DAK LAK PROVINCIAL PEOPLE'S COMMITTEE

SPECIALIZED PROVINCIAL PROJECT MANAGEMENT UNIT

TERMS OF REFERENCE
FOR
DETAILED ENGINEERING DESIGN

Subproject: Upgrading the Irrigation Systems for Watering Crops in Dak Lak Province

Project: Water Efficiency Improvement in Drought-Affected Provinces

DAK LAK, October 2019

LIST OF ABBREVIATIONS

GoV	Government of The Socialist Republic of Vietnam
ADB	The Asian Development Bank
SBV	State Bank of Vietnam
ADF	Asian Development Fund
ARP	Agriculture Restructure Policy
CPO	Central Project Office
DWR	Directorate of Water Resources
CMD	Construction Management Department
DARD	Department of Agriculture and Rural Development
HVCs	High-Value Crops
IMC	Irrigation Management Company
MARD	Ministry of Agriculture and Rural Development
MoF	Ministry of Finance
MPI	Ministry of Planning and Investment
PMU	Project Management Unit
PPC	Provincial People's Committee
PPMU	Provincial Project Management Unit
SPPMU	Specialized Provincial Project Management Unit
ToR	Terms of Reference
DMF	Design and Monitor Framework
IWR	Irrigation Watering Request
O&M	Operation & Maintenance
PAM	Project Administration Manual
PPTA	Project Preparatory Technical Assistance
RP	Resettlement Plan
TA	Technical Assistance
USD	US Dollar
WEAT	Water Efficiency Assistance Technology
WEIDAP	Water Efficiency Improvement in Drought-Affected Provinces

TABLE OF CONTENTS

LIST OF TABLES

1 PROJECT BACKGROUND

- The Project name in Vietnamese: "Nâng cao hiệu quả sử dụng nước cho các tỉnh bị ảnh hưởng bởi hạn hán" (WEIDAP/ADB8).
- The Project name in English: "Water Efficiency Improvement in Drought-Affected Provinces".
- Sponsor: The Asian Development Bank (ADB).
- Executing Agency: Ministry of Agriculture and Rural Development.
- Effectiveness Date: 26 June 2019.
- Implementation Period: From June 2019 to 31 December 2025.

1.1 Overview

The Water Efficiency Improvement in Drought-Affected Provinces Project integrates climate-resilient agricultural practices through a transformational shift in irrigation modernization, including (i) strengthening irrigation management to improve climate resilience, (ii) modernizing irrigation infrastructure, and (iii) supporting efficient on-farm water management practices. Specifically, the Project will modernize eight irrigation systems respectively eight Subprojects: Tra Tan, Du Du, Thanh Son - Phuoc Nhon, Nhon Hai - Thanh Hai, Suoi Dau and Cam Ranh, Dak Lak, Cu Jut, and Dak Mil in five drought-affected provinces: Binh Thuan, Dak Lak, Dak Nong, Khanh Hoa, and Ninh Thuan. The modernized systems will enhance the provinces' ability to manage climate variability, improve the water productivity of agriculture, and increase incomes by supporting farmers in growing high-value crops (HVCs) such as coffee, peppers, grapes, apples, dragon fruits, and mangoes.

1.2 Rationale

In Viet Nam, more than half of the irrigation systems operate below their potential capacity mainly because of the poor condition of the asset base. Inadequate and deferred maintenance is a leading cause of premature deterioration of irrigation infrastructure.

The southern central coastal and central highlands regions of Viet Nam are particularly vulnerable to climate change. A climate vulnerability assessment carried out for the project indicated that changes in precipitation will result in hotter and wetter wet seasons and hotter and drier dry seasons. The ENSO-induced drought in 2014−2016 was the most severe in 40 years. About 60,000 hectares of agricultural land in the central highlands was affected to varying degrees, including permanent loss of perennial crops such as coffee and pepper. The impact is most severe on smallholder farmers who rely on rainfed surface water sources for irrigation.

Water scarcity and economic factors have prompted farmers in the south central coastal and central highlands regions to grow HVCs that can withstand longer dry spells and are more suited to the changing agroecological environment. Notably, an increasing number of farmers are also adopting on-farm micro-irrigation practices such as drip or sprinkler systems. They do so primarily to reduce input costs, including labor, electricity (mainly for pumping of water), and fertilizer. Irrigation systems supporting HVCs and micro irrigation must be sufficiently robust to support the desired level of service, and flexible (able to irrigate only when required), reliable (able to deliver water at a specified flow rate and duration), and accessible (with a point of delivery within 1 kilometer of the farm gate). However, many irrigation existing systems were originally designed for rice and are inappropriate for HVCs.

To address the issue, the Project will combine an innovative solution of pressurized piped irrigation systems with high level technology that meets the level of service required by farmers growing HVCs. These will function like domestic water supply systems and provide water on demand through a system of hydrants and control valves, thereby giving farmers greater flexibility to control the amount and duration of irrigation. Piped distribution systems also allow operators to control and measure water more effectively and apply volumetric water charges. These are necessary conditions to improve efficiency and sustainability, particularly in the operation and maintenance (O&M) of systems, including through third-

party service contracts. Finally, piped systems are more resilient to extreme weather conditions and require less maintenance, making them more efficient and cost-effective in the long-term.

The uptake of on-farm micro-irrigation practices by farmers in the project areas is supporting a local micro-irrigation solutions industry. However, farmers lack awareness of and extension services to help them optimize micro-irrigation options and adopt good practices, including fertigation methods. The project will also strengthen the capacity of farmers to use and operate micro-irrigation techniques aimed at improving on-farm water productivity. Once the irrigation systems are fully operational, incremental production of HVCs such as dragon fruit, coffee, black pepper and mangoes are expected to boost incomes in the targeted provinces.

The Project aligns with key government policies, strategies, and laws, including (i) the government's agriculture restructuring plan; (ii) the Ministry of Agriculture and Rural Development strategy that calls for adopting advanced and water-saving irrigation techniques and technologies on 500,000 ha of upland crops by 2020 to improve productivity, decrease irrigation water use, and increase household incomes; (iii) the national climate change strategy; and (iv) the Law on Water Resources Engineering (2017), which allows for water pricing for irrigation services.

1.3 Impact and Outcome

The Project is aligned with the following impact: climate resilience and water productivity in agriculture improved.

The Project will have the following outcome: climate-resilient and modernized irrigation systems in five provinces established.

1.4 Outputs

Output 1: Irrigation management services strengthened. This output will support policy and institutional development measures to improve climate resilience of agriculture by strengthening irrigation management while taking social and gender dimensions in all relevant activities into consideration. Specifically, the Project will (i) install irrigation water

allocation and delivery services, including (a) surface and groundwater assessments, (b) an irrigation water-sharing and allocation framework, and (c) a real-time decision support system for farmers to optimize crop water application; and (ii) improve maintenance of irrigation systems, including (a) developing an asset inventory and management database for each irrigation system supported by the project, (b) developing a systematic asset maintenance schedule with a rigorous approach to funding based on asset condition assessments, (c) developing a water charge pricing framework, and (d) assessing options for engaging third parties in O&M of irrigation systems.

Output 2: Modern irrigation infrastructure developed. This output will modernize eight irrigation subprojects in the five provinces to provide water on-demand to farmers cultivating HVCs, reducing their vulnerability to climate change. The underlying principle of all systems is to provide a higher level of service - more flexible, reliable, and accessible supply of water to farmers than they currently receive. The infrastructure works include three broad categories: (i) pressurized pipe systems that connect canals or reservoirs with supply hydrants located in reasonable proximity to farmers' fields (enabling direct connection with a hose), with basic supervisory control and data acquisition systems to facilitate operations and monitoring of system flows; (ii) main system modernization, including canal lining, control structures, storage, and installation of flow control and measurement devices with remote monitoring; and (iii) new and improved weirs to replace temporary weirs constructed by farmers to provide storage from which farmers can pump to irrigate HVCs. Other works include upgrading culverts and farm roads to improve management of irrigation systems.

Output 3: Efficient on-farm water management practices adopted. This output will focus on improving on-farm water productivity in the subproject command areas to improve climate change resilience. Water productivity assessments conducted under output 1 will help determine suitable norms for different crops under different agroecological conditions. Based on this information, farmers will receive training and

advisory services to improve on-farm water management to cope with climate variability. The service providers will consult with and provide technical advice to male and female farmers to identify and develop appropriate micro-irrigation systems that meet their individual requirements. Farmers will also be linked with private sector suppliers and provided O&M training on micro-irrigation systems.

2 INTRODUCTION TO THE SUBPROJECT

2.1 General information

- The Subproject name: Upgrading the irrigation systems for watering crops in Dak Lak province.
- Name of the Sponsor: The Asian Development Bank (ADB).
- Implementing Agency: Project Management Board of Investment on Works of Transport, and Agriculture and Rural Development under Dak Lak Provincial People's Committee.
- Implementation time: until 31 December 2025.

The Feasibility Study for Dak Lak composite Subproject was approved by Dak Lak Provincial People's Committee at the Decision No. 06/QĐ-UBND on January 2, 2019. The Subproject comprises five separate irrigation systems. Each comprises an existing storage reservoir, from which water will be pumped to support high-value crop (HVC) production - primarily black pepper and coffee. The storage reservoirs also supply gravity canal systems with a mix of cropping, including paddy.

The modernized irrigation systems within the Dak Lak composite Subproject will enable increased and sustainable high-value cropping though efficient distribution and use of water from storage reservoirs. Cropped areas will expand and the pressure on groundwater use will be reduced. For farmers in areas where there is no groundwater, or where groundwater is not reliable, preventing investment in perennial crops, will be able to consider high-value perennial crops.

Improved monitoring and management of supply though a basic supervisory control and data acquisition (SCADA) systems will enable more efficient and productive use of water. The modernized irrigation systems, with assured irrigation water supplies, available at appropriate flows, will encourage farmers to invest in improved on-farm irrigation equipment, sprinkler and drip/ bubbler, allowing irrigation at non-social times, supporting crop production increases, and reducing labor and pumping costs.

2.2 Technical works proposed at the approved Feasibility level designs

The feasibility level design, which was approved by Dak Lak Provincial People's Committee at the Decision No. 06/QĐ-UBND on January 2, 2019, comprises eight new storage irrigation systems, taking water from five existing reservoirs, serving a total of 2,650 ha (Table 1). Seven of the irrigation systems are pump – piped systems. Engineering works include: (i) pumping stations, (ii) access roads to pumping stations, (iii) pressurized pipe systems supplying hydrants, (iv) header tanks as required, and (v) control and monitoring systems.

Table 1: Summary table of Irrigation Systems' parameters

Reservoir	Irrigation system		Area (ha)	length (km)		Density (m/ha)
	Supply	Distribution				
Ea Drang	New pump station	New piped	150	2,70		18,0
Buôn Yong	New pump station	New piped	451	8,51		18,9
Ea Kuang	New pump station	New piped	422	15,78		18,7
	Existing open canal	New piped	424			
Krong Buk Ha	New pump station	New piped	200	3,45		17,3
	New pump station	New piped	400	6,86		17,2
	New pump station	New piped	200	3,85		19,3
		New piped	200	3,31		16,5
Doi 500	New pump station	New piped	203	4,07		20,0
Total = 5	**8 systems**		**2650**	**48,53**		**AV 18,3**

- Irrigation systems are required to deliver the peak irrigation water requirement (IWR) in the critical month (April). The peak crop water requirement (CWR) for the pump-pipe systems, where coffee and pepper are the dominant crops, is 1.04 l/s/ha, taking into account conveyance-application efficiencies, and proving some operational flexibility. Details of the calculations are presented in The Design Principles for Subprojects.

- To cope with variations in reservoir water levels, about 8 m for Doi 500 Hill reservoir, and over 10 m for the Krong Buk Ha reservoir: (i) submerged turbine pumps, and (ii) surface motors, located above maximum reservoir water levels, are to be connected by, (iii) long vertical drive shafts. Each of the pumping stations would be provided with two operational pumps and one stand-by pump. Pumping heads range from 16 m to 55 m, motor capacities for 50 kW to 230 kW and transformer station capacities from 180 kVA to 800 kVA.

- The total capacity of the 16 operational pumps is 10,880 m^3/hr = 3,022 l/s and their unit design discharge is 3,022 / 2,650 = 1.14 l/s/ha. Therefore, the operational pump capacity includes a factor of safety of 10% as the required flexible system delivery capacity is only 1.04 l/s/ha. This is equivalent to pumping 22 hours/day instead of continuously 24 hours/day.

- Pressurized pipe distribution systems have been designed to meet the modern level of irrigation service adopted for the Water Efficiency Improvement in Drought-Affected Provinces Project. Pipe densities range from 16.5 m/ha to 20.0 m/ha and the average is 18.3 m/ha. Of the total command area, some 1,781 ha (67%) will have access to water within 250 m, 830 ha (31%) from 250 m to 500 m, and only 39 ha (2%) beyond 500 m.

- Each new pressurized ring (loop) pipe system will comprise a pumping station supplying water to a pipe distribution system, with 60 mm hydrant - manifolds to which farmers may connect. Farms within 0.5-1.0 kilometer (km) of the lake will not be supplied, as farmers here can and will continue to pump water directly from the lake/reservoir. The hydrants located at 50-100 meter (m) intervals along the pipelines will command 5-ha plots on either side of the pipeline.

- The Subproject will equip the piped sub-systems with 550 standard hydrant – manifolds, each with a 5 l/s design discharge. Therefore, the total design discharge of the 550 hydrant manifolds is 2.75 m3/s, which is very nearly the system design discharge of 1.04 l/s/ha x 2,650 ha = 2,756 m3/s.

- The average spacing of hydrant - manifolds will be less than 87 m to be confirmed at the detailed engineering design. Each hydrant - manifold will serve an area comprising about 6-10 households. Farmers will not pay a connection fee and will have one standard digital flow meter per connecting farmer.

- The design flows for each of the pumped pipe systems are based on 1.04 l/s/ha.

- The flow at each hydrant will ensure that all hydrants can operate at the same time supplying 5l/s. There will be several farmers connecting to each hydrant taking water in turns and as per their requirements. Sufficient flexibility shall be provided so that, generally, all farmers can irrigate within daylight hours.

- To facilitate operations, pressures and flows at key points shall be monitored - the pumps shall turn on/off depending on water levels in the

header tanks located at high points within the command area or on water pressures at pressure meters.

- For each scheme, a basic supervisory control and data acquisition (SCADA) system will be installed to monitor operations for both pressure pipe system and canal systems.

For pipe systems remote monitoring of pump operations, pressures and flows is proposed. The decision concerning local or remote read of flows at hydrants will be made following consultations between central and provincial authorities.

For canal systems water levels and flows will be monitored at a few selected points: reservoir, head of main canal, and balancing storage in tail of system.

Adoption of two sensors for important data is recommended, including data that inform reservoir releases and pump operations. Also, the sensor types should be different; e.g. piezometric (pressure) and ultrasonic sensors. An alarm signal shall be transmitted if the level or pressure readings are significantly different from each other.

It is expected that transmission of data/ coded signals from sensors – loggers/ remote terminal units (RTUs) to central control rooms (offices) and vice versa will use the Internet and the 4G/ 5G universal mobile telecommunication system (UMTS) or the latest mobile technology.

- The two largest schemes are Ea Kuang and Krong Buk Ha with gross areas of 1,206 ha and 927 ha respectively. Engineering recommendations focus on these two schemes, but principles for level of service and engineering design are common to all Dak Lak schemes.

