Environmental Impact Assessment (Draft)

May 2018

PRC: Yunnan Lincang Border Economic Cooperation Zone Development Project
(Annexes: Appendix 2 - Water and Soil Conservation Report)

Prepared by Lincang Border Economic Cooperation Zone Development Project, People's Republic of China for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 15 May 2018)

Currency Unit	–	yuan (CNY)
CNY1.00	=	$0.158
$1.00	=	CNY 6.340

NOTE

In this report, “$” refers to US dollars.

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APPENDIX - 2

Project Number: TA 9373 - PRC
December 2017

People's Republic of China: Yunnan Lincang Border Economic

Cooperation Zone Development Project (P49310-002)

Water and Soil Conservation Report

Dated on April 4 2018

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1 General Description

1.1 Project Overview

1.1.1 Necessity of Project Construction

Mengding Qingshui River Port is a land port, located at Mengding Town, Gengma Dai and Wa Autonomous County, Lincang Municipality, connected with Qingshui River Port of Shan State, Myanmar, looking across the river is Nandeng Special Zone of Shan State in Myanmar; Qingshui River Port is the only Class I port in Lincang Municipality. In 1991, Mengding Qingshui River Port was approved by Yunnan Provincial Government as Class II port; in October 2004, it was upgraded by the State Council as national Class I port. On January 7, 2016, the State Council issue the Several Policies and Measures to Support the Development and Opening of Key Border Regions (No. 72, 2015), Mengding Qingshui River Port was included into the national strategy for the development and opening of border regions for the third time; in other words, it is now taking a leading position in implementing the country's "One Belt, One Road" Strategy. The development of Qingshui River Port Economic Zone prioritizes the economic and trade cooperation with Myanmar which also radiate to Indian ocean countries and regions, with a focus on developing Qingshui River Port as a front window in GMS regional cooperation and Golden Quadrangle Cooperation (China, Myanmar, Laos and Thailand).

To align with the overall development of Lincang Border Economic Cooperation Zone, and support the successful development of Qingshui River Port area, new water supply system needs to be developed in Qingshui River area to meet increasing demands from urban expansion and population growth. Current water supply and distribution pipelines cannot meet the water demands from future development, it is necessary to construct urban infrastructures to cover the planning areas.

Drainage pipelines and wastewater treatment plant are important parts of urban infrastructure. Strengthening the construction of wastewater pipeline can improve

the wastewater collection and treatment, and reduce the environmental pollution caused by wastewater. Strengthening the construction of municipal infrastructures in Qingshui River Port, especially the drainage system, will improve local living environment and investment environment. Qingshui River Port is an important window for the country's opening-up, which makes its development more significant. The project will construct solid waste collection and transfer stations to collect the solid waste from Mending Town and Qingshui River Port Economic Zone, and transfer to the landfill in Mengding Town for disposal, to achieve one-off non-hazardous treatment of the municipal solid waste, eradicate waste dumping and deterioration of ecological environment.

Qingshui River is the main river channel in the area. With rapid economic and social development in recent years, the population in the watershed is continuously increasing, and large amount of untreated wastewater is directly discharged to Qingshui River. Without control measures taken for the water environment in the watershed in a timely manner, the river channels in the area will be polluted.

Mengding Qingshui River Port Economic Zone is developing rapidly, all infrastructures are continuously improving. The adequacy of supporting infrastructures directly affects the living of the residents. The project will improve the public transport system from Mengding to Qingshui River Port and Mangka. The public transport system will extend to Mangka area, which will help the border transportation and logistics, and facilitate the economic development in Myanmar.

1.1.2 Basic Information

Yunnan Lincang Border Economic Cooperation Zone is located in Qingshui River Port Economic Zone and Mangka, Mengding Town, Gengma County, Lincang Municipality. The administration jurisdiction is within Mengding Town of Gengma County. The geographic coordinates are: N23° 29′ 5.63″，E98° 49′ 58.58″, the project area is adjacent to the trunk road and secondary road (construction period 2017-2018), in the south, it is 0.4km from the highway Qingshuihe to Gengma County through Mengding included in the planning of Mengding Qingshuihe Port

Economic Zone, 29km from Mengding Town, 83km from Gengma County, the traffic is very convenient.

Lincang Border Economic Cooperation Zone Investment and Development Company is responsible for project construction. The project proposal was approved by Yunnan Provincial Development and Reform Commission on December 30, 2016. The project is consisting of 5 components, i.e. water supply in Mengding Qingshuihe Port Area, wastewater treatment plant and associated works in Mengding Qingshuihe Port Area, solid waste management in Mengding Town and Qingshuihe Port Economic Zone, Qingshui River rehabilitation in Qingshuihe Port Area, urban public transport infrastructure from Mengding to Qingshuihe.

Project construction scope: (1)Water supply in Mengding Qingshui River Port Area: ①Water intake, including 1 new water intake structure of low dam type, and water intake capacity is up to 21,000 m3/d; ②Raw water transmission, DN700 pipelines for 32km, using ductile iron pipe and steel pipe with 2.5MPa pressure rating; ③ Water treatment plant: 20,000m3/d in the short term, a land area of 2.0hm2; ④ Water distribution network, DN200-DN700 pipeline for 33km; PE pipe with pressure rating of 1.0MPa. Total cost estimate for this component is CNY 166,879,800, including civil works cost of CNY133,691,600. (2)Wastewater treatment plant and ancillary works in Mengding Qingshui River Port Area: ①wastewater treatment plant: with a capacity of 10,000m3/d, and an area of 2.48 hm2; ②wastewater pipelines: DN400-DN800 for 16.5km. Buble PE wastewater pipe is adopted for pressure flow, and steel band reinforced HDPE pipe is adopted for gravity flow. Total cost estimate for this component is CNY 63,019,300, including civil works cost of CNY48,657,800. (3)Solid Waste Treatment in Mengding downtown and Qingshui River Port Economic Zone: Qingshui river port area: In the port trade area, one new solid waste transfer station with a capacity of 27t/d and an area of 0.30 hm2, and to provide functions of parking and sanitation center; one collection station at the transport and logistics park and the production cooperation zone, with a capacity of 7t/d and 8t/d and a land area of 0.06hm2 and 0.04hm2, respectively; total cost estimate for this component is CNY 16,459,600, including civil works cost of

CNY12,936,400. (4) Qingshuihe River integrated rehabilitation, sediment dredging, wastewater inception along the river, and river landscaping, total length included under this component is 1000m. Total cost estimate for this component is CNY97,025,600, including civil works cost of CNY72,390,100. (5) Public Transportation Infrastructure from Meng Ding to Qingshuihe: 10 charging piles/stations on the way from Mending to Qingshuihe Port and Mangka area, including 3 in Qingshuihe Port Economic Zone, 5 in Mengding Town and 2 in Mangka. Total cost estimate for this component is CNY 76,224,400, including civil works cost of CNY68,314,700.

According to the topographic map and land use status quo provided by the IA, and the requirements on land use categorization stated in Yunnan Provincial Department of Water Resources' Notice on Strengthening the Review and Approval of Water and Soil Conservation Plan for Production and Construction Projects, the project will require a land area of 68.05hm2 in total, including (divided by different project components and works): 37.57hm2 for water supply component (this includes 0.04hm2 for water intake, 7.68hm2 for raw water transmission, 2.40hm2 for water treatment plant, 4.28hm2 for distribution networks, and 23.17hm2 for temporary site for construction of pipelines); 10.77hm2 for wastewater treatment plant and associated works (this includes 2.48hm2 for WWTP, 2.63hm2 for wastewater pipelines, 5.66hm2 for temporary site for construction of pipelines); 0.44hm2 for solid waste management component (this includes 0.09hm2 for buildings and structures, 0.17hm2 for roads and hardened areas, 0.18hm2 for greening areas); 12.67hm2 for Qingshui River Rehabilitation (this includes 2.44hm2 for flood control, 2.00hm2 for wastewater interception, 8.23hm2 for ecological rehabilitation); 6.60hm2 for public transport infrastructure (this includes 1.27hm2 for buildings and structures, 4.61hm2 for roads and hardened areas, and 0.72hm2 for greening areas). By land use nature, the project will require permanent land use of 22.63hm2 and temporary land occupation of 45.42hm2.

According to the project design data and site survey results, the project land use is estimated at 68.05hm2. Types of land occupied include forest land, grass land,

construction land, transport land, slope cropland, waters and water facility land, of which 16.99h is forest land. It is estimated that 9798m3 of spoil will be generated from project construction.

Total project cost estimate is CNY419,608,700, including CNY 335,990,600 for civil works; the project fund will mainly come from ADB loan; the remaining will be provided by local government, as well as central, provincial and municipal government financial supports and self-raised funds by Lincang Border Economic Cooperation Zone Huitong Project Management Company.

According to the project design data, the construction period of the project is 32 months, i.e. commencement is scheduled in April 2018, and completion is scheduled in December 2012.

1.2 Project Area Overview

Project location, topography, geology, climate, precipitation, soil type.

The project area is not located within drinking water protection zone, protection and reservation zone of Class I water function areas, nature reserve, place of world cultural and natural reserve, tourist attractions, geopark, forest park or key wetlands. According to the Classification and Categorization Standards for Soil Erosion (SL 190-2007), the project area is the west earth-rock mountain region with mainly water erosion, the allowable soil loss is 500t/km^2·a, the average soil erosion modulus of the original landform of the project area is 216.81t/km^2·a, which is micro erosion.

1.3 Prevention and Rehabilitation Standards and Target Value

The project area is designated as national key areas of rehabilitation for water and soil loss in the southwest watershed and alpine valley region, and provincial key areas for rehabilitation of water and soil loss. According to the Water and Soil Conservation Standards for Development and Construction Projects (GB 50434-2008), the water and soil conservation for construction project will implement Class I standard. Considering the precipitation in the project area and native soil

erosion modulus, the control targets are corrected as follows: disturbed land remediation rate 95%, total control of water and soil loss 97%, soil loss control rate 1.0, spoil retention rate 95%, vegetation restoration rate 99%, forest coverage rate 27%.

1.4 Analysis and Assessment of the Water and Soil Conservation Measured incorporated in the Project Design

According to the project design: 1. Looking at the project location and surrounding ecological environment, the project site is not located within sensitive areas defined by the country, which is in compliance with the water and soil conservation requirements on project site selection set out in the Water and Soil Conservation Law of China, Water and Soil Conservation Regulation of Yunnan Province, and the Technical Specification for Water and Soil Conservation of Development and Construction Projects (GB 50433-2008), and No. 184 Document on Water and Soil Conservation (2007), the project construction doesn't present any constraints in terms of water and soil conservation; 2. the project engineering layout is rational, the construction organization design is feasible, the project construction doesn't require occupation of productive land including paddy field and irrigable land, the excavated earth during construction will be reasonable utilized to avoid generation of spoil, which are in line with water and soil conservation requirements; 3. Based on assessment on the water and soil conservation measures provided by the project design: the project design already incorporated water and soil conservation measures, which provides the functions of reducing scouring from runoff and conservation of water and soil, the prevention and protection measures in different zones/engineering areas are all in compliance with water and soil conservation requirements. Based on the actual situations of engineering construction, this plan provide supplement to the project design for prevention and rehabilitation of water and soil loss, including engineering measures, vegetation measures and temporary measures, to develop a complete water and soil protection system. The water and soil loss will occur mainly during the construction period of the project, therefore the

water and soil conservation measures in this plan focus on temporary measures during construction period, the design and implementation of temporary measures can effectively control and rehabilitate the water and soil loss during construction period.

To sum up, according to the characteristics of the water and soil loss newly generated during project construction and operation, based on the assessment of the water and soil conservation functions provided by the project design, and taking into account of the prevention and protection in different engineering areas, an ecological rehabilitation system which integrates engineering measures, vegetation measures and temporary measures will be established to minimize water and soil loss. The construction contractor shall implement the measures in strict accordance with the requirements of this plan, the project design doesn't present any constraints in terms of water and soil conservation, it is feasible and reasonable. The water and soil conservation priority of this project is to carry out proper temporary protection measures during project construction to prevent and rehabilitate the water and soil loss during construction, develop detailed design for those measures design in this plan during the stage of detailed design (construction drawings), construction activities shall complete within the project boundary lines to avoid impact on the surroundings, conduct regular checks on the water and soil conservation facilities during natural recovery, and strengthen the nurturing and maintenance of the greening.

1.5 Scope for Water and Soil Loss Prevention and Rehabilitation

The scope for water and soil loss prevention and rehabilitation includes project construction area and direct impact area. The total area for water and soil prevention and rehabilitation is 85.64hm2, including 68.05hm2 of project construction area and 17.59hm2 of project direct impact area. The scope is divided into two Class I prevention and rehabilitation area, i.e. project construction area and direct impact area; the project construction area is then divided to be Class II areas, including water supply, WWTP and associated works, solid waste management, Qingshui

river rehabilitation and public transport infrastructures; each item is divided again into Class III areas.

1.6 Water and Soil Erosion Estimate

According to calculations and estimate, the project construction will cause disturbance to 68.005hm2 of the earth surface; damage to 21.97hm2 of water and soil conservation facilities; may cause 68.05hm2 of water and soil loss; the project construction will generate earth excavation of 426482m3, including 84900m3 from land leveling excavation, 125992m3 from foundation and trench excavation, 65910m3 from topsoil stripping; the project construction will generate backfill of 416684m3, including 60400m3 for land levelling backfill, 272821m3 for foundation and trench backfill, and 65910m3 for greening earthing. The stripped topsoil will be temporary stored at the planned earth stacking site for greening earthing. The project construction will generate spoil of 9798m3. During the estimate period, the project will cause soil erosion of 4124.41t, including loss of native soil 370.50t, and new soil loss of 3753.91t, the new soil loss during construction will mainly come from the ecological rehabilitation of river, followed by temporary site for construction of pipelines for water supply component, temporary site for construction of pipelines for WWTP component, roads and hardened area of the public transport infrastructure, greening area of solid waste management component. Those five areas should be the key areas for water and soil loss monitoring and prevention and rehabilitation.

1.7 Water and Soil Loss Prevention and Rehabilitation Zoning and General Layout of Measures

It is divided into two Class I prevention and rehabilitation area, i.e. project construction area and direct impact area; the project construction area includes water supply, WWTP and associated works, solid waste management, Qingshui river rehabilitation and public transport infrastructures;

1.7.1 Water and Soil Loss Prevention and Rehabilitation Zoning

The area for water and soil loss prevention and rehabilitation of the project is divided into two Class I areas, i.e. project construction area and direct impact area; project construction area is divided into water supply, wastewater treatment plant and associated works, solid waste management, Qingshuihe River rehabilitation, and public transport infrastructure from Mengding to Qingshuihe.

1.7.2 General Layout of Measures

Effective water and soil loss prevention and rehabilitation measures should be taken, in accordance with the zoning, soil and water loss estimate, water and soil loss characteristics and extent of damage during construction and operation of the project, and taking into account of the water and soil conservation functions provided by the main works. The water and soil loss prevention and rehabilitation for this project will adopt both engineering measures and vegetation measures, both permanent measures and temporary prevention measures, and incorporate those water and soil conservation measures provided by the design of the main works into the water and soil loss prevention and rehabilitation system, to establish a complete and effective water and soil conservation system. The general layout of the water and soil conservation plan will be properly developed to form a complete and scientific water and soil conservation system. The general layout of the measures is presented in detail in Table 8-1.

1. Water Supply in Qingshui River Port Area

(1) Construction Site of Water Intake

After completion of construction, the area will be covered by structures and buildings, the design of the main works didn't provide any water and soil conservation measures. Based on the water and soil loss characteristics in this area, respective management measures are developed in this plan.

(2) Construction Site of Raw Water Transmission

The design of the main works includes topsoil stripping and vegetation restoration, this plan, in addition, proposed sediment tanks/basins at the outlet, and developed relevant management measures.

(3) Construction Site of the Water Treatment Plant

The design of the main works (project design) includes topsoil stripping, storm water pipelines, landscape greening, for which professional landscape and greening firm was engaged for the design, those measures are in line with water and soil conservation requirements. Additionally, this plan provides temporary drainage ditches, temporary sediment basin, temporary retaining/blocking and temporary cover, and relevant management measures.

(4) Construction Site for Water Transmission and Distribution Networks

The design of the main works includes topsoil stripping and vegetation restoration; additionally, this plan provides sediment tanks at the outlet, and relevant management measures.

(5) Temporary Construction Site for Pipeline Works

The design of the main works includes topsoil stripping and vegetation restoration; additionally, this plan provides temporary retaining/blocking and temporary cover, and relevant management measures.

2. WWTP and Associated Works

(1) Construction Site of the WWTP

The design of the main works (project design) includes topsoil stripping, storm water pipelines, landscape greening, for which professional landscape and greening firm was engaged for the design, those measures are in line with water and soil conservation requirements. Additionally, this plan provides temporary drainage ditches, temporary sediment basin, temporary retaining/blocking and temporary cover, and relevant management measures.

(2) Construction Site of Associated Wastewater Pipeline Network

The design of the main works didn’t provide any water and soil conservation measures. According to the water and soil loss characteristics in this area, this plan will provide sediment tanks at the outlet, and relevant management measures.

(3) Temporary Construction Site for Pipeline Works

The design of the main works didn't provide any water and soil conservation measures. According to the water and soil loss characteristics in this area, this plan will provide temporary retaining/blocking and temporary cover, and relevant management measures.

3. Solid Waste Management at Mending Town and Qingshui River Port Area

(1) Construction Site for Buildings and Structures

After construction completion, the area will be covered by structures and buildings. The design of the main works includes topsoil stripping measures. According to the water and soil loss characteristics in this area, this plan provides relevant management measures.

(2) Roads and Hardened Area

The design of the main works includes topsoil stripping, storm water pipelines. Additionally, this plan provides temporary drainage ditches, temporary sediment basin, and relevant management measures.

(3) Greening Area

The design of the main works includes topsoil stripping, landscape greening, for which professional landscape and greening firm was engaged for the design, those measures are in line with water and soil conservation requirements. Additionally, this plan provides temporary retaining/blocking and temporary cover, and relevant management measures.

4. Qingshuihe River Integrated Rehabilitation

(1) Flood Control Works

The design of the main works didn't include any water and soil conservation measures. According to the water and soil loss characteristics in this area, this plan proposed relevant management measures.

(2) Wastewater Interception Works

The design of the main works includes topsoil stripping and vegetation restoration. Additionally, this plan provides sediment tanks at the outlet, temporary retaining/blocking and temporary cover, and relevant management measures.

(3) Ecological Rehabilitation Works

The design of the main works includes topsoil stripping, landscaping greening. According to the water and soil loss characteristics in this area, this plan proposed relevant management measures.

5. Public Transport Infrastructure from Mengding to Qingshui River Port

(1) Construction Site for Buildings and Structures

After construction completion, the area will be covered by structures and buildings. The design of the main works includes topsoil stripping measures. According to the water and soil loss characteristics in this area, this plan provides relevant management measures.

(2) Roads and Hardened Area

The design of the main works includes topsoil stripping, storm water pipelines. Additionally, this plan provides temporary drainage ditches, temporary sediment basin, and relevant management measures.

(3) Greening Area

The design of the main works includes topsoil stripping, landscape greening, for which professional landscape and greening firm was engaged for the design, those measures are in line with water and soil conservation requirements. Additionally, this plan provides temporary retaining/blocking and temporary cover, and relevant management measures.

1.7.3 Bill of Quantities of Water and Soil Conservation Measures

(1) Bill of quantities of the measures with water and soil conservation functions in the project design

Those measures from the design of main works of the project components that are included into this plan include: a. engineering measures: 60690m3 of topsoil

stripping, 3706m of storm water pipeline; b. vegetation measures: 3.76hm2 of landscape greening, 10.40hm2 of vegetation restoration, and 8.23hm2 of greening.

(2) Additional Water and Soil Conservation Measures in This Plan

Additional temporary water and soil conservation measures included in this plan are: raw water transmission pipelines: 10 mobile sediment tanks; water treatment plant: 1500m2 of temporary cover, 500m of temporary drainage ditches, 1 temporary sediment basin and 160m of temporary retaining/blocking; water distribution networks: 10 mobile sediment tanks, 20000m2 temporary cover for temporary construction site of pipelines, and 6000m of temporary retaining and blocking; WWTP: 1200m2 of temporary cover, 686m of temporary drainage, 1 temporary sediment basin, 136m of temporary retaining and blocking; wastewater pipeline network: 5 mobile sediment tanks, and 5000m2 of temporary covering and 1124m temporary retaining/blocking for temporary site of pipeline construction; municipal solid waste management: road and hardened area-264m of temporary drainage, 2 temporary sediment basins; greening area-200m2 temporary cover, 22m temporary retaining/blocking; wastewater inception along the river: 20 mobile sediment tanks, 900m2 temporary cover, 600m temporary retaining/blocking; public transport infrastructure: roads and hardened areas-3240m temporary drainage, 10 temporary sediment basins; greening area-760m2 temporary cover, 240 temporary retaining and covering. Bill of quantities includes: 1009.76m3 of earthwork excavation, 715.61m3 of earth compaction, 56m3 brickwork, 29560m2 geotextile, 6.4t steel, 12358.75m3 woven bags filled with soil, 12358.75m3 for removal of woven bags filled with soil.

1.8 Water and Soil Conservation Monitoring

The scope of water and soil conservation monitoring is the area falls into the responsibility for water and soil loss prevention of the project, with an area of 85.64hm2. According to engineering characteristics and construction layout, the project is divided into 5 monitoring zones, i.e. water supply in Mengding Qingshuihe

Port Area, wastewater treatment plant and associated works in Mending Qingshuihe Port Area, Qingshuihe River rehabilitation, and public transport infrastructure from Mengding to Qingshuihe. During construction, there will be a total of 36 monitoring points of all kinds; during natural recovery period, there will be a total of 11 monitoring and check points. Water supply component: 1 monitoring point at the water intake construction area of the water supply component, 3 monitoring points at the raw water transmission network construction area, 3 monitoring points at the water treatment plant, 3 monitoring points at the water distribution networks construction area, 4 monitoring points at the temporary site for pipeline construction, a total of 13 monitoring points; and 4 monitoring and check points during natural recovery period. WWTP component: 2 monitoring points at the WWTP construction area, 2 monitoring points at the wastewater pipeline construction area, 2 monitoring points at the temporary site for pipeline construction, a total of 6 monitoring points; and 1 monitoring and check point during natural recovery period. Solid waste management component: 1 monitoring point at the buildings and structures area, 1 monitoring point at the roads and hardened area, 1 monitoring point at the greening area, a total of 3 monitoring points; and 1 monitoring and check point during natural recovery period. Qingshui River Rehabilitation: 1 monitoring point at the flood control works, 2 monitoring points at the wastewater inception works, 2 monitoring points at the ecological rehabilitation site, a total of 5 monitoring points; and 2 monitoring and check point during natural recovery period. Public Transport Infrastructure from Mengding to Qingshuihe: 3 monitoring points at the buildings and structures area, 3 monitoring points at the roads and hardened areas, 3 monitoring points at the greening area, a total of 9 monitoring points; and 3 monitoring and check points during natural recovery period. The monitoring of the direct impact area will be conducted through inspection checks, taking into account of the results at the monitoring points, and will not have separate monitoring points. It should be noted that the monitoring points arranged in this plan are initially proposed locations, the monitoring agency shall further select specific site within those locations to conduct monitoring. The monitoring period for the project is 3.67 years, including 2.67 years

(April 2018 to December 2020) during construction period, and 1 year (January 2021 to December 2021) during natural recovery period. During construction period, monitoring will be conducted monthly during rainy seasons, and one additional monitoring in case $R_{24h} \geqslant 50mm$; monitoring will be conducted on a quarterly basis during dry seasons. During natural recovery period, monitoring will be conducted on a bimonthly basis during rainy seasons, and quarterly during dry seasons, and additional one monitoring in case $R_{24h} \geqslant 50mm$. Upon engagement, the monitoring agency will conduct a comprehensive baseline survey on the water and soil loss of the project area and its surroundings.

1.9 Water and Soil Conservation Cost Estimate and Benefit Analysis

The total cost estimate for the water and soil conservation of the Project is CNY 8,702,500, including 3,825,200 for those water and soil conservation measures included in the project design, and 4,877,300 for those additional water and soil conservation measures in this plan.

The total cost estimate for the water and soil conservation of the Project is CNY 8,702,500, including 1,372,600 for engineering measures, 2,452,600 for vegetation measures, 2,689,500 for temporary measures, and 1,462,300 for other costs (including 213,600 for water and soil conservation supervision and 940,400 for water and soil conservation monitoring), physical contingency of 249,100, compensation for water and soil conservation facilities of 476,400.

Through implementation of all kinds of prevention and rehabilitation measures, at the end of the design level year, the remediation rate of disturbed land in the project area will reach 99%, total rehabilitation rate of water and soil loss to reach 99%, control rate of soil loss to reach 1.55, spoil retention rate to reach 99%, vegetation restoration rate to reach 99%, vegetation coverage to reach 32.90%.

1.10 Conclusions and Recommendations

The construction and site selection of the project do not present any constraints in the regard of water and soil conservation. The water and soil loss will accelerate during construction period, but it will be effectively controlled and rehabilitated through implementation of this plan. After project completion, the project area will be covered by buildings, structures, hardened surface, water and greening. The water and soil loss are micro in extents. The project construction can create ecological benefits, economic benefits and social benefits.

It is suggested that in the next stage, the design institute shall fully incorporate the contents of this water and soil conservation plan, and further develop water and soil conservation measures in detail, and prepare detailed engineering design for water and soil conservation. During the bid for the construction works, the bidding documents for the project works shall include the contents of this plan, and specify in the bidding document how to meet water and soil conservation requirements during construction. Following the water and soil loss prevention and rehabilitation measures developed in this plan, the construction contractor shall strengthen the awareness in water and soil conservation. The implementing unit shall carry out water and soil conservation monitoring at the earliest after approval of this plan, and undertake supervision and monitoring on water and soil conservation during project construction. The surface runoff generated during the construction period of the project must go through sedimentation before discharging.

Water and Soil Conservation Plan Elements

Project name	Yunnan Lincang Border Economic Cooperation Zone Infrastructure Development Project-Environmental Components			Watershed management agency		Yangtze River Water Resources Commission
Province	Yunnan Province		Or the number of cities involved	Lincang Municipality	Project County	Gengma County
Project scale	68.05hm2 of land use		Total cost estimate (CNY 10,000)	41960.87	Cost of Civil Works (CNY 10,000)	33599.06
Commencement time	April 2018		Completion Time	December 2020	Design level year	2021
Project components	Construction area	Length / Area (m / hm2)	Excavated volume (m3)		Fill volume (m3)	Spoil(m3)
	Water Supply in Mending Qingshui River Port Area	37.57	217079		207281	9798
	Waste water treatment and associated works in in Mending Qingshui River Port Area	10.77	73233			177 265
	Solid waste management in in Mending and Qingshui River Port Area	0.44	15,000			101 356
	Qingshui River Rehabilitation in Mending Qingshui River Port Area	12.67	73090			
	Public transport infrastructure from Mending to Qingshuihe	6.60	48080			
	Total	68.05	426 482		416 684	399 591
National or provincial key prevention and rehabilitation area		National and provincial key areas for prevention and rehabilitation	Landform		Alluvial plain low heat valley area	
Soil type		Latosol	Climate type		North tropical humid climate	
Vegetation Type		Subtropical evergreen broadleaf forest	Original topography soil erosion modulus [t / (km2 · a)]		266.73	
Scope/ area (hm2)		85.64	Soil Loss Tolerance [t / (km^2 · a)]		500	
Project area (hm2)		68.05	Disturbed Surface area(hm^2)		68.05	
Direct impact area (hm2)		17.59	Area of water and soil conservation facilities damaged (hm2)		21.97	
Total water and soil erosion (t)		4124.41	Additional/New Soil Erosion (t)		3753.91	
Major area for new soil erosion		Roads and hardened area, buildings, structures				
Targets	Disturbed land remediation rate (%)	95	Total control of soil erosion (%)		97	
	Soil erosion control ratio	1.0	Spoil retention (%)		95	
	Vegetation restoration rate(%)	99	Forest and grass coverage rate (%)		27	
Measure	Zoning	Engineering measures	Vegetation measures		Temporary measures	
	Water Supply	Project design: topsoil stripping 35640m3	Project design: landscape-style		This plan: 20 mobile sediment tanks, temporary cover 21500m2, temporary	

	Storm water pipeline 550m	greening 1.50hm2, vegetation restoration 9.48hm2	drainage ditch 500m, 1 temporary sediment basin, temporary retaining 6160m	
WWTP and associated works	Project design: topsoil stripping 7440m3 S storm water pipeline 550m	Project design: landscape-style greening 1.36hm2	This plan: Temporary cove r6200m2, temporary drainage ditch 1810m, 1 sediment basin, temporary retaining 136m, 5 mobile sediment tanks	
Solid Waste Management	Project design: topsoil stripping 1200m3 storm water pipeline 376m	Project design: landscape-style greening 0.18hm2	This plan: temporary drainage 264m, 2 temporary sediment basins, temporary covering 200m2, temporary retaining 22m	
Qingshui River Rehabilitation	Project design: topsoil stripping 16410m3	Project design: landscaping 8.23hm2, vegetation restoration 0.92hm2	This plan: 20 sediment tanks, temporary covering 900m2, temporary retaining 600m	
Public Transport Infrastructure	Project design: topsoil stripping 5220m3 Storm water pipeline 2000m	Project design: landscape-style greening 0.72hm2	This plan:Temporary drainage 3240m, 10 temporary sediment basin,temporary cover 760m2, temporary retaining 240m	
Cost Estimate (CNY 10,000)	137.26	245.26	268.95	
Total cost estimate for water and soil conservation (CNY 10,000)	870.25, of which the main design: 382.52 New program: 487.73	Other costs (CNY 10,000)	146.23	
Soil and water conservation supervision fee (CNY 10,000)	21.36	Monitoring fees (CNY 10,000)	94.04	Compensation (CNY 10,000) 47.64
Prepared by	Yunnan a mine Engineering Limited	PIU	Lincang Border Economic Cooperation Zone Investment and Development Co., Ltd.	
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2.2 Basis for Preparation of the Plan

2.2.1 Laws and regulations

（1）《Law of the People's Republic of China on Water and Soil Conservation》（Adopted on June 29, 1991, amended on December 25, 2010 and implemented on March 1, 2011）;

（2）《Environmental Protection Law of the People's Republic of China》（Adopted on December 26, 1989, amended on April 24, 2014, implemented on January 1, 2015）;

（3）《Law of the People's Republic of China on Water and Soil Conservation Implementation Regulations》（Published on August 1, 1993, amended January 8, 2011）;

（4）《Flood Control Law of the People's Republic of China》（Adopted on August 29, 1997 and amended on July 2, 2016）;

（5）《Water Law of the People's Republic of China》（Adopted on January 21, 1988, amended on July 2, 2016）;

（6）《Land Administration Law of the People's Republic of China》（Adopted on June 25, 1986, amended on August 28, 2004）

（7）《Regulation on the Administration of Construction Project Environmental Protection》（published on November 29, 1998 and amended on July 16, 2017）;

（8）《River Management Regulations of the People's Republic of China》（Adopted on June 3, 1988, amended on March 1, 2017）;

（9）《Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste》（October 30, 1995, amended November 7, 2016）;

（10）《Law of the People's Republic of China on the Prevention and Control of Water Pollution》（Adopted on May 11, 1984, amended June 27, 2017）;

（11）《Law of the People's Republic of China on Environmental Impact Assessment》（Adopted on October 28, 2002 and amended on July 2, 2016）;

（12）《Soil and Water Conservation regulation of Yunnan Province》（Adopted on July 27, 2014, implemented on October 1, 2014）;

2.2.2 Rules and Regulations of the Central Government Ministries

（1）《Measures for the Administration of Soil and Water Conservation Plans for Development and Construction Projects》（NO.513，Ministry of Water Resources of the People's Republic of China, National Health and Family Planning Commission of the People's Republic of China (NHFPC)， State Environmental Protection Administration of China (SEPA)，published on Nov 22, 1994）

（2）《Measures for the Management of Soil and Water Conservation and Ecological Environment Monitoring Network》（Issued by Order No. 12 of Ministry of Water Resources of the People's Republic of China on January 31, 2000，amended according to Order No. 46 of Ministry of Water Resources of the People's Republic of China, on August 19, 2014）

（3）《Enterprise Investment Project Approval and Record Management Regulations》（Published on December 14, 2016, implemented on February 1, 2017）

（4）《Regulations on the Examination and Approval of Soil and Water Conservation Plans for Development and Construction Projects》（Order No. 5 of Ministry of Water Resources of the People's Republic of China, amended according to Order No. 24, 2005）

（5）《Decision of the Ministry of Water Resources on Revising Some Water Administration License Regulations》（Order No. 24 of Ministry of Water Resources of the People's Republic of China, on July 8 2005）

3 Project Overview

3.1 Basic Information of the Project

3.1.1 Basic Introduction

Project Name: Yunnan Lincang Cross-border Economic Cooperation Zone Infrastructure Development Project-Environmental Components

Project Implementing Entity: Lincang Cross-border Economic Cooperation Zone Investment and Development Company

Project Location: Qingshui River Port area and Mangka area of Mengding Town, Gengma County, Lincang Municipality

Construction: new construction/construction;

Project construction scope: (1)Water supply in Mengding Qingshui River Port Area: ① Water intake, including 1 new water intake structure of low dam type, and water intake capacity is up to 21,000 m^3/d; ②Raw water transmission, DN700 pipelines for 32km, using ductile iron pipe and steel pipe with 2.5MPa pressure rating; ③Water treatment plant: 20,000m^3/d in the short term, a land area of 2.0hm^2; ④Water distribution network, DN200-DN700 pipeline for 33km; PE pipe with pressure rating of 1.0MPa. (2)Wastewater treatment plant and ancillary works in Mengding Qingshui River Port Area: ①wastewater treatment plant: with a capacity of 10,000m^3/d, and an area of 2.48 hm^2; ②wastewater pipelines: DN400-DN800 for 16.5km. Buble PE wastewater pipe is adopted for pressure flow, and steel band reinforced pipe is adopted for gravity flow. (3)Solid Waste Treatment in Mengding downtown and Qingshui River Port Economic Zone: ①Qingshui river port area: In the port trade area, one new solid waste transfer station with a capacity of 27t/d and an area of 0.30 hm^2, and to provide functions of parking and sanitation center; one collection station at the transport and logistics park and the production cooperation zone, with a capacity of 7t/d and 8t/d and a land area of 0.06hm^2 and 0.04hm^2, respectively; ②

Mengding Downtown: 6 MSW chambers (with public toilets) to collect solid waste from the villages nearby Mengding Town , with a land area of 0.04 hm^2; ③ 2600 trash cans, 1346 garbage bins with a volume of 240L,60 3m^3hook arm boxes, 59 0.3t motor tricycles，15 1T tank-detachable garbage trucks, 1 3T back-loaded compression garbage truck, 1 4T back-loaded compression garbage truck, 1 1T suction truck and 1 5T road sweeper. (4) Qingshuihe River integrated rehabilitation, sediment dredging, wastewater inception along the river, and river landscaping, total length included under this component is 1000m. (5) Public Transportation Infrastructure from Meng Ding to Qingshuihe: 10 charging piles/stations on the way from Mending to Qingshuihe Port and Mangka area, including 3 in Qingshuihe Port Economic Zone, 5 in Mengding Town and 2 in Mangka.

Construction period: 32 months, from April 2018 to December 2020;

Total investment: 419,608,700 RMB, including 335,990,600 RMB for civil works;

Project land use: 58.62hm^2.

4 Overview of the Project Area

4.1 Natural conditions

4.1.1 Geology

4.1Natural conditions

4.1.1Geology

(1) Geological structure

The project is located in West of the Minjiang fault of Dianxi meridional structural belt， middle of Baoshan Menglian subduction zone，and is in the holding belt between Nantinghe fault zone and Gengma fault zone, which shows a relatively complicated geological structure.

(2) Lithology

There is complicated lithologic stratigraphy in the area of the project. The structure is developing. The Stratum is dominated by Q4al sandy pebble soil, coarse sand, fine silty sands and silty sands. There are Jurassic sandstone, Triassic limestone, Triassic dolomites, Triassic siltstone, Permian gray dolomite , Permian oolitic limestone and permian bioaccumulated limestone in the surrounding slope. The carboniferous system contains C3w basalt, tuff, tuffaceous siltstone and tuffaceous shale. The lower Paleozoic contains thousands of Pzd slate, schist,metamorphic rock, and siliceous rocks.

(3) Earthquake

No serious earthquake occurred in the area of the project. On November 6th, 1988, there were 7.6-magnitude and 7.2-magnitude earthquakes in Lancang Lahu Autonomous County and at the border of Gengma County and Cangyuan County respectively, which caused a slight impact on Mengding. According to the " Seismic Zoning Map of China" (GB 18306-2015) and “China Seismic Intensity Scale”（GB/T 17742-2008），the seismic intensity in the area of the project is VII degrees, Peak ground acceleration (PGA) is 0.30g, and the response spectra is 0.45s.

(4) Hydrogeology

The groundwater in the area of the project belongs to two types: either quaternary loose porosity perched water or underlying bedrock karst aquifer. The main aquifer in quaternary loose porosity perched water is the cohesive layers on the top of the bedrock, with poor water permeability, water content and water yield property. It mainly operates through the infiltration of atmospheric precipitation, water stagnant and evaporation. Underlying bedrock karst aquifer belongs to fault zone, with weak pressure resistance and rich water. The source of recharge is through atmospheric precipitation and pore water and discharge is through the form of springs.

(5) Unfavorable geological conditions

Based on the geological survey of the project area and the surrounding area, it is to check whether there is unfavorable geological effects exist such as landslides, collapses, mudslide, gullies, underground goafs, fissures, unstable slopes, land subsidence, etc.

4.1.2 Landform

Mengding County is located in middle and lower section of the dissected area of dissected mountain in southern Dianxi Hengduan Mountains, in the wide valley alluvial dam of Nanting River Basin and geothermal valley. Mountains and rivers tend to be northeast-southwest and the terrain gradually descends from northeast to southwest. The average elevation is 511m, with the highest is 2973m, and the lowest is 450m. It is located at the junction of the Qingshui River and the Nanting River, it belongs to the low-latitude and low-altitude alluvial dam geothermal valley.

The area of the project is located in “Mengding Qingshuihe Port Economic Zone” in Mengding County and belongs to Qingshuihe Village in terms of administrative area. The geomorphology type is alluvial dam geothermal valley. The terrain elevations of original landform are 525m to 475m with a maximum terrain elevation of 50m with a relatively ground slope.

4.1.3 Climate

The project area presents typical vertical climate, the weather varies significantly with the altitude and distance, the tropic of cancer goes across the whole area, bring typical north tropical humid climate, with high temperature and long sunshine hours, frost-free all year around, annual average temperature is 21.7°C, the temperature of the hottest month (June) is 25.8°C, and 14.3°C during the coldest month (January), the total annual accumulated temperature is 7920.5°C, the annual sunshine hours is 2094.8h, sunshine rate is 48%, annual average precipitation is 1600mm, the precipitation during rainy seasons (May to October) accounts for 88% of that of the whole year, annual average evaporation is 1602mm; foggy during winter and spring, with multi-year average 89.9 foggy days, multi-year average humidity 20.7%, relative humidity 75~80%, multi-year average wind speed 2.2m/s, the prevailing wind directions are southwest and northwest.

For the 20 years maximum rainfall in the project area, the 1h precipitation was 79.56mm, 12h precipitation was 87.5mm, and 24h precipitation was 126.78mm.

4.1.4 Hydrology

There are 15 rivers of different size within the territory of Mengding, including connected with Nujiang River watershed 1 class I tributary (Nanting River), 12 class II tributaries (Gulao River, Nanwen River, Nanwang River, Nandi River, Nanpeng River, Nangun River, Qingshuihe River, Nanwa River, Xiaohei River, Nanzhuang River, Nanpa River and Moya River), 1 class III tributary (Nanpian River), the total flow within the territory is 218m^3/s, total water resource is 2.539 billion m^3.

The surface drainage in the project area is Qingshuihe River, a class I tributary of Nanting River, converging with Nanting River 500m downstream of the project area.

Nanting River: Class I tributary of Nujiang River watershed, originated from Liang Mountain (altitude 2480m) southwest of Yongquan Village, Boshang Town, Linxiang District, mainstream length 272.9km, head 1860m, average gradient 22‰, catchment area is 8208km^2.

Qingshuihe River: within Nujiang River watershed, a Class I tributary at the right bank downstream Nanting River, originated in Gonglaoshu Mountain southeast of Sandui Mountain in Myanmar, the catchment area is 77.8km^2 (including 0.9km^2 in Myanmar), the river length is 20km, head 1360m, average gradient 6.8%, drainage density 0.77.

The temporary drainage during construction period in the project area will be discharged into the municipal storm water pipeline after sedimentation at the sediment basins provided by this plan, storm water and wastewater separation will be adopted during operation period, the domestic wastewater and rainwater will be separately discharged into wastewater pipelines and storm water pipelines, respectively. The wastewater will be treated by reclaimed water facility for greening and road watering, the remaining will be discharged into municipal wastewater pipelines, the storm water will be collected through the rainwater grates before discharging into the storm water pipelines, and finally discharge into the municipal storm water pipeline.

The distribution of watersheds and rivers around the project area are presented in Figure 2.

4.1.5 Soil

Mengding Town has strips of different soils, including laterite, red loam, lime soil and paddy soil, the flat area of Mengding is located in the laterite strip under north tropical climate.

It is mainly laterite in the project area.

4.1.6 Vegetation

Mengding Town has various varieties of vegetation, including north tropic monsoon forest, subtropical evergreen broad-leaved forest and broadleaved deciduous forest, rich in tropical rare plant species such as teak, mesua ferrea and bombacaceae. The forest area of the whole territory is 65604.74hm2, with a forest coverage rate of 60.7% and standing forest stock of 2,445,300m^3.

The vegetation type in the project area is subtropical evergreen broad-leaved forest, the vegetation coverage rate of the project area is 32.29%.

4.1.7 Others

The project area is not located within drinking water protection zone, protection and reservation zone of Class I water function areas, nature reserve, place of world cultural and natural reserve, tourist attractions, geopark, forest park or key wetlands.

4.2 Socioeconomic Profile

4.2.1 Socio-economic Profile

The project is located in Qingshuihe Village, Mengding Town of Gengma County, Gengma County administers 9 townships, 2 farm management committees, 1 overseas Chinese management area, 82 village committees and 4 communities, in which, Mending Town is a sub-county level township, national Class I opening-up port.

Based on the 2016 statistical yearbook and other socio-economic data of Gengma County, the socio-economic profile of Gengma County, Mengding Town and Qingshuihe Village are summarized in Table 4-1.

Table 4-1: 2016 Socio-Economic Profile of the Project Area

Administrative Zoning	Total area (Km2)	Arable land (mu)	Total population (CNY10,000)	Agriculture population (CNY 10,000)	Gross agricultural production (CNY 10,000)	Rural per capita arable land (mu)	Rural per capita net income (CNY yuan)
Gengma County	3727.23	630 555	29.63	25.19	233 436	2.51	9267
Mengding Town	1005.87	343,532.85	9.55	7.0	34027	4.91	4861
Qingshuihe Village	9.00	1620.00	0.21	0.21	3182	0.77	7753

4.2.2 Current Land Use

Gengma County has a land area of 3727.23km2, including 42037hm2 of farmland, 212657hm2 of forest land, 9669hm2 of garden land, 3545hm2 of water area, 6906hm2 of uncultivated area, and 97909hm2 of other land areas.

Mengding Town has a land area of 1005.87km2, including 22902.19hm2 of farmland, 13315.53 hm2 of garden land, 7060.89hm2 of other agricultural land, 53072.77hm2 of forest land, 1789.99 hm2 of construction land, and 2447.63hm2 of uncultivated land.

Qingshuihe Village Committee has a land area of 9.00km2, the village has 108hm2 of farmland, 735hm2 of forest land, and 57hm2 of other land.

The project area is 68.05hm2, including 16.99hm2 of forest land, 4.98hm2 of grass land, 6.03hm2 of construction land, 31.82hm2 of transport land, 2.72hm2 of slope cropland, and 5.51hm2 of water area and water conservancy facilities.

4.3 Current water and soil loss and conservation

4.3.1 Current status of water and soil loss

(1) Current water and soil loss at Gengma County

According to the Yunnan Province 2015 Soil Erosion Survey Report (Yunnan Water Conservancy and Hydropower Research Institute), the total land area of Gengma County is 3727.23km2, in which, area of micro erosion is 2461.82km2, accounting for 66.05%; area of soil erosion is 1265.41km2, accounting for 33.95%. Among the area of soil erosion: area of mild erosion is 657.30km2, accounting for 51.94%; area of moderate erosion is 231.36km2, accounting for 18.28%; area of strong erosion is 108.14km2, accounting for 8.55%; area of very strong erosion is 165.02km2, accounting for 13.04%; area of intensive erosion is 103.59km2, accounting for 8.19%.

Table 4-2 Soil Erosion in Gengma County unit: km^2

Area	Land area	Micro erosion	Soil Erosion					
			Subtotal	Mild	Moderate	Strong	Very	Intensive

							strong	
Gengma County	3727.23	2461.82	1265.41	657.30	231.36	108.14	165.02	103.59

According to the categorization in the Categorization and Classification Standard for Soil Erosion (SL 190-2007), the project is located in the southwest earth-rock mountain region where soil erosion type is mainly water erosion, allowable soil loss is 500t/km2.a.

(2) Water and soil loss in the project area

The project is newly construction which is not started yet. The project will require occupation of land, including forest land, grassland, transport land, mild slope cropland, water area and water conservancy facilities land. The soil erosion modulus of different land types are taken from the Categorization and Classification Standard for Soil Erosion (SL 190-2007), the weighted average by area is the current water and soil loss intensity of the project area, which is micro erosion, the current average soil erosion modulus of the project area is 266.73t/km2·a, the REF value of current soil erosion modulus is detailed in Table 4-3.

Table 4-3: Native Soil Erosion Modulus

Estimates by different areas		The total area (hm2)	Original Land Composition and Area		Soil erosion modulus (t / km2 · a)	Average soil erosion modulus (t / km2 · a)	Remarks
			Composition of Land	Area (hm2)			
Water Supply in Mending Qingshuihe Port Area	Water intake	0.04	Waters and water conservancy facilities	0.04	200	200.00	Micro-degree erosion
	Raw water conveyance	7.68	Forest land	3.42	300	866.67	Mild erosion
			Land Transportation	2.68	450		
			Slope cropland	1.58	2800		
	WTP	2.40	Forest land	2.40	300	300.00	Micro-degree erosion
	Water distribution networks	4.28	Forest land	0.42	300	415.65	Micro-degree erosion
			Construction land	0.24	100		
			Land Transportation	3.62	450		
	Temporary site of pipeline construction	23.17	Forest land	4.36	300	400.73	Micro-degree erosion
			Grass land	1.28	400		
			Construction land	1.21	100		
			Land Transportation	16.32	450		
WWTP and associated works	WWTP	2.48	Forest land	2.48	300	300.00	Micro-degree erosion
	Wastewater pipelines	2.63	Land Transportation	2.63	450	450.00	Micro-degree erosion
	Temporary site of pipeline construction	5.66	Construction land	1.48	100	358.48	Micro-degree erosion
			Land Transportation	4.18	450		
Solid waste management	Buildings and Structures	0.09	Forest land	0.05	300	211.11	Micro-degree erosion
			Construction land	0.04	100		

	Roads and hardened areas	0.17	Forest land	0.17	300	300.00	Micro-degree erosion
	Greening areas	0.18	Forest land	0.18	300	300.00	Micro-degree erosion
Qingshuihe River Rehabilitation	Flood Control	2.44	Waters and water conservancy facilities	2.44	200	300.00	Micro-degree erosion
	Wastewater Interception	2.00	Forest land	0.66	300	364.00	Micro-degree erosion
			Grass land	0.26	400		
			Land Transportation	0.84	450		
			Waters and water conservancy facilities	0.24	200		
	Ecological rehabilitation	8.23	Forest land	2.15	300	311.48	Micro-degree erosion
			Grass land	2.40	400		
			Land Transportation	0.89	450		
			Waters and water conservancy facilities	2.79	200		
Urban public transport infrastructure	Buildings and Structures	1.27	Forest land	0.26	300	947.64	Mild erosion
			Construction land	0.50	100		
			Transportation	0.15	450		
			Slope cropland	0.36	2800		
	Roads and hardened area	4.61	Forest land	0.22	300	605.53	Mild erosion
			Grass land	0.92	400		
			Construction land	2.30	100		
			Transportation	0.43	450		
			Slope cropland	0.74	2800		
	Greening areas	0.72	Forest land	0.22	300	400.00	Mild erosion
			Grass land	0.12	400		

			Construction land	0.26	100		
			Transportation	0.08	450		
			Slope cropland	0.04	2800		
Total		**68.05**		**68.05**		**420.14**	**Micro-degree erosion**

4.3.2 Current Status of Soil and Water Conservation

(1) Water and Soil Conservation Status of Gengma County

In recent years, Gengma county has sugar, tea and rubber as its main resources, under the context of industrial restructuring, Gengma is committed to establish better relationship between economic development and environmental protection, to build a green homeland where man and nature are developing in harmony. The Sustainable Development Strategy is being carefully implemented, water and soil conservation is being carry out with Nanting River watershed as the key planning area, the accumulated water and soil loss rehabilitation area is 256.53km2.

However in the meantime, it should be clearly noted that the project area is facing serious situations in water and soil conservation: serious water and soil loss, poor transportation, bad information access; inadequate participation from farmers and development and construction entities; severe water and soil loss caused by development and construction projects, relevant mitigation and rehabilitation measures are inadequate; difficulty in raising fund for prevention and rehabilitation of water and soil loss, limited inputs from central and local governments.

(2) Water and Soil Conservation Status of the Project Area

According to the site survey, there are no dedicated water and soil conservation measures in the project area, the project will occupy forest land and garden land, the existing and undisturbed forest land and garden is in good conditions of water and soil conservation.

The project area is located in Mengding Town, Gengma Dai and Wa Autonomous County, Lincang Municipality of Yunnan Province. According to the National Water and Soil Conservation Zoning for Key Prevention Areas and Key Rehabilitation Areas (No. 188, 2013, Ministry of Water Resources) and Yunnan Provincial Zoning for Key Prevention Areas and Key Rehabilitation Areas (No. 48, August, 2017, Yunnan Provincial Department of Water Resources), the project area is designated as national key areas of rehabilitation for water and soil loss in the southwest

watershed and alpine valley region, and provincial key areas for rehabilitation of water and soil loss.

(3) Water and Soil Conservation Experience of Similar Projects

According to the comparison and survey of similar projects in Gengma County, such as industrial factory building, real estate development, pipeline construction and river rehabilitation, the following issues are identified, which commonly exist during the construction: vegetation damage caused by land levelling during construction, resulting in degradation or loss of water and soil conservation function of the water and soil conservation facilities on the original earth surface. There is a lack of awarness in water and soil conservation during construction, such as dumping of spoils and materials, inadequate temporary protection measures, resulting in severe water and soil loss. Water and soil conservation experience has been drawn from previous lessons, looking at the commissioned similar projects, the lessons that can be drawn for this project include:

1. During the widening of river channels, the excavated earthwork should be temporarily stacked in order, with proper temporary retaining, blocking and cover measures in place;
2. Strengthen temporary drainage measures on the site during construction, temporary drainage, together with permanent drainage facilities and sediment basins/tanks can effectively prevent water and soil loss caused by surface runoff during strong rainfall;
3. Around the river are residential area and municipal roads, to avoid impact on the surrounding environment caused by the sand and mud carried by the wheels of construction machinery and trucks, management of the construction vehicles should be strengthened, such as cleaning of the vehicle wheels before exiting the construction site, to reduce water and soil loss caused by the construction vehicles.
4. Along the river are residential areas, color plate will be set up on both site of the pipelines under construction for retaining and blocking, to avoid impacts on the surrounding environment;

5. Arrange properly the construction sequence and construction methods, try to avoid earth excavation during rainy day. During sunny days, the sprinkler should be deployed to water the construction sites and roads to prevent dust;
6. Set up temporary earth bag cofferdam and temporary pumping and drainage facilities during construction;
7. Use machinery to clear the site, the dredged sediment, after drying, should be cleared through mechanical or manual methods, loaded to trucks for transportation.
8. Provide large quantities of landscape and greening facilities on both sides of the embankment.

FIG 4-1 long arm type mechanical cleaning Fig 4-2 Sludge Loading

Figure 4-3 Landscaping and Greening Measures at Riverbanks

Figure 4-4 Temporary cofferdam with earth bags Figure 4-5 Pipeline trench excavation construction plan

Figure 4-4 Temporary Cover of Backfill Figure 4-5 Vegetation Restoration for the Site of Pipelines

5 Analysis and Assessment on the Water and Soil Conservation Measures of the Project Design

5.1 Project Site Constraints in regard to water and soil conservation

According to the typographic conditions, resource and transport conditions, and the water and soil conservation requirements on project site selection set out in the Water and Soil Conservation Law of China, Water and Soil Conservation Regulation of Yunnan Province, and the Technical Specification for Water and Soil Conservation of Development and Construction Projects (GB 50433-2008), and No. 184 Document on Water and Soil Conservation (2007), the project construction doesn't present any constraints in terms of water and soil conservation.

5.3 Water and Soil Conservation Analysis and Assessment of the Recommended Project Design

5.3.1 Project Engineering Design and Layout Assessment

The project design developed reasonable engineering layout for all function areas in the project area which makes the layout compact and rational. In order to minimize earth excavation, the alignment is designed along the existing roads, where there will not be big excavations or deep fills; in addition, the project design includes large landscape style greening area at the water treatment plant, wastewater treatment plant, solid waste collection/transfer stations and charging piles, to increase filtration of the rain and reduce water loss in the project area.

In general, the overall layout of the project is favorable to earthwork receiving, without any big cut or fill, the overall layout is rational, which can meet the water and soil conservation function requirements; in addition, the project design includes greening measures which can effectively reduce water and soil loss in the project area.

River rehabilitation works will be conducted along the river strip, the engineering layout is circling the river channel, other associated facilities will be set up closely along the river or within the river with the river as the axis; the construction camp will use the residential houses nearby through lease, therefore there is no need to acquire additional land for camp construction; the construction materials will be temporarily stacked at the side of area where the wastewater interception pipeline will be laid; the project construction will minimize land acquisition and occupation, avoid temporary land occupation, to save land resources. The overall construction layout can maximize the utilization of limited land resource, with great importance attached to environmental protection and water and soil conservation, the water and soil conservation requirements are well complied with. The engineering layout is compact, and will avoid ecologically vulnerable areas and areas with good ecological works and water and soil conditions; the construction will be enclosed to avoid impact on the surrounding ecological environment. The engineering layout is rational, without any constraint to the engineering construction.

In conclusion, the engineering design and layout don't present any constraints.

5.3.2 Project Land Use Assessment

The project is located within the planning and development area of Qingshuihe Port Economic Zone. The project land occupation doesn't present constraints. According to the project design data and site survey, the project will occupy an area of 68.05hm2, including 16.99hm2 of forest land, 4.98hm2 of grass land, 6.03hm2 of construction land, 31.82hm2 of transport land, 2.72hm2 of slope cropland, and 5.51hm2 of water area and water conservancy facilities.

The project construction will not occupy any basic farmland, however the forest land, grassland and slope cropland to be occupied by the project have certain water and soil conservation functions, which will be damaged by the project construction. As the land to be occupied by the project construction has been included into the construction land use planning, which is in line with the planning requirements and is a necessity to urban development. Therefore, the project construction is reasonable

and feasible.

The land occupation of the project is 68.05hm2 in total, including 45.42hm2 of temporary land occupation, accounting for 66.75%; the occupation and damage to those land caused by project construction will generate large amount of water and soil loss. This plan requires the project design to optimize the construction plan, and require the construction contractor to minimize temporary land occupation during construction.

5.3.3 Earthwork Balance Analysis and Assessment

The project will generate earth excavation of 426482m3 in total, including 84900m3 from land leveling excavation, 125992m3 from foundation and trench excavation, 65910m3 from topsoil stripping; the project construction will generate backfill of 416684m3, including 60400m3 for land levelling backfill, 272821m3 for foundation and trench backfill, and 65910m3 for greening earthing. The stripped topsoil will be temporary stored at the planned earth stacking site for greening earthing. The project construction will generate spoil of 9798m3.

The excavated earth generated during construction will all be used for backfill, some spoil will be used for backfill in other projects in the area. The project will not establish any spoil dump site to reduce land occupation and disturbance. The earthwork balance of the project complies with the water and soil conservation requirements.

5.3.4 Analysis and Assessment of the (Rock and Materials) Borrowing Site

The earth (rock) materials that the project needs to borrow will be purchased from licensed (rock, material) borrow site. The water and soil conservation of the borrow site fall on the owner of the borrow site. The project will not separately set up borrow site to reduce unnecessary land occupation and protect water and soil.

5.3.5 Analysis and Assessment of Temporary Earth Stacking Site Arrangement

The project design includes 22.39hm2 of greening area. To address the earthing of greening, the design of this plan includes stripping of the topsoil within the site and temporary stacking for later use as earthing for greening, the total amount of topsoil stripped will be 65910m2 which will be gathered and stacked in centralized manner. It is planned to set up temporary stacking site at each of the zones, which will become greening area and parking lot after construction completion; in regard to construction sequence, it can be arranged at the end of the project construction. Such design will not only reduce temporary land occupation, but also avoid disturbance to project construction.

The temporary earth stacking site will be set up in each of the zones, which doesn't require additional land occupation; in the meantime, temporary measures will be designed for protection. These are in compliance with water and soil conservation requirements.

5.3.6 Analysis and evaluation on Construction Methods (Technique)

Provided that the safety and quality are ensured, the engineering excavation shall minimize the disturbance, avoid unnecessary excavation and excessive damage to original soil. The earth excavation shall avoid rainy season, temporary protection measures should be taken during construction.

The earth excavation shall mainly use small machinery and manual construction; building construction shall mainly use labor, simple excavation method allows better control of the earth excavation, reduce generation of surplus earthwork; land leveling shall maximize the use of machinery to reduce construction period; in the meantime, small-scale foundation excavation shall mainly use labor to reduce construction working face, and reduce disturbance to earth surface.

The above construction methods allows linkage among working sequence, it can meet the needs of construction schedule, ensure construction safety, reduce

repeated excavation and disturbance, ensure excavated materials can be transported to the backfill site, which contributes to water and soil conservation. The construction methods adopted by the project design are reasonable.

The design of the above construction methods can, to some extent, help the prevention and control of water and soil loss. Based on the analysis, the construction methods adopted for the project construction don't have any constraints in terms of impact, and it is deemed as feasible from the perspective of water and soil conservation.

5.3.7 Analysis and Assessment of the Measures with Water and Soil Conservation Functions in the Project Design

To address safety concerns, all kinds of protection measures are included in the design to meet the requirements of the project construction and to provide water and soil conservation. During the preparation of this plan, analysis and assessment on the protection measures adopted by the project design need to be conducted to evaluate the effectiveness of the protection measures, in order to improve the water and soil conservation system. In addition, this can further optimize the project design to avoid repeated design of measures.

(1) Topsoil Stripping

To increase the survival rate of seedlings for greening and improve the quality of greening works. According to the project design, the usable mellow soil layer within the site will be stripped at the beginning of construction, the stripped topsoil will be stacked along the line or the planned stacking site to be used for earthing of the vegetation restoration. According to the Technical Specification for Water and Soil Conservation of Development and Construction Projects (GB50433-2008): topsoil stripping and centralized storage before construction, and comprehensive utilization at later stage have the function of water and soil conservation.

Water and soil conservation assessment: the stripped topsoil will be stacked in a centralized manner, and will be used for earthing of the greening works in a later stage. Topsoil stripping can achieve reuse of the valuable topsoil and improve

survival of the seedlings.

(2) Storm Water Pipeline

Storm water pipeline will be laid along the roads. The ground rainwater will collected at the storm water grates and enter the storm water pipelines, then discharged into the storm water collection pond to be used for watering of the greening area, surplus storm water will be discharged into the municipal storm water pipeline through the storm water pipe of the plant area. The storm water inlets will be installed along the outdoor roads at an interval of 3m. Outdoor storm water pipe will adopt reinforced concrete pipe with rubber ring socket type connection, the pipe diameter is DN 300-600.

Water and soil conservation assessment: storm water pipeline can provide effective drainage for the storm water within the plant area, which demonstrates water and soil conservation function.

(3) Landscape Greening

Greening will be conducted where appropriate in the surroundings of the buildings and roads. The greening trees and grass species are local ornamental trees and grass with beautiful shapes, which normally are evergreen trees, shrubs and grass, for a better effect of landscape greening and dust prevention. The greening will improve the environment in the project area while prevent water and soil loss.

From water and soil conservation perspective, the greening provided by the project will not only provide greening and beautification, but also create a better and comfortable environment; meanwhile the trees and grass can conserve the water and soil.

(4) Vegetation Restoration

The project design includes vegetation restoration of the forest land and grass land occupied by the project along the alignment, this will help better the environment, reduce and prevent pollution, purify and improve air quality, and alternate ground temperature and air temperature, thereby improve the microclimate. The plant roots can stable the soil; the soil improvement made by leaves and ground cover plant can conserve the water, reduce and prevent storm water scouring, retain or reduce

surface runoff, avoid water and soil loss. Those features themselves are water and soil conservation measures.

(5) Greening

The riverbank greening on the both side of the embankment is included in the main design. stretches of suitable and ornamental aquatic plants will be planted in some river sections, such as Lythrum salicaria L., reed, Scripus Tabernaemontani and Typha orientialis Presl. The greening should highlight the ecological waterfront scenery for visitors to enjoy leisure, and provide science education. Create a colorful, richful, diversified riverside scenery.

5.3.8 Defining Water and Soil Conservation Measures

5.3.8.1 Defining principles

For the project design, the following principles are adopted to define water and soil conservation measures:

(1) Protective works with preventing water and soil loss as the main objective should be defined as water and soil conservation measure. Works mainly serve the project design, but also demonstrate water and soil conservation functions will not be included into the water and soil conservation system. For this, only analysis and assessment will be conducted.

(2) Land temporarily occupied during construction will be returned to the people and government after construction completion. The responsibility in water and soil loss prevention and rehabilitation will be transferred; this will be confirmed by water and soil conservation acceptance. All protection measures should be defined as water and soil conservation measures and included into the water and soil loss conservation system.

(3) For those protective measures that are difficult to distinguish design functions and water and soil conservation functions, exclusion can be made following the assumption: if without the protective measures, the main design function can still be effective, but large amount of water and soil loss will be

generated; then such protective measure should be defined as water and soil conservation measure and included into the water and soil conservation system.

5.3.8.2 Defining of Water Conservation Measures

Following the defining principle for water and soil conservation measures, the inclusion and exclusion of those functions of the project design into/from the water and soil conservation system are summarized in Table 5-5. .

Table 5-5: Defining of Soil and Water Conservation Measures in the Project Design

Project Zoning		Included into water and soil conservation measures	Excluded from water and soil conservation measures
Water Supply	Water intake area	/	/
	Raw water transmission	Topsoil stripping, Vegetation restoration	Retaining wall,water wells
	Water treatment	Topsoil stripping, storm water pipe network, landscape greening	Wastewater pipe network, enclosure walls, ground hardening, pit pumping
	Water distribution	Topsoil stripping, vegetation restoration	Water wells
	Temporary site for pipeline construction	Topsoil stripping, vegetation restoration	Color plate retaining/blocking
WWTP	WWTP	Topsoil stripping, storm water pipe network, landscape greening	Wastewater pipe network, enclosure walls, ground hardening , pit pumping
	Associated wastewater pipeline	/	Water wells
	Temporary site for pipeline construction	/	Color plate retaining/blocking
Solid Waste Management	Buildings and Structures	Topsoil stripping	/
	Roads and hardened zone	Topsoil stripping, Storm water pipeline	Wastewater pipe network, ground hardening
	Greening areas	Topsoil stripping, landscape greening	Enclosure wall
River Rehabilitation	Flood Control	/	Cofferdam construction,drainage measures
	Wastewater Interception	Topsoil stripping, vegetation restoration	Color plate retaining/blocking,water wells
	Ecological rehabilitation	Topsoil stripping, Landscaping	Color plate retaining/blocking

Urban public transport infrastructure	Buildings and Structures	Topsoil stripping	/
	Roads and hardened areas	Topsoil stripping, storm water pipeline	Wastewater pipe network, ground hardening
	Greening areas	Topsoil stripping, landscape greening	Enclosure wall

5.3.8.3 With Water and Soil Conservation Functions but not included in the Cost of Water and Soil Conservation

For those protection measures in the project design in consideration of the operation safety focus on the protection of the main works, but also provide water and soil conservation functions, the plan only assess the water and soil conservation function, and will not include those measures into the water and soil conservation measures system or into the water and soil conservation investment.

Measures that mainly serve for the project main works while provide water and soil conservation functions include: wastewater pipeline, retaining wall, hardened ground, water well, pit pumping/drainage, color plate retaining/blocking, enclosure wall, construction cofferdam, and pumping and drainage measures.

(1) Wastewater Pipeline Network

The drainage system in the project area will adopt separation of storm water and wastewater. Domestic wastewater will be discharged into the reclaimed water station for treatment through inspection well from the indoor drainage pipeline, the reclaimed water from the station will be conveyed to the area for greening, road watering, the remaining will be discharged into the municipal wastewater pipeline through the main wastewater pipeline by gravity flow. Wastewater pipeline will adopt reinforced concrete drainage pipeline, laid underground, which are important supporting facilities of the main works. Such measures will not be included into the water and soil conservation investment of this plan.

(2) Hardened Ground

In addition to the road pavement and building &structures, the project design also includes hardening of the surrounding field and small squares, after hardening, water and soil loss can be controlled, however these are part of the project works, therefore not included into the water and soil conservation investment.

(3) Retaining wall

According to the project design data, in order to maintain the stability of the slopes

on the site, masonry retaining wall will be constructed at the foot of the slope generated from excavation. The retaining wall will adopt cantilevered structure and trapezoidal cross-section, the wall height varies from 2.0 to 6.0m.

From water and soil conservation perspective, inclusion of masonry retaining wall in the project design is to stabilize the slopes, ensure safety and smooth construction. Construction of retaining wall will retain and block the earthwork during construction, avoid impact on the surrounding environment. The retaining walls have certain water and soil conservation functions, but they are key works of the project facility construction to meet construction specification and safety requirements. Therefore it's not included in the water and soil conservation investment.

(4) Water (accumulation) well

According to the project design, to avoid impacts from rainfall during trench excavation and pipe laying, the project design includes water wells at the lowest point of the trench to collect water flow in the trench, the water will be drained by pumping. This measure has some water and soil conservation function, but it mainly serves the main works, therefore this plan didn't include it into the water and soil conservation measures system.

(5) Foundation pit drainage by pumping

According to the project design data, the plant area will have multiple underground buildings and structures. During foundation pit excavation, drainage will be conducted through pumping.

From water and soil conservation perspective, the inclusion of pumping drainage in the project design is to ensure safety and smooth construction. This measure has certain water and soil conservation function, but it is key part of the main works to meet construction specification and safety requirements, therefore it is not included into the water and soil conservation investment.

(6) Color plate retaining and blocking

According to the project design, the main works include color plate retaining and blocking during construction of pipelines, to avoid impact on the surrounding environment during excavation and backfill, the color plate retaining and blocking

can protect the water and soil from loss, but this measure mainly serves for the main works, therefore it is not included into the water and soil conservation measures.

(7) Construction cofferdam

According to the project design, the river rehabilitation will have construction cofferdam to separate the construction site with the upstream water, through pumping and drainage measures, the water will be drained to the downstream of the section under construction. This allows easy construction and avoid additional water and soil loss as the flowing water will scour the sediment. This measure can ensure construction safety and provide certain water and soil conservation function, but this measure mainly serves for the main works, therefore this plan didn't include it into the water and soil conservation measures system.

5.3.8.4 With Water and Soil Conservation Functions and included into the Cost of Water and Soil Conservation

The measures provided by the project design and included into this plan include storm water pipeline and gas planting tiles for roads and hardened areas, and greening measures at the greening area, in which the project design developed detailed design for the storm water pipeline, and requirement for greening. According to site survey and analysis, the measures listed in the project design can meet the requirements of water and soil loss prevention and rehabilitation after the project is completed.

(1) Top Soil Stripping

To increase the survival rate of seedlings for greening and improve the quality of greening works. According to the project design, the usable mellow soil layer within the site will be stripped at the beginning of construction, the stripped topsoil will be stacked along the line or the planned stacking site to be used for earthing of the vegetation restoration. The project will strip 60690m3 of topsoil, including 35640m3 from water supply component, 7440m3 from wastewater treatment component, 1200m3 from solid waste management component, 16410m3 from river

rehabilitation component, and 5220m3 from public transport infrastructure component.

(2) Storm Water Pipeline

Storm water pipeline will be laid along the roads. The ground rainwater will collected at the storm water grates and enter the storm water pipelines, then discharged into the storm water collection pond to be used for watering of the greening area, surplus storm water will be discharged into the municipal storm water pipeline through the storm water pipe of the plant area. The storm water inlets will be installed along the outdoor roads at an interval of 3m. Outdoor storm water pipe will adopt reinforced concrete pipe with rubber ring socket type connection, the pipe diameter is DN 300-600. A total of 3706m storm water pipeline will be installed, including 550m for water supply component, 780m for wastewater treatment component, 376m for solid waste management component, 2000m for urban public transport infrastructure component. From water and soil conservation perspective, storm water pipeline can guide the storm water and reduce scouring on the project area, therefore storm water pipeline has certain water and soil conservation function.

(3) Landscape greening

Landscape greening will be provided around the buildings, with a variety of tree species. Total greening area is 3.76hm2, including 1.50hm2 for water supply component, 1.36hm2 for wastewater treatment component, 0.18hm2 for solid waste management component, 0.72hm2 for urban public transport infrastructure.

From water and soil conservation perspective, the greening provided by the project will not only provide greening and beautification, but also create a better and comfortable environment; meanwhile the trees and grass can conserve the water and soil.

(4)Vegetation Restoration

The project design includes restoration of the forest land and grass land occupied by the project. Total vegetation restoration area is 10.40hm2, including 9.48hm2 for water supply component, 0.92hm2 for river rehabilitation component.

(5)Landscaping

The project design includes embankment landscaping, total area for landscaping is 8.23hm2.

(6) Bill of quantities and investment for those measures (included in the project design) with water and soil conservation functions

This includes 60690m3 of topsoil stripping, 3706m of storm water pipeline, 3.76hm2 of landscape greening, 10.40hm2 of vegetation restoration, 8.23hm2 of landscaping; total investment is 3.8252 million yuan, details are provided in Table 5-6 and 5-7.

Table 5-6: Engineering Measures included in the Project Design with Water and Soil Conservation Functions and Investment

No.	Project Zoning		Engineering measures									
			Measure	unit	Quantity	Unit price CNY yuan	Subtotal CNY 10,000	Measure	unit	Quantity	Unit price CNY yuan	Subtotal CNY 10,000
1	Water Supply	Raw water transmission	Topsoil stripping	m3	10260	14.64	15.02	Storm water pipeline	m	/	110	/
		Water treatment plant			7200		10.54			550		6.05
		Water distribution network			1260		1.84			/		/
		Temporary site of pipeline construction			16920		24.77			/		/
Subtotal					**35640**		**52.18**			**550**		**6.05**
2	Wastewater Treatment Plant and Associated Works	Wastewater Treatment Plant			7440		10.89			780		8.58
Subtotal					**7440**		**10.89**			**780**		**8.58**
3	Solid waste management	Buildings and Structures			150		0.22			/		/
		Roads and hardened areas			510		0.75			376		4.14
		Greening areas			540		0.79			/		/
Subtotal					**1200**		**1.76**			**376**		**4.14**
4	Qingshui River Rehabilitation	Wastewater Interception			2760		4.04			/		/
		Ecological rehabilitation			13650		19.98			/		/
	Subtotal				**16410**		**24.02**			/		/
5	Urban public transport infrastructure	Buildings and Structures			780		1.14			/		/
		Roads and hardened areas			3420		5.01			2000		22.00

		Greening areas			1020		1.49			/		/
	Subtotal				**5220**		**7.64**			**2000**		**22.00**
Total					**65910**	**/**	**96.49**			**3706**		**40.77**

Table 5-7: Vegetation Measures included in the Project Design with Water and Soil Conservation Functions and Investment

No.	Project zoning		Vegetation measures	Unit	Quantity	Unit price CNY yuan	Subtotal CNY 10,000
1	Water Supply	Water treatment	Landscape greening	hm²	1.50	120,000.00	18.00
2	Wastewater Treatment Plant and Associated Works	Wastewater Treatment Plant			1.36		16.32
3	Solid waste management	Greening areas			0.18		2.16
4	Urban public transport infrastructure	Greening areas			0.72		8.64
Subtotal					**3.76**	**/**	**45.12**
5	Water Supply	Raw water transmission	Vegetation restoration	hm²	3.42	50000.00	17.10
6		Water distribution network			0.42		2.10
7		Temporary site of pipeline construction			5.64		28.20
8	Qingshui River Rehabilitation	Wastewater interception			0.92		4.60
Subtotal					**10.40**	**/**	**52.00**
9	Qingshui River Rehabilitation	Ecological rehabilitation	Landscaping	hm²	8.23	180,000.00	148.14
Subtotal					**8.23**	**/**	**148.14**

Total	**22.39**	**/**	**245.26**

Water and soil loss from engineering construction is inevitable. The project construction will cause disturbance to large area of earth surface, it requires large amount of earth excavation, the water and soil loss will be caused. But scientific design and arrangement of water and soil conservation measures can reduce water and soil loss and impact on surrounding environment during project construction.

According to site survey and analysis, the water and soil loss will mainly occur during construction. The water and soil loss prevention measures provided by the project design are inadequate to meet the requirements in the Water and Soil Conservation Standards for Development and Construction Projects. This plan will supplement water and soil conservation measures in each of the zones based on the water and soil loss characteristics of each engineering unit to develop a complete prevention and rehabilitation measures system. After carry out the measures in the project design and water and soil conservation plan, the water and soil loss caused by construction will not pose constraint to engineering construction. However, the construction layout and process should be further optimized during detailed design, to reduce earth surface disturbance. Ecological environmental protection shall be carried out throughout project construction.

5.3.9 Special Requirements of Different Types of Water and Soil Loss Areas and Different Type of Projects

5.3.9.1 Water and Soil Conservation Assessment for Different Types of Water and Soil Loss Areas

According to the Water and Soil Conservation Specification for Development and Construction Project (GB50433-2008), the project in the southwest earth-rock mountainous region shall comply with the following requirements: 1. Proper topsoil stripping and utilization, restore farmland or vegetation; 2. Spoil (earth, rock) site selection, stacking and protection should avoid landslide and mudslide; 3. Construction site and upper part of the spoil site shall set up interception and drainage, protection standard can be increased as appropriate based on actual situations. The project will strip the topsoil as needed, and use it for vegetation

restoration; excavated earthwork from the project will all be used for backfill within the Qingshuihe Port Economic Zone, no spoil will be generated; construction site will be within the project area, without occupying additional land, those are in compliance with the requirements of the Water and Soil Conservation Specification for Development and Construction Project.

5.3.9.2 Water and Soil Conservation Assessment on Special Requirements of Different Types of Projects

The project is new construction project, according to the requirements of the Water and Soil Conservation Specification for Development and Construction Project (GB50433-2008), when excavating steep slopes, retaining/blocking and drainage facilities shall be set up in advance at the lower part of the slope, with interception ditch at the upper part of the slope; Construction spoil shall be stacked after sorting in a centralized manner. For the project site, excavation will be carry out for the upper part, backfill for the lower part, and cut even at the high point, no steep slopes will be generated, which are in compliance with relevant requirements. Special requirements of different water and soil loss areas and different types of projects are summarized in Table 5-8.

Table 5-8: Special requirements of different water and soil loss areas and different types of projects

No.	Special requirements of different water and soil loss areas and different types of projects	This Project	Compliance
1	spoil shall be stacked after sorting in a centralized manner	The project will not generate spoil, the excavated earth will be utilized	Yes
2	For key water-control and hydropower station project, the spoil site selection shall be at the downstream of the dam or outside of the backwater area of the reservoir	This project is not key water-control or hydropower station project	Yes
3	Protection standard shall be increased for project development in urban area (including its planning area), development zone and industrial park	The project is not developed in those prescribed areas	Yes
4	Construction diversion should not be use	This project will not adopt	Yes

	self-crushing cofferdam	self-crushing cofferdam	

5.4 Conclusions

According to the project design: 1. Looking at the project location and surrounding ecological environment, the project site is not located within sensitive areas defined by the country, which is in compliance with the water and soil conservation requirements on project site selection set out in the Water and Soil Conservation Law of China, Water and Soil Conservation Regulation of Yunnan Province, and the Technical Specification for Water and Soil Conservation of Development and Construction Projects (GB 50433-2008), and No. 184 Document on Water and Soil Conservation (2007), the project construction doesn't present any constraints in terms of water and soil conservation; 2. the project engineering layout is rational, the construction organization design is feasible, the project construction doesn't require occupation of productive land including paddy field and irrigable land, the excavated earth during construction will be reasonable utilized to avoid generation of spoil, which are in line with water and soil conservation requirements; 3. Based on assessment on the water and soil conservation measures provided by the project design: the project design already incorporated water and soil conservation measures, which provides the functions of reducing scouring from runoff and conservation of water and soil, the prevention and protection measures in different zones/engineering areas are all in compliance with water and soil conservation requirements. Based on the actual situations of engineering construction, this plan provide supplement to the project design for prevention and rehabilitation of water and soil loss, including engineering measures, vegetation measures and temporary measures, to develop a complete water and soil protection system. The water and soil loss will occur mainly during the construction period of the project, therefore the water and soil conservation measures in this plan focus on temporary measures during construction period, the design and implementation of temporary measures can effectively control and rehabilitate the water and soil loss during construction period.

To sum up, according to the characteristics of the water and soil loss newly generated during project construction and operation, based on the assessment of the water and soil conservation functions provided by the project design, and taking into account of the prevention and protection in different engineering areas, an ecological rehabilitation system which integrates engineering measures, vegetation measures and temporary measures will be established to minimize water and soil loss. The construction contractor shall implement the measures in strict accordance with the requirements of this plan, the project design doesn't present any constraints in terms of water and soil conservation, it is feasible and reasonable. The water and soil conservation priority of this project is to carry out proper temporary protection measures during project construction to prevent and rehabilitate the water and soil loss during construction, develop detailed design for those measures design in this plan during the stage of detailed design (construction drawings), construction activities shall complete within the project boundary lines to avoid impact on the surroundings, conduct regular checks on the water and soil conservation facilities during natural recovery, and strengthen the nurturing and maintenance of the greening.

7 Soil Erosion Estimate

7.1 Estimate of Earth Surface Disturbance and Damage to Water and Soil Conservation Facilities

7.1.1 Estimate of Earth Surface Disturbance

According to project land occupation, the project will occupy a land area of 68.05hm2, the types of land that will be disturbed include forest land, grass land, construction land, transport land, slope cropland, and water area and water conservancy facilities, including 16.99hm2 of forest land, 4.98hm2 of grass land, 6.03hm2 of construction land, 31.82hm2 of transport land, 2.72hm2 of slope cropland, and 5.51hm2 of water area and water conservancy facilities.

Table 7-1 Statistics of Disturbed Surface Area Unit: hm^2

No.	Estimate zoning		Disturbed Surface type and area						
			Forestland	Grassland	Construction land	Transport land	Slope cropland	Water areas and facilities	Subtotal
1	Water Supply	Water intake						0.04	0.04
		Raw water transmission	3.42			2.68	1.58		7.68
		Water treatment	2.40						2.40
		Water distribution network	0.42		0.24	3.62			4.28
		Temporary site of pipeline construction	4.36	1.28	1.21	16.32			23.17
		Subtotal	10.6	1.28	1.45	22.62	1.58	0.04	**37.57**
2	Wastewater treatment plant and associated works	Wastewater Treatment Plant	2.48						2.48
		Wastewater pipeline network				2.63			2.63
		Temporary site of pipeline construction			1.48	4.18			5.66
		Subtotal	2.48		1.48	6.81			**10.77**
3	Solid waste Management	Buildings and Structures	0.05		0.04				0.09
		Roads and hardened areas	0.17						0.17
		Greening areas	0.18						0.18
		Subtotal	0.4		0.04				**0.44**
4	Qingshuihe River Rehabilitation	Flood Control						2.44	2.44
		Wastewater Interception	0.66	0.26		0.84		0.24	2.00
		Ecological rehabilitation	2.15	2.40		0.89		2.79	8.23
		Subtotal	2.81	2.66		1.73		5.47	**12.67**
5	Urban public transport infrastructure	Buildings and Structures	0.26		0.50	0.15	0.36		1.27
		Roads and hardened area	0.22	0.92	2.30	0.43	0.74		4.61
		Greening areas	0.22	0.12	0.26	0.08	0.04		0.72
		Subtotal	0.70	1.04	3.06	0.66	1.14		**6.60**
Total			**16.99**	**4.98**	**6.03**	**31.82**	**2.72**	**5.51**	**68.05**

7.1.2 Estimate of Damage to Water and Soil Conservation Facilities

According to site survey, there are no dedicated water and soil conservation facilities in the project area. The forest land and grass land to be occupied by the project will be accounted into the area of damaged water and soil conservation facilities. The damaged water and soil conservation facilities is 21.97hm2 in total, details are provided in Table 7-2.

Table 7-2 Damage to Water and Soil Conservation Facilities and Area Unit: hm2

Estimate Zoning		Area (hm2)	Area of damage to soil and water conservation facilities (hm2)		
			Forest land	Grass land	Subtotal
Water Supply	Water intake	0.04	/	/	/
	Raw water transmission	7.68	3.42	/	3.42
	Water treatment	2.40	2.40	/	2.4
	Water distribution network	4.28	0.42	/	0.42
	Temporary site of pipeline construction	23.17	4.36	1.28	5.64
	Subtotal	**37.57**	**10.6**	**1.28**	**11.88**
Wastewater treatment plant and associated works	Wastewater Treatment Plant	2.48	2.48	/	2.48
	Wastewater pipeline network	2.63	/	/	/
	Temporary site of pipeline construction	5.66	/	/	/
	Subtotal	**10.77**	**2.48**	/	**2.48**
Solid waste Management	Buildings and Structures	0.09	0.05	/	/
	Roads and hardened areas	0.17	0.17	/	0.17
	Greening areas	0.18	0.18	/	0.18
	Subtotal	**0.44**	**0.4**	/	**0.4**
Qingshuihe River Rehabilitation	Flood Control	2.44	/	/	/
	Wastewater Interception	2.00	0.66	0.26	0.92
	Ecological	8.23	2.15	2.40	4.55

	rehabilitation				
	Subtotal	**12.67**	**2.81**	**2.66**	**5.47**
Urban public transport infrastructure	Buildings and Structures	1.27	0.26	/	0.26
	Roads and hardened area	4.61	0.22	0.92	1.14
	Greening areas	0.72	0.22	0.12	0.34
	Subtotal	**6.60**	**0.70**	**1.04**	**1.74**
Total		**68.05**	**16.99**	**4.98**	**21.97**

7.2 Estimate of Spoil

The project will generate earth excavation of 426482m3 in total, including 84900m3 from land leveling excavation, 125992m3 from foundation and trench excavation, 65910m3 from topsoil stripping; the project construction will generate backfill of 416684m3, including 60400m3 for land levelling backfill, 272821m3 for foundation and trench backfill, and 65910m3 for greening earthing. The stripped topsoil will be temporary stored at the planned earth stacking site for greening earthing. The project construction will generate spoil of 9798m3.

7.3 Estimate of Water and Soil Loss

7.3.1 Estimate Scope

The water and soil loss estimate scope is the project construction area within the water and soil loss prevention and rehabilitation area, i.e. 68.05hm^2, including 37.57hm2 for water supply component, 10.77hm2 for wastewater treatment plant and associated facilities, 0.44hm2 for solid waste management, 12.67hm2 for Qingshui River rehabilitation, 6.60hm2 for urban public transport infrastructure.

7.3.2 Zoning

The estimate is conducted based on the water and soil conservation zoning, i.e. the area is firstly divided by project components into Class I monitoring zones: water supply, wastewater treatment plant and associated facilities, solid waste management, Qingshui River rehabilitation, urban public transport infrastructure. Then those are each divided into subzones, i.e. water supply is divided into water

intake, raw water transmission, water treatment, water distribution, temporary site for pipeline construction; wastewater treatment plant and associated works are divided into WWTP, wastewater pipeline network, temporary site for pipeline construction; solid waste management is divided into buildings and structures, roads and hardened areas, and greening area; Qingshui River rehabilitation is divided into flood control, wastewater interception and ecological rehabilitation; urban public transport infrastructure is divided into buildings and structures, roads and hardened areas, and greening area. The estimate zoning and areas are listed in Table 7-3.

Table 7-3: Estimate Zoning

No.	Zoning	
1	Water supply	Water intake
		Raw water transmission
		Water treatment
		Water distribution network
		Temporary site of pipeline construction
2	Wastewater treatment plant and associated works	Wastewater Treatment Plant
		Wastewater pipeline network
		Temporary site of pipeline construction
3	Solid waste management	Buildings and Structures
		Roads and hardened areas
		Greening areas
4	Qingshuihe River Rehabilitation	Flood Control
		Wastewater Interception
		Ecological rehabilitation
5	Urban public transport infrastructure	Buildings and Structures
		Roads and hardened area
		Greening areas

7.3.3 Period for Estimation

The water and soil loss estimate starts from construction commencement to design level year, including construction period and natural recovery period. During construction period, the excavation, backfill and construction activities will alter the original landscape, cause earth surface exposure, damage the soil structure, and cause large amount of water and soil loss; during natural recovery period, with the

water and soil conservation measures coming into function and gradual recovery of vegetation, the water and soil loss can be put under control. The estimation period will take into account of the worst case scenario, if it goes beyond the rainy season, it will be calculated by year, otherwise it will be calculated by percentage to the duration of rainy season.

(1) construction period

The project construction period is from April 2018 to December 2020, by components, water supply is from October 2018 to April 2019, the estimation period during construction is 0.58 year; WWTP is from November 2018 to December 2019, the estimation period during construction is 1.17years; solid waste management is from August 2018 to December 2020, the estimation period during construction is 2.42 years; Qingshui River rehabilitation is from December 2018 to December 2020, the estimation period during construction is 2.08 years; urban public transport infrastructure is from April 2018 to January 2019, the estimation period during construction is 0.83 year.

(2) natural recovery period

After construction completion, the greening measures after implementation will enter natural recovery period, according to experience from similar projects and local average precipitation, the recovery period will be 1.0 year, i.e. May 2019 to April 2020 for water supply; January 2020 to December 2020 for wastewater treatment plant and associated works; January 2021 to December 2021 for solid waste management; January 2021 to December 2021 for Qingshui River rehabilitation; and February 2019 to February 2020 for urban public transport infrastructure. The water and soil loss estimation period is detailed in Table 7-4.

Table 7-4 Period for Water and Soil Loss Estimate

No.	Estimation Zoning		Estimation period		
			Construction Period	Natural recovery	Subtotal
1	Water supply	Water intake	0.58	/	0.58
		Raw water transmission	0.58	1.00	1.58
		Water treatment	0.58	1.00	1.58

		Water distribution network	0.58	1.00	1.58
		Temporary site of pipeline construction	0.58	1.00	1.58
2	Wastewater treatment plant and associated works	Wastewater Treatment Plant	1.17	1.00	2.17
		Wastewater pipeline network	1.17	/	1.17
		Temporary site of pipeline construction	1.17	/	1.17
3	Solid waste management	Buildings and Structures	2.42	/	2.42
		Roads and hardened areas	2.42	/	2.42
		Greening areas	2.42	1.00	3.42
4	Qingshuihe River Rehabilitation	Flood Control	2.08	/	2.08
		Wastewater Interception	2.08	1.00	3.08
		Ecological rehabilitation	2.08	1.00	3.08
5	Urban public transport infrastructure	Buildings and Structures	0.83	/	0.83
		Roads and hardened area	0.83	/	0.83
		Greening areas	0.83	1.00	1.83

7.3.4 Area of Estimation Zones

Disturbance will be caused in all project area during construction period, therefore the estimation area is the land occupation area of the project; after construction completion, the greening works will be completed and enter into natural recovery period. The project will occupy an area of 68.05hm2, where disturbance will occur during construction, therefore the water and soil loss area during construction will be 68.05hm2; during natural recovery period, the water and soil loss area is the landscape greening, vegetation restoration and landscaping in the greening area, 1.26hm2. Estimation areas and estimation period are detailed in Table 7-5.

Table 7-5 Estimation areas and estimation period

No.	**A prediction unit (partition)**		**Forecast area**	
			Construction Period	**Natural recovery**
1	Water Supply	Water intake	0.04	/
		Raw water transmission	7.68	3.42
		Water treatment	2.40	1.50
		Water distribution network	4.28	0.42

		Temporary site of pipeline construction	23.17	5.64
		Subtotal	**37.57**	**10.98**
2	Wastewater treatment plant and associated works	Wastewater Treatment Plant	2.48	1.36
		Wastewater pipeline network	2.63	/
		Temporary site of pipeline construction	5.66	/
		Subtotal	**10.77**	**1.36**
3	Solid waste Management	Buildings and Structures	0.09	/
		Roads and hardened areas	0.17	/
		Greening areas	0.18	0.18
		Subtotal	**0.44**	**0.18**
4	Qingshuihe River Rehabilitation	Flood Control	2.44	/
		Wastewater Interception	2.00	0.92
		Ecological rehabilitation	8.23	8.23
		Subtotal	**12.67**	**9.15**
5	Urban public transport infrastructure	Buildings and Structures	1.27	/
		Roads and hardened area	4.61	/
		Greening areas	0.72	0.72
		Subtotal	**6.60**	**0.72**
Total			**68.05**	**22.39**

7.3.5 Prediction Methods

The original water and soil loss and disturbed earth surface loss are estimated according to soil erosion theory and erosion modulus method, the spoil loss is estimated using loss coefficient method, then derive the new water and soil loss generated.

(1) Original soil erosion estimate

Original soil erosion estimate is calculated using soil erosion modulus method:

$$W_i = \sum_{i}^{n} (M_i \times F_i \times T_i)$$ (Formula 7-1)

Wherein: Wi -----amount of original water and soil loss-, t;

i-- different land use types;

Mi-- original landform soil erosion modulus, t/km^2·a;

Fi—area of different geomorphic unit, km^2;

Ti—water and soil loss estimation period, year (a).

(2) Estimate of water and soil loss on disturbed earth surface

The estimation method is the same as that for the estimation of original water and soil loss, i.e. soil erosion modulus method.

$$W_{扰} = \sum_{i=1}^{n} \sum_{j=1}^{3} (M_{ji} \times F_{ji} \times T_{ji}) \quad \text{(Formula 7-2)}$$

Wherein: $W_{disturb}$- water and soil loss on disturbed earth surface, t;

Fji—estimation area of certain period at certain unit, km^2;

Mji—soil erosion modulus at certain period and certain unit , $t/km^2 \cdot a$;

Tji—estimation time at certain period and certain unit, a;

i-- estimate unit, i = 1,2,3, n;

j-- estimate period, j = 1,2,3, it refers to the construction period and natural recovery period.

(3) possible new water and soil loss

Additional Soil Erosion may be caused by the project is calculated as follows:

$W_{new} = W_{spoil} + W_{disturb} - W_{original}$ (Formula 7-3)

Wherein: W_{New} --- additional soil erosion from project construction, t;

W_{spoil} -construction spoil loss, t;

$W_{disturb}$ -water and soil loss on disturbed earth surface, t;

$W_{original}$ -original water and soil loss, t.

During calculation, relevant survey data and natural conditions in the project area will be taken into account for identifying relevant calculation factors.

(4) Topsoil loss: adopt loss coefficient method.

7.3.6 Original Soil Erosion Modulus

Original soil erosion modulus is identified according to the current water and soil loss and conservation mentioned in section 4.3.1, the original soil erosion modulus is shown in Table 7-6.

Table 7-6: Original Soil Erosion Modulus

Estimate Zoning		Total land area (hm2)	Original earth surface composition and area		Soil erosion modulus (t / km2·a)	Average soil erosion modulus (t / km2 · a)	Remarks
			Current composition	Area (hm2)			
Water supply Qingshuihe River Rehabilitation	Water intake	0.04	Water areas and water conservancy facilities	0.04	200	200.00	Micro-degree erosion
	Raw water transmission	7.68	Forest land	3.42	300	866.67	Mild erosion
			Transport land	2.68	450		
			Slope cropland	1.58	2800		
	Water treatment plant	2.40	Forestland	2.40	300	300.00	Micro-degree erosion
	Water Distribution Network	4.28	forestland	0.42	300	415.65	Micro-degree erosion
			Construction land	0.24	100		
			Transport land	3.62	450		
	Temporary site of pipeline construction	23.17	Forest land	4.36	300	400.73	Micro-degree erosion
			Grass land	1.28	400		
			Construction land	1.21	100		
			Transport land	16.32	450		
Wastewater treatment plant and associated works	Wastewater treatment plant	2.48	Forest land	2.48	300	300.00	Micro-degree erosion
	Associated pipeline network	2.63	Transport land	2.63	450	450.00	Micro-degree erosion
	Temporary site of pipeline construction	5.66	Construction land	1.48	100	358.48	Micro-degree erosion
			Transport land	4.18	450		
Solid waste	Buildings and Structures	0.09	Forest land	0.05	300	211.11	Micro-degree erosion
			Construction land	0.04	100		

management	Roads and hardened area	0.17	Forest land	0.17	300	300.00	Micro-degree erosion
	Greening area	0.18	Forest land	0.18	300	300.00	Micro-degree erosion
Qingshuihe River Rehabilitation	Flood control	2.44	Water areas and water conservancy facilities land	2.44	200	300.00	Micro-degree erosion
	Wastewater Interception	2.00	Forest land	0.66	300	364.00	Micro-degree erosion
			Grass land	0.26	400		
			Transport land	0.84	450		
			Water areas and water conservancy facilities land	0.24	200		
	Ecological rehabilitation	8.23	Forest land	2.15	300	311.48	Micro-degree erosion
			Grass land	2.40	400		
			Transport land	0.89	450		
			Water areas and water conservancy facilities	2.79	200		
Urban transport infrastructure	Buildings and Structures	1.27	Forest land	0.26	300	947.64	Mild erosion
			Construction land	0.50	100		
			Transport land	0.15	450		
			Slope cropland	0.36	2800		
	Roads and hardened area	4.61	Forest land	0.22	300	605.53	Mild erosion
			Grass land	0.92	400		
			Construction land	2.30	100		
			Transport land	0.43	450		
			Slope cropland	0.74	2800		

	Greening area	0.72	Forest land	0.22	300	400.00	Mild erosion
			Grass land	0.12	400		
			Construction land	0.26	100		
			Transport land	0.08	450		
			Slope cropland	0.04	2800		
Total		**68.05**		**68.05**		**420.14**	**Micro-degree erosion**

7.3.7 Erosion Modulus of the Soil after Disturbance

(1) Construction period

During construction, land leveling, foundation excavation, buildings and structures, roads, greening will be carry out, which will greatly disturb the earth surface, the earth excavation is large, the erosion modulus of the soil after disturbance is 6500t/km2·a; pipeline foundation excavation will be conducted during construction, which will cause disturbance, the earth excavation is large, the erosion modulus of the soil after disturbance is 6000t/km2·a; river foundation excavation, embankment construction, river dredging and cofferdam will be carry out, which will cause disturbance, the earth excavation is large, the erosion modulus of the soil after disturbance is 4000t/km2·a, details are provided in Table 7-7.

(2) Natural recovery

After construction completion, the greening works will be completed and enter into natural recovery period, the buildings and structures area will be covered by structures and buildings, no water and soil loss will be generated; roads will be hardened, no water and soil loss will be generated, therefore, during natural recovery period, water and soil loss will only occur at the greening area. The greening area will adopt high level garden greening, soil erosion modulus is 6000t/km^2·a; during natural recovery period, the river rehabilitation area will be covered by embankment and water, the water and soil loss in those areas is insignificant. The vegetation will be developing slowly at the pipeline area where the vegetation will be restored, but the greening standard is high, the soil erosion modulus is 600 t/km^2·a. Details are provided in Table 7-7.

Table 7-7 Soil Erosion Modulus after Disturbance

No.	Zoning		Soil erosion modulus after disturbance	
			Construction Period	Natural recovery Period
1	Water supply	Water intake	6500	/
		Raw water transmission	6000	600
		Water treatment	6500	600
		Water distribution network	6000	600
		Temporary site of pipeline construction	6000	600
2	Wastewater treatment plant and associated works	Wastewater Treatment Plant	6500	600
		Wastewater pipeline network	6000	/
		Temporary site of pipeline construction	6000	/
3	Solid waste management	Buildings and Structures	6500	/
		Roads and hardened areas	6500	/
		Greening areas	6500	600
4	Qingshuihe River Rehabilitation	Flood Control	4000	/
		Wastewater Interception	6000	600
		Ecological rehabilitation	6000	600
5	Urban public transport infrastructure	Buildings and Structures	6500	/
		Roads and hardened area	6500	/
		Greening areas	6500	600

7.3.8 Estimate of soil loss may be caused

The project will cause soil loss of 4124.41t, including original soil loss of 370.50t and new soil loss of 3753.91t.

(1) Estimate of original water and soil loss

According to the predictions of water and soil loss area, water and soil loss periods and soil erosion modulus calculations, the original water and soil loss in the project area is 370.50t, details are provided in Table 7-8.

Table 7-8: Original Soil Erosion

Zoning		Estimate of Original Water and Soil Loss								
		Construction period				Natural recovery period				Total Loss (t)
		Disturbed area (hm2)	Estimate period (a)	Original soil erosion modulus (t / km2.a)	Loss (t)	Disturbed area (hm2)	Estimate period (a)	Original soil erosion modulus (t / km2.a)	Loss (t)	
Water Supply	Water intake	0.04	0.58	200.00	0.05					0.05
	Raw water transmission	7.68	0.58	866.67	38.60	3.42	1	866.67	29.64	68.25
	Water treatment	2.40	0.58	300.00	4.18	1.50	1	300.00	4.50	8.68
	Water distribution network	4.28	0.58	415.65	10.32	0.42	1	415.65	1.75	12.06
	Temporary site of pipeline construction	23.17	0.58	400.73	53.85	5.64	1	400.73	22.60	76.45
	Subtotal	**37.57**			**107.00**	**10.98**			**58.49**	**165.48**
Wastewater treatment plant and associated works	Wastewater Treatment Plant	2.48	1.17	300.00	8.70	1.36	1	300.00	4.08	12.78
	Wastewater pipeline network	2.63	1.17	450.00	13.85					13.85
	Temporary site of pipeline construction	5.66	1.17	358.48	23.74					23.74
	Subtotal	**10.77**			**46.29**	**1.36**			**4.08**	**5.44**
Solid waste Management	Buildings and Structures	0.09	2.42	211.11	0.46					0.46
	Roads and hardened areas	0.17	2.42	300.00	1.23					1.23
	Greening areas	0.18	2.42	300.00	1.31	0.18	1	300.00	0.54	1.85
	Subtotal	**0.44**	**/**		**3.00**	**0.18**			**0.54**	**3.54**
Qingshuihe River Rehabilitation	Flood Control	2.44	2.08	300.00	15.23					15.23
	Wastewater Interception	2.00	2.08	364.00	15.14	0.92	1	364.00	3.35	18.49

	Ecological rehabilitation	8.23	2.08	311.48	53.32	8.23	1	311.48	25.63	78.96
	Subtotal	**12.67**			**83.69**	**9.15**			**28.98**	**112.67**
Urban public transport infrastructure	Buildings and Structures	1.27	0.83	947.64	9.99					9.99
	Roads and hardened area	4.61	0.83	605.53	23.17					23.17
	Greening areas	0.72	0.83	400.00	2.39	0.72	1	400.00	2.88	5.27
	Subtotal	**6.60**			**35.55**	**0.72**			**2.88**	**38.43**
Total		**68.05**			**275.53**	**22.39**			**94.97**	**370.50**

(2) Estimate of soil loss after disturbance

Water and soil loss after disturbance is estimated according to the original landform, damaged land area and water and soil loss estimation period. According to the estimation period, the water and soil loss on the disturbed earth surface is 4124.41t. Details are provided in Table 7-9.

Table 7-9: Soil loss after disturbance

Prediction partition		Soil loss prediction table after disturbance								
		Construction period				Natural recovery Period				Total loss (t)
		Disturbed area (hm2)	Estimation period (a)	Original soil erosion modulus (t / km2.a)	Loss (t)	Disturbed area (hm2)	Estimation period (a)	Original soil erosion modulus (t / km2.a)	Loss (t)	
Water Supply	Water intake	0.04	0.58	6500	1.51					1.51
	Raw water transmission	7.68	0.58	6000	267.26	3.42	1	600	20.52	287.78
	Water treatment	2.40	0.58	6500	90.48	1.50	1	600	9.00	99.48
	Water distribution network	4.28	0.58	6000	148.94	0.42	1	600	2.52	151.46
	Temporary site of pipeline construction	23.17	0.58	6000	806.32	5.64	1	600	33.84	840.16
	Subtotal	**37.57**			**1314.51**	**10.98**			**65.88**	**1380.39**
Wastewater treatment plant and associated works	Wastewater Treatment Plant	2.48	1.17	6500	188.60	1.36	1	600	8.16	196.76
	Wastewater pipeline network	2.63	1.17	6000	184.63					184.63
	Temporary site of pipeline construction	5.66	1.17	6000	397.33					397.33
	Subtotal	**10.77**			**770.56**	**1.36**			**8.16**	**778.72**
Solid waste Management	Buildings and Structures	0.09	2.42	6500	14.16					14.16
	Roads and hardened areas	0.17	2.42	6500	26.74					26.74
	Greening areas	0.18	2.42	6500	28.31	0.18	1	600	1.08	29.39
	Subtotal	**0.44**	**/**		**69.21**	**0.18**			**1.08**	**70.29**
Qingshuihe River Rehabilitation	Flood Control	2.44	2.08	4000	203.01					203.01
	Wastewater Interception	2.00	2.08	6000	249.60	0.92	1	600	5.52	255.12

	Ecological rehabilitation	8.23	2.08	6000	1027.10	8.23	1	600	49.38	1076.48
	Subtotal	**12.67**			**1479.71**	**9.15**			**54.90**	**1534.61**
Urban public transport infrastructure	Buildings and Structures	1.27	0.83	6500	68.52					68.52
	Roads and hardened area	4.61	0.83	6500	248.71					248.71
	Greening areas	0.72	0.83	6500	38.84	0.72	1	600	4.32	43.16
	Subtotal	**6.60**			**356.07**	**0.72**			**4.32**	**360.39**
Total		**68.05**			**3990.07**	**22.39**			**134.34**	**4124.41**

(3) Total water and soil loss that may be caused by the project construction

According to estimation, the total soil loss caused by the project is 4125.41t, including original soil loss of 370.50t and new soil loss of 3753.91t, details are provided in Table 7-10.

According to the estimation results, new soil loss during project construction will mainly come from the following areas: ecological rehabilitation works under river rehabilitation component, followed by temporary site for pipeline construction under water supply component, temporary site for pipeline construction under wastewater treatment component, roads and hardened areas under urban public transport infrastructure component, greening area under solid waste management component, those 5 areas should be the key areas for water and soil loss prevention; during natural recovery period, the additional soil loss amount will be small, but the soil erosion modulus is higher than the allowable modulus, monitoring should also be strengthened.

Table 7-10: Estimate of New Water and Soil Loss

Zoning		Original soil erosion amount (t)	Erosion after disturbance amount (t)	New Soil Erosion (t)	Ratio of water and soil loss after disturbance(%)
Water Supply	Water intake	0.05	1.51	1.46	0.04
	Raw water transmission	68.25	287.78	219.53	5.85
	Water treatment	8.68	99.48	90.8	2.42
	Water distribution network	12.06	151.46	139.4	3.71
	Temporary site of pipeline construction	76.45	840.16	763.71	20.34
	Subtotal	**165.48**	**1380.39**	**1214.91**	**32.36**
Wastewater treatment plant and associated works	Wastewater Treatment Plant	12.78	196.76	183.98	4.90
	Wastewater pipeline network	13.85	184.63	170.78	4.55
	Temporary site of pipeline construction	23.74	397.33	373.59	9.95
	Subtotal	**5.44**	**778.72**	**773.28**	**20.60**

Solid waste Management	Buildings and Structures	0.46	14.16	13.7	0.36
	Roads and hardened areas	1.23	26.74	25.51	0.68
	Greening areas	1.85	29.39	27.54	0.73
	Subtotal	**3.54**	**70.29**	66.75	1.78
Qingshuihe River Rehabilitation	Flood Control	15.23	203.01	187.78	5.00
	Wastewater Interception	18.49	255.12	236.63	6.30
	Ecological rehabilitation	78.96	1076.48	997.52	26.57
	Subtotal	**112.67**	**1534.61**	**1421.94**	**37.88**
Urban public transport infrastructure	Buildings and Structures	9.99	68.52	58.53	1.56
	Roads and hardened area	23.17	248.71	225.54	6.01
	Greening areas	5.27	43.16	37.89	1.01
	Subtotal	**38.43**	**360.39**	**321.96**	**8.58**
Total		**370.50**	**4124.41**	**3753.91**	**100.00**

7.4 Soil Erosion Hazard Analysis

During construction, the earth surface within the project area will be disturbed and damaged, local landform will change significantly. If there are no additional control measures to those already included into the project design, a total of 4124.41t of water and soil loss may be generated during the estimation period, a total of 3753.91t of new water and soil loss will be generated. According to the estimation results, the loss during construction is large, the soil loss during construction will mainly come from new water and soil loss areas including ecological rehabilitation works under river rehabilitation component, followed by temporary site for pipeline construction under water supply component, temporary site for pipeline construction under wastewater treatment component, roads and hardened areas under urban public transport infrastructure component, greening area under solid waste management component, those 5 areas should be the key areas for water and soil loss prevention; during natural recovery period, the additional soil loss amount will be small, but the soil erosion modulus is higher than the allowable modulus, monitoring should also be strengthened.

Water and soil loss will definitely affect and harm the engineering works themselves and the surrounding environment, this plan conducted analysis, based on the actual situations of the project and the project area, on the potential harm that may be caused by the water and soil loss:

(1) impacts on the ecological environment in the project area and nearby areas

After project commencement, if without effective water and soil conservation measures, the water and gravity erosion, especially during rainy season, will damage the ecological environment in the project area and nearby areas, resulting in water and soil loss hazard.

(2) Impacts on the production and living of the nearby residents

Water and soil loss caused by project construction is closely related to the safety of the project. Potential water and soil loss caused by earth disturbance will bring negative impacts on the nearby production and living, if not effectively controlled.

(3) Impacts on project construction

Without adequate water and soil conservation, the mud and logged water will affect project construction and create safety hazard.

(4) Impacts on nearby rivers

During project construction, excavation and earth surface disturbance will generate large amount of loose excavated materials, without proper protection, the sediment will be carried into Qingshui River, then into Nanting River, affecting the flood drainage.

7.5 Comprehensive analysis and Suggestions

7.5.1 Comprehensive Analysis

According to calculations and estimate, the project construction will cause disturbance to 68.005hm2 of the earth surface; damage to 21.97hm2 of water and soil conservation facilities; may cause 68.05hm2 of water and soil loss; the project construction will generate earth excavation of 426482m3, including 84900m3 from land leveling excavation, 125992m3 from foundation and trench excavation, 65910m3 from topsoil stripping; the project construction will generate backfill of

416684m3, including 60400m3 for land levelling backfill, 272821m3 for foundation and trench backfill, and 65910m3 for greening earthing. The stripped topsoil will be temporary stored at the planned earth stacking site for greening earthing. The project construction will generate spoil of 9798m3. During the estimate period, the project will cause soil erosion of 4124.41t, including loss of native soil 370.50t, and new soil loss of 3753.91t, the new soil loss during construction will mainly come from the ecological rehabilitation of river, followed by temporary site for construction of pipelines for water supply component, temporary site for construction of pipelines for WWTP component, roads and hardened area of the public transport infrastructure, greening area of solid waste management component. Those five areas should be the key areas for water and soil loss monitoring and prevention and rehabilitation.

7.5.2 Suggestions

It can be concluded from the water and soil loss predictions and impacts analysis, the main impacts caused by project construction on the water and soil loss are earth surface disturbance and earth excavation, which degrade the original water and soil conservation function. The main negative impact from water and soil loss is that the flood drainage system will be silt up, affecting smooth flood drainage during rainy season. Considering the particularity of the project's geographic location, water and soil conservation measures should be considered during project construction. The following suggestions are provided on ensuring the implementation of water and soil conservation measures.

1. Suggestions on layout of prevention and control measures

On the basis of the water and soil conservation functions provided by the project design, based on the water and soil loss predictions, suggestions are provided from the perspectives of landscaping, environmental protection and water and soil conservation, to supplement the control measures:

a. The additional water and soil control measures provided in this plan shall well coordinate with those provided by the project design, ensure no overlapping or missing, and economically feasible;

b. The plan will provide additional measures to those measures provided by the project design to supplement; the measures not meeting the water and soil conservation requirements should re-designed;
c. Exposed earth surface should be covered during strong wind and heavy rain.

2. Other suggestions

Engage monitoring agency in a timely manner to conduct water and soil conservation monitoring or conduct self-monitoring, The monitoring should prioritize the roads and hardened areas in the key areas during construction period, and the areas of buildings and structures, make proper records; after project construction completion, inspection acceptance should be conducted on the water and soil conservation facilities.

8 Water and Soil Conservation Targets and Arrangement of Measures

8.1 Water and Soil Conservation Targets

The project area is located in Mengding Town, Gengma Dai and Wa Autonomous County, Lincang Municipality of Yunnan Province. According to the National Water and Soil Conservation Zoning for Key Prevention Areas and Key Rehabilitation Areas (No. 188, 2013, Ministry of Water Resources) and Yunnan Provincial Zoning for Key Prevention Areas and Key Rehabilitation Areas (No. 48, August, 2017, Yunnan Provincial Department of Water Resources), the project area is designated as national key areas of rehabilitation for water and soil loss in the southwest watershed and alpine valley region, and provincial key areas for rehabilitation of water and soil loss. According to the Water and Soil Conservation Standards for Development and Construction Projects (GB 50434-2008), the water and soil conservation for construction project will implement Class I standard. The water and soil conservation targets are developed based on the typography, landform, soil, and water and soil loss characteristics. Through pertinent engineering and vegetation water and soil conservation measures, the target is to effectively control new water and soil loss during construction, and rehabilitate the existing water and soil loss, reduce damages caused by new water and soil loss, restore and protect the water and soil conservation facilities in the construction area and nearby area, improve the ecological environment in the project area, and achieve coordinated development of project construction, ecological environment and regional economy.

According to the Water and Soil Conservation Standards for Development and Construction Projects (GB 50434-2008), and considering the precipitation in the project area (1600mm) and native soil erosion modulus 216.82km^2·a (micro erosion), the control targets are corrected. Main targets are summarized in Table 8-1.

Table 8-1: Water and Soil Conservation Targets of the Plan

N	Control	Class I Standard	Precipitati	Soil	Ultimate Control Targets

o.	Indicators	Construction Period	Commissioning	on correction	erosion intensity correction	Construction Period	Commissioning
1	Disturbed land remediation rate (%)	*	95			*	95
2	Total control of soil erosion (%)	*	95	+2		*	97
3	Soil erosion control rate	0.7	0.8		+0.2	0.9	1.0
4	Spoil Retaining rate (%)	95	95			95	95
5	Vegetation restoration rate (%)	*	97	+2		*	99
6	Vegetation coverage rate (%)	*	25	+2		*	27

8.2 Arrangement of Water and Soil Conservation Measures

8.2.1 Overall layout of control measures

8.2.1.1 Principle for Layout of Water and Soil Loss Control Measures

The objective of water and soil conservation in the project area is to prevent and control additional water and soil loss, with an aim to protect production and ecological land, facilitate coordinated development of economy and environment. The measures shall follow the laws and regulations on water and soil conservation,

technical standards, overall environment protection principles; and the layout of measures shall follow the below principles which are defined based on the project characteristics:

(1) based on the actual situations of the construction and current water and soil loss in the project area, the measures should be practical, pertinent, holistic, scientific and integrating both prevention and rehabilitation;

(2) reduce the damage to the original topography and vegetation, develop proper zoning of measures to reduce excavation;

(3) During project construction, attention should be paid to environmental protection with temporary protection measures, to reduce disturbance and spoil generation during construction activities;

(4) Draw lessons from successful local practices in water and soil conservation, introduce advanced technologies home and aboard;

(5) Establish harmony between man and nature, respect the law of nature, and make coordination's with the surrounding landscape;

(6) Make proper combinations and overall considerations of the engineering measures, vegetation measures and temporary measures to develop an integrated protection system;

(7) Engineering measures should maximize the use of local materials, and should be technologically reliable and economically reasonable;

(8) Vegetation measures should maximize the use of local suitable species, with considerations of the greening and landscape;

(9) Layout of prevention and rehabilitation measures shall closely coordinate with the main works.

8.2.1.2 Water and Soil Loss Prevention and Rehabilitation Measures System and General Layout

Effective water and soil loss prevention and rehabilitation measures should be taken, in accordance with the zoning, soil and water loss estimate, water and soil loss

characteristics and extent of damage during construction and operation of the project, and taking into account of the water and soil conservation functions provided by the main works. The water and soil loss prevention and rehabilitation for this project will adopt both engineering measures and vegetation measures, both permanent measures and temporary prevention measures, and incorporate those water and soil conservation measures provided by the design of the main works into the water and soil loss prevention and rehabilitation system, to establish a complete and effective water and soil conservation system. The general layout of the water and soil conservation plan will be properly developed to form a complete and scientific water and soil conservation system. The general layout of the measures is presented in detail in Table 8-1.

1. Water Supply in Qingshui River Port Area

(1) Construction Site of Water Intake

After completion of construction, the area will be covered by structures and buildings, the design of the main works didn't provide any water and soil conservation measures. Based on the water and soil loss characteristics in this area, respective management measures are developed in this plan.

(2) Construction Site of Raw Water Transmission

The design of the main works includes topsoil stripping and vegetation restoration, this plan, in addition, proposed sediment tanks/basins at the outlet, and developed relevant management measures.

(3) Construction Site of the Water Treatment Plant

The design of the main works (project design) includes topsoil stripping, storm water pipelines, landscape greening, for which professional landscape and greening firm was engaged for the design, those measures are in line with water and soil conservation requirements. Additionally, this plan provides temporary drainage ditches, temporary sediment basin, temporary retaining/blocking and temporary cover, and relevant management measures.

(4) Construction Site for Water Transmission and Distribution Networks

The design of the main works includes topsoil stripping and vegetation restoration; additionally, this plan provides sediment tanks at the outlet, and relevant management measures.

(5) Temporary Construction Site for Pipeline Works

The design of the main works includes topsoil stripping and vegetation restoration; additionally, this plan provides temporary retaining/blocking and temporary cover, and relevant management measures.

2. WWTP and Associated Works

(1) Construction Site of the WWTP

The design of the main works (project design) includes topsoil stripping, storm water pipelines, landscape greening, for which professional landscape and greening firm was engaged for the design, those measures are in line with water and soil conservation requirements. Additionally, this plan provides temporary drainage ditches, temporary sediment basin, temporary retaining/blocking and temporary cover, and relevant management measures.

(2) Construction Site of Associated Wastewater Pipeline Network

The design of the main works didn't provide any water and soil conservation measures. According to the water and soil loss characteristics in this area, this plan will provide sediment tanks at the outlet, and relevant management measures.

(3) Temporary Construction Site for Pipeline Works

The design of the main works didn't provide any water and soil conservation measures. According to the water and soil loss characteristics in this area, this plan will provide temporary retaining/blocking and temporary cover, and relevant management measures.

3. Solid Waste Management at Mending Town and Qingshui River Port Area

(1) Construction Site for Buildings and Structures

After construction completion, the area will be covered by structures and buildings. The design of the main works includes topsoil stripping measures. According to the

water and soil loss characteristics in this area, this plan provides relevant management measures.

(2) Roads and Hardened Area

The design of the main works includes topsoil stripping, storm water pipelines. Additionally, this plan provides temporary drainage ditches, temporary sediment basin, and relevant management measures.

(3) Greening Area

The design of the main works includes topsoil stripping, landscape greening, for which professional landscape and greening firm was engaged for the design, those measures are in line with water and soil conservation requirements. Additionally, this plan provides temporary retaining/blocking and temporary cover, and relevant management measures.

4. Qingshuihe River Integrated Rehabilitation

(1) Flood Control Works

The design of the main works didn't include any water and soil conservation measures. According to the water and soil loss characteristics in this area, this plan proposed relevant management measures.

(2) Wastewater Interception Works

The design of the main works includes topsoil stripping and vegetation restoration. Additionally, this plan provides sediment tanks at the outlet, temporary retaining/blocking and temporary cover, and relevant management measures.

(3) Ecological Rehabilitation Works

The design of the main works includes topsoil stripping, landscaping greening. According to the water and soil loss characteristics in this area, this plan proposed relevant management measures.

V. Public Transport Infrastructure from Mengding to Qingshui River Port

(1) Construction Site for Buildings and Structures

After construction completion, the area will be covered by structures and buildings. The design of the main works includes topsoil stripping measures. According to the

water and soil loss characteristics in this area, this plan provides relevant management measures.

(2) Roads and Hardened Area

The design of the main works includes topsoil stripping, storm water pipelines. Additionally, this plan provides temporary drainage ditches, temporary sediment basin, and relevant management measures.

(3) Greening Area

The design of the main works includes topsoil stripping, landscape greening, for which professional landscape and greening firm was engaged for the design, those measures are in line with water and soil conservation requirements. Additionally, this plan provides temporary retaining/blocking and temporary cover, and relevant management measures.

Prevention and rehabilitation measures system of the water and soil conservation plan for this project is shown in Table 8-1.

Table 8-2: Water and Soil Loss Prevention and Rehabilitation Measures System

Zoning		Prevention and Rehabilitation Measures	Remarks
Water Supply	Water intake	Management measures	This Plan
	Raw water transmission	Topsoil stripping	Project design
		Vegetation restoration measures	Project design
		Temporary sediment tanks	This Plan
		Management measures	This Plan
	WTP	Topsoil stripping	Project design
		Storm water pipeline	Project design
		Landscape greening	Project design
		Temporary drainage ditches	This Plan
		Temporary sediment tanks	This Plan
		Temporary retaining	This Plan
		Temporary cover	This Plan
		Management measures	This Plan
	Water transmission and distribution network	Topsoil stripping	Project design
		Vegetation restoration measures	Project design
		Temporary sediment tanks	This Plan
		Management measures	This Plan
	Temporary site for construction of pipelines	Topsoil stripping	Project design
		Vegetation restoration measures	Project design

		Temporary retaining measure	This Plan
		Temporary cover	This Plan
		Management measures	This Plan
WWTP and associated works	WWTP	Topsoil stripping	Project design
		Storm water pipeline	Project design
		Landscape greening	Project design
		Temporary drainage ditches	This Plan
		Temporary sediment tanks	This Plan
		Temporary cover	This Plan
		Temporary retaining	This Plan
		Management measures	This Plan
	Wastewater pipelines	Temporary sediment tanks	This Plan
		Management measures	This Plan
	Temporary site for construction of pipelines	Temporary retaining	This Plan
		Temporary cover	This Plan
		Management measures	This Plan
Solid waste management	Buildings and Structures	Topsoil stripping	This Plan
		Management measures	This Plan
	Roads and hardened area	Topsoil stripping	Project design
		Storm water pipeline	Project design
		Temporary drainage ditches	This Plan
		Temporary sediment tanks	This Plan
		Management measures	This Plan
	Greening areas	Topsoil stripping	Project design
		Landscape greening	Project design
		Temporary retaining	This Plan
		Temporary cover	This Plan
		Management measures	This Plan
Qingshuihe River Rehabilitation	Flood control	Management measures	This Plan
	Wastewater interception	Topsoil stripping	Project design
		Vegetation restoration measures	Project design
		Temporary sediment tanks	This Plan
		Temporary retaining	This Plan
		Temporary cover	This Plan
		Management measures	This Plan
	Ecological rehabilitation	Topsoil stripping	Project design
		Landscaping	Project design
		Management measures	This Plan
Urban Public Transport Infrastructure from Mending to Qingshui River Port	Buildings and Structures	Topsoil stripping	Project design
		Management measures	This Plan
	Roads and hardened area	Topsoil stripping	Project design
		Storm water pipelines	Project design
		Temporary drainage ditches	This Plan
		Temporary sediment tanks	This Plan
		Management measures	This Plan
	Greening areas	Topsoil stripping	Project design
		Landscape greening	Project design

		Temporary retaining	This Plan
		Temporary cover	This Plan
		Management measures	This Plan

8.2.2 Layout of Zoning-based Conservation Measures and Typical Design

8.2.2.1 Design Principles and Standards

(1) Design of management measures: it should be systematic, comprehensive, instructive and practical.

(2) Design of engineering measures: according to the main engineering layout and the characteristics of soil and water loss, principles of “adjusting measures to local conditions, pertinent measures, focusing on the priorities, efficiency” should be followed. Take corresponding engineering preventive measures to prevent the soil and water loss at the sites, the retaining and damming should be safe, economic, require less physical work quantity, and operable.

(3) Design of Vegetation measures

① Referring to local experience in soil and water conservation and afforestation, and existing vegetation measures in the project area, based on the local conditions, the design should adopt feasible afforestation technologies;

② proper plantation selection to adapt to local conditions, select local quality species according to ecological and biological features of the species and landscaping requirements;

③ The density of afforestation should be based on the purpose of forestation, the characteristics of tree species and site conditions. And the initial planting density for main suitable forestation species should be determined according to *the Technical Specification for Soil and Water Conservation*.

(4) Design of temporary measures: the temporary measures should be set up properly according to the degree of construction disturbance and topography, implementation of measures should be simple and feasible, and well-coordinated with permanent measures to avoid multiple times of excavation.

(5) Design standard: 20 years flood protection is adopted for the temporary drainage measures.

8.2.2.2 Design of Water and Soil Conservation Measures for Water Supply Component in Qingshui River Port Area

1. Construction site for the water intake.

1. The requirements for soil and water conservation

(1) Prior to construction of foundations of structures/buildings, proper construction plan should be developed according to the geological structures stated in the design data and geo-survey report, and provide temporary drainage system and retaining measures around the area according to the topography and landform, which should follow the principle of drainage and blocking first.

(2) We should strengthen the management of engineering construction, and carry out construction in strict accordance with the engineering design and construction schedule, to reduce the time of surface exposure; the excavated soil during construction shall be transferred in a timely manner.

(3) The construction of the building foundation requires a lot of physical works, so the construction period should avoid rainy season when possible to reduce the water and soil loss.

(4) Clean up the construction site immediately upon completion of individual items of works to reduce the water and soil loss.

(5) Hang banners with slogans of water and soil conservation on the construction safety net during the construction, to publicize the policy of water and soil conservation and build awareness of every worker on the importance of water and soil conservation.

2. Construction Site for Raw Water Transmission

1. Requirements for water and soil conservation

(1) Strengthen the construction management, and carry out construction in strict accordance with the engineering design and construction plan to reduce the time of earth surface exposure.

(2) The excavation of trenches, laying of pipelines, backfill of trenches of the transmission pipes should be implemented in strict accordance with the construction specifications, to avoid the excavation outside the trenches and carry out the laying of pipelines and backfill of trenches in a timely manner.

(3) The construction should avoid rainy seasons. If there is a sudden rain during the construction, please take temporary shelter in a timely manner.

(4) The greening measures or land remediation measures should be implemented in time in the area of excavation after the laying of pipelines completed.

(5) Strengthen the management and maintenance of all water and soil conservation facilities and check the operation status regularly during the construction to prevent problems from occurring or take remediations or corrective measures in time when there is a problem.

(6) Strengthen the management and protection of the afforested areas, no pulling or breaking off or trampling, and ensure replenishments and the survival rate of trees and grass.

(7) Set up no entrance or enclosure signage at exposed area to prevent treading and disturbance.

2. Layout and typical design of measures

(1) Engineering measures

①Topsoil stripping – project design

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so

as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. According to statistics, 10260m^3 of topsoil will be stripped.

(2) Vegetation Measures

①Vegetation restoration – project design

The construction of raw water transmission pipelines will occupy the woodland and grassland along the alignment, for which vegetation restoration will be conducted. It is suggested that native trees and grass species should be selected for landscaping; the greening area will be 3.42hm^2.

(3) Temporary measures

①Temporary sediment tanks

The surface runoff is collected by excavation of trenches during the construction of raw water transmission pipelines according to the design of main body, and the water retaining well is set at the lowest point of trenches and drained using the water pump. In order to strengthen the management of water sediment from the drainage flow, the temporary mobile sediment tank is designed at the outlet of the drainage, so the water flows are discharged to the nearby natural groove after the sedimentation. The mobile sediment tank is fabricated by welding of 6 mm steel, and the design dimension is 2.0 m (length) × 1.5m (width) × 1.2 m (depth). Two 0.5 m-high baffles are set in the sediment tank, and the waste water drained from the trenches is pumped into the sedimentation tank using the water pump, which can meet the requirements of this plan. One tank requires 12.90 m2 steel, and 13.55 m2 steel is required considering the steel cutting loss (at 5% loss), so a total of 0.64 t steel is needed, and they can be reused in different locations. According to statistics, a total of 10 temporary sediment tanks. will be needed, requiring a total of 6.40 ton steel.

3. Construction Site for the water treatment plant

1. The requirements for soil and water conservation

(1) Prior to construction of foundations of structures/buildings, proper construction plan should be developed according to the geological structures stated in the design data and geo-survey report, and provide temporary drainage system

and retaining measures around the area according to the topography and landform, which should follow the principle of drainage and blocking first.

(2) We should strengthen the management of engineering construction, and carry out construction in strict accordance with the engineering design and construction schedule, to reduce the time of surface exposure; the excavated soil during construction shall be transferred in a timely manner.

(3) The construction of the building foundation requires a lot of physical works, so the construction period should avoid rainy season when possible to reduce the water and soil loss.

(4) Clean up the construction site immediately upon completion of individual items of works to reduce the water and soil loss.

(5) Hang banners with slogans of water and soil conservation on the construction safety net during the construction, to publicize the policy of water and soil conservation and build awareness of every worker on the importance of water and soil conservation.

2. Layout and typical design of measures

(1) Engineering measures

①Topsoil stripping – project design

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. According to statistics, 7200m^3 of topsoil will be stripped.

② Storm water pipe network

The main body design will provide storm water drainage pipeline at lower positions along the road, so that the ground rainwater will be collected at the gully inlet grate and enter the storm water pipelines through the grate, finally discharged into the head rainwater pipe in Qingshui River port economic zone from the storm water

pipelines. The storm water inlets are set along the outdoor roads with an interval of 3m. The outdoor storm water pipelines adopt the rubber ring socket connection, with the diameter of DN300~600, and a total of 550m storm water pipelines will be set up.

(2) Vegetation measures

① Landscape greening

Greening will be conducted where appropriate in the surroundings of the buildings and roads. The greening trees and grass species are local ornamental trees and grass with beautiful shapes, which normally are evergreen trees, shrubs and grass, for a better effect of landscape greening and dust prevention. The greening will improve the environment in the project area while prevent water and soil loss. After calculation, the total greening area will be 1.50hm^2.

(3) Temporary measures

① Temporary cover

In order to minimize the washing by rainfall of the topsoil and trench backfill which is stacked in the construction site, the geotextile will be used as a temporary cover, with a covering area of 1500m^2. It is covered by geotextile and can be reused.

② Temporary drainage ditches

In order to prevent and control the rainfall to scour the site during construction, the design scheme will provide temporary drainage ditches for rainwater drainage during construction period. The ditches are arranged at the edge of the project area, and forms a loop along the edge, to collect and drain the surface rainwater in the whole project area. The outlet is connected with the temporary sediment tank, the rainwater, after sedimentation, will be drained into the municipal storm water pipe network which is planned to be built under the road. The drainage ditch adopts trapezoidal cross-section, with a depth of 0.2m, bottom width of 0.3m, inner slope proportion of 1:1. The flow face is compacted by shovel, and the earth excavation is compacted nearby (compaction coefficient is 0.85). Total 500m temporary drainage ditches will be set up.

Total bills of quantity: earth excavation is 89.74m^3, and the earth compaction is 76.39m^3.

③ Temporary sediment basins

In order to manage the sedimentation of the flow in the temporary drainage ditches, the sediment basin will be set up at the end of temporary drainage ditch. The sediment basin adopts rectangular cross-section, with dimensions of a×b×h=3m×2m×1.5m, brick structure, including 24cm wall, 20cm bottom, and 12cm deceleration wall. It shall be cleaned regularly during the construction, and filled up after completing the construction. The bill of quantity for each sediment basin includes: earth excavation 12m^3 and the brick masonry 4m^3. A total of one sediment basin is needed, the bill of quantity includes: earth excavation 12m^3 and the brick masonry 4m^3.

④ Temporary retaining and blocking

The plan includes temporary earth stacking site to place the stripped soil. In order to prevent the loss of topsoil, the temporary blocking will be set up around the stacking site using woven bags filled with soil, the blocking height is 1.5m, trapezoidal cross-section, top width 1.0m, inner and outer slopes proportion of 1:0.3. Total 160m temporary blocking will be set up.

Bill of quantity: 360.00m^3 of woven bags filled with soil , and 360.00m^3 removal of woven bags filling with soil.

4. Construction Site of the Transmission and Distribution Networks

1. Requirements for water and soil conservation

(1) Strengthen the construction management, and carry out construction in strict accordance with the engineering design and construction plan to reduce the time of earth surface exposure.

(2) The excavation of trenches, laying of pipelines, backfill of trenches of the transmission pipes should be implemented in strict accordance with the construction specifications, to avoid the excavation outside the trenches and carry out the laying of pipelines and backfill of trenches in a timely manner.

(3) The construction should avoid rainy seasons. If there is a sudden rain during the construction, please take temporary shelter in a timely manner.

(4) The greening measures or land remediation measures should be implemented in time in the area of excavation after the laying of pipelines completed.

(5) Strengthen the management and maintenance of all water and soil conservation facilities, and check the operation status regularly during the construction to prevent problems from occurring or take remediations or corrective measures in time when there is a problem.

(6) Strengthen the management and protection of the afforested areas, no pulling or breaking off or trampling, and ensure replenishments and the survival rate of trees and grass.

(7) Set up no entrance or enclosure signage at exposed area to prevent treading and disturbance.

2. Layout and typical design of measures

(1) Engineering measures

①Topsoil striping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. According to statistics, 1260m^3 of topsoil will be stripped.

(2) Vegetation measures

① Vegetation restoration

The grassland and forest land occupied by the project will be restored. It is suggested to select the native trees and grass species for landscaping, with an area of 0.42hm^2.

(3) Temporary measures

① Temporary sediment tanks

The surface runoff is collected by excavation of trenches during the construction of raw water transmission pipelines according to the design of main body, and the water retaining well is set at the lowest point of trenches and drained using the water pump. In order to strengthen the management of water sediment from the drainage flow, the temporary mobile sediment tank is designed at the outlet of the drainage, so the water flows are discharged to the nearby natural groove after the sedimentation. The mobile sediment tank is fabricated by welding of 6 mm steel, and the design dimension is 2.0 m (length) × 1.5m (width) × 1.2 m (depth). Two 0.5 m-high baffles are set in the sediment tank, and the waste water drained from the trenches is pumped into the sedimentation tank using the water pump, which can meet the requirements of this plan. One tank requires 12.90 m2 steel, and 13.55 m2 steel is required considering the steel cutting loss (at 5% loss), so a total of 0.64 t steel is needed, and they can be reused in different locations. According to statistics, a total of 10 temporary sediment tanks. will be needed, requiring a total of 6.40 ton steel. Considering the recycling usage of the temporary sediment tank, the sediment tanks used in raw water transmission network will be reused, therefore the bill of quantity is excluded here.

5. Temporary site for pipeline construction

1. Requirements for water and soil conservation

(1) Prior to construction of foundations of structures/buildings, proper construction plan should be developed according to the geological structures stated in the design data and geo-survey report, and provide temporary drainage system and retaining measures around the area according to the topography and landform, which should follow the principle of drainage and blocking first.

(2) We should strengthen the management of engineering construction, and carry out construction in strict accordance with the engineering design and construction schedule, to reduce the time of surface exposure; the excavated soil during construction shall be transferred in a timely manner.

(3) Carry out excavation as appropriate, minimize dumping and stacking, spoil should be cleared in a timely manner, backfill shall be covered in a timely manner,

the site should be compacted after backfill.

(4) Avoid the windy days and rainy day as much as possible during the construction. Take necessary temporary measures for water and soil conservation to reduce the water and soil loss and prevent the sediment from damaging the surrounding areas.

(5) The pipe laying shall be closely connected as required, to avoid earth exposure during operation and water and soil loss therefrom.

2. Layout and typical design of measures

(1) Engineering measures

① Topsoil stripping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. According to statistics, 16920m^3 of topsoil will be stripped.

(2) Vegetation measures

① Vegetation restoration

The grassland and forest land occupied by the project will be restored. It is suggested to select the native trees and grass species for landscaping, with an area of 5.64hm^2.

(3) Temporary measures

① Temporary cover

In order to minimize the washing by rainfall of the topsoil and trench backfill which is stacked in the construction site, the geotextile will be used as a temporary cover, with a covering area of 20000m^2. It is covered by geotextile and can be reused.

② Temporary blocking

In order to prevent the loss of topsoil and backfill soil, the temporary blockings around the temporary construction site will be set up, using woven bags filled with

soil, the blocking structure will be 1.2m high, 0.8m and 1.6m in top and bottom width. A total of 6000m temporary blockings will be set up.

Bill of quantity: woven bags filled with soil 8625m^3, and the removal of woven bags filled with soil 8625m^3.

8.2.2.3 Water and Soil Conservation Measures Design for WWTP and Associated Facilities in Qingshui River Port of Mending

1. WWTP

1. Requirements for water and soil conservation

(1) Prior to construction of foundations of structures/buildings, proper construction plan should be developed according to the geological structures stated in the design data and geo-survey report, and provide temporary drainage system and retaining measures around the area according to the topography and landform, which should follow the principle of drainage and blocking first.

(2) We should strengthen the management of engineering construction, and carry out construction in strict accordance with the engineering design and construction schedule, to reduce the time of surface exposure; the excavated soil during construction shall be transferred in a timely manner.

(3) The construction of the building foundation requires a lot of physical works, so the construction period should avoid rainy season when possible to reduce the water and soil loss.

(4) Clean up the construction site immediately upon completion of individual items of works to reduce the water and soil loss.

(5) Hang banners with slogans of water and soil conservation on the construction safety net during the construction, to publicize the policy of water and soil conservation and build awareness of every worker on the importance of water and soil conservation.

2. Layout and typical design of measures

(1) Engineering measures

①Topsoil stripping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. According to statistics, 7440m^3 of topsoil will be stripped.

② Storm water pipeline

The main body design will provide storm water drainage pipeline at lower positions along the road, so that the ground rainwater will be collected at the gully inlet grate and enter the storm water pipelines through the grate, finally discharged into the head rainwater pipe in Qingshui River port economic zone from the storm water pipelines. The storm water inlets are set along the outdoor roads with an interval of 3m. The outdoor storm water pipelines adopt the rubber ring socket connection, with the diameter of DN300~600, and a total of 780m storm water pipelines will be set up.

(2) Vegetation measures

① Landscape greening

The main works also include greening measures where appropriate in the surroundings of the buildings and roads. The greening trees and grass species will adopt local ornamental trees and grass with beautiful shapes, which normally are evergreen trees, shrubs and grass, for a better effect of landscape greening and dust prevention. The greening will improve the environment in the project area while prevent water and soil loss. After calculation, the total greening area will be 1.36hm^2.

(3) Temporary measures

① Temporary recovery

In order to minimize the washing by rainfall of the topsoil and trench backfill which is stacked in the construction site, the geotextile will be used as a temporary cover, with a covering area of 1200m^2. It is covered by geotextile and can be reused.

② Temporary drainage ditches

In order to prevent and control the rainfall to scour the site during construction, the design scheme will provide temporary drainage ditches for rainwater drainage during construction period. The ditches are arranged at the edge of the project area, and forms a loop along the edge, to collect and drain the surface rainwater in the whole project area. The outlet is connected with the temporary sediment tank, the rainwater, after sedimentation, will be drained into the municipal storm water pipe network which is planned to be built under the road. The drainage ditch adopts trapezoidal cross-section, with a depth of 0.3m, bottom width of 0.3m, inner slope proportion of 1:1. The flow face is compacted by shovel, and the earth excavation is compacted nearby (compaction coefficient is 0.85). Total 686m temporary drainage ditches will be set up.

Total bills of quantity: earth excavation is 123.12m^3, and the earth compaction is 104.65m^3.

③ Temporary sediment basin

In order to manage the sedimentation of the flow in the temporary drainage ditches, the sediment basin will be set up at the end of temporary drainage ditch. The sediment basin adopts rectangular cross-section, with dimensions of a×b×h=3m×2m×1.5m, brick structure, including 24cm wall, 20cm bottom, and 12cm deceleration wall. It shall be cleaned regularly during the construction, and filled up after completing the construction. The bill of quantity for each sediment basin includes: earth excavation 12m^3 and the brick masonry 4m^3. A total of one sediment basin is needed, the bill of quantity includes: earth excavation 12m^3 and the brick masonry 4m^3.

④ Temporary blocking

The plan includes temporary earth stacking site to place the stripped soil. In order to prevent the loss of topsoil, the temporary blocking will be set up around the stacking site using woven bags filled with soil, the blocking height is 1.5m, trapezoidal cross-section, top width 1.0m, inner and outer slopes proportion of 1:0.3. A total of 136m temporary blocking will be set up.

Bill of quantity: 306.00m^3 of woven bags filled with soil , and 306.00m^3 removal of woven bags filling with soil.

2. Wastewater Pipelines

1. Requirements of water and soil conservation

(1) Strengthen the construction management, and carry out construction in strict accordance with the engineering design and construction plan to reduce the time of earth surface exposure.

(2) The excavation of trenches, laying of pipelines, backfill of trenches of the transmission pipes should be implemented in strict accordance with the construction specifications, to avoid the excavation outside the trenches and carry out the laying of pipelines and backfill of trenches in a timely manner.

(3) The construction should avoid rainy seasons. If there is a sudden rain during the construction, please take temporary shelter in a timely manner.

(4) The greening measures or land remediation measures should be implemented in time in the area of excavation after the laying of pipelines completed.

(5) Strengthen the management and maintenance of all water and soil conservation facilities, and check the operation status regularly during the construction to prevent problems from occurring or take remediations or corrective measures in time when there is a problem.

(6) Strengthen the management and protection of the afforested areas, no pulling or breaking off or trampling, and ensure replenishments and the survival rate of trees and grass.

(7) Set up no entrance or enclosure signage at exposed area to prevent treading and disturbance.

2. Layout and typical design of measures

(1) Temporary measures

①Temporary sediment tanks

The surface runoff is collected by excavation of trenches during the construction of raw water transmission pipelines according to the design of main body, and the

water retaining well is set at the lowest point of trenches and drained using the water pump. In order to strengthen the management of water sediment from the drainage flow, the temporary mobile sediment tank is designed at the outlet of the drainage, so the water flows are discharged to the nearby natural groove after the sedimentation. The mobile sediment tank is fabricated by welding of 6 mm steel, and the design dimension is 2.0 m (length) × 1.5m (width) × 1.2 m (depth). Two 0.5 m-high baffles are set in the sediment tank, and the waste water drained from the trenches is pumped into the sedimentation tank using the water pump, which can meet the requirements of this plan. One tank requires 12.90 m^2 steel, and 13.55 m^2 steel is required considering the steel cutting loss (at 5% loss), so a total of 0.64 t steel is needed, and they can be reused in different locations. According to statistics, a total of 5 temporary sediment tanks. will be needed, requiring a total of 3.2 ton of steel. Considering the recycling usage of the temporary sediment tank, the sediment tanks used in raw water transmission network will be reused, therefore the bill of quantity is excluded here.

3. Temporary Site for Construction of Pipeline Network

1. Requirements of water and soil conservation

(1) Prior to construction of foundations of structures/buildings, proper construction plan should be developed according to the geological structures stated in the design data and geo-survey report, and provide temporary drainage system and retaining measures around the area according to the topography and landform, which should follow the principle of drainage and blocking first.

(2) We should strengthen the management of engineering construction, and carry out construction in strict accordance with the engineering design and construction schedule, to reduce the time of surface exposure; the excavated soil during construction shall be transferred in a timely manner.

(3) Carry out excavation as appropriate, minimize dumping and stacking, spoil should be cleared in a timely manner, backfill shall be covered in a timely manner, the site should be compacted after backfill.

(4) Avoid the windy days and rainy day as much as possible during the

construction. Take necessary temporary measures for water and soil conservation to reduce the water and soil loss and prevent the sediment from damaging the surrounding areas.

(5) The pipe laying shall be closely connected as required, to avoid earth exposure during operation and water and soil loss therefrom.

2. Layout and typical design of measures

(1) Temporary measures

① Temporary cover

In order to minimize the washing by rainfall of the topsoil and trench backfill which is stacked in the construction site, the geotextile will be used as a temporary cover, with a covering area of 5000m^2. It is covered by geotextile and can be reused.

② Temporary retaining/ blocking

In order to prevent the loss of topsoil and backfill soil, the temporary blockings around the temporary construction site will be set up, using woven bags filled with soil, the blocking structure will be 1.2m high, 0.8m and 1.6m in top and bottom width. A total of 1124m temporary blockings will be set up.

Bill of quantity: woven bags filled with soil 1615.75m^3, and the removal of woven bags filled with soil 1615.75m^3.

8.2.2.4 Solid Waste Management Component

1. Site for Structures/Buildings

1. Requirements for water and soil conservation

(1) Prior to construction of foundations of structures/buildings, proper construction plan should be developed according to the geological structures stated in the design data and geo-survey report, and provide temporary drainage system and retaining measures around the area according to the topography and landform, which should follow the principle of drainage and blocking first.

(2) We should strengthen the management of engineering construction, and carry out construction in strict accordance with the engineering design and

construction schedule, to reduce the time of surface exposure; the excavated soil during construction shall be transferred in a timely manner.

(3) The construction of the building foundation requires a lot of physical works, so the construction period should avoid rainy season when possible to reduce the water and soil loss.

(4) Clean up the construction site immediately upon completion of individual items of works to reduce the water and soil loss.

(5) Hang banners with slogans of water and soil conservation on the construction safety net during the construction, to publicize the policy of water and soil conservation and build awareness of every worker on the importance of water and soil conservation.

2. Layout and typical design of measures

(1) Engineering measures

① Topsoil stripping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. Based on calculations, a total of 150m^3 of topsoil will be stripped.

2. Roads and Hardened Areas

1. Requirements of water and soil conservation

(1) The construction should be in strict accordance with the schedule and sequence;

(2) The pavement and hardening should be implemented as early as possible according to the construction schedule to avoid the long period of exposure.

2. Layout and typical design of measures

(1) Engineering measures

① Topsoil stripping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. Based on calculations, a total of 510m^3 of topsoil will be stripped.

② Storm water pipeline network

The design will provide storm water drainage pipeline at lower positions along the road, so that the ground rainwater will be collected at the gully inlet grate and enter the storm water pipelines through the grate, finally discharged into the head storm water pipe in Qingshui River Port Economic Zone from the storm water pipelines. The storm water inlets are set along the outdoor roads with an interval of 3m. The outdoor storm water pipelines will adopt rubber ring socket connection, with the diameter of DN300~600, and a total of 376m storm water pipelines will be set up.

(2) Temporary measures

① Temporary drainage ditches

In order to prevent and control the rainfall to scour the site during construction, the design scheme will provide temporary drainage ditches for rainwater drainage during construction period. The ditches are arranged at the edge of the project area, and forms a loop along the edge, to collect and drain the surface rainwater in the whole project area. The outlet is connected with the temporary sediment tank, the rainwater, after sedimentation, will be drained into the municipal storm water pipe network which is planned to be built under the road. The drainage ditch adopts trapezoidal cross-section, with a depth of 0.3m, bottom width of 0.3m, inner slope proportion of 1:1. The flow face is compacted by shovel, and the earth excavation is compacted nearby (compaction coefficient is 0.85). Total 264m temporary drainage ditches will be set up.

Total bills of quantity: earth excavation is 47.38m^3, and the earth compaction is 40.28m^3.

② Temporary sediment basins

In order to manage the sedimentation of the flow in the temporary drainage ditches, the sediment basin will be set up at the end of temporary drainage ditch. The sediment basin adopts rectangular cross-section, with dimensions of a×b×h=3m×2m×1.5m, brick structure, including 24cm wall, 20cm bottom, and 12cm deceleration wall. It shall be cleaned regularly during the construction, and filled up after completing the construction. The bill of quantity for each sediment basin includes: earth excavation 12m^3 and the brick masonry 4m^3. A total of two sediment basins will be needed, the bill of quantity includes: earth excavation 24m^3 and the brick masonry 8m^3.

3. Area for Greening Works

1. Requirements of water and soil conservation

(1) Strengthen the construction management, and carry out construction in strict accordance with the engineering design and construction plan to reduce the time of earth surface exposure.

(2) The construction should avoid rainy seasons. If there is a sudden rain during the construction, please take temporary sheltering and covering in a timely manner.

(3) Strengthen the management and maintenance of all water and soil conservation facilities, and check the operation status regularly during the construction to prevent problems from occurring or take remediations or corrective measures in time when there is a problem.

(4) Strengthen the management and protection of the afforested areas, no pulling or breaking off or trampling, and ensure replenishments and the survival rate of trees and grass.

(5) Set up no entrance or enclosure signage at exposed area to prevent treading and disturbance.

2. Layout and typical design of measures

(1) Engineering measures

① Topsoil stripping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. According to statistics, 540m^3 of topsoil will be stripped.

(2) Vegetation measures

① Landscape greening

Greening will be conducted where appropriate in the surroundings of the buildings and roads. The greening trees and grass species are local ornamental trees and grass with beautiful shapes, which normally are evergreen trees, shrubs and grass, for a better effect of landscape greening and dust prevention. The greening will improve the environment in the project area while prevent water and soil loss. After calculation, the total greening area will be 0.18hm^2.

(3) Temporary measures

① Temporary cover

In order to minimize the washing by rainfall of the topsoil which is stacked in the construction site, the geotextile will be used as a temporary cover, with a covering area of 200m^2. It is covered by geotextile and can be reused.

② Temporary retaining/blocking

The plan includes temporary earth stacking site to place the stripped soil. In order to prevent the loss of topsoil, the temporary blocking will be set up around the stacking site using woven bags filled with soil, the blocking height is 1.5m, trapezoidal cross-section, top width 1.0m, inner and outer slopes proportion of 1:0.3. Total 22m temporary blocking will be set up.

Bill of quantity: 49.50m^3 of woven bags filled with soil , and 49.50m^3 removal of woven bags filling with soil.

8.2.2.5 Qingshui River Rehabilitation Component

1. Flood Control

1. Requirements for water and soil conservation

(1) The cofferdam construction should be implemented in strict accordance with the construction specifications to avoid the impact of river flow on dredging area.

(2) Pay attention to the vegetation on both sides of the river to prevent trampling during the construction or the installation of pipes.

(3) Strengthen the construction management, and construct in strict accordance with the engineering design and construction schedule to reduce the time of surface exposure.

(4) Strengthen the management and maintenance of all water and soil conservation facilities, and check the operation status regularly during the construction to prevent problems from occuring or take remediations or corrective measures in time when there is a problem.

(5) Strengthen the management and protection of the afforested areas, no pulling or breaking off or trampling, and ensure replenishments and the survival rate of trees and grass.

(6) Set up no entrance or enclosure signage at exposed area to prevent treading and disturbance.

(7) Carry out excavation as appropriate, minimize dumping and stacking, spoil should be cleared in a timely manner, backfill shall be covered in a timely manner, the site should be compacted after backfill.

(8) Avoid the windy days and rainy day as much as possible during the construction. Take necessary temporary measures for water and soil conservation to reduce the water and soil loss and prevent the sediment from damaging the surrounding areas.

(9) The pipe laying shall be closely connected as required, to avoid earth exposure during operation and water and soil loss therefrom.

2. Wastewater Interception

1. Requirements for water and soil conservation

(1) Strengthen the construction management, and carry out construction in strict accordance with the engineering design and construction plan to reduce the time of earth surface exposure.

(2) The excavation of trenches, laying of pipelines, backfill of trenches of the transmission pipes should be implemented in strict accordance with the construction specifications, to avoid the excavation outside the trenches and carry out the laying of pipelines and backfill of trenches in a timely manner.

(3) The construction should avoid rainy seasons. If there is a sudden rain during the construction, take temporary sheltering and covering in a timely manner.

(4) The greening measures or land remediation measures should be implemented in time in the area of excavation after the laying of pipelines completed.

(5) Strengthen the management and maintenance of all water and soil conservation facilities, and check the operation status regularly during the construction to prevent problems from occurring or take remediations or corrective measures in time when there is a problem.

(6) Strengthen the management and protection of the afforested areas, no pulling or breaking off or trampling, and ensure replenishments and the survival rate of trees and grass.

(7) Set up no entrance or enclosure signage at exposed area to prevent treading and disturbance.

2. Layout and typical design of measures

(1) Engineering measures

①Topsoil stripping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line

with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. Based on calculations, 2760m^3 of topsoil will be stripped.

(2) Vegetation measures

① Vegetation restoration

The construction of raw water transmission pipelines will occupy the woodland and grassland along the alignment, for which vegetation restoration will be conducted. It is suggested that native trees and grass species should be selected for landscaping; the greening area will be 0.92hm^2.

(3) Temporary measures

① Temporary sediment tanks

The surface runoff is collected by excavation of trenches during the construction of transmission pipelines according to the design of main body, and the water retaining well is set at the lowest point of trenches and drained using the water pump. In order to strengthen the management of water sediment from the drainage flow, the temporary mobile sediment tank is designed at the outlet of the drainage, so the water flows are discharged to the nearby natural groove after the sedimentation. The mobile sediment tank is fabricated by welding of 6 mm steel, and the design dimension is 2.0 m (length) × 1.5m (width) × 1.2 m (depth). Two 0.5 m-high baffles are set in the sediment tank, and the waste water drained from the trenches is pumped into the sedimentation tank using the water pump, which can meet the requirements of this plan. One tank requires 12.90 m^2 steel, and 13.55 m^2 steel is required considering the steel cutting loss (at 5% loss), so a total of 0.64 t steel is needed, and they can be reused in different locations. According to statistics, a total of 2 temporary sediment tanks. will be needed, requiring a total of 1.28-ton steel. Considering the recycling usage of the temporary sediment tank, the sediment tanks used in raw water transmission network will be reused, therefore the bill of quantity is excluded here.

②Temporary cover

In order to minimize the washing by rainfall of the topsoil and trench backfill which is stacked in the construction site, the geotextile will be used as a temporary cover, with a covering area of 900m^2. It is covered by geotextile and can be reused.

③ Temporary blocking

In order to prevent the loss of topsoil and backfill soil, the temporary blockings around the temporary construction site will be set up, using woven bags filled with soil, the blocking structure will be 1.2m high, 0.8m and 1.6m in top and bottom width. A total of 600m temporary blockings will be set up.

Bill of quantity: woven bags filled with soil 862.50m^3, and the removal of woven bags filled with soil 862.50m^3.

3. Ecological Rehabilitation

1. Requirements of water and soil conservation

(1) Strengthen the construction management, and carry out construction in strict accordance with the engineering design and construction plan to reduce the time of earth surface exposure.

(2) During the implementation of greening works, temporary protection measures should be provided. If there is a sudden rain during the construction, take temporary sheltering and covering in a timely manner.

(3) Strengthen the management and maintenance of all water and soil conservation facilities, and check the operation status regularly during the construction to prevent problems from occurring or take remediations or corrective measures in time when there is a problem.

(4) Strengthen the management and protection of the afforested areas, no pulling or breaking off or trampling, and ensure replenishments and the survival rate of trees and grass.

(5) Set up no entrance or enclosure signage at exposed area to prevent treading and disturbance.

2. Layout and typical design of measures

(1) Engineering measures

① Topsoil stripping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. According to statistics, 13650m^3 of topsoil will be stripped.

(2) Vegetation measures

① Landscape greening

The riverbank greening on the both side of the embankment is included in the main design. stretches of suitable and ornamental aquatic plants will be planted in some river sections, such as Lythrum salicaria L., reed, Scripus Tabernaemontani and Typha orientialis Presl. The greening should highlight the ecological waterfront scenery for visitors to enjoy leisure, and provide science education. Create a colorful, richful, diversified riverside scenery. Based on calculations, the area of landscape greening will be 8.23hm^2.

8.2.2.6 Urban Public Transport Infrastructure from Mengding to Qingshuihe

1. Construction Site for Buildings/Structures

1. Requirements of water and soil conservation

(1) Prior to construction of foundations of structures/buildings, proper construction plan should be developed according to the geological structures stated in the design data and geo-survey report, and provide temporary drainage system and retaining measures around the area according to the topography and landform, which should follow the principle of drainage and blocking first.

(2) We should strengthen the management of engineering construction, and carry out construction in strict accordance with the engineering design and construction schedule, to reduce the time of surface exposure; the excavated soil during construction shall be transferred in a timely manner.

(3) The construction of the building foundation requires a lot of physical works, so the construction period should avoid rainy season when possible to reduce the water and soil loss.

(4) Clean up the construction site immediately upon completion of individual items of works to reduce the water and soil loss.

(5) Hang banners with slogans of water and soil conservation on the construction safety net during the construction, to publicize the policy of water and soil conservation and build awareness of every worker on the importance of water and soil conservation.

2. Layout and typical design of measures

(1) Engineering measures

① Topsoil stripping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. Based on calculations, a total of 780m^3 of topsoil will be stripped.

2. Roads and Hardened Areas

1. Requirements of water and soil conservation

(1) The construction should be in strict accordance with the schedule and sequence;

(2) The pavement and hardening should be implemented as early as possible according to the construction schedule to avoid the long period of exposure.

2. Layout and typical design of measures

(1) Engineering measures

① Topsoil stripping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before

trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. Based on calculations, a total of 3420m^3 of topsoil will be stripped.

② Storm water pipeline network

The design will provide storm water drainage pipeline at lower positions along the road, so that the ground rainwater will be collected at the gully inlet grate and enter the storm water pipelines through the grate, finally discharged into the head storm water pipe in Qingshui River Port Economic Zone from the storm water pipelines. The storm water inlets are set along the outdoor roads with an interval of 3m. The outdoor storm water pipelines will adopt rubber ring socket connection, with the diameter of DN300~600, and a total of 2000m storm water pipelines will be set up.

(2) Temporary measures

① Temporary drainage ditches

In order to prevent and control the rainfall to scour the site during construction, the design scheme will provide temporary drainage ditches for rainwater drainage during construction period. The ditches are arranged at the edge of the project area, and forms a loop along the edge, to collect and drain the surface rainwater in the whole project area. The outlet is connected with the temporary sediment tank, the rainwater, after sedimentation, will be drained into the municipal storm water pipe network which is planned to be built under the road. The drainage ditch adopts trapezoidal cross-section, with a depth of 0.3m, bottom width of 0.3m, inner slope proportion of 1:1. The flow face is compacted by shovel, and the earth excavation is compacted nearby (compaction coefficient is 0.85). Total 3240m temporary drainage ditches will be set up.

Total bills of quantity: earth excavation is 581.52m^3, and the earth compaction is 494.29m^3.

② Temporary sediment basins

In order to manage the sedimentation of the flow in the temporary drainage ditches, the sediment basin will be set up at the end of temporary drainage ditch. The

sediment basin adopts rectangular cross-section, with dimensions of a×b×h=3m×2m×1.5m, brick structure, including 24cm wall, 20cm bottom, and 12cm deceleration wall. It shall be cleaned regularly during the construction, and filled up after completing the construction. The bill of quantity for each sediment basin includes: earth excavation 12m^3 and the brick masonry 4m^3. A total of 10 sediment basins will be needed, the bill of quantity includes: earth excavation 120m^3 and the brick masonry 40m^3.

3. Area for Greening Works

1. Requirements of water and soil conservation

(1) Strengthen the construction management, and carry out construction in strict accordance with the engineering design and construction plan to reduce the time of earth surface exposure.

(2) Provide proper temporary protection measures during greening works. If there is a sudden rain during the construction, take temporary sheltering and covering in a timely manner.

(3) Strengthen the management and maintenance of all water and soil conservation facilities, and check the operation status regularly during the construction to prevent problems from occurring or take remediations or corrective measures in time when there is a problem.

(4) Strengthen the management and protection of the afforested areas, no pulling or breaking off or trampling, and ensure replenishments and the survival rate of trees and grass.

(5) Set up no entrance or enclosure signage at exposed area to prevent treading and disturbance.

2. Layout and typical design of measures

(1) Engineering measures

① Topsoil stripping

In order to improve the survival rate of the green seedlings during vegetation restoration, protect the quality of greening and topsoil resources, the mellow soil at usable layers of forest land and grass land within the site can be stripped before

trench excavation. The stripped topsoil should be stacked separately along the line with the backfill soil, and later used as the casing soil for vegetation restoration, so as to achieve reuse of the valuable topsoil and improve survival rate of the seedlings. Based on calculations, 1020m^3 of topsoil will be stripped.

(2) Vegetations measures

① Landscape greening

The main works also include greening measures where appropriate in the surroundings of the buildings and roads. The greening trees and grass species will adopt local ornamental trees and grass with beautiful shapes, which normally are evergreen trees, shrubs and grass, for a better effect of landscape greening and dust prevention. The greening will improve the environment in the project area while prevent water and soil loss. After calculation, the total greening area will be 0.72hm^2.

(3) Temporary measures

① Temporary cover

In order to minimize the washing by rainfall of the topsoil and trench backfill which is stacked in the construction site, the geotextile will be used as a temporary cover, with a covering area of 760m^2. It is covered by geotextile and can be reused.

② Temporary retaining/ blocking

The plan includes temporary earth stacking site to place the stripped soil. In order to prevent the loss of topsoil, the temporary blocking will be set up around the stacking site using woven bags filled with soil, the blocking height is 1.5m, trapezoidal cross-section, top width 1.0m, inner and outer slopes proportion of 1:0.3. Total 240m temporary blocking will be set up.

Bill of quantity: 540m^3 of woven bags filled with soil , and 540m^3 removal of woven bags filling with soil.

8.2.2.7 Prevention and protection measures for direct impact area

The direct impact area is in the range of 5m diameter outside of the construction zone. The construction activities may occupy, damage the original natural features, therefore the following management measures are developed in this plan:

(1) The construction shall use the land within the land acquisition scope as far as possible, and complete the construction activities within the construction area to reduce the disturbance to and occupation of the surrounding areas.

(2) Strictly implement the main works and measures designed in this plan to avoid water and soil loss impact on the surrounding areas, and additional water and soil loss therefrom.

(3) If there is occupation or disturbance occurred in the direct impact area, the waste and spoil shall be cleaned in a timely manner, and damaged water and soil facilities shall be restored.

8.2.3 Summary Bill of Quantities of Water and Soil Conservation Measures

The water and soil conservation measures for Yunnan Lincang Border Economic Cooperation Zone includes those measures in the design of the main works of different project components and those additional measures in this water and soil conservation plan.

8.2.3.1 Bill of Quantities from Those Measures in the Design of Main Works, which are included into the bill of quantities of this plan

Those measures from the design of main works of the project components that are included into this plan include: a. engineering measures: 60690m^3 of topsoil stripping, 3706m of storm water pipeline; b. vegetation measures: 3.76hm^2 of landscape greening, 10.40hm^2 of vegetation restoration, and 8.23hm^2 of greening. Details are provided in Table 5-6 and 5-7.

8.2.3.2 Additional Water and Soil Conservation Measures in This Plan

Additional temporary water and soil conservation measures included in this plan are: raw water transmission pipelines: 10 mobile sediment tanks; water treatment plant: 1500m2 of temporary cover, 500m of temporary drainage ditches, 1 temporary sediment basin and 160m of temporary retaining/blocking; water distribution networks: 10 mobile sediment tanks, 20000m2 temporary cover for temporary construction site of pipelines, and 6000m of temporary retaining and blocking; WWTP: 1200m2 of temporary cover, 686m of temporary drainage, 1 temporary sediment basin, 136m of temporary retaining and blocking; wastewater pipeline network: 5 mobile sediment tanks, and 5000m2 of temporary covering and 1124m temporary retaining/blocking for temporary site of pipeline construction; municipal solid waste management: road and hardened area-264m of temporary drainage, 2 temporary sediment basins; greening area-200m2 temporary cover, 22m temporary retaining/blocking; wastewater inception along the river: 20 mobile sediment tanks, 900m2 temporary cover, 600m temporary retaining/blocking; public transport infrastructure: roads and hardened areas-3240m temporary drainage, 10 temporary sediment basins; greening area-760m2 temporary cover, 240 temporary retaining and covering. Bill of quantities includes: 1009.76m3 of earthwork excavation, 715.61m3 of earth compaction, 56m3 brickwork, 29560m2 geotextile, 6.4t steel, 12358.75m3 woven bags filled with soil, 12358.75m3 for removal of woven bags filled with soil, details are provided in Table 8-3.

Table 8-3：Additional Water and Soil Conservation Measures included in This Plan

No.	Project area		Measures	Quantity（m^2/m）	Bill of Quantities						
					Earth Excavation（m^3）	Earth Compaction（m^3）	Brickwork（m^3）	Laying of Geotextile（m^2）	Steel（t）	Woven Bags filled with soil（m^3）	Removal of woven bags（m^3）
1	Water Supply	Raw water transmission	Temporary sediment tank	10					6.4		
		Water treatment plant	Temporary cover	1500				1500			
			Temporary drainage ditch	500	89.74	76.39					
			Temporary sediment tank	1	12		4				
			Temporary retaining	160						360	360
		Water transmission and distribution	Temporary sediment tank	10					unaccounted		
		Temporary construction site	Temporary cover	20000				20000			
			Temporary retaining	6000						8625	8625
2	WWTP and associated works	WWTP	Temporary drainage ditch	686	123.12	104.65					
			Temporary sediment basin	1	12		4				
			Temporary retaining	136						306	306
			Temporary cover	1200				1200			
		Associated wastewater pipeline	Temporary sediment basin	5					unaccounted		

		Temporary construction site for pipeline works	Temporary retaining	1124						1615.75	1615.75
			Temporary cover	5000				5000			
3	Solid Waste Management	Roads and hardened area	Temporary drainage ditch	264	47.38	40.28					
			Temporary sediment basin	2	24		8				
		Greening area	Temporary retaining	22						49.50	49.50
			Temporary cover	200				200			
4	Integrated River Rehabilitation	Wastewater interception	Temporary sediment basin	2					unaccounted		
			Temporary retaining	600						862.50	862.50
			Temporary cover	900				900			
5	Public Transport Infrastructure	Roads and hardened area	Temporary drainage ditch	3240	581.52	494.29					
			Temporary sediment basin	10	120		40				
		Greening area	Temporary retaining	240						540	540
			Temporary cover	760				760			
Total					**1009.76**	**715.61**	**56**	**29560**	**6.4**	**12358.75**	**12358.75**

9 Monitoring of Water and Soil Conservation

9.1 Monitoring objective and principles

9.1.1 Monitoring objective

According to stipulations and requirements of water and soil conservation laws and regulations, the implementing agency shall conduct water and soil conservation monitoring throughout construction preparation, construction, and construction completion, commissioning and operation. The objective of the water and soil conservation monitoring is to :

(1) understand the period, strength and spatial distribution of water and soil loss occurred in the project area, understand the effectiveness of the water and soil conservation measures, timely identify issues and provide corrective measures, ensure proper functioning of all water and soil conservation measures, and minimize water and soil loss.

(2) Provide reference for water and soil loss prediction and development of prevention and control measures for similar development and construction projects. The project site monitoring and results will provide basis for water and soil loss estimate modeling and identification of indicators. Meanwhile inspection and evaluation on the control measures included in the water and soil conservation plan will be conducted to improve the pertinence of the prevention and control measures system.

(3) Provide basis for water and soil conservation inspection acceptance. Through whole-process water and soil conservation monitoring, the objective is to evaluate the effectiveness of control measures during construction preparation, construction, production and operation, and to check whether the control targets set by the national prevention and control standards and this plan, and to provide basis for water and soil conservation inspection acceptance.

(4) provide data for water and soil conservation management and supervision. Based on the monitoring results, we can assess the vulnerable link in water and soil

loss during different stages of construction and spatial distribution, to provide basis for supervision and management and improve management capacity.

(5) Facilitate the implementation of water and soil conservation plan. Monitoring on the cause, quantity, strength, impact scope and consequences of new water and soil loss through ground monitoring, site check and survey monitoring will be conducted to evaluate the plan implementation and performance. Through monitoring and supervision, the inadequacy of the measures will be identified and improved, so as to perfect the water and soil loss control measures system.

9.1.2 Monitoring principles

Water and soil conservation is professional undertaking. According to water and soil conservation laws and regulations, the personnel for water and soil conservation monitoring shall prepare detailed monitoring rules and conduct monitoring in accordance with the Technical Specification of Water and Soil Conservation Monitoring (SL 277-2002) and the Specification of Water and Soil Conservation Monitoring for Production and Construction Projects (trial implementation), and report monitoring results to local authority as one of the basis for supervision inspection and acceptance. Therefore this plan only proposes the following principles according to the water and soil loss characteristics in the project area:

(1) Integrate macro and micro monitoring, and focus on regular monitoring. To fully understand the implementation status of the water and soil conservation measures;

(2) Integrate fixed monitoring points and temporary monitoring points, with a focus on temporary monitoring points.

(3) Arrange proper monitoring points according to the characteristics of the water and soil loss caused by the project.

(4) To timely, accurately and comprehensively reflect the water and soil loss control, water and soil loss dynamics and issues, to provide basis for water and soil loss control, supervision and management decision-making.

(5) Monitoring should be pertinent and operable, identify priorities, emphasize actual effectiveness; monitoring methods should be easy and economic.

(6) Monitoring contents, methods and periods should be determined as rational, economic and operable.

(7) According to the Management Regulation of Water and Soil Conservation Monitoring for Development and Construction Projects in Yunnan Province issued by the Provincial Department of Water Resources (No. 3, 2009), the project land occupation is over 10hm2, the monitoring items shall not be reduced.

9.2 Monitoring Scope and Period

9.2.1 Monitoring Scope

In order to understand the change of water and soil loss within the scope of responsibility for the prevention and control of water and soil loss if the entire project, the project construction area and direct impact area should be monitored. The monitoring scope is the responsibility area for the prevention and control of water and soil loss in this project, with the area of 85.64hm^2. The monitoring zoning is consistent with the zoning of water and soil conservation.

9.2.2 Monitoring Period

The monitoring period of this project is 3.67 years, including the construction period of 2.67 years (2018.04~2020.12) and natural recovery period of 1 year (2021.01~2021.12).

9.3 Monitoring contents, methods, frequency, and distribution of monitoring points

9.3.1 Contents of monitoring

(1) Water and soil loss baseline monitoring

① survey on the current land use in the project construction area and direct impact area

② Survey on the social and economic profile of the project area;

③ Survey on water and soil loss and conservation in the project area;

④ Survey on topography, geomorphology, climate and hydrology in the project area;

⑤ Survey on vegetation and soil conditions in the project area.

(2) Monitoring of water and soil loss

① Monitoring of disturbed area;

② Monitoring of the type and quantity of damaged water and soil conservation facilities;

③ Monitoring of area where water and soil loss occurred

④ Monitoring of earthwork quantity.

(3) Monitoring of water and soil loss hazard and major events

Provide early warning on the sites where may be damaged by water and soil loss, record the major events of water and soil loss. Check the damages caused by water and soil loss in the downstream area which caused by the construction, and visit the local people to understand the time and degree of the damage.

(4) Monitoring of the prevention and control of water and soil loss

① Monitoring on number of conservation measures implemented.

Monitoring on the conservation measures, including the number of the measures and area covered

② Monitoring on the quality of the prevention and control measures of water and soil loss

Mainly monitor the implementation standards and technical indicators of each measure; the stability, integrity and operation status of engineering measures, the survival rate, preservation rate and growth status of biological measures.

③ Water and soil conservation performance

Whether the prevention and control measures have been implemented in all areas where have water and soil loss, and whether the water and soil loss in the area has been effectively controlled after the implementation of all measures.

④ The implementations of supervision and management measures.

(5) Monitoring the elements of water and soil loss

9.3.2 Monitoring Methods

GPS survey, measurement, data collection and other methods are adopted for area of earth surface disturbance, area of water and soil loss caused, quantities of water and soil conservation bio-facilities damaged, earthwork; sediment basin and simple water and soil loss observation methods are adopted for amount of water and soil loss; site visit, interview, questionnaire are adopted for monitoring the impacts from water and soil loss on the production and living of the local people; census, GPS survey, sampling survey, data collection, sample-plot survey and site check are adopted for monitoring of water and soil control measures' performance. The monitoring methods for all monitoring indicators are provided in Table 9-1.

Table 9-1: Monitoring Contents and Monitoring Methods

Monitoring contents	Monitoring methods
Disturbed earth surface area	GPS survey, measurement, data collection
Number of water and soil conservation bio-facilities damaged	
Area of water and soil loss caused	
Quantity of earthwork and stability	
Water and soil erosion amount monitoring	Sediment basin monitoring, simple soil erosion observation
Monitoring the impact on local people's production and life	Inspections, visits, interviews, sample survey
Quality and quality of soil and water conservation and control measures	Census, GPS surveys, sampling, data collection, site investigation, inspection
Vegetation measures survival rate, preserving rate, growth and coverage	
Soil and water conservation performance after the implementation of control measures	

9.3.3 Monitoring frequency

According to monitoring codes, during construction period, monitoring will be conducted monthly during rainy seasons, and one additional monitoring in case R24h≥50mm; monitoring will be conducted on a quarterly basis during dry seasons. During natural recovery period, monitoring will be conducted on a bimonthly basis during rainy seasons, and quarterly during dry seasons, and additional one monitoring in case R24h≥50mm. Upon engagement, the monitoring agency will

conduct a comprehensive baseline survey on the water and soil loss of the project area and its surroundings.

9.3.4 Monitoring Points/Locations Arrangements

According to engineering characteristics and construction layout, the project is divided into 5 monitoring zones, i.e. water supply in Mengding Qingshuihe Port Area, wastewater treatment plant and associated works in Mending Qingshuihe Port Area, Qingshuihe River rehabilitation, and public transport infrastructure from Mengding to Qingshuihe. During construction, there will be a total of 36 monitoring points of all kinds; during natural recovery period, there will be a total of 11 monitoring and check points. Water supply component: 1 monitoring point at the water intake construction area of the water supply component, 3 monitoring points at the raw water transmission network construction area, 3 monitoring points at the water treatment plant, 3 monitoring points at the water distribution networks construction area, 4 monitoring points at the temporary site for pipeline construction, a total of 13 monitoring points; and 4 monitoring and check points during natural recovery period. WWTP component: 2 monitoring points at the WWTP construction area, 2 monitoring points at the wastewater pipeline construction area, 2 monitoring points at the temporary site for pipeline construction, a total of 6 monitoring points; and 1 monitoring and check point during natural recovery period. Solid waste management component: 1 monitoring point at the buildings and structures area, 1 monitoring point at the roads and hardened area, 1 monitoring point at the greening area, a total of 3 monitoring points; and 1 monitoring and check point during natural recovery period. Qingshui River Rehabilitation: 1 monitoring point at the flood control works, 2 monitoring points at the wastewater inception works, 2 monitoring points at the ecological rehabilitation site, a total of 5 monitoring points; and 2 monitoring and check point during natural recovery period. Public Transport Infrastructure from Mengding to Qingshuihe: 3 monitoring points at the buildings and structures area, 3 monitoring points at the roads and hardened areas, 3 monitoring points at the greening area, a total of 9 monitoring points; and 3 monitoring and check points

during natural recovery period. The monitoring of the direct impact area will be conducted through inspection checks, taking into account of the results at the monitoring points, and will not have separate monitoring points. It should be noted that the monitoring points arranged in this plan are initially proposed locations, the monitoring agency shall further select specific site within those locations to conduct monitoring.

10 Soil and Water Conservation Cost Estimate and Cost Effectiveness Analysis

10.1 Cost Estimate

10.1.1 Principles and Basis

10.1.1.1 Principles

(1) water and soil conservation plan is an important part of the project construction. The basis for cost estimate preparation, price level year, key works prices, costs calculations, etc. are the same as the project; the rest are calculated according to the Code for Preparation of Water and Soil Conservation Cost Estimate issued by the Ministry of Water Resources (No. 2003, No.67), including labor cost, machinery cost, materials cost and seedlings costs.

(2) Cost estimate for main materials are calculated according to the estimated prices of the project works.

(3) The construction methods of the water and soil conservation works are considered as regular construction organization.

(4) The already implemented water and soil conservation measures are not included into the total cost estimate of the water and soil conservation.

(5) The project area altitude is lower than 2000m, therefore the labor consumption and machinery consumption are not adjusted.

10.1.2.7 Total Cost Estimate

The total cost estimate for the water and soil conservation of the Project is CNY 8,702,500, including 3,825,200 for those water and soil conservation measures included in the project design, and 4,877,300 for those additional water and soil conservation measures in this plan.

The total cost estimate for the water and soil conservation of the Project is CNY 8,702,500, including 1,372,600 for engineering measures, 2,452,600 for vegetation

measures, 2,689,500 for temporary measures, and 1,462,300 for other costs (including 213,600 for water and soil conservation supervision and 940,400 for water and soil conservation monitoring), physical contingency of 249,100, compensation for water and soil conservation facilities of 476,400.

The cost estimate for water and soil conservation is detailed in Table 10-7 ~ 10-14.

Table 10-7 Total Cost Estimate for Water and Soil Conservation Measures Unit: CNY 10,000

No.	Name of Project or Works	Additional measures				Additional investment	Project works investment	Total
		Construction and installation	Vegetation measures		Independent costs			
			Planting costs	Seedlings fee				
I Engineering Measures							137.26	**137.26**
1	Water Supply						58.23	58.23
2	Wastewater treatment plant and associated works						19.47	19.47
3	Solid Waste Management						5.9	5.9
4	Qingshuihe River Rehabilitation						24.02	24.02
5	Urban public transport infrastructure						29.64	29.64
II Vegetation Measures							245.26	**245.26**
1	Water Supply						65.4	65.4
2	Wastewater treatment plant and associated works						16.32	16.32
3	Solid Waste Management						2.16	2.16
4	Qingshuihe River Rehabilitation						152.74	152.74
5	Urban public transport infrastructure						8.64	8.64
III Temporary Measures		268.95				268.95		**268.95**
1	Water Supply	192.13				192.13		192.13
2	Wastewater treatment plant and associated works	41.37				41.37		41.37
3	Solid Waste Management	1.70				1.70		1.70
4	Qingshuihe River Rehabilitation	17.71				17.71		17.71
5	Urban public transport infrastructure	16.05				16.05		16.05
6	Other temporary works	0.00				0.00		0.00

Total of I, II, III						268.95	382.52	**268.95**
IV Independent Costs					146.23	146.23		146.23
1	Construction management fee				5.38	5.38		5.38
2	Project supervision fee				21.36	21.36		21.36
3	Research and survey and design fee				13.45	13.45		13.45
4	Monitoring fee				94.04	94.04		94.04
5	Consulting service for preparation of the technical specification of water and soil conservation				2.00	2.00		2.00
6	Water and soil conservation plan preparation fee				10.00	10.00		10.00
Total of I to IV					146.23	415.18	382.52	**797.70**
V Contingency						24.91		24.91
VI Compensation for water and soil conservation facilities						47.64		47.64
VII Total investment of water and soil conservation		**268.95**			**146.23**	**487.73**	**382.52**	**870.25**

Table 10-8: Engineering Measures with Water and Soil Conservation Functions in the Project Design and Cost Estimate

No.	Project Zoning		Engineering measures									
			Measure	unit	Quantity	Unit price yuan	Total Price CNY 10,000	Measure	unit	Quantity	Unit price yuan	Total Price CNY 10,000
1	Water Supply	Raw water transmission	Top soil stripping	m3	10260	14.64	15.02	Storm water network	m	/	110	/
		Water treatment plant			7200		10.54			550		6.05
		Water distribution network			1260		1.84			/		/
		Temporary site of pipeline construction			16920		24.77			/		/
Subtotal					**35640**		**52.18**			**550**		**6.05**
2	Wastewater treatment plant and associated works	WWTP			7440		10.89			780		8.58
Subtotal					**7440**		**10.89**			**780**		**8.58**
3	Solid waste management	Buildings and Structures			150		0.22			/		/
		Roads and hardened areas			510		0.75			376		4.14
		Greening areas			540		0.79			/		/
Subtotal					**1200**		**1.76**			**376**		**4.14**
4	Qingshuihe River Rehabilitation	Wastewater interception			2760		4.04			/		/
		Ecological rehabilitation			13650		19.98			/		/
	Subtotal				**16410**		**24.02**			/		/

5	Urban public transport infrastructure	Buildings and Structures			780		1.14			/		/
		Roads and hardened areas			3420		5.01			2000		22.00
		Greening areas			1020		1.49			/		/
	Subtotal				**5220**		**7.64**			**2000**		**22.00**
Total					**60690**	**/**	**96.49**			**3706**		**40.77**

Table 10-9: Vegetation Measures with Water and Soil Conservation Functions in the Project Design and Cost Estimate

No.	Project Zoning		Plant measures	Unit	Quantity	Unit price yuan	Total CNY 10,000
1	Water Supply	Water treatment plant	Garden/landscape greening	hm²	1.50	120,000.00	18.00
2	Wastewater treatment plant and associated works	Wastewater Treatment Plant			1.36		16.32
3	Solid waste management	Greening areas			0.18		2.16
4	Urban public transport infrastructure	Greening areas			0.72		8.64
Subtotal					**3.76**	**/**	**45.12**
5	Water Supply	Raw water transmission	Vegetation restoration	hm²	3.42	50000.00	17.10
6		Water distribution network			0.42		2.10
7		Temporary site of pipeline construction			5.64		28.20
8	Qingshuihe River rehabilitation	Wastewater interception			0.92		4.60
Subtotal					**10.40**	**/**	**52.00**

9	Qingshuihe River rehabilitation	Ecological rehabilitation	Landscaping	hm²	8.23	180,000.00	148.14
Subtotal					**8.23**	**/**	**148.14**
Total					**22.39**	**/**	**245.26**

Table 10-10: Cost Estimate for Additional Water and Soil Conservation Measures in this Plan

No.	Items	Unit	Quantity	Unit Price (yuan)	Total (CNY 10,000)
(I) Engineering Measures					0
(II) Vegetation Measures					0
(III) Temporary Measures					268.95
I	Water Supply				192.13
(1)	Raw water transmission				3.84
1	Mobile sediment tanks				3.84
	Steel plate	t	6.4	6000	3.84
(2)	Water Treatment Plant				8.33
1	Temporary covering measures				0.40
	Geotextile	m2	1500	2.64	0.40
2	Temporary drainage ditches				0.44
	Earth excavation	m3	89.74	20.71	0.19
	Earth compaction	m3	76.39	32.93	0.25
3	Temporary sediment basin				0.21
	Earth excavation	m3	12	21.6	0.03
	M7.5 bricklaying	m3	4	454.43	0.18
4	Temporary retaining/blocking				7.29
	Bags filled with earth	m3	360	185.74	6.69
	Bags removal	m3	360	16.79	0.60
(3)	Temporary site of pipeline construction				179.96
1	Temporary retaining/blocking				174.68
	Bags filled with earth	m3	8625	185.74	160.20
	Bags removal	m3	8625	16.79	14.48
2	Temporary covering measures				5.28
	Geotextile	m2	20,000	2.64	5.28
II	Wastewater treatment plant and associated works				41.37
(1)	Wastewater Treatment Plant				7.32
1	Temporary covering measures				0.32
	Geotextile	m2	1200	2.64	0.32
2	Temporary retaining/blocking				6.20
	Earth bags	m3	306	185.74	5.68
	Bags removal	m3	306	16.79	0.51
3	Temporary drainage ditches				0.60
	Earth excavation	m3	123.12	20.71	0.25
	Earth compaction	m3	104.65	32.93	0.34

4	Temporary sediment basin				0.21
	Earth excavation	m3	12	21.6	0.03
	M7.5 bricklaying	m3	4	454.43	0.18
(2)	Temporary site of pipeline construction				34.04
1	Temporary retaining/blocking				32.72
	Earth bags	m3	1615.75	185.74	30.01
	Bags removal	m3	1615.75	16.79	2.71
2	Temporary covering measures				1.32
	Geotextile	m2	5000	2.64	1.32
III	Solid waste management				1.70
(1)	Roads and hardened areas				0.65
1	Temporary drainage ditches				0.23
	Earth excavation	m3	47.38	20.71	0.10
	Earth compaction	m3	40.28	32.93	0.13
2	Temporary sediment basin				0.42
	Earth excavation	m3	24	21.6	0.05
	M7.5 bricklaying	m3	8	454.43	0.36
(2)	Greening areas				1.06
1	Temporary retaining/blocking				1.00
	Earth bags	m3	49.5	185.74	0.92
	Bags removal	m3	49.5	16.79	0.08
2	Temporary covering measures				0.05
	Geotextile	m2	200	2.64	0.05
IV	Qingshuihe River rehabilitation				17.71
(2)	Wastewater Interception				17.71
1	Temporary retaining/blocking				17.47
	Earth bags	m3	862.5	185.74	16.02
	Bags removal	m3	862.5	16.79	1.45
2	Temporary covering measures				0.24
	Geotextile	m2	900	2.64	0.24
V	Urban public transport infrastructure				16.05
(1)	Roads and hardened areas				4.91
1	Temporary drainage ditches				2.83
	Earth excavation	m3	581.52	20.71	1.20
	Earth compaction	m3	494.29	32.93	1.63
2	Temporary sediment basin				2.08
	Earth excavation	m3	120	21.6	0.26
	M7.5 bricklaying	m3	40	454.43	1.82
(2)	Greening areas				11.14
1	Temporary retaining/blocking				10.94

	Earth bags	m3	540	185.74	10.03
	Bags removal	m3	540	16.79	0.91
2	Temporary covering measures				0.20
	Geotextile	m2	760	2.64	0.20
VI	Other temporary works	%	2	0.00	0.00
Total of (I) to (III)					**268.95**
(IV) Independent fee					146.23
I	Construction management fee	%	2	2,689,530.80	5.38
II	Construction supervision fee	item	1	213 600	21.36
III	Research and survey and design fees	%	5	2,689,530.80	13.45
IV	Monitoring fee	item	1	940 400	94.04
V	Consulting service for preparation of technical document of water and soil conservation	item	1	20,000	2.00
VI	Soil and water conservation plan preparation fee	item	1	100 000	10.00
Total of (I) to (IV)					**415.18**
(V) Contingency		%	6	4,151,797.96	24.91
(VI) Compensation fee		hm2	68.05	7000	47.64
(VII) Total Investment of Water and Soil Conservation					**487.73**

Table 10-11 Independent cost estimate Unit: CNY 10,000

No.	Name of Cost	Basis and calculation formula	Quantity	Price (yuan)	Total (10,000)
I	Construction management fee	2% of the sum of I and III	2%	2,689,530.80	5.38
II	Construction supervision fee	/	1	213 600	21.36
III	Research and survey and design fees	State Planning Commission, Ministry of Construction Pricing No.10 Document [2002].	5%	2,689,530.80	13.45
IV	Monitoring fee	/	1	940 400	94.04
V	Consulting service for preparation of technical document of water and soil conservation	/	1	2000	2.00
VI	Soil and water	actual contract price	1	100 000	10.00

	conservation plan preparation fee				
Total		**/**	**/**	**/**	**487.73**

Table 10-12 Water and Soil Conservation Facilities Compensation Unit: 10,000

No.	Project name	Unit	Area of water and soil conservation facilities damaged	Price (10,000)	Total price (10,000)
1	Soil and water conservation compensation	hm^2	68.05	0.70	47.64

10.1.2.8 Yearly Investment

According to the construction schedule of the project, design proper layout and implementation of the engineering measures, and fully utilize the water and soil conservation functions of the works, after acceptance of water and soil conservation measures, nurturing and maintenance shall be properly conducted to ensure effectiveness. According to the schedule of water and soil conservation works, the yearly investment in water and soil conservation is listed in Table 10-13.

Table 10-13 Yearly Investment of Water and Soil Conservation Investment

Unit: CNY 10,000

No.	Name of works	Total	By year	
			Construction period (2020.12 ~ 2018.4)	Natural recovery period (2021.12 ~ 2021.1)
I	Engineering measures	137.26	137.26	
II	Vegetation measures	245.26	245.26	
III	Temporary measures	268.95	268.95	
IV	Independent costs	146.23	132.47	13.76
1	Construction management fee	5.38	5.38	
2	Construction supervision fee	21.36	21.36	
3	Research and survey and design fees	13.45	13.45	
4	Monitoring fee	94.04	80.28	13.76

5	Soil and water conservation plan preparation fee	10.00	10.00	
6	Consulting services for preparation of the technical specification of water and soil conservation	2.00	2.00	
Total of I to IV		797.70	783.94	13.76
V	Contingency	24.91	20.16	4.75
VI	Soil and water conservation facilities compensation	47.64	47.64	
VII	Total investment of water and soil conservation	870.25	851.73	18.51

12 Conclusions and Recommendations

12.1 Conclusions

(1) Project Overview

Yunnan Lincang Border Economic Cooperation Zone is located in Qingshui River Port Economic Zone and Mangka, Mengding Town, Gengma County, Lincang Municipality. The administration jurisdiction is within Mengding Town of Gengma County. The geographic coordinates are: N23° 29′ 5.63″，E98° 49′ 58.58″, the project area is adjacent to the trunk road and secondary road (construction period 2017-2018), in the south, it is 0.4km from the highway Qingshuihe to Gengma County through Mengding included in the planning of Mengding Qingshuihe Port Economic Zone, 29km from Mengding Town, 83km from Gengma County, the traffic is very convenient.

Lincang Border Economic Cooperation Zone Investment and Development Company is responsible for project construction. The project proposal was approved by Yunnan Provincial Development and Reform Commission on December 30, 2016. The project is consisting of 5 components, i.e. water supply in Mengding Qingshuihe Port Area, wastewater treatment plant and associated works in Mengding Qingshuihe Port Area, solid waste management in Mengding Town and Qingshuihe Port Economic Zone, Qingshui River rehabilitation in Qingshuihe Port Area, urban public transport infrastructure from Mengding to Qingshuihe.

Project construction scope: (1)Water supply in Mengding Qingshui River Port Area: ①Water intake, including 1 new water intake structure of low dam type, and water intake capacity is up to 21,000 m3/d; ②Raw water transmission, DN700 pipelines for 32km, using ductile iron pipe and steel pipe with 2.5MPa pressure rating; ③ Water treatment plant: 20,000m3/d in the short term, a land area of 2.0hm2; ④ Water distribution network, DN200-DN700 pipeline for 33km; PE pipe with pressure rating of 1.0MPa. Total cost estimate for this component is CNY 166,879,800, including civil works cost of CNY133,691,600. (2)Wastewater treatment plant and

ancillary works in Mengding Qingshui River Port Area: ①wastewater treatment plant: with a capacity of 10,000m3/d, and an area of 2.48 hm2; ②wastewater pipelines: DN400-DN800 for 16.5km. Buble PE wastewater pipe is adopted for pressure flow, and steel band reinforced HDPE pipe is adopted for gravity flow. Total cost estimate for this component is CNY 63,019,300, including civil works cost of CNY48,657,800. (3)Solid Waste Treatment in Mengding downtown and Qingshui River Port Economic Zone: Qingshui river port area: In the port trade area, one new solid waste transfer station with a capacity of 27t/d and an area of 0.30 hm2, and to provide functions of parking and sanitation center; one collection station at the transport and logistics park and the production cooperation zone, with a capacity of 7t/d and 8t/d and a land area of 0.06hm2 and 0.04hm2, respectively; total cost estimate for this component is CNY 16,459,600, including civil works cost of CNY12,936,400. (4) Qingshuihe River integrated rehabilitation, sediment dredging, wastewater inception along the river, and river landscaping, total length included under this component is 1000m. Total cost estimate for this component is CNY97,025,600, including civil works cost of CNY72,390,100. (5) Public Transportation Infrastructure from Meng Ding to Qingshuihe: 10 charging piles/stations on the way from Mending to Qingshuihe Port and Mangka area, including 3 in Qingshuihe Port Economic Zone, 5 in Mengding Town and 2 in Mangka. Total cost estimate for this component is CNY 76,224,400, including civil works cost of CNY68,314,700.

According to the topographic map and land use status quo provided by the IA, and the requirements on land use categorization stated in Yunnan Provincial Department of Water Resources' Notice on Strengthening the Review and Approval of Water and Soil Conservation Plan for Production and Construction Projects, the project will require a land area of 68.05hm2 in total, including (divided by different project components and works): 37.57hm2 for water supply component (this includes 0.04hm2 for water intake, 7.68hm2 for raw water transmission, 2.40hm2 for water treatment plant, 4.28hm2 for distribution networks, and 23.17hm2 for temporary site for construction of pipelines); 10.77hm2 for wastewater treatment plant and

associated works (this includes 2.48hm2 for WWTP, 2.63hm2 for wastewater pipelines, 5.66hm2 for temporary site for construction of pipelines); 0.44hm2 for solid waste management component (this includes 0.09hm2 for buildings and structures, 0.17hm2 for roads and hardened areas, 0.18hm2 for greening areas); 12.67hm2 for Qingshui River Rehabilitation (this includes 2.44hm2 for flood control, 2.00hm2 for wastewater interception, 8.23hm2 for ecological rehabilitation); 6.60hm2 for public transport infrastructure (this includes 1.27hm2 for buildings and structures, 4.61hm2 for roads and hardened areas, and 0.72hm2 for greening areas). By land use nature, the project will require permanent land use of 22.63hm2 and temporary land occupation of 45.42hm2.

According to the project design data and site survey results, the project land use is estimated at 68.05hm2. Types of land occupied include forest land, grass land, construction land, transport land, slope cropland, waters and water facility land, of which 16.99h is forest land. It is estimated that 9798m3 of spoil will be generated from project construction.

Total project cost estimate is CNY419,608,700, including CNY 335,990,600 for civil works; the project fund will mainly come from ADB loan; the remaining will be provided by local government, as well as central, provincial and municipal government financial supports and self-raised funds by Lincang Border Economic Cooperation Zone Huitong Project Management Company.

According to the project design data, the construction period of the project is 32 months, i.e. commencement is scheduled in April 2018, and completion is scheduled in December 2012.

(2) Plan preparation phase, level year and control targets

This project is new construction project, design year is the year of construction completion or the first year after construction completion, the project is plan to commence in April 2018, and expected completion is in December 2020, design level year will be the first year after project completion, i.e. 2021. The plan preparation phase is the project feasibility study phase.

The project area is designated as national key areas of rehabilitation for water and soil loss in the southwest watershed and alpine valley region, and provincial key areas for rehabilitation of water and soil loss. According to the Water and Soil Conservation Standards for Development and Construction Projects (GB 50434-2008), the water and soil conservation for construction project will implement Class I standard. Considering the precipitation in the project area and native soil erosion modulus, the control targets are corrected as follows: disturbed land remediation rate 95%, total control of water and soil loss 97%, soil loss control rate 1.0, spoil retention rate 95%, vegetation restoration rate 99%, forest coverage rate 27%.

(3) Assessment on the project works

According to the project design: 1. Looking at the project location and surrounding ecological environment, the project site is not located within sensitive areas defined by the country, which is in compliance with the water and soil conservation requirements on project site selection set out in the Water and Soil Conservation Law of China, Water and Soil Conservation Regulation of Yunnan Province, and the Technical Specification for Water and Soil Conservation of Development and Construction Projects (GB 50433-2008), and No. 184 Document on Water and Soil Conservation (2007), the project construction doesn't present any constraints in terms of water and soil conservation; 2. the project engineering layout is rational, the construction organization design is feasible, the project construction doesn't require occupation of productive land including paddy field and irrigable land, the excavated earth during construction will be reasonable utilized to avoid generation of spoil, which are in line with water and soil conservation requirements; 3. Based on assessment on the water and soil conservation measures provided by the project design: the project design already incorporated water and soil conservation measures, which provides the functions of reducing scouring from runoff and conservation of water and soil, the prevention and protection measures in different zones/engineering areas are all in compliance with water and soil conservation requirements. Based on the actual situations of engineering construction, this plan

provide supplement to the project design for prevention and rehabilitation of water and soil loss, including engineering measures, vegetation measures and temporary measures, to develop a complete water and soil protection system. The water and soil loss will occur mainly during the construction period of the project, therefore the water and soil conservation measures in this plan focus on temporary measures during construction period, the design and implementation of temporary measures can effectively control and rehabilitate the water and soil loss during construction period.

To sum up, according to the characteristics of the water and soil loss newly generated during project construction and operation, based on the assessment of the water and soil conservation functions provided by the project design, and taking into account of the prevention and protection in different engineering areas, an ecological rehabilitation system which integrates engineering measures, vegetation measures and temporary measures will be established to minimize water and soil loss. The construction contractor shall implement the measures in strict accordance with the requirements of this plan, the project design doesn't present any constraints in terms of water and soil conservation, it is feasible and reasonable. The water and soil conservation priority of this project is to carry out proper temporary protection measures during project construction to prevent and rehabilitate the water and soil loss during construction, develop detailed design for those measures design in this plan during the stage of detailed design (construction drawings), construction activities shall complete within the project boundary lines to avoid impact on the surroundings, conduct regular checks on the water and soil conservation facilities during natural recovery, and strengthen the nurturing and maintenance of the greening.

(4) Water and Soil Loss Prevention and Rehabilitation Responsibility Scope and Zoning

The scope for water and soil loss prevention and rehabilitation includes project construction area and direct impact area. The total area for water and soil prevention and rehabilitation is 85.64hm2, including 68.05hm2 of project construction area and

17.59hm2 of project direct impact area. The scope is divided into two Class I prevention and rehabilitation area, i.e. project construction area and direct impact area; the project construction area is then divided to be Class II areas, including water supply, WWTP and associated works, solid waste management, Qingshui river rehabilitation and public transport infrastructures; each item is divided again into Class III areas.

(5) Water and Soil Loss Estimate

According to calculations and estimate, the project construction will cause disturbance to 68.005hm2 of the earth surface; damage to 21.97hm2 of water and soil conservation facilities; may cause 68.05hm2 of water and soil loss; the project construction will generate earth excavation of 426482m3, including 84900m3 from land leveling excavation, 125992m3 from foundation and trench excavation, 65910m3 from topsoil stripping; the project construction will generate backfill of 416684m3, including 60400m3 for land levelling backfill, 272821m3 for foundation and trench backfill, and 65910m3 for greening earthing. The stripped topsoil will be temporary stored at the planned earth stacking site for greening earthing. The project construction will generate spoil of 9798m3. During the estimate period, the project will cause soil erosion of 4124.41t, including loss of native soil 370.50t, and new soil loss of 3753.91t, the new soil loss during construction will mainly come from the ecological rehabilitation of river, followed by temporary site for construction of pipelines for water supply component, temporary site for construction of pipelines for WWTP component, roads and hardened area of the public transport infrastructure, greening area of solid waste management component. Those five areas should be the key areas for water and soil loss monitoring and prevention and rehabilitation.

(6) Water and Soil Conservation Measures General Layout and Bill of Quantities

Those measures from the design of main works of the project components that are included into this plan include: a. engineering measures: 60690m3 of topsoil stripping, 3706m of storm water pipeline; b. vegetation measures: 3.76hm2 of landscape greening, 10.40hm2 of vegetation restoration, and 8.23hm2 of greening.

Additional temporary water and soil conservation measures included in this plan are: raw water transmission pipelines: 10 mobile sediment tanks; water treatment plant: 1500m2 of temporary cover, 500m of temporary drainage ditches, 1 temporary sediment basin and 160m of temporary retaining/blocking; water distribution networks: 10 mobile sediment tanks, 20000m2 temporary cover for temporary construction site of pipelines, and 6000m of temporary retaining and blocking; WWTP: 1200m2 of temporary cover, 686m of temporary drainage, 1 temporary sediment basin, 136m of temporary retaining and blocking; wastewater pipeline network: 5 mobile sediment tanks, and 5000m2 of temporary covering and 1124m temporary retaining/blocking for temporary site of pipeline construction; municipal solid waste management: road and hardened area-264m of temporary drainage, 2 temporary sediment basins; greening area-200m2 temporary cover, 22m temporary retaining/blocking; wastewater inception along the river: 20 mobile sediment tanks, 900m2 temporary cover, 600m temporary retaining/blocking; public transport infrastructure: roads and hardened areas-3240m temporary drainage, 10 temporary sediment basins; greening area-760m2 temporary cover, 240 temporary retaining and covering. Bill of quantities includes: 1009.76m3 of earthwork excavation, 715.61m3 of earth compaction, 56m3 brickwork, 29560m2 geotextile, 6.4t steel, 12358.75m3 woven bags filled with soil, 12358.75m3 for removal of woven bags filled with soil.

(7) Water and Soil Conservation Monitoring

The scope of water and soil conservation monitoring is the area falls into the responsibility for water and soil loss prevention of the project, with an area of 85.64hm2. According to engineering characteristics and construction layout, the project is divided into 5 monitoring zones, i.e. water supply in Mengding Qingshuihe Port Area, wastewater treatment plant and associated works in Mending Qingshuihe Port Area, Qingshuihe River rehabilitation, and public transport infrastructure from Mengding to Qingshuihe. During construction, there will be a total of 36 monitoring points of all kinds; during natural recovery period, there will be a total of 11 monitoring and check points. Water supply component: 1 monitoring point at the

water intake construction area of the water supply component, 3 monitoring points at the raw water transmission network construction area, 3 monitoring points at the water treatment plant, 3 monitoring points at the water distribution networks construction area, 4 monitoring points at the temporary site for pipeline construction, a total of 13 monitoring points; and 4 monitoring and check points during natural recovery period. WWTP component: 2 monitoring points at the WWTP construction area, 2 monitoring points at the wastewater pipeline construction area, 2 monitoring points at the temporary site for pipeline construction, a total of 6 monitoring points; and 1 monitoring and check point during natural recovery period. Solid waste management component: 1 monitoring point at the buildings and structures area, 1 monitoring point at the roads and hardened area, 1 monitoring point at the greening area, a total of 3 monitoring points; and 1 monitoring and check point during natural recovery period. Qingshui River Rehabilitation: 1 monitoring point at the flood control works, 2 monitoring points at the wastewater inception works, 2 monitoring points at the ecological rehabilitation site, a total of 5 monitoring points; and 2 monitoring and check point during natural recovery period. Public Transport Infrastructure from Mengding to Qingshuihe: 3 monitoring points at the buildings and structures area, 3 monitoring points at the roads and hardened areas, 3 monitoring points at the greening area, a total of 9 monitoring points; and 3 monitoring and check points during natural recovery period. The monitoring of the direct impact area will be conducted through inspection checks, taking into account of the results at the monitoring points, and will not have separate monitoring points. It should be noted that the monitoring points arranged in this plan are initially proposed locations, the monitoring agency shall further select specific site within those locations to conduct monitoring. The monitoring period for the project is 3.67 years, including 2.67 years (April 2018 to December 2020) during construction period, and 1 year (January 2021 to December 2021) during natural recovery period. During construction period, monitoring will be conducted monthly during rainy seasons, and one additional monitoring in case $R_{24h} \geqslant 50mm$; monitoring will be conducted on a quarterly basis during dry seasons. During natural recovery period, monitoring will be conducted on

a bimonthly basis during rainy seasons, and quarterly during dry seasons, and additional one monitoring in case $R_{24h} \geqslant 50mm$. Upon engagement, the monitoring agency will conduct a comprehensive baseline survey on the water and soil loss of the project area and its surroundings.

(8) Water and Soil Conservation Investment and Benefit Analysis

The total cost estimate for the water and soil conservation of the Project is CNY 8,702,500, including 3,825,200 for those water and soil conservation measures included in the project design, and 4,877,300 for those additional water and soil conservation measures in this plan.

The total cost estimate for the water and soil conservation of the Project is CNY 8,702,500, including 1,372,600 for engineering measures, 2,452,600 for vegetation measures, 2,689,500 for temporary measures, and 1,462,300 for other costs (including 213,600 for water and soil conservation supervision and 940,400 for water and soil conservation monitoring), physical contingency of 249,100, compensation for water and soil conservation facilities of 476,400.

Through implementation of all kinds of prevention and rehabilitation measures, at the end of the design level year, the remediation rate of disturbed land in the project area will reach 99%, total rehabilitation rate of water and soil loss to reach 99%, control rate of soil loss to reach 1.55, spoil retention rate to reach 99%, vegetation restoration rate to reach 99%, vegetation coverage to reach 32.90%.

(9) Conclusions

The construction and site selection of the project do not present any constraints in the regard of water and soil conservation. The water and soil loss will accelerate during construction period, but it will be effectively controlled and rehabilitated through implementation of this plan. After project completion, the project area will be covered by buildings, structures, hardened surface, water and greening. The water and soil loss are micro in extents. The project construction can create ecological benefits, economic benefits and social benefits.

12.2 Suggestions

In order to achieve proper water and soil conservation for the project construction area and direct impact area, ensure “three simultaneous” between water and soil conservation measures and main project works, to effectively prevent potential water and soil loss during construction and operation. This plan provides the following Suggestions based on the project situation and characteristics.

12.2.1 Suggestions to the Design Institute

(1) The design institute of the project should conduct comprehensive and detailed analysis on the water and soil conservation measures provided by the project design, and make close coordination between project design and this water and soil conservation plan, optimize the drawings design, conduct further analysis on the rationality of the water and soil conservation measures, avoid overlapping and missing, to establish a complete, well-conceived water and soil prevention and rehabilitation system, increase the effectiveness of water and soil conservation measures, save engineering investment.

(2) Draw lessons, introduce good practices in water and soil conservation into this project.

(3) The additional prevention and rehabilitation measures proposed in this plan should be developed in more detail during the detailed design stage of the project.

12.2.2 Suggestions to the Construction Unit (IU)

(1) Establish and perfect management mechanism and supervision mechanism, strengthen the supervision and management on the effectiveness of the water and soil conservation plan; conduct monitoring and management of the implementation schedule, quality and funding of the water and soil conservation measures, ensure the engineering quality of water and soil conservation measures.

(2) Prior to the implementation of water and soil conservation measures, experienced construction contractor with strong technical capacity should be

selected, the water and soil conservation responsibilities of the construction contractor shall be clearly stipulated in the contract.

(3) In case of design change during project construction, design change should be made accordingly in the water and soil conservation plan, and report to authority for approval.

(4) The implementing unit shall actively establish communication with the local water administration authority, and receive its supervision and inspection, and report on a regular basis to the authority on the implementation status of the water and soil conservation, and comply with the “three simultaneously” system;

(5) Supervision agency to be engaged by the the implementing unit must have certain number of water and soil conservation supervision engineers (water and soil conservation certification is not necessarily required), the personnel on the supervision team shall have water and soil conservation engineer certificate or supervisor certificate;

(6) The implementing unit can engage qualified monitoring agency to conduct the water and soil conservation monitoring of the project.

(7) The leadership and management should be strengthened during construction, establish a leading group for the implementation of water and soil conservation, improve the awareness of the construction workers, make available of the funding for water and soil conservation, ensure effective implementation of the water and soil conservation plan.

12.2.3 Suggestions to the Construction Contractor

(1) The construction contractor shall carry out the water and soil conservation measures in the project temporarily occupied areas, focus on slope protection and temporary topsoil disposal in the construction area, and carry out greening works in a timely manner toward the end of the construction period. Strengthen temporary protection measures during construction, such as temporary drainage system.

(2) The construction contractor shall develop detailed implementation guidelines for water and soil conservation in the construction manual, and further

detail the water and soil conservation measures stated in the water and soil conservation plan and design documents, ensure management and supervision, and accountability.

(3) The construction contractor shall report in a timely manner if there are issued identified during construction, develop effective prevention and rehabilitation plan at the earliest, ensure smooth implementation and accomplishment of control targets.

(4) Emphasize the implementation of temporary measures during construction to minimize water and soil loss during construction;

(5) Pay attention to the protection of the land outside of the land acquisition scope, prohibit disturbance or occupation to the land outside of the land acquisition scope.

12.2.4 Suggestions to the Supervision Agency

(1) The supervision agency shall conduct supervision on the implementation of the water and soil conservation plan, ensure actual implementation of all measures in the plan; the supervision personnel or supervision agency shall submit to the construction management unit, implementation schedule and quality report.

(2) The supervision agency shall submit supervision report after completion acceptance of the water and soil conservation measures, the supervision report should meet the requirements of completion acceptance.

12.2.5 Suggestions to the Monitoring Agency

(1) The water and soil conservation monitoring agency should prepare monitoring design and implementation plan according to the water and soil conservation monitoring requirements in this plan, and organize the implementation.

(2) The monitoring agency shall report monitoring results to the implementing unit and water administration authority, and submit water and soil conservation monitoring report upon completion acceptance of the water and soil conservation

facilities, the monitoring report should meet the requirements of the completion acceptance.