



Environmental Monitoring Report

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January–December 2016

People's Republic of China: Inner Mongolia Autonomous Region Environment Improvement Project

Semi-annual environmental monitoring report for January–December 2016

Prepared by the Project Management Office, Government of Inner Mongolia Autonomous Region for the People's Republic of China and the Asian Development Bank (ADB).

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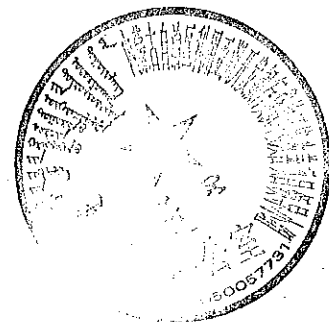
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Inner Mongolia Autonomous Region Environment Improvement Project (Period January-December 2016)



Prepared by Project Management Office, Government of Inner Mongolia Autonomous Region.

I. DESCRIPTION OF THE PROJECT

1. The district heating supply component of the Project will have eight subcomponents:

- (i) the Wulateqian subcomponent will construct (a) three units of hot water boilers with 29 MW capacity and auxiliaries, (b) nine heat exchange stations, and (c) 9.8 kilometers (km) of heat supply pipeline, and will close (d) 64 small coal-fired boilers;
- (ii) the Wulatezhong subcomponent will construct (a) two units of hot water boilers with 29 MW capacity and auxiliaries, (b) eight heat exchange stations, and (c) 3.0 km of heat supply pipeline, and will close (d) 20 small coal-fired boilers;
- (iii) the Wulatehou subcomponent will construct (a) two units of hot water boilers with 29 MW capacity and auxiliaries, (b) 14 heat exchange stations, and (c) 11.4 km of heat supply pipeline, and close (d) 35 small coal-fired boilers;
- (iv) the Linhe subcomponent will construct (a) four units of 70 MW heat source, (b) 100 heat exchange stations, (c) 167.4 km of heat supply pipeline, and (d) 58 small coal-fired boiler closure.
- (v) the Wuyuan subcomponent will construct (a) four units of circulating fluidized bed (CFB)-type hot water boilers with 29 MW capacity and auxiliaries, (b) 12 heat exchange stations, and (c) 9.8 km of heat supply pipeline, and will close (d) 57 small coal-fired boilers;
- (vi) the Dengkou subcomponent will construct (a) 11 heat exchange stations, and (b) 3.0 km of heat supply pipeline, and will close (c) 39 small coal-fired boilers;
- (vii) the Hangjinhou subcomponent will construct (a) three units of hot water boilers with 58 MW capacity and auxiliaries, (b) 36 heat exchange stations, and (c) 10.6 km of heat supply pipeline, and will close (d) 11 small coal-fired boilers; and
- (viii) the Wuhai subcomponent will construct (a) 69 heat exchange stations, and (c) 35.29km of heat supply pipeline, and will close (d) 112 small coal-fired boilers.

2. The natural gas transmission and distribution improvement component will have two subcomponents:

- (i) the Changqing–Wuhai–Linhe natural gas transmission pipeline subcomponent will construct 426 km of pipeline across the region of Erdo's, Wuhai and Bayannur; and
- (ii) the natural gas distribution networks in eight cities and one master CNG station, including the natural gas city networks in the cities of Wuhai, Dengkou, Linhe, Wulateqian, Wulatezhong, Wulatehou, Hangjinhou, Wuyuan, and a master CNG station in Linhe, will supply CNG to these cities.

3. The city wastewater treatment component will have two subcomponents

- (i) the Wulatehou wastewater treatment plant and sewage network subcomponent will construct (a) a 6,000 ton/day wastewater treatment plant, and (b) a 13.2 km sewage piping network; and

II. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Environmental Benefits and Impacts

4. **Outdoor Air Quality.** The central heating supply subcomponents will significantly improve the local air quality by closing 396 small, inefficient coal-fired boilers. Water and soil pollution will be indirectly reduced because there will be fewer particulate matter emissions and less acid rain. The closure of the small coal-fired boilers will also (i) increase the urban coverage of district heating, resulting in less indoor coal burning for heating, with its associated outdoor emission reductions; (ii) reduce traffic hazards caused by coal-transport vehicles in urban areas (all proposed heating plants will be located on the outskirts of towns); and (iii) improve public health and the living environment in areas currently affected by noise and flue dust from small boilers. The NGS subcomponents will significantly reduce outdoor air pollutants emitted from the combustion of coal for indoor cooking purposes. The transportation of natural gas through a pipeline (compared with the transportation of coal by road) will eliminate pollutants generated from trucking, including vehicle emissions, noise, and fugitive dust. Additionally, the Project will establish a compressed natural gas automobile filling station to support a proposed fleet of public buses and taxis which will be converted from diesel or gasoline consumption. This will significantly improve urban pollution levels.

5. **Surface Water Quality.** The two WWTPs will significantly reduce annual pollutant loads into the Yellow River and the Wuliangsu Lake. About 26.28 million tons per year of treated effluent from the Wulate Qian WWTP will be reused for agricultural irrigation and power plant cooling. This will save an estimated 9,733 tons/year chemical fertilizer.

6. **Indoor Air Quality.** The central heating supply component will replace indoor coal burning with district heat in some areas, thereby reducing indoor air pollution. This will have a significant positive impact on the health of residents. An estimated 167,000 people, or 28% of the population of the urban areas, will substitute coal burning for centralized heating as a result of this Project. In some areas, NGS will replace indoor coal burning for cooking with natural gas, also contributing to improved indoor air quality.

7. **Urban Coal Transport.** The central heating supply component will reduce the number of coal truck trips through the urban areas to supply small boilers. All new centralized boilers will be located on the edge of the urban area. The NGS subproject will replace the use of coal for cooking purposes in some urban areas, further reducing the need for coal truck trips. The reduction in coal trucks entering urban areas will improve the urban environment by reducing dust levels and reducing urban vehicle exhaust emissions. It is estimated that more than 28,400 coal truck trips a year will be saved by the central heating and natural gas supply subcomponents.

B. Environmental Impacts and Mitigation Measures—Construction Phase

8. **Soil.** Potential environmental impacts on soil by the Project include (i) soil erosion, (ii) soil contamination, (iii) temporary and permanent acquisition of agricultural land, and (iv) impact from construction traffic. Soil erosion may be caused by the excavation of pipe trenches and spoil

earthwork from pipeline construction, as well as by demolition and site preparation for construction of the natural gas stations, central heating stations, and WWTPs. Mitigation measures will include (i) covering temporary soil stockpiles, (ii) minimizing active excavation areas during pipe laying, (iii) appropriate recompaction of pipe trenches, and (iv) installation of sediment fences where appropriate to minimize sediment runoff. Disturbed surfaces, such as recompacted pipeline trenches, will be revegetated to minimize erosion. Soil contamination may be caused by inappropriate storage and disposal of hazardous materials and waste. Mitigation measures will include appropriate storage of hazardous materials and waste in secure, covered areas with secondary containment. Spill cleanup equipment will be provided at each construction site, and training will be conducted on emergency spills response procedures. All waste will be removed from sites to approved waste disposal sites.

9. Water. Potential environmental impacts on water by the Project include (i) increased sedimentation of adjacent water resources from construction activities, and (ii) inappropriate wastewater disposal. Construction activities will disturb surface soils and have the potential to increase sediment runoff into adjacent waterways. In particular, gas pipelines will be constructed across a number of rivers and canals. Inappropriate disposal of domestic wastewater from construction camps and disposal of wash down water from construction equipment and vehicles have the potential to affect adjacent surface water resources. Mitigation measures will include installation of appropriate septic disposal systems at construction camps. All construction equipment wash down areas will be equipped with water collection basins and sediment traps.

10. Air Quality and Noise. Potential environmental impacts on air quality and noise during construction include (i) dust from construction activities, (ii) construction vehicle emissions, and (iii) construction noise. Fugitive dust may be caused by excavation, demolition, vehicle movement, and materials handling, particularly downwind from the construction sites. Mitigation measures will include water spraying of transportation routes and materials handling sites where dust is being generated. Particular attention will be paid to dust suppression adjacent to sensitive receptors such as schools or residential areas. Materials will be stored in appropriate places and covered or sprayed to minimize fugitive dust. Materials will be covered during transportation to avoid spillage or dust generation. Air pollution may be caused by emissions from vehicles and construction machinery. Vehicles and construction machinery will be properly maintained and will comply with emission standards. Noise may be caused by construction equipment and vehicular movement, potentially affecting residents of nearby residential areas and schools. Vehicles and construction machinery will be required to be properly maintained and to comply with emission standards. Construction will be prohibited between 19:00 and 06:00 in sites adjacent to residential areas. There is a potential impact on residents from noise levels from district heating boilers during the operational phase. However, it is anticipated that this will be relatively minor, as the boilers are located either in industrial areas or in sparsely populated areas on the outskirts of urban areas. Mitigation measures will include strict compliance with noise standards.

11. Waste Management. Inappropriate waste storage and disposal has the potential to affect soil, groundwater, and surface water resources and consequently public health. Mitigation measures will include appropriate storage of hazardous materials and waste in secure, covered areas with secondary containment. Hazardous waste will be stored separately from nonhazardous waste. All waste (hazardous and non-hazardous) will be removed from sites to approved waste disposal sites. There will be no on-site landfills at any of the construction sites. Construction waste will be promptly removed from the sites. Burning of waste will be prohibited.

12. **Flora and Fauna.** Potential impact to flora and fauna from the proposed Project includes (i) removal of vegetation during construction activities, and (ii) impact on *Tetraena mongolica Maxim* in the WENNR. There will be some removal of vegetation along the pipeline trenches for the NGS, as well as from construction at the central heating supply and WWTP subcomponents. All works will be carried out so that damage or disruption to vegetation is minimized. Trees or shrubs will only be felled or removed if they impinge directly on the permanent works or necessary temporary works. After pipe-laying construction, the trenches will be revegetated.

13. The Changqing–Wuhai–Linhe NGS main pipeline and the urban pipe network in Wuhai City will cross about 15 km of the experimental zone of the WENNR, established in 1997 to protect the endangered palaeo-species *Tetraena mongolica Maxim*, a national class II protected species. In addition to standard protection measures, specific mitigation measures will include (i) limiting the construction corridor to 9 m width (including trenching activities and access roads); (ii) providing training for all construction workers on environmental management issues relating to protected species; (iii) special precautions to prevent fires during construction; (iv) revegetation of recompacted trenches, including removal and preservation of *Tetraena mongolica Maxim* plants, if encountered, and replanting after completion of pipeline laying activities; and (v) burying the pipeline 2 m below ground.

14. **Cultural.** Construction activities have the potential to disturb cultural sites, although none has yet been identified. Procedures will be established so that cultural sites can be identified and protected if they are discovered during construction. Mitigation measures will include immediate suspension of construction activities if any archaeological or other cultural relics are encountered. The relevant cultural authority, as well as the Project Implementation Unit (PIU), will be promptly notified, and construction will resume only after a thorough investigation. As no cultural or archeological sites have been identified along the project alignment, the potential for affecting cultural sites is considered to be low.

15. **Social Issues.** Potential social impacts include (i) traffic congestion, (ii) interruption to municipal services, and (iii) threats to public safety. Traffic congestion may be caused by an increase in construction traffic in urban areas. Roads may be fully or partially closed during construction, causing temporary inconvenience to residents, commercial operations, and institutions. Construction scheduling will consider impacts to traffic congestion. In conjunction with the relevant authority and traffic plans will be prepared before construction begins in congested urban centers. Construction of project facilities may require relocation of municipal utilities such as sewers, gas, water supplies, communication cables, and power poles. This may require temporary suspension of services to adjacent communities. Construction activities will be planned with a view to keeping disturbances to utility services to a minimum. Temporary land occupation will be planned well ahead of construction to minimize the impact of the disturbance. Land will be reinstated to its original condition upon completion of construction. Construction sites will be located in residential and commercial urban areas, which may present a threat to public safety. Mitigation measures will include implementation of safety measures at the construction sites to protect the public, including warning signs to alert the public of potential safety hazards and barriers to prevent public access to construction sites.

C. Environmental Impacts and Mitigation Measures—Operational Phase

16. **Wastewater Treatment Plants.** The primary air emissions from the wastewater treatment plants (WWTPs) will be nuisance odors generated by screening, grit removal, primary tanks, secondary (aeration) tanks, and sludge handling processes caused typically by ammonia (NH₃), and hydrogen sulfide (H₂S). The sites of the WWTPs have been selected so that they are at least

300 m from residential areas. Other mitigation measures involve minimizing potential odors, including source control, through proper ventilation for the sludge dewatering room and planting trees around the WWTPs. The two WWTPs will generate a total of about 1,465 tons of dry sludge cake a year. Handling and final disposal of this waste in a safe, proper, and environmentally responsible manner will be a substantial task. Dry sludge disposal will occur by agricultural application and landfill at solid waste disposal sites. Additionally, (i) operational procedures will ensure plants and sludge disposal facilities are operated as designed, (ii) low noise equipment will be used, and (iii) regular consultations will be held with residents in nearby communities and issues will be addressed promptly. Treated wastewater will be used for irrigation on adjacent agricultural land. There is potential for land contamination if appropriate treatment levels are not achieved. Mitigation measures will include effluent monitoring to ensure compliance with appropriate discharge standards. The wastewater discharge from the WWTPs will conform to discharge standards, as summarized below.

- (i) Wulate Hou county WWTP. Treated wastewater will discharge directly into a drainage canal connected to the Yellow River. Discharge standards will comply with national standards for Grade II "Pollutant Discharge Standards of Urban Wastewater Treatment Plants" (GB18921-2002).
- (ii) Wulate Qian county WWTP. Treated wastewater will be used for agricultural irrigation. Discharge standards will comply with the levels stipulated for dry-land crops in the national "Standard for Irrigation Water Quality" (GB5084-92).

17. District Heating. Adverse environmental impacts from district heating during the operation period will be mitigated by ensuring (i) the boiler stacks are 80–100 m high to minimize direct impacts on adjacent areas; (ii) electro or wet precipitators are not less than 95% efficient; (iii) flue gas desulfurization equipment is not less than 85% efficient; (iv) dust-suppression activities, such as spraying water on coal and fly-ash and covering coal stockyards, minimize the dispersion of airborne dust during coal and fly-ash offloading, stockpiling, and handling in the plants; (v) clay or synthetic liners minimize contamination of groundwater from fly-ash stockyards; (vi) wastewater from wet fly-ash disposal and coal spraying is recycled to conserve water; and (vii) soundproof covers and walls in the plants reduce noise. Air emissions from the boilers will comply with "Emission Standards for Coal-fired, Oil-fired and Gas-fired Boilers" (GB13271-2001).

18. Natural Gas System. Adverse environmental impacts from the NGS activities during the operation period will be mitigated by ensuring that (i) domestic wastewater from NGS stations will be treated in septic tanks and then discharged into a municipal sewer or used for watering trees and grass, (ii) low-noise equipment and the planting of trees around the stations will minimize the noise impact on adjacent residents, (iii) gas leakage monitoring will be conducted regularly at the stations and along the pipeline alignment, and (iv) revegetation will be inspected along the pipeline routes for at least 3 years after completion of construction.

III. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MANAGEMENT PLAN

A. Institutional Requirements

19. The IMAR Development and Reform Commission (DRC) is the Executing Agency (EA) for the Project. A project management office (PMO) has been established under the EA to manage project implementation. The Project has been divided into a number of contract packages. Each will be managed by a separate implementing agency (IA), which manage individual contracts. The

PMO will designate an environmental representative to coordinate environmental management. Each IA established an environmental management unit (EMU) to coordinate environmental management issues associated with each contract package. The EMUs oversees environmental management and monitoring during construction and operation, including environmental supervision of contractors. A grievance redress committee was established in December 2006 under the Project to address public complaints. The contractor is responsible for managing the grievance redress system and the committee is chaired by the Project Leading Group under the Government of Inner Mongolia Autonomous Region.

B. Environmental Management Plan

20. The EA has overall responsibility for ensuring that all environmental standards and procedures are followed. A summary environmental management plan (EMP) is presented in the Appendix. This will be updated during the engineering design stage, translated into Chinese and incorporated into bidding documents and civil contracts. Successful contractors are responsible for preparing comprehensive EMPs, based on the summary EMP. The IA EMUs are responsible for reviewing and approving the comprehensive EMPs, and for ensuring that the contractors comply with their provisions during the construction and operational phases. The EMUs are responsible for ensuring that EMPs are updated periodically during the construction period. This SIEE is based on six EIAs which are currently under review by SEPA. The EA ensures that any changes required by SEPA are reflected in the EMPs and the project final design. The EMPs will be implemented by the contractors under supervision of the EMUs. The construction contractor designated an environmental representative who will manage environmental issues during construction.

C. Environmental Monitoring

21. The IA EMUs prepare detailed environmental monitoring plans for the Project before bidding for construction contracts begins. The EMP are included in all bidding contractor documents and construction contracts. The EMUs have to ensure that it is updated, as required, during project construction and operational phases. Environmental monitoring will be undertaken by a range of authorities, including local EPBs, Forestry Department, Relics Bureau, etc. The EMU is responsible for coordination of all environmental monitoring activities, including collation of all monitoring results.

22. The PMO environment representative collects environmental monitoring reports from the IA EMUs and submit environmental monitoring reports to the EA and ADB twice a year during construction and once a year for 2 years after completion of construction. The environmental monitoring reports includes (i) environmental mitigation measures undertaken, monitoring results against relevant standards, (v) additional mitigation measures required (if any), (vi) environmental training conducted, and (vii) environmental regulatory violations. A project completion environmental monitoring report will be submitted after completion of construction, which will summarize project environmental impacts.

23. For compliance monitoring, the monitoring follows national standard methods for monitoring pollutants. The Wuhai and Bayanur municipal EPBs, as well as the county-level EPBs, through their certified environmental monitoring stations, will undertake environmental compliance monitoring of the individual projects. The environmental monitoring capacity of the EPBs has been assessed and is considered satisfactory for the proposed monitoring requirements. Three levels of EPBs will be involved in the Project (provincial, municipal, and county). County-level EPBs typically have about 30 staff and basic monitoring equipment, which is suitable for most monitoring

requirements. Where county EPBs lack equipment or qualified staff for specialized monitoring, expertise will be obtained from municipal or provincial EPBs.

IV. Project Implementation Progress and Issues

26. No complains and grievance have been received by the contractors and the implementing agencies for subprojects. All subprojects were completed in district heating, natural gas supply, and wastewater.

V. ENVIRONMENT MONITORING

27. An evaluation of the implementation of the EMP is summarized in the following sections. Major important aspects of the implementation of mitigation measures are highlighted as follow. Implementation status of EMP is in Attachment 1, and air quality and noise monitoring results are in Attachment 2.

28 **Work safety.** The contractor takes precautionary measures to ensure workers' safety. Protective equipment is worn at all times for any person entering the construction site. Safety training shall be undertaken for workers and staff. In case of bodily harm to any worker, the contractor has full responsibility for medical care and compensation according to the labor law. The contractor is also responsible for any bodily harm and property damage caused by construction activities on site or in the vicinities, including land occupation. The contractor is required to strengthen safety management, especially the use of flammables, explosives, toxic and corrosive substances. Before the start of construction, the contractor shall submit to the independent construction supervision agency an emergency preparedness and response plan if such substances are used. Information dissemination for preventing sexually transmitted diseases to construction labor is also responsibility of the contractor with an assistance of the county health bureau.

29 **Wastewater.** The major pollutant in construction wastewater is suspended solids. At the construction sites, settlement ponds are used to retain the sediments in the construction wastewater before they are discharged into municipal storm sewers or nearby surface water bodies. The settlement ponds are cleaned when they are filled up with sediments. Tires of construction vehicles are cleaned with water sprays before they leave the construction site. The sewage from construction camps is discharged directly into the septic tanks with proper pre-treatment.

30 **Air Pollution Control.** The major sources of air emissions are construction equipment and construction vehicles. The vehicles delivering granular and/or fine materials to the sites are covered with tarpaulin sheets. Overloading of these vehicles has been avoided. Vehicle speeds are controlled on construction sites. All the roads on the construction sites are sprayed by water trucks to suppress dust, according to a daily schedule and taking weather conditions into consideration. These roads are kept clean, solid, smooth, and clear of all dust, mud, or extraneous materials dropped from transportation vehicles. The construction sites are enclosed by the appropriate walls and sprayed with water at least twice a day. Dust suppression equipment has been installed in concrete-batching plants. Materials storage sites are sited more than 300 m from residential areas. The materials in the storage site are organized, such as separate stone and sand materials; store concrete in separate storage place and reduce the on-site storage time of the construction. The transportation distance from the storage site to the construction site has been optimized to minimize disturbance to local communities. When construction takes places during dry and windy days, water is sprayed on earth piles and exposed surfaces to suppress

dust. Construction will be stopped during strong winds and the stockpile is covered.

31 Noise Control. Construction facilities and equipment include bulldozers, air picks, air compressors, excavators, graders, stabilizers, concrete mixers, drills, stone-crushing and screening, rollers, poker vibrations, concrete pumps, loading machines, and other heavy machineries. It is estimated that noise intensity from these activities are in the range of 75~105 dB (A). The contractors have undertaken a series of measures to reduce noise levels. Equipment that generates low levels of noise has been selected, and all machinery is properly maintained to minimize noise. Noise reduction devices or methods (e.g., hoarding) have been applied where piling equipment is operating within 500 m of sensitive sites such as schools. Concrete-mixing plants and similar activities are located at least 300 m away from sensitive areas such as residences, schools, and hospitals. The construction works have been prohibited between 7:00 pm and 6:00 am.

32. Solid Waste Management and Soil Erosion Control. Small quantities of garbage from construction camps is collected by the municipal sanitation bureau and disposed of in the municipal sanitary landfill. The civil works contractors have taken measures to control soil erosion. Soil erosion measures during construction include minimizing land surface disturbance and exposure and use of settlement ponds. Upon completion of construction, all the construction sites will be re-vegetated with trees and grasses.

33. Natural Gas Supply Transmission line. Upon completion, PMO and PIA confirmed that (i) Domestic wastewater from NGS stations is being treated by septic tank and then discharged into a municipal sewer or used for watering trees and grass. (ii) the stations are with low-noise equipment and trees, (iii) Gas leakage monitoring is being conducted regularly at the stations and along the pipeline alignment. (iv) Revegetation is regularly inspected along the pipeline routes for after completion of construction.

34. Competed district heating subprojects. Stack heights of one unit heat source in Hanjinhou is 100 meters high, Electro precipitators were installed with 95-98% efficiency, flue gas desulfurization equipment was also installed with 89-93% efficiency. Dust suppression activities with water spraying and coal stock yard cover to minimize dust dispersion is being implemented. To avoid ground water contamination, all fly-ash stockyards are with clay liners. Sound proof covers and walls were also installed in noise mitigation.

35. Emission concentration. Stack emissions from Hanjinhou was measured by local EPB. Upon measurement, the maximum emission concentrations of SO₂, flue dust, and NO_x from these heat source met the PRC national standards as specified in GB13271-2001/2014. Stack emission monitoring results are in Attachment 2.

36. Discharged wastewater. Quality of discharged wastewater from the Hanjinhou district heating subprojects was also monitored by local EPB and the monitoring results are in Attachment 2. The discharged wastewater is being treated by municipal wastewater treatment plant.

37. Information Disclosure. A project information bulletin board has been erected at each construction site. The bulletin board contains a description about the project, layout map, construction safety, labor standards, environmental and health standards, name of the project implementing agencies, contractors, and contact information of the on-site managers and EMU heads.

VI. KEY ENVIRONMENT ISSUES AND ACTION REQUIRED

38. None during this reporting period.

Attachment 1: EMP IMPLEMENTATION STATUS

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Implementation Status
			Implemented by	Supervised by	
Construction Phase					
Erosion and Spoil	Soil erosion	Mitigation measures will include (i) covering temporary soil stockpiles, (ii) minimizing active excavation areas during pipe laying, (iii) appropriate recompaction of pipe trenches, and (iv) installation of sediment fences where appropriate to minimize sediment runoff. Disturbed surfaces, such as recompacted pipeline trenches, will be revegetated to minimize erosion.	Contractors directed by EMUs	EMU supported by PMO	Fulfilled. All mitigation measures were appropriately implemented.
	Soil contamination by hazardous waste and materials, including hydrocarbons	Mitigation measures will include appropriate storage of hazardous materials and waste in secure, covered areas with secondary containment. Spill cleanup equipment will be provided at each construction site, and training will be conducted regarding emergency spills response procedures. All waste will be removed from sites to approved waste disposal sites.			
	Impact on temporarily acquired agricultural land	Mitigation measures for the impact on soil will include the selection, where possible, of sites (permanent and temporary) that do not occupy agricultural land. Where land is temporarily occupied, appropriate rehabilitation will be conducted following completion of construction activities. During excavation of pipeline trenches, topsoil will be stockpiled, stored, and replaced after the laying of pipelines			
	Loss of topsoil	The topsoil from all areas to be permanently covered will be stripped and stored in stockpiles. Topsoil will be used for revegetation works. Construction vehicles, machinery, and equipment be moved or be stationed in designated areas. Access to adjacent agricultural land will be minimized.			

Attachment 1: EMP IMPLEMENTATION STATUS

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Implementation Status
			Implemented by	Supervised by	
Wastewater	Siltation into water bodies	Mitigation measures will include erosion control measures and appropriate engineering design to minimize generation of sediment runoff during construction activities.	Contractors directed by EMUs	EMU supported by PMO	Fulfilled. Construction wastewater was treated with detention and settlement ponds. Sewage was treated with a septic tank.
	Inappropriate wastewater Disposal	Mitigation measures will include installation of appropriate septic disposal systems at construction camps and operation sites. All construction equipment wash down areas will be equipped with water collection basins, including oil separators, and sediment traps.			
Air Quality	Generation of dust	Mitigation measures will include water spraying of transportation routes and materials handling sites where dust is being generated. Particular attention will be paid to dust suppression adjacent to sensitive receptors such as schools or residential areas. Materials will be stored in appropriate places and covered or sprayed to minimize fugitive dust. Materials will be covered during transportation to avoid spillage or dust generation.	Contractors directed by EMUs	EMU supported by PMO	Fulfilled. All construction vehicles and machinery were certified to comply with the applicable national emission standards.
	Emission from construction machinery	Vehicles and construction machinery will be properly maintained and will comply with relevant emission standards			Dust suppression measures were adopted and during dry, windy days.

Attachment 1: EMP IMPLEMENTATION STATUS

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Implementation Status
			Implemented by	Supervised by	
Noise	Impacts from construction noise on sensitive resources	Vehicles and construction machinery will be required to be properly maintained and to comply with relevant emission standards. Construction will be prohibited between 7:00 pm and 6:00 am adjacent to residential areas.	Contractors directed by EMUs	EMU supported by PMO	Fulfilled. All construction vehicles and equipment were certified to comply with the applicable national standards. Transport routes were carefully selected to avoid community disturbance. Construction activities were suspended between 5 pm-6 am.
Solid Waste	Soil and water contamination from inappropriate storage and disposal	hazardous materials and waste in secure, covered areas with secondary containment. Hazardous waste will be stored separately from non-hazardous waste. All waste (hazardous and non-hazardous) will be removed from sites to approved waste disposal sites by licensed contractors. There will be no on-site landfills developed at any of the construction sites. Construction waste will be promptly removed from the sites. Burning of waste will be prohibited.	Contractors, local sanitation departments (domestic waste), licensed waste collection companies (construction waste)	EMU supported by PMO	Fulfilled. Garbage bins were used at construction sites and camps. Garbage were collected regularly and disposed at local landfills.

Attachment 1: EMP IMPLEMENTATION STATUS

Category	Potential Impacts and Issues	Mitigation Measures and/or Safeguards	Responsibility		Implementation Status
			Implemented by	Supervised by	
Flora	Loss of or damage to vegetation	All works will be carried out so damage or disruption to vegetation is minimized. Trees or shrubs will only be felled or removed if they impinge directly on the permanent works or necessary temporary works. After pipe laying construction, the trenches will be revegetated.	Design Institute (plan design), Contractors (plan implementation)	EMU/EPB supported by PMO	Fulfilled. Vegetation removal and exposed surface were minimized. Spoils were disposed in preselected sites which were rehabilitated upon completion of construction.
	Impact on Tetraena mongolica Maxim in the WENNRR	Specific mitigation measures will include (i) limiting the construction corridor to 9 m width (including trenching activities and access roads), (ii) providing an environmental training program for all construction workers regarding environmental management issues relating to protection of the protected species, (iii) special precautions to prevent fire during construction, (iv) revegetating recompact trenches, including removal and preservation of Tetraena mongolica Maxim plants, if encountered, and replanting after completion of pipeline laying activities, and (v) burying the pipeline 2 m below ground.		EMU/ WENNRR Authority	Detailed design was reviewed and approved by local EPBs and WENNRR authority.
Historical, Cultural, and Archeological	Sites encountered during construction	Should a historical, cultural, or archaeological be encountered during construction, all activities will halt and an established action plan will be enacted.	Contractor	EMU supported by PMO	Fulfilled. No historical, cultural archaeological matters were encountered.
Social Impact	Traffic congestion	Construction scheduling will consider impacts on traffic congestion. In conjunction with the relevant authority, traffic plans will be prepared prior to commencement of construction in the congested urban centers	Contractor	EMU supported by PMO	Fulfilled. Construction schedule and activities, and public safety complied with mitigation measures.
	Interruption to municipal Services	Construction activities will be planned to minimize duration of disturbance to utility services.			
	Impacts on public safety	Mitigation measures will include implementation of safety measures at the construction sites to protect the public, including warning signs to alert the public of potential safety hazards and barriers to prevent public access to construction sites.			

C. Operation Phase (not applicable so far)

Attachment 1: EMP IMPLEMENTATION STATUS

Wastewater Treatment plant	The primary air emissions from the WWTPs will be nuisance odors generated by screening, grit removal, primary tanks, secondary (aeration) tanks, and sludge handling processes (typically by NH3, H2S and methyl sulphide). (i) The sites of the WWTPs have been selected so that they are at least 300 m from residential areas. (ii) Other mitigation measures include source control, such as proper ventilation for the sludge dewatering room and planting trees around the WWTPs.	Implementing Agency	EPB/PMO	The subproject locates 820 m away from residential areas. The plant was confirmed meeting with the PRC Government Standard. The plant met with Technical Specification of Sludge Treatment for the Wastewater Treatment (CJJ 131-2008), and operation manual was prepared and is being implemented.
	<p>The two WWTPs will generate a total of about 1,465 tons yearly of dry sludge cake. (i) Dry sludge disposal will occur by agricultural application and landfill at solid waste disposal sites. (ii) Operational procedures will ensure plants and sludge disposal facilities are operated as designed.</p> <p>(iii) Low-noise equipment will be used to reduce noise impact. (iv) Regular consultations will be held with residents in nearby communities and issues will be addressed promptly. Treated wastewater will be used for irrigation on adjacent agricultural land. There is potential for land contamination if appropriate treatment levels are not achieved. (i) Continual effluent monitoring will ensure compliance with appropriate discharge standards.</p> <p>(ii) The wastewater discharge from the WWTPs will conform to the relevant discharge standards</p>			<p>Quality of the treated wastewater was measured by local EPB and the results met the water quality standard for scenic environment use (GB/T 18921-2002). The discharged treated water quality was between 35-46 mg per liter of BOD, 90-110 mg per liter of COD, and 49-58 mg per liter of SS. These imply that the treated wastewater can be fully utilized for irrigation in accordance with GB/T 19921-2002. Discharged treated water will be continued to monitor till the end 2010.</p>

Attachment 1: EMP IMPLEMENTATION STATUS

District Heating	Stacks of the designed boilers will be 80–100 m high to minimize direct impact to adjacent areas. (ii) Electro or wet precipitators will be installed and will be at 95% efficient. (iii) Flue gas desulfurization equipment will be installed and will be at least 85% efficient. (iv) Dust suppression activities will be conducted, such as spraying water on coal and fly-ash, covering coal stockyards, to minimize the dispersion of airborne dust during coal and fly-ash offloading, stockpiling, and handling in the plants. (v) Contamination of groundwater from fly-ash stockyards will be minimized by installation of clay or synthetic liners. (vi) Water conservation will be prioritized by recycling wastewaters from wet fly-ash disposal and coal spraying. (vii) Noise mitigation measures will be adopted, including soundproof covers and walls in the plants (viii) Air emissions from the boilers will comply with "Emission Standards for Coal-fired, Oil-fired and Gas-fired Boilers" (GB13271-2001).	Implementing Agency	EPB/PMO	Stack heights of all subprojects having new boilers are between 86-121 meters high, Electro precipitators were installed with 95-98% efficiency, flue gas desulfurization equipment was also installed with 89-93% efficiency. Dust suppression activities with water spraying and coal stock yard cover to minimize dust dispersion is being implemented. All fly-ash stockyards are with clay liners. Sound proof covers and walls were also installed.
				The maximum emission concentrations of SO ₂ , flue dust, and NO _x from these heat source met the PRC national standards as specified in GB13271-2001/2014.

Attachment 1: EMP IMPLEMENTATION STATUS

Category	Potential Impacts and Issues	Responsibility		Implementation Status
		Implemented by	Supervised by	
Natural Gas Distribution	<p>(i) Domestic wastewater from NGS stations will be treated by septic tank and then discharged into a municipal sewer or used for watering trees and grass.</p> <p>(ii) Noise will be minimized by installing low-noise equipment and planting trees around the stations.</p> <p>(iii) Gas leakage monitoring will be conducted regularly at the stations and along the pipeline alignment.</p> <p>(iv) Revegetation will be inspected along the pipeline routes for at least 3 years after completion of construction.</p>	Implementing Agency	EPB/PMO	<p>Upon completion, PMO and PIA confirmed that (i) Domestic wastewater from NGS stations is being treated by septic tank and then discharged into a municipal sewer or used for watering trees and grass. (ii) the stations are with low-noise equipment and trees, (iii) Gas leakage monitoring is being conducted regularly at the stations and along the pipeline alignment. (iv) Revegetation is regularly inspected along the pipeline routes for after completion of construction.</p>

Attachment 2 Monitoring Results

1. **Air quality.** Environmental monitoring was conducted by EMUs and EPBs. Monitoring was undertaken monthly in January-December 2016 PM, SO₂ and NO₂ (24-hour average concentration). Wind direction, wind speed, air temperature, barometric pressure, cloud cover and other meteorological parameters were also monitored.

2. The results indicate that the overall air quality at the subproject sites is good, and all results for PM, SO₂, and NO₂ complied with Class II PRC standards.

Table 1: Air quality Monitoring

	PM	SO ₂	NO ₂
Standard mg/m ³	0.150	0.150	0.080
Wuhai (DHS)	0.136-0.137	0.043-0.049	0.047-0.049
Linhe (DHS)	0.131-0.135	0.041-0.042	0.045-0.048
Honjinhouqi (DHS)	0.134-0.138	0.034-0.039	0.035-0.038

DHS=District Heating System, WWTP=Wastewater Treatment Plant, NGS=Natural Gas Supply

3. **Noise.** EMU undertook noise monitoring at the project site boundaries. The monitoring was carried out twice a quarter between January-December 2016. Weather conditions were sunny and cloudless with wind speed less 5 m/s, which complied with relevant PRC meteorological requirements for noise monitoring. Monitoring was undertaken with multi-functional ambient noise detectors. Monitoring at the HSP site boundaries was undertaken in accordance with the relevant requirements in PRC Noise Standards for Industrial Enterprises at Site boundary. Subprojects met the applicable Class II standards (60 dB(A) daytime, 50 dB(A) nighttime).

Table 2: Noise Monitoring Results

	Daytime Average Leq dB(A) (06:00 – 22:00)	Nighttime Average Leq dB(A) (22:00 – 06:00)
Standard dB (A)	60	50
Wuhai (DHS)	41.1-46.2	36.7-38.1
Linhe (DHS)	42.6-43.6	39.4-40.4
Honjinhouqi (DHS)	43.1-44.5	39.3-41.2

DHS=District Heating System, WWTP=Wastewater Treatment Plant, NGS=Natural Gas Supply

4. **Stuck Emission.** The maximum emission concentrations of SO₂, flue dust, and NO_x from heat source between January-December 2016 met the PRC national standards as specified in GB13271-2001/2014. (Table 4). Stuck emission is daily monitored and measured emissions were regularly reported to local EPBs through online monitoring system.

The maximum emission concentration for the completed District Heating Subprojects

mg/m ³	Dust	SO ₂	NO ₂
National Standard	200 (80)	900 (400)	400 (400)
Hanjinhouqi	47.6	312	160
Linhe	45.8	301	144
Wuhai	41.2	297	122

Note: Lower numbers in national standard is GB 13271-2004. Number of Wuhai is from the CHP heat source

5. **Discharged wastewater quality.** Wastewater discharge quality from completed district heating subproject was also measured between January-December 2016. These emission results were met the PRC national Standard GJ 3082-1999 and GJ 343-2010.

Attachment 2 Monitoring Results

The maximum discharged wastewater from the completed District Heating Subprojects

mg/L	Oil	COD	ph
National Standard	20	550	400
Hanjinhouqi	2.8	74.2	58.9
Linhe	2.3	73.6	54.8
Wuhai	2.2	71.7	52.9

Note: Number of Wuhai is from the CHP heat source

