probability of full pipe diameter leakage is 1.0×10^{-7}（m•a) , because of the length of the pipeline, the leakage of the full pipe diameter is the largest credible accident of the pipeline.

10.4.2.3 Maximum trusted incident source entry

(1) Natural gas leakage

According to *the Guidelines for Environmental Risk Assessment of Construction Projects*(HJ 169-2018) , the risk source strength of the oil and gas pipeline project should estimate the leakage amount according to the 100% fracture of the pipe cross section and consider the leakage amount before and after the start of the truncated valve chamber. The leakage amount before starting the shutoff valve shall be determined according to the actual working condition; After the shutoff valve chamber is started, the amount of leakage is measured by the time it takes the pipeline to relieve pressure to the ambient pressure balance.

The gas release rate of this project (Nangang Branch Transmitting Station ~ #2 Valve Chamber) is shown in Figure 10.4-1; The maximum source of methane accident in this segment is shown in Table 10.4-1

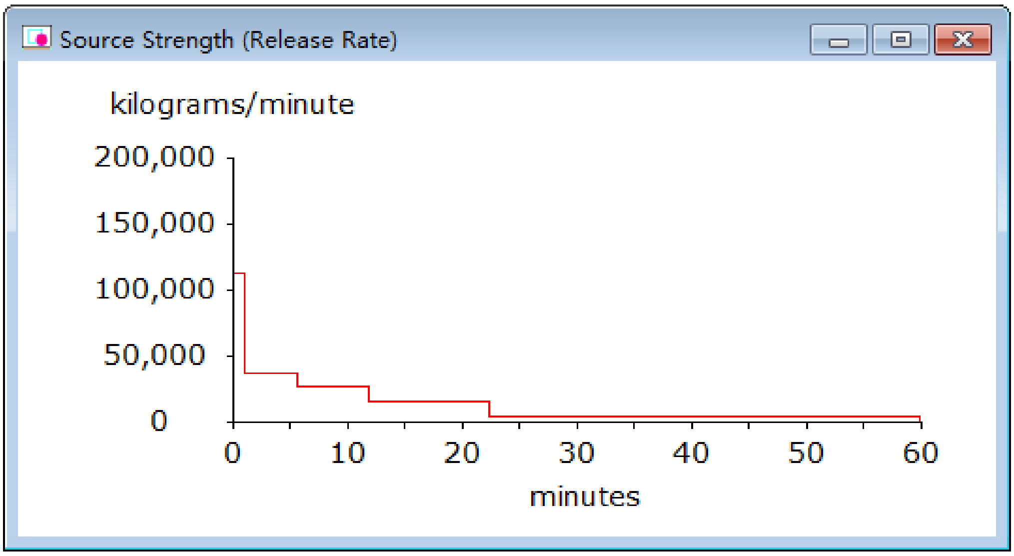

Figure 10.4-1 Rate of Release of Natural Gas Leakage for this Project (South Harbour Branch Station ~ #2 Valve Chamber)

Table 10.4-3 Sources of the methane of maximum credible accident for this project

Risk source	Accident site	Pipe diameter (mm)	Pressure (MPa)	Length (km)	Maximum leakage rate (kg/s)	Average leakage rate (kg/s)
Pipeline	South Harbour Transfer Station ~2 # Valve Room	1219	10.0	32.7	6667	2185

(2) Secondary pollutant carbon monoxide

Natural gas leakage occurs in gas transmission pipe section and station yard, which can easily cause fire. Gas instantaneous large leakage, easy to produce incomplete combustion, will produce carbon monoxide. Reference is made to the parameters of pollutants from natural gas combustion in the *Beijing Environmental Master Plan Study* (Volume II) : the coefficient of CO production is 0.35 g/m^3 natural gas. The maximum rate of carbon monoxide is calculated to be 1.03 kg/s.

10.5 Risk prediction and evaluation

10.5.1 Atmospheric Environmental Risk Prediction and Assessment

10.5.1.1 Analysis of atmospheric environmental impact of natural gas leakage in pipelines

1) Prediction model

The atmospheric diffusion of natural gas is based on the *Technical Guidelines for Environmental Risk Assessment of Construction Projects* (HJ 169-2018) .

2) Meteorological conditions

Wind speed 1.5 m/s, temperature 25℃, relative humidity 50%, atmospheric stability F class.

3) Prediction parameters

After natural gas pipeline fracture, the uplift height of the gas flow directly affects the prediction results. For this reason, the evaluation unit has collected some reports about natural gas pipeline accidents and consulted some safety evaluation units. The injection height of natural gas flow can reach more than 50m when most large diameter and high pressure pipelines break.

Because the pipe is closed by pneumatic valve, the cutting speed is 2.54cm (1 inch) per second and the cutting time is calculated according to the pipe diameter. Φ 1219 Pipe completely truncated, 32 seconds required. After complete truncation, the guide risk simulation program is used to predict the time period and corresponding source strength of pipeline leakage.

4) Calculation results and analysis

(1) Methane

The results of predicting the maximum axial concentration of methane in the case of gas leakage at the maximum stage of pipe breakage are shown in the following table.

Table 10.5-1 Prediction of maximum concentration of natural gas (methane) leakage axis

No.	Distance（m) (mg/m3)	Concentration occurrence time (min)	Peak concentration (mg/m^3)
1	6.0000E+01	5.0000E-01	1.2949E+00
2	1.1000E+02	9.1667E-01	3.8140E+04
3	1.6000E+02	1.3333E+00	1.1398E+05
4	2.1000E+02	1.7500E+00	1.1265E+05
5	2.6000E+02	2.1667E+00	8.9560E+04

As can be seen from the above table, the maximum landing concentration of methane is 113980 mg/m^3 under the set prediction condition when the maximum pipe stock control node unit is broken and the maximum gas reservoir leakage occurs. There was no toxic endpoint concentration of-1 and toxic endpoint concentration of-2.

10.5.1.2 Analysis of atmospheric environmental effects of pipeline secondary pollutant carbon monoxide

The maximum axial concentration of CO produced by fire is predicted in the following table when the gas leakage occurs at the maximum segment of the pipe stock.

Table 10.5-2 Prediction results of atmospheric pollution CO during fire

No.	Distance（m) (mg/m3)	Concentration occurrence time (min)	Peak concentration (mg/m^3)
1	6.0000E+01	5.0000E-01	6.1040E-04
2	1.1000E+02	9.1667E-01	1.7979E+01
3	1.6000E+02	1.3333E+00	5.3732E+01
4	2.1000E+02	1.7500E+00	5.3102E+01
5	2.6000E+02	2.1667E+00	4.2218E+01

As can be seen from the table above, if the maximum pipe stock control node unit is broken and the maximum gas reservoir leakage occurs in the event of fire, the maximum ground floor area of CO is 53.7 mg/m^3 under the set forecast conditions, and no toxic end point concentration -1 and toxic end point concentration -2 are present.

10.5.1.3 Atmospheric Environmental Risk Prediction Conclusions

1) The predicted results show that the maximum landing concentration of methane is 113980 mg/m^3 under the set prediction condition if the maximum pipe stock control node unit is broken and the maximum gas reservoir in the station is leaking. There was no toxic endpoint concentration of -1 and toxic endpoint concentration of -2.

2) Natural gas leakage can easily cause fire. Gas instantaneous large leakage, easy to produce incomplete combustion, will produce carbon monoxide. Due to the low sulfur content in this project, the concentration of SO_2 pollutants produced by natural gas leakage combustion is limited ($\ngtr$10mg/m^3) , which will not result in the increase of SO_2 pollutants and exceeding the standard. The predicted results show that, if the maximum gas storage capacity of the maximum pipe stock control node unit is broken, the maximum ground floor area of CO is 53.7 mg/m^3 under the set forecast condition. No toxic end point concentration -1 and toxic end point concentration -2 are found.

10.5.2 Analysis of Surface Water Environmental Impact

Because the natural gas density is smaller than air, the boiling point is very low (-161.5 °C) , and it is almost insoluble in water.

If the pipeline fire and explosion accident occurs, the water body will be disturbed and the suspension will be increased, which will affect the water quality in the short term. The construction unit shall, through strict management and standardization of construction, minimize the impact.

10.6 Environmental risk management

10.6.1 Environmental Risk Management of Send-out pipeline

10.6.1.1 Accident prevention measures during construction period

1) In the process of construction, strengthen supervision to ensure the quality of coating construction;

2) Establish a construction quality assurance system to improve the level of construction inspectors and strengthen inspection methods ;

3) Make strict rules and regulations, find defects timely and correct repair and make records ;

4) The pressure test shall be carried out strictly according to the pressure test scheme to eliminate more defects existing in the weld and the master material, in order to increase the safety of pipelines;

5) Select experienced units to carry out the construction, and through the third party supervision of the construction quality of its strong supervision to reduce construction defects ;

6) Establish and implement health, safety and environment (HSSE) management system, quality management system and quality supervision system, strengthen the quality safety consciousness of construction personnel and improve the technical level of construction personnel. These are effective ways to ensure construction quality and reduce construction quality accidents.

7) In the area of landslide and collapse, effective measures shall be taken during construction to avoid possible damage to pipeline caused by landslide.

8) Hydraulic protection shall be provided in the alluvial fan area at the front of the mountain and in the scour area of the mountain valley.

10.6.1.2 Management Measures for Risk Prevention in Operation Period

1) Strengthening management as required by the *Law of the People's Republic of China on the Protection of Petroleum and Natural Gas Pipeline*

The construction unit shall conduct publicity and education on the safety protection of pipeline facilities to the people along the line, cooperate with the public security organs to do a good job in the safety protection of pipeline facilities, so as to ensure the safe operation of pipelines and their ancillary facilities ;

(1) Within 5 meters of each side of the central line of the pipeline, no operation activities such as soil removal, excavation of ponds and other operations that are likely to damage the pipeline shall be allowed ;

(2) Within 50 meters of each side of the central line of the pipeline and within 50 meters of each other outside the site of the pipeline facilities, it is prohibited to blast, demolish, open mountains and construct large buildings and structures;

(3) Blasting shall be carried out within a range of 50 m to 500 m on each side of the central line of the pipeline and shall be reported in advance to the competent authority of the construction party for approval before taking safety protection measures;

2) Establishment of an environmental risk management system

Pipeline must establish comprehensive management, HSSE management and risk management system during operation period. The comprehensive management system includes: management of organizational structure, tasks and responsibilities, formulation of operating procedures, safety regulations, staff training, emergency plans, construction of pipeline system data files. In order to prevent accident risk, the main accident prevention documents must be prepared ;

3) Establishment of a gas pipeline integrity management system

In order to ensure the safety of residents and property along the gas pipeline, after the completion of the pipeline, it is suggested that the pipeline company establish a complete management system for the gas pipeline, and do a good investigation of HCA (high-consequence area) along the pipeline, including :

(1) Third and fourth types of areas ;

(2) The approximate number of persons close to the pipeline (including considering the level of protection that may be provided by an artificial or natural obstacle) ;

(3) The approximate number of places with restricted or restricted scope of activities (such as hospitals, schools, kindergartens, nursing homes, prisons and recreational facilities) , in particular outside areas that are not protected ;

(4) Possible damage to property and environmental damage ;

(5) Public facilities and equipment ;

The above information is collected to provide the basis for drawing up emergency rescue plan for natural gas pipeline accidents in this project.

4) Before the pipeline system is put into operation, the operation manual and maintenance manual shall be drawn up for normal, abnormal or emergency situations, and the operation and maintenance personnel shall be trained and certified to work to avoid accidents caused by serious operation errors;

5) To formulate emergency operating procedures, which shall describe the operation steps to be taken in the event of pipeline accidents, specify the progress of rush repairs, limit the impact of accidents, and also explain safety problems related to pipeline operators;

6) Operators should carry out safety activities every week, improve the safety awareness of workers and workers, identify the abnormal state before the accident, and take corresponding measures;

7) To strengthen education for residents living near pipelines, further publicize and implement the *Law on the Protection of Petroleum and Natural Gas Pipelines* to reduce and avoid third party damage;

8) Complete inspection items and maintenance methods for important equipment; Carry out regular maintenance according to plan; Special files (including maintenance records files) , complete documents.

9) Strictly control the temperament of natural gas, clean the pipe regularly, remove the water and dirt in the pipe, so as to reduce the corrosion in the pipe;

10) Regular measurement of pipe wall thickness, timely maintenance and replacement of pipe sections which have been seriously thinned, to avoid pipe burst;

11) Regular inspection of the pipeline safety protection system (such as cut-off valve, safety valve, vent system, etc.) , so that the pipeline can be safely processed during overpressure, so as to minimize the scope of damage;

12) The marks at the crossing points of railways, highways and rivers shall be clear, and shall be visible from different directions and angles;

13) Increase the frequency of patrol lines and improve their effectiveness; Check the pipeline construction belt every day, check the surface conditions, and pay attention to the activities of personnel in this area, find out the acts that have an impact on the pipeline safety, should be stopped in time, take corresponding measures and report to the higher authorities ;

14) Regular inspection of pipelines passing through sensitive areas such as rivers ;

15) During the flood period, special attention should be paid to the safety of the pipeline in the river crossing section ;

16) Fire prevention should be paid attention to when emptying the vent pipe accident.

10.6.1.3 Risk Prevention Measures of Leakage Accident

1) The valve chamber of the site of this project is equipped with an emergency shut-off valve of gas-liquid linkage, which automatically closes the upstream and downstream valves of the leakage point by on-line detecting the pressure drop rate of the main pipeline under the condition of leakage accident, cutting off the gas

source in time to reduce the leakage and effectively avoid the occurrence of secondary disasters.

2) In the event of an accident in the pipeline, the vent vertical pipe set by the cut-off valve chamber shall be emptied.

3) A weather vane is arranged at the display position of the gas transmission station, so that the workers can choose the correct operation orientation and choose the correct evacuation direction in the case of an accident.

4) The integrated office building, station control room, corridor and other places are equipped with addressable intelligent fire detectors and manual fire alarm buttons. The fire alarm controller of the station control room receives the fire detection signal of the fire detection equipment, and carries out the fire acousto-optic alarm in case of fire. The fire alarm signal is sent to the station control part to complete the interlocking and cutting of the station yard.

5) Most of the equipments in the installation area are arranged in the open air to ensure good ventilation conditions. Flammable gas alarm devices shall be set in the installation area and gas generator room where flammable gas leakage is likely to occur in the gas transmission station yard, and combustible gas alarm devices shall be set in the station control room.

① The position of combustible gas alarm is chosen near the downwind side of the local maximum frequency wind direction at the leakage point, and the sensitivity test and appraisal are made regularly.

② The contact signal of the high concentration alarm output relay of combustible gas alarm at the station is transmitted to the station control system. Fire control in installation area is designed according to relevant standards. The device is equipped with mobile fire extinguishing facilities. All stations are equipped with portable combustible gas detectors. Gas stations are equipped with gas masks and portable leak detectors for flammable gases according to personnel.

10.6.1.4 Risk Prevention Measures for Environmental Sensitive Areas and Key Sections

Risk prevention measures for environmental sensitive areas and key areas are shown in the following table.

Table 10.6-1 Risk Behavior Measures for Key Pipe Segments

Risk type	Description of focused section	Damage	Risk prevention measures
Riparian erosion	Project pipeline crossing each river area	Damage the pipeline	1) During the design phase, the damage of flood to the scour and erosion of the engineering facilities should be fully taken into account. 2) During the construction phase, the construction unit shall regularly contact the local water conservancy department to have a comprehensive understanding of the river water regime along the pipeline and to know early prevention of possible conditions. 3) During the operation phase, daily patrol and monitoring and regular inspection shall be carried out, the changes of the river banks shall be noted, hidden dangers shall be discovered and timely measures shall be taken to avoid the occurrence of dangerous conditions.
Proximity settlement	Villages and residents on both sides of the pipeline of this project	In the event of an accident, it will pose a threat to the health of the residents at close range	1) Reasonable choice of route direction: when choosing the route direction, avoid the population concentration area and the urban development planning area as far as possible, so as to reduce the leakage, fire and explosion accidents caused by natural gas leakage to the residents; 2) To improve the design level: To increase the design level in sensitive areas such as population concentration areas and close residential areas along the pipeline that cannot be avoided, so as to enhance the capacity of the pipeline to resist possible external damage, as follows : (1) The wall thickness of local pipeline is increased. (2) Spiral seam submerged arc welded steel pipe and straight seam submerged arc welded steel pipe are used throughout the pipeline. (3) The outer corrosion protection layer of the pipeline is three layers PE, and the outer corrosion protection layer of some sensitive areas is three layers PE. 3) Measures to prevent accidents in the construction stage (1) Strengthen supervision during construction. The pipeline weld adopts 100% ray flaw detection 100% ultrasonic flaw detection to ensure the quality of the weld. (2) Establish a construction quality assurance system to improve the level of construction inspectors and strengthen inspection methods; Make strict rules and regulations, find defects timely and correct repair and record. (3) Select experienced units to carry out construction, and have excellent third parties to the construction quality of their strong supervision to reduce construction errors. 4) Measures to prevent accidents during operation (1) To strengthen the publicity of the *Law of the People's Republic of China on the Protection of Petroleum and Natural Gas Pipelines*, popularize the knowledge of natural gas and pipeline transportation, raise awareness of the safety protection (pipeline protection and self-protection) of residents in close quarters and population concentration areas, and report problems in time ;Formulate emergency plans for special accidents in densely populated areas and close residential areas. (2) Regular measurement of pipe wall thickness, timely maintenance and replacement of pipe sections with serious pipe wall thinning to avoid pipe burst; Check the pipeline safety protection system (such as cut-off valve, safety valve, vent system, etc.) every half year, so that the pipeline can be safely handled during overpressure, so as to minimize the damage. (3) Increase the frequency of patrol line and improve the effectiveness

Risk type	Description of focused section	Damage	Risk prevention measures
			of patrol line; Check the pipeline construction belt regularly, check the surface conditions, pay attention to the activities of the personnel in this area, and find out the behaviors that have an impact on the pipeline safety.
Environment sensitive area	Key prevention and control areas for water and soil conservation	In the event of an accident, it affects the sensitive area	1) Environmental supervision as a key point. 2) Scientific organization and civilized construction to avoid the damage of corrosion protection layer and pipe body in the process of construction. 3) Reasonable setting of the cut-off valve chamber, in order to be able to emergency cut off in the event of an accident, to avoid a wide range of accidents. 4) Strictly control the operating belt and protect animals and plants found in construction 5) Strengthen pipeline patrol, intensify publicity and education on pipeline safety protection and raise awareness of the safety of the people along the line.
Pipeline parallel segment	Parallel with other linear engineering	In the event of an accident, it affects adjacent pipes	1) The vertical net distance at crossing shall not be less than 0.3m, and the pipe sections extending more than 10m on each side of intersection shall ensure that the corrosion protection layer of the pipeline after construction is free of leakage. 2) As far as possible, the cross section pipeline shall be laid through elastically, cross piles or warning signs shall be arranged at the cross section of the pipeline and the buried depth shall be indicated. 3) A cathodic protection test pile shall be set at the intersection of the pipeline and reasonable protective measures shall be taken in conjunction with the interference test. 4) The quality inspection of the pipeline shall be carried out by electric spark leak detector according to the grade of anticorrosion layer before the new groove is built in the cross section. After backfilling, the pipeline should be inspected by PCM floor, and the leakage point should be excavated and repaired to ensure the safety of the pipeline body. 5) Key inspection of cross section pipeline during operation period. 6) The exact position of the pipeline should be detected when crossing the existing pipeline, the manual excavation should be the main method and the mechanical excavation should be the auxiliary method to avoid the damage of the pipeline. The construction of any side of the pipeline at the intersection shall be carried out in accordance with the provisions of *the Law of the People's Republic of China on the Protection of Petroleum and Natural Gas Pipeline*. The other party shall inform the third party owner, construction party and other relevant units of the location and depth of the pipeline and optical cable. Arrange on-site supervision by special personnel if necessary. 7) The pipeline of the cross section shall be tested periodically for negative protection, and timely remedial measures shall be taken in case of negative protection interference or damage to the anticorrosion layer.
Pipeline cross section	Cross section with other oil and gas pipelines	In the event of an accident, it affects	1) Suggested measures in the design (1) The vertical net distance at crossing shall not be less than 0.3m, and the pipe sections extending more than 10m on each side of intersection shall be ensured that the corrosion protection layer of the pipeline shall be leak-free.

Risk type	Description of focused section	Damage	Risk prevention measures
		adjacent pipes	(2) As far as possible, the pipelines in the cross section shall be laid through elastically. Crossover piles or warning signs shall be arranged at the cross section of the pipelines and the depth of buried pipeline shall be indicated. (3) A cathodic protection test pile is arranged at the intersection of the pipeline, and reasonable protection measures are taken in conjunction with the interference test. (4) The quality inspection of the pipeline shall be carried out by electric spark leak detector according to the grade of anticorrosion layer before the new groove is built in the cross section. After backfilling, the pipeline should be inspected by PCM floor, and the leakage point should be excavated and repaired to ensure the safety of the pipeline body. 2) Suggested measures in construction (1) Prior to construction, the pipeline management unit shall be fully communicated with the pipeline management unit and the pipeline location shall be determined, and excavation shall be carried out with the consent of the built pipeline management department. (2) Manual excavation shall be carried out to the extent possible within 10m on each side of the intersection, and necessary support and protection measures shall be taken for the existing pipes in a timely manner, such as support and protection by means of tile supports, angle steel or steel pipes. (3) Adopt the operation method of continuous construction, complete the pipe resistance welding as soon as possible, and fill the pipe trench in time to minimize the exposure time of the original pipe. When the pipe is in the lower ditch, the pipe ditch and the machine and tools shall not kowtow to the built pipe. (4) When backfilling the pipe trench, the pipe trench shall be compacted in layers to prevent damage to the built pipe due to the sinking of the pipe trench backfill soil. (5) Electric spark leak detector shall be used to inspect the quality of the pipeline before backfilling of the pipe trench in the cross section. It is found that the damage must be repaired before backfilling the pipe trench to ensure the integrity of the anticorrosion layer of the pipeline and to ensure the safety of the pipeline body. 3) Suggested measures during the operational period (1) During the operation period, the key inspection of cross section pipeline shall be conducted. (2) The construction of any side of the pipeline at the intersection shall be carried out in accordance with the provisions of the *Law of the People's Republic of China on the Protection of Petroleum and Natural Gas Pipeline*. The other party shall inform the third party owner, construction party and other relevant units of the location and depth of the pipeline and optical cable. Arrange on-site supervision by special personnel if necessary. (3) The pipeline of the cross section shall be tested periodically for negative protection, and timely remedial measures shall be taken in case of negative protection interference or damage to the anticorrosion layer.

10.6.1.5 Analysis on rationality of valve chamber setting across sensitive region

In accordance with the *Gas Pipeline Engineering Design Code* (GB 50251-2015) , the maximum distance between shutoff valves shall be as follows:

(1) The pipe segment in the first-level area shall not be larger than 32 km ;

(2) The pipe segment in the second-level zone shall not be more than 24 km ;

(3) The pipe segment in the third-level area shall not be larger than 16 km ;

(4) The pipe segment in the fourth-level area shall not be larger than 8 km.

The project has a total of 10 circuit cut-off valve rooms across the entire line, a total of 3 environmental sensitive areas, and in each sensitive area across the upstream and downstream section are equipped with valve rooms. It can be used to cut off the sensitive area under the condition of accident to avoid pollution to sensitive areas.

10.6.1.6 Risk emergency measures

The environmental risk emergency shall focus on the emergency measures taken to avoid the influence of secondary pollution on the environment caused by fire and explosion accidents caused by pipeline leakage, and the corresponding emergency measures shall be taken to prevent the environmental pollution accidents caused by the accident state on the drinking functional water body and the chain reaction of the parallel and crossed oil and gas pipelines.