2.3 General options for compensation, support and resettlement

2.4.1 Principles of implementation

- According to Section 2, Article 87, the Law of Land No.45/2013/QH13, Compensation, support and resettlement for special cases regulates that "For projects using loans from international organizations, foreign countries with which Vietnam has a commitment on compensation, support and resettlement policy frameworks follow that policy framework".

- Resettlement Policy Framework for WEIDAP Project is prepared as an independent document to implement the Government's resettlement policy, while meeting the requirement of involuntary resettlement policy upon request of ADB. Through research activities, consultation and analysis of policies, potential social impacts of the subprojects, the Policy Framework shall address mitigation measures and implementation rules of the Action Plan of Resettlement for the subprojects of the provinces in accordance with the existing government and Sponsor resettlement policies, legal practices and instruments.

- Contents of Resettlement Policy Framework (RPF) include:

+ The objectives and principles of appropriate policies as well as the requirements of safety policies required for the preparation and implementation of Subprojects or components;

+ Explain the potential impacts of Subprojects or components invested in the project;

+ The requirements shall be implemented to review, classify, evaluate and setup plan the project, including information and consultation on solutions related to vulnerable groups including women, any procedure of claims;

+ Describe the procedures including funding, organizational arrangements, and capacity building requirements;

+ Requirements for monitoring and reporting;

+ Determining clearly the responsibilities and powers of the parties related to the preparation, submission, review and approval of documents on social safety policies, monitoring the implementation of social safety plans.

- The Resettlement Action Plan (RAP) will be prepared for the subproject based on the Resettlement Policy Framework of the project. The RAP Implementation Plan for the subproject will be prepared and approved before the loan agreement is negotiated.

- The repair, upgrading and construction of new items will cause land acquisition impacts which affect to assets and livelihoods. Resettlement

Action Plan/Clearance Compensation Plan based on the principle of compensation/support to the losses of affected households must be fully implemented based on the principles included in the Resettlement Policy Framework of the project and the specific provisions set out in the approved Resettlement Action Plan.

- Preparation of Resettlement Action Plan reports aims to minimize involuntary resettlement by studying and designing alternatives, or in case the resettlement is inevitable, policies need to be developed to improve or at least restore the living standards of the affected people compared to the status prior to the implementation of the project, improve the living standards of the poor and affected or relocated groups. In case of the affected land and assets as mentioned above, the subproject Resettlement Action Plan should be prepared and approved by the competent authority before the signing of the Agreement. After the detailed technical designs are completed, the number of affected people shall be reviewed, compensation rates for all types of impacts and grants and grants shall be updated and both are detailed in the updated Resettlement Action Plan.

- In case the project components cause negative impacts on the livelihood of displaced people, support measures shall be applied during the implementation of the Resettlement Action Plan so that they can restore or improve living standards compared to the pre-project implementation. In the process of implementation, it will monitor to check how the livelihood restoration process is implemented, if it cannot be restored, additional support policies shall be applied so that they can recover soon their earnings and living standards.

- Related activities: This policy applies to all components of the project related to resettlement issues regardless of funding sources. This policy also applies to other activities related to resettlement:

+ Activities that are directly and seriously related to the project;
+ The necessity of achieving the project objectives;
+ Being implemented or planned simultaneously with the project.

- Method of valuation and compensation is a method used to determine the value of damage to use for compensation activities, support for impacts of land acquisition and resettlement of the project (replacement cost) applies to damages including damage to land, construction works, other assets and trees and crops damaged in this project. Compensation and resettlement units will survey, investigate and propose replacement prices for the affected land and structures (both agricultural land and residential land) and market prices for trees and crops that are damaged, this price is determined for the

calculation of compensation costs when the State acquires land. Replacement cost survey will be conducted when updating Resettlement Action Plan.

2.4.2 Responsibilities of agencies implementing compensation, support and resettlement

- Responsibilities for drafting and implementing Resettlement Policy Framework (RPF) and Resettlement Action Plan (RAP) are as follows:

+ The task of preparing and implementing the Resettlement Policy Framework belongs to the Central Management Board of irrigation projects. CPO will hire consultants, collaborating with relevant agencies including central ministries/departments, People's Committees of provinces/districts to participate in the project and the affected communities to proceed and set up the Resettlement Policy Framework. This Resettlement Policy Framework is approved by the Prime Minister and approved by the Sponsor prior to the negotiation of the Agreement.

+ The Resettlement Action Plan of the subproject shall be prepared by a social consultant hired by CPO and supported by the locality on the basis of the principles at the above Resettlement Policy Framework. PPC shall be responsible for approving and implementing this Resettlement Action Plan.

+ Funds for the preparation and implementation of compensation, support and resettlement of the subprojects shall come from the local counterpart fund.

- CPO is responsible for ensuring the effective implementation of the Resettlement Policy Framework and Resettlement Action Plan in coordination with and consultation with agencies at the same level and provinces participating in the Project.

- The implementation of resettlement activities requires the participation of local agencies and organizations at provincial, district and commune levels. PPC shall take overall responsibility for the implementation of the Resettlement Policy Framework and the subproject's specific Resettlement Action Plan. Compensation, support and resettlement committees shall be established at the provincial/district level in accordance with the provisions of Decree 47/2014/CP. The terms and policies of this Policy Framework and Resettlement Action Plans shall be the legal basis for implementing compensation and resettlement activities in the subproject.

a. Central level

- MARD on behalf of the Government is the project host which is responsible for overall management of the project. The People's Committees of the provinces in the project area are the investors of the subprojects under the project that are responsible for any decision of the investment of the

subprojects managed by the Ministry and the province. A Project Steering Committee (PSC) shall be established, consisting of representatives from the Ministry of MARD, and People's Committees of the project provinces are responsible for regularly monitoring and managing the Project during the implementation process.

- CPO whose representative is CPMU shall be responsible for monitoring to advise and supervise in order to ensure the compliance with the RPF and fully implement procedures for RAP of the project, including:

+ Coordinating with the provincial People's Committees to direct the implementation of compensation and resettlement which ensures the compliance with the provisions in the RPF and the construction schedule.

+ Training and capacity building for project implementing agencies (PPMUs and District Clearance and Compensation Committee) on the process of implementing RPF and RAP.

+ Coordinating with PPMUs to monitor internal implementation of compensation and resettlement of the whole project.

+ Selecting and coordinating an independent monitoring and resettlement unit for the whole project.

+ Periodically report on resettlement issues to MARD and ADB.

b. People's Committee of Dak Lak province

- PPC is fully responsible for the implementation of compensation, site clearance and resettlement within the province. PPC is responsible for:

+ Notify or authorize the district People's Committees to notify land acquisition right after selecting the subproject locations.

+ Issue decisions on land acquisition.

+ Approve on the Resettlement Action Plan (RAP) of the subprojects.

+ Approve on the overall compensation plan.

+ Directly guide the People's Committees of districts to implement compensation, resettlement and site clearance.

+ Grant sufficiently and timely fund for compensation payment.

- In special cases where provincial authorities need to approve the compensation plan, the Provincial Competent Authority establishes a Provincial Appraisal Council to assess compensation plans made by the Boards of Compensation normally, district-level support and resettlement are submitted to advise provincial authorities for approval in accordance with Government regulations on compensation, support, and resettlement policies applicable for the project.

c. Investor for the subproject

The Investor of the subproject is responsible for the management of the implementation of compensation, support and resettlement at the subproject, including:

- Make RAP and update RAP;

- Submit RAP to the Competent Authority for approval;

- Coordinate closely with the departments, agencies and People's Committees of the project districts in the implementation of compensation, support and resettlement to ensure appropriate compensation and resettlement implementation with construction and installation plans;

- Internally monitor to the implementation of compensation, support and resettlement of the subproject, quarterly reports on the progress of compensation, support and resettlement of the subproject for CPO.

d. At district level with projects:

District People's Committees have the following responsibilities:

- Approval of compensation, support and resettlement plans made by district-level compensation, support and resettlement units and submit them to provincial People's Committees for consideration and comments.

- Give decisions on land acquisition of individuals and households.

- Resolve complaints and grievances of the affected people within their jurisdiction.

- Units of compensation, support and resettlement at district level (hereinafter referred to as DRC) are responsible for implementing compensation and site clearance for works in the district, including:

- Prepare compensation plan to submit to the District / Provincial People's Committee for approval.

- Implementation of compensation and site clearance.

e. At the affected provincies/wards/towns and communities:

At commune / ward / town people's committee has the responsibility:

- Propagate and mobilize people to contribute to the resettlement policy framework and law compliance;

- Protect and regulate or use land and participate in protecting safety corridors of dams and reservoirs, maintaining security and order in the locality;

- Provide a map of land plots, determine the origin of land use for the Compensation Council and appoint officials to participate in the inventory of affected assets of households;

- Coordinate with the district level Compensation Council to organize information dissemination and community consultation;

- Settle any query/claim of the affected people related to their inventory.

- Facilitate and help the affected households to restore their livelihoods, incomes and stabilize their lives.

At Community level: The affected communities appoint their representatives to participate into the team of the affected asset inventory team to monitor the implementation process and sign the Household Inventory of the affected assets inventory.

2.4.3 Demand of land area

- Land for long-term use: 6,425 ha.
  + Area of pumping station and the roads for management.
  + Area of discharge pipeline, water storage tank and protective corridor for irrigation pipeline.
- Land for temporary use: 15,55 ha mainly is agriculture land.
  + Housing, warehouse and camping area.
  + Area of irrigation pipeline
  + Area of pumping station and discharge pipeline.

2.5 Total investment, sponsor fund and financial regime

2.5.1 Total investment amount

- According to the memorandum of March 2016, the subproject shall provide financial support for investment items from key works to irrigation management transfer points of WUGs, cost components supported by the subproject. The project includes:

- Costs for site clearance and compensation are paid to:

+ Compensation for long-term land acquisition of pumping stations and water pipelines;
+ Compensation for temporary land acquisition during construction;
+ Compensation for assets on land including infrastructure, houses, trees, crops...;
+ Support resettlement, fixed cultivation, stable production and daily life;
+ Costs for making compensation, support and resettlement plans, fixed cultivation;
+ Cost of implementing clearance and compensation.

- Construction costs are paid for construction preparation costs (clearing, clearing the ground); construction of construction items

(solidifying degraded canal sections, pumping stations and water pipelines), construction of camps and temporary works for construction.

- Equipment costs are paid for water level gauges, water pipelines, pumps and control devices, transformer stations for pumping stations.

- Project management costs paid for the organization of managing the implementation of project management jobs from the project preparation phase and project implementation to the completion and acceptance of the project, putting the work into utilization.

- The consulting costs will cover the preparation phase and the project implementation phase, including the cost of survey, design, phase verification, monitoring and verification.

- Other costs to pay for detection and destruction of boms, mines and explosive objects; construction insurance; construction deformation monitoring; audit, verification and approval of investment capital settlement; fees and charges as prescribed.

- Contingency cost includes volume and contingency provisions during construction.

Table 2: Total approved investment

NO.	CONTENT		VALUE AFTER TAX	COUNTERPART FUND	LOAN
1	Cost of construction		353.204.283.000	32.109.480.282	321.094.802.820
2	Cost of equipment		46.369.826.000	4.215.438.698	42.154.386.984
3	Cost of project management		5.517.755.000	5.517.755.000	
4	Cost of construction consultancy		20.622.505.000	9.193.444.068	11.429.060.827
5	Other costs		47.837.999.000	6.910.103.000	40.927.895.000
6	Cost of site clearance and compensation		10.735.253.000	10.735.253.000	
7	Contingency cost		60.987.179.000	12.181.329.000	48.805.850.000
	TOTAL INVESTMENT	**VND**	**545,274,000,000**	**80,862,803,000**	**464.411.996.000**
		USD	**23,303,000**	**3,378,000**	**19,925,000**

(In word: Five hundred and forty five billions, two hundred and seventy four millions Vietnam dong).

2.5.2 Sponsor Fund (Donation Fund)

- Loan from Asian Development Fund by The Asian Development Bank (ADB);
- Counterpartfund by Government of Vietnam as the budget fund at local province (Dak Lak province).

a. As for the loan

- To implement the project, using the Official Development Assistance (ODA) loan from Asian Development Bank, the loan budget is 19.925 million USD, equivalent to 84.78% of the total capital of the project. ODA capital shall be used mainly for: Detailed engineering design activities, construction, supply and installation of equipment.

- Based on commitments and memorandums of understanding between the Government and Sponsors, based on the demand for capital and reciprocal capacity of Dak Lak province, the financial conditions of the Sponsor refer to the International Development Association (IDA) that ADB is a member of.

b. As for counterpart fund

- The counterpartfund by Government of Vietnam from the local budget (the province participating in the project) is about 3.578 million USD (equivalent to 15.22% of the total project capital). The counterpart funds shall be used for compensation, support and resettlement costs; Cost of subproject management; Cost of investment consultancy.

- The provinces participating in the project will formulate, appraise and approve medium-term investment plans and commit to allocate sufficient capital.

2.5.3 Financial regime

- The subproject is a component of the project ofWater Efficiency Improvement in Drought Affected Provinces that have been agreed by the Government so the financial mechanism of the subproject will comply with the financial mechanism of the project regulated by the Government.

- The People's Committee of Dak Lak province is the investment decision level. The subproject will be responsible for allocating local budget for the task of spending from counterpart funds. The expected counterpart fund includes compensation, support and resettlement, consultancy and subproject management. The subproject uses borrowed capital through allocation and re-lending to implement the contents to support the strengthening of institutions and policies, building technical and economic norms;

construction and installation of canal systems, pumping stations and pipelines; implementing economical irrigation on the field.

- Strengthen the management and improvement of efficiency of public debt use in the spirit of Directive No.02/CT-TTg dated 14/02/2015 by the Prime Minister.

- Therefore, the proposed financial mechanism for the project is as follows:

- ***As for the loan***

- Total loan amount (ADB) is 19.925 million USD, equivalent to 464.412 billion VND;

In which:

+ Central budget allocates 80% of the total loan, equivalent to 371.53 billion VND, about 15.94 million USD;

+Local budget re-lends 20% of the total loan, equivalent to 92.882 billion VND, about 3.985 millionUSD.

- ***As for counterpart fund:***

The counterpart fund is 80.862 billion VND, equivalent to 3.378 million USD.

3 OBJECTIVES AND SCOPE, TASKS OF CONSULTING SERVICES

3.1 Objectives of consulting services

Objectives of consulting services are to prepare the Detailed Engineering Design for upgrading and modernizing the irrigation systems within Dak Lak Subproject based upon the WEIDAP Guidelines for Detailed Engineering Design, and in order for facilitating O&M, climate resilience and water productivity in agriculture improved, Irrigation management services strengthened (Output 1) and Efficient on-farm water management practices adopted (Output 3).

3.2 Scope of Consulting Services

The Scope of Consulting Services consists of, but not limited to the following:

- Studying further and Identifying, Proposing modifications/ options/ solutions for improving the feasibility study level designs.

- Supporting Dak Lak SPPMU (the Investor) to carry out necessary surveys.

- Preparing the detailed engineering design documents for the Subproject.

- Updating the Resettlement Plan and Preparing the Environmental Management Plan for the Subproject.

- Supporting the Investor in the process of submission and explanation of examinations and evaluation comments.

- Attending the study tour in Australia to visit the systems in the Riverland region of South Australia where the policy and institutional framework has been established, to increase water use efficiency in agriculture and developed pressure piping systems and/or water-saving irrigation technologies to be installed in the system.

- Organizing design workshops to report design options and consult the experts.

- Working closely with the project implementation support consultants, if recruited/ appointed.

- Regularly reporting the work progress to the Investor/ Dak Lak SPPMU.

- Providing the oversight of the detailed engineering design authors' right, etc.

3.3 Specific Tasks of the Detailed Engineering Design

The specific tasks of the Detailed Engineering Design include, but not limited to the following:

(i) Studying further and Identifying, Proposing modifications/ options/ solutions for improving the feasibility study level designs.
(ii) Determining what data to collect/survey and conducting surveys.
(iii) Preparing the detailed engineering design.
(iv) Updating changes in the detailed engineering design into the resettlement and environmental management plans, etc.

The Detailed Engineering Design shall be aligned with those in the approved the Feasibility Study and shall observe current design standards/ regulations. Specifically, designs of pressured pipe systems shall/ should observe the design standard: Water supply - Distribution pipeline system and facilities (TCXDVN 33:2006).

During the implementation process, the consultants must comply with the recommended standard frameworks for surveys and design as listed in the Appendix 01.

3.3.1 Studying further and Identifying, Proposing modifications/ options/ solutions for improving the feasibility study level designs

* **Construction sites and solutions**: Construction sites and solutions were suggested during the feasibility study phase. At the detailed engineering design, when the basic documents are collected, more detailed and full surveys will be needed for confirming the optimization of the selected locations and solutions. In case of any changes in the investment project preparation phase, there must be a valid argument. Also, basic documents/ data from the surveys and designed works must allow to ensures sufficient volume components (specifically, see Section 3.3.3).

For the pumped pipe systems, the pumped pipe system service (command) areas should be further refined to ensure that only high value (coffee and pepper) areas are included. Rice (valley) areas should be excluded.

* **Layout of headworks**: There shall be two options for the layout of headworks:

- Option 1 (FS proposed): Pumping into a header tank for subsequent gravity supply (by a pressurized pipe system).

- Option 2: Direct pumping into a main pipeline of a pressurized pipe system. As part of the detailed engineering design, this additional option shall be costed and compared.

Selecting the optimal option for the layout of headworks shall be based on technical and economic arguments/ evaluations, and the requirements for irrigation water delivery services: Equity, Reliability and Flexibility in

irrigation modernization projects. It is expected that header tanks will not be required and that the pumping stations shall deliver water directly into a HDPE pressurized pipe system supplying hydrants.

In case of selecting Option 2, pressurized pipe (ring) systems shall be adopted. A single small header tank may be located at the highest (and furthest) location in each pipe system, with pressures (or water levels) triggering pump operations. Alternatively, pump operations may be controlled by pressure sensors in the pipeline.

* **Map of irrigation areas**: For the irrigation areas of Ea Kuang reservoir, there is an item of lining of the old canal at the length of 3,860 m serving irrigation for nearly 400 ha of rice. Therefore, it is necessary to draw a map of the irrigation areas to serve the calculation of irrigation to ensure the control of self-flowing irrigation *(mapping the scale of 1/2000 contour of 1m).*

Other design improvements building on the feasibility study level designs are presented in the following appropriate sections.

3.3.2 Collecting hydro-meteorological data, conducting topographic and geological surveys

- Depending on the specific conditions of each Subproject, additional topographic and geological surveys, hydrogeological works and other data are required. All work must comply with relevant technical standards, regulations and norms.

- The purpose of construction survey work aims to provide topographic, geological, meteorological and hydrological documents for the design of the technical design phase of construction of pumping stations and primary irrigation the subproject of Upgrading the irrigation system for watering plants in Dak Lak province.

- The consultant should base on the quantity of meteorological, topographic and geological documents surveyed in the previous period to propose additional survey tasks in accordance with the accuracy requirements of documents in construction engineering design stage.

(The quantity composition of topographic and geological surveys conducted during the preparation of FS see Appendix 03)

3.3.3 Evaluating current available documents to propose necessary survey activities

Control of the surface at class IV, grade 2, coordinate system VN2000, control of the height of class IV - Hon Dau (Hai Phong) in accordance with current standards: Re-using the surface control and altitude has been implemented during the F/S phase to deploy the entire measurement area.

- The detailed engineering design will reuse the available topographic maps, including:

+ Topographic map in scale of 1/500 with 0.5m contour line in the area of headworks, water storage tank and management office;

+ Topographic map in scale of 1/1000 with 1.0m contour line in the area of reservoir (Doi 500 and Ea Kuang reservoirs);

+ Topographic map in scale of 1/1000 with 1.0m contour line in the area of pipeline systems;

- For topographic map of irrigation canal of Ea Kuang reservoir, the F/S phasehas not yet implemented. So, in the detailed technical design, it is necessary to measure the topographic map of 1/2000 with 1.0m contour line for this irrigated area.

- For topographic map of the roads for management,the F/S phase has not yet implemented. So, in the detailed technical design, it is necessary to measure the topographic map of 1/1000 with 1.0m contour line.

- For longitudinal sections, cross-sectiond of construction items that have not been implemented in the period phase of the sub-project, they will be measuredin the detailed technical design.

- Plugging the center of the works, monitoring benchmarks, and land clearance boundariesthat have not been implemented in the period phase of the sub-project, they will be measuredin the detailed technical design.

3.3.4 Identifying components and quantity of topographic survey work in the detailed design phase

3.3.4.1 Data collection

The work of collecting data is an important task which help the consultant have enough data to analyze and calculate in order to provide reasonable solutions when conducting surveys and technical design of construction details and construction works:

Data to be collected in the period of detailed engineering design include:

- Topographic maps of all kinds of structure (pipelines, pumping stations, water storage tanks, canals and main pipelines).

- Documents on control points (coordinates, altitudes, benchmarks).
- Other relevant survey materials.

3.3.4.2 Identifying quantity of all topographic survey work items

a. Horizontal control network

The horizontal control network in this phase is only built for measuring scale of 1/1000 with 1.0m contour line at the locations of materialyeard.

b. Technical leveling

The technical leveling is guided from the traverse network - grade 1 set up in the previous phase to the station points for the measurement of the topographic section of the construction items.

c. Topography of material yards at the scale of 1/1000 and contour line h= 1.0m

The location of material yards handed over in the field by the geological survey team leader, the areas for earth embankment and the works must be surveyed to determine the area and boundaries of crops. Quantity of surveying is 07ha (each survey area is 1ha).

d. Topography of benefit area

- The previous period has not implemented the basic design on the map with the scale of 1/10,000 combined with the road map of scale 1/1000. At consideration of the basic design plan and existing documents, it is shown that the irrigation system is mainly by pumping water. Particularly, Ea Kuang reservoir has a gravity irrigation canal that is solidified on the existing earthcanals. The irrigation area has a number of concrete canals and earth canals for irrigation. Therefore it is not necessary to measure the benefit area.

- Detailed engineering design consulting unit reviews and updates the survey data on the position map, the map shows the pipeline, irrigation canal and combined with the longitudinal and cross-section measurement data in the period serves the detailed design work.

- Proposing proposals if any.

e. Measuring longitudinal section

Measuring scope includes the system carrying water from the reservoir to the station, power lines, main pipelines, irrigation pipeline and the roads for management.

f. Measuring cross section

Cross-section measurement range includes the system carrying water from the reservoir to the station, the main pipeline, irrigation pipeline and the the roads for management.

g. Plugging the center of the works

Installation of work items includes the beginning and the end points and the turning points.

h. Determination of the boundary of land clearance.

The benchmark system is to determine the boundary of land clearance. It is necessary to define the boundary of the system carrying water from the reservoir to the station, pumping station, water storage tank, power line, feeder pipeline, main pipeline, irrigation pipeline and the roads for management ... for site clearance, make compensation fund.

- Ground accuracy determined by accuracy of grade 2.

- Height accuracy determined according to technical leveling.

- Benchmark size is 10x10x60cm concrete column with name and code number.

(Quantity table of topographic survey for detailed engineering design, see appendix 03).

3.3.5 Identifying components and quantity of geological survey work in the detailed engineering design phase

3.3.5.1 Collecting documents

- The existing documents of the items are only guaranteed to be evaluated at the locations with boreholes and excavation surveys. The distance and the number of survey positions does not guarantee the assessment for the entire route. During this phase, additional surveys are needed at the locations of pumping stations, water storage tanks, discharge pipelines, main pipelines irrigation pipelines and the roads for management.

3.3.5.2 Identifying quantity of geological survey items.

a. Digging the survey pit

- Excavation work is to determine stratigraphy, soil layer depth and take soil and rock sampling.

- The distance between excavated pits in the centerline of the pipeline is usually from 50 m to 75 m (at each of the abutments of the pressure pipe, manholes should have at least one survey pit) with a depth lower than the foundation expected process from 1m to 2m (or in medium weathered rock zone from 1 m to 2 m).

- The distance between excavated pits in the centerline of the road is 500 m. The depth of the surveyed pits must be deeper than the foundation expected from 2m to 3m.

- For mountainous canals with a flow of Q ≥ 0.5m^3/s, the distance of boreholes along the centerline of the canal is 100m to 200m/hole. The depth of boreholes, pit and pierced through the centerline of the canal should be lower than the canal bottom from 2m to 5m. In case the canal bottom is in soft and weak layer, the survey depth must pass that layer from 1m to 2m. If the weak soft layer is too thick, the survey depth must be greater than 2b (b is the width of the canal bank bottom) and greater than 1.5h (h is the height of the canal).

(Table of excavation work quantity, see to Appendix 03).

b. Drilling work

- Drilling work is to determine stratigraphy, soil layer depth and take soil and rock sampling.

- The depth of boreholes must pass the foundation level of the works from 3 m to 10 m and greater than 1.5B (with B as the foundation width).

- In case of encountering soft soil layer, there must be at least 1 hole to pass through soft soil layer and into a good soil layer below that not less than 2 m. In all cases, the depth of borehole does not exceed 15 times of S (with S as the depth of foundation buried from its bottom elevation). In case of encountering ancient alluvial layer, the depth of borehole must be deep into this layer of 5 m to 7 m.In case of encountering rock, this value is from 3 m to 5 m.

- Drilling work is arranged at pumping stations, water storage tanks. The F/S phase was surveyed with each location of 1 to 2 drill holes. In this phase, boreholes should be arranged at positions not yet surveyed.

(Table of drilling work quantity, see to Appendix 03).

c. Surveying at material yard

Each material yard is expected to dig 3 pits.Each pit has a distance of 200m each and 4m deep. It is expected that each area will survey 01 material yard. The digging volume is as 7 areas x 3 pits/ area x 4m = 84m.

d. Standard penetration test (SPT)

- SPT testing aims to serve the calculation of the soil bearing capacity, to check the status and structure of soil at the site, to be carried out in top soil and strong weathering rock layers.

- This testing is performed in the boreholes at the pumping station and water storage tank locations.

- Pursuant to TCVN 8477: 2010 - 7.3.3.6 In-room and outdoor testings - Standard Penetration test (SPT) in the remaining soil layers under the works. At each soil layer there are no less than 05 SPT values. Expected to have 3 layers of soil and volume of 15 times.

e. Testing sample with 9 criteria

- The testing sample with 9 criteria is to provide physical and mechanical parameter to serve the calculation of the stability of the works.

- Samples are taken in boreholes andpit. Samples to be taken must be representative of the entire stratum of the survey.

- Based on TCVN 8477: 2010 - 7.3.4. Main waterways: canal routes, tunnels (tunnels), water pipelines and river bank protection embankments, 7.3.4.3 Water tunnel, water pipeline, pressure pipe and 7.3.5 Other works: Hydroelectric power plants, power distribution stations, management office, road serving for construction and electric lines. Testing soil samples from 6 to 10 samples each.

(Table of experimental work of undisturbed soil samples, see Appendix 03).

f. Testing rock samples

- The purpose is to determine the compressive resistance intensity of rock samples in natural state and saturated state.

- Samples are taken in boreholes at pumping station and water storage tank locations. It is expected to have 1 weathered rock layer / 1 hole, 1 sample for each hole.

- Total rock samples is 2 samples.

g. Testing to determine standard compaction criteria, soil properties of material yards

- Samples are taken at material yard locations. The sample is non-intact. Serving the earthworks at the lower elevations than the required elevation, each material yard is expected to have 1 usable layer of soil, each layer will take 3 compaction samples, 3 prepared samples. Survey quantity is as follows:

- Standard compaction model: 24 samples

- Preparation testing: 24 samples.

(Summary of geological survey quantity in the detailed engineering design phase, see Appendix 03).

3.3.6 Preparing the detailed engineering design

3.3.6.1 Checking Required hydrological and irrigation calculations

- Check and evaluate the calculation data in the phase of preparing the FS report;

- Irrigation calculations are carried out for engineering items, pumping stations, hydraulic pressure pipes and dams, canal systems and related items to determine/confirm the size of items as well as to evaluate options/technical solutions to improve/modify feasibility level design.

- The design flows for each of the pumped pipe systems are based on 1.04 l/s/ha. The required capacity may be reassessed/ confirmed at detailed engineering design.

3.3.6.2 Requirements for hydraulic work calculations of pressurized pipeline systems

- Hydraulic diagram and software for hydraulic calculations: Calculation of hydraulic works of focal points; calculating hydraulic piping hydraulic by Epanet or WaterGems software unless other is approved.

- Outputs of hydraulic problems: Determination of size and elevation of intake pump tank, pipeline, push pipe; determine the size of the irrigation pipe.

3.3.6.3 Requirements for calculations of the detailed engineering design

a) Calculating and selecting types of pumping station and pumps

- Calculating and selecting the type of pumping stations:

The feasibility designs has proposed on-shore pumping stations with vertical turbine pumps. Due to large reservoir water level fluctuations, these are expensive structures with long intake channels. As part of the detailed design, for each reservoir, to select the type of pumping station, the consultants must study and design two types of pumping stations - the following additional options shall be costed and compared:

(1) Off-shore floating pumping station: placed in the middle of the reservoir, this type of station is suitable when the difference in the water level between normal water level and dead water level is high.

(2) On-shore pumping station but with submersible pumps, as well as vertical turbine pumps: This is a type of pumping station located on the reservoir's edge. The type of pumping station is suitable when the difference in the water level between normal water level and dead water level is small.

After designing, it is necessary to analyzing the advantages and disadvantages of economic conditions, construction, operation management, etc. so that the most appropriate type of the pumping station can be applied to each reservoir within the Subproject.

- Calculating and selecting the number of pump units and types of pumps (vertical, horizontal, submersible ...) in the pumping stations: The consultants must consider a problem on the management of irrigation operations to compare and select the number of units (02, 03 or 04 units). The chosen the number of pump units and types of pumps must be the logical ones in the operation management and it must be the most energy-saving planning.

It is recommended that at least one of the pumps provided shall be variable speed using a variable-speed (inverter) for flexibility and energy efficiency.

- For Krong Buk Ha – east, where two separate areas are supplied, the options of two pumping stations, or just one shall be costed and assessed.

b) SCADA systems

- SCADA systems shall allow remote monitoring of water levels, pressures, flows and water meter reading data at appropriate points in the reservoir, on pipeline and open channel systems, in the header tank supplying water for pipe systems, in the main pipeline leading from the pumping stations, at all/ hydrants. Pumping stations shall also be monitored. The operation of the pumps shall be linked to pipe pressures.

- SCADA systems shall link the pumping stations, monitoring stations at the fields, the water measurement system and the central control office via the Internet and the 4G/ 5G universal mobile telecommunication system (UMTS) or the latest mobile technology. The central office shall be located, rehabilitated and equipped as required with server/ computer/ devices/ Internet/ UMTS connections, software, databases and so on.

At the detailed engineering design, the consultants shall consider further:

(i) The transmission of data/ coded signals from sensors – loggers/ remote terminal units (RTUs) to central control offices and vice versa should use the Internet and the 4G/ 5G universal mobile telecommunication system or the latest mobile technology;

(ii) Real time SCADA and applications of Internet of Things (IoT) technology shall be considered;

(iii) The Websocket protocol/ technology shall be applied for real time SCADA systems;

(iv) SQL Server and ArcGIS databases will be very useful for control and management as well as maintenance of pressure pipe systems, etc.

(4) SQL Server and ArcGIS Database will be very useful for control and management as well as maintenance of pressure pipeline systems, etc.

c) Calculating and selecting types of push pipe material and economic diameter

- The push pipe will have to prepare from 02 to 03 plans for materials used (the recommended materials can be: Steel, HDPE or Composite ...).

The choice of pipe material (steel, HDPE, composite...) will depend on topographic, geological, economic analysis, advantages and disadvantages. The pipe diameter is determined through the calculation of the economic diameter, the optimum velocity in the pipe ranges from 0.7 m/s to 1.2m/s.

d) Calculation and selection of header tank capacity (In case of selecting Option 2)

- The determination of header tank capacity should be based on the following problem: (1) The tank is responsible for directly regulating irrigation water supply and operating pumping stations through water level sensors (Irrigation pipes will take water directly from the tank); (2) The tank has almost no use for regulating irrigation water (the irrigation pipes will then be connected directly to the pump). With this option, the tank has only

the task of operating the pump and storing a certain amount of water to provide irrigation in case the pump fails to operate.

- Irrigation characteristics of the project area are manual, scattered, spontaneous and unstable

- Irrigation area is small and scattered make it difficult to manage (some households have 5 ha but some others have 0.5 ha...)

Therefore, there must be a header tank with the main purpose of supporting the initial operation of the pump, after the irrigation system has stabilized the water inlet valve on the tank will be closed.

The selection of tank capacity should be based on the operation problem of the irrigation pump to choose the most appropriate plan. It is recommended that the tank should have a capacity of at least 20 minutes to 30 minutes pumping with all units.

e) Electricity supplied to the station

- A suspended or on-ground substation will be located in the area of management and operation. The capacity of the station must be calculated to ensure the operation of the pumping station.

- Connection: The connection point is taken at the local medium voltage line passing through the pump station area and there must be an approved connection dossier. Medium voltage 22 kV transmission line will be built from the connection point to the substation.

f) Irrigation/ distribution pipe systems

It is a closed-loop HDPE pipe system that is responsible for transferring water to the irrigation area. The system includes the following components:

(1) HDPE pipes (main distribution pipe): Closed-loop design to increase flexibility in water supply. The pipeline is arranged in the irrigation area to ensure that at the outlet points on the pipeline, the farmers there when connecting their pipes to irrigate fields ensure that the farthest pipe distance is no longer than 500m. Length of distribution pipe should not be more about than 20m/ha. The pipe diameter is determined through hydraulic calculation (by EPANET) to ensure that the velocity in pipe is between 0.30 m/s and 2.5m/s. At the hydrant outlets, the designed water column is at least 2.5m for

gravity systems when the flow control valves are not required, and at least 10m for the pressure piping system, The flow at each hydrant shall be 5l/s when the system is operating at the designed flow. After determining the pressure in the pipe corresponding to the design flow, the chosen pipe type must be able to withstand pressure greater than 1.5 times the design pressure.

(2) Hydrant-Manifolds (for farmer hose connections):

It is the location on the water distribution pipeline that farmers put their hoses to take water to irrigate the field. The consultants will have to go on a field trip, hold a consultation meeting with the local people/ farmers and the beneficiary area to find the most suitable location for connecting, avoiding disputes later on.

Technically: Each hydrant will be designed with a flow of 5l/s ± 10% when the flow in pipe is at the design flow. The design of hydrant is designed to be 63mm in diameter and the loss of water columns through the manifolds is about 6.5m. On each manifold will be installed 1 flow meter, 8 water distribution pipes and water meters. It can be done in the following ways:

- Adjust the diameter of the hydrant so that when it is installed in the main pipe, there will be a water column corresponding to the designed flow. This method is cheap and farmers can get a larger flow if others do not, but when taken with smaller flow than designed will have excess water column.

- Installation of pressure reducing valves on the main pipe so that the pressure at each hydrant with the same design flow, but this will also cause loss to the water column at the taps. This method can be applied at some water intake points that have too much pressure.

- Install a valve to control the constant flow of each hydrant, this way all the hydrant has the same design flow, but it also limits the ability to take water when others do not, but it does not cause loss to the water column.

Consultants will have to base on specific conditions in each case to choose the most reasonable and cost-effective design.

- Cost effective hydrant - manifolds designs shall be adopted so that hydrant flows are +5 l/s for a range of residual heads at design flow with metering and flow control devices. Direct fuse connections are envisaged

between the main HDPE pipeline and the off taking pipe. Adequate protection against tampering shall be considered. Further, constant flow valves shall be adopted at hydrants.

- Relating to minimizing deposit in pipes and suspended materials in water for micro-irrigation systems, farmers may tank up micro-irrigation (drip/ sprinkler) from the pressure pipe hydrants (outlets), and appropriate arrangements need to be made to prevent ingress of sediment. This is likely to require screens at the pumping stations.

(3) Arrangement of measuring and control equipment on pipelines:

- Main isolation valves (closed/open) to control the flow will be located at the pumping station, and at strategic locations where it may be desired to cut off flow for maintenance. They will also also be provided at each hydrant and for the manifolds.

- Air discharge valves will be arranged at high points and certain distances along the pipelines.

- The sediment discharge valves will be arranged at low/sunken points and/or at the end of the pipe or through the cutting points through rivers and streams.

- At the Hydrant-Manifold and 8 distribution pipes of each manifold must have a simple flow regulating valve (globe valve).

- The requirement for valves shall be firmed up at the detailed engineering design, and will include air valves at intervals/ high points along the pipelines, washout valves at gully crossings, and flow control valves to allow parts of the pipeline to be isolated.

- Pressure measuring devices may be arranged at water outlet points for single branch pipes, at the end of each pipe and connected to:

+ The sirens when broken pipes or incidents occur.

+ Instant display tables.

+ The pumps.

- Flow measurement requirements:

For overall pipe system: continuous monitoring relayed to central office/ control at following points: (i) head of main pipeline, (ii) several

strategic points around the system to enable monitoring of water use/ distribution and to identify any leaks.

Hydrants: continuous monitoring relayed to central office is ideal, but if this is too expensive, a few of the remote reading type shall be installed, with locally read meters installed at other locations. This will enable operators to see if some areas are getting disproportionally more flow and can allow adjustments to be made.

Individual farmer meters: local read for sharing purposes and post-paid charging if this is envisaged.

At the detailed engineering design, the consultants shall consider the use of smart water meters likely RTUs to measure water at the farm offtakes, together with one of communication technologies, especially the Narrowband Internet of Things (NB-IoT). NB-IoT uses an existing infrastructure of antenna sites used for mobile communication (LTE) today. NB-IoT is optimised for good coverage and very small data amounts. This makes NB-IoT interesting for remote reading of smart water meters, which are often installed underground or in stell/ plastic boxes, etc. Remote reading NB-IoT systems can read water metering data from smart water meters.

g) General requirements for hydraulic calculation and design

In addition to the specific requirements for each of the items above, the following general requirements for hydraulic calculation must also be complied with:

- Check and repair structural items, design criteria and design standards of approved items in previous periods;

- Confirm the optimization of the tasks and measures of items identified in the investment project;

- Carry out additional design work to improve the technical works that are determined to be feasible: In case of need to adjust and supplement the tasks and structural measures of the project, it is necessary to recalculate and redefine requests for items in order to have explanations for such adjustments and additions;

- For the proposed technical solutions, it is necessary to study and find solutions to treat the ground in accordance with the geological conditions,

select the size of the structure and measures according to the principle of making the best use of the local materials and easy construction;

- Design and accurately arrange the layout of the main items, including pumping stations, power stations, low voltage lines, intake sump tanks, push pipes and discharge tanks, canals, input items, pipelines and related items according to the landscape architecture planning for works and in line with the road system, in the subproject area;

- Review the location choices of items in the previous phase in the subproject area to select the optimal location;

+ Basis of choice: Characteristics of categories, natural and social conditions, management requirements...

+ Selecting places to design;

+ The overall layout of items according to each location's options;

+ Possibility of land acquisition and resettlement (if any);

+ Determining the basic size of items;

+ Calculation and analysis to select the optimal category position.

- Select and approve on the best technical plan: Technical plans will be presented and approved by the relevant authorities as prescribed, then the detailed engineering design will be carried out. Based on the approved basic design in the preparation of the Feasibility Study Report, adjustments and additions to the project's structural tasks and measures (if any) and the optimal structural location select and give the main part of the pumping station: Based on the approved items in the step of preparing the feasibility study report, adjustments and supplements to the tasks and structural measures of the project (if yes) and the optimal category position is selected, to calculate and select the optimal size and item of the works, item details and categories and items and select the optimal solution for foundation treatment.

- Check to correct the ratio and basic dimensions of the structures, calculate the stability of the structures.

- Calculate the stability of items of pump houses, suction tanks, propellers, water storage tanks, managers, roads and other auxiliary facilities.

3.3.6.4 Requirements for roads and management office

a. Requirements for traffic roads

- Determine the cross section for the road according to rural road standards - design requirements: TCVN10380-2014.

- Visits to review the current status of the road to serve the design requirements based on the following principles:

+ The road must meet favorable connection with existing roads and construction items, serving for project management and operation.

+ Considerate to make full use of the existing road and construction road to upgrade and expand to meet the design requirements before new construction.

+ Must take advantage of the available local materials (or on-site materials) into the road and structure.

- Regarding the roadbed compaction level, permissible settlement of the road bed must comply with current standards.

- Crossroads at intersections and crossroads need to be arranged with curved radius in accordance with the standard to ensure visibility for vehicles to run.

- Signage pile system, road markings, protective guardrails, and metal structure detailed drawings (if any).

b. Requirements for management stations

- Determining main items, service area to meet management requirements.

- Reasonable and convenient location for stations to connect with the main works.

- Designed in accordance with local architecture and regional landscape to meet requirements.

c. Requirements for Access roads

For access roads, at least to reach the pumping stations, shall be designed and costed.

3.3.6.5 Requirements for mechanical designs

- Assign requirements to calculate and select items of lifting equipment including location, structure size of lifting equipment for each structure; calculating lift, lowering force and lifting equipment for buildings;

- Select type and layout of crane structure in pumping stations.

- Calculation and selection of materials for water pipeline (steel, HDPE), pipe thickness.

3.3.6.6 Requirements for electrical design

It is necessary to calculate the power load of the project (pumping station, manager), the load for the construction work (the whole construction

site) as a basis for asking the power source and connection point, and working with the Electricity Company. Local to locate the connection point, voltage level and the length of the power line to operate the project management and provide electricity for construction.

Design and calculate the main items and set up premises and records of power supply lines for the work of pumping stations, including traverse lines and substations.

Electrical works to provide necessary 3-phase power to each pump station need more accurate design and costing.

Low voltage system design including main electrical connection diagram; Engine control, measurement and protection diagrams to open and close pumping stations, diagrams of monitoring and communication systems, lightning protection systems and grounding systems.

3.3.6.7 Requirements on design of construction organization and construction method.

- Optimal method of exploiting and transporting construction materials.
- Method of construction of main works;
- Construction quality control measures;
- Fire and explosion prevention, and labor safety;
- Environmental protection during construction;
- Transportation inside and outside the construction site;
- Auxiliary facilities (factories, camps ...) and systems to provide electricity, water, and communications for construction and on-site activities;
- Total construction ground general construction progress;
- Provide main materials and equipment for the project;
- Navigation diagrams and construction by year;
- Measures to prevent flow (specifications and volume of materials;
- Construction method of structure;
- Planning and using construction materials;
- Other necessary drawings.

3.3.6.8 Requirements for construction cost estimates

The consultants will study the basic construction unit prices in the locality, the norms of basic construction costs, the current regime and policies of the state and the province in terms of capital construction, make a summary table of volumes and a detailed forecast, and cost estimates for the works and the total cost of the subproject.

3.3.6.9 Requirements for operational development and maintenance guidelines

In order to develop processes for operation, management, exploitation, maintenance and protection of buildings, including:

- Instructions on O&M;

- Detailed scope of protection and management;

- Details of the item and architecture of the project to serve the operation and protection management of the project;

- Details of the monitoring and control network;

- Details of the communication system;

- The exact number and quantity of equipment and construction operation management system;

3.3.6.10 Requirements for supervision of the detailed engineering design authors'right.

- The consultant is responsible for conducting supervision of the authors'right according to the current regulations (Decree 46/2015/ND-CP on quality management and construction maintenance).

- Appointing the qualified people to supervise the authors'right during the construction process. The main tasks are as follows: responsible for explaining and clarifying construction design documents to the Investor and other contractors for management and construction in accordance with the design; modify the design for the content which is not consistent with the actual standards and conditions of the project; detect errors compared to the design; ...

3.3.6.11 Update resettlement plan

Based on the resettlement plan, it is required to set up in the project investment phase, the consultants will update minor changes in the pipeline and canal design during the detailed design process, so that the plan is re-implemented. Settlement must be updated in accordance with technical amendments.

3.3.6.12 Prepare an environmental management plan (EMP)

Items and contents of the EMP of the project must be in accordance with Annex 2.10 in Circular No.27/2015/TT-BTNMT dated on 29/05/2015 issued by the Minister of Natural Resources and Environment on environmental assessment, strategies, environmental impact assessments and environmental protection plans. The main content is as follows:

Measures and plans to minimize negative impacts on the environment during the preparation phase (if any) and the project construction phase, including:

- Minimize negative impacts on the surface water environment (if any)
- Minimize negative impacts on groundwater environment (if any);
- Minimize negative impacts on the air environment (if any);
- Minimize bad impacts due to noise and vibration (if any);
- Minimize negative impacts on the community (if any);
- Collection, temporary storage, transportation and disposal of waste;
- Minimize other negative impacts (if any).

Planning to build environmental protection items for the operation phase of the project (if any), including:

Wastewater treatment works;

Water treatment factory;

Waste treatment works;

Projects for storing and treating ordinary solid wastes and hazardous wastes;

Plan for construction and installation of other environmental protection projects: The content of construction plans and installation of environmental protection works for the operation phase of the project must clearly show the expected construction time, installation and finishing.

Environmental monitoring program during the construction phase of the project: The content of the environmental monitoring program should clearly state the monitoring position, monitoring frequency, monitoring parameters and technical standards and regulationsapplied to assess environmental sample quality with approved sampling locations in environmental impact assessment reports

3.4 Essential Documents attached to the TOR needing to be observed and referred

3.4.1 The Guidelines for Detailed Engineering Design

The Guidelines for Detailed Engineering Design (Revised version 2019) is prepared to guide the detailed engineering design process, for use by MARD, DARDs, SPPMUs/PPMUs involved in the WEIDAP Project, and ADB, AWP, and will be included/ attached to the Terms of Reference for the

procurement of services for detailed engineering designs with support from CPO/CPMU.

The Guidelines, which give the Key Design Principles for design of the Subprojects as well as specific guidance for Subrojects in each Province, shall be observed by the detailed engineering design consultants.

The Guidelines for Detailed Engineering Design can be downloaded at:

http://onlinedroughtcontrol.com/FinalRevisedGuidelines4DED.pdf.

3.4.2 The Subproject Report: Dak Lak Subproject

The consultants shall also review the following report when preparing the detailed engineering designs.

"Subproject Report: Dak Lak Subproject",

https://www.adb.org/sites/default/files/linked-documents/49404-002-sd-04.pdf

This report is one of the linked documents to the ADB's Report and Recommendation to the President (RRP: VIE 49404-002) on the proposed loan, grant, and administration of grant to Viet Nam for the Water Efficiency Improvement in Drought-Affected Provinces Project.

3.4.3 The Design Principles for Subprojects

The Design Principles for Subprojects can be downloaded at:

https://www.adb.org/sites/default/files/linked-documents/49404-002-sd-01.pdf.

The Design Principles for Subprojects, especially the specific guidance for System Design Discharges should be referred.

3.4.4 The Feasibility Study report

The Feasibility Study for Dak Lak Subproject was approved by Dak Lak Provincial People's Committee at the Decision No. 06/QĐ-UBND on January 2, 2019.

The design consultants shall review the Decision and the Feasibility Study Report at:

http://onlinedroughtcontrol.com/DecisionOfDakLakPPConApprovingtheFS.pdf,

and http://onlinedroughtcontrol.com/DakLakFeasibilityStudyReport.pdf.

4 IMPLEMENTATION DURATION

Consultancy services for the detailed engineering design are expected to begin just after signing the contract. Contract implementation duration is 270 days (09 months). The technical proposal of the Consultant will include an action plan with expected members of the consulting team and the progress of mobilizing experts and support staff:

- Phase 1: the delivery time of completed consulting products is 120 days (04 months), from the effective date of the contract.

- Phase 2: the Consulting services shall coordinate with consultants, PPMU shall implement the subproject to provide services until the approval of the detailed engineering design and no approval or objection from ADB, the expected time of 05 months.

5 REPORTING REQUIREMENTS AND TIME SCHEDULE FOR SUBMISSIONS OF THE DELIVERABLES

5.1 Reporting requirements

Dosseirs of the detailed technical design must be prepared in accordance with relevant industry standards and norms and other relevant State regulations and procedures and the Guidelines for Detailed Engineering Design mentioned above.

Main reports and working documents: The components of reports must comply with the National Technical Regulation on composition and content of technical design documents and detailed technical designs of irrigation works. QCVN 04-02: 2010 / BNN-PTNT.

Language of reports: Vietnamese and English

(i) Detailed engineering design description/ full report.

(ii) Specialized reports:

- Topography report: complying with the topographic standards.

- Geological report: complying with geological standards.

- Hydraulic and hydrological calculation report: complying with meteorological and hydrological standards.

- Structural design report.

- Mechanical design report.

- Electrical design report.

- Report on organization and construction measures.

- Report on operation and maintenance procedures.

(iii) Detailed engineering design drawings

- Site geological engineering drawings: in comply with the promulgated regulations on composition and quantity of geological survey in project planning and design phases.

- Drawings of the existing structures.

- Structural design drawings: show the entire contents of a detailed design of the structures, including the location, size, details of elements, equipment layout, construction measures and measures for ecological environment protection, operation, management and maintenance of works. Design drawings must fully and accurately show details to allow actual construction at the construction site according to design requirements; faithfully reflect the content of approved basic designs; clearly, scientifically and comprehensively presented in a specified format.

- Mechanical design drawings.

- Electrical design drawings.

- Design drawings of construction organization, etc

Survey files and construction design drawings

The results of consultancy services must fully reflect the contents and components of survey dossiers and detailed technical designs according to current regulations. The design dossier must be clear, accurate, complete, qualified and approved by competent authorities.

The number of submitted documents is 09 parts in Vietnamese, including:

- Part 1: Explanation of detailed technical design;

- Part 2: Summary report;

- Part 3: Specialized reports: Hydrological and hydraulic calculation report; construction design; mechanical design; electrical design; construction organization and construction measures;

- Part 4: Topographic survey report (notes, drawings and appendices)

- Part 5: Geological survey report (explanatory notes, drawings, testings, drill samples, drilling images ...)

- Part 6: Engineering design drawings;

- Part 7: Construction cost estimates;

- Part 8: Technical guidelines on construction method;

- Part 9: Operation and maintenance procedure.

Design consultants are responsible for translating design documents into English upon request of the Investor. Do not translate the entire record but only translate the documents to serve the Sponsor's requirements and stakeholders.

Note: Attached to the USB, write the contents of detailed engineering design documents and data and original documents of construction survey documents (including all the data from the above part 1 to part 9 above).

5.2 Time schedule for submissions of the deliverables

Table 3: Progress of submitting the deliverables

No	Name of the dossier	Time of submission	
		Draft dossier	**Official dossier**
1	Survey and design plan (detailed work plan)	03 days	05 days
2	Topographic survey dossier	25 days after the contract takes effect	30 days after the contract takes effect

No	Name of the dossier	Time of submission	
		Draft dossier	**Official dossier**
3	Geological survey dossier	25 days after the contract takes effect	30 days after the contract takes effect
4	Dossier of the detailed engineering design (including the Study Tour Report, Minutes of Design Workshops and Lists of Participants)	90 days after the contract takes effect (This time includes: Sightseeing, workshops and consults the experts): DARD/SPPMU/PPMU submits detailed engineering design dossiers (review the drafts of detailed design drawings, reports and calculations) for MARD (CPO/CPMU) to review and comment, with the help of ADB and AWP	30 days after obtaining MARD's comments: Submit final engineering design dossiers including full reports, specialized reports, maps, detailed design drawings, calculations, quantity and estimates; technical guidance for construction and installation, operating procedures etc. has been modified
5	Translating consulting products into English at the request of the parties involved.	Per request	
6	Editing consulting products and services at the request of appraisal agencies and Sponsor (if any)	Per request	
7	Summary report of consulting services	Per request	

6 QUALIFICATION REQUIREMENTS FOR CONSULTING FIRM

6.1 Requirements on the capacity of the consulting firm

- The consulting firm must meet the eligibility requirements in accordance with current regulations of Vietnam and "Guidelines on the Use of Consultants by Asian Development Bank and Its Borrowers".

- The consulting firm must be a unit with full legal status and business registration in accordance with the scope of work; with a certificate of construction consulting activity in accordance with regulations;

- The consulting firm has a strong financial capacity in the last 3 years (2016, 2017, 2018), with sufficient infrastructure and necessary equipment for surveying and designing and detailed specifications required;

- Having registered information on the National Bidding Network, having a system of quality management and organization in accordance with the current regulations of the State.

- The consultancy unit must have at least 05 years of experience and 05 consultancy contracts for project preparation, design of ODA projects and projects in the fields of rural development, water resource development and water supply, drainage. The consultancy unit must have at least 03 projects of similar scale and nature: projects with pressurized irrigation supply systems.

- All potential consultants must attend an "information workshop" before submitting bids.

- If the Consultant is a joint venture, each member must satisfy the requirements as for independent consultant corresponding to the work undertaken.

6.2 Qualification requirements for key specialists

- The Consultant must mobilize qualified and experienced experts in the proposed areas and one of them will be appointed as Consulting Team Leader to coordinate and implement the subproject.

- Note that if the positions do not overlap, an ex ?pert can take on multiple positions. The minimum requirements on the number, qualifications and experience of key experts are as follows:

Table 4: Requirements on qualifications and experience of consultants

No	Expert	Quantity	Requirements on experience and capability	Tasks	Duration (Month)
1	Consulting team leader (CNDA)	01	- Graduated from the University of Water Resources, preferably a master's degree in irrigation work or above; Having a valid, appropriate design practice certificate. - Having over 15 years of working experience in the field of design consultancy	- Head of coordination of consultants, connecting with PPMU and stakeholders in organizing the implementation of the subproject: - Responsible for organizing production, ensuring the progress and quality of reports and	4 months

No	Expert	Quantity	Requirements on experience and capability	Tasks	Duration (Month)
			for irrigation, hydropower works; - Experience in implementing design consultancy for 05 irrigation projects as the Consulting Team Leader; - Experience in implementing design consultancy for 03 similar ODA projects with the role of Consulting Team Leader. - Priority experience in participating in consulting services in similar geographical areas. - Priority to meet and speak English, prepare documents in English.	products and coordinating with relevant agencies and advisory teams supported by ADB. - Monitor and evaluate the performance of consultants; Support PPMU to coordinate with MARD and WB in the implementation and approval of detailed technical design. - Prepare and be responsible for the progress and quality of jobs and products of consulting services. - Instructions for collecting and updating subproject related documents prepared by other consultants. - Technical guidance and review is proposed by the member consultants for surveys and detailed engineering design of components underthe subproject. - Author supervision at the request of the investor.	
2	Hydrological and hydraulic experts	02	- Having have an appropriate university degreea; Preferably have a master's degree in hydrology. - Having over 10 years of working experience in the professional field. - Experience in participating in 03 irrigation projects as a hydrological/hydraulic expert; - Priority of experienced experts in irrigation projects from ODA.	- Responsible for conducting data collection activities and performing related calculations and hydrological and hydraulic calculations. - Synthesizing and reporting specialized hydrology and hydraulics.	4 months

No	Expert	Quantity	Requirements on experience and capability	Tasks	Duration (Month)
			- Priority experience in participating in consulting services in similar geographical areas. - Priority to meet and speak English, prepare documents in English.		
3	Hydraulic structure experts	05 (each expert is in charge of 01 component project)	- Having a university degree in irrigation work; having a valid, appropriate design practice certificate. - Having over 10 years of experience working in the field of irrigation design consultancy; - Experience in participating in 02 similar projects as a hydraulic / design expert; - Experience in participating in 02 irrigation projects as a hydraulic expert; Priority is given to experts who have participated and experienced in ODA-funded irrigation projects. - Priority experience in participating in consulting services in similar geographical areas. - Priority to meet and speak English, prepare documents in English.	- Fieldwork, analysis of documents, assessment of the current status of works. - Proposing and synthesizing solutions of construction, non-construction, analyzing and evaluating the overall stability, calculating and designing the construction items. - Participate in the preparation of detailed design documents for the subproject, formulate plans for construction and reporting of hydrodemolition. - Coordinate and support CNDA in author supervision as prescribed.	4 months
4	Structural expert	02	- Having a university degree in irrigation work; having a valid, appropriate design practice certificate. - Having over 5 years of experience working in the field of irrigation design consultancy; - Experience in participating in 02 irrigation project design projects with the role of calculating structure design;	- Analyzing and evaluating construction stability, calculating structure of work items. - Coordinate with hydraulic experts to set up appendices and design explanations.	4 months

No	Expert	Quantity	Requirements on experience and capability	Tasks	Duration (Month)
			Priority is given to experts who have participated and experienced in ODA-funded irrigation projects. - Priority experience in participating in consulting services in similar geographical areas.		
5	Construction expert	02	- Having a university degree in irrigation work; having a valid, appropriate design practice certificate. - Having over 10 years of experience working in the field of irrigation design consultancy; - Experience in participating in 02 similar projects as a construction expert; - Experience in participating in 02 irrigation projects with the role of construction specialist; Priority is given to experts who have participated and experienced in ODA-funded irrigation projects. - Priority experience in participating in consulting services in similar geographical areas.	- Fieldwork, coordinate with other experts to assess the current status of the work, analyze relevant documents. - Coordinate with the Consulting Team Leader and other experts to set up construction methods, make notes and appendices to calculate the construction flow. - Coordinate and support CNDA in author supervision as prescribed.	4 months
6	Mechanic experts	01	- Having a university degree in mechanical engineering; have an appropriate design practice certificate. - Over 5 years of experience working in the field of irrigation / hydroelectric design consultancy. - Experience in participating in 02 similar projects as a mechanical expert; Priority is given to experts who have been involved and experienced in ODA / hydropower projects with	- Propose and synthesize solutions to design mechanical structures of the project. - Participate in making technical design details of Subprojects, making plans and reporting on mechanical engineering. - Coordinate and support CNDA in author supervision as prescribed.	4 months

No	Expert	Quantity	Requirements on experience and capability	Tasks	Duration (Month)
			ODA capital.		
7	Electrical and mechanical experts	01	- Having a university degree in electrical major; having certificate of electrical - mechanical engineering design work. - Over 5 years of experience working in the field of irrigation/hydroelectric design consultancy. - Experience in participating in 02 similar projects with the role of electrical and mechanical experts; Priority is given to experts who have been involved and experienced in ODA / hydropower projects with ODA capital.	- Propose and synthesize solutions to design electrical systems, lines, transformer stations, etc. of the project. - Participate in making technical design details of Subprojects, making plans and reporting on electricity. - Coordinate and support CNDA in author supervision as prescribed.	4 months
8	Economic experts	02	- Having a university degree in economics/irrigation works; have a certificate of practice in valuation engineer. - Having over 10 years of working experience in the field of estimation, economic analysis, evaluating the effectiveness of the project. - Experience in participating in 02 similar projects as an estimation expert; Priority is given to experts who have participated and experienced in ODA-funded irrigation projects. - Experience in participating in similar geographical consultancy services.	- Review the Decrees, Circulars, Norms applicable to the subproject. - Gather and review the estimated data from the subproject's designs. - Take responsible for chairing and calculating construction cost estimates.	4 months
9	Topographic survey specialist	01	- Having a university degree in geodesy, map; having a topographic survey practice certificate. - Having over 10 years of working experience in the field of survey and surveying	- Beingtopographic survey team leader. - Prepare technical survey plans, topographic survey records as prescribed. - Construction and	4 months

No	Expert	Quantity	Requirements on experience and capability	Tasks	Duration (Month)
			works. - Experience in participating in 02 similar projects as a topographic survey specialist; Priority is given to experts who have participated and experienced in ODA-funded irrigation projects. - Experience in participating in consulting services in similar geographical areas.	handover of control points. - Explanation when required.	
10	Geological survey specialist	01	- Having a university degree in engineering geology major; having certificate of geological survey practice. - Having over 10 years of experience working in the field of geological survey and surveying works. - Experience in participating in 02 similar projects as a geological survey specialist; Priority is given to experts who have participated and experienced in ODA-funded irrigation projects. - Experience in participating in consulting services in similar geographical areas.	- Geological survey team leader in the field. - Prepare technical survey plans, geological survey records as prescribed. - Propose measures to handle foundation, body, slope causing instability of the project. - Explanation when required.	4 months
11	Support staff	30	- Have a university degree in suitable majors. - For topographic and geological survey workers must have an appropriate technical intermediate degree. (14 workers in total: 4 in topography and 10 in geology) - Having over 03 years of experience in the field of conducting surveys, data collection, community consultation, irrigation work design, support to implement	- Support key experts in field surveys, information collection, community consultation, quantitative and qualitative information processing. - Support the main experts to implement the detailed planning and cost estimation contents. - Support administrative, accounting, transaction and general reporting procedures. - Support editing, printing,	4 months

No	Expert	Quantity	Requirements on experience and capability	Tasks	Duration (Month)
			the consultancy tasks; - Priority is given to officials who have participated in the implementation of one or more similar projects for ODA funded projects.	publishing documents.	

7 COST ESTIMATIONS FOR CONSULTING SERVICE

7.1 Basis for estimations for consulting service

- Decision No.79/QD-BXD dated on 15/02/2017 regulating the cost norms of project management and construction investment consultancy;

- Circular No.219/2009/TT-BTC dated 19/11/2009 by the Ministry of Finance stipulating some spending norms applicable to projects / programs using Official Development Assistance (ODA). Circular No.192/2011/TT-BTC dated on 26/12/2011 by the Ministry of Finance amending and supplementing a number of articles of Circular No.219/2009/TT-BTC;

- Circular No. 02/2015/TT-BLĐTBXH dated on 12/01/2015 by the Ministry of Labor, War Invalids and Social Affairs stipulating the salary for domestic consultants as a basis for estimating the package of private service provision for adoption of a contract based on the use of state capital.

- Circular No.05/2016/TT-BXD dated on 10/03/2016 by the Ministry of Construction guiding the determination of labor unit prices in management of construction investment costs;

- Circular No.40/2017/TT-BTC by the Ministry of Finance dated on 28/04/2017 stipulating the business trip allowance and conference expenses applicable to state agencies, public and non-government agencies business, political organizations, socio-political organizations and associations that use state budget funds;

- Circular No.01/2017/TT-BXD dated on 06/02/2017 by the Ministry of Construction guiding the determination and management of construction survey costs;

- Estimated cost of construction - Part of construction survey published together with Decision No.1354/QD-BXD dated on 28/12/2016 by the Minister of Construction;

- Decision No.35/2017/QD-UBND dated on 21/12/2017 by Dak Lak People's Committee on adjusting labor costs, construction machine costs in some works construction unit prices issued by the Provincial People's Committee father in Dak Lak province;

- Decision No.02/2018/QD-UBND dated on 19/01/2018 on the announcement of the Unit price for construction of works - Construction survey in Dak Lak province;

- Decision No.2362/QD-NLDK dated on 17/12/2003 by the Ministry of Industry on the height and coordinates of measuring electrical works;

Policies and regulations of the State.

7.2 Cost estimations for consulting service

Estimated cost of consulting service is 9,308,000,000 VND

(In word: Nine billion three hundred and eight million Vietnamese dongs)

In which:

- Construction survey	3,500,000,000	VND
- Detailed engineering design and cost estimates	4,962,000,000	VND
- Contingency cost (10%)	846,000,000	VND

8 COORDINATION AND MONITORING

The Consultant must report to the Investor on the progress of the monthly implementation, prepare the documents and attend meetings/workshops on the relevant issues as required by the Investor.

The Consultant will coordinate with the subproject implementation advisors and other stakeholders such as CPO and ADB/ AWP. Specifically, the discussions/inspections on milestones of subproject are required (as stated in the WEIDAP guidelines). The Consultant should closely coordinate and provide necessary data, information and reports for subproject implementation advisors and other stakeholders during the implementation process. The Consultant must participate in meetings and discussions with relevant agencies at the central and local levels.

The Consultant should work closely with community representatives (traditional and non-traditional way) to ensure the information collection

during the FS phase, and accurately assess the impacts of the subproject as well as related issues on the environmental and social protection policies.

9 ORGANIZATION OF IMPLEMENTATION

During the implementation of the task, the Consultant will report directly to PPMU. PPMU will be responsible for providing the Consultant with the contact information of other agencies as required.

The Consultant must organize the implementation of the subproject. All relevant estimated costs must be anticipated in the bidding document and there will be no change in the total cost when signing the contract.

All costs related to fieldwork and data needed to meet the technical requirements of this consulting work must be fully considered in the proposal. Terrain and meteorological data and other information must be expected during the bidding process to ensure that the work is completed within the estimated total cost. For this purpose, the Consultant must estimate the corresponding workload and costs because there will be no change in the total cost of the subproject after signing the contract for any reason.

The Consultant will pay for all travel and accommodation related expenses (including field trips) for the entire consulting team during the contract period. The Consultant will also pay for all support staff (administrative, translators, office clerks, accountants) and field staff to perform the work for all data collection activities.

Technical reports and consulting products will be provided as described in the distribution section. The Investor will only accept the sub-project when subproject implementation advisors agree with the consultingproducts and ADB issues theNo Objection Letter (NOL).

10 SUPPORTS FROM THE INVESTOR

10.1 Responsibilities of the Consultant

- Implement the consultancy service in accordance with the agreed content and workload, and regulations on the application of Vietnamese and ADB standards and regulations;

- Submit the report to the Investor within the time limit required by ToR;

- Ensure the mobilization and arrangement of personnel, offices and transport facilities;

- Ensure that all consulting works implemented by the Consultant are in accordance with Vietnamese law.

- Implement and be responsible for the quality of the consulting products;

- Participate in meetings related to consulting products when the Investor requests it during the implementation process, ensuring compliance with the regulations of MARD, PMU, PPC as well as the Sponsor; based on the Decision on approval of feasibility study report of the project and the subproject to recommends the Investor to supplement the missing contents according to the Decision;

- Commitment that the Consultant will appoint a competent representative to resolve any problems at any time at the request of the Investor.

- Comply with the direction and guidance of the investor, except for guidances or requirements that are contrary to the law or are not feasible.

- The Consultant shall not disclose any confidential or proprietary information relating to the consulting work, the contract or the work activities of the Investor without prior approval of the Investor in written document.

- The Consultant is responsible for searching and applying appropriate standards and regulations for the subproject. In the absence of such standards, the relevant international standards must be consulted and agreed by the Investor. Some key standards are expected to apply.

10.2. Responsibilities of the Investor

- The Investor provides the Consultant with documents of the feasibility study and other relevant legal documents;

- Creates the best possible conditions for the Consultant to perform consulting work;

- Supports and creates conditions for the Consultant to have access to the works location;

- Provides necessary documents according to the Consultant's proposal for the Consultant to perform the consulting work. The Investor is responsible for the accuracy and completeness of the documents provided;

- Reviews the requirements and proposals of the Consultant regarding the implementation of consulting and approval work within a reasonable period of time so as not to delay the implementation of the consultancy;

- Pays for the Consultant as the contract price in accordance with the regulations;

- Answers in writing the proposals or requests of the Consultant;

- Appoints any qualified and professional individuals suitable to each job to work with the Consultant and specified in the specific decisions of the Investor.

To clarify the information in this terms of reference, please contact the Investor with the following information:

Investor: Management board of investment projects on construction of transport and rural development in Dak Lak province.

Address: 07 Dinh Tien Hoang street, Tu An ward, Buon Ma Thuot city, Dak Lak province, Vietnam

Tel: 0262 - 3854357

Fax: 0262 - 3856381

Email: khth.gtnn@gmail.com

APPENDIXES

Appendix 1. Legal Basis

- Law of Construction No.50/2014/QH13 dated on 18/06/2014 by the National Assembly session 13;

- Law of Bids No.43/2013/QH13 dated on 26/11/2013 by the National Assembly session 13;

- Law of Investment No.49/2014/QH13 dated 18/6/2014 by the National Assembly session 13;

- Decree No.63/2014/NĐ-CP dated on 15/10/2009 by the Government regulating in details the implementing the Law of Bids and bidder selection under the Law of Construction;

- Decree No.16/2016/NĐ-CP by the Government regulating the capital management and usage from the Official Development Assistant (ODA) source and other preferential loan from foreign Sponsors.

- Decision No.48/QĐ-TTg dated on 03/04/2008 regulating the Guidance on feasibility study report using ODA source from 5 banks (ADB, AFD, JBIC, KfW, WB).

- Document No.1101/BKHĐT-THdated on 02/ 03/2015 by the Ministry of Planning and Investment regulating on the approval of the undertakings and decision of investment on public project and program.

- Circular No.02/2015/TT-BLĐTBXH dated on 12/01/2015 by Ministry of Labor, Invalids and Social Affairs regulating the salary levels for local consultants as the basis to estimate the bid of supplying consulting services using State capital in contract form.

- Decision No.1476/QD-BTCdated on 28/6/2016 on the disapproval of some articles at Circular No. 219/2009/TT-BTC and Circular No192/2011/TT-BTC by the Ministry of Finance.

- Circular No.40/2017/TT-BTC dated on 28/4/2017by the Ministry of Finance regulating the regime of business allowance fee and seminar/meeting fees;

- Document No.1447/VPCP- HTQT dated on 02/3/2015 by the Government Office on upgrading the efficiency cooperation with Sponsors of ODA and preferential loan.

- Cent Memorandum of the Visiting Members to ADB8 Project by Asia Development Bank on 30/3/2016.

- Decisions of the Ministry of Agriculture and Rural Development: No.3239/QĐ-BNN-TCCB dated on 22/10/2008 regulating functions, power, duties and organizational structure of the Central Management Committee for the irrigation projects; No.110/QĐ-BNN-TCCB dated on 13/01/2009 issuing the Charter of Operation and Structure for the Central Management Committee;

- Decision No.727/QĐ-TTg dated on 28/4/2016 by the Prime Minister on the approval of lists of ADB8 Projects with loans at Asia Development Bank (ADB).

Table 01: Standards applied to the survey and design work

No.	NUMBER	STANDARDS
I	**Standards used for survey work**	
1	QCVN 04 - 05: 2010/BNNPTNT	National technical regulation on irrigation works - the main regulations on design
2	QCVN 04 - 02: 2010/BNNPTNT	National technical regulations on composition, content of technical design documents and design of construction works of irrigation works.
3	TCVN 8478:2010	Irrigation works - Requirements on composition and quantity of topographic survey during project and design phases
4	TCVN 8224:2009	Irrigation works - The main regulations on net control of terrain
5	TCVN 8225:2009	Irrigation works - The main regulations on net control of terrain elevation
6	TCVN 8226:2009	Irrigation works - The main regulations on surveying cross-sections and topographic maps from 1/200 to 1/5000
7	TCVN 8477 : 2010	Irrigation works -Requirements on composition and quantity of geological survey in project planning and design phases
8	TCVN 9155-2012	Irrigation works - Technical requirements for machine drilling in geological survey work
9	TCVN 8352-2012	Construction land - Static test method
10	TCVN 8720-2012	Land for construction of irrigation works - Methods of taking, packing, transporting and preserving samples
11	TCVN 8868- 2011	Testing to determine non-cohesive shear resistance - non-draining and consolidation - drainage of soil adhesive on three-axis compression equipment
12	TCVN 9140-2012	Irrigation works - Required to preserve drilling samples in engineering geological survey work
13	TCVN 9351-2012	Construction land - Method of field Testing - Standard penetration test (SPT)
14	TCVN 4195:2012	Construction land - Methods for determining specific gravity in the laboratory
15	TCVN 4196:2012	Methods of determining humidity and moisture absorption in the laboratory
16	TCVN 4197:2012	Methods of determining the flow limit and plastic limit in the laboratory

No.	NUMBER	STANDARDS
17	TCVN 4198-2014	Construction land. Methods of particle composition analysis in the laboratory
18	14 TCN 4 – 2003	Composition, content, quantity of investigation and survey and hydro-meteorological calculation of the project development phases and design of irrigation works
II	**Standards for design work**	
1	TCVN 10380:2014	Rural roads - Design requirements
2	TCVN 8423:2012	Standard of irrigation works - Irrigation and drainage pumping stations - Requirements for designing hydraulic works
3	TCVN 4118:2012	Irrigation works - Irrigation systems - Design technical requirements
4	TCVN 8732:2012	Land for construction of irrigation works - Term and definition
5	TCVN 8218:2009	Hydraulic concrete - Technical requirements
6	TCVN 8228:2009	Hydro-concrete mixture - Technical requirements
7	TCVN 8636:2011	Irrigation works - Steel pressure pipe - Technical requirements in design, fabrication and installation.
8	TCVN 8412:2010	Irrigation works - Instructions on operating procedures.
9	TCVN 8299:2009	Irrigation works - Technical requirements in the design of valve gates and steel valve slots
10	TCVN 9141:2012	Standard of irrigation works - Irrigation and drainage pumping stations - Requirements of engine and mechanical equipment design
11	TCVN 2622:1995	Fire prevention and fire fighting for houses and buildings - design requirements
12	TCVN 8297:2009	Irrigation works - Earth dams - technical requirements in construction by compaction method
13	TCVN 9145:2012	Irrigation works - Process of calculating steel pipelines
14	TCVN 9162:2012	Irrigation works - Construction road - Design requirements

No.	NUMBER	STANDARDS
15	TCVN 9163:2012	Irrigation works - M&E drawings - Content requirements
16		Other relevant standards and regulations

Appendix 2. Specification table of Reservoirs

Table 02: Specification table of Krong Buk Ha Reservoir

No.	Content	Unit	Specification			
			Ea Phe reservoir		Krong Buk reservoir	
1	**Duties of the work**					
-	Irrigating for the pepper	ha	120		180	
-	Irrigating for the coffee	ha	280		420	
2	**Level of the work**		**IV**		**IV**	
3	**Reservoir**					
-	Exceedance Flood Level	m	483.79			
-	The lowest level	m	469.00			
-	The Total volume	10^6m^3	109.34			
-	Dead volume	10^6m^3	13.60			
-	Effective volume	10^6m^3	95.74			
4	**Irrigation system**					
4.1	Electric pumping station		Station 3	Station 4	Station 1	Station 2
-	Designed water flow	m3/s	0.4194	0.2111	0.2111	0.4194
-	Height of pumping water	m	50	40	38	43
-	HDPE pipeline	m	260x2		179x2	170x2
-	Diameter of HDPE pipe (PN6)	m	0.63		0.50	0.63
-	Length of steel discharge pipeline	m	1924	2028	900	1532
-	Diameter of discharge pipeline	m	0.60	0.45	0.45	0.60
4.2	Internal road					
-	Length	m	150	550	385	300
-	Surface width (the whole)	m	5	5	5	5
-	Surface width M200	m	3.5	3.5	3.5	3.5
4.3	Upgrading the internal surface road	m	2350	3000	5000	4000
4.4	Water storage tank					
-	Reinforced concrete M200					
-	Capacity	m3	5200	2040	2040	5200
4.5	Irrigation pipeline (HDPE)					
-	Length	m	3853	3305	3455	6861
-	Diameter of pipeline	m	0.110 ÷ 0.450	0.110 ÷ 0.280	0.110 ÷ 0.560	0.110 ÷ 0.710
4.6	Manhole system for irrigation					
-	Internal measurement	m	1x0.8x1	1x0.8x1	1x0.8x1	1x0.8x1

No.	Content	Unit	Specification			
			Ea Phe reservoir		Krong Buk reservoir	
-	Quantity	manhole	40	40	40	80
4.7	Operational power system					
-	Capacity of the power station	kVA	630	250	250	560
-	Power line of 22KV connecting to pumping station	m	300	1000	400	450

Table 03: Specification table of Ea Kuang Reservoir

No.	Content	Unit	Specification
1	Duties of the work items		
-	Irrigating for the coffee crop	ha	835.8
2	Level of works		IV
3	Reservoir		
-	Exceedance Flood Level	m	596
-	Lowest level (dead level)	m	581.4
-	Total volume	10^6m^3	5.5
-	Dead volume	10^6m^3	0.5
-	Effective volume	10^6m^3	5
4	Irrigation system		
4.1	Power pumping station		
-	Designed water flow	m3/s	0.4306
-	Height of pumping water column	m	16
-	Length of discharge pipe	m	1022
-	Diameter of discharge pipe	m	0.65
4.2	Main canal		
-	Length	m	3860
-	BxH	m	0.5x0.55÷0.9x1.25
-	Reinforced concrete structure,slope coef. m=0		
4.3	The roads for management		
-	Length	m	320
-	Surface width (the whole)	m	5
-	Concrete surface width M200	m	3.5
4.4	Upgrading internal road surface	m	5000
4.5	Water storage tank		
-	Reinforced concrete structure M200		

No.	Content	Unit	Specification
-	Capacity	m3	4750
4.6	Irrigation pipeline system (HDPE)		
-	Length	m	11917
-	Diameter of pipeline	m	0.110÷0.56
4.7	Manhole system		
-	Internal measurement	m	1x0.8x1
-	Quantity	manhole	168
4.8	Operational power system		
-	Capacity of power station	kVA	180
-	Power line 22KV connecting pumping station	m	600

Table 04: Specification table of BuonYong Reservoir

No.	Content	Unit	Specification
1	Duties of the work items		
-	Irrigating for pepper crop	ha	135.29
-	Irrigating for coffee crop	ha	315.68
2	Level of the work items		IV
3	Reservoir		
-	Normal Water Level	m	506.8
-	Lowest level (dead level)	m	494.5
-	Total volume	10^6m^3	17.34
-	Dead volume	10^6m^3	2.1
-	Effective volume	10^6m^3	15.24
4	Irrigation system		
4.1	Power pumping station		
-	Designed water flow	m3/s	0.4722
-	Height of pumping water column	m	54
-	HDPE pipeline carrying water from reservoir to the tank	m	24.43x2
-	Diameter of HDPE pipeline (PN6)	m	0.56
-	Length of discharge pipeline	m	1096
-	Diameter of discharge pipeline	m	0.65
4.2	Internal road		
-	Length	m	245
-	Surface width (the whole)	m	5
-	Concrete surface width M200	m	3.5
4.3	Upgrading surface for internal road	m	7710

No.	Content	Unit	Specification
4.4	Water storage tank		
-	Reinforced concrete structure M200		
-	Capacity	m3	5200
4.5	Irrigation Pipeline System (HDPE)		
-	Length	m	8507
-	Diamater of pipeline	m	0.11÷0.560
4.6	Manhole system		
-	Internal measurement	m	1x0.8x1
-	Quantity	manhole	91
4.7	Operational power system		
-	Capacity of the power station	kVA	800
-	Power line of 22KV connecting to pumping station	m	450

Table 05: Specification table of Doi 500 Reservoir

No.	Content	Unit	Specification
1	Duties of the work items		
-	Irrigating for pepper crop	ha	183
-	Irrigating for coffee crop	ha	20.5
2	Level of the work items		IV
3	Reservoir		
-	Normal Water Level	m	449.6
-	Lowest level (dead level)	m	443.85
-	Total volume	10^6m^3	1.99
-	Dead volume	10^6m^3	0.353
-	Effective volume	10^6m^3	1.637
4	Irrigation system		
4.1	Power pumping station		
-	Designed water flow	m3/s	0.214
-	Height of pumping water column	m	55
-	HDPE pipeline carrying water from reservoir to the tank	m	65x2
-	Diameter of HDPE pipeline (PN6)	m	0.45
-	Length of discharge pipeline	m	235
-	Diameter of discharge pipeline	m	0.45
4.2	The road for management		
-	Length	m	129.6

No.	Content	Unit	Specification
-	Surface width (the whole)	m	5
-	Concrete surface width M200	m	3.5
4.3	Upgrading surface for internal road	m	6000
4.4	Water storage tank		
-	Reinforced concrete structure M200		
-	Capacity	m3	2040
4.5	Irrigation Pipeline System (HDPE)		
-	Length	m	4066
-	Diamater of pipeline	m	0.11÷0.40
4.6	Manhole system		
-	Internal measurement	m	1x0.8x1
-	Quantity	manhole	41
4.7	Operational power system		
-	Capacity of the power station	kVA	400
-	Power line of 22KV connecting to pumping station	m	300

Table 06: Specification table of Thi Tran reservoir

No.	Content	Unit	Specification
1	Duties of the work items		
-	Irrigating for pepper crop	ha	45
-	Irrigating for coffee crop	ha	105
2	Level of the work items		IV
3	Reservoir		
-	Normal Water Level	m	565.63
-	Lowest level (dead level)	m	558
-	Total volume	10^6m^3	1.217
-	Dead volume	10^6m^3	0.1037
-	Effective volume	10^6m^3	1.113
4	Irrigation system		
4.1	Power pumping station		
-	Designed water flow	m3/s	0.1583
-	Height of pumping water column	m	50
-	HDPE pipeline carrying water from reservoir to the tank	m	100x2
-	Diameter of HDPE pipeline (PN6)	m	0.40
-	Length of discharge pipeline	m	1100

No.	Content	Unit	Specification
-	Diameter of discharge pipeline	m	0.40
4.2	Internal road		
-	Length	m	5000
-	Surface width (the whole)	m	5
-	Concrete surface width M200	m	3.5
4.3	Water storage tank		
-	Reinforced concrete structure M200		
-	Capacity	m3	1570
4.4	Irrigation Pipeline System (HDPE)		
-	Length	m	2784
-	Diamater of pipeline	m	0.11÷0.40
4.5	Manhole system		
-	Internal measurement	m	1x0.8x1
-	Quantity	manhole	30
4.6	Operational power system		
-	Capacity of the power station	kVA	250
-	Power line of 22KV connecting to pumping station	m	200

Appendix 3. Surveys quantity

Table 07: Topographic survey quantity has been carried out in the FS phase

No.	Content	Unit	Doi 500 Reservoir	BuonYong Reservoir	Krong Buk Ha Reservoir	Thi Tran Reservoir	Ea Kuang Reservoir	Total
1	Traverse grid - level IV	Point	4	2	5	2	2	**15**
2	Traverse grid - grade I	Point	12	12	40	10	12	**86**
3	Leveling - grade 4	km	40.1	16.2	79.1	7.32	36.93	**179.65**
4	Technical leveling	km	10.06	9.12	38.5	8.57	15.8	**82.05**
5	Map in scale 1/500, contour 0.5m	ha	1	3	6	1	6	**17**
6	Map in scale 1/1000, contour1m, pipeline	ha	6	15.6	43.5	7	33.05	**106.45**
7	Map in scale 1/1000, contour1m, reservoir bed	ha	75.5	-	-	-	152	**194.4**
8	Longitudinal section along the route	m	-	-	-	-	3.595	**3,595.0**
9	Measuring the height of boreholes	point	3	4	12	5	4	**28**

Table 08: Geological survey quantity has been carried out in the FS phase

No	Items	Unit	Quantity
I.	**Pumping station at Doi 500 Reservoir**		
1	Rotating drilling and pump washing with sample tube at shallow top of borehole, the depth from 0m to 30m for rock level I - III	m	35
2	Testing to determine physical and mechanical properties of undisturbed soil samples (cut, compressed by 1 axis method)	Sample	3
II.	**Pumping station at BuonYong Reservoir**		
1	Rotating drilling and pump washing with sample tube at shallow top of borehole, the depth from 0m to 30m for rock level I - III	m	45
2	Testing to determine physical and mechanical properties of undisturbed soil samples (cut, compressed by 1 axis method)	Sample	4
III.	**Pumping station at zone 1 of Krong Buk Ha Reservoir**		
1	Rotating drilling and pump washing with sample tube at shallow top of borehole, the depth from 0m to 30m for rock level I - III	m	45
2	Testing to determine physical and mechanical properties of undisturbed soil samples (cut, compressed by 1 axis method)	Sample	2
3	Testing to determine physical and mechanical properties of rock samples	Sample	7
IV.	**Pumping station at zone 2 of Krong Buk Ha Reservoir**		
1	3 drill holes (1 hole at 10m)	m	10
2	The testing to determine the soil properties of undistrubed sample with 9 criteria	Sample	2
V.	**Pumping station at zone 3 of Krong Buk Ha Reservoir**		
1	3 drill holes (1 hole at 15m, 6 holes at 10m)	m	75
2	The testing to determine the soil properties of undistrubed sample with 9 criteria	Sample	8
3	Testing to determine physical and mechanical properties of rock samples	Sample	5
VI. Pumping station at Thi Tran reservoir			
1	Rotating drilling and pump washing with sample tube at shallow top of borehole depth from 0m to 30m of rock level I - III	m	52
2	Rotating drilling and pump washing with sample tube at shallow top of borehole, the depth from 0m to 30m for rock levelIV - VI	m	7
3	Testing to determine physical and mechanical properties of undisturbed soil samples (cut and compressed by 1 axis method)	Sample	5

No	Items	Unit	Quantity
4	Testing to determine physical and mechanical properties of rock samples	Sample	1
VI.	**Pumping station at Ea Kuang Reservoir**		
1	Rotating drilling and pump washing with sample tube at shallow top of borehole, the depth from 0m to 30m for rock level I - III	m	33
2	Rotating drilling and pump washing with sample tube at shallow top of borehole, the depth from 0m to 30m for rock levelIV - VI	m	12
3	Testing to determine physical and mechanical properties of undisturbed soil samples (cut and compressed by 1 axis method)	Sample	4
4	Testing to determine physical and mechanical properties of rock samples	Sample	1

Table 09: Topographic survey quantity during the engineering design phase of Doi 500 reservoir

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
I	**The system carrying water from the reservoir to the station**				
1	Technical leveling	Km	III	0.073	Longitudinal and cross section along the line
2	Measure longitudinal section on land, the vertical scale 1/100, horizontal scale 1/500	100m	III	0.730	Measure according to the length of the pipeline
3	Cross-section measurement on land at scale 1/200, topography level II	100m	III	0.087	Measure 100m / 5m-wide cross section
4	Plugging the center of the works	Bench mark	III	2	Start and end of the route
II	**Pumping station**				
1	Technology Standards	Km	III	0.535	Longitudinal and cross section along the line
2	Measure longitudinal section on land; the steel discharge pipe at D450mm and L = 235mlong	100m	III	2.35	Measure along the route length
3	Measure longitudinal section on land; the construction of medium voltage line	100m	III	3	Measure along the route length

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
	22KV and 300m long				
4	Cross-section measurement on land in the scale of 1/200	100m	III	0.168	Measure 100m / 5m-wide cross section
5	Plugging the center of the steel discharge pipe at D450mm	Bench mark	III	2	Start and end of route
6	Plugging the center of the works	Bench mark	III	2	Start and end of route
III	**Water storage tank**				
1	Plugging the center of the works	Bench mark	III	2	
IV	**Irrigation pipe**				
1	Technical leveling	Km	III	4.066	Longitudinal and cross section along the line
2	Longitudinal section measurements on land, the vertical scale 1/100, and the horizontal scale 1/200	100m	III	40.66	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	2.083	Measure 100m / 5m-wide cross section
4	Plugging at center of the works	Bench mark	III	9	Average 500m / benchmark
V	**Road for management**				
1	Technical leveling	Km	III	6.13	Longitudinal and cross section along the line
2	Longitudinal section measurement, the vertical scale 1/100, horizontal scale 1/200;	100m	III	61.30	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	12.36	Measuring 50m / 10m-wide cross section
4	Plugging the center of the works	Bench mark	III	13	Start point and turning point
VI	**Material yards**				

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
1	Traverse line - grade 2	Point	III	2	Each position is 2 benchmarks
2	Topographic map at scale 1/1000, 1 meter contour line	ha	III	1	100m long and 100m wide

Table 10: Topographic survey quantity during the engineering design phase of BuonYong reservoir

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
I	**System carrying water from reservoir to pumping station**				
1	Technical leveling	Km	III	0.025	Longitudinal and cross section along the line
2	Measure longitudinal section on land, the vertical scale 1/100, horizontal scale 1/500	100m	III	0.250	Measure according to the length of the pipeline
3	Cross-section measurement on land at scale 1/200, topography level II	100m	III	0.063	Measure 100m / 5m-wide cross section
4	Plugging the center of the works	Bench mark	III	2	Start and end of the route
II	**Pumping station**				
1	Technical leveling	Km	III	1.546	Longitudinal and cross section along the line
2	Measure longitudinal sectionon land of D450mm steel discharge pipeline	100m	III	10.96	Measure along the route length
3	Measure longitudinal section on land of 22KV medium voltage line	100m	III	4.50	Measure along the route length
4	Cross-sectional measurements on the scale of 1/200	100m	III	0.6	Measure 100m / 5m-wide cross section
5	Plugging the center of the works of D450mm steel discharge pipe	Bench mark	III	3	Start point, end point and turning point
6	Plugging the center of the construction work of 22KV medium voltage line	Bench mark	III	2	Start point and end point of the route

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
III	**Water storage tank**				
1	Pluging center of the works	Bench mark	III	2	
IV	**Irrigation pipeline**				
1	Technical leveling	Km	III	8.507	Longitudinal and cross section along the line
2	Longitudinal section measurements on land, the vertical scale 1/100, and the horizontal scale 1/200	100m	III	85.07	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	4.304	Measure 100m / 5m-wide cross section
4	Plugging at center of the works	Bench mark	III	17	Average 500m / benchmark
V	**Road for management**				
1	Technical leveling	Km	III	7.945	Longitudinal and cross section along the line
2	Longitudinal section measurement, the vertical scale 1/100, horizontal scale 1/200;	100m	III	79.45	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	15.99	Measuring 50m / 10m-wide cross section
4	Plugging the center of the works	Bench mark	III	17	Start point and turning point
VI	**Material yard**				
1	Traverse line - grade 2	Point	III	2	Each position is 2 benchmarks
2	Topographic map at scale 1/1000, 1 meter contour line	ha	III	1	100m long and 100m wide

Table 11: Topographic survey quantity during the engineering design phase of Krong Buk Ha Reservoir–Irrigation area 1

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
I	**System carrying water from reservoir to pumping station**				
1	Technical leveling	Km	III	0.204	Longitudinal and cross section along the line
2	Measure longitudinal section on land, the vertical scale 1/100, horizontal scale 1/500	100m	III	2.036	Measure according to the length of the pipeline
3	Cross-section measurement on land at scale 1/200, topography level II	100m	III	0.152	Measure 100m / 5m-wide cross section
4	Plugging the center of the works	Bench mark	III	2	Start and end of the route
II	**Pumping station**				
1	Technical leveling	Km	III	1.35	Longitudinal and cross section along the line
2	Measure longitudinal sectionon land of D450mm steel discharge pipeline	100m	III	9	Measure along the route length
3	Measure longitudinal section on land of 22KV medium voltage line		III	4.5	Measure along the route length
4	Cross-sectional measurements on the scale of 1/200	100m	III	0.50	Measure 100m / 5m-wide cross section
5	Plugging the center of the works of D450mm steel discharge pipe	Bench mark	III	3	Start point, end point and turning point
6	Plugging the center of the construction work of 22KV medium voltage line	Bench mark	III	2	Start point and end point of the route
III	**Water storage tank**				
1	Pluging center of the works	Bench mark	III	2	
IV	**Irrigation pipeline**				
1	Technical leveling	Km	III	3.455	Longitudinal and cross section along the line

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
2	Longitudinal section measurements on land, the vertical scale 1/100, and the horizontal scale 1/200	100m	III	34.55	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	1.778	Measure 100m / 5m-wide cross section
4	Plugging at center of the works	Bench mark	III	8	Average 500m / benchmark
V	**Road for management**				
1	Technical leveling	Km	III	5.085	Longitudinal and cross section along the line
2	Longitudinal section measurement, the vertical scale 1/100, horizontal scale 1/200;	100m	III	50.85	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	10.270	Measuring 50m / 10m-wide cross section
4	Plugging the center of the works	Bench mark	III	11	Start point and turning point
VI	**Material yard**				
1	Traverse line - grade 2	Point	III	2	Each position is 2 benchmarks
2	Topographic map at scale 1/1000, 1 meter contour line	ha	III	1	100m long and 100m wide

Table 12: Topographic survey quantity during the engineering design phase of Krong Buk Ha Reservoir–Irrigation area 2

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
I	**System carrying water from reservoir to pumping station**				
1	Technical leveling	Km	III	0.195	Longitudinal and cross section along the line
2	Measure longitudinal section on land, the vertical scale 1/100, horizontal scale 1/500	100m	III	1.946	Measure according to the length of the pipeline
3	Cross-section measurement on	100m	III	0.245	Measure 100m / 5m-

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
	land at scale 1/200, topography level II				wide cross section
4	Plugging the center of the works	Bench mark	III	2	Start and end of the route
II	**Pumping station**				
1	Technical leveling	Km	III	1.982	Longitudinal and cross section along the line
2	Measure longitudinal sectionon land of D450mm steel discharge pipeline	100m	III	15.32	Measure along the route length
3	Measure longitudinal section on land of 22KV medium voltage line		III	4.5	Measure along the route length
4	Cross-sectional measurements on the scale of 1/200	100m	III	0.816	Measure 100m / 5m-wide cross section
5	Plugging the center of the works of D450mm steel discharge pipe	Bench mark	III	4	Start point, end point and turning point
6	Plugging the center of the construction work of 22KV medium voltage line	Bench mark	III	2	Start point and end point of the route
III	**Water storage tank**				
1	Pluging center of the works	Bench mark	III	2	
IV	**Irrigation pipeline**				
1	Technical leveling	Km	III	6.86	Longitudinal and cross section along the line
2	Longitudinal section measurements on land, the vertical scale 1/100, and the horizontal scale 1/200	100m	III	68.6	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	3.480	Measure 100m / 5m-wide cross section
4	Plugging at center of the works	Bench mark	III	14	Average 500m / benchmark
V	**Road for management**				

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
1	Technical leveling	Km	III	4.30	Longitudinal and cross section along the line
2	Longitudinal section measurement, the vertical scale 1/100, horizontal scale 1/200;	100m	III	43	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	8.70	Measuring 50m /10m-wide cross section
4	Plugging the center of the works	Bench mark	III	10	Start point and turning point
VI	**Material yard**				
1	Traverse line - grade 2	Point	III	2	Each position is 2 benchmarks
2	Topographic map at scale 1/1000, 1 meter contour line	ha	III	1	100m long and 100m wide

Table: Topographic survey quantity during the engineering design phase of Krong Buk Ha Reservoir–Irrigation area 3+4

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
I	**System carrying water from reservoir to pumping station**				
1	Technical leveling	Km	III	0.285	Longitudinal and cross section along the line
2	Measure longitudinal section on land, the vertical scale 1/100, horizontal scale 1/500	100m	III	2.846	Measure according to the length of the pipeline
3	Cross-section measurement on land at scale 1/200, topography level II	100m	III	0.192	Measure 100m / 5m-wide cross section
4	Plugging the center of the works	Bench mark	III	2	Start and end of the route
II	**Pumping station**				
1	Technical leveling	Km	III	5.252	Longitudinal and cross section along the line
2	Measure longitudinal sectionon land of D450mm steel discharge	100m	III	39.52	Measure along the route length

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
	pipeline				
3	Measure longitudinal section on land of 22KV medium voltage line	100m	III	13.0	Measure along the route length
4	Cross-sectional measurements on the scale of 1/200	100m	III	2.026	Measure 100m / 5m-wide cross section
5	Plugging the center of the works of D450mm steel discharge pipe	Bench mark	III	9	Start point, end point and turning point
6	Plugging the center of the construction work of 22KV medium voltage line	Bench mark	III	3	Start point and end point of the route
III	**Water storage tank**				
1	Pluging center of the works	Bench mark	III	2	
IV	**Irrigation pipeline**				
1	Technical leveling	Km	III	7.16	Longitudinal and cross section along the line
2	Longitudinal section measurements on land, the vertical scale 1/100, and the horizontal scale 1/200	100m	III	71.6	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	3.63	Measure 100m / 5m-wide cross section
4	Plugging at center of the works	Bench mark	III	15	Average 500m / benchmark
V	**Road for management**				
1	Technical leveling	Km	III	6.10	Longitudinal and cross section along the line
2	Longitudinal section measurement, the vertical scale 1/100, horizontal scale 1/200;	100m	III	61.0	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	12.3	Measuring 50m/10m-wide cross section
4	Plugging the center of the works	Bench	III	13	Start point and turning

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
		mark			point
VI	**Material yard**				
1	Traverse line - grade 2	Point	III	2	Each position is 2 benchmarks
2	Topographic map at scale 1/1000, 1 meter contour line	ha	III	1	100m long and 100m wide

Table: Topographic survey quantity during the engineering design phase of Thi Tran Reservoir

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
I	**System carrying water from reservoir to pumping station**				
1	Technical leveling	Km	III	0.10	Longitudinal and cross section along the line
2	Measure longitudinal section on land, the vertical scale 1/100, horizontal scale 1/500	100m	III	1.0	Measure according to the length of the pipeline
3	Cross-section measurement on land at scale 1/200, topography level II	100m	III	0.10	Measure 100m / 5m-wide cross section
4	Plugging the center of the works	Bench mark	III	2	Start and end of the route
II	**Pumping station**				
1	Technical leveling	Km	III	1.3	Longitudinal and cross section along the line
2	Measure longitudinal sectionon land of D450mm steel discharge pipeline	100m	III	11	Measure along the route length
3	Measure longitudinal sectionon land of 22KV medium voltage line		III	2	Measure along the route length
4	Cross-sectional measurements on the scale of 1/200	100m	III	0.65	Measure 100m / 5m-wide cross section

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
5	Plugging the center of the works of D450mm steel discharge pipe	Bench mark	III	3	Start point, end point and turning point
6	Plugging the center of the construction work of 22KV medium voltage line	Bench mark	III	2	Start point and end point of the route
III	**Water storage tank**				
1	Pluging center of the works	Bench mark	III	2	
IV	**Irrigation pipeline**				
1	Technical leveling	Km	III	2.784	Longitudinal and cross section along the line
2	Longitudinal section measurements on land, the vertical scale 1/100, and the horizontal scale 1/200	100m	III	27.84	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	1.442	Measure 100m / 5m-wide cross section
4	Plugging at center of the works	Bench mark	III	6	Average 500m / benchmark
V	**Road for management**				
1	Technical leveling	Km	III	5.0	Longitudinal and cross section along the line
2	Longitudinal section measurement, the vertical scale 1/100, horizontal scale 1/200;	100m	III	50.0	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	10.1	Measuring 50m / 10m-wide cross section
4	Plugging the center of the works	Bench mark	III	11	Start point and turning point
VI	**Material yard**				
1	Traverse line - grade 2	Point	III	2	Each position is 2 benchmarks
2	Topographic map at scale 1/1000, 1 meter contour line	ha	III	1	100m long and 100m wide

Table 15: Topographic survey quantity during the engineering design phase of Ea Kuang Reservoir

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
I	**System carrying water from reservoir to pumping station**				Directly carrying water from the reservoir
II	**Pumping station**				
1	Technical leveling	Km	III	1.622	Longitudinal and cross section along the line
2	Measure longitudinal sectionon land of D450mm steel discharge pipeline	100m	III	10.22	Measure along the route length
3	Measure longitudinal section on land of 22KV medium voltage line	100m	III	6.0	Measure along the route length
4	Cross-sectional measurements on the scale of 1/200	100m	III	0.561	Measure 100m / 5m-wide cross section
5	Plugging the center of the works of D450mm steel discharge pipe	Bench mark	III	3	Start point, end point and turning point
6	Plugging the center of the construction work of 22KV medium voltage line	Bench mark	III	2	Start point and end point of the route
III	**Water storage tank**				
1	Pluging center of the works	Bench mark	III	2	
IV	**Irrigation pipeline**				
1	Technical leveling	Km	III	11.918	Longitudinal and cross section along the line
2	Longitudinal section measurements on land, the vertical scale 1/100, and the horizontal scale 1/200	100m	III	119.18	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	6.01	Measure 100m / 5m-wide cross section
4	Plugging at center of the works	Bench mark	III	25	Average 500m / benchmark
V	**Road for management**				

No.	Survey item	Unit	Topographic grade	Quantity	Explanation
1	Technical leveling	Km	III	5.32	Longitudinal and cross section along the line
2	Longitudinal section measurement, the vertical scale 1/100, horizontal scale 1/200;	100m	III	53.2	Measure along the route length
3	Cross-section measurement on land in the scale of 1/200	100m	III	10.74	Measuring 50m / 10m-wide cross section
4	Plugging the center of the works	Bench mark	III	12	Start point and turning point
VI	**Material yard**				
1	Traverse line - grade 2	Point	III	2	Each position is 2 benchmarks
2	Topographic map at scale 1/1000, 1 meter contour line	ha	III	1	100m long and 100m wide

Table 16: Geological survey hole excavation work quantity during the engineering design phase

No.	Items	Quantity (hole)	Quantity (m3)	Explanation
I. Pumping station at Doi 500 Reservoir				
1	Discharge pipe from station to tank (235m)	2	4	On average, each 100m is arranged with a survey excavation pit. Each pit is 2m deep.
2	Irrigation pipe (4,066m)	27	54	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
3	The roads for management (6,129.6m)	12	24	On average, each 500m is arranged for a survey excavation pit. Each pit is 2m deep.
Total		**41**	**82**	
II. Pumping station at BuonYong Reservoir				

No.	Items	Quantity (hole)	Quantity (m3)	Explanation
1	Discharge pipe from station to tank (1,096m)	7	14	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
2	Irrigation pipeline (8,507m)	57	114	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
3	The roads for management (7,945m)	15	30	On average, each 500m is arranged for a survey excavation pit. Each pit is 2m deep.
Total		**79**	**158**	
III. Pumping station at zone 1 ofKrong Buk Ha Reservoir				
1	Discharge pipe from station to tank (900m)	6	12	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
2	Irrigation pipeline(3,455m)	23	46	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
3	The roads for management (5,385m)	10	20	On average, each 500m is arranged for a survey excavation pit. Each pit is 2m deep.
Total		**39**	**78**	
IV. Pumping station at zone 2 ofKrong Buk Ha Reservoir				
1	Discharge pipe from station to tank (1,532m)	10	20	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
2	Irrigation pipeline(6,860m)	46	92	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.

No.	Items	Quantity (hole)	Quantity (m3)	Explanation
3	The roads for management (4,300m)	**8**	**16**	On average, each 500m is arranged for a survey excavation pit. Each pit is 2m deep.
Total		**64**	**128**	
V. Pumping station at zone 3 of Krong Buk Ha Reservoir				
1	Discharge pipe from station to tank (3,952m)	26	52	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
2	Irrigation pipeline(7,160m)	48	96	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
3	The roads for management(6,100m)	12	24	On average, each 500m is arranged for a survey excavation pit. Each pit is 2m deep.
Total		**86**	**172**	
VI. Pumping station at Thi Tran reservoir				
1	Discharge pipe from station to tank (1,100m)	7	14	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
2	Irrigation pipeline(2,784m)	18	36	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
3	The roads for management(5000m)	10	20	On average, each 500m is arranged for a survey excavation pit. Each pit is 2m deep.
Total		**35**	**70**	
VII. Pumping station at Ea Kuang Reservoir				
1	Discharge pipe from station to tank (1,022m)	7	14	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m

No.	Items	Quantity (hole)	Quantity (m3)	Explanation
				deep.
2	Irrigation pipeline (11,918m)	79	158	On average, each 150m is arranged with a survey excavation pit. Each pit is 2m deep.
3	Concrete canal (3,860m)	19	57	On average, each 200m is arranged for a survey excavation pit. Each pit is 2m deep.
4	The roads for management (5,320m)	10	20	On average, each 500m is arranged for a survey excavation pit. Each pit is 2m deep.
Total		**115**	**149**	

Table 17: Geological survey drilling work quantity during the engineering design phase

No.	Item	Quantity	Volume	Explanation
Pumping station at zone 2 of Krong Buk Ha Reservoir				
1	Pumping station	1	15	Arrange 01 survey borehole, drilling to15m deep
2	Water storage tank*1	1	10	Tank capacity is about 4,590m3, the F/S phase has surveyed 01 borehole, this phase needs to add 01 hole of 10m deep.
Total		**2**	**25**	

Table 18: The quantity of experimental work of pure soil samples

No.	Items	Quantity (sample)	Explanation
1	Pumping station at Doi 500 Reservoir	18	Pipelines and roads take 03 samples in 1layer for each item. Expected survey area has 2 layers.
2	Pumping station at BuonYong Reservoir	9	Pipelines and roads take 03 samples in 1layer for each item. The survey area is expected to have 1 layer.
3	Pumping station at Krong Buk Ha Reservoir	50	Pipelines and roads take1 to 3 samples per layer for each item. Expected survey area has 3 layers. At the locations of boreholes for pumping stations and water storage tanks, an average of 3m is taken for each sample.
4	Pumping station at Thi Tran Reservoir	9	Pipelines and roads take 03 samples in 1layer for each item. The survey area is expected to have 1 layer.
5	Pumping station at Ea Kuang Reservoir	18	Pipelines and roads take 03 samples in 1layer for each item. Expected survey area has 2 layers.
Total		**104**	

Table 19: Summary of geological survey quantity in the engineering design phase

No.	Content of the works	Unit	Quantity	Note
Pumping station at Doi 500 Reservoir				
1	Digging non-pillar, the depth of excavation pit is from 0<=2m, soil level I-III	m3	82	
2	Digging non-pillar, the depth of excavation pit is from 0<=4m, soil level I-III	m3	12	
3	The testing to determine the soil properties of undistrubed sample with 9 criteria	Sample	18	
4	The testing to determine standard compaction criteria	Sample	3	
5	The testing to determine the property of material yard	Sample	6	
Pumping station at BuonYong Reservoir				
1	Digging non-pillar, the depth of excavation pit is from 0<=2m, soil level I-III	m3	158	
2	Digging non-pillar, the depth of excavation pit is from 0<=4m, soil level I-III	m3	12	
3	The testing to determine the soil properties of undistrubed sample with 9 criteria	Sample	9	
4	The testing to determine standard compaction criteria	Sample	3	
5	The testing to determine the property of material yard	Sample	6	
Pumping station atKrong Buk Ha Reservoir				
1	Terrestrial drilling on land from 0 - 15m, soil level I-III	m	11	
2	Terrestrial drilling on land from 0-15m, soil level IV-VI	m	8	
3	Terrestrial drilling on land from 0-15m, soil level VII-VIII	m	6	
4	Digging non-pillar to the depth of excavation pit is from 0<=2m, soil level I-III	m3	378	
5	Digging non-pillar to the depth of excavation pit is from 0<=4m, soil level I-III	m3	36	
6	SPT testing, Soil/rock level I-III	time	15	
7	The testing to determine the soil properties of undistrubed sample with 9 criteria	Sample	50	
8	The testing to determine physical properties of rock samples	Sample	2	
9	The testing to determine standard compaction criteria	Sample	3	
10	The testing to determine the property of material yard	Sample	6	

No.	Content of the works	Unit	Quantity	Note
Pumping station at Thi Tran reservoir				
1	Digging non-pillar to the depth of excavation pit is from 0<=2m, soil level I-III	m3	70	
2	Digging non-pillar to the depth of excavation pit is from 0<=4m, soil level I-III	m3	12	
3	The testing to determine the soil properties of undistrubed sample with 9 criteria	Sample	9	
4	The testing to determine standard compaction criteria	Sample	3	
5	The testing to determine the property of material yard	Sample	6	
Pumping station at Ea Kuang Reservoir				
1	Digging non-pillar to the depth of excavation pit is from 0<=2m, soil level I-III	m3	92	
2	Digging non-pillar to the depth of excavation pit is from 0<=4m, soil level I-III	m3	69	
3	The testing to determine the soil properties of undistrubed sample with 9 criteria	Sample	18	
4	The testing to determine standard compaction criteria	Sample	3	
5	The testing to determine the property of material yard	Sample	6	