

**TERMS OF REFERENCE FOR FEASIBILITY STUDY AND
DETAIL DESIGN FOR DAMS' CONSTRUCTION AT JESR
AL MALAQY AREA IN AL FARA'A- NABLUS
GOVERNORATE**

**State of Palestine
Water Authority/ Ramallah**

September 2022

1. Context

Available Water Resource

Although current potential water resources in West Bank, comes mainly from groundwater and springs (142 MCM in 2021), in addition to the water purchased from Israel (77MCM in 2021), wadies runoff and treated wastewater are considered important conventional and nonconventional water resources that needs to be utilized.

Wells and springs are located in three main basins in the West Bank: the Eastern Basin, the North-Eastern Basin and the Western Basin. Each of these basins contains several aquifers which are renewable. The water coming from wells and springs is used for both domestic and agricultural purposes although around 5 % only of the cultivated land is irrigated due to water scarcity (should more water be available this value would increase).

Faced with changing climate and rising intensity of climate extremes, surface storage may be an option to allow for direct use for irrigation or other purposes to be defined. Rainwater may be stored and infiltrated into the aquifers either to sustain the yield of the aquifer or to allow for the creation of additional wells. Intentional groundwater replenishment known as Managed Aquifer Recharge (MAR) is an increasingly important water management strategy to maintain, enhance and secure stressed groundwater systems and to protect and improve groundwater quality. The scarcity of water resources in semiarid regions such as the West Bank is usually accompanied by brief periods of quite intense precipitation. In such regions, the use of runoff water for aquifer recharge can contribute to both flooding prevention and effective management of water resources.

To date, no comprehensive or conclusive study has been conducted to assess the potential quantities and qualities that may feasibly be captured by harvesting rainwater¹and reusing treated wastewater. However, the availability of hydrological, geological and topographic data is sufficient to prepare a large-scale water harvesting Master Plan. Currently, a Water Harvesting Master Plan is being developed to provide the main conceptual guidelines applicable to the local context in terms of water harvesting and the best locations and the main characteristics of individual water harvesting projects.

Al Fara'a watershed

During the recent 20 years, many studies were conducted on Al Fara'a watershed with focus on runoff estimations and principles of integrated water resources management and sustainability. A National Committee from Palestinian Water Authority (PWA), Ministry of Agriculture (MoA), Ministry of Local Government (MoLG), and Nablus Governorate; was established recently by the Cabinet of Minister to conduct a study on Al Badan springs where set of recommended interventions were issued to optimize spring management

¹Stormwater is any water running off a land surface before it reaches a natural water body. It occurs when the rate of precipitation is greater than it can infiltrate, or soak, into the soil. Rainwater harvesting offers a small-scale best management practice to reduce stormwater runoff and the problems associated with it. By harvesting the rainfall and storing it, the water can be slowly released back into the soil, either through irrigation or direct application. The water then moves into groundwater table, providing a steady supply of water to local streams and rivers.

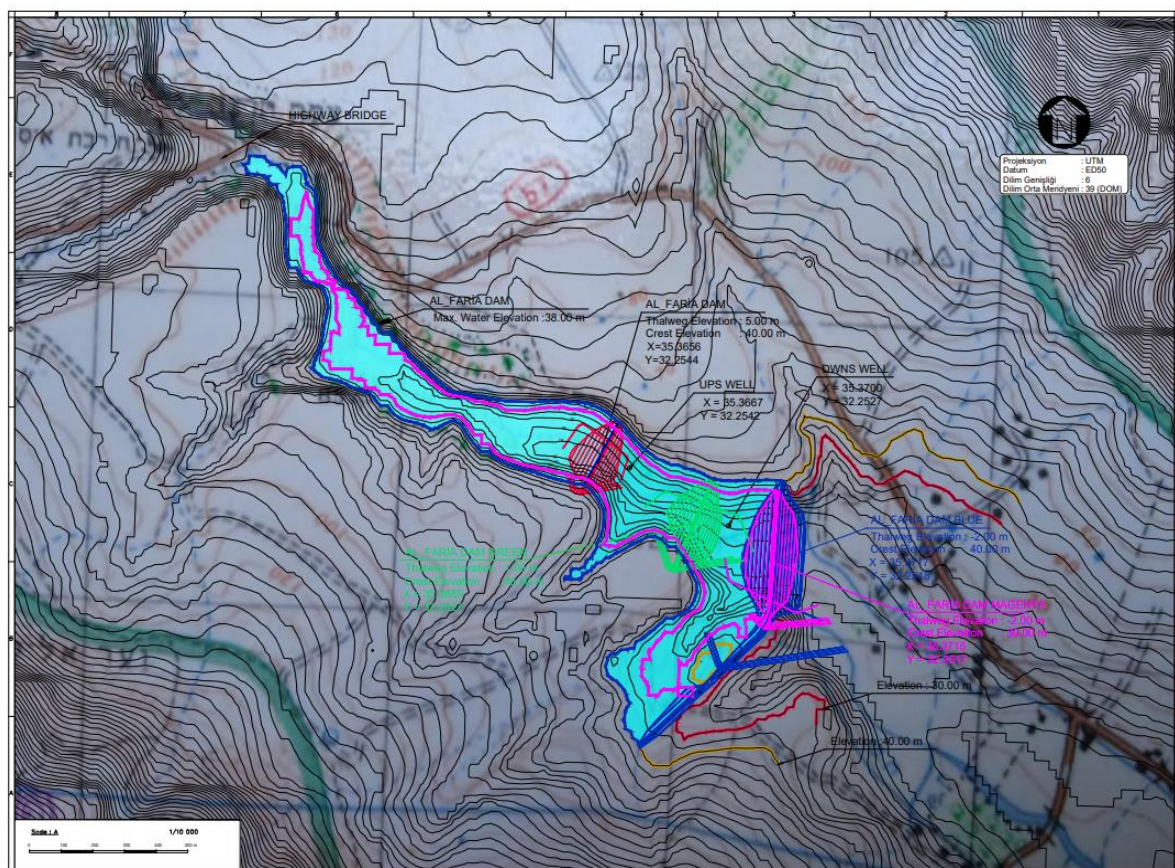
water sustainably, and efficiently. One of the recommendation raised was the need to construct a dam at El Malaki bridge (Al-Fara'a Dam) to manage the water of the Badan and Fara'a springs in an integrated and sustainable manner, in addition to collecting flood water and storing treated wastewater from eastern Nablus area WWTP, in order to maximize the utilization of water resources and provide additional quantities of water for irrigation use, especially in summer, through storing and managing it effectively and sustainably, as the area is irrigated agricultural lands.

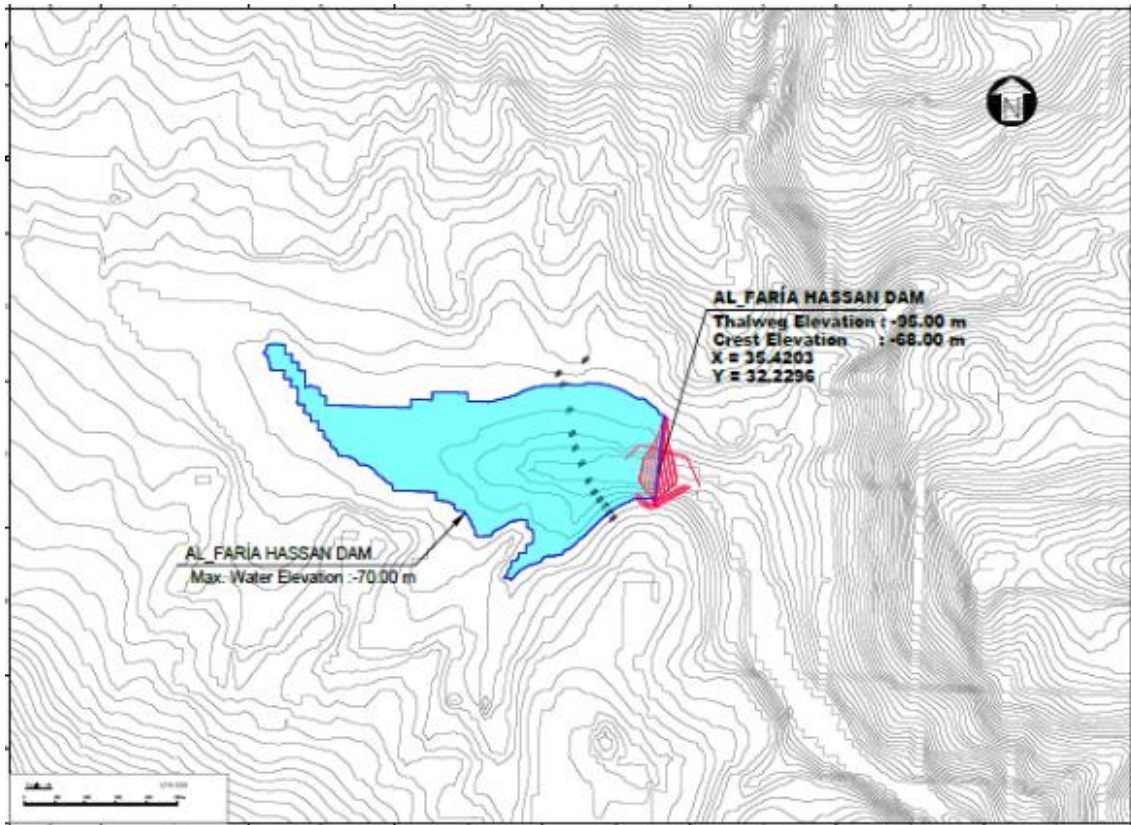
The project is expected to contribute to increasing demand for agricultural water, especially in the Jiftlik area, hence will reduce pressure on groundwater wells, and support Palestinian people on their land.

In this context, and considering the available studies; preliminary results and according to the urgent need to construct water harvesting structure to increase water availability and manage the water resources sustainably; in line with PWA strategic vision; MoA vision and needs; a dam was proposed in EL Malaki bridge area.

The initial designs for the project was prepared by specialists with three potential locations. However, selecting the proper location will depend on the feasibility study results.

The proposed dam locations with the preliminary main dimensions are presented in the Figures below:





In accordance with the requirement to carry out the necessary dam construction consultancy works; the consultancy outputs shall be as follows:

- Feasibility study for the dam’s construction in the proposed locations and selecting the optimal location.
- Detail dam design
- A complete set of Tender Documents

2. Overall objective and purpose

The overall objective of the project is to:

1. Increase the available water quantities through managing spring water in the area sustainably, in addition to harvesting of rain water and storing the treated wastewater from Nablus East, which mainly aims to provide food security.
2. Optimize the utilization of water resources in AL Fara’a catchment area.
3. Support the development of the ecosystem that seeks to improve the livelihoods of communities by enhancing the productive infrastructure and access to basic services.

The purpose of this Contract is to provide services for the investigation and design of new dam at El Malaki Bridge (Al Fara’a Dam). An outline of the services to be provided is indicated below. Detailed requirements are given in the following Sections.

The Contract will be undertaken in two phases separately, the implementation of the following phase will depend on the results of the previous phase, and accordingly a break down for the two phases should be included in the financial offer, the two phases are:

- **Phase 1:** Feasibility and Preliminary Design.
- The investigation, feasibility review and preliminary design of the dam;
- **Phase 2:** Detailed Design and Tender Documents
- The preparation of engineering detailed design and construction contract documentation.

Phase 1 – Investigation and Preliminary Design

The services required for feasibility, investigation, and preliminary design of the new dams comprise of the following:

- Undertaking further topographical, geological, hydrological and environmental studies shall be considered necessary in order to be able to finalize the precise location, size and type of dam in order to maximize the potential output from the construction of the dam;
- The preparation and submission of an overall Feasibility Study Report summarizing the findings and recommendations identified from the foregoing investigations and studies, together with a Cost Benefit Analysis and Preliminary Design Report;

Phase 2: Engineering Design and Construction Contract Documentation

The services required for the engineering design of the new dam shall comprise of the design and preparation of all of the technical documentation to be used to compile tender documents for the construction of the works, including detailed design drawings, technical specifications, bills of quantities, investigation reports, survey reports, and environmental management requirements.

3. Output and results to be achieved by the Consultant

The results to be achieved by the Consultant shall include:

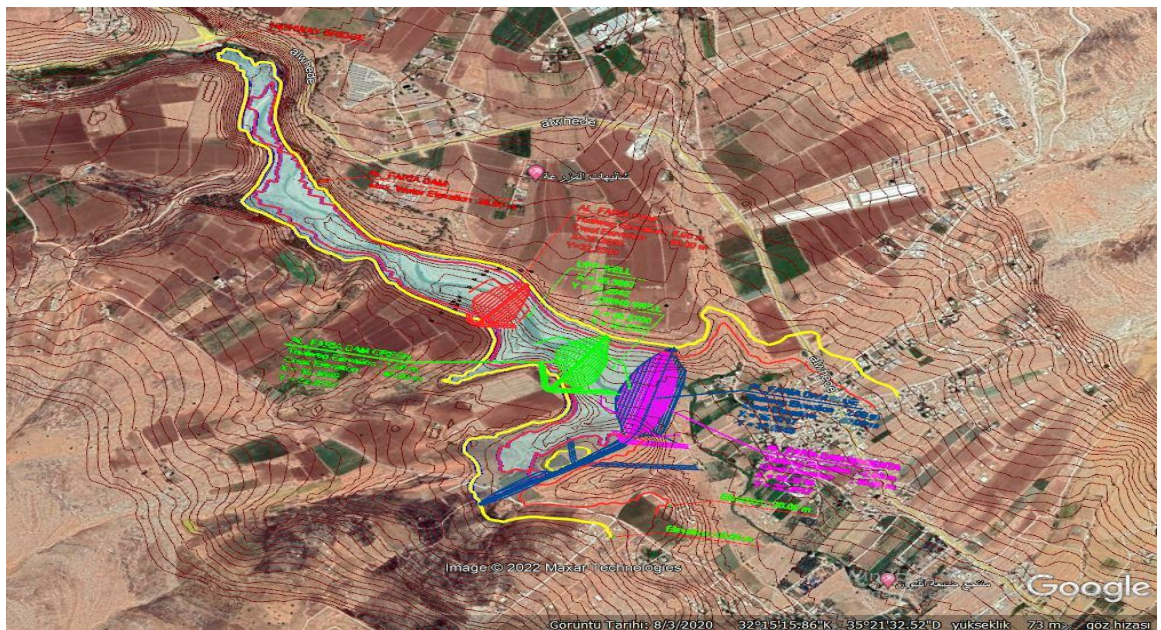
- Feasibility Study
- Cost Benefit Analysis
- Dam detailed design Report
- Dam safety and emergency plan
- Implementation Plan
- Drawings, technical reports and digital media relating to the various surveys, investigations and tests performed by the Consultant as well as its computation notes for the dimensions of the dam's infrastructure.
- Technical specifications, bill of quantities (BOQ), cost estimate, provisional construction schedule to a level sufficient for incorporation in the Tender Documents for the construction of the dam.

Land Ownership

Land ownership investigations should be part of the feasibility study.

Geographical area to be covered

The geographical area that the comprehensive feasibility study and detailed design of the proposed Dam is depicted in the figures below



Dam proposed locations alternatives 1 &2



Dam proposed location alternative 3

4. SCOPE OF WORKS

4.1. Activity 0 - Inception phase

During the inception phase, the Consultant shall:

- Review the existing data, available studies and planning documents (see Annex 1 for reference document)
- Prepare a draft inception report that shall feature an adjusted work plan and methodology and shall provide an update to the TOR
- Prepare a final inception report and work plan based on comments obtained at the inception meeting.

4.2. Phase 1 - Feasibility studies (Feasibility and Preliminary Design).

The first phase of the consultancy Contract aims at assessing the feasibility of the project in a comprehensive manner; from the technical, economic and environmental perspective. It will include the following tasks and their respective technical reports:

The work to be carried out shall be, but is not limited to, the following:

- Review and analysis of previous data and documents.
- Field data collection and analysis.
- Hydrological studies.
- Hydrogeological studies.
- Geological studies and site investigation.
- Topographic survey and mapping.
- Data analysis and design criteria.
- Dam optimization studies.
- Preliminary dam design and costing to feasibility study level.
- Environmental impact assessment studies.
- Economic analyses for project optimization.

Task 1.1 Information Review: The Consultant shall review the previous studies undertaken and examine the validity of the assumptions that were done including the findings related to the siting of the dam. The Consultant shall acquire at their own expense all maps, satellite photos, numerical and digital databases required for the studies.

Task 1.2 Topographical survey: The Consultant shall carry out various methods of topographical surveys (on site surveys, numerical data bases, satellite imagery, LIDAR, etc.) as necessary to capture specific site features such as the proposed dam axis, spillway area, etc.

The scope of survey activities to be performed for the design of Al Fara'a Dam by the Consultant should include:

- Performing field surveying of the dam reservoir area up to the proposed dam crest elevation. Field survey works shall be carried out including & identifying locations and dimensions of all public or private installations, facilities, or properties within

the storage reservoir using latest updated field survey instrument such as Total Station.

- The level of the topographic survey details should be sufficient to prepare and make the final dam design, as well as drawing the stage-storage capacity curves of the dam reservoir at each (1) m interval of height.
- At least (4) Bench Marks (reference points) shall be established at site: (1) point on each left & right abutments and (2) points on the dam axis. The spatial properties such as geographical coordination and elevations shall be identified & recorded. These points would be used in any future surveying works.
- An advanced engineering software program such as AutoCAD or Surfer program should be used to draw the resulting spatial grid, as well as a contour map that shows the change in the terrain of wadi bed with flow direction on the map.
- Cross-Sections of the wadi shall be drawn with an appropriate scale (1: 100) vertical and (1: 500) horizontal, to clarify the details of the changes in the topographical form of the wadi course.
- Small- and large-scale topographic maps of the dam site should be prepared in the final report.

Task 1.3 Geophysical studies: The consultant shall perform Geophysical studies at the dam location

Task 1.4 Geological and geotechnical investigations: The Consultant shall identify and geo-reference for illustration on maps, crucial soil and rock features, establish the engineering properties of rocks and soils, superficial deposits, and tectonic-structural patterns. Field Investigations shall include but not be limited to:

- i) Exploratory boreholes and trial pits for soil sampling and testing,
- ii) Preparation of geological profiles for the dam foundation,
- iii) Geo-reference possible sources of construction materials, and carry out tests to assess their engineering properties;

The Geotechnical investigation program shall comprise but not limited to the following:

- Borehole drilling: According to the geophysical exploration results and recommendations, the geotechnical boreholes shall be drilled at the appropriate locations selected by the consultant along the dam axis at the right & left abutments and through wadi course. The envisaged quantity of drilling for this investigation work is 500 m. The boreholes must be extended into bed rock by 20 m and out of this at least 10 m penetrated into competent rock. Maximum depth of borehole in the wadi section may reach 70 m, while the depths of holes at the abutments may vary depending upon rock slopes. The drilling will be conducted by suitable drilling rigs and equipment using double/triple core barrel.
- Soil and Rock Sampling: Upon the drilling completion of each borehole, all obtained soil and rock core samples will be systematically logged, described, arranged in core boxes to ensure proper identification of samples and must be

comprehensively labeled, photographed and transported to the geotechnical lab and kept for further inspection and testing.

- In situ Geotechnical testing in soils:
 - 1- Standard Penetration Test (SPT): to estimates the relative density, effective friction angle and deformation modulus (E) of cohesionless (alluvium) soils, and to assess the liquefaction potential of saturated sands and silty sands. Results should be analyzed by the dam designer to assess alluvium suitability for stopping internal erosion of completely weathered rock.
 - 2- In situ permeability test in soils: by either constant head tests or falling head procedures test and should be applied according to the British standard/ASTM. It is important to determine the permeability of the dam foundation
 - 3- In situ permeability test in rocks: clarify the presence of weathered zones, or zones of high permeability in bedrock, which would require grouting and foundation treatment.
- Laboratory testing & interpretation of results: As per international practices, the consultant should be responsible for the entire relevant laboratory testing and its interpretation related to dam design. In-situ tests should be compared with laboratory tests.

Task 1.5 Hydrology and water resources assessment: The consultant shall review and determine as necessary the hydrological patterns of the catchment area at the dam site in order to dimension the critical components of the scheme (the spillway, etc.).

The task of the Consultant shall include but not be limited to:

- i) Review and undertake hydrological analyses to estimate reservoir yield, inflow design flood (Probable maximum flood- PMF) and releasing discharge rates to facilitate the design and sizing of the different hydraulic structures such as the reservoir, spillway and outlet/conveyance works;
- ii) Assessment of the reservoir sediment Yield to calculate dead and live storages
- iii) Assess the spatial and seasonal fluctuations of climatic variables on the hydrological characteristics retained for the project,
- iv) Collect any and all information available in records and with local communities on the history of flooding, severity and damage caused by floods in the project areas;
- v) Analyze hydro-meteorological records to assess the risk of flooding in the project areas;
- vi) Detect the suitable recurrence design storm interval of cofferdam for prevention of overtopping during construction stage.

Hydrologic assessment procedures shall include the following:

- Rainfall Frequency Analysis: The rainfall analysis should be carried out based on a pooled analysis of all rainfall stations within and nearby catchment area.
- Watershed Modeling: Based on the watershed morphometric study, schematic of the Fara'a watershed and sub-basins can be modeled the HEC-HMS or any other

appropriate models. The results generated by the hydrological model should be obtained.

- Mean annual Runoff Estimation: The consultant shall make estimation for Mean annual rainfall depth and volume, as well as the annual runoff coefficient, and estimating the average annual floods reaching to the dam storage reservoir using the latest studies in Palestine
- Design Storm Duration

Task 1.6 Environmental and Social Impact Assessment including land ownership investigation.

Task 1.7 Preliminary Design: The Consultant shall use the information derived under the previous tasks to determine the optimum location, type and configuration for the proposed dam, and shall prepare an outline design for the dam, draw-off facilities, spillway, access and any necessary ancillary works. The outline design shall take into consideration the underlying geology and foundation, construction methods and materials available, the costs of the possible alternatives.

4.3. Phase 2 - Engineering design

Based on the Agreed Preliminary Design Report, the Consultant shall undertake the detailed design including as appendices all of the technical documentation to be used to compile tender documents for the construction of the dam and ancillary works, including detailed design drawings, technical specifications, bills of quantities, investigation reports, survey reports and environmental management requirements, including but not limited to:

- i) Selection of Dam Type taking into consideration the technical feasibility, material availability and economic feasibility.
- ii) Detailed structural and hydraulic designs of the various dam components, including foundations and abutments, dam structure, spillways, Intake, Outlet System and Electro- Mechanical
- iii) Works Provide the architectural, structural, electrical and sanitary design of envisaged appurtenant structures for the dam like Main Access Roads, office building, instrument house & dam operation building etc. Existing buildings like guard house & generator house shall be reviewed for completion of construction.
- iv) Control of Diversion during Dam Construction including coffer dams and diversion channels
- v) Dam Break Analysis
- vi) Recommended dam safety monitoring, management systems and alarm systems
- vii) Emergency Preparedness/Action Plan to specify the roles of responsible parties when emergency situations are observed.
- viii) Issued for Construction (IFC) drawings, bill/schedule of quantities (BOQ) in Excel format, and Technical Specifications
- ix) Dam & Reservoir Operation & Maintenance (O&M) Plan for the Dam & reservoir operation under the normal and emergency cases anticipated during the service life of the dam and maintenances required.

Preliminary Construction / Implementation Plan: The Consultant shall prepare preliminary construction schedules for the implementation of the project components.

Dam Safety Plan: The Consultant shall prepare safeguards and operational procedures relating to dam safety. The consultant will prepare the Emergency Action Plan and provide Flood Maps and evacuation maps in case of dam break conditions

4.4. Capacity Development

The Consultant shall provide on job capacity development for designated engineers from PWA and MoA staff on dam design, construction, operation and maintenance. At project completion, it is anticipated that participants in the training program will be familiar with the feasibility study, drawing, and contract technical bidding document preparation process. In addition to operation and maintenance of dams.

5. Deliverables

5.1. List of deliverables

The outputs expected from the Consultant are presented in Table below

Table 1 List of deliverables

output	Submit date
Inception Report	End of month No. 1
Feasibility Report and preliminary design (output 1)	End of month No. 3
Detail Design Report with all needed calculations and drawings (output 2)	End of month No. 5
Tender documents including the detailed drawings, BoQ and cost estimate (output 3)	End of month No. 6

5.2. Requirements for deliverables

All documents shall be in English and as comprehensive as possible avoiding lengthy textbook sections.

They should comply with the following requirements:

- Compliance with the terms of reference
- Clarity, soundness and relevance of their content

The reports will be submitted in three (3) hard, colored copies; all reports shall be bound. Maps and drawings included in the reports must be easily readable.

Three soft copies on flash memories shall also be provided (in pdf, Word, Excel, MS-Project, Arc-GIS 10 - appropriate software versions to be coordinated with PWA - with linked shapefiles, suitable for PWA to work on).

It is important that the deliverables presented by the Consultant be clear and transparent. As such the Consultant will ensure the following aspects are included in his final reports:

- The source of all collected data shall be traceable
- The methodology and assumptions used shall be fully described

5.3. Approval procedure of deliverables

Deliverables will be submitted to PWA for approval. PWA will review and organize comments from all relevant stakeholders within 3-4 weeks after reception. The Consultant shall integrate the requested modifications and comments within 2 weeks after receipt of PWA comments, unless otherwise indicated, prior to submitting the final version.

6. Staff Requirements

The Consultant's team shall comprise of at least the experts presented in **table 2** below.

The CVs submitted by the Consultant shall reflect this requirement. In addition, a chief backstopping person as well as his deputy shall be nominated. This has to be understood as a tentative list of experts, however, the Consultant shall feel free to add extra and/or multi-skilled staff, as he deems necessary and appropriate to satisfactory reach the objectives of the Project based on his professional judgment.

The Consultant shall provide adequate, qualified and experienced staff for the good and timely execution of the study he has been assigned to. All such staff has to be approved by the Client and it is the right of the Client to withdraw at any time any approval for such staff if they are found to be unsuitable or otherwise not desirable, in which case the person or persons in question shall be replaced by others approved by PWA.

In addition to key staff, any supporting staff and any logistical support including rent transportation either for local and or international, cost of accommodation and any administrative cost, printing and producing all reports and documents as mentioned above shall be estimated by the Consultant and shall be included in the lump sum amount of the financial proposal.

Table 2: list of required staff

No.	Staff	Minimum Qualifications	Level of Effort
Key Expert			
1	Team Leader / Project Manager	B.Sc. Civil Engineering with at least 15 years' experience in Construction Management / hydraulics / Water Resources Engineering- International Expert	6 months
2	Dams and structural Design Specialist	Master degree in Dam design/Hydraulic structures with at least 10 years dam design experience- International Expert	3 months
3	Geotechnical Engineer	Geologist or B.Sc. Civil Engineering with degree in Geology with at least 10 years' experience in geotechnical/ geophysical investigation of dam projects- International Expert	2 months
Non-Key Expert			
4	Topographic Survey Engineer	bachelor's degree in survey with a minimum of 10 years' general survey experience- Local Expert	2 months

5	Hydrologist and sedimentation	Bsc in fields relate to Hydrology, Msc in related engineering fields with 5 years of experience - International Expert	2 months
6	Geologist	Bsc in fields relate to Geology with 5 years of experience - International Expert	2 months
7	Draftsmen- CAD Operator	Relevant experience in Dam projects design Local/international Expert	4 month
8	Environmental specialist	BS Environmental Sciences / Environmental Engineering. with 5 years of experience -Local / International Expert	1 month
9	Social/Sociology Specialist	BS. Sociology / Rural Sociology / Social Work / Social Sciences. With 5 years of experience in sociological investigations-Local Expert	1 month
10	Cost Estimator	BSc or recognized professional qualification with a minimum of 3 years' experience in cost estimation of similar projects- Local Expert	1 month

7. Time Frame of the Project

The Consultant shall commence his work after the signature of the Contract within the time period stipulated in the Contract. The PWA will make available to the Consultant all documents listed in **Annex 1**. before the date of Commencement of Services. The Consultant will liaise with the PWA and other institutions, form his team and take up the Project activities.

The Consultant shall carry out all tasks of the Project within an estimated total period of six (6) months from the date of Commencement of Services. The Consultant is invited to carefully study if he will be able to follow the proposed time schedule as presented in figure below. In his proposal the Consultant can propose another time schedule as deemed appropriate with associated justification to considered by the client

Activity	Title	Months					
		1	2	3	4	5	6
0	Inception phase						
	phase 1 - feasibility studies						
	phase 2 - engineering design – Detail Design						
	phase 2 - engineering design- Tender document						
	Closure						

Figure 1 Tentative time schedule for the completion of the Project

8. Project organization

8.1. Project executing agency

The Project executing agency is the Palestinian Water Authority (PWA).

8.2. Stakeholder participation

For the success of the Project it is important that all relevant stakeholders (governmental bodies including relevant Ministries (MoA) , relevant LGUS, service provider, communities', water users' associations, NGOs, etc.). Therefore, throughout the Project, the team leader - and other experts if required - shall be available for meetings called by the PWA and for ad-hoc telephone or internet consultations on any matter concerning the Project.

The Consultant shall be ready to prepare a couple of formal presentations on the results of the Project at various stages. The audience for the presentation will be decided by the PWA and may include funding agencies.

9. Responsibilities of PWA

- PWA will coordinate and supervise the work of the Consultant and will oversee the activities on a day to day basis thus following the progress of the Project. PWA will review and provide comments on the Consultants' deliverables in a timely manner. PWA review does not alleviate the Consultant of his responsibilities for ensuring that his work is completed diligently and accurately.
- PWA will provide the Consultant with relevant available information and data and any other documents of general nature relevant to the assignment, the vast majority of which is available in English. The existing documents shall be made available by PWA before the start of the consulting activities on site.
- Comments by PWA shall be provided within 3-4 weeks of submission of deliverables.
- PWA will provide at its facilities in Ramallah meeting room for meetings (with needed facilities, and refreshments) upon prior notice. This will be provided free of any costs to the Consultant. The Consultant will work closely with the relevant PWA staff.
- PWA will not provide office space, furniture or related services in its premises in the West Bank or Gaza.
- All of the above-mentioned items will be provided by PWA, any other items needed must be provided by the consultant.

10. Responsibilities of the Consultant

The Consultant shall carry out his duties in a timely, diligent and professional manner according to this TOR. As mentioned above, the Consultant is requested to review the TOR in his proposal, but also during the inception phase to amend - if necessary - the tasks in order to come up with final deliverables fulfilling the intended purpose of the Project.

The Consultant shall cover all costs needed to accomplish the requested tasks indicated in the TOR and deliver quality outputs. This shall include the necessary office space and equipment, transportation, etc.

11. Backstopping and Quality Control

The home office of the Consultant shall maintain continuous support to the team working in the Project area. Before submitting any report, the home office is obliged to carefully review the respective document to assure the required quality. The Project shall be the basis for future project funding decisions in the Project area.

The corresponding cost shall be included in the financial proposal of the Consultant.

12. Contracts Type and Payments Schedule

The contract is lump Sum. The payments schedule (Reference to section 5.1 of the ToR) is:

Table 3 payments schedule

Payment No	Outputs Delivered and acceptable to PWA
First payment: 40% of the contract price	upon the submission and completion of Feasibility Study and Preliminary Design Report (output # 1)
Second payment: 40% of the contract price	upon the submission of the Draft and Final Detail Design acceptable to PWA (output # 2)
Third payment: 20% of the contract price	upon the submission of Tender documents acceptable to PWA (Output #3)

The financial proposal shall be submitted with clear division in between two independent phases (1) Feasibility Study Phase (2) Detail Design Phase. The implementation of Detail Design Phase shall be subject to the Client clearance and will be considered as provision Phase.

13. Beneficiary Country and Contracting Authority

The Contracting Authority and Executing Agency for the Project will be the PWA through the Water Resource Directorate

14. Qualification of the Firm

- Evidence of Firm capability and relevant experience in the execution of Consultancy Assignment of a similar nature, including the nature and value of the relevant contracts, as well as works in hand and contractually committed.
- The evidence shall include successful experience in the execution of at least two (2) Consultancy Services of a similar nature and size and complexity during the last five (5) years.
- Have been in business for at least the past 10 years.
- Availability of appropriate skills among staff as shown in section 6 of Staff requirements and/or the ability to mobilize a diversified team of experts with

appropriate knowledge and skills.

Annex1: References Documents

1. Evaluation of water harvesting and managed aquifer recharge potential in Upper Fara' basin in Palestine, Int. J. Global Environmental Issues, Vol. 16, Nos. 1/2/3, 2017
https://staff-beta.najah.edu/media/published_research/2017/04/10/Evaluation_of_water_harvesting_and_managed_aquifer_recharge_potential_in_Upper_Fara_basin_in_Palestine-comparing_MYWAS_and_water_productivity_approaches.pdf
2. Evaluating farmers' attitudes toward raw wastewater irrigation in Wadi Al-Far'a, Palestine,
<https://journals.aisrp.com/index.php/jaevs/article/download/4877/4644/7647>
3. Assessing Suitable Techniques for Rainwater Harvesting Using Analytical Hierarchy Process (AHP) Methods and GIS Techniques
<https://www.mdpi.com/2073-4441/14/13/2110/pdf>
4. Evaluation of water harvesting and managed aquifer recharge potential in Upper Fara' basin in Palestine: Comparing MYWAS and water productivity approaches
<https://www.inderscience.com/info/inarticle.php?artid=83432>
5. Developing a GIS-based agro-land suitability map for the Faria agricultural catchment, Palestine
https://staff-beta.najah.edu/media/published_research/2017/04/10/Developing_a_GIS-based_agro-land_suitability_map_for_the_Faria_agricultural_catchment_Palestine.pdf
6. Assessment of Groundwater Quality in the Faria Catchment, Palestine
https://journals.najah.edu/media/journals/full_texts/5_8z6cryJ.pdf
7. A preliminary investigation of wadi–aquifer interaction in the semi-arid watershed of Faria, Palestine using tracer-based methodology
<https://link.springer.com/article/10.1007/s12665-014-3944-8>
8. DEVELOPING QUANTITATIVE AND QUALITATIVE RELATIONSHIPS OF WADI-AQUIFER INTERACTION IN THE SEMI-ARID WATERSHED OF FARIA, PALESTINE
<http://dsr.ppu.edu/publications/conference/170>
9. Best Surface Water Management Options for Faria Catchment: Present Knowledge and Up to Date Modeling Capabilities
https://www.researchgate.net/publication/235978978_Best_Surface_Water_Management_Options_for_Faria_Catchment_Present_Knowledge_and_Up_to_Date_Modeling_Capabilities
10. MANAGEMENT OPTIONS OF WADI FARIA BASEFLOW
https://staff-old.najah.edu/sites/default/files/Management_Options_of_Wadi_Faria_Baseflow_.pdf