(I) Characterization of accident impact

The accident types of the send-out pipeline of this project are leakage, fire and explosion.The impact of the accident on the passing through and adjacent environmental sensitive areas and social areas of concern is described in the following table.

Table 10.6-2 Accident state influence characterization of The types of leakage, fire and explosion involved in the send-out pipeline of this project

Accident type	Impact object	Influencing stage and characterization	
		Accident stage	Maintenance stage
Leakage accident	Water body	No impact	Has an impact This may result in increased water suspensions, leakage of fuel from maintenance machinery, and increased oil in water, affecting potential water and water supply
	Forest land	No impact	No impact Influence the surface vegetation,

Accident type	Impact object	Influencing stage and characterization	
		Accident stage	Maintenance stage
			destroy the surface grass and shrub vegetation in the maintenance area
	Immovable cultural relics	No impact, avoiding in line selection stage	No impact, avoiding in line selection stage
	Social concerned area	Has an impact We need local evacuees, cordon lines, fire control.	Has an impact Mechanical noise affects peripheral residents
Fire accident	Water body	No impact	Has an impact This may result in increased water suspensions, leakage of fuel from maintenance machinery, and increased oil in water, affecting potential water and water supply
	Forest land	Has an impact A certain range of forest land is ignited, and may lead to fire spread; Reptiles in local areas may be burned, and animals that move quickly may quickly evade	No impact The surface grass and shrub vegetation in the maintenance area are damaged, and the forest loss needs to be compensated
	Social concerned area	Has an impact A range of wooden structures may be ignited; Local evacuation is needed to avoid heat radiation burn; Set up a cordon to control the fire	Has an impact Mechanical noise affects peripheral residents Compensation for damaged buildings
Explosion accident	Water body	Has an impact The lake shore may be damaged, the mud in the accident section is severely disturbed, affecting the river water quality, potentially affecting downstream water intake, water supply	Has an impact This may result in increased water suspensions, leakage of fuel from maintenance machinery, and increased oil in water, affecting potential water and water supply
	Forest land	Has an impact Causes the forest tree to lie down in the vicinity of the vegetation damage accident above the pipe section, the influence range is nearly 200 m	No impact Influence the surface vegetation, destroy the surface grass and shrub vegetation in the maintenance area
	Social concerned area	Has an impact Could lead to death and injury	Has an impact Mechanical noise affects peripheral residents

(II) Emergency response measures in relevant regions

If there is any need to inform local emergency organization according to corresponding level after the accident of this project, see figure below.

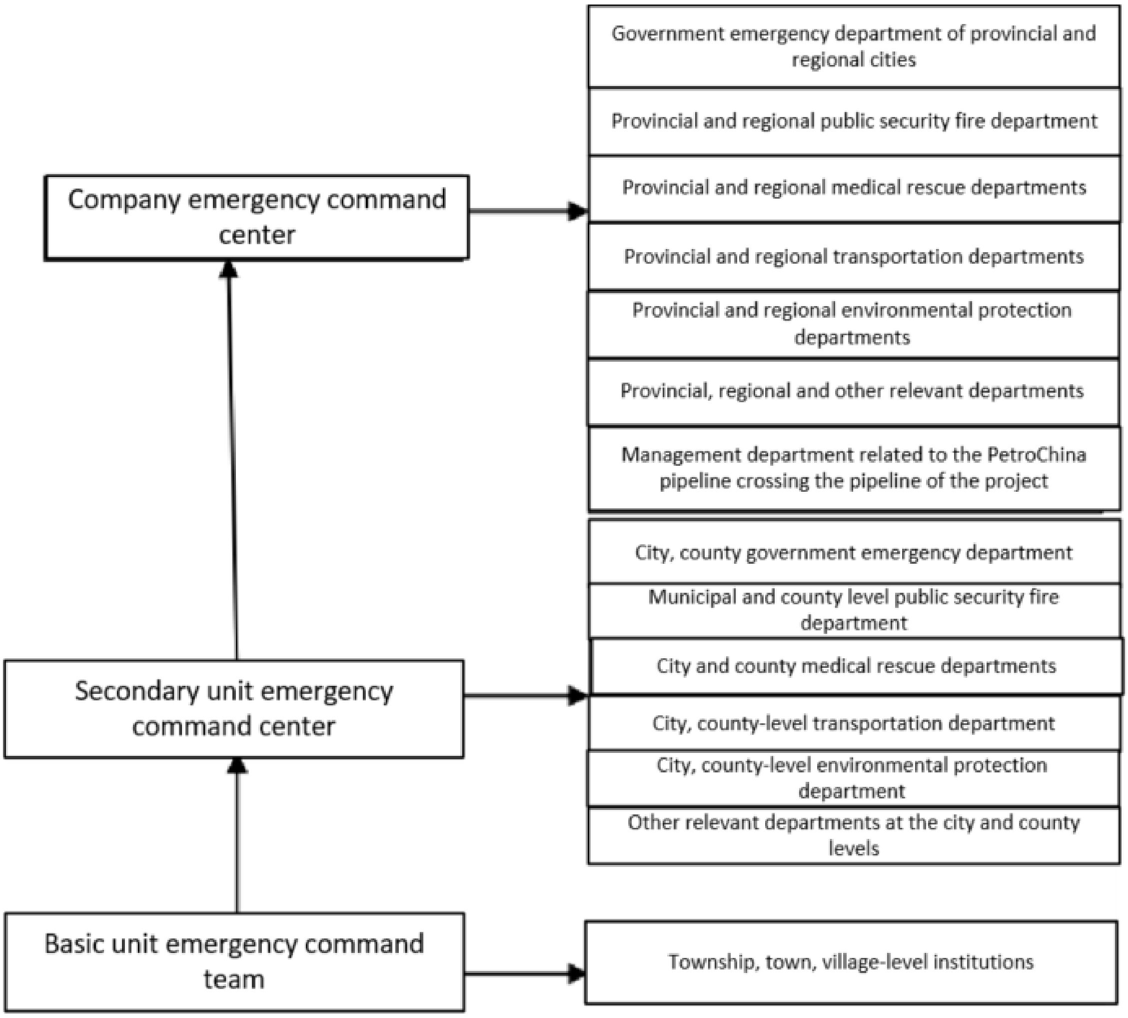

Figure 10.6-1 Regional emergency response mechanism

If the existing oil and gas pipeline of this project is parallel or cross, in order to reduce the mutual influence under the accident situation and reduce the chance of secondary disasters, after the accident of this project pipeline, timely notify the oil and gas pipeline management department concerned with this project pipeline to take the risk emergency measures on the spot and establish a practical linkage mechanism.

In order to reduce casualties and property losses, the local government should contact the local medical, public security, armed police, fire control, water conservancy and environmental protection departments directly after notifying local emergency organizations to ensure that rescue forces arrive at the scene of the accident early for rescue.

(III) Establishment of emergency management bodies and material distribution

The pipeline passes through Tianjin and Langfang area, which has the Branch of China Petroleum Pipeline Bureau Engineering Ltd., located in Langfang City, which is the earliest unit engaged in repairing and plugging operation in China. The Branch of China Petroleum Pipeline Bureau Engineering Ltd. is close to the Escort, convenient transportation and good overall supporting conditions. And the Branch of China Petroleum Pipeline Bureau Engineering Ltd. rush repair branch can carry out customized repair program according to the pressure of the pipeline, pipe diameter and owner's requirements. The repair includes routine maintenance work, 24 hours a day on call, and timely response to attendance. The emergency repair of the pipeline, station, valve room, they can meet all demands.

The site evaluation personnel can reach the repair site within 8 hours; The large rush repair equipment (hole opener, stopper, pipe breaker, generator, etc.) will arrive at the rush repair site within 16 hours; The rush repair of station/gate station pipeline and pipe fittings requires quick and efficient completion, material cleaning and site cleaning.

Therefore, the project is no longer to build new maintenance agencies, relying on the maintance of the China Petroleum Pipeline Bureau Engineering Ltd. for daily maintenance and repair work.

Table 10.6-3 Establishment and Jurisdiction of Maintenance Agencies

No.	Agency name	Jurisdiction	Length (km)	Remark
1	The Maintenance Repair Branch of the China Petroleum Pipeline Bureau Engineering Ltd.,	Full line station, pipeline and valve room	Whole line	Rely on

(IV) Emergency measures for natural gas leakage in gas transmission station yard

1) According to the process conditions, measures can be taken to open the station overstep valve, close the inlet and outlet valve emergency vent the natural gas in the station. Use the control center or station control system to operate, if the remote control failure, by the station process personnel on the corresponding operation. In case of emergency, the station personnel can start ESD button immediately and then report; In the case that the production station cannot enter, the upstream station, downstream main line valve chamber or station yard shall be closed immediately, and the vent valve shall be opened and emptied to micro-positive pressure;

2) The process personnel shall inspect the concentration of natural gas and, if necessary, immediately safely cut off the power supply on the production site and confirm the on-site process cut off;

3) If necessary, to the public security department (110) , fire department (119) , medical first aid (120) and other departments for assistance;

4) Arrange special personnel to carry out on-site inspection, set up a cordon line on the road at a certain distance from the center of the accident, and send personnel to guide the public security, fire control and medical rescue teams or vehicles; If necessary, immediately request the local government at the site of the accident to start the emergency evacuation plan;

5) Emergency teams shall immediately carry out emergency repair work in accordance with the division of emergency preparedness plans, carry out emergency repair work under the unified command of the on-site emergency headquarters, and conduct natural gas concentration monitoring at any time during the emergency repair process.

6) Inform the relevant users promptly of the impact on the user's supply of gas.

(V) Emergency measures for natural gas leakage outside the gas station yard

1) General measures of disposal

(1) Station personnel or line patrol personnel report immediately to the emergency command center office and quickly identify the specific location of the leak;

(2) The upstream and downstream valve chamber cut-off valve of the pipeline accident point shall be closed by remote control; If the shut-off valve fails to close by remote control, inform the patrol personnel to close the valve chamber at the scene to cut off the valve, confirm that the gas in the event pipe section will be emptied to micro-positive pressure after closing, and the patrol personnel will be stationed in the valve chamber to take care until the rescue is over to restore the gas supply;

(3) The rescue team shall take effective pressure relief measures according to the situation on site, such as emptying the leaking pipe section;

(4) The emergency monitoring group shall continuously inspect the combustible gas concentration, wind direction and wind force at the leakage site, analyze and evaluate the hazards of the relevant data, determine the development trend and hazard scope of the accident, and provide reasonable measures for the correct handling of the accident;

(5) The security team shall keep the scene of the incident under guard and quarantine, set up danger warning signs around the site of the leakage, and do a good job of fire prevention; According to the amount of leakage and wind direction to determine the isolation distance, in addition to rescue workers, equipment and other personnel, vehicles are prohibited to enter the area of isolation; Assign a person to guide the vehicle; Evacuation of unrelated personnel in the security area; Fully identify the geographical environment, carry out risk identification, and request the public security department (110) to alert and evacuate the nearby people to safety area if necessary;

(6) The combustible gas leaking from the site shall be swept by forced ventilation equipment, and the direction of sweeping shall be directed toward the safe diffusion area, and determined by the conditions of wind direction, wind force and humidity on the site;

(7) For the relatively enclosed space where flammable gas may accumulate, water injection and foam injection shall be used to treat it, and full-time personnel shall be set up to carry out continuous inspection to prevent secondary disasters such as fire, poisoning and asphyxiation due to natural gas accumulation;

(8) The affected users shall be notified in a timely manner.

(9) Emergency operations

① For emergency operations where combustible (toxic) gas concentration exceeds the warning value, the fire source shall be strictly controlled, and continuous ventilation or purging shall be maintained.

② Clear the obstacles on the approach road and reinforce the difficult road with paving stones, bridge rows and steel plates. The normal road and emergency escape passage shall be taken into account when setting up the road.

③ Emergency equipment shall be arranged, and explosion-proof equipment shall be used in the area where combustible gas may be present. Emergency personnel and equipment shall be in the upper wind direction or the side wind direction.

④ According to the environmental conditions around the leakage point and the requirements of emergency operation, organize the removal of obstacles within the operation area, and set up full-time personnel to continuously inspect the situation on the site;

⑤ The sealing or replacement of the leakage point pipeline involves strict safety conditions verification prior to fire operation.

(10) Evacuation of personnel

① Cleaning the construction site and checking the number of people;

② Detect the scene of the accident and confirm that there is no hidden danger of environmental pollution before the evacuation of personnel can be organized;

③ The emergency command center shall organize personnel to evacuate the site if the site hazard removal has been transferred to a professional organization for execution.

(11) Considerations

① Personnel entering into possible natural gas environmental detection, rescue and operation shall wear individual protective equipment ;

② Professional personnel shall be set up to continuously monitor the sites and surrounding areas where natural gas may be present, strictly control the number of personnel entering the warning area, strictly control the fire source on site and control the electricity consumption;

③ Keep the communication on site smooth, keep the escape passage and emergency evacuation passage clear, forbid the personnel on site to act without supervision, evacuate the personnel to the emergency gathering point of the upper wind outlet according to the weathervane instruction, and count the number;

④ When warning, it is necessary to clearly report the time, place and position of leakage (pile number) , casualties, leakage, etc.

⑤ Fully identify the geographical environment, conduct risk analysis and avoid secondary disasters;

⑥ Fire prevention and explosion protection requirements: all personnel entering the accident area must close electronic equipment such as mobile phones, patrol vehicles standing several types of fire protection caps, forklifts and other rescue vehicles to the scene and fashion wear, standing with fluorescent warning signs (hazard tips) .

2) The following measures shall be taken in addition to the general measures for handling pipeline leakage when it is in the key crossing section (such as railway, high-grade highway, etc.) and causes traffic disruption :

(1) To report immediately to the local government departments in charge of railways and transport, and request that the corresponding emergency plans of local government departments be initiated;

(2) After emptying, the pipeline shall be replaced by nitrogen or blocked according to the conditions, and the construction operation shall be carried out after the operation conditions are met;

(3) Organize and clear the main traffic arteries immediately and restore the traffic in time.

(VI) Emergency linkage of pipelines involving environmentally sensitive areas

After the completion of this project, the management unit shall, in accordance with the management requirements of Beijing Gas Group and in accordance with the characteristics of this project, communicate fully with the competent authority of the environmentally sensitive area to formulate emergency plans for this project. In the plan, the environmental risk emergency linkage mechanism should be established between the environmental sensitive area management department and the environmental sensitive area management department passing along the pipeline. According to the characteristics of different sensitive area, make emergency drill plan and emergency materials list. When there is an accident in the pipeline in sensitive area, it is necessary to report to the competent department of sensitive area and start the emergency plan at the corresponding level at the same time. The escalation should include at least :

1) The name of the unit, the time of occurrence, the place and the type of the event;

2) Types and quantities of major pollutants discharged ;

3) The extent to which the accident affected ;

4) Casualties;

5) Summary of events ;

6) Measures taken and possible environmental consequences, etc.

(VII) Emergency evacuation plan

1) Evacuees: In case of an accident, the evacuation shall be carried out in an orderly manner, in coordination with the local government departments and in accordance with the prevailing meteorological conditions, in the surrounding areas and places that may be polluted after the diffusion of pollutants.

2) Means of notification: the evacuation warning shall be made by telephone or radio, especially in the event of an accident at night.

3) Level of evacuation plan: First heavy and then light, first close and then far, first easy and then difficult.

4) Temporary relocation sites are selected in open areas and have the capacity to accommodate emergency evacuees.

5) Evacuation route: In case of fire and explosion, choose the road near the accident point, and the personnel in the downwind direction of the prevailing wind direction will be evacuated to the upper wind direction of the prevailing wind direction.

6) Ensure the safe evacuation of all affected personnel within 60 minutes.

7) Rescue measures for personnel: priority should be given to rescue and transport injured and poisoned persons during emergency evacuation.

Medical rescue units first according to the emergency command center notice carry rescue equipment and drugs into the scene. The seriously wounded who are in critical condition will be rescued temporarily on the spot, and then the seriously wounded, i.e. the wounded who are in danger of life and can not take care of themselves, will be sent to the medical unit for timely rescue and treatment. Local medical institutions can not meet the needs of rescue technology to ensure that the wounded must be sent to nearby hospitals in time for treatment; Generally, the injured can be centrally located in temporary settlements, medical units at that time on-site treatment.

8) The supply of water and food for domestic use in temporary settlements shall be coordinated and guaranteed by the pipeline operation units in coordination with the local government departments where the accident occurred.

10.6.2 Air environment risk prevention measures

(1) According to the requirements of the *Code for the Design of Gas Pipeline Project* (GB 50251-2015) , the pipeline project of this project shall take preventive measures from the aspects of anti-corrosion measures, cathodic protection, reasonable setting of cut-off valves, adopting SCADA control system and setting up emergency rescue command and communication system.

(2) The following measures shall be taken in the project of gas transmission station: ①The plane shall be arranged strictly according to the fire prevention regulations; ②

All equipment and pipelines in the station shall be explosion-proof, lightning protection and electrostatic grounding; ③Installation of fire equipment detection instruments, fire control facilities; ④The installation of combustible gas detectors in places where natural gas leakage or accumulation may occur; ⑤Emergency shut-off valve (ESD) can be closed when there is an accident in the station or pipeline; ⑥Adopt the advanced technology and equipment such as semi-automatic non-stop gas cleaning, automatic shutoff valve block, etc; ⑦To some extent, measures such as the safety discharge system in the station yard can avoid the pollution caused by the direct discharge of methane or toxic gas from the atmosphere.

10.6.3 Contingency plan for sudden accident

This evaluation put forward that the project should prepare emergency plan, because the project is still in the feasibility study stage, so the construction unit should set up a perfect management system before the project is put into trial production, prepare a feasible and targeted emergency plan, incorporate the emergency plan into the unified management of the emergency plan, and do well with the competent department of environmentally sensitive areas and the relevant competent department of local government contingency plan.

10.7 Conclusions

The results of the risk assessment show that the relevant national environmental protection and safety regulations and standards are basically met under the precondition of adopting environmental risk prevention measures and emergency plans, implementing environmental protection measures and relevant recommendations made in this report, designing atmospheric risk prevention facilities for the implementation project, and effectively linking the risk emergency plans with the competent departments of environmentally sensitive areas and relevant local government departments . The accident risk of the send-out pipeline of this project can be prevented and controlled, but the enterprise still needs to improve the risk management level and strengthen the risk prevention measures.

10.8 Suggestions

1) The send-out pipeline of this project has potential accident risk. Although the maximum probability of credible accident is small, the essential safety design of pipeline should be strengthened in the next design step, and the quality of construction and the management of operation period should be strengthened, which is the fundamental measure to ensure the prevention of risk accidents.

2) The construction unit shall regularly maintain and timely update the risk prevention facilities to ensure the effectiveness of the risk prevention measures and to avoid the occurrence of risk accidents to the maximum extent possible.

3) In the event of an accident, urgent engineering emergency measures shall be taken and, if necessary, social emergency measures shall be taken to control the accident and reduce the harm to the environment.

4) According to the principle of "self-rescue of enterprises, territorial-oriented, graded response and regional linkage", emergency plans for sudden environmental accidents are formulated according to the characteristics of the project, and the effective connection between emergency plans for sudden environmental accidents is realized with local governments or relevant administrative departments.

5) The construction units must attach great importance to ensuring that the alarm bell for risk prevention is constantly ringing, that safety production management is constantly working tirelessly, that all risk prevention measures are strictly implemented, and that the risk management system and emergency plans are constantly improved.

11 Environmental Protection and Mitigation measures and Techno-economic Demonstration

11.1 Environmental protection measures during construction period

11.1.1 Ecological environment protection measures during construction period

1) Protective measures for land occupancy in projects

(1) Construction personnel, construction vehicles and various equipment shall drive and operate according to the prescribed route, and shall not damage roads or other facilities at random when passing through such environmentally sensitive areas as the Beidaigang Wetland Nature Reserve, Tianjin Permanent Protection Ecological Region, Hebei Province Ecological Red Line and the South-to-North Water Transfer Project.

(2) In the process of pipeline construction, it is necessary to delaminate, excavate, stack and backfill the soil in the ditch area (namely after the completion of the pipeline construction, the backfill soil must be layered in order, and finally the surface layer of the more fertile soil in the upper layer). Minimize the effects on soil nutrients and maximize soil recovery.

(3) The cultivated land occupied in construction shall go through relevant formalities with the relevant administrative departments in accordance with the procedures prescribed by the *Land Law*, and shall be financially compensated and cultivated land compensated in accordance with the provisions of the local government.

(4) The trees that must be destroyed shall be given economic compensation or planted in other places, usually on either side of the railway, highway or canal.

2) Vegetation protection and restoration measures

(1) When the pipeline passes through the forest land, especially the forest belt type of Tianjin permanent protection ecological area, the width of the construction operation zone should be minimized, and the felling of trees outside the construction operation zone should be strictly prohibited. In the forestland and orchard areas, artificial excavation is adopted to minimize the damage caused by mechanical operation.

(2) Temporary buildings in the construction site shall be constructed by finished products or simple assembling methods to minimize damage to soil and vegetation. To minimize the construction personnel and construction machinery to the outside of the

operation of the shrub grass damage; The service road of the construction vehicle shall be strictly stipulated to prevent the construction vehicle from traveling arbitrarily in the vegetated area.

(3) The existing roads shall be used as far as possible on the construction service roads, which can generally meet the construction requirements by means of reconstruction or appropriate widening, so as to avoid crossing the forest land.

(4) The construction operation zone along the line shall not arbitrarily expand the scope and destroy the surrounding farmland and forest land vegetation.

(5) After the completion of the construction, vegetation restoration shall be carried out in time to temporarily occupy the land. It shall be carried out according to the principle of local conditions according to the specific conditions along the road. As a forestland section, the forest land should be restored after reclamation in principle. If the forest land can not be restored, the grass planting and greening should be considered. According to the safety requirements of the pipeline projects, deep root plants or economic trees cannot be planted in the 50m range on both sides of the line in principle . For the forest land crossing section in this area, the loss of forest land shall be compensated economically and ecologically in accordance with the principle of " taking up one and making up one ".

(6) Restoration and greening of disturbed areas of forest land

The project is mainly planted with grass within 5m of each side of the forestland crossing section. If necessary, shallow root semi-shrubs and shrubs can be considered. Among them, the selection of afforesting plant species in the protection forest section of the dike should take into account the actual effect of fixing the dike, and the shallow root plant species with developed surface root system is preferred. The selection of plant species in the cross section of farmland shelterbelt should not only consider the actual protection effect, but also consider the effect on farmland crops. The afforested plant species selection should not produce common host diseases for the original stand tree species.

3) Measures for the restoration of temporary land use

(1) Temporary land such as construction construction material stacking yard shall be considered as far as possible to be set up in the construction operation zone, if it is

unavoidable to be set up outside the construction operation zone, and if the overall investment of the project is not increased, the existing stacking site nearby shall be considered as far as possible; The construction material stacking site in the farmland area shall be forbidden to carry out the operation of landscape reconstruction, and the reclamation shall be carried out immediately after the completion of the construction.

(2) Within a certain range around the construction material stacking yard, certain protective measures shall be taken to avoid the diffusion of pollutants such as building materials and chemicals containing harmful substances; Strengthen the supervision of pollution sources during the construction period.

(3) Temporary land, such as construction sites for building materials stacking and large-scale crossing projects, shall not occupy or occupy less farmland, so as to reduce the contradiction of local land resource utilization.

(4) The site of operation zone should be cleaned before construction, pay attention to the stacking and protection of surface soil, avoid rainy day construction, cause soil erosion damage and pollute the surrounding environment; Implement reclamation measures immediately after the temporary land is used up; Strengthen the supervision of temporary projects covering land reclamation.

4) Measures for ecological protection of surface water body

(1) In order to prevent the ecological environment of rivers from being affected, directional drilling is often used to cross large and medium-sized rivers, and when large excavation is used for small river crossing, the dry water period shall be selected as far as possible, and dry masonry stone shall be built on the bottom of the river, and slurry block stone bank revetment shall be set on both banks to prevent soil erosion.

(2) In the process of crossing the river, the construction personnel shall strictly be required to put an end to the bad habits of spitting, defecation and waste disposal.

5) Soil protection measures

In the main pipeline construction, the measures of "layer excavation, layer stacking and layer backfilling" are implemented in the process of ditch excavation, and the soil is piled separately. After the pipeline is completed, the original appearance of the surface along the line will be restored as soon as possible, such as planting new grassland and other plants suitable for the new environment.

6) Hydraulic protection measures for pipeline engineering

The hydraulic protection measures of general line section include the retaining of backfilling and surface water diversion. The measures of backfilling soil mainly refer to retaining wall, water cut-off wall, drainage ditch, artificial planting grass revetment, etc. Surface water diversion measures refer to the surface strip water cut-off wall, water retaining wall, drainage ditch and so on.

(1) The revetment engineering department shall adopt the mortar stone revetment, geogrid revetment or plant revetment according to local conditions.

(2) Retaining walls are generally suitable for steep slopes, steep slopes and river bank slopes.

(3) The water cut-off wall shall be used for retaining the backfilling soil of the pipe trench along the slope laying section. It shall be divided into straw bag type and masonry type wall. Straw bag type wall shall be used for gentle slope with slope less than 25°, and masonry type wall shall be used for steep slope with slope greater than 25°.

(4) The function of surface water diversion measures is to take the method of retaining, intercepting and guiding according to the topographical situation, in addition to the surface water diversion ditch area, the adoption and absence of specific measures. Water retaining walls and drains are generally used where the top of the slope is prone to form catchments.

When crossing a river by means of excavation, appropriate hydraulic protection measures shall be selected according to the geological conditions of the river, the hydrological conditions and the revetment conditions of the existing rivers. The main structural forms of the hydraulic protection measures are river bank protection and bottom protection measures. In order to ensure the safety of the pipeline, concrete weight blocks should be set as appropriate.

7) Measures for prevention and control of soil erosion

(1) Arrange the construction schedule and time reasonably, choose the season without rain and wind, avoid dust and soil erosion. During the construction of the excavation section of rivers and ditches, excavation, transportation, pavement and pressure shall be carried out without leaving or leaving as little loose ground as possible. Shorten the construction period as much as possible, shorten the time of soil exposure,

and quickly backfill.

(2) When excavating through rivers and agricultural irrigation canals, dry or non-centralized irrigation periods shall be chosen. Excavation earthwork shall not be allowed to be piled in the river for long periods. The earthwork needed for backfilling shall be temporarily piled on the outside of the river bank. The surface of the pipeline after laying and backfilling shall be consistent with the original surface height, the original shape of the riverbed shall not be changed, the abandoned earthwork shall not be left in the river channel or carried away by the water body; After the completion of the construction of the cofferdam, the cofferdam shall be removed section by section and transported to the dump site for stacking or reasonable utilization.

(3) When crossing the river, the original protective canal shall be restored in the same way as the original protective wall; The grouting stone protection works should be added to the unstable riverbank of the passage section. For the banks of the cohesive soil, layered compaction of backfillling can be adopted. After the completion of the construction, the river should be cleaned and restored to its original condition, the construction wastes and the abandoned earthwork should be cleared and transported in time.

(4) The abandoned earthwork produced in the construction can be treated from the following aspects: the roadbed can be used for road construction; Can be used for water and soil conservation projects; The remaining part shall be piled with special slag yard, the choice of which shall be reasonable, shall avoid the local spillway, and with the consent of the local water and soil conservation and ecological environment authorities, the spoil yard shall build a ballast dam, cut off a ditch and carry out leveling greening.

(5) After the construction backfill, it shall be compacted properly and slightly higher than the original ground surface, so as to prevent the formation of drainage channels in the future due to the sunken ground and increase the backfillling elevation according to the topography at appropriate intervals in order to block the flue-flow effect.

(6) The location, mode, construction technology and temporary dumping of the river crossing project along the line shall be subject to the approval of the water conservancy administrative department, so as to avoid any adverse effects on the flood discharge of the river.

(7) Take protective measures against excavated earthwork, such as proper pressure, water spraying on dry season surfaces or fabric covering, and take necessary protective measures around temporary storage sites.

(8) For construction areas adjacent to river water bodies, river closure ditches shall be established at the boundary of the construction area to prevent surface runoff from polluting surface water bodies.

8) Wildlife protection measures

The construction unit shall carry out publicity work for the construction personnel to enhance the awareness of wildlife protection and put an end to the hunting and catching of frogs, snakes and birds near the construction work area. It is suggested to set up warning signs at main construction sites to remind construction personnel to protect wildlife.

9) Measures for mitigating environmental impacts of ecological landscape

(1) Strengthen the environmental protection education of construction team workers and standardize the behavior of construction personnel. Educate staff and workers to take good care of the environment and protect the crops and trees around the construction site.

(2) Strictly delimit the scope of construction operation and construct within the construction zone. In order to ensure the smooth construction of the premise, as much as possible to reduce the floor area. In the forest land, orchard construction, should use less mechanical operation, to minimize the damage to trees, landscape damage.

(3) During the construction, the operation code of layered excavation shall be carried out, and the construction zone shall not be too long . After the completion of the construction, backfill shall be made immediately in sequence according to the soil layer, greening at the same time and reducing the damage to the landscape ecological environment.

10) Measures for ecological restoration and protection in different ecological zones

(1) Agroecological zone

① Try to avoid the growing season of crops in order to reduce the loss of agricultural production.

② Attention should be paid to the protection and utilization of ripened soil. Before construction, the ripened soil of the surface layer should be pushed as far as possible to the appropriate place and concentrated. After the completion of construction, it will be applied to the site where vegetation construction is to be carried out, so that it can be fully and effectively utilized.

③ After the completion of construction, the site shall be cleaned up and resumed, including field ridges, irrigation and water conservancy facilities, etc.

④ In the case of farmland shelterbelt damaged by construction, it is forbidden to plant deep root plants within 5 meters on both sides of pipeline, so it is necessary to plant shallow root plants and crops. Farmland shelterbelt can be restored beyond 5 meters on both sides of pipeline.

⑤ Plant slope protection: irrigation channel fill section or field sill damaged by pipeline, in order to protect slope surface and prevent wind erosion, should be planted according to the technical requirements of plant slope protection, such as bluegrass, white clover, bromegrass, Gupta grass, etc.. Planting can be selected according to local site conditions for mixed sowing.

(2) Artificial forest ecological zone

① Under the condition of satisfying the construction conditions, the width of the construction operation zone of the artificial forest and grassland passing through the pipeline shall be narrowed as far as possible, and the scope of construction operation shall be strictly controlled.

② Before the construction, the grass of grassland should be scooped up as far as possible, placed aside and watered. After the completion of the construction, the turf should be covered on the construction operation belt and sown with suitable grass seeds for vegetation restoration.

③ During the construction process, it is found that the key protective plants should be transplanted and protected.

④ After the completion of forest construction, only shallow root plants such as grass seeds and flowers can be planted within 5 meters on both sides of the central line of the pipeline.

11) Control requirements of construction operation belt

According to the above regulation, taking into account the geomorphological characteristics of this section, combined with the actual situation of large pipe diameter, the working band width of general section of D1219mm pipeline is 28m, the working band width of water network and river channel is 45m, the working band width of pipe ditch is 5m, and the area of economic crops, woodlands and protected areas shall be reduced to 24~26m. The general operating belt width of D1016mm pipeline is 26m, the working belt width of the excavation section of water network and river channel is 43m, and the working belt width of the excavation section is 48m for the excavation depth exceeding 5m. The area of economic crops, forest land and protected areas shall be reduced as far as possible to cover an area of 22~24m.

11.1.2 Pollution control measures during construction period

1) Prevention and control measures of exhaust gas pollution

The construction waste gas mainly comes from the dust generated by ground excavation and transportation vehicles and the smoke emitted by construction machinery (diesel engine).

(1) Construction dust

Compared with other construction waste gases, construction dust is the most serious pollution to the surrounding air environment . In order to reduce the generation of dust in construction projects, the following measures are proposed :

① In the process of excavation and construction, the sprinkler is used to sprinkle water on the working surface and the earth mound regularly to keep a certain humidity and reduce the dust emission during construction period.

② Reasonable management shall be carried out at the construction site, materials shall be piled up uniformly, cement shall be piled in special warehouse, the transport links shall be minimized, and the bags shall be handled with light lifting to prevent breakage.

③ The construction site shall be provided with a fence or part of a fence to reduce the spread of construction dust.

④ When the wind speed is too high, construction work shall be stopped and construction materials such as piled sand powder shall be covered.

⑤ Keep the transport vehicle in good condition, but fully loaded, take covering and sealing measures as far as possible, reduce spills along the road, clean the soil and construction materials scattered on the road in time, wash the tyres, regularly sprinkle water and dust, and reduce dust in the transport process. The dust amount of construction decreases with the improvement of the management method, if the management measures are correct, the dust amount will be reduced by 50- 70% , and the environmental impact will be greatly reduced. During the construction of this project, while implementing the above measures, attention should be paid to strengthening the management of the construction team, such as establishing the construction rules and regulations, finding the construction units certified by *ISO 14000* , etc.

(2) Exhaust gas from diesel engine

The exhaust gas from construction machinery (diesel engine) is mainly produced at the directional drilling site. This project mainly uses the directional drilling construction method when crossing the river, its exhaust emission is small, and is intermittence and short-term. Therefore will not cause the big pollution to the surrounding environment.

2) Control measures for wastewater dyeing

During the construction period, the waste water mainly comes from the domestic sewage produced by the construction workers and the waste water discharged during the pipe cleaning and pressure test after installation.

(1) Domestic sewage

According to the past construction experience, in the general area, construction teams generally rely on local hotels and hotels. In the construction site where directional drills are used to cross medium sized rivers, most of the personnel live in hotels or local houses, and only the guards live in their own mobile rooms at night. The above measures have brought about the basic control of environmental pollution by domestic sewage.

(2) Clean pipe pressure test water

The waste water of cleaning pipe and pressure test is mainly composed of rust and sediment. Because the pipeline cleaning and pressure test are carried out in sections, the local discharge is relatively small, and the wastewater mainly contains a small amount of rust, welding slag and mud sand, so after collection and precipitation treatment, it is feasible to discharge into nearby ditches and rivers with low functional requirements.

In view of the large number of rivers along the project, it is prohibited for construction units to discharge sewage (including domestic and production wastewater) into the rivers along the project during the construction sections; The waste water produced during the pressure test stage of the pipe cleaning requires the construction unit to communicate well with the local village and town so as to ensure the full and reasonable utilization of the waste water.

In order to reduce the waste of water resources, the waste water should be collected as much as possible in the process of pressure test of clean pipe, increase the reuse rate, and strengthen the management and drainage of wastewater collection and discharge.

The pressure test water of the cleaning pipe shall be discharged according to the requirements of the local ecological environment authority before discharge.

3) Prevention measures for solid waste contamination

The solid waste generated during construction period is mainly domestic waste, waste mud, engineering waste and construction waste.

(1) Domestic refuse

The domestic garbage produced during construction period has a large dispersion and a short duration. Construction personnel generally rely on local hotels and restaurants or residential buildings, their waste water and garbage treatment are based on local treatment facilities. If they cannot be addressed locally, they should be collected and processed uniformly by the sanitation sector.

(2) Waste mud

The remaining mud shall be recovered and transported by the construction unit after the completion of construction.

(3) Project spoil

In the process of construction, the abandoned soil is mainly the excess soil and gravel when the pipeline is laid on land or across roads and railways. Different measures shall be taken in different locations to make full use of this part of the earthwork.

① When excavating in the cultivation area, the soil (surface tillage) is piled separately from the raw soil (lower layer soil), and the pipe and groove are filled in order to protect the tillage layer. After backfilling, there is a natural settlement margin (0.3-0.5 m above the ground) above the trench, and the excess earthwork is leveled nearby.

② When crossing roads and railways, the surplus soil and gravel produced by the top pipe are used for local township construction filler or road slope protection.

(4) Construction waste

The construction waste mainly includes waste welding rod in welding operation, waste anticorrosion material in anticorrosion operation and waste concrete in construction process. Part of the construction waste can be recycled, the remaining waste on the basis of local functional departments paid clearance.

(5) Directional drilling mud

PVC material shall be laid at the bottom and around the directional drilling mud pool to prevent the infiltration of sewage. After the completion of the construction, the remaining mud is collected as waste after pH adjustment in the mud pit and, with the consent of the local ecological environment authority, is buried in the impervious mud pit after solidification treatment, covered with 40 cm of tillage soil to ensure the restoration of the original topography.

4) Noise control measures

The noise source during construction mainly comes from construction machinery, such as excavator, electric welding machine, directional drilling, etc., whose strength is 85-100 dB(A). The following noise control measures are proposed during the construction period :

(1) The construction units must select construction machines and transport vehicles that meet the relevant national standards, choose construction machinery and technology with low noise as far as possible, and install shock absorber seat for fixed mechanical equipment with large vibration, strengthen the maintenance and maintenance of all kinds of construction equipment, maintain its good working conditions, so as to fundamentally reduce the noise source strength.

(2) The local government control regulations shall be strictly implemented in the construction near residential areas, especially in close proximity residential areas within the range of 40m. High-noise construction shall be strictly prohibited from 10 pm to 6 pm the next day.

(3) Strictly control the operation time during the construction, arrange the construction time reasonably according to the specific conditions, improve the operation level, do a good job of communication with the surrounding residents, reduce the impact on sensitive sites and prevent the occurrence of noise disturbing the people.

(4) Transport vehicles should minimize the number of calls, especially at night and during lunch breaks.

(5) Reasonable layout of the construction site, avoid arranging a large number of power machinery equipment in the same place, lest the local sound level is too high.

(6) The pipeline transportation and hoisting shall be arranged in the daytime, when the construction workshop passes through the villages and towns, the whistle shall not be sounded.

11.1.3 Environmental protection measures to be taken in directional drilling construction

In order to minimize the impact of directional drilling construction on water crossing, the environmental protection measures to be implemented in the course of construction for possible environmental impacts are detailed in Table 11.1-1 below.

Table 11.1-1 Environmental protection measures to be implemented in directional drilling construction

Possible environmental impact of construction	Environmental protection measures to be implemented
Water quality deterioration	It is prohibited to discharge sewage and all pollutants into the water bodies of rivers and associated tributaries.
	Construction sites and temporary toilets should be as far away from the river as possible to prevent domestic sewage and domestic waste directly into the river.
Oil polluted water body	The construction machinery shall not be refueled or stored in oil storage tanks within the levees on both sides of the river, nor shall the construction machinery and sewage be cleaned in the river crossing and the related tributaries connected therewith.
Pollution of surface water or coastal groundwater by waste mud	Priority is given to the selection of environmentally friendly mud, slurry pools to set up anti-seepage film and to consider a certain margin, to prevent rain erosion overflow; The mud pools should be located as far away from the river as possible to ensure that the mud does not flow into the water. The bottom and sides of the slurry pool shall be covered with PVC material to prevent the infiltration of sewage. After the completion of the construction, the remaining

	mud is collected as waste after pH adjustment in the mud pit, and after solidification treatment, it is buried in the impermeable slurry pool, covered with 40 cm of tillage soil to ensure the restoration of the original topography.
May cause soil erosion	The site should be restored as soon as possible after the completion of construction to reduce soil erosion.
Pollutants in test water may contaminate water body	It is strictly prohibited to discharge the pressure test water in the channel as the source of water.

11.1.4 Environmental protection measures to be taken for excavation through river

1) No filling or storage of oil storage tanks for construction machinery shall be allowed in the two levees crossing the river, and no cleaning of construction machinery or vehicles shall be allowed in the main stream area and the beach area. If there is oil leakage phenomenon in the machinery equipment, the scattered oil should be cleaned in time, and collected and processed uniformly after the completion of construction.

2) Rivers under large excavation shall, according to their functions, avoid irrigation seasons and prevent downstream water collection from being affected by construction.

3) After the completion of the construction, the original riverbed of the construction section shall be restored to its original appearance as far as possible, and the excess earth and rock may be piled evenly on the backwater side of the bank slope of the river crossing area after the backfill of the pipe trench, compacted or used for the construction of the dam; Care must be taken to clear the cofferdam soil and the earthwork generated by the excavation of the open diversion channel to avoid blocking the river course, which can be used to backfill the open diversion channel and to build dykes; In addition, the relevant regulations in the river management of dikes should be strictly implemented to minimize the impact on hydraulic safety facilities such as dikes.

4) The excavation of small river ditches shall be carried out in the non-flood season in May to September of each year. The water level in the flood season is 1~2m higher than that in the non-flood season.

5) To prevent any disposal of construction pollutants, especially to prevent oil spills from leaking into the water body. The main measures to prevent oil spills include: strengthening maintenance of the equipment, laying a tarpaulin at the bottom of the leaking equipment, and cleaning the oil spills in time. Oil storage tanks on the ground to be specially collected, after the completion of the construction to the local sewage

treatment station. Cleaning of construction machinery is not allowed in rivers near the site.

6) The garbage generated from the construction shall be classified as excavated and piled up. After the completion of the construction, the garbage shall be collected or transported to the local rubbish dump for disposal.

7) Any excess earthwork resulting from the excavation of a river shall first seek the advice of the local village or ecological environment authorities, select suitable sites and methods for disposal, and recommend more earthwork for the rehabilitation or maintenance of river embankments.

8) For the discharge of the seepage water produced during the excavation of the riverbed, although the effect is local, the water quality of the river will be restored to its original state after the river has passed a certain distance due to the sediment redeposition, but for the slow flow and serious siltation of the river, the method of filtering before discharging into the river should be adopted.

9) The relevant provisions in local river management shall be strictly implemented so as to avoid damaging existing hydraulic safety facilities such as dams and other requirements.

10) When crossing the water body, manually excavating the ditch and distributing the pipe shall be used as far as possible to reduce the influence of oil leakage on the water body.

11) Large excavated rivers should avoid fish spawning and migration as much as possible.

11.1.5 Environmental protection measures to be trench excavation

1) The surplus earthwork generated from the excavation of pipe ditches shall first seek the advice of the local village or ecological environment authorities, and choose suitable sites and methods for disposal.

2) For the discharge of seepage water from trench excavation, the method of filtration before discharge into the river should be adopted. It is suggested that a fine sand net be used to intercept sediment and suspended matter, etc.

3) After the completion of construction, the surface shall be completely restored to its original appearance, and any excess earth and rock may be used to build dykes after the backfilling of pipes and ditches.

4) In the construction of buried pipe, reasonable construction scheme should be adopted to minimize the possible impact on surface water environment.

11.1.6 Countermeasures for preventing and curing the influence on road traffic

1) The trunk roads and local important roads passed by this project are all passed by top pipe, which has little effect on the traffic; For small rural roads, the construction unit shall work out the construction plan together with the construction unit to design the temporary service road near the traffic sensitive road and complete the road excavation, pipeline burying and soil backfilling in as short a time as possible.

2) During the construction, the excavated soil shall be cleaned and transported in time, except for backfilling, so as to avoid the accumulation of soil occupying the road and affecting traffic, so as to ensure the traffic operation of the excavated road.

3) Stop or reduce construction transport vehicles during peak local traffic hours to reduce congestion and prevent traffic accidents.

4) The construction section shall have traffic identifiers and eye-catching traffic sign lights at night. Safety supervisors shall also be set up at each construction section to prevent pedestrians and vehicles from falling into the excavated ditch by mistake.

5) Where a reduction in the number of roads and corridors is caused, traffic lights are used or directed by traffic management personnel.

11.1.7 Environmental measures for groundwater environment

According to the prediction and analysis, the influence of the project construction period on the groundwater environment protection target along the pipeline is very small, mainly in the disturbance to the gas inclusion zone, only a few areas of groundwater level above the depth of the ditch excavation will appear pit water, resulting in a certain range of groundwater level on both sides of the ditch lower. During the construction of some pipe sections, the leakage of sewage will lead to groundwater pollution, but the content of pollutants is low, the types are small and the toxicity is low. At the same time, because the pipeline construction is piecewise construction, with short construction time series, the overall impact is smaller. The groundwater environment protection measures during construction of pipeline area are detailed in the following table.

Table 11.1-2 Summary of groundwater environmental protection measures during pipeline construction

No.	Measures	Influencing factor	Suitable engineering position
1	1. Organize the construction personnel to study the groundwater source protection regulations and enhance the awareness of groundwater environment protection. 2. Temporary toilets are prohibited in the district. 3. Domestic and production sewage shall not be discharged on site, solid waste shall not be discarded at will. 4. Strengthen management of potentially oily equipment to prevent leakage. 5. In rainy days, the construction supplementary material is covered with plastic film to prevent the sewage formed by rain water leaching from entering the groundwater aquifer. 6. Monitoring of groundwater quality in water sources.	Polluted groundwater by sewage leakage	Pipeline construction near water source and Karst area
2	1. When the water source well with less than 50m distance from the pipeline is found during construction, the line shall be fine-tuned. 2. Strengthen the monitoring of water quality and water level of protection targets. 3. Collection and treatment of construction waste water shall be uniformly discharged to rivers permitted by the government. 5. Make pollution emergency plan. 6. Drain water should be removed in time.	Cause wells and springs to dry up	Pipeline and Station Construction in General Section

11.1.8 Environmental supervision during construction period

Construction units shall carry out environmental supervision during construction period, strengthen environmental protection during construction period, and control the environmental impact of construction period from the source.

(1) Organization

HSE management department shall be set up during the construction period to be responsible for the environmental supervision during the construction period.

(2) Main Responsibilities

The environmental supervision work during construction period shall carry out on-site supervision and management of the following works of the contractor: water quality protection, aquatic biological protection, ecological protection, noise pollution control, waste disposal, solid waste disposal and domestic sewage discharge, and inspect the implementation of environmental protection measures.

The environmental supervision engineer shall, upon the entrustment of the owner, carry out the work according to the project environmental supervision plan and the key points of supervision during the construction period, ensure that the construction site, material yard, construction service road and construction camp meet the environmental protection requirements, supervise the implementation of the environmental protection measures proposed in the environmental assessment report, and control the environmental problems in the construction through the instructions issued by the project supervision.

11.2 Environmental protection measures in operation period and technical and economic demonstration

11.2.1 Measures of atmospheric environmental protection in operation period and technical and economic demonstration

11.2.1.1 Atmospheric environmental protection measures

（1）High efficiency low nitrogen combustion technology used in station heating furnace

Low nitrogen burner is a burner with low NOx emission during fuel combustion. Conventional natural gas boiler burners usually emit about 120-150 mg/m³ of NOx. The NOX emission of low nitrogen burner is about 30-80 mg/m³.

At present, the low nitrogen burner can be divided into the following categories according to the principle :

1）Stage combustion burner

The stage burner is designed according to the principle of staged combustion, which makes the fuel and air mixed in stages.

2）Self-recirculation burner

One is the use of combustion-supporting air pressure head, part of the smoke inhalation back into the burner, mixed with air combustion. Because of the recirculation of flue gas, the heat capacity of combustion flue gas is large, the combustion temperature is lower and the NOx is reduced.

Another kind of self-recycling burner is to put part of the flue gas directly into the burner to re-cycle and add the combustion process. This kind of burner has the dual effect of restraining nitrogen oxide and saving energy.

3）Concentrated and light separation combustion burner

The principle is that one part of the fuel is overburned and the other part of the fuel is underburned, but the overall air volume remains constant. Since both parts are burning at a deviation from the stoichiometric ratio, NO_X is very low, which is also called off-combustion or non-stoichiometric combustion.

4）Split flame burner

The principle is to divide a flame into several small flames, because of the large area of small flame radiation, low flame temperature, so that the " thermal reaction NO " decreased. In addition, the small flame shortens the residence time of oxygen and nitrogen in the flame, and has the obvious inhibition effect to the "thermal reaction NO" and "fuel NO".

5) **Mixed promotion burner 混合促进型燃烧器**

The residence time of flue gas in the high temperature zone is one of the main factors affecting the NO_X production. Improving the mixture of combustion and air can reduce the thickness of the flame surface and shorten the residence time of the flue gas in the high temperature zone under the same combustion load. The mixed-boost burner is designed on this principle.

6) **Low NOX precombustion chamber burner**

The precombustion chamber is a kind of high efficiency and low nitrogen staged combustion technology developed and studied in China in recent 10 years. The precombustion chamber is composed of primary air (or secondary air) and fuel injection system. The fuel and primary air are mixed rapidly, and a fuel-rich mixture is formed in the primary combustion area of the precombustion chamber. The fuel precipitates volatiles in the primary flame zone with low oxygen and flame temperature, thus reducing the formation of NOx.

Any kind of low nitrogen combustion technology is essentially a technology to control the combustion process. According to the 20 years experience of low nitrogen burner in Europe and America, it is not enough for industrial boiler to replace or reconstruct the low nitrogen burner.

In this project, the low nitrogen combustion technology of stage burner is used to control the emission of exhaust gas. The process takes 80% to 85% fuel to the main combustion zone, the fuel produces NO_X in the main combustion zone, 15% to 20% fuel reenters the reburning zone, the excess air coefficient of the reburning zone is less than 1.0, has a strong reducing atmosphere, and the NO_X produced in the main combustion zone is reduced. The reburning zone can not only restore the generated NOx, but also inhibit the new NOx formation. A certain amount of air is supplied in the burndown zone to ensure that the incomplete combustion products from the reburning zone are exhausted. According to the research results of Zhuo Jiankun, chief engineer of the National Engineering Research Center for Clean Coal Combustion of Tsinghua University, the advantages of the staged combustion process are simple control, and the emission value is between 30 and 80 mg/m^3, which can effectively reduce NOx emission.

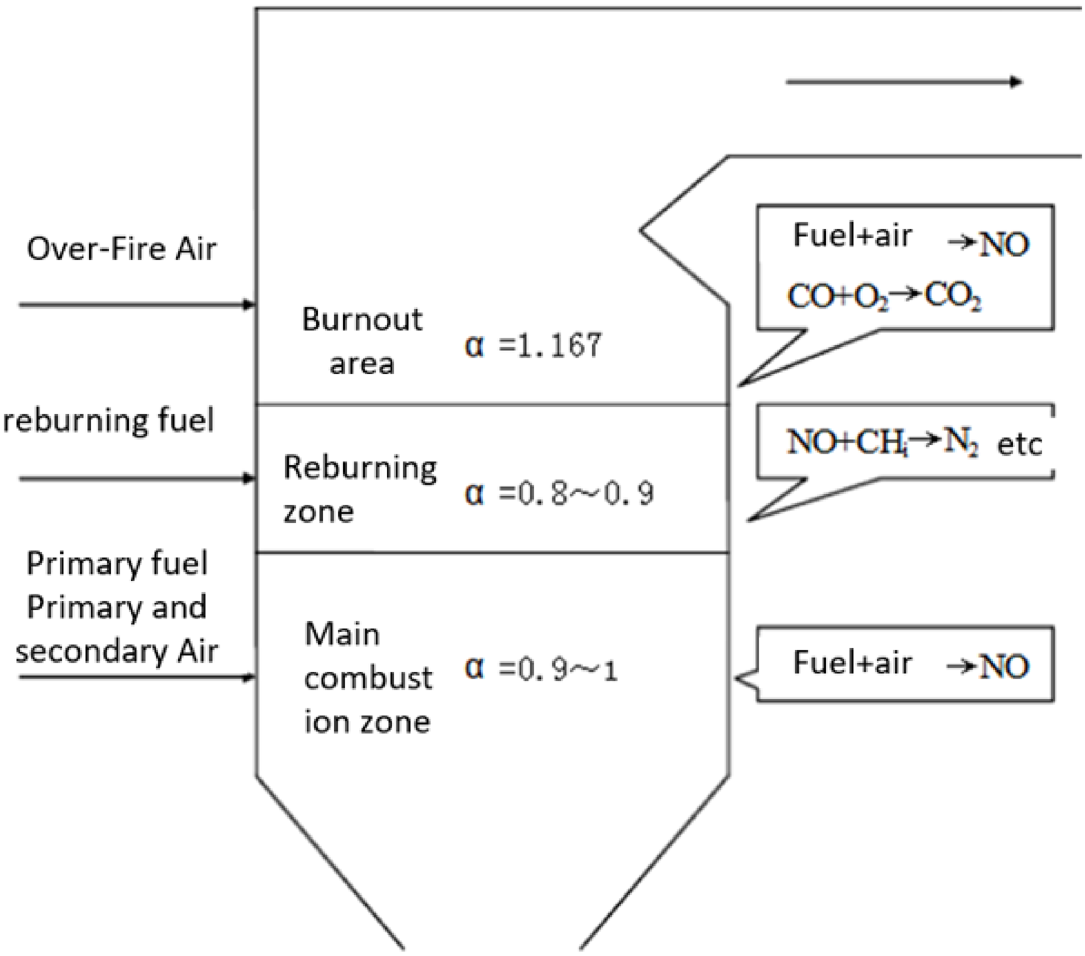

Figure 11.2-1 Priciple of stage burner

(2) Other measures for the protection of the atmospheric environment

① Design and use quality reliable equipment, pipes, valves and pipe accessories to ensure quality during construction.

② Strict and perfect management and maintenance measures are set up in production to minimize running, running, dropping and leakage.

11.2.1.2 Techno-economic demonstration

The air environment protection measures to be taken in this project have been applied in similar projects, all of which are technically reliable and economically feasible. Long operating experience shows that the atmospheric environmental protection measures can greatly reduce the emission of pollutants and contribute to environmental protection.

11.2.2 Measures of water environmental protection in operation period and technical and economic demonstration

The domestic sewage produced by each station of this project is pretreated by septic tank and treated by integrated sewage treatment device.

11.2.3 Measures for protection of groundwater environment in operation period

After the completion of the construction of the river crossing, the formation of the new flow field of the drilled groundwater makes the groundwater level return to normal. At the same time, the pipeline anticorrosion design strictly according to the relevant regulations, will not cause groundwater pollution during the operation period. During the construction period, the pipeline adopted the measure of pipe stabilization, reached the safety design standard, so the probability of pipeline rupture is low. Natural gas is insoluble in water under the accident condition, and the density is light. It will not enter the groundwater or river water to have an impact. During the operation period, the monitoring of water level and water quality of well water around the crossing area should be strengthened.

In the operation period, the underground water protection measures of gas transmission station are mainly preventive, and the anti-seepage and anti-leakage measures shall be carried out in the temporary storage area of solid waste and the sewage treatment area of gas transmission station, to prevent the pollution of groundwater caused by pollutants, to strengthen the management of production process, and to prevent the pollution such as running, rising, dropping and leaking.

11.2.4 Control measures for noise pollution in operation period

In order to minimize the effect of station noise, it is suggested that:

(1) Site selection is far from residential areas.

(2) The equipment type selection selects the low-noise equipment as far as possible.

11.2.5 Prevention measures of solid waste pollution in operation period

11.2.5.1 General solid waste

The solid waste produced during the operation of this project is domestic waste, cleaning powder and separator maintenance powder.

11.2.5.2 Domestic garbage

The domestic waste generated from each station of the project is collected and sent to the local sanitation department for removal and treatment.

11.2.5.3 Cleaning powder and separator inspection powder

The small amount of solid powder produced by the cleaning operation and the maintenance of the separator shall, with the consent of the local ecological environment authority, reasonably choose the appropriate place for regular landfill disposal, and shall strengthen the management, and shall not be thrown or stacked at will.

11.3 Environmental Sensitive Target Protection Measures

According to different ecological red line types, wetlands, artificial forest areas, important rivers and other ecological functional units and the specific ecological protection targets, the environmental protection measures are put forward.

11.3.1 Environmental protection measures for Tianjin permanent ecological region

The environmental protection measures in the thematic report should be included in the environmental assessment report according to the approval of the Tianjin Municipal Government on the project's crossing through the permanently protected ecological area. Therefore, the following environmental protection measures are drawn from the *Beijing Gas Tianjin Nangang LNG Emergency Reserve Project for Natural Gas* in July 2019 prepared by Tianjin Environmental Planning Science and Technology Development Ltd. The specific environmental protection measures are described below.

11.3.1.1 Environmental protection measures during construction period

1) Vegetation protection measures

Strictly control the scope of pipeline construction site and the width of construction operation belt. In the concrete construction process, the construction operation zone cleaning should be carried out by the personnel familiar with the natural conditions in the construction section area and the requirements of construction technology, so as to minimize the scope of construction operation; Construction vehicles, personnel activities and other activities shall not be allowed to cross the construction operation zone, in order to reduce the occupation of wetlands and artificial herbal crushing and destruction; The earthwork produced during the excavation of pipelines and canals shall not be piled outside the construction working area, and the interference and destruction of surrounding vegetation and ecosystem caused by earthwork stacking shall be reduced.

Try to protect the vegetation landscape in the construction operation zone. For the vegetation in the construction operation zone, the other parts should keep the original vegetation as far as possible, and do not destroy the vegetation landscape in these areas, so as to shorten the time of natural vegetation restoration, increase the chance of natural plant growth, and benefit the later vegetation restoration.

Restore the original landscape as soon as possible. After the completion of construction, the temporary facilities for construction shall be completely dismantled and the waste materials shall be completely removed. All places damaged by construction vehicles and machinery shall be repaired in time to restore the temporary vegetation cover and restore the original geomorphology.

2) Wildlife protection measures

There is a close relationship between wildlife and vegetation, and the quality of vegetation conditions is a very important factor affecting the composition of wildlife species. The destruction of vegetation in the project area will lead to the reduction of animal species and quantity in the area. Therefore, the construction site should be strictly planned during the construction period, the vegetation damage caused by the construction process should be minimized, and the vegetation environment on which wild animals depend should be protected.

For reptiles, mammals and other terrestrial animals, the noise of construction personnel, construction machinery, vehicles will have a short shock and interference. Therefore, should be staged construction, as far as possible shorten the construction period, to avoid a continuous area of wild animal activity alarm; The low-noise construction machinery and transport vehicles are selected, and the high-pitched loudspeakers are prohibited to reduce the construction environment noise, and the porous sound-absorbing materials are actively used to reduce the construction machinery noise, so as to reduce the disturbance to wild animals; As hunting activities will force wild animals to leave the area along the pipeline construction and change the composition of wetland animals, the behavior of construction personnel should be strictly regulated and hunting of wild animals should be prohibited.

For fish, zooplankton and other aquatic animals, as the construction operation zone of this project involves some rivers and ponds, construction activities will form a driving effect on aquatic animals. Therefore, it is necessary to shorten the construction period of some sections of the water area, select vehicles with low noise and cooperate with the noise reduction equipment to reduce the noise during construction, minimize the loud noise of the construction personnel and minimize the disturbance to aquatic animals. Avoid fish breeding season construction, increase its survival rate; Pollutants such as construction materials, sewage, garbage and other waste oils of construction machinery shall be strictly prohibited from entering the nearby water body, affecting the water quality of the construction river and the pit pond, so as to avoid affecting the aquatic organisms in the construction reach; It is strictly prohibited for construction personnel to prey on aquatic animals.

3) Protection measures for birds

In view of the current situation of bird habitat and the impact of construction on birds, the following precautionary ecological protection measures are suggested.

(1) In view of the linear distribution characteristics of the project, it is suggested that construction be carried out in sections and seasons. Shorten the time limit as soon as possible, leave a certain habitat for birds, reduce the impact on birds.

(2) There are different rules of bird habitat in different areas of the region, therefore, in view of the bird habitat in different areas along the construction line, reasonable time limit should be arranged to avoid bird habitat and breeding peak. The specific provisions are as follows: the area near the surface of the gas station (pipeline from 7.8km to 10.5 km into the protected area from the west) is the main habitat for migratory birds in spring and autumn, and there are many rare birds. Therefore, the migration peak in spring and autumn, i.e., in April-May, construction in this area is prohibited from October-November; The reed-marsh habitat (other than the above

section), which is the ideal habitat for many birds to feed and breed, is restricted from construction in summer (June-August).

(3) Birds have developed auditory organs, have strong sound source positioning ability, construction activities will have a certain impact on the surrounding 1-1.5km of bird activities and habitat, so no matter which section of construction operation, should choose the low-noise construction machinery and transport vehicles, prohibit the vehicles from playing high-pitched horns, and actively use porous sound-absorbing materials to reduce construction machinery noise, and avoid construction personnel loud noise to reduce construction noise to the birds.

(4) Birds are also sensitive to light, so construction lighting can also affect bird activity. Birds in the area are usually active during the day and rest at night. Therefore, night construction is prohibited in areas where birds are concentrated, such as the surface of the air station.

(5) Strictly control the behaviour of construction personnel and strictly prohibit the hunting of birds.

(6) In order to reduce the impact of the construction team on birds, the construction operation area shall be strictly demarcated, the construction area shall be marked and the non-construction area shall not be allowed to move.

(7) Do a good job of publicity and education on animal protection for construction personnel. It is suggested that an animal protection billboard be set up at the site to explain to the construction personnel the relevant laws and regulations on wildlife protection and nature reserve protection, and to formulate provisions and penalties for animal protection and ecological protection.

4) Soil protection measures

Strictly control the width of the construction operation band, and do not exceed the specified standard limit, in order to reduce soil disturbance and bare land and earthwork exposure area; All construction operations make the best use of the existing roads, along the existing rutting road, the maximum protection of the original lower cushion; To prevent the occurrence of random rolling of vehicles, do not open the service road at will; In the process of excavation, the soil should be excavated in layers, buried separately and restored in layers to reduce the nutrient loss of the overturning layer on the raw soil due to the construction, and the soil erosion caused by the discontinuous overlying soil should be avoided. The construction personnel shall not keep or dump the domestic garbage and sewage into the construction site to avoid causing pollution to the soil; After the completion of the construction, the construction wastes such as the waste anticorrosion materials are cleaned, which is difficult to degrade in the soil and affects the soil environment.

5) Measures for prevention and control of soil erosion

(1) Arrange the construction schedule and time reasonably, choose the season without rain and wind, avoid dust and soil erosion. During the construction of the excavation section of rivers and ditches, excavation, transportation, pavement and pressure shall be carried out without leaving or leaving as little loose ground as possible. Shorten the construction period as much as possible, shorten the time of soil exposure, and quickly backfill.

(2) When excavating through rivers and agricultural irrigation canals, dry or non-centralized irrigation periods shall be chosen. Excavation earthwork shall not be allowed to be piled in the river for long periods. The earthwork needed for backfilling shall be temporarily piled on the outside of the river bank. The surface of the pipeline after laying and backfilling shall be consistent with the original surface height, the original shape of the riverbed shall not be changed, the abandoned earthwork shall not be left in the river channel or carried away by the water body; After the completion of the construction of the cofferdam, the cofferdam shall be removed section by section and transported to the dump site for stacking or reasonable utilization.

(3) When crossing the river, the original protective canal shall be restored in the same way as the original protective wall; The grouting stone protection works should be added to the unstable riverbank of the passage section. For the banks of the cohesive soil, layered compaction of backfill can be adopted. After the completion of the construction, the river should be cleaned and restored to its original condition, the construction wastes and the abandoned earthwork should be cleared and transported in time.

(4) The abandoned earthwork produced in the construction can be treated from the following aspects: the roadbed can be used for road construction; Can be used for water and soil conservation projects; The remaining part shall be piled with special slag yard, and the selection of the slag yard shall be reasonable, and the local spillway shall be avoided, with the consent of the local water and soil conservation and environmental

protection administration department, and the slag-heap yard shall build a ballast dam, cut off a ditch and be afforested evenly.

(5) After the construction backfill, it shall be compacted properly and slightly higher than the original ground surface, so as to prevent the formation of drainage channels in the future due to the sunken ground and increase the backfill elevation according to the topography at appropriate intervals in order to block the flue-flow effect.

(6) The location, mode, construction technology and temporary dumping of the river crossing project along the line shall be subject to the approval of the water conservancy administrative department, so as to avoid any adverse effects on the flood discharge of the river.

(7) Take protective measures against excavated earthwork, such as proper pressure, water spraying on dry season surfaces or fabric covering, and take necessary protective measures around temporary storage sites.

(8) For construction areas adjacent to river water bodies, river closure ditches shall be established at the boundary of the construction area to prevent surface runoff from polluting surface water bodies in the construction area.

6) Measures for mitigating environmental impacts of ecological landscape

(1) Strengthen the environmental protection education of construction team workers and standardize the behavior of construction personnel. Educate staff and workers to take good care of the environment and protect the crops and trees around the construction site.

(2) Strictly delimit the scope of construction operation and construct within the construction zone. On the premise of smooth construction, minimize the floor space. In the forest land, orchard construction, should use less mechanical operation, to minimize the damage to trees, landscape damage.

(3) During the construction, the operation code of layered excavation shall be carried out, and the construction zone shall not be too long. After the completion of the construction, backfill shall be made immediately in sequence according to the soil layer, greening at the same time and reducing the damage to the landscape ecological environment.

7) Other protective measures

(1) Measures for environmental protection of surface water

Oily wastewater from construction machinery shall not be discharged into nearby water bodies. For construction sites close to the urban area, construction vehicles, mechanical maintenance and maintenance shall be sent to the urban area, and the oily wastewater from cleaning and maintenance shall not be discharged into the water area of the project area; Domestic sewage can not be discharged directly into water or farmland during construction period, and must be removed and transported regularly after treatment by septic tank as farmland for agricultural fertilizer irrigation project area; Strict management of construction machinery, oil leakage and dumping of waste oil; Waste earth and rock discharged during pipeline laying and river crossing operations shall be piled at designated places and shall not be dumped in surrounding ditches; The backfilled earth and rock shall be temporarily piled outside the river course, and the excess earth and rock shall be directly used to reinforce the dam.

The slurry pool shall be set up in accordance with the regulations, and its volume shall take into account the 30% surplus to prevent the rain water from flushing and overflowing. After the completion of construction, the site should be leveled and green as soon as possible to reduce soil erosion. Construction surplus earthwork shall be used as far as possible for the berm along the coast and shall not be disposed of at will; The construction units shall strengthen environmental management during construction period. The excavation of pipes and ditches, the construction of temporary roads, the crossing of rivers and canals shall avoid the rainy season and reduce soil erosion and the impact on aquatic ecosystems.

(2) Measures for environmental protection of groundwater

Before the pipeline construction, the construction equipment shall be inspected carefully. It is forbidden to oil the construction equipment, store oil storage tanks, clean the construction machinery and discharge sewage in the excavation pipe trench. If there is any pollution such as mechanical leakage, we should cut off the pollution diffusion way in time, make the pollutant in situ purification treatment, eliminate the pollution source as soon as possible; Prior to construction, the local ecological environment department and water department shall be informed of the construction plan and schedule, and under their supervision; The slurry pool should be well treated to prevent mud from contaminating groundwater.

(3) Measures for the protection of the atmospheric environment

The construction should be avoided in spring windy season and summer heavy rain season, shorten the construction time as much as possible, improve the construction efficiency and reduce the time of bare surface; In case of windy weather, large earthwork such as excavation and backfilling should be avoided or water spray dust suppression measures should be taken; The construction unit must strengthen the planning and management of the construction area, and the stackyard of the building materials shall be fixed in a fixed position, and take measures to prevent dust and dust, such as in windy weather, and water spray method shall be applied to the stackyard to prevent dust, so as to reduce the dust escaping in the process of handling, stacking and stirring of the construction materials, and to reduce the local air pollution caused by the construction.

When transporting dust-prone materials by automobile, cover the cloth, control the speed, prevent the material from falling and generating dust; When unloading the vehicle, the drop should be minimized to reduce dust; The main road in and out of the transport vehicle shall be cleaned regularly with water, and the road surface at the vehicle entrance and exit shall be clean and wetted. In addition, the transport route should avoid the village as far as possible, and the construction service road should be tamped and hardened as possible to reduce dust emission.

(4) Measures for the protection of the acoustic environment

a) Construction units must select construction tools and transport vehicles that meet the relevant national standards, use construction machinery and technology with low noise as far as possible, and install shock absorber base for fixed mechanical equipment with large vibration, and strengthen the maintenance and maintenance of various construction equipment to maintain good operation so as to fundamentally reduce the noise source.

b) The operation with strong noise source shall be carried out in daylight (06: 00~22: 00) or shall be adjusted appropriately for the operation of various construction machinery. In order to reduce the sound sources of construction activities such as material transportation, knocking and shouting during construction, the contractor is required to alleviate them through civilized construction and strengthening effective management.

c) For construction sites within 150 meters from residential areas, construction machinery with large noise shall be stopped at night (22:00 to 06:00). The construction unit shall contact the local environmental protection department in time according to the specific conditions, apply for the night construction license according to the regulations, and issue a public notice to maximize the support of the public. In the case of a section of residents within 50 meters of the construction service road, it shall be prohibited to transport construction materials on the service road at night.

d) The stacking point of the yard shall be 150 meters away from the sensitive point, and shall be selected as far as possible on the back side of the residence with the residents.

e) For transportation roads, such as construction materials and slag soil, attention should be paid to route selection, avoid concentrated areas of residents, and control the transportation time, and take corresponding measures to reduce noise and noise.

f) Sampling and monitoring the sensitive points close to the construction site, taking measures such as mobile or temporary sound barrier to prevent noise according to the monitoring results.

g) The construction site shall be closed and wall block standardized to reduce pollution and impact on the surrounding environment. When high noise machines such as bulldozers, excavators and cranes are constructed in close proximity to residential areas, they can be separated from residential areas by wall baffles to prevent noise transmission.

h) Construction vehicles shall be prohibited from honking high-pitched horns and driving at a uniform speed to reduce the influence of traffic noise on the periphery.

i) Setting prohibited whistle signs and speed limit signs on sections of centralized residential areas; Traffic management shall be strengthened and old vehicles with high noise and no license plates shall be prohibited from travelling.

j) In order to protect the health of the construction personnel, the construction unit shall reasonably arrange the staff to operate the construction machinery with high radiation and noise in turn to reduce the time of exposure to high noise. In addition to wearing protective earplugs or helmets, construction personnel close to the source of high intensity radiation noise should also shorten their working hours.

k) The construction unit shall instruct the construction unit to mark the construction site with a notice and a telephone number for complaints. The construction unit shall promptly contact the local environmental protection department after receiving the report, so as to deal with all kinds of environmental disputes in a timely manner.

8) Management measures

Strengthen environmental management to protect species that need to be protected around the working zone during construction. Especially during the construction period, the construction unit and the environmental protection department cooperate to establish a sound management system. The environmental protection department shall perform the functions of supervising the implementation process of the project, and the construction party shall contact the environmental protection department in time after the problems are found to ensure the safety of the key protected species.

Carry out environmental supervision for sensitive areas. In the course of construction, supervise and inspect the behavior of the construction party, check the documents such as exploration and construction permit for the construction section, monitor the scope of construction operation, construction time on site, standardize construction behavior, eliminate the hunting and killing of wild animals and plants, and slow down the impact of construction activities on the protected area.

Strengthen the environmental awareness of construction personnel. In the process of pipeline construction, the plant should not be trampled on at will . If any plants need to be protected are found, the plant should be reported to the local environmental protection department and forestry department immediately. At the same time, we should increase the publicity and adopt various methods, such as propaganda column, listing, etc., so that construction personnel understand the importance of protecting species.

Strengthen the publicity of wildlife protection. In the course of construction, the phenomenon that the construction personnel preys on the wild animals may occur, and the wild animal resources will be seriously affected if the incidents are not effectively contained. Therefore, it is necessary to increase the publicity of the wildlife protection law, raise the awareness of the construction workers to the wildlife protection, and put an end to the phenomenon of predation.

11.3.1.2 Operation period environmental protection measures

The influence of natural gas pipeline project on environment is mainly manifested in ecological environment during construction period and environmental risk is the main operation period. The natural gas transported by gas pipeline belongs to Class A flammable gas, and the pipeline transportation pressure is high, which is potentially dangerous to fire and explosion .If natural gas leakage occurs during pipe wall rupture during pipeline operation, fire explosion will occur in the event of open flame, which will have a great impact on the surrounding environment. The explosion of natural gas is the burning process of high pressure and high temperature (3000 ℃) in a flash (thousands of seconds). The wave velocity can reach 3000 m/s. It is very destructive and causes different degrees of environmental pollution, ecological damage, loss of property and casualties in different areas. Therefore, after the pipeline is completed and put into use, it is necessary to increase the patrolling strength of the protection section to avoid fire and explosion accidents. Meanwhile, the operation unit should make an effective emergency plan for fire prevention and flood control during the operation period.

11.3.1.3 Ecological monitoring and supervision measures

1) Measures for ecological monitoring

The proposed project shall take ecological monitoring measures during the construction period and the initial operation period (3-5 years). The construction unit shall entrust the relevant administrative departments (district level) of the northwest wind-proof sand-resistant forest belt, high speed forest belt and country park to arrange monitoring points reasonably in the project area and surrounding area (see attached figure for the proposed monitoring points).

The main ecological monitoring factors are vegetation restoration, mud disposal, birds, soil and water conservation. The key monitoring contents include vegetation restoration in and around the construction project area and soil and water conservation monitoring and tracking investigation around the pipeline area; Construction area and ambient air quality (mainly dust).

2) Supervision measures

To be engaged in ecological supervision should follow the principles of law-abiding, honesty, justice and science. The scope of environmental supervision during construction period is engineering construction area and construction influence area. The whole process of construction shall be supervised and managed.

The key supervision contents include: the management of construction personnel, construction area, construction mode, construction time, the influence of environmental pollution such as noise and dust generated during construction period, and the inspection of the implementation of pollution prevention and control and ecological protection facilities and measures by construction units. If the environmental supervision during construction period finds that the construction unit has not implemented the environmental protection facilities and measures as required, the construction unit shall be required to make rectification in time; If it is found that it may cause environmental pollution or ecological damage, the construction shall be temporarily stopped and rectification shall be carried out.

It is suggested that the main supervision measures of the construction unit are as follows :

(1) Organize the environmental protection supervision disclosure meeting and relevant coordination meeting to review the ecological environment protection scheme in the construction organization design.

(2) Select a qualified environmental protection supervision institution and supervise the preparation of detailed rules for environmental protection supervision planning and implementation of environmental protection supervision.

(3) Prior to commencement of construction, be familiar with the relevant contents of the project, and take timely supervision of the resident site, regular inspection and inspection of the supervision records and behaviors of the environmental protection supervision institutions.

(4) The construction units and emergency plans for sudden environmental risk events and the implementation of environmental risk prevention measures shall be emphatically checked to prevent the occurrence of sudden environmental risk events.

11.3.1.4 List of ecological conservation and restoration programmes

The project is to take ecological protection and restoration measures such as geomorphology restoration, and at the same time take anti-seepage measures of directional drilling mud pit to prevent groundwater pollution. At the same time, we should strengthen the site construction management of the project through environmental supervision, implement various ecological protection and restoration measures, and invest about 117,5 million yuan, as shown in the following table.

Table 11.3-1 List of ecological protection and rehabilitation programmes (estimates, excluding environmental risk prevention)

No.	Measures	Main content	Completion time	Estimated investment budget (10 thousand yuan)	Subject of responsibility
1	Engineering measures	Construction production of living areas, surface soil stripping in temporary dump site.	Pre-construction	200.0	Beijing Gas Group Ltd.

		Land reclamation in main engineering area; Construction production of living areas, temporary soil storage areas of the flat soil coverage.	After construction		
		Directional drilling mud pool anti-seepage treatment, and mud treatment.	Pre-construction		
2	Plant measures	Construction production living area irrigation combined with vegetation restoration; Sowing grass seeds in temporary soil storage area to prevent soil erosion; Greening of valve chamber and distribution station	After construction	550.0	Beijing Gas Group Ltd.
3	Compensating balance	Planting and conservation of temporary land occupation and supplementary plots	After construction	300.0	Entrust third party
4	Interim measure	Main engineering area excavation face, construction machinery, materials, such as dust screen cover; Dust net covering in temporary soil storage area.	Under construction	50.0	Beijing Gas Group Ltd.
5	Environmental supervision	Carry out ecological protection and restoration measures and implement ecological environmental supervision for the crossing of ecological areas involving permanent protection.	Construction period: one to two years after completion of construction	75.0	Beijing Gas Group Ltd.
Total				1175.0	

11.3.2 Environmental Measures in the Wetland Protection Area of Beidaigang

According to the report of the National Forestry and Grassland Bureau Investigation Planning and Design Institute on the *ecological impact assessment of the pipeline crossing of the LNG emergency reserve project in Nangang Port of Tianjin Gas in Beijing on the wetland nature reserve of Beidagang in Tianjin* in April 2019, the main environmental protection measures adopted by this project are as follows :

11.3.2.1 Ecological protection measures during construction period

1) Vegetation protection measures

The impact of the construction of this project is shown that the excavation of local earthwork will destroy the biodiversity to some extent, especially the wetland vegetation. Impacts on biodiversity to some extent.

The impact on vegetation mainly exists in the construction preparation stage. Construction of temporary construction roads, excavation of buried sites, storage of equipment, processing materials and ancillary production works are required during the construction phase. Therefore, the local wetland will be cleared plant root system, stripped planting topsoil, site leveling, so that the original geomorphic disturbance, surface cover is removed, large areas of the surface bare. This part of the land affected by the construction should be covered by reed, tamarix, etc.

During the construction process, the area of vegetation damage should be reduced as far as possible to reduce the impact on the local ecological environment, and if necessary, afforestation should be carried out to restore the occupied plant habitat in accordance with the corresponding national standards.

2) Wildlife protection measures

On the basis of investigating the species and living habits of nearby wild animals, the following measures should be taken to reduce the negative impact of the project construction :

With regard to habitat impacts, human activities will be reduced after the project's send-out pipeline project runs, so plants will be restored according to the scope of the project, and as much as possible large-scale vigorous activities will be reduced in order to restore and increase the wildlife activity space in the project area.

As a result of the construction needs, there will inevitably be an increase in the number of external personnel, the occurrence of interference, fear or killing phenomenon, destroying habitat. As a result, warning signs should be set up in wildlife areas that are accessible to humans, and personnel should be sensitized to strengthen the management of the area. Noise from construction work can also affect wildlife. Before large-scale construction work, we should carefully observe the existence of animal nests around us and, if necessary, check with comrades in the nature reserve. This sensitive time should be avoided when animals are found to be in reproductive activity. When construction is necessary, the construction machinery shall adopt sound deadening and sound insulation measures whenever possible.

Construction noise can interfere with the mating, laying eggs, hatching or litter of wild animals along the road. Reasonable selection should be made during construction period to avoid breeding and overwintering of birds and to reduce the impact on animal and bird habitats.

3) Measures for water and soil conservation

With the excavation, filling and leveling of the construction site, the original topsoil layer is damaged, the soil becomes loose, or the earth pile formed during the excavation and filling process cannot be cleaned in time, and the soil erosion is easy to occur due to heavy rainfall. Therefore, strengthening construction management and reasonable construction schedule can reduce soil erosion.

Water and soil erosion control measures mainly adopt comprehensive protective measures combining engineering measures, plant measures, temporary measures and management measures to form a system of water and soil conservation measures in time and space :

The project takes the following ecological protection measures :

① The operating range of construction machinery and personnel on site shall be strictly limited to the working band, that is, the width of the road construction operation shall be within 10m from the two sides of the middle axle of the road and the width of the construction service road shall be within 6 meters to minimize the construction failure surface; At the same time, construction work should be avoided in strong wind (level 6 and above).

② After the completion of construction work, all kinds of construction sites shall be leveled in time and compacted.

③ As far as possible to reduce large mechanical construction, after excavation, as soon as possible construction, timely backfill. The surface layer is rolled to shorten the bare time and reduce the dust.

4) Pollution control measures

(1) Water pollution control measures

After the project is carried out, all the waste water in the station will be reinjected after being treated to the standard.

The living facilities of personnel shall not be located in the nature reserve during construction period, and the domestic sewage shall not be involved. In summary, the wastewater during construction period will not affect the surrounding surface water environment.

(2) Measures for preventing and controlling fugitive dust

In order to minimize the impact of industrial site construction on the surrounding environment, the following prevention and control measures are put forward :

① Preventing and controlling soil and water loss in the site, the disturbed surface should be smooth and compacted in time;

② Bare the surface of the site, sprinkle water regularly, keep soil moisture, and restrain dust on the surface;

③ To clean the main transportation road related to construction in time, keep the road surface clean and reduce dust on the road surface;

④ For transportation vehicles with bulk materials, a cloth covering shall be added to prevent dust pollution caused by material falling;

⑤ The main fugitive dust operation points, such as the cement yard, shall be located at the main construction site and the downwind direction of the sensitive points, and at the same time the isolation wall and air baffle shall be set around them to effectively prevent the generation and further spread of fugitive dust; Material storage should be covered with a cloth.

11.3.2.2 Ecological Protection Measures in Operation Period

1) Animal and plant protection

The send-out pipeline project of this project will not affect animals and plants during normal operation. In the case of accidents, such as natural gas leakage, which may affect animals and plants, the construction units should make relevant emergency plans to reduce the impact of accidents on animals and plants. The construction units shall carry out as little or no more vigorous activities as possible to prevent disturbing the surrounding wildlife, especially the protected animals. Overall, the impact of the project on flora and fauna is temporary and will not lead to a significant reduction in the number of species of fauna and flora.

2) Ecological restoration of temporary land occupation

The temporary occupation of some wetlands, which are the main habitat for animals and plants, will reduce the habitat and feeding place of birds and the number of animals and plants. In addition, the construction of the project area and the road outside the project cut the wetland into a patch, destroying the wetland soil, vegetation and hydrological conditions and affecting the surrounding ecological environment. Therefore, necessary measures should be taken during the construction to minimize the adverse effects in order to promote ecological recovery. The following measures have been taken :

(1) To reduce the area of occupied wetland in construction, improve the efficiency of construction, and reduce the accumulation and congestion effect in time and space;

(2) For layered excavation and separate burying of wetland soil, backfill the project area and green belt construction according to the original soil layer (first filling the core soil and then covering the topsoil);

(3) The reed wetland temporarily occupied and destroyed by the project shall be restored according to the original scale, and the seedlings of low-growing wetland plants such as reed shall be planted after the completion of the construction to reduce the impact of the construction on the ecological function of the wetland;

(4) The wetland water supply facilities occupied by the project area shall be reconstructed immediately, the connectivity of the wetland water supply channels shall be restored, and the impact of the construction on the wetland water supply facilities shall be minimized.

3) Measures for ecological monitoring

Monitoring of ecological environment is the prerequisite of ecological protection, the basis of ecological management and the basis of ecological laws and regulations. Ecological monitoring should be guided by environmental management, penetrate into all fields of environmental management, actively serve ecological protection, ecological construction and ecological management, and maintain the health of ecosystems.

The main contents of ecological monitoring include bird distribution, plant growth and so on.

11.3.2.3 List of ecological conservation and restoration programmes

According to the analysis of ecological environment impact, the pipeline project of this project will have some effect on the ecological system of Beidaigang Wetland Nature Reserve, although there is no permanent land area. The engineering construction department shall pay the relevant rehabilitation cost, or the construction department shall restore the management itself or entrust the department in charge of the nature reserve with unified rehabilitation.

Table 11.3-2 Cost of ecological restoration

No.	Measures	Main content	Completion time	Investment（10 thousand Yuan）

1	Hydrologic and water environment restoration	Removing construction wall block	Within one month after completion of construction	20
2	Base Structure and Soil Restoration	Topographic rehabilitation and reconstruction (structural deepwater areas, depressions, shoals, gentle slopes, etc.)	Within one month after completion of construction	10
3	Base Structure and Soil Restoration	Construction refuse removal	Within half a month after completion of construction	2
4	Vegetation restoration	Planting Tamarix chinensis, Reed, Saltweed and other wetland plants	Be completed the following spring	30
5	Wetland habitat improvement	Habitat island construction	Within three months after completion of construction	15
6	Wetland habitat improvement	Bird feed supply	Within two yeats after completion of construction	10
7	Wetland habitat improvement	Artificial floating island	Within one year after completion of construction	10
合计				97

11.3.3 Environmental protection measures of ecological red line in Hebei Province

The project crosses the ecological red line of Yongding River and the ecological red line of Jian river in Langfang City, Hebei Province. The main environmental measures taken are :

1) The domestic sewage, domestic garbage and feces of the construction personnel shall be treated centrally.

2) To control the construction scope, especially the large excavation section of the river, the dry water period should be selected for construction and the construction work surface should be controlled to avoid causing extensive damage to the riverbed.

3) The construction site shall be as compact as possible to reduce the floor space; After solidification treatment, the waste mud is buried in the impermeable slurry pool and covered with 40cm tillage soil to ensure the restoration of the original topography.

4) No wastewater from construction production (including mud separation water, pipeline pressure test water, seepage from trench excavation and construction machinery waste water, etc.) shall be discharged at will.

5) Waste oil and other substances produced during construction shall not be dumped or thrown into the water body, and construction equipment and machinery shall

not be cleaned near the water body. Strengthen the maintenance of construction machinery to prevent oil leakage of construction machinery.

6) Construction materials containing harmful substances, such as asphalt and cement, shall not be piled near the floodplain, and shall be covered and fenced so as to prevent rainwater from washing into the water body.

7) The slurry pools to be drilled through by directional drilling shall be set up in accordance with the regulations, with a capacity of 30% to be taken into account in order to prevent rainwater from flushing and overflowing.

8) After the completion of construction, waste and excess fill shall be removed, the original surface height shall be maintained and the original riverbed shall be restored to protect the integrity of the aquatic ecosystem.

9) Construction camps shall be prohibited from being located within the ecological red line and construction sites shall be equipped with movable and environment-friendly toilets to prevent domestic sewage from being discharged into the ecological red line.

10) All construction materials shall not be stored in the river for long periods; Temporary storage materials shall be provided with containment facilities and necessary covering facilities (such as rain-proof cloth) to prevent the wind-blown dispersion in dry weather and erosion in rainy days, resulting in pollution to the river. For hazardous pollutants, such as oil pollution, which are hazardous wastes, the evaluation recommends that the centralized collection be entrusted to qualified units for disposal. In rainy days, the oil receiver must be collected and covered in advance to avoid washing away the polluted water source. Pollution prevention and control shall be carried out during the construction process, and all attachments in the construction site and ground residues (including potentially contaminated soil and residual materials) which may cause pollution to the surface water source shall be cleaned in time after the completion of the construction to ensure the safety of the surface water source.

11) No construction shall be carried out on rainy days, and adequate prevention and control of soil and water loss shall be carried out, such as temporary earth excavation covered with rainproof cloth and temporary retaining walls to prevent soil and water loss. At the same time, the construction period is chosen in the dry season with little rain in winter. Temporary storage sites for construction materials are selected in safe areas which are not easy to affect the river course, and temporary shelter and rainproof facilities are set up to prevent the pollution of the river caused by wind

blowing and rain scouring.

12) Temporary excavation earthwork shall be covered with rainproof cloth, and timely backfilling shall be smooth and vegetation restoration after completion of construction. Construction of excess earthwork may be used for the berm along the coast and may not be disposed of at will.

13) Take necessary emergency precautions against pipeline leakage accidents during the operation period to avoid affecting water sources.

11.3.4 Environmental Measures for Crossing Sensitive Rivers

The project has passed through the ecological red line of the Jian river, Yongding River, Duliujian rRiver, South Canal, the Great Qinghe River, Ziya River, the south-to-north water diversion, Yellow River, and other water bodies and important functions. The main environmental measures taken are :

1) The domestic sewage, domestic garbage and feces of the construction personnel shall be treated centrally.

2) To control the construction scope, especially the large excavation section of the river, the dry water period should be selected for construction and the construction work surface should be controlled to avoid causing extensive damage to the riverbed.

3) The construction site shall be as compact as possible to reduce the floor space; After solidification treatment, the waste mud is buried in the impermeable slurry pool and covered with 40cm tillage soil to ensure the restoration of the original topography.

4) No wastewater from construction production (including mud separation water, pipeline pressure test water, seepage from trench excavation and construction machinery waste water, etc.) shall be discharged at will.

5) Waste oil and other substances produced during construction shall not be dumped or thrown into the water body, and construction equipment and machinery shall not be cleaned near the water body. Strengthen the maintenance of construction machinery to prevent oil leakage of construction machinery.

6) Construction materials containing harmful substances, such as asphalt and cement, shall not be piled near the floodplain, and shall be covered and fenced so as to prevent rainwater from washing into the water body.

7) The slurry pools to be drilled through by directional drilling shall be set up in accordance with the regulations, with a capacity of 30% to be taken into account in order to prevent rainwater from flushing and overflowing.

8) After the completion of construction, waste and excess fill shall be removed, the original surface height shall be maintained and the original riverbed shall be restored to protect the integrity of the aquatic ecosystem.

9) Construction camps shall be prohibited from being located within the ecological red line and construction sites shall be equipped with movable and environment-friendly toilets to prevent domestic sewage from being discharged into the ecological red line.

10) All construction materials shall not be stored in the river for long periods; Temporary storage materials shall be provided with containment facilities and necessary covering facilities (such as rain-proof cloth) to prevent the wind-blown dispersion in dry weather and erosion in rainy days, resulting in pollution to the river. For hazardous pollutants, such as oil pollution, which are hazardous wastes, the evaluation recommends that the centralized collection be entrusted to qualified units for disposal. In rainy days, the oil receiver must be collected and covered in advance to avoid washing away the polluted water source. Pollution prevention and control shall be carried out during the construction process, and all attachments in the construction site and ground residues (including potentially contaminated soil and residual materials) which may cause pollution to the surface water source shall be cleaned in time after the completion of the construction to ensure the safety of the surface water source.

11) No construction shall be carried out on rainy days, and adequate prevention and control of soil and water loss shall be carried out, such as temporary earth excavation covered with rainproof cloth and temporary retaining walls to prevent soil and water loss. At the same time, the construction period is chosen in the dry season with little rain in winter. Temporary storage sites for construction materials are selected in safe areas which are not easy to affect the river course, and temporary shelter and rainproof facilities are set up to prevent the pollution of the river caused by wind blowing and rain scouring.

12) Temporary excavation earthwork shall be covered with rainproof cloth, and timely backfilling shall be smooth and vegetation restoration after completion of construction. Construction of excess earthwork may be used for the berm along the coast and may not be disposed of at will.

13) Take necessary emergency precautions against pipeline leakage accidents during the operation period to avoid affecting water sources.

11.4 Summary

Table 11.4-1 List of Major Environmental Measures

Type	Project Name	Content	Desired effect	Investment (10,000 RMB)	Implementation body	Subject of responsibility
Pollution control	Sewage treatment	Septic tank, integrated Sewage treatment facility	Wastewater discharge up to standard	25	Entrust third party	Beijing Gas Group Ltd.
	Noise control	To install or place noise-reducing device in a room.	Noise up to standard discharge	374.93	Entrust third party	Beijing Gas Group Ltd.
	Solid waste	Domestic garbage temporary storage facility	Harmless treatment of solid waste	12.5	Entrust third party	Beijing Gas Group Ltd.
Ecological protection and rehabilitation measures	Directional drilling through	Adopt advanced international technology	Reduce risk accident probability	1980.19	Entrust third party	Beijing Gas Group Ltd.
	Station yard greening	Planting lawn	Reduce soil erosion	6.25	Entrust third party	Beijing Gas Group Ltd.
	Restoration of geomorphology, vegetation and prevention of soil erosion	Restoration of the original use of land	Reduce soil erosion	2011.12	Entrust third party	Beijing Gas Group Ltd.
	Ecological compensation and restoration	Ecological Red Line of Tianjin, Beidagang Nature Reserve and ecological restoration of all Projects	Reducing ecological and water environmental impacts	15962.4	Entrust third party	Beijing Gas Group Ltd.
Environmental management	Environmental management	Environmental training, regulations establishment and implementation	Standard management to reduce accident probability	12.5	Beijing Gas Group Ltd.	Beijing Gas Group Ltd.
	Environmental monitoring and supervision	Environmental monitoring, supervision during construction period and	Verify the environmental impact of the project and take timely mitigation	37.49	Entrust third party	Beijing Gas Group Ltd.

		environmental monitoring during operation period	measures			
Environmental risk prevention	Pipeline anticorrosion and cathodic protection	Anticorrosion paint, cathodic protection station	Reduce risk accident probability	2032.12	Beijing Gas Group Ltd.	Beijing Gas Group Ltd.
	Automatic control monitoring system	Combustible gas alarm, flame detector, gas-liquid linkage system	Reduce risk accident probability	1023.56	Beijing Gas Group Ltd.	Beijing Gas Group Ltd.
	Increase pipe wall thickness		Reduce risk accident probability	6490.21	Beijing Gas Group Ltd.	Beijing Gas Group Ltd.
	Cut-off valve chamber		Reduce the amount of leaking natural gas	3421.6	Beijing Gas Group Ltd.	Beijing Gas Group Ltd.
	Emergency rescue plan	Emergency scheme	Reduce environmental impact in accident situations	11.25	Beijing Gas Group Ltd.	Beijing Gas Group Ltd.
Total				33401.12		

12 Supplementary measures and recommendations for Occupational Health and Safety

12.1 Supplementary Measures for Protection against Occupational Hazards

12.1.1 Supplementary Measures for Protection of Occupational Hazards

（1） Conspicuous position of terminal, LNG storage tank area, loading area, external transmission pipeline station yard, and the three-stage area through which the pipeline passes shall be provided with weather vane at appropriate position ;

（2） Spray/eyewash or tap water devices shall be installed at the sewage treatment station of the send-out pipeline station.

（3） The sewage treatment station of receiving station, maintenance workshop and sewage treatment station of send-out pipeline station, where there may be strong corrosive substances such as poison or acid and alkali, shall have flushing facilities . The floor of the workshop shall be smooth and slippery, easy to clean and clean.

（4） The receiving station or station shall be equipped with at least 3 hand-held combustible gas indicators ;

（5） Provide portable weather vane for welding operations, corrosion protection operations and other positions in contact with toxic and harmful substances ;

（6） The minimum wind direction of Anci Station and Yongqing Station is west, the emptying area of Yongqing Station is located on the south side of the plant area, and the emptying area of Anji Station is located on the northeast wind direction of the plant area. In the next design, further verification should be made as to whether the vent area of each substation site is located in the upper wind direction of the lowest wind frequency wind direction throughout the year.

12.1.2 Individual protection supplement

According to the analogy engineering situation, the operators of this project should complete the personal protective equipment according to Table 12.1-1, in addition to the basic safety helmet, anti-static working clothes and working shoes.

Table 12.1-1 Reference Table for Personal Protective Equipment

Evaluation Unit	Evaluation subunit	Job title	Number of contacts	Risk factors of occupational disease	Personal protective articles and main parameters
Export pipeline system	Station yard	Station operator	20	Carbon monoxide, high temperature, methane, noise, low temperature, other dust, sodium hydroxide, hydrogen sulfide, ammonia	Antifreeze gloves: suitable for people working in cold environment to wear, soft feel, high flexibility, strong touch Goggles: can be directly covered with general myopia glasses Dust mask: APF>10 (over N 95) Gas mask: dual filter cartridge low-maintenance type
		Station technician	28	High temperature, methane, noise, low temperature, carbon monoxide, nitrogen oxides, sulfur dioxide	
	Pipeline	Line inspector	12	High temperature and low temperature	Sunbonnet: UV protection Protective glasses: protection against ultraviolet radiation Anti-mosquito bite: Anti-mosquito Water Anti-mouse, anti-chigger mite: siamese clothing or wearing light-colored long clothes, cuff, trouser leg tight ; Avoid sitting on the grass

In accordance with the Basic Requirements for Personal Protective Equipment (GB/T 29510-2013), Selection, Use and Maintenance of Respiratory Protective Equipment (GB/T 18664-2002), or Selection Guide for Hearing Protector (GB/T 23466-2009), the operator shall determine the release cycle and type of protective equipment according to its own conditions.

12.1.3 Emergency rescue supplementary measures

According to article 25 of the law on prevention and treatment of occupational diseases, " the employing unit shall set up alarm devices for toxic and harmful workplaces that may cause acute occupational injury, and shall allocate on-site first aid supplies, washing equipment, emergency evacuation channels and necessary evacuation zones ".

（1） The operating unit shall implement the relevant provisions of the Occupational Disease Prevention and Control Law, set up medical kit, emergency medicine, protective clothing not exposed to LNG, positive pressure respirator and other emergency materials, and place them in convenient access places such as terminal, LNG gasification area, tanker loading area, send-out pipeline station, and store them in conspicuous places and set warning signs.

（2） Installation of flushing equipment such as spray eyewash or flowing water tap in the chlorine-making room and sewage treatment room, and installation of clear marking to enhance personnel training and maintenance so as to ensure that operators can get flushing in time in case of accidents.

（3） The air suction outlet of the accident exhaust of the nitrogen production station and substation shall be located at the place where the material discharge volume may be the largest or the most concentrated, and the leakage alarm device with the interlocking of the accident exhaust system shall be installed in the substation.

（4） The ventilator for accident ventilation shall be provided with an electric switch in the room and on the outer wall near the outer door respectively.

（5） In case of conditions, an on-site medical service agreement can be signed with the Binhai Hospital of Peking University, a green medical passageway can be set up, and a medical clinic can be set up in the receiving station for the use of medical personnel stationed in the hospital. The main contents of the medical clinic are on-site first aid, diagnosis and treatment of common diseases (to provide routine drugs ; Treatment and dressing of the wound ; To regularly assign qualified personnel to the receiving station and the personnel of the send-out pipeline for first-aid training, timely delivery of critically ill patients, medical care guidance and health consultation, etc.

（6） Gas protection cabinet equipment reference: Acousto-optic alarm, equipped with positive pressure air breathing apparatus, Su Sheng device, safety helmet, safety belt, body protective clothing, acid and alkali proof rubber trousers, insulation bar, insulating boots, gloves, bedding, stretcher, explosion-proof lighting and other rescue appliances.

In addition, before the project is officially operational, it is necessary to set up and perfect emergency plans and on-site treatment plans for occupational hazards such as heatstroke, frostbite, asphyxiation, sulfur hexafluoride leakage accident, hydrogen sulfide acute poisoning, LNG leakage, nitrogen leakage, acid and alkali corrosion caused by chemical leakage in chlorine-making room and chemical warehouse, and carry out emergency rescue plans. See Table 12.1-2 for specific emergency relief supplementary measures.

12.1.4 Supplementary measures for warning signs

The research report on the receiving station and terminal of this project refers to the establishment of safety signs in places and equipment that are prone to accidents or endanger life safety, as well as in places that require the attention of operators ; It is mentioned in the feasibility study report of the send-out pipeline that the signs such as mileage pile, corner pile, cross pile, encrypted pile, warning plate and warning belt are set up, but they are not specified. The design unit shall improve the design content of the warning signs in accordance with the requirements of the Occupational Hazards Warning Mark in the Workplace (GBZ 158-2003) and the Regulations for the Administration of Occupational Hazards Notification and Warning Mark in the Employer (Security and Supervision Bureau, Security [2014] 111). Notice boards shall be set up in the office to publicize the rules and regulations for the prevention and control of occupational diseases, the relevant operating procedures for occupational health, emergency measures for occupational hazards, the results of the examination of occupational hazards and the results of occupational health examination.

The warning signs and bulletin boards can refer to Table 12.1-3 and Table 12.1-4. Inform the card and warning signs that they should be checked at least once every half a year and that they should be repaired or replaced in time if they are found to be damaged, deforming, discoloration, loss of graphic symbols, and aging of brightness.

Table 12.1-2 Alert ID settings

Set Up Locations	Main occupational hazard factors	Warning ID	Instruction identification	Inhibit identification
Station yard	Noise	Noise harmful	Ear protector	/

complex				
Station yard sewage treatment system	Hydrogen sulfide, ammonia, sodium hydroxide	Watch out for gas, watch out for corrosion	Wear protective gloves, pay attention to ventilation, wear protective glasses	/
Depot maintenance workshop	Noise, toxic gas, ultraviolet radiation	Harmful noise, gas, arc light	Wear earmuffs, respirator, ventilation, protective gloves and goggles	/

Table 12.1-3 Bulletin Board, Notification Card Setup

Set Location	Facilities	Content
Station entrance	Bulletin board	Rules and regulations for the prevention and control of occupational diseases, operating procedures, emergency measures for occupational hazards, monitoring results of occupational hazards, and regular testing and evaluation results
	Notification card	To set up a notification card for methane and noise ; Name of occupational-disease-inductive factors, physical and chemical characteristics, health hazards, protective measures, emergency treatment, operation and storage precautions, disposal methods, emergency and emergency telephone etc
Station integrated equipment room	Notification card	A noise and methane notification card is set at the entrance. The contents of the card should include the name of the hazard, physical and chemical characteristics, health hazards, emergency treatment measures, protective measures, emergency telephone etc

12.1.5 Supplementary measures for architectural hygiene and auxiliary room design

According to the Design and Sanitation Standard for Industrial Enterprises (GBZ1-2010), the sanitary signs of this project shall be graded to 3 levels, and the auxiliary use rooms such as clothesroom, washroom, bathroom, rest room, dining place and toilet shall meet the following requirements :

（1） The auxiliary room should avoid the influence of harmful substances, pathogens, high temperature and other occupational-disease-inductive factors. The internal structure of the building shall be easy to clean and the sanitary facilities shall be easy to use.

（2） The total number of people working in a single class shall be designed as auxiliary use room according to the following standard: the shower bath shall be arranged according to the needs of 1 shower per 9 people, the number of toilet taps shall be allocated according to the needs of 31-40 people per faucet, the toilet shall not be too far from the work place, and shall have measures for deodorizing and fly prevention. The toilet in the workshop should generally be flush type, at the same time should be set up wash basin, wash dirty pool, cold area should be set indoors. In addition to special needs, the squatting number of toilets should be designed according to the number of users. Men's toilets: the number of male workers and staff with less than 100 workers in the workplace can be set by 25 people a squatting position ; A squatting position is added for every 50 additional persons in the workplace of more than 100 persons. The number of urinals is the same as the number of squatting places. Women's toilets: the number of women workers and staff in the workplace less than 100 people can be set by 15 people 1-2 squatting position.

（3） The casual clothes rooms and work clothes rooms can be designed according to the principle of separate storage in the same cabinet, and the dressing rooms and rest rooms can be combined.

（4） The toilet facilities should be centrally located in different districts. The washroom inside the workshop shall be well drained of ground, and the toilet facilities outside the workshop shall be provided with awning and anti-freezing.

（5） Clean drinking water facilities shall be provided in the lounge. In the case of more women workers, maternity rest rooms or rest areas should be set up in the clean and quiet areas of the administrative building.

（6） The canteen shall set up a sufficient number of hand washing facilities according to the number of people who eat. The dining area and the food provided shall meet the relevant sanitary requirements.

（7） The indoor temperature of the auxiliary room shall be as follows: the bathroom and dressing room shall not be less than 25℃ ; The office, lounge and canteen shall not be below 18℃ ; Toilets and toilets shall not be below 14℃.

（8） Natural ventilation shall be provided with inlet, outlet or sash with small resistance coefficient and easy to switch and repair. Mechanical switches or adjustment devices shall be provided for inlet, outlet or sash that are not convenient for personnel switches or need to be constantly adjusted.

（9） The lower edge of the air inlet for natural ventilation in summer should not be more than 1.2 m. The air inlet for natural ventilation in winter shall take measures to prevent the cold wind from blowing to the work place when the lower edge of the air inlet is less than 4 m from the indoor ground.

（10） Mechanical ventilation shall be provided in substation, boiler house, heating furnace area, diesel generator room (ventilation times ≥12 times/h), maintenance workshop of send-out pipeline station. Make sure the normal exhaust cooling facilities and accident exhaust requirements of boiler room and heating furnace area.

（11） The installation of the fine chemical room in the heating furnace area of the receiving station boiler house and station yard.

（12） According to " Lighting Luminance and Measurement Method of Port Loading and Unloading Area " JT/T 557-2004 and " Architectural Lighting Design Standard " GB 50034-2013, the site and pipeline illumination standards of send-out pipeline shall be refined.

12.1.6 Supplementary Measures for Occupational Hazards Protection During Construction and Equipment Installation and Commissioning

12.1.6.1 Dust control measures

Adopt construction technology, construction equipment and tools that do not or do not produce dust as much as possible, and eliminate construction technology, construction equipment and tools that are seriously damaged by dust ; The use of non-hazardous or less hazardous construction materials ; Use of mechanical, automated or closed isolation operations ; Take wet work ; Set up local dust control facilities and purification and discharge devices.

12.1.6.2 Antitoxic measure

Priority is given to the selection of non-toxic, low-toxic materials to replace toxic, high-toxic materials ; As far as possible to choose the production process without or little toxic substances in the construction process and construction technology ; The process of production, transportation, pulverization and packaging shall be closed ; Use of mechanical, automated or closed isolation operations ; Setting up effective ventilation devices ; The presence of toxic chemical chemicals near the construction site to set up toilet equipment, equipped with personal special trunks ; Showers should be provided in workplaces where high toxic substances are used ; Emergency eyewash and shower should be set up near the operation site when exposed to toxic substances with high risk of percutaneous absorption and local action.

12.1.6.3 Anti-noise control measures

As far as possible, low-noise construction facilities and construction technology are used instead of high-noise construction equipment and construction technology ; The noise-generating equipment shall be installed with a vibration-damping foundation, and measures such as sound insulation, noise elimination, vibration isolation and noise reduction shall be taken for the high-noise construction equipment. Try to isolate the noise source from the living area, low noise area or workers ; Minimize the density of high noise equipment operating points.

12.1.6.4 Anti-vibration measure

Strengthening the renovation and transition of construction technology, equipment and tools ; The metal parts of the pneumatic tool are replaced with plastic or rubber or with additional padding to reduce vibration due to impact. The hand-held vibration tool shall be provided with an anti-vibration handle ; Take rotating operation mode to reduce the time of contact vibration of workers.

12.1.6.5 High temperature control measures

The construction units shall strictly implement the relevant provisions of the Measures for the Management of the Measures for the Prevention of Summer Cooling (No. 89 of the General Security Administration [2012]).

Summer high temperature season should reasonably adjust the schedule, avoid noon high temperature time construction ; Reduce the labor intensity of workers, take a rotation of the way to increase the number of workers rest and rest time ; Air conditioning shall be provided in the operation room and cab of various mechanical and transport vehicles ; In summer, workers are provided with a cool drink containing salt. When the maximum temperature of the day reaches above 40℃, outdoor outdoor operations shall be stopped on that day.

12.1.6.6 Anti-low temperature control measures

Avoid or reduce the use of low-temperature operation of the construction process ; Adopt mechanization, automation technology as far as possible, reduce low temperature operation time ; Do the measures of cold-proof and warm-keeping, set the heating room and the rest room near the construction site.

12.1.6.7 Power frequency electric field prevention measures

The radiation source is shielded by shielding net, shield or shielding chamber . The electrical equipment and lines are shielded by metal grid and grounding measures and reinforced concrete. A reliable grounding is provided, and the shielding grounding is not replaced by the protective earthing of general electric energy, so as to avoid the shield becoming the secondary radiation source. The electrical equipment is installed in the cabinet with radiation protection function . The operators should keep away from the radiation source as far as possible and reduce the radiation injury.

12.1.6.8 Ultraviolet radiation protection measures

The use of automatic or semi-automatic welding equipment to increase the distance between workers and radiation sources ; Use opaque or translucent baffles to separate construction sites that produce ultraviolet radiation from other construction areas.

12.2 Occupational Health Management Recommendations

（1） The operating units shall set up occupational health management institutions and administrative systems in accordance with the relevant provisions of the Occupational Disease Prevention and Control Law of the People's Republic of China, the Regulations on Occupational Health Supervision and Management in the Workplace and the Measures on Supervision and Administration for Occupational Disease Protection in Construction Projects at the same time . the relevant systems include the liability system for prevention and treatment of occupational hazards, the warning and notification system for occupational hazards, the declaration system for occupational-disease-inductive items, the training system for occupational-disease-prevention publicity, the maintenance and inspection system for occupational-disease-prevention facilities, the management system for occupational-disease-prevention products, the monitoring and evaluation system for occupational hazards, the occupational health monitoring and file management system for construction projects, the treatment and reporting system for occupational-disease-prevention and other occupational health regulations, and carry out according to the system.

（2） The operating units shall clearly identify the occupational health management institutions or organizations, provide full-time occupational health management personnel, and formulate occupational disease prevention plans and implementation programmes.

（3） In accordance with the requirements of the Occupational Disease Prevention and Control Law of the People's Republic of China that " the cost of the occupational-disease-prevention facilities of the construction project shall be included in the project budget of the construction project, and the funds for all occupational-disease-prevention facilities shall be separately allocated ", the send-out pipeline shall be improved for the occupational-disease-prevention measures and the estimated investment of the facilities.

（4） The occupational-disease-prevention facilities shall be designed in accordance with the requirements of the relevant laws, regulations, rules and standards for the prevention and control of occupational diseases prior to the construction, including: design basis, general situation and engineering analysis of the construction project, analysis of occupational-disease-inductive factors and prediction of the degree of harm, name, specifications, type, quantity and distribution of the occupational-disease-prevention facilities and emergency rescue facilities to be adopted . it also analyzes the prevention and control performance, the setting of auxiliary rooms and sanitary facilities, the explanation of the occupational-disease-prevention facilities to be adopted in the pre-evaluation report, the adoption of protective measures and countermeasures, the detailed investment budget of occupational-disease-prevention facilities and emergency rescue facilities, the expected effects of occupational-disease-prevention facilities and emergency rescue facilities.

（5） After the completion of the design of the occupational-disease-prevention facilities, the business unit shall organize the professional health professionals to review the occupational-disease-prevention facilities design and form an evaluation opinion.

（6） After the project is put into operation, a sound occupational health file shall be established in accordance with the requirements of the Occupational Health Records Management Code (Security and Safety of the Office of the Director-General [2013] No. 171). The occupational health archives shall include the construction project occupational health " three simultaneous " files, occupational health management files, occupational health publicity and training files, occupational-disease-inductive factors monitoring and evaluation files, occupational health monitoring and management files of the employing unit, and workers's personal occupational health monitoring files.

（7） Before the project is put into operation, workers engaged in occupational-disease-inductive work shall be organized to carry out pre-employment occupational health examination, and the results shall be communicated to the workers in writing ; In case of emergency, the company should also organize emergency occupational health examination, and emergency occupational health examination into the occupational health monitoring file management. The occupational health examination shall be undertaken by the medical and health institutions that have filed a record with the provincial health authorities.

（8） The operator shall, in addition to the pre-post medical examination and departure medical examination, conduct regular occupational health examination every year and inform the operator in writing of the results of the examination.

（9） When entering into a labor contract with workers (including employment contract), the occupational-disease-inductive factors of the work process and the consequences thereof, occupational-disease-inductive measures and treatment (post allowance, inductrial injury insurance, etc.) shall be specified in the labor contract. At the same time, the labor dispatch personnel shall be informed in writing. If the text of the form contract is incomplete, the occupational-disease-inductive notification shall be signed in the form of an annex to the contract. When the laborer is engaged in the occupational-disease-inductive work that is not disclosed in the labor contract with the laborer due to the change of the work position or the content of the work during the performance of the labor contract, the employing unit shall perform the duty of truthful notification to the laborer and negotiate the modification of the relevant provisions of the original labor contract.

（10） Workers should be provided with pre-employment occupational health training and regular occupational health training during the on-job period, so that workers are aware of occupational hazards in the workplace, grasp the regulations, operating procedures, emergency relief measures, occupational-disease-prevention facilities and personal protective products of the correct use of maintenance methods and the meaning of relevant warning signs, and after passing written and practical operational tests.

（11） The operating unit shall formulate emergency plans and on-site solutions for occupational hazards such as heatstroke, asphyxia, carbon monoxide poisoning, acute hydrogen sulfide poisoning, sulfur hexafluoride leakage, asphyxiation or explosion caused by hydrogen leakage, chlorine poisoning, etc., establish emergency rescue teams for occupational hazards, define the responsibilities and work of emergency relief agencies. In addition, the operating units shall be equipped with first-aid protection equipment, medicine boxes and commonly used medicines, formulate management systems, and conduct regular evacuation, first aid, fire drill and training. Its rescue system, organization and personnel should be able to meet the requirements of relevant national standards.

（12） If there are female workers among the workers, they shall also, in accordance with the relevant provisions of the Special Provisions on the Labour Protection of Female Workers (State Council Order [2012] No. 619), strengthen the labour protection of female workers and workers, take measures to improve the occupational health conditions of female workers and provide vocational health training for female workers.

（13） During the trial operation of the project, the occupational-disease-prevention facilities shall be put into operation at the same time as the main works. The trial run time shall be no less than 30 days and no more than 180 days. During the trial operation, the operation of the occupational-disease-prevention facilities and the occupational-disease-inductive factors in the workplace should be tested, and the effects of occupational-disease-inductive control should be evaluated.

（14） During the loading process of LNG, there will be a connecting process between the loading arm and the tank car . These operations are liable to cause natural gas leakage. In addition to the installation of vehicle interlocking, operating procedures shall be formulated to urge operators to use cold-proof gloves and protective glasses.

（15） In the course of the operation of this project, if there is an outsourcing committee, such as emergency repair and daily maintenance operations relying on the Central Petroleum Emergency Response Center, the occupational health management responsibilities of the employees of the external contractors and the responsibility for the prevention and control of occupational diseases shall be fully clarified (see Section 4.3.10 for details). The operating unit shall not outsource the occupational-disease-inductive work to the units and individuals without occupational-disease-inductive protection conditions, and shall fulfill the obligations of the employing unit stipulated in the Occupational Disease Prevention and Control Law.

（16） In the next design of this project, we will improve the estimation of the investment for the protection measures and facilities for occupational diseases by the terminal and the send-out pipeline.

（17） In abnormal condition or during overhaul, maintenance or sealing operation, management shall be strengthened, operation procedures shall be strictly enforced, toxic gas concentration and air oxygen content shall be monitored, personnel shall be placed under supervision, personal protective articles shall be worn as required, and local ventilation shall be observed.

（18） To establish and improve the responsibility system for occupational safety and health production before the operation of this project, establish, improve and strictly implement various occupational safety and health rules and regulations (management system, operating procedures, equipment maintenance and education and training, etc.), and strengthen the prevention, control and treatment of accidents, property losses and hidden dangers of accidents.

12.3 Suggestions on occupational health management during construction and equipment installation and commissioning

（1） The operating unit shall clearly define its responsibility for the occupational health management and prevention of occupational diseases for the employees of the construction unit, and shall not outsource the occupational-disease-inductive operations to units and individuals without occupational-disease-inductive protection conditions.

（2） The construction units shall set up occupational health management institutions and related systems to provide effective occupational-disease-prevention facilities in accordance with the requirements of the " occupational-disease-prevention facilities for construction projects " (Decree No. 90 of the State Administration of Safety Production Supervision and Administration), the " Occupational Hazards Prevention and Control Code for Construction Industry " (GBZ/T 211-2008) and the " Technical Specification for Occupational Hazards Prevention and Control of Construction Enterprises " (AQ/T

4256-2015) make reasonable labor system, strengthen construction process occupational health management and education training, set up corresponding occupational disease protection facilities and warning signs, and equip workers with qualified personal protective articles, organize workers to carry out pre-job, on-job and off-duty occupational health inspection.

（3） After the construction plan is determined, the construction unit may entrust the professional health technical service organization with corresponding qualifications to supplement the relevant pre-evaluation contents. During the construction, the management unit shall supervise the occupational-disease-prevention measures taken by the contractor in accordance with the prevention and control requirements of occupational-disease-inductive factors in the Code for the Prevention and Control of Occupational Hazards in the Construction Industry (GBZ/T 211-2008), and inspect the construction operation and find problems in time to require the contractor to correct them. The construction unit shall provide the construction unit with a summary report on the prevention and treatment of occupational hazards in the construction process after the completion of the project.

（4） The construction unit shall, in cooperation with the contractor, establish emergency relief agencies or organizations during the construction period ; The construction site shall be equipped with trained first aid workers, first aid kits, stretchers, blankets and other first aid items.

（5） During the construction phase of the project, the construction unit shall require the construction unit to design a special article according to the occupational-disease-prevention facilities and simultaneously construct the main part of the project.

13 Environment and Economic Cost-Benefit Analysis

13.1 Analysis of social and economic benefits

（1) The project is in line with China's long-term energy planning strategy and is an important measure to optimize the energy consumption structure and promote energy conservation and emission reduction in the Beijing-Tianjin-Hebei region.

The next five years and even longer are the key period for China's energy transition. Air pollution control and climate change pressures urgently need to be supported by clean low-carbon energy. Renewable energy is constrained by various factors such as technology, cost, and energy storage techniques. Objectively, a considerable amount of flexible power supply is needed to match it. Gas-fired power plants have excellent regulation and response capabilities, as well as rapid start-stop and flexible operation. The combination of gas-electricity and wind power or photovoltaic power generation with “co-complementary” or “pho-complementary” combined units can effectively solve the current abandonment. The problem of wind and light is to increase the total output level of the generator set and the reliability of the grid operation. Therefore, cooperating with natural gas has become an important way for China to develop wind power and photovoltaic power in large scale in the future.

As an efficient, clean and low-carbon high-quality energy source, natural gas itself has abundant resources, sufficient supply, relatively low cost, convenient use, and remarkable energy saving and emission reduction effects. The thermal efficiency of natural gas on power generation and industrial fuel is about 10% higher than that of coal. The heat supply efficiency of natural gas cold and heat electricity is nearly double that of coal-fired power generation; the carbon dioxide emissions of natural gas are 59% of coal and 72% of fuel oil; large gas-steam The concentration of sulfur dioxide in the combined cycle unit is almost zero. The sulfur dioxide emissions from industrial boilers are 17% of coal and 25% of fuel oil. The nitrogen oxide emissions of large gas-steam combined cycle units are 73% of ultra-low emission coal-fired units. Natural gas emissions from industrial boilers are 20% of coal; at the same time, natural gas has no dust emissions compared with coal and fuel oil.

The design capacity of the LNG receiving station is 5 million tons/year, equivalent to 6.937 billion square meters of natural gas, which can replace the standard coal of 8.9994 million tons, reduce the sulfur dioxide emissions by 27225.4102 tons/year, reduce the emission of soot by 67699.86 tons/year, and reduce the carbon dioxide emissions by 7,504,300 tons/Year, can reduce nitrogen oxides by 78,841.03 tons / year.

（2) The project is an important facility for the " interconnection " of the Beijing-Tianjin-Hebei region and the national natural gas pipeline network.

According to statistics, as of the end of 2017, the total length of the national natural gas pipeline network reached 68,000 kilometers, and the total gas transmission capacity was about 290 billion cubic meters per year, which formed the West-East Gas Transmission System, Shaanxi-Beijing System, Sichuan-East Gas Transmission System, and Southwest Pipeline. The system is a nationwide gas supply network that spans the east and west and runs through the north and south and connects to the overseas. However, due to the different ownership of the natural gas pipelines and the imperfect regional network, the pipelines are not completely interconnected, and it is difficult to play the role of peak regulation and supply at critical moments.

In addition, at present, most LNG receiving stations in China supply gas nearby, only a few connected to the large pipe network system, the coastal transmission line has not yet formed. If two intersecting or parallel pipelines can be connected, and one of the pipelines is stopped by the upstream accident, the upstream of the other pipeline can be urgently increased, thereby ensuring the basic gas demand of the downstream users of the accident pipeline and enhancing the pipeline emergency support capability. After the completion of the project, it will improve the peaking capacity of the Beijing-Tianjin-Hebei region, ensure the safety of gas consumption in Beijing, play a positive role in maintaining the stability of the natural gas market, and contribute to the sustainable development of the national economy.

The indirect economic benefits of the project mainly include the use of natural gas, natural gas power generation, savings in coal-fired power plant investment, coal freight savings, ease of railway and road transport pressure, and improvement of the environment to improve the quality of life of residents. The project's internal rate of return is 8.93%, which is greater than 8% of the social discount rate. The economic net present value is 408.81 million yuan (i=8%) , which is greater than zero. The investment recovery period is 12.02 years (including the construction period) and has a good internal rate of return.

13.2 Environmental benefit analysis

13.2.1 Positive environmental benefits of project construction

13.2.1.1 Conducive to environmental governance

Natural gas is currently the cleanest fuel. The problem of other fuel oil and coal burning relative to gas is that SO2 and soot pollution are more obvious. The replacement of coal in this project is conducive to the improvement of local ambient air quality.

13.2.1.2 Estimation of Pollutant Reduction for Natural Gas Alternative to Other Fuels

LNG is clean energy, and SO2, NOx and CO2 emissions from LNG gas combustion are 19.2% and 42.1%, respectively, of coal and fuel emissions. The use of LNG to optimize the energy structure has greatly alleviated the pressure brought by air pollution, and it is of great significance to improve the ecological environment and achieve sustainable development. The design capacity of the LNG receiving station is 5 million tons/year, equivalent to 6.937 billion square meters of natural gas, which can replace the standard coal of 8.4994 million tons, reduce the sulfur dioxide emissions by 27,225.4102 tons/year, reduce the emission of soot by 67,699.86 tons/year, and reduce the carbon dioxide emissions by 7,504,300 tons./Year, can reduce nitrogen oxides by 78,841.03 tons / year.

1．Basic data

(1) The heat loss value of the receiving station G1: 34.01 MJ/m3

(2) Receiver station rich gas heat value G2: 37.81MJ/m3

(3) Standard coal calorific value G3: 7000.00Kcal/kg (29307.6kJ/kg)

(4) Ordinary coal calorific value G4: 5000.00Kcal/kg (20934kJ/kg)

(5) The density of natural gas is: $\rho 1$=0.6692kg/m3 to $\rho 2$=0.7724kg/m3

2. Calculation of natural gas volume conversion V at the receiving station and conversion of standard coal quantity M

(1) The natural gas calorific value of the receiving station: G=(G1+G2) /2=35.91MJ/m3

(2) Average value of natural gas density ρ=(ρ1+ρ2) /2=(0.6692+0.7724) /2=0.7208kg/m3

(3) LNG receiving station design capacity 5 million tons / year

Natural gas volume V=500*10000*1000/ρ=6936736958.93m^3=6.937 billion m^3

Natural gas calorific value Q=G×V=249098224195.34MJ

Standard coal M1=Q/G3/10000= 8.4994 million tons

Equivalent to ordinary coal M1=Q/G4/10000=11.8992 million tons

3. Calculation of emission reduction (since the chain furnace is the most widely used, the following values are based on the chain furnace)

(1) Calculation of emission reduction of sulphur dioxide

The mass of sulphur dioxide produced by ordinary coal combustion is calculated by the following formula :

$$M_{SO_2} = B \bullet C\left(1 - \frac{\eta_{SO_2}}{100}\right)\frac{S_{ar}}{100}\frac{64}{32}$$

in which ***B*** coal consumption (ton / year) value 11,899,217.74; C sulfur coal produced in the chain furnace after the generation of SO_2 quota value of 0.8; ηso2 desulfurization efficiency boiler room is 89; Sar fuel base sulfur content value of 1.30 . Thus, the quality of sulfur dioxide produced by ordinary coal combustion is M_{SO2} = 27,225.4102 tons / year.

M_{SO2}	Boiler SO2 Emissions (T/A)
B	Consumption of coal (10000 t/a)
C	SO2 fraction from combustion of sulfur-containing coal
	Chain furnace: 0.8
	Power Plant Pulverizer: 0.9
MSO2	Desulfurization efficiency :
	Boiler House: 89%
S_{ar}	Fuel received base sulfur content (%) 0.6-1.5

LNG is a clean energy source with very low sulfur content and can be neglected. Therefore, the emission reduction of sulfur dioxide is 27,225.4102 tons/year.

(2) Calculation of smoke and dust emission reduction

The mass of smoke dust produced by ordinary coal combustion is calculated by the following formula :

$$M_{Ai} = B \cdot \left(\frac{A_{ar}}{100} + \frac{q_4}{100} \bullet \frac{Q_{ar.net}}{4.187 \times 8100} \right) a_{fh} \cdot \eta$$

in which *B* consumption of coal (ton/year) value 11899217.74 ; A_{ar} fuel received base ash content value 16.3 ; η of Boiler room value 12 ; The low calorific value (KJ/kg) of Q_{arnet} fuel is 20931 KJ/Kg; The fly ash share of A_{fh} boiler is 0.2 ; q_4 mechanical incomplete combustion heat loss chain furnace value 12. The resulting sulfur dioxide mass produced by ordinary coal combustion is M_{ai} = 67,699.86 tons/year.

Mai	Boiler TSP Emissions (T/A)
q4	Mechanical incomplete combustion heat loss
	Chain furnace: 12%
	Power Plant Pulverizer: 5%
Black sheep	Discharge ratio after dedusting device
	Thermal Power Plant: 0. 5%
	Peak-shaving boiler house: 12% before and 1% after reconstruction
	Dispersed Boiler House: 12% Present Situation, 1% New
A_{ar}	Fuel received base ash content 16.3 (%)
Q_{arnet}	Low calorific value of fuel (kJ/kg) 20931
A_{fh}	Fly ash fraction from boiler exhaust
	Chain furnace: 0.2 pulverized coal furnace: 0.9
b	Consumption of coal (T/A)

LNG is a clean energy source, combustion does not produce soot, so the emission reduction is 67699.86 tons per year.

(3) Calculation of carbon dioxide emission reductions

①The quality of carbon dioxide produced by coal-fired boilers is calculated by the following formula :

$$M_{co2}=B*44/12*a*b*c/1000000$$

in which B consumption of coal (10,000 tons/year) value 1189.9218 ; A CO2 emissions per unit heat of coal burning (tC/TJ) 27.49 ; b is Coal calorific value (kJ/kg) 20931; c is Carbon oxidation rate with a value 0.85 . The resulting carbon dioxide mass from ordinary coal combustion is M_{CO2} = 21,339,000 tons/year.

$\boldsymbol{M_{CO\,2}}$	Boiler CO2 Emissions (10000 T/A)
B	Average coal consumption (10000 t/a)
a	CO2 emissions per unit heat of coal burning: 27.49 TC/TJ
b	Calorific value of ordinary coal: 20931 kJ/kg
c	Carbon Oxidation Rate: 0.85

②The quality of carbon dioxide produced by gas boilers is calculated by the following formula :

$$Mco2=B*44/12*a*b*c/10000000$$

in which ***B*** is the consumption (10,000 Nm^3/year) value 693673.70 ; ***a*** is the calorific value of natural gas (GJ/10000 Nm3) is 359.10 ; ***b*** is the carbon content (T/GJ) is 15.3; ***c*** is the Carbon oxidation rate is 0.99 . The resulting combustion of natural gas produces a carbon dioxide mass of M_{CO2} = 13,834,666.27 tonnes/year.

$\boldsymbol{M_{CO\,2}}$	Boiler CO_2 Emissions (10000 T/A)
B	Annual gas consumption (10000 Nm3)
a	Calorific value of natural gas (GJ/10000 Nm3) 359.10
b	Carbon content （T/TJ） 15.3
c	Carbon Oxidation Rate: 0.99

Therefore, the carbon dioxide emission reduction after the use of LNG is 7.5043 million tons/year.

(4) Calculation of NOx emission reduction

①The mass of nitrogen oxides produced by coal-fired boilers is calculated by the following formula :

$$Nox=1.63*B*(N*\beta+0.000938)$$

in which **B** consumption of coal (ton/year) value 11899217.74 ; The value of beta conversion rate was 0.25 ; N The nitrogen content in fuel is 0.015 . The mass of nitrogen oxides produced by ordinary coal combustion is N_{OX} = 90,927.16 t/year.

N_{OX}	Nitrogen oxide content
B	Consumption of coal (T/A)
β	Conversion rate (%) ; Related to fuel nitrogen content N. Under normal combustion conditions, the coal layer combustion furnace is 25- 50% , the fuel boiler is 32- 40% , and the coal powder furnace is 20- 25%
N	Nitrogen content in fuel (%) , coal average 1. 5%

②The mass of nitrogen oxides produced by gas boilers is calculated by the following formula :

$$Nox=B*N*12/10^5$$

in which ***B*** consumption (10,000 nm 3/year) value 693673.70 ; N The nitrogen content in fuel is 150 . The resulting nitrogen oxide mass from natural gas combustion is N_{OX} = 12486.13 t/year.

Therefore, the NOX emission reduction after using LNG is 78,441.03 tons/year.

13.2.1.3 Resulting environmental benefits

Replacing coal and fuel with natural gas can reduce SO2 emissions with the following environmental benefits :

1) Savings in SO2 processing costs

According to statistics, the cost of SO2 treatment is 1.0 yuan/kg, after the completion of the project can directly save SO2 governance costs 592,680,000 RMB per year.

2) Reduction of diseases caused by environmental air pollution

According to the environment statistics at home and abroad, chronic tracheitis, asthma and lung cancer are the main diseases caused by environmental air pollution. The incidence rate of chronic tracheitis is 9.4 ‰ in polluted area (considered according to SO2 above the national secondary standard) and 11 ‰ in clean area.

3) Reduction of environmental pollution due to transport

Pipeline transportation is a safe, stable and efficient mode of transportation. Because natural gas is transported in closed pipeline, there will be no pollution to the environment during transportation. However, the use of coal or oil requires transportation by car and ship, which will produce a certain amount of air pollutants, such as automobile exhaust and secondary dust. Therefore, the use of natural gas can avoid the environmental pollution caused by transportation, protect the ecological environment and have better environmental benefits.

13.2.2 Environmental protection investment

The environmental protection investment of the terminal and receiving station of the project is 334,011,2000 RMB.

Table 13.2-1 Estimated Environmental Investment for the Send-out pipeline

Type	Project Name	Content	Investment (10,000 RMB)
Pollution control	Sewage treatment	Septic Tank, Integrated Sewage Treatment Facility	25
	Noise control	To install or place in a room.	374.93
	Solid waste	Domestic garbage temporary storage facility	12.5
Ecological protection and rehabilitation measures	Directional drilling through	Adopt advanced international technology	1980.19
	Station yard greening	Planting lawn	6.25
	Restoration of geomorphology, vegetation and prevention of soil erosion	Restoration of the original use of land	2011.12
	Ecological compensation and restoration	Ecological Red Line of Tianjin, Beidagang Nature Reserve and Ecological Restoration of All Projects	15962.4
Environmental management	Environmental management	Environmental Training, Regulations Establishment and Implementation	12.5
	Environmental monitoring and supervision	Environmental monitoring, supervision during construction period and environmental monitoring during operation period	37.49
Environmental risk prevention	Pipeline Anticorrosion and Cathodic Protection	Anticorrosion paint, cathodic protection station	2032.12
	Automatic control monitoring system	Combustible gas alarm, flame detector, gas-liquid linkage system	1023.56
	Increase pipe wall thickness		6490.21
	Cut-off valve chamber		3421.6
	Emergency rescue plan	Emergency scheme	11.25
Total			33401.12

14 Environmental Protection Management and Monitoring Program

14.1 Environmental Protection Management

(1) Environmental Protection Management Department

The environmental protection administrative departments at all levels are responsible for the environmental management, environmental monitoring, and supervision and management of pollution prevention and control of the project.

In addition to the above-mentioned relevant departments, the environmental protection management work during the construction period of the project shall be implemented by the project construction unit and cooperate with the environmental protection law enforcement and supervision and management of the above-mentioned institutions.

(2) Responsibilities of the environmental protection management organization of the project construction unit

1 to publicize and implement relevant national environmental protection laws, regulations, standards, and supervise the implementation of relevant departments;

2 Responsible for the environmental protection management during the construction period of the project. Responsible for supervising the implementation and implementation of various environmental protection measures;

3 At the construction site, the project environmental supervision personnel shall follow up the monitoring and management at the construction site to monitor the setting and implementation of environmental protection facilities;

4 The project environmental supervision shall be incorporated into the project supervision and be supervised and supervised by the environmental protection department of Tianjin Ecological Environment Bureau to better perform its duties;

5 Report various environmental management reports according to the regulations and requirements of the environmental protection department;

6 Responsible for the investigation, monitoring and analysis of pollution accidents during the construction period, and write an investigation report;

7 Implementation of environmental monitoring work and monitoring plan

Table 14.1-1 List of environmental management plans for this project

Phase	Environmental factors	Recommendations for preventive measures	Implementing agency	Supervisory authority
Construction	Occupy land during construction, reduce waste of land resources	Reduce the land requisition area, reduce the land occupation time, restore the original function as soon as possible	Construction unit and owner	Environment protection Sectors
	Dust and noise at construction site	Use low-noise equipment or noise-reducing facilities for dust suppression by water spraying	Construction unit and owner	Environment protection Sectors
	Affect original traffic on site	Consult with the management department to strengthen management	Management department, construction unit and owner	Traffic Sectors
	The influence of sewage, garbage and feces in construction living area on environment	The garbage is piled centrally and transported regularly, and suitable toilets are set up	Construction unit and owner	Sanitation Sectors
	Effects of collection, storage, transport and disposal of hazardous wastes on the environment	New hazardous waste storage room, storage in special container, strict five-in-one system	Construction units, owners and external contractors	Environment protection Sectors
Operation	Effects of Domestic Sewage, Production Wastewater, Noise and Solid Waste on Environment	Strengthen the comprehensive sewage treatment station management, sewage discharge up to standard ; Solid waste disposal or disposal as required by the environmental protection department	Local environmental management bodies and local environmental monitoring stations	Environment protection Sectors
	Effects of collection, storage, transport and disposal of hazardous wastes on the environment	New hazardous waste storage room, storage in special container, strict five-in-one system	Owners and external contractors	Environment protection Sectors
	Engineering construction destroys ecological environment	Develop a green plan to plant trees and grass in suitable areas within the designated site	Local environmental management bodies and local environmental monitoring stations	Environment protection Sectors

14.2 Environmental Supervision

According to the Ministry of Communications, Jiaohuan [2004] No. 314, "Notice on Conducting Environmental Supervision of Traffic Engineering" and "Implementation Plan for Environmental Supervision of Traffic Engineering", the project environmental supervision work is mainly based on national and local laws and regulations concerning environmental protection. And the documents, environmental impact reports, relevant technical specifications and design documents, etc., the project environmental supervision includes all aspects of environmental protection work such as ecological protection, soil and water conservation, greening, pollutant prevention and control. The engineering environmental supervision work should be an important part of the project supervision and should be considered in the project supervision system.

14.2.1 Organization and implementation of engineering environmental supervision

(1) Qualification of engineering environmental supervision units and personnel

The construction unit shall entrust an entity with engineering supervision qualifications and professional training in environmental protection to undertake the project environmental supervision work. The qualifications of the project environmental supervision units and personnel shall be implemented in accordance with the relevant provisions of the Ministry of Communications on project supervision.

(2) Management of project bidding, contracts and other documents

The construction unit shall formulate the project environmental supervision plan during the construction period according to the relevant requirements of the environmental impact report, engineering design and other documents, and clarify the construction unit and the project supervision unit in the construction bidding documents, construction contract, project supervision bidding documents and supervision contract. Environmental responsibility and target tasks.

(3) Principles of the engineering environment

1) Basis for environmental supervision: national and local environmental protection laws, regulations and documents, environmental impact reports or project environmental action plans, technical specifications, design documents, engineering and environmental quality standards.

2) Main contents of environmental supervision: mainly including environmental protection compliance supervision and environmental protection engineering supervision. Environmental protection compliance supervision is to ensure that the construction of the main project meets the requirements of environmental protection.

Noise, exhaust gas, sewage and other discharges should meet the standards listed in this environmental impact report; environmental protection engineering supervision includes ecological environmental protection, soil and water conservation, etc., including sewage Supervision of the construction of environmental protection facilities such as facilities and greening.

3) Environmental supervision organization: The engineering director office of the construction project is responsible for the unified supervision of the project and the environment. Generally, a part-time or full-time deputy director of engineering environmental supervision can be set up at the director's office to focus on the environmental supervision of the project. The resident office may appoint a certain number of engineering environmental supervision engineers (engineering supervision engineers) to implement the environmental protection work of each project.

4) Environmental supervision assessment: The content of the project supervision assessment should include the corresponding content of the project environmental supervision, and complete the summary report of the project environmental supervision situation separately. The summary report should be one of the materials for environmental protection single acceptance. When assessing and accepting individual projects for environmental protection, personnel responsible for environmental protection in the traffic management department shall participate.

14.2.2 The specific work content of the project environmental supervision during the construction period of the project

During the construction of the construction project, the project environmental supervision personnel mainly carry out the following monitoring work:

(1) Supervision of water pollution prevention and control

The environmental supervision engineer shall supervise the source, discharge, water quality index, construction process and treatment effect of the production and domestic sewage during the construction period, check whether the monitoring and monitoring have reached the approved emission standards, or whether measures are taken to control the generation of pollutants. Supervise and inspect whether the construction vessel has a treatment device or storage that is compatible with the amount of domestic sewage produced, and the disposal of oily sewage and other domestic garbage generated during the operation of the ship.

(2) Ecological environment supervision

Focus on the following aspects:

1) Implementation of various ecological protection measures during dredging and excavation and landfilling;

2) Supervise the construction and construction units to do ecological protection and compensation work.

(3) Supervision of solid waste

Supervise and inspect the daily collection, classification, storage and disposal of domestic waste from construction vessels.

(4) Other aspects

During the construction period, the construction personnel will be trained in environmental protection, cultivate awareness of environmental protection and pollution prevention, and participate in the investigation and handling of environmental pollution accidents and environmental pollution disputes during the construction period.

14.3 Environmental Monitoring Plan

14.3.1 Construction Period Environmental Monitoring Plan

The environmental inspection and monitoring during the construction period is mainly on-site inspection and monitoring of the construction site and surrounding environment quality along the line. The scope, project and frequency can be determined according to local conditions and determined according to the requirements of the local environmental protection department. The specific monitoring and monitoring plan for the construction period can be referred to the following table.

Table 14.3-1 Construction Period Monitoring Plan Reference

Monitoring content or objects	Monitoring index	Monitoring position	Working mode	Monitoring frequency	Implementing unit	Supervisory unit
Occupied farmland	Cover the soil and return the land after the completion of construction	Pipeline construction occupies farmland	On-site inspection	Construction period and completion	Environmental supervision	Environmental Management Department of Project Department

Monitoring content or objects	Monitoring index	Monitoring position	Working mode	Monitoring frequency	Implementing unit	Supervisory unit
Construction noise	LEQ	The village sensitive point takes the village closest to the project as the focal point, chooses the village closest to the pipeline 3 ~ 5 places, the spot monitoring suggestion carries on the monitoring in the Xue Jia Fang Cun, ShunMin Tun, Tong Jia Zhuang Cun, Liu Zheng Cun	Monitoring construction activity peak period of construction work	Once during construction	Environmental monitoring units commissioned by construction units	Environmental Management Department of Project Department
Surface water	PH, CODCR, ammonia nitrogen, SS, petroleum, permanganate index	Choose in alkali river, Yongding river, Duliujian river, south canal, big qinghe river, Ziya river, middle line of south-to-north water transfer (corridor main canal, Tianjin main canal), the Yellow River crossing point upstream 100 m, downstream 500 m	Monitoring during peak period of excavation operation through construction work	Monitoring 1 during construction period	Environmental monitoring units commissioned by construction units	Environmental Management Department of Project Department

14.3.2 Environmental Monitoring Plan during Operation Period

According to the characteristics of environmental pollution during the operation period of the project, environmental monitoring mainly includes regular monitoring of wastewater at each station, noise at the boundary of the plant, and non-methane total hydrocarbons at the boundary of the plant. It is recommended that the daily monitoring plan be formulated with reference to the Technical Guidelines for Self-Monitoring of Sewage Units - General (HJ819-2017), which can be formulated with reference to the following table.

Table 14.3-2 Environmental Monitoring Plan for the Operation Period

Sequence number	Monitoring content	Monitoring point position	Monitoring factor	Monitoring frequency	Monitoring unit	Execution criteria
1	Station sewage	Septic tanks at Nanbu station, Nangang sub-	COD, Ammonia Nitrogen, pH,	It is recommended to monitor for half a year for one period and for	Qualified monitori	Water Intake Index of Sewage Treatment Plant

		transmission station, Jinghai transmission station, Yongqing transmission station and Anji sub-transmission station	BOD, Petroleum	two consecutive days.	ng unit	
2	Noise	One monitoring point will be set up around the plant boundary of each station	Equivalent sound level	It is recommended to monitor for half a year for one period and continuously for two days	Qualified monitoring unit	Environmental Noise Emission Standard for Industrial Enterprises, Class 2 (GB 12348-2008)
3	Ambient air	One point of wind on the factory boundary and three points of wind on the downwind	Total hydrocarbon, non-methane total hydrocarbon	It is recommended to monitor for half a year for one period and continuously for two days	Qualified monitoring unit	Limits for Monitoring Concentration of Unorganized Emissions in the Standard for Integrated Emission of Atmospheric Pollutants (GB 16297-1996)

15 Public participation and information disclosure

Public participation is an important part of environmental impact assessment. Regional construction will have a certain impact on the surrounding nature, social environment, residents, etc. Public participation aims to listen to the opinions of relevant units and the public, and to reflect the public's suggestions and opinions to the construction department and management department, and pay full attention to the people during construction. Opinions to minimize the impact of project construction on the environment, and obtain valuable opinions and suggestions, improve project layout and construction management, and make the project construction work more complete and more popular.

According to the “General Guidelines for Technical Guidelines for Environmental Impact Assessment of Construction Projects” (HJ2.1-2016) and the “Public Participation Measures for Environmental Impact Assessment” (Order of the Ministry of Environmental Protection [2018] No. 4) issued by the Ministry of Environmental Protection, Beijing Gas Group limited liability company shall publicize the relevant information of the project environmental impact assessment and solicit public opinions.

15.1 The first information disclosure of environmental impact assessment

According to Article 9 of the 'Technical guidelines for environmental impact assessment General principle' (Order of the Ministry of Environmental Protection [2018] No. 4): “ After the determination of the organization for environmental impact reporting , the construction company should publicize the information through its own website, the local public media website or the local government website (hereinafter collectively referred to as the network platform) within 7 working days and solicit opinions related to the environmental impact of the construction project.

At the same time, Article 31 of ‘Public Participation Measures for Environmental Impact Assessment’ (Order No. 4 of the Ministry of Environmental Protection [2018]) states:

"For construction projects approved by law within the industrial park, if the industrial park has carried out the public participation in the planning environmental impact assessment according to law, and the nature and scale of the construction project are in line with the planning environmental impact report reviewed and approved by the competent department of ecological environment. When the construction company carries out public participation in environmental impact assessment of construction projects, it can be simplified as follows:

(1) Exempting from the public procedures stipulated in Article 9 of these Measures, and the contents that should be disclosed can be disclosed in Article 10 of these Measures;

(2) The deadline of 10 working days can be reduced to 5 working days as stipulated in the second paragraph of Article 10 and the first paragraph of Article 11;

(3) Exempting from the way of posting announcements as stipulated in the third item, the first paragraph of Article 11.

According to the above-mentioned measures and the original "Public Participation Interim Measures for Environmental Impact Assessment", the construction company publicized the project environmental assessment on the YiHuanPing website on June 18, 2019, with a public notice date of 10 working days.

15.1.1 Public content and date

On June 18, 2019, the construction company conducted the first environmental impact assessment publicity on the YiHuanPing website (http://www.yihuanping.cn/32529.html). The publicity contents are as follows:

15.1.2 Disclosure

On June 18, 2019, the first environmental impact assessment publicity was carried out on the YiHuanPing website (http://www.yihuanping.cn/32529.html). The public notice date was 10 working days, which met the relevant requirements.

15.1.3 Public comments

During the publicity period, neither the construction company nor the YiHuanPing website received feedback.

北京燃气天津南港LNG应急储备项目环境影响评价第一次公示

公示编号:	AEIA2019061832529	公示类型:	环评公示
建设单位:	北京市燃气集团有限责任公司	建设地点:	天津
公示时间:	2019 年 6 月 18 日	环评单位:	天科院环境科技发展（天津）有限公司

北京燃气天津南港LNG应急储备项目环境影响评价第一次公示

根据《中华人民共和国环境影响评价法》及《环境影响评价公众参与办法》（生态环境部令第4号）相关要求，将北京燃气天津南港LNG应急储备项目的环境影响情况进行公示，公众如有意见可联系环境影响评价单位、建设单位或环境主管部门。

1、项目概况

（1）项目名称：北京燃气天津南港LNG应急储备项目

（2）项目申请单位：北京市燃气集团有限责任公司

（3）项目建设性质：新建

（4）项目建设地点：天津南港工业区位于天津市滨海新区所属大港区独流减河入海口，地处天津市东南，东临渤海湾，东北与塘沽区相连，西与静海县接壤，北与津南区毗邻，南与河北省黄骅市交界，是天津市滨海新区的重要发展区域。

北京燃气天津南港LNG应急储备项目位于天津市南港工业区，接收站站址位于南港区东港池东侧，中石化LNG接收站南侧空地；场区西侧边界距西防浪堤319m，场区东侧边界距东防浪堤264m。码头位于南港工业区东港池东突堤东侧岸线的北端。

（5）建设内容及规模：

本工程建设接收站一座，建设规模500×104t/a，建设10座20×104m3LNG储罐及配套工艺设备，以及辅助公用工程设施，远期预留2座20×104m3LNG储罐用地；建设取、排水口各一个；建设可靠泊1～26.6万方LNG船的专用泊位1个，工作船泊位1个；建设外输管线229公里，其中海域段19.04公里。项目建成后，LNG 装车能力为170×104t/a，最大气化外输能力为6000×104Nm3/d。

本项目接收站部分建设投资为1380990万元，码头及栈桥为208708万元，外输管道为564373万元。施工工期约44个月（含施工准备期）。。

燃气环评

北京燃气天津南港LNG应急储备项目环境影响评价第一次公示

公示编号:	AEIA2019061832529	公示类型:	环评公示
建设单位:	北京市燃气集团有限责任公司	建设地点:	天津
公示时间:	2019 年 6 月 18 日	环评单位:	天科院环境科技发展（天津）有限公司

北京燃气天津南港LNG应急储备项目环境影响评价第一次公示

根据《中华人民共和国环境影响评价法》及《环境影响评价公众参与办法》（生态环境部令第4号）相关要求，将北京燃气天津南港LNG应急储备项目的环境影响情况进行公示，公众如有意见可联系环境影响评价单位、建设单位或环境主管部门。

1、项目概况

（1）项目名称：北京燃气天津南港LNG应急储备项目

（2）项目申请单位：北京市燃气集团有限责任公司

（3）项目建设性质：新建

（4）项目建设地点：天津南港工业区位于天津市滨海新区所属大港区独流减河入海口，地处天津市东南，东临渤海湾，东北与塘沽区相连，西与静海县接壤，北与津南区毗邻，南与河北省黄骅市交界，是天津市滨海新区的重要发展区域。

北京燃气天津南港LNG应急储备项目位于天津市南港工业区，接收站站址位于南港区东港池东侧，中石化LNG接收站南侧空地；场区西侧边界距西防浪堤319m，场区东侧边界距东防浪堤264m。码头位于南港工业区东港池东突堤东侧岸线的北端。

（5）建设内容及规模：

本工程建设接收站一座，建设规模500×104t/a，建设10座20×104m3LNG储罐及配套工艺设备，以及辅助公用工程设施，远期预留2座20×104m3LNG储罐用地；建设取、排水口各一个；建设可靠泊1－26.6万方LNG船的专用泊位1个，工作船泊位1个；建设外输管线229公里，其中海域段19.04公里。项目建成后，LNG 装车能力为170×104t/a，最大气化外输能力为6000×104Nm3/d。

本项目接收站部分建设投资为1380990万元，码头及栈桥为208708万元，外输管道为564373万元。施工工期约44个月（含施工准备期）。。

2、环境影响评价工作程序

本项目环境影响评价的工作程序为：天科院环境科技发展（天津）有限公司接受建设单位委托开展前期工作（含资料收集、现场踏家、建设单位进行公众参与调查）→编制报告（含委托监测单位进行环境质量本底调查、收集公众意见）→报送生态环境主管部门审查→专家评审→报告修改→生态环境主管部门出具审批意见。

3、环境影响评价主要工作内容

评价单位将按《中华人民共和国环境影响评价法》等有关国家、地方环保法规的要求，以环评导则为指导，结合本工程的特点，充分利用已有资料，补充必要的现状监测，结合工程设计和预测数据，预测评价本项目的建设期和营运期对项目所在区域大气环境、水环境、海洋生态环境等产生的影响以及对环境可能造成的风险影响，从方案合理、技术可行的角度提出环境保护措施、环境管理与环境监测计划。

4、本工程的主要环境影响

（1）施工期、营运期产生的污废水对附近水域环境的影响。

（2）施工期产生的噪声，粉尘对附近环境的影响。

（3）施工期疏浚悬浮物对水环境、生态环境的影响。

（4）工程占用海域对海洋生物造成的影响。

（5）营运期间作业产生的挥发性有机物对大气环境的影响。

（6）施工期、营运期风险事故的影响。

（7）施工期、营运期产生的固体废物对环境的影响。

5、项目公示期间公众意见受理的通讯方式：

为确保公示期间，公众可以顺畅地将对本项目的意见及时反馈，特公布相关部门意见受理的通讯方式。

建设单位：北京市燃气集团有限责任公司

联系人：孔先生 电话：13332272089

电子邮箱：lgkong06@163.com

6、征求公众意见主要事项

（1）征求公众意见的公众范围

本次征求公众意见的范围是建设项目附近可能受到影响的个人或团体。

（2）公众意见表的网络链接

公众意见表见附件

（3）公众提出意见的方式和途径

若您对项目有什么意见和建议，请于公示之日起10个工作日内，可以通过信函、传真、电子邮件等方式，将填写的公众意见表（见链接）提交建设单位。

（4）公众提出意见的起止时间

本次公示时间为公示之日起10个工作日。

附件

- 建设项目环境影响评价公众意见表

15.2 Publicity of the draft for comments

15.2.1 Publicity content and time

In accordance with the Public Participation Interim Measures for Environmental Impact Assessment and the New Public Participation Measures for Environmental Impact Assessment issued by the Ministry of Ecology and Environment, the construction company carried out the second public announcement on July 22, July 28, July 29 and July 31, 2019, respectively. The publicity time is 10 working days.

15.2.2 Publicity method

According to Articles 10 and 11 of Public Participation Measures for Environmental Impact Assessment (Order No. 4 of the Ministry of Environmental Protection [2018]:

After the formation of the draft of the construction project environmental impact report, the construction company should disclose the following information and solicit opinions related to the environmental impact of the construction project:

(1) The online link of the full text of the environmental impact report and the way and means of accessing the paper report;

(2) The public scope for soliciting opinions;

(3) An online link to the form of public comment;

(4) Ways and means for the public to make comments;

(5) The starting and ending time of the public's comments. The time limit for the construction company to solicit public opinions shall not be less than 10 working days.

The construction company should, in accordance with the provisions of Article 10 of these Measures, disclose the information in the three following ways:

(1) Publicity through online platforms, and the duration of continuous disclosure shall not be less than 10 working days;

(2) It shall be public through accessible local newspapers, and the public information shall not be less than 2 times within 10 working days;

(3) It shall be disclosed by posting notices in places that are easily known to the local public and the duration of continuous disclosure shall not be less than 10 working days. ”

At the same time, according to Article 31 of the ‘Public Participation Measures for Environmental Impact Assessment’ (Order of the Ministry of Environmental Protection [2018] No. 4), the disclosure method of this consultation draft is conducted at the same time on the YiHuanPing website and the China Reform Newspaper.

15.2.2.1 Networking

（1）Compliance analysis of carrier selection

According to the relevant provisions of Articles 10 and 31 of the ‘Public Participation Measures for Environmental Impact Assessment’, Beijing gas Refco Group Ltd is in compliance with the information published on the YiHuanPing website.

（2）Networking publicity time

The networking publicity time is from July 28 to August 10, 2019, for a total of 10 working days.

（3）Publicity website and screenshot

On July 28, 2019, the second environmental impact assessment was publicized on the website of the Environmental assessment company (http://www.tkyhj.com/publicityinfo.aspx?newsID=79&CateId=31). On July 22, 2019, the second environmental impact announcement of the project was again conducted on the YiHuanPing website (http://www.yihuanping.cn/33686.html).

The screenshot of the networking publicity is as follows:

公示编号:	AEIA2019080133686	公示类型:	环评公示
建设单位:	北京市燃气集团有限责任公司	建设地点:	天津
公示时间:	2019年7月28日	环评单位:	天科院环境科技发展（天津）有限公司

北京燃气天津南港LNG应急储备项目环境影响评价第二次公示

一、环境影响报告书征求意见稿全文网络链接及查阅纸质报告书的方式及途径

环境影响报告书征求意见稿全文网络链接：http://www.tkyhj.com/publicityinfo.aspx?newsID=79&CateId=31

查阅纸质报告书的方式及途径：北京市燃气集团有限责任公司天津液化天然气应急储备项目部（地址：天津市东丽区汇城科技大厦1407室）

二、征求公众意见的公众范围

本次征求公众意见的范围是建设项目附近可能受到影响的个人或团体。

三、公众意见表的网络链接

公众意见表的网络链接见：http://www.tkyhj.com/publicityinfo.aspx?newsID=79&CateId=31

四、公众提出意见的方式和途径

若您对项目有什么意见和建议，请于公示之日起10个工作日内，可以通过信函、传真、电子邮件等方式，将填写的公众意见表（见链接）提交建设单位。

五、公众提出意见的起止时间

本次公示时间为公示之日起10个工作日。

六、联系方式

建设单位：北京市燃气集团有限责任公司

联系人：孔先生 电话：13332272089

电子邮箱：lgkong06@163.com

联系地址：天津市东丽区汇城科技大厦1407室

邮政编码：300300

15.2.2.2 Newspapers

According to Article 11 of the‘Public Participation Measures for Environmental Impact Assessment’, Opened by publicly accessible newspapers in the location of the construction project, and the public information shall be no less than 2 times within 10 working days for soliciting opinions, it was published on July 29, 2019 and July 31, 2019 in the China Reform Newspaper and in line with relevant regulations.

Screenshot of Newspapers:

CHINA REFORM DAILY

2019.07.29 星期一

北京燃气天津南港LNG应急储备项目环境影响评价第二次公示

一、环境影响报告书征求意见稿全文网络链接及查阅纸质报告书的方式及途径

环境影响报告书征求意见稿全文网络链接：http://www.tkyhj.com/publicityinfo.aspx?newsID=79&CateId=31

查阅纸质报告书的方式及途径：北京市燃气集团有限责任公司天津液化天然气应急储备项目部(地址：天津市东丽区汇城科技大厦1407室)

二、征求公众意见的公众范围

本次征求公众意见的范围是建设项目附近可能受到影响的个人或团体。

三、公众意见表的网络链接

公众意见表的网络链接见：http://www.tkyhj.com/publicityinfo.aspx?newsID=79&CateId=31

四、公众提出意见的方式和途径

若您对项目有什么意见和建议，请于公示之日起10个工作日内，可以通过信函、传真、电子邮件等方式，将填写的公众意见表(见链接)提交建设单位。

五、公众提出意见的起止时间

本次公示时间为公示之日起10个工作日。

六、联系方式

建设单位：北京市燃气集团有限责任公司

联系人：孔先生　　电话：13332272089

电子邮箱：lgkong06@163.com

联系地址：天津市东丽区汇城科技大厦1407室

邮政编码：300300

中国改革报

2019.07.31

星期三

北京燃气天津南港LNG应急储备项目
环境影响评价第二次公示

一、环境影响报告书征求意见稿全文网络链接及查阅纸质报告书的方式及途径

环境影响报告书征求意见稿全文网络链接：http://www.tkyhj.com/publicityinfo.aspx?newsID=79&CateId=31

查阅纸质报告书的方式及途径：北京市燃气集团有限责任公司天津液化天然气应急储备项目部（地址：天津市东丽区汇城科技大厦1407室）

二、征求公众意见的公众范围

本次征求公众意见的范围是建设项目附近可能受到影响的个人或团体。

三、公众意见表的网络链接

公众意见表的网络链接见：http://www.tkyhj.com/publicityinfo.aspx?newsID=79&CateId=31

四、公众提出意见的方式和途径

若您对项目有什么意见和建议，请于公示之日起10个工作日内，可以通过信函、传真、电子邮件等方式，将填写的公众意见表（见链接）提交建设单位。

五、公众提出意见的起止时间

本次公示时间为公示之日起10个工作日。

六、联系方式

建设单位：北京市燃气集团有限责任公司

联系人：孔先生　　电话：13332272089

电子邮箱：lgkong66@163.com

联系地址：天津市东丽区汇城科技大厦1407室

邮政编码：300300

15.2.2.3 Posting

According to Article 31 of the Measures for Public Participation in Environmental Impact Assessment, for the construction projects in the industrial park approved by law, if the industrial park has carried out the public participation in the planning environmental impact assessment according to law, and the nature and scale of the construction project are consistent with the The environmental impact report and review opinions reviewed and approved by the competent department of ecological environment shall be simplified by the construction unit when conducting public participation in the environmental impact assessment of the construction project:

(1) Exempting from the public procedures stipulated in Article 9 of these Measures, and the contents that should be disclosed shall be disclosed in the public content specified in Article 10 of these Measures;

(2) The period of 10 working days as stipulated in the second paragraph of Article 10 of the present Measures and the first paragraph of Article 11 is reduced to 5 working days;

(3) Exempting from the way of posting announcements as stipulated in the third paragraph of Article 11 of these Measures.

The project is located along the line of Changliuzhuang, Dabei City, Xunzi Village, Guankeng Village, Hengting Village, Miaoxiaozhai Village, Nanrenying Village, Neiguanzhuang Village, Shunmin Village, Xiaoz Village, Xinglongzhuang Village and Yang Xiaozhuang Village posted an announcement.


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经联社


党员承诺


支部委员会

15.2.3 Inquiry

During the publicity period of the consultation draft, the public can check the environmental impact report of the project through the online link in the publicity content: http://www.tkyhj.com/publicityinfo.aspx?newsID=79&CateId=31, and the public can call and email to the constraction company for a paper-based report. During the publicity period, no publicly requested paper copies by telephone and e-mail; 20 people visited and looked up the report through the website.

15.2.4 Public comments

During the publicity period of the consultation draft, no comments received.

15.3 Treatment of public comments

During the publicity of networking and newspapers, no feedbacks received.

15.4 Investigate visits with relevant government departments and the public

From October 18, 2018 to October 20, 2018, the project department went to the Management Center of Beidagang Wetland Nature Reserve, Zhongtang Town Government of Binhai New Area, Daqiuzhuang Town Government of Jinghai District, Tuanbo Town Government of Jinghai District, West of Jinghai District. The government of Xinzhuang Town carried out the research on the docking of government departments;

On October 22, 2018, the project department went to the Jinghai District Weiwen Office and the Xinkou Town Government of Xiqing District to conduct interviews with government departments and post announcements;

On October 23, 2018, the project department went to Xiqing District Weiwen Office, Wuqing District Wangqingyu Town, Wuqing District Weiwen Office, and conducted interviews with government departments and posted announcements;

On October 24, 2018, the project department went to Nangang Industrial Zone Development Co., Ltd., Nangang Water Affairs Co., Ltd. and Nangang Investment Co., Ltd. to conduct research and interviews on enterprises and institutions, and posted announcements;

On October 25, 2018, the project department went to the Xinkou Town Comprehensive Management Office and the Dangcheng Town, Shuikou Village and the Sixth Village of Xinkou Town to conduct interviews with government departments and grassroots organizations, and posted announcements;

On October 29, 2018, the project department went to the Xiqing District Letters and Visits Office, Wang Qingyu Letters and Visits Office, and the Shuangtang Town

Government of Jinghai District, the Duliu Town Government, the Chenguantun Town Government, and the Liangtou Town Government. Work and post an announcement;

On October 30, 2018, the project department went to Dongshuangtang Village, Xishuangtang Village, Pulou Village, Zhoujiayuan Village and Dongmoyuan Village, Shuangtang Town, Jinghai District, and conducted interviews with grassroots organizations and posted announcements;

From October 31, 2018 to November 1, 2018, the project department went to Xinzhuangzi Village, Guzhuangzi Village, Dongjiakou Village, Qiandengzhuang Village and Donghetou Village, Liangtou Town, Jinghai District, and carried out grassroots organizations. Interview work and post an announcement;

On November 2, 2018 and November 5, 2018, the project department went to the Wuqing District Letters and Visits Office and the Wuqing District Construction Committee to conduct interviews with government departments and post announcements;

On November 6, 2018, the project department went to the Jinghai Town Government of Jinghai District and Caigongzhuang Town of Jinghai District to conduct interviews with government departments and post announcements;

From November 7th, 2018 to November 8th, 2018, the project department went to Xichangtun Village, Wangguantun Village, Jizhuangzi Village, Xiaoji Village and Huxinzhuang Village of Chenguantun Town in Jinghai District to conduct interviews with grassroots organizations. And post an announcement;

On November 9, 2018, the project department went to the government of Duliu Town, Jinghai District, and conducted an interview with the government department and posted an announcement;

From November 12, 2018 to November 13, 2018, the project department went to Manjingzi Village, Taiping Village, Datun Village, Guankeng Village, Hu Lianzhuang Village, and Daegu Zhuang Town, Daqiuzhuang Town, Jinghai District, respectively. Interviews with grassroots organizations and business units, and posted announcements;

On November 14, 2018, the project department went to Yangliyuan Village, Dahetan Village, Xiaokouzimen Village and Yidukou Village, Jinghai Town, Jinghai

District, and conducted interviews with grassroots organizations and posted announcements;

From November 15th, 2018 to November 16th, 2018, the project department went to Xuejia House Village, Xuebo Village, Tuanbo Town, Jinghai District, and contractors of Xuejia House Village, and Shengli Street, Yihe Street and Jiuba Fort in Duliu Town, Jinghai District. Village, Democracy Street, and Tuanjie Street carried out interviews with grassroots organizations and posted announcements;

On November 21, 2018, the project department went to Shunmintun Village, Yangxiaozhuang Village, Anjiazhuang Village and Hexin Village, Xiqiaozhuang Town, Jinghai District, and conducted interviews with grassroots organizations and posted announcements;

On November 23, 2018, the project department went to the Jinghai District Letters and Visits Office to conduct an interview with the government department and posted an announcement;

On November 30, 2018, the project department went to Wangqingyu Town, Wuqing District to establish an office, conducted an interview with the government department, and posted an announcement;

On February 27, 2019, the project department went to the Dagang Marine Management Office of Tianjin Maritime Bureau to conduct an interview with the government department;









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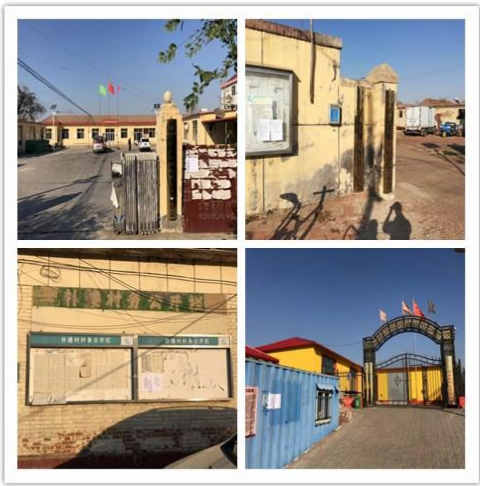	贺新村综合服务站 顺民屯村支部委员会


梁头镇综合服务中心

16 Conclusions and Recommendations

16.1 Conclusions

In summary, the background of this project includes the economic and social development in the Beijing-Tianjin-Hebei region, and the demand for clean energy such as LNG continues to grow, the implementation of the "Beijing-Tianjin-Hebei and Surrounding Areas 2017 Air Pollution Prevention and Control Action Plan" and the "Northern Area Winter Clean Heating Plan" 2017-2021) and the "Overall Plan for Gas Source Reconstruction of Coal to Gas in Winter in the Key Areas of the North" will accelerate the promotion of the "coal to gas" project in parts of North China. The send-out pipeline project is an important project for the support of gas supply. It can provide emergency security and gas supply for the Beijing-Tianjin-Hebei region, and take into account the peak-shaving function, effectively alleviating the situation of winter gas supply in the Beijing-Tianjin-Hebei region. At the same time, it can realize the interconnection of the pipeline network and improve the Bohai Rim region. The project is an important link to improve the pipeline capacity of resource-importing import areas to the consumption areas, promote the interconnection of pipeline networks, and realize the "one network nationwide" at an early date.

The length of the project pipeline is 229km, passing through Tianjin, Hebei Province and Beijing 3 provinces (cities) and 8 districts. The pipeline route has undergone repeated site surveys and economic and technical demonstrations of multiple schemes. The selected routes generally conform to the urban development planning and land use planning along the route.

The various processes of the project are relatively advanced, meeting the requirements of clean production, all kinds of pollutants can be discharged to the standard, its impact on the environment is small, environmental risks can be prevented and controlled, pollution prevention measures are feasible, and the losses caused by ecology are temporary. Recoverable and compensated. Therefore, after implementing various pollution prevention measures, ecological protection measures, risk control measures and emergency plans, this project is feasible from the perspective of environmental protection.

16.2 Recommendations

1) In the follow-up construction and operation process, strictly follow the national, industry and local laws and regulations and relevant standards and norms, improve, improve, implement and maintain the safety control measures and facilities of the project's risk sources;

2) Establish, improve and implement accident prevention measures and emergency plans, especially near the environmentally sensitive areas, strengthen the nearby inspection and emergency response capabilities, further improve the safety level of the equipment and ensure the safety of personnel and property. Environmental risks are preventable and controllable;

3) After the completion of the project, it is necessary to strengthen management, adopt scientific and effective measures, formulate emergency plans for accident prevention, strengthen safety education, improve the safety awareness of operators, and strictly implement operational procedures to prevent environmental risk accidents.