

CARIBBEAN DEVELOPMENT BANK



**TECHNICAL ASSISTANCE
PLACENCIA PENINSULA WASTEWATER MANAGEMENT PROJECT –
NUTRIENT FATE AND TRANSPORT STUDY - BELIZE**

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Considered at the Two Hundred and Seventy-Fourth Meeting of the Board of Directors on December 8, 2016.

(Paper BD 149/16)

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CARIBBEAN DEVELOPMENT BANK

TWO HUNDRED AND SEVENTY-FOURTH MEETING OF THE BOARD OF DIRECTORS

TO BE HELD IN BARBADOS

DECEMBER 8, 2016

PAPER BD 149/16

TECHNICAL ASSISTANCE
PLACENCIA PENINSULA WASTEWATER MANAGEMENT PROJECT –
NUTRIENT FATE AND TRANSPORT STUDY - BELIZE

1. APPLICATION

1.01 By letter dated August 16, 2016, the Government of Belize (GOBZ) submitted a request for funding from the Caribbean Development Bank (CDB) to assist in financing the services of consultants to conduct a Nutrient Fate and Transport (NFT) Study to inform the design of a wastewater management system for the Placencia Peninsula.

1.02 GOBZ will be the beneficiary of the financing for this Technical Assistance (TA) Project, and the Belize Water Services Limited (BWS) (a company owned by GOBZ, with a mandate for the provision of water supply and wastewater management services in Belize) will be the executing agency.

1.03 The total cost of this Project is estimated at one million (mn) one hundred and seventy-five thousand United States dollars (USD1,175,000), of which CDB's contribution will be:

- (a) a loan not exceeding the equivalent of five hundred and ninety-six thousand United States dollars (USD596,000) from CDB's Special Funds Resources (SFR); and
- (b) a contingently recoverable grant of an amount not exceeding the equivalent of four hundred thousand United States dollars (USD400,000) from CDB's SFR, consisting of:
 - (i) an amount not exceeding the equivalent of two hundred thousand United States dollars (USD200,000) from CDB's Special Development Fund (SDF); and
 - (ii) an amount not exceeding the equivalent of two hundred thousand United States dollars (USD200,000) allocated from resources provided by the European Investment Bank (EIB) under the Grant Facility for Climate Action Support to CDB (EIB CAS Resources).

Counterpart funding, of an amount not less than the equivalent of three hundred and fifty-eight thousand Belize dollars (BZD358,000) will be provided by BWS.

2. **BACKGROUND**

2.01 The country of Belize is the only official English-speaking country in Central America. With a population of 377,968¹ and an area of approximately 2.3 mn hectares, Belize has the lowest population density in Central America. BWS is the utility with responsibility for the provision of potable water supply and wastewater management services for all major urban areas and contiguous villages in Belize. The Placencia Peninsula is one of BWS's service areas where potable water is supplied to residential and commercial customers.

2.02 The Placencia Peninsula is in a rural section of the Stann Creek District². It is located approximately 110 kilometres (km) south of the old capital Belize City. It is approximately 24 km long and 0.4 to 1.2 km wide. The area, which has several settlements including the villages of Maya Beach, Seine Bight and Placencia, is considered as having the finest beaches in the country. The largest settlement is Placencia Village, which is located on the southernmost part of the Peninsula. The Peninsula is bound on the east by the Caribbean Sea, on the north by the mainland, and on the west by the Placencia Lagoon. A single main road connects the Peninsula to the rest of the country via the Southern Highway. The current permanent population of the area is approximately 3,093.

2.03 The villages along the Peninsula are home to a diverse population, which includes Garifuna, Creole, Mestizo and Maya residents. The majority of village men have traditionally been self-employed in fishing and other marine-related activities. In recent years, because of declining fish stocks, these activities have become difficult for income-generation and many villagers have turned to the tourism industry for employment. The industry also provides income-earning opportunities for women as housekeepers, waitresses, and in other related service areas. In addition, recent developments in the tourism industry have contributed to a diversified local economy with local residents responding to the new opportunities for employment and income-generation. Some residents have established small-scale commercial ventures such as tour guiding, restaurants, guesthouses, and clerical services to support the tourism industry.

2.04 According to the Belize Third National Communication to the United Nations Framework Convention on Climate Change, an increase in air temperature ranging from 2°C to 4°C and decrease in annual rainfall of about 10% is projected by 2100 for Belize. The Stann Creek District, where Placencia is located, exhibits the most intense reduction in precipitation. The annual precipitation in the area around Placencia is expected to decrease to 1,200 mm/year (by 2060-2069). These changes in the climatic conditions have the potential to exacerbate the potential impacts of pollution loads on the functioning of the ecosystem, and on the aquatic life in particular.

2.05 Recognising the need for improving wastewater management practices in Placencia, GOBZ commissioned two consultancies, a feasibility study, and subsequently detailed designs for a centralised Placencia Peninsula Wastewater Management System. The Feasibility Study, funded by the United States Trade and Development Agency, was completed in 2012 and recommended that a NFT Study be conducted in parallel to the preparation of the detailed designs. The Inter-American Development Bank funded the design consultancy, and preliminary designs were completed for the wastewater treatment facility and the collection system. During the design phase, BWS was unable to source resources to fund the NFT Study. The Study is essential to inform the selection of a final effluent disposal location that was not only appropriate to deal with the treated effluent, but that would have the support of the various community stakeholders. Consequently the detailed design consultancy for the Placencia Peninsula Wastewater Management System was terminated, and funding to undertake the required baseline studies was sought by GOBZ.

¹ Statistical Institute of Belize 2016 Mid-Year Estimate

² The CDB-supported Country Poverty Assessment (2009) revealed that Stann Creek District (23%) had the second highest proportion of foreign-born households, after Cayo at 35%. The poverty level was 43.7% in the District, 2.4% more than the national level.

2.06 BWS is therefore seeking to engage consultants to undertake the NFT Study on the Placencia Peninsula and marine environs. The NFT Study will inform a future design consultancy for a centralised wastewater management system for Placencia.

3. PROPOSAL

3.01 It is proposed that CDB approve financing to GOBZ of an amount not exceeding the equivalent of nine hundred and ninety-six thousand, United States dollars (USD996,000) from CDB's SFR comprising:

- (a) a loan of an amount not exceeding the equivalent of five hundred and ninety-six thousand United States dollars (USD596,000); and
- (b) a contingently recoverable grant of an amount not exceeding the equivalent of four hundred thousand United States dollars (USD400,000) consisting of:
 - (i) an amount not exceeding the equivalent of two hundred thousand United States dollars (USD200,000) from CDB's SDF; and
 - (ii) an amount not exceeding the equivalent of two hundred thousand United States dollars (USD200,000) allocated from the EIB CAS Resources,

to be used by BWS to undertake the NFT Study on the Placencia Peninsula and marine environs to inform a future design consultancy for a centralised wastewater management system for Placencia, in accordance with the draft Terms of Reference (TOR) set out in Appendix 1.

3.02 The Consultants' scope of works will include:

- (a) the conduct of a baseline water quality study in the Placencia Peninsula and the surrounding marine environments with respect to nutrients, faecal bacteria, and physio-chemical parameters;
- (b) an assessment of the rate of uptake of nutrients by plants in the study area to determine their assimilative capacity;
- (c) an assessment of the potential for deleterious impacts of nutrients on aquatic life;
- (d) an assessment of the impacts of climate change on the functioning of the Placencia Lagoon ecosystem, including the fate of nutrients and faecal pollution and the potential consequences on the aquatic life; and
- (e) development of a comprehensive model to predict the transport and fate of nutrients and faecal bacteria in the Placencia Lagoon and the surrounding coastal Caribbean Sea off the Placencia Peninsula.

The data gathered from these studies will be used to determine the optimal locations for the wastewater treatment and effluent discharge facilities, and inform the completion of an Environmental and Social Impact Assessment and the detailed designs.

4. EXPECTED OUTCOME

4.01 The expected outcome of this TA project is enhanced capacity of BWS to undertake efficacious designs for a centralised wastewater management system for the Placencia Peninsula. The expected impact of the TA is a wastewater management system implemented in Placencia, which is climate resilient and effective in protecting the natural environment and public health. The Design and Monitoring Framework is set out at Appendix 2.

5. JUSTIFICATION

5.01 Over the last decade, the importance of tourism as an economic sector in Belize has increased to an extent where tourism expenditure is approximately 20% of Gross Domestic Product³. This places the tourism sector at the forefront of the country's economic activity, generating revenue, foreign exchange and employment and attracting foreign direct investment into the country. Much of the tourism product on which Belize has built its reputation involves diving and snorkelling along the extensive barrier reef.

5.02 The Placencia Peninsula is booming as a result of tourism development. Between 2000 and 2010, the Peninsula experienced the highest average growth rate of any urban centre in the country [9.1% per annum (p.a.) versus the national average of 2.65% p.a.]. The Placencia Peninsula is one of the most environmentally sensitive regions of Belize. The Placencia Lagoon serves as a habitat for several diverse aquatic organisms and plays an important role in the overall health of the Belize Barrier Reef, which is located a few kilometres to the east of the Peninsula. Protection of these natural resources is therefore paramount to the sustainability of the vital tourism sector in Belize.

5.03 Currently in Placencia, various types of onsite wastewater treatment systems are used by residents and businesses, ranging from traditional septic tanks to more advanced wastewater treatment facilities, which recycle water for irrigation. These individual systems are not effectively monitored and regulated by GOBZ. Hence, GOBZ has very little control over the way wastewater is treated and disposed of in Placencia. Consequently, there is high risk of groundwater contamination and pollution of the lagoon and the Caribbean Sea - resources on which the well-being of the main economic activity, tourism, and many local residents' livelihoods depend. This risk is exacerbated by the rapid population growth being experienced on the Peninsula. If wastewater management in the Peninsula is not improved, there is a likelihood that these contaminants will accumulate and become a public health hazard (waterborne diseases, ear and skin infections) to the residents of the Peninsula and will have a negative effect on the tourism product that drives the economy of this area.

5.04 GOBZ has therefore concluded that a centralised wastewater management system, managed by BWS, is the best option for minimising pollution of the sensitive natural environment in Placencia and reducing health, and livelihood risks. The proposed TA is therefore required, as it forms a fundamental building block for the design of a wastewater management system. The TA will facilitate the determination of the optimal locations for the treatment facility and final effluent disposal, by providing the baseline information and modelling tools to be used by design consultants for the Placencia Wastewater Management System.

³ Miller. C, 2015, *Belize Tourism Sector Study: Data Collection and Analysis for Appraisal of Fourth Consolidated Line of Credit – Belize*. CDB.

5.05 Based on CDB’s TA Performance Rating System (see Appendix 3), the Project has been rated highly satisfactory (scored at 3.75). This indicates that the TA has a good chance of meeting its development objectives. The project has also been assessed to have no contribution to gender equality (with a score of 0). Under the future design consultancy, a full environmental, social and gender impact assessment of the proposed wastewater management system will be undertaken. The gender marker is summarised in Table 5.1 below.

TABLE 5.1: GENDER MARKER SUMMARY

| Gender Marker | Analysis | Design | Implementation | Monitoring & Evaluation | Score | Code |
|----------------------|-----------------|---------------|-----------------------|------------------------------------|--------------|-----------------|
| | 0 | 0 | 0 | 0 | 0 | NO ⁴ |

5.06 The proposed TA is consistent with:

- (a) CDB’s Strategic Objective of supporting inclusive growth and sustainable development within its Borrowing Member Countries.
- (b) CDB’s Corporate Priority of strengthening and modernising social and economic infrastructure.
- (c) The SDF 8 Strategic Theme of promoting Inclusive and Sustainable growth.
- (d) CDB’s TA Policy and Operational Strategy of commitment to strengthening the synergies between TA operations and the Bank’s investment lending.
- (e) CDB’s Strategy as outlined in the Belize 2016-2020 Country Strategy Paper, where there is a commitment to: (i) inclusive social and economic development; and (ii) environmental sustainability.
- (f) Sustainable Development Goals (SDG) 6, 9 and 13⁵.

6. RISK ASSESSMENT AND MITIGATION

| Risk Type | Description of Risk | Mitigation Measures |
|------------------|---|--|
| Implementation | Stakeholder engagement and confidence in the Project outputs may be weak. | At an early stage of the consultancy, BWS’s Public Relations Department will identify appropriate opportunities: to engage with stakeholders; to communicate the objectives of the assignment; and at appropriate stages during implementation in order to obtain stakeholders’ perspectives, and enhance buy-in for the TA’s outputs. |

⁴ NO – No Contribution to Gender Equality.

⁵ SDG 6: Ensure available and sustainable management of water and sanitation for all. SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation. SDG 13: Take urgent action to combat climate change and its impacts

7. EXECUTION

7.01 BWS, through its Resident Consultant Engineer (RCE), will coordinate and oversee project implementation. The RCE will assume responsibility for project management. CDB will assist, as and when required, to ensure that the timing and quality of the Consultants' outputs satisfy the TOR requirements.

7.02 CDB's resources will be utilised to meet the cost of consultancy fees, travel, per diem and report preparation and reproduction. BWS will provide secretarial and support services, as well as office accommodation and communication facilities when the Consultants are operating at BWS' headquarters.

8. COST AND FINANCING

8.01 The total cost of the Project is estimated at USD1,175,000. The detailed budget is attached at Appendix 4 and is summarised in Table 8.1 below:

TABLE 8.1: BUDGET FOR CONSULTANCY SERVICES

| Contributors | USD | % |
|---------------------|------------------|------------|
| CDB (SFR Loan) | 596,000 | 51 |
| CDB (SDF Grant) | 200,000 | 17 |
| CDB (EIB CAS Grant) | 200,000 | 17 |
| BWS | 179,000 | 15 |
| Total | 1,175,000 | 100 |

8.02 CDB's contribution of an amount not exceeding the equivalent of USD996,000 is eligible for financing from its SFR. Funds are available within existing resources. It is proposed that the loan component be repayable in 32 equal or approximately equal and consecutive quarterly instalments, commencing 2 years after the date of the Loan Agreement. The interest rate is 2.5% p.a. fixed. The first disbursement of the loan and the grant shall be made by May 31, 2017 and the loan and grant shall be fully disbursed by May 31, 2019.

8.03 In the event that GOBZ obtains financing from CDB or other sources for a project or programme resulting from the Project, the following shall apply: (a) the amount of the Loan withdrawn and outstanding, together with the interest thereon, shall be payable in one payment from the proceeds of the first disbursement of such financing; and (b) the amount of the Grant, in full, shall be converted to a loan and shall be payable in one payment from the proceeds of the first disbursement of such financing.

9. PROCUREMENT

9.01 Procurement shall be in accordance with CDB's Guidelines for the Selection and Engagement of Consultants by Recipients of CDB Financing (October 2011), except that as EIB CAS Resources are being used together with CDB's SDF resources, to comply with the requirements of the EIB Grant Facility for Climate Action Support, a waiver is sought to extend eligibility to countries eligible for procurement under EIB-funded projects, which are not CDB member countries. The estimated value of the waiver being requested is USD796,000. Further details of the procurement arrangements are provided in the Procurement Plan set out at Appendix 5.

10. REPORTING REQUIREMENTS

10.01 BWS will be required to submit to CDB the following reports:

- (a) quarterly reports on the implementation of the TA Project. These reports are to be submitted within 14 days after the end of each quarter until implementation of the Project is completed; and
- (b) two copies of the Consultant's Reports as required in the draft TOR at Appendix 1.

11. RECOMMENDATION

11.01 The proposed financing for this Project is as follows:

- (a) a loan to GOBZ of an amount not exceeding the equivalent of five hundred and ninety-six thousand United States dollars (USD596,000) (the Loan); and
- (b) a contingently recoverable grant to GOBZ of an amount not exceeding the equivalent of four hundred thousand United States dollars (USD400,000) (the Grant),

from CDB's SFR, to assist GOBZ in financing the services of consultant(s) (the Consultant(s)) to conduct a NFT Study on the Placencia Peninsula and marine environs to inform a future design consultancy for a centralised wastewater management system for Placencia, in accordance with the TOR set out in Appendix 1 (the Project).

11.02 It is recommended that CDB approve a loan to GOBZ of an amount not exceeding the equivalent of five hundred and ninety-six thousand United States dollars (USD596,000) (the Loan) from CDB's SFR to assist GOBZ in financing the Project, on CDB's standard terms and conditions and on the following terms and conditions:

(1) **Repayment:**

- (a) Repayment of the Loan shall be made in thirty-two (32) equal or approximately equal and consecutive quarterly instalments commencing two (2) years after the date of the Loan Agreement.
- (b) If GOBZ obtains financing from CDB or other sources for a project or programme resulting from the Project, the amount of the Loan withdrawn and outstanding, together with the interest thereon, shall be payable in one payment from the proceeds of the first disbursement of such financing, if such payment is compatible with the operating policy of the source of such financing.

(2) **Interest:** Interest shall be payable quarterly at the rate of two decimal five percent (2.5%) per annum on the amount of the Loan withdrawn and outstanding from time to time.

(3) **Disbursement:**

- (a) The first disbursement of the Loan shall be made by May 31, 2017 and the Loan shall be fully disbursed by May 31, 2019, or such later dates as CDB may specify in writing.

- (b) Except as CDB may otherwise agree:
 - (i) the Loan shall be used to finance the components of the Project allocated for financing by CDB as shown in the budget for the Project set out at Appendix 4 (the Budget) up to the respective limits specified therein; and
 - (ii) total disbursements of the Loan shall not exceed in the aggregate fifty-one percent (51%) of the cost of the Project.
- (c) Except as CDB may otherwise agree, disbursements shall be made rateably from the Loan and the Grant in proportion to the respective amounts thereof.
- (d) The Loan shall not be used to finance, directly or indirectly, any part of the cost of the Project which consists of identifiable taxes or duties.

(4) **Procurement:**

- (a) Except as provided in sub-paragraph (b) below, procurement shall be in accordance with the procedures set out and/or referred to in the Loan Agreement between CDB, GOBZ and BWS providing for the Loan, or such other procedures as CDB may from time to time specify in writing.
- (b) Where EIB-CAS Resources under the Grant are being used together with CDB's SDF resources under the Loan, eligibility for procurement shall be extended to consultants from countries eligible for procurement under EIB-funded projects, which are not CDB Member Countries.
- (c) The Procurement Plan approved by CDB is set out at Appendix 5 (Procurement Plan). Any revisions to the Procurement Plan shall require CDB's prior approval in writing.

(5) **Other Conditions:**

- (a) Except as CDB may otherwise agree, GOBZ shall:
 - (i) execute the Project through RCE of BWS, who shall be responsible for project management;
 - (ii) make the proceeds of the Loan available to BWS for the purpose of executing the Project; and
 - (iii) take all necessary steps to facilitate and ensure the performance by BWS of its obligations set out and referred to herein.
- (b) As a condition of GOBZ making the Loan available to BWS, BWS shall undertake to observe and perform the obligations on its part to be observed and performed as set out and referred to herein.
- (c) Except as CDB may otherwise agree, Section 3.11 of the General Provisions shall not apply to this Loan.
- (d) BWS shall:

- (i) ensure that the proceeds of the Loan are used exclusively for the Project;
- (ii) keep its staff at levels consistent with financial prudence and technical and administrative competence;
- (iii) contribute to the Project an amount of not less than the equivalent of three hundred and fifty-eight thousand Belize dollars (BZD358,000) which shall be expended in a timely manner on the Project, unless CDB shall otherwise specify in writing;
- (iv) in accordance with the procurement procedures applicable to the Loan, select and engage consultant(s) to carry out the NFT Study set out in the TOR at Appendix 1 and within a time frame acceptable to CDB implement such recommendations arising from the NFT Study as may be acceptable to CDB; and
- (v) except as CDB may otherwise agree, furnish or cause to be furnished to CDB:
 - (aa) during implementation of the Project, quarterly reports on the implementation of the Project, within fourteen (14) days after the end of each quarter; and
 - (bb) the reports to be provided by the Consultant(s) in accordance with the TOR at Appendix 1, in the forms specified or in such form or forms as CDB may require, not later than the times/periods specified therein for so doing.
- (e) GOBZ and BWS shall:
 - (i) carry out the Project at all times with due diligence and efficiency, with management personnel whose qualifications and experience are acceptable to CDB, and in accordance with sound technical, environmental, financial and managerial standards and practices; and
 - (ii) institute and maintain organisational, administrative, accounting and auditing arrangements acceptable to CDB.
- (f) CDB shall be entitled to suspend, cancel or call in the Loan, or any part thereof, if the Grant, or any part thereof, is suspended, cancelled or required to be refunded.

11.03 It is also recommended that CDB make a contingently recoverable grant to GOBZ from CDB's SFR of an amount not exceeding the equivalent of four hundred thousand United States dollars (USD400,000), consisting of:

- (a) an amount not exceeding the equivalent of two hundred thousand United States dollars (USD200,000) from CDB's SDF; and
- (b) an amount not exceeding the equivalent of two hundred thousand United States dollars (USD200,000) allocated from the EIB CAS Resources,

to finance the Project, on CDB's standard terms and conditions and on the following terms and conditions:

(1) **Disbursement:**

- (a) Except as CDB may otherwise agree, and subject to the provisions of paragraph (b) below, the Grant shall be paid by CDB to BWS, on behalf of GOBZ, periodically, on account of expenditures allocated for financing by CDB as shown in the Budget, up to the respective limits shown therein.
- (b) Provided, however, that CDB shall not be under any obligation to make:
 - (i) the first payment pursuant to paragraph (1)(a) above until CDB shall have received
 - (aa) a request in writing from BWS for such funds; and
 - (bb) a copy of the signed contract between GOBZ and the Consultants engaged to carry out the NFT Study;
 - (ii) any payment, pursuant to paragraph (1)(a) above until CDB shall have received:
 - (aa) the requisite number of copies of the reports or other deliverables, in form and substance acceptable to CDB, required to be furnished for the time being by the Consultant to CDB in accordance with the TOR; and
 - (bb) an account and documentation, satisfactory to CDB, in support of expenditures incurred by BWS in respect of, and in connection with, the Project; and
 - (iii) payments exceeding the equivalent of three hundred and sixty thousand United States dollars (USD360,000), or ninety percent (90%) of the amount of the Grant, until CDB shall have received:
 - (aa) the requisite number of copies of the reports or other deliverables, in form and substance acceptable to CDB, to be furnished by the Consultant(s) to CDB in accordance with the TOR; and
 - (bb) a certified statement of the expenditures incurred by BWS in respect of, and in connection with, the Project.
- (c) Except as CDB may otherwise agree, disbursements shall be made rateably from the Loan and the Grant in proportion to the respective amounts thereof.
- (d) The first disbursement of the Grant shall be made by May 31, 2017 and the Grant shall be fully disbursed by May 31, 2019, or such later dates as CDB may specify in writing.

(2) **Contingent Repayment:** If GOBZ obtains financing from other sources for a project or programme resulting from the Project, the amount of the Grant, in full, shall be converted to a loan and shall be payable in one payment from the proceeds of the first disbursement of such financing, if such payment is compatible with the operating policy of the source of such financing and, if not, shall be payable on terms and conditions to be agreed with CDB.

(3) **Procurement:**

- (a) Except as provided in sub-paragraph (b) below, procurement shall be in accordance with the procedures set out and/or referred to in the Grant Agreement between CDB, GOBZ and BWS providing for the Grant, or such other procedures as CDB may from time to time specify in writing.
- (b) Where EIB CAS Resources are being used together with CDB's SDF resources under the Grant, eligibility for procurement shall be extended to consultants from countries eligible for procurement under EIB-funded projects, which are not CDB member countries.
- (c) The Procurement Plan approved by CDB is set out at Appendix 5. Any revisions to the Procurement Plan shall require CDB's prior approval in writing.

(4) **Other Conditions:**

- (a) Except as CDB may otherwise agree, GOBZ shall:
 - (i) execute the Project through RCE of BWS, who shall be responsible for project management;
 - (ii) make the proceeds of the Grant available to BWS for the purpose of executing the Project; and
 - (iii) take all necessary steps to facilitate and ensure the performance by BWS of its obligations set out and referred to herein.
- (b) As a condition of making the Grant available to BWS, BWS shall undertake to observe and perform the obligations on its part to be observed and performed as set out and referred to herein.
- (c) BWS shall:
 - (i) ensure that the proceeds of the Grant are used exclusively for the Project;
 - (ii) keep its staff at levels consistent with financial prudence and technical and administrative competence;
 - (iii) in accordance with the procurement procedures applicable to the Grant, select and engage consultant(s) to carry out the NFT Study set out in the TOR at Appendix 1 and within a time frame acceptable to CDB implement such recommendations arising from the NFT Study as may be acceptable to CDB; and

- (iv) except as CDB may otherwise agree, furnish or cause to be furnished to CDB:
 - (aa) during implementation of the Project, quarterly reports on the implementation of the Project, within fourteen (14) days after the end of each quarter; and
 - (bb) the reports to be provided by the Consultant(s) in accordance with the TOR at Appendix 1, in the forms specified or in such form or forms as CDB may require, not later than the times/periods specified therein for so doing.

- (d) GOBZ and BWS shall:
 - (i) carry out the Project at all times with due diligence and efficiency, with management personnel whose qualifications and experience are acceptable to CDB, and in accordance with sound technical, environmental, financial and managerial standards and practices;
 - (ii) institute and maintain organisational, administrative, accounting and auditing arrangements acceptable to CDB;
 - (iii) ensure that each deliverable produced by the Consultant under the Project contains the following statements:

“This technical assistance operation is financed under the second envelope of the Cotonou Agreement.”

and

“The authors take full responsibility for the content of this report. The opinions expressed do not necessarily reflect the view of the European Investment Bank.”;
 - (iv) facilitate and permit any authorised representative of CDB or EIB to communicate with and if necessary visit the Consultant in order to obtain all such information as CDB and EIB may require with regard to the progress of the Project; and
 - (v) permit CDB and EIB, or any person appointed thereby, to audit the expenditures financed by the Grant and their eligibility prior to or after the relevant payments, and to provide CDB and EIB, or the appointed person with all reasonably required assistance, documents and information.

- (e) GOBZ and BWS acknowledge that CDB may be obliged to divulge such documents relating to the Project and the Consultant(s) to any competent European Union institution or body in accordance with the relevant mandatory provisions of European Union law.
- (f) Except as CDB may otherwise agree, GOBZ shall, or shall procure that BWS:
 - (i) meet or cause to be met:
 - (aa) the cost of the items designated for financing by GOBZ in the Budget;
 - (bb) any amount by which the cost of the Project exceeds the estimated cost set out in the Budget; and
 - (cc) the cost of any other items needed for the purpose of, or in connection with, the Project; and
 - (ii) provide or cause to be provided, all other inputs required for the punctual and efficient carrying out of the Project not being financed by CDB.
- (g) CDB shall be entitled to suspend, cancel or require a refund of the Grant or any part thereof if:
 - (i) the Loan or any part thereof is suspended, cancelled or called in; or
 - (ii) the EIB CAS Resources or any part thereof are suspended, cancelled or required to be refunded,

except that GOBZ shall not be required to refund any amount of the Grant already expended in connection with the Project and not recoverable by GOBZ.

SUPPORTING DOCUMENTATION

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| Appendix 1 | Draft Terms of Reference – Nutrient Fate and Transport Study for the Placencia Peninsula Wastewater Management Project |
| Annex 1 | Water Quality Monitoring Resources |
| Annex 2 | Bathymetric Survey Requirements |
| Appendix 2 | Design and Monitoring Framework |
| Appendix 3 | Performance Rating System |
| Appendix 4 | Budget |
| Appendix 5 | Procurement Plan |

DRAFT TERMS OF REFERENCE
NUTRIENT FATE AND TRANSPORT STUDY FOR THE
PLACENCIA PENINSULA WASTEWATER MANAGEMENT PROJECT

1. BACKGROUND

1.01 The Placencia Peninsula is located approximately 110 kilometres (km) south of the old capital Belize City. It is approximately 24 km long and 0.4 to 1.2 km wide, and is situated between the Caribbean Sea on the east and south; the Placencia Lagoon on the west; and the main land to the north. The Peninsula is composed of three main development areas: Maya Beach, Seine Bight and Placencia Villages. A single main road connects the Peninsula to the rest of the country via the Southern Highway.

1.02 The Placencia Lagoon serves as a habitat for several diverse aquatic organisms and plays an important role in the overall health of the Belize Barrier Reef, which is located a few kilometres to the east of the Peninsula. Feeding into the lagoon are several tributaries nestled within mangroves, which support several types of wildlife as well, the three main ones being Santa Maria Creek, Hemsley Creek, and August/Mango Creek. Some of these receive effluent from agricultural operations like shrimp farms. Located 20 km south of the Peninsula tip is the Monkey River, a main tributary feeding into the Caribbean Sea. The Peninsula is at an elevation of approximately 1.0 meter above sea level and the soil is primarily sandy in nature.

1.03 Between 2000 and 2010, the Peninsula experienced the highest average growth rate of any urban centre in the country [9.1% per annum (p.a.) versus the national average of 2.65% p.a.]. The current permanent population of the peninsula is approximately 3093, and has approximately 729 hotel rooms with an estimated average monthly tourist population of 584. The largest settlement on the Peninsula is Placencia Village, which is located on the southernmost part of the Peninsula, and further north Seine Bight and Maya Beach are rapidly increasing in size. Presently many homes and establishments dispose of their wastewater and raw sewage into the Peninsula's sandy soil, which threaten the surrounding ground water sources, the Caribbean Sea and the tidal lagoon. Various types of onsite wastewater treatment systems are used, from traditional septic tanks to more advanced resource recovery facilities.

1.04 According to Belize Third National Communication to the United Nations Framework Convention on Climate Change (UNFCCC), an increase in air temperature ranging from 2°C to 4°C is projected by 2100 for Belize. Similarly, a general decrease in annual rainfall of about 10% is projected by 2100. The Stann Creek District, where Placencia is located, exhibits the most intense reduction in precipitation. The annual precipitation in the area around Placencia is expected decrease 1,200 mm/year (by 2060-2069). These changes in the climatic conditions have the potential to exacerbate the potential impacts of pollution loads on the functioning of the ecosystem, and on the aquatic life in particular.

1.05 Recognising the potential for groundwater contamination, and pollution of the lagoon and the Caribbean Sea as a consequence of the intensified and rapid population growth being experienced on the Peninsula, the GOB commissioned two consultancies, a feasibility study and detailed design, for implementing the Placencia Peninsula Wastewater Management Project. The Feasibility Study, funded by the United States Trade and Development Agency, was completed in 2012; and the Inter-American Development Bank funded detailed designs consultancy.

1.06 During the detailed designs phase it became apparent that background considerations relating to the project's Sewage Treatment Plant site(s) and final effluent disposal locations required further studies to definitively establish these sites that not only best dealt with the treated effluent, but that also had the support of the various community stakeholders. Consequently the detailed designs for the Placencia Peninsula Wastewater Management Project has been put on hold while the required background data is being gathered and analysed. Components of the Detailed Designs which were completed included:

- (a) Customer sewer upgrade survey.
- (b) Land and property designation survey.
- (c) Existing and forecast population to 2040.
- (d) Preliminary Collection and Wastewater Treatment System Layout.
- (e) Preliminary soil testing.

1.07 Belize Water Services is seeking to engage consultants to undertake the Nutrient Fate and Transport (NFT) Study on the Placencia Peninsula and marine environs. The NFT Study will complement the Feasibility Study, and facilitate the determination of the optimal locations for the treatment facility and final effluent disposal. The data gathered from these studies will be used to determine the optimal locations for the treatment facility and effluent disposal.

2. OBJECTIVES

2.01 The main objectives of the consultancy are to:

- (a) develop a comprehensive model to predict the transport and fate of nutrients and fecal bacteria in the Placencia Lagoon and surrounding coastal Caribbean Sea off the Placencia Peninsula. The consultant will assume diffuse (non-point) sources and selected point sources corresponding to potential sites for the proposed Placencia Wastewater Treatment System. The model will take account of potential climate change impacts; and
- (b) recommend optimal locations for the sewerage treatment facility and final effluent disposal.

3. DURATION

3.01 It is expected that the consultancy will be completed over a period of eighteen (18) months from the date of signing the contract.

4. SCOPE OF WORK

4.01 The services of the Consultant are to be conducted in accordance with generally accepted international standards, internationally recognised good practice and professional practices acceptable to the Government of Belize. The scope of work covers all activities necessary to accomplish the objectives of the consultancy, whether or not a specific activity is cited in these Terms of Reference (TOR). The methodology for carrying out this study as well as supporting literature must be provided. All studies carried out as part of this project as well as details/data collected in the ongoing monitoring program will be made available to bidders. Water quality sampling and analyses must adhere to best international practices. The consultant, as a cost saving measure for the BWS, is encourage to utilise all the water quality monitoring resources available from Belize Water Services Limited (BWS), including laboratory, equipment and personnel, and all other items listed in Annex 1, to carry out further data collection for the study. A minimum of 15% of all samples must be independently validated.

4.02 Specific tasks to be undertaken by the Consultant include, but are not limited to:

- (a) The consultant should assess the current monitoring programme's sampling sites as described in Annex 1 to determine their suitability for the baseline study. Should different and/or additional sites be needed, the consultant must specify locations and characteristics.
- (b) Installation of monitoring wells at appropriate sites in the peninsula and mainland and measurement of levels of nutrients and fecal bacteria in groundwater. If adequate, the eight wells currently being sampled by BWS should be used (Annex 1). If additional or different wells are required the consulting team must specify the number of, locations, depth, and unit cost per well in their technical and priced proposals.
- (c) Measurement of levels of nutrients and fecal bacteria in surface waters of the lagoon, surrounding coastal Caribbean Sea, and mouths of the three main tributaries to the study area (Santa Maria Creek, Hemsley Creek, and August/Mango Creek). The consulting team may incorporate all or some of the ongoing monitoring programme being carried out by BWS in the study area, including data already collected.
- (d) Determination of the hydraulic characteristics of the three main tributaries identified above to the study area using appropriate methodology to be specified in the technical proposal.
- (e) Estimation of water inputs and pollutant loads in the area of interest based on best available information and the ongoing environmental monitoring in the Placencia lagoon ecosystem. An analysis of the impacts of extreme hydrologic conditions in the area of interest should be undertaken. These extreme conditions shall include floods and drought, as well as heat waves (and high sea surface temperatures anomalies). Critical conditions, for impact assessment, should be defined based on events with recurrence periods of 10 and 20 years.
- (f) Determination of the current and tidal characteristics in the lagoon and surrounding coastal Caribbean Sea, including flushing times and rates, using appropriate methodology to be specified in the technical proposal.
- (g) Determination of the bathymetry of the Placencia Lagoon and surrounding marine areas in order to incorporate such information into the modeling effort. The methodology used for this activity should be detailed by the consulting team. Further details of the Bathymetry requirements may be found at Annex 2.
- (h) Evaluation of the soil characteristics (including grain size, permeability, porosity, water-holding capacity, infiltration capacity, and density), topography and other characteristics of the land in the study area through a combination of literature research and field work. Specific methodology must be detailed in the technical proposal.
- (i) Measurement of groundwater discharge into the Placencia Lagoon and surrounding coastal Caribbean Sea off the peninsula.

- (j) Measurement of levels of nutrients, fecal bacteria and selected physico-chemical parameters in surface waters of the lagoon, mouths of the three main tributaries and surrounding coastal Caribbean Sea, and in groundwater in the study area. Measurements must be carried out over a minimum 12-month period to ensure adequate temporal data is generated for modeling purposes. The frequency of monitoring must be sufficient for purposes of the baseline study and modeling but must be at minimum twice per month.
- (k) Use the data generated above, along with any other needed data, to generate a baseline report of levels of the above parameters for the study area. Parameters to be measured must, at minimum, include the following:
 - (i) Physical and Chemical Parameters: pH, Temperature, Secchi Disk Depth, Salinity, Dissolved Oxygen, Chlorophyll-A, Biochemical Oxygen Demand, Chemical Oxygen Demand, and Total Suspended Solids.
 - (ii) Nutrients: TP, Reactive Phosphorous, TN, TKN, Nitrates, Nitrites, Ammonia.
 - (iii) Bacteriological Parameters: Fecal Coliform, Fecal Streptococci, E. coli, and Enterococci.
- (l) Measurement of the rate of uptake of nutrients by aquatic plants in the study area to determine their assimilative capacity, and assess the potential for deleterious impacts on aquatic life.
- (m) Measurement of the levels of nutrients in plants, especially mangroves and seagrass, in the study area as a function of time to determine uptake rates and mass loadings.
- (n) Estimation of seagrass and mangrove coverage.
- (o) Calculation of the assimilative capacity of nutrients by plants in the study area using the above data and any other that may impact this capacity.
- (p) Assess the impacts of climate change in the functioning of the Placencia Lagoon ecosystem, including the fate of nutrients and fecal pollution and the potential consequences on the aquatic life:
 - (i) Key climate variables of interest are temperature (near surface temperature), precipitation, and evapotranspiration. Also, sea surface temperature, with emphasis on high-temperature anomalies and sea level rise should be included. These climate variables have the potential to exacerbate the impact of pollution loads, as well as making the lagoon environment less apt to existing species.
 - (ii) Develop climate scenarios for midcentury. Using the best available information, including Belize Third National Communication to UNFCCC, the consultant shall identify climate condition for simulating the expected conditions in the Placencia Lagoon ecosystem. The scenarios should incorporate the following changes associated with global warming: sea level rise, (atmospheric and sea surface) temperature, precipitation, evapotranspiration, seawater acidification, and extreme events in the form of floods and droughts. These scenarios will

define the “environment” for the application of the comprehensive model to predict the transport and fate of nutrients and other pollution loads. For final assessment purposes, the consultant should select critical environment scenarios with the recurrence period of 10 and 20 years (or with a probability of occurring of 10% or 5%) by mid-century.

- (iii) Assessment of the impacts of pollution loads on water quality and ecosystem response for selected climate change scenarios, as agreed with the Government of Belize and BWS.
- (iv) Assessment of wastewater treatment plant location on water quality and ecosystem response for the selected climate change scenarios.
- (q) Use of the data gathered above, along with any additional data existent and/or needed, to generate a comprehensive model to predict the movement and ultimate fate of nutrients and fecal bacteria assuming both non-point sources and selected point sources corresponding to potential sites for the proposed Placencia Peninsula Wastewater Treatment System.
- (r) The model shall cover the lagoon and the Caribbean Sea, east and south of the Peninsula, extending sufficiently offshore to fully model the extent of offshore transport of nutrients and fecal bacteria. (For pricing the proposal a distance of 1.6 km offshore shall be used and the final offshore distance/square area, shall be negotiated). The methodology in the technical proposal should justify the distance offshore that will be modeled.

5. INPUTS

5.01 BWS will make available to the consultants: plans, reports and records for all the works completed to date on the previous studies and designs that might be necessary and applicable in the execution of the work required under these TOR.

5.02 The consultants will be responsible for obtaining all additional information, the execution of all studies, surveys and other services necessary for the correct execution of the work required under these TOR.

5.03 BWS will assist the consultants in obtaining from government departments and other sources, other basic data that might be necessary for the execution of the work required under these TOR.

5.04 All equipment and reagents acquired through the project shall become the property of BWS upon project completion (unless otherwise agreed upon by the consultant and BWS).

6. REPORTING REQUIREMENTS

6.01 The consultant(s) will submit to BWS and the Caribbean Development Bank all reports and drawings required electronically in relevant proprietary format (Auto-cad, Microsoft Office Suite) and ‘pdf’ format, in addition to any hard copy issued. These Reports are as follows:

- (a) Inception Report: The consultant will submit to the BWS an Inception Report, one (1) month after contract signing, confirming and documenting scope of services incorporating inputs from BWS as discussed during the start-up meeting; feedback from

the site inspections; available data, and data to be generated; and review of all existing documentation, plans, and reports. Also to be included shall be any established interactive working arrangement with BWS, assignment of counterpart staff (if any), lines of communication, project schedule, work plan, and delivery dates.

- (b) Draft Bathymetric Report: The consultant will submit to the BWS the draft of the bathymetric report required at Annex 2 of these TOR, 3 months after contract signing. A revised work-plan and updated schedule should also be provided.
- (c) Final Bathymetric Report: The consultant will submit to the BWS (and make an audio-visual presentation to BWS and other stakeholders) a Final Bathymetric Report and a Progress Report (6 months after contract signing). A revised work-plan and updated schedule should also be provided.
- (d) Draft Water Quality Monitoring Baseline Report: The consultant will submit to the BWS (and make an audio-visual presentation to BWS and other stakeholders) a Draft Water Quality Monitoring Baseline Report (9 months after contract signing). A revised work-plan and updated schedule should also be provided.
- (e) Draft Report on Predictive Model of Transport and Fate of nutrients and bacteria: The consultant will submit to the BWS (and make an audio-visual presentation to BWS and other stakeholders) a Draft Report on Predictive Model of Transport and Fate of nutrients and bacteria (14 months after contract signing). The draft modelling report should contain:
 - (i) an updated Draft Water Quality Monitoring Baseline Report;
 - (ii) a draft plant nutrient assimilative capacity report; and
 - (iii) a draft recommendation of best site location for the proposed Placencia Wastewater Management System based on results of the predictive model.
- (f) Final Report: The consultant will submit to the BWS (and make an audio-visual presentation to BWS and other stakeholders) The Final Project Report (18 months after contract signing). The Final Report should contain:
 - (i) Final Predictive Model;
 - (ii) Final Baseline Study report;
 - (iii) Final plant nutrient assimilative capacity report; and
 - (iv) Final recommendation of best site location for the proposed Placencia Wastewater Management System.

7. QUALIFICATIONS

7.01 All of the members of the consulting team must have excellent communication and interpersonal skills and must be fluent in English. Local and regional expertise along with experience in the Caribbean Region and in Belize will be an asset. The key experts required for the Consultant's team and their minimum qualifications and experience are as follows:

(a) **Key Expert No 1: Environmental Scientist/Modeller – Team Leader**

- (i) A minimum fifteen (15) years' experience in modelling tropical coastal ecosystems and at least five (5) years' experience in project management or team leadership. The candidate should possess good communication (oral and written), interpersonal and teamwork skills.
- (i) Education: An advanced degree in environmental science or environmental resource management from an internationally accredited university.

(b) **Key Expert No. 2: Environmental Engineer**

- (i) A professional environmental engineer with a minimum ten (10) years' experience in wastewater management systems design and operations. Experience in managing municipal wastewater supply systems and climate change will be an asset.
- (ii) Education: An advanced degree in environmental engineering or similar from an internationally accredited university.

(c) **Key Expert No. 3: Hydrogeologist**

- (i) A minimum fifteen (15) years' experience nutrient transport in tropical coastal environments.
- (ii) Education: An advanced degree in hydrology or hydrogeology, or equivalent from a recognised university.

(d) **Key Expert No. 4: Biochemist**

- (i) A minimum ten (10) years' experience nutrient transport in tropical coastal environments.
- (ii) Education: An advanced degree in aquatic chemistry, microbiology, or related field.

(e) **Key Expert No. 5: Oceanographer**

- (i) A minimum of ten (10) years' experience in coastal ecosystem dynamics; ocean currents, waves and coastal fluid dynamics.
- (ii) Education: A degree in coastal engineering or related field. Relevant computer skills and fluency in English are also required.

(f) **Key Expert No. 6: Climate Risk Assessment Specialist**

- (i) A minimum of ten (10) years' work experience in the area of climate change impacts and adaptation, including familiarity with analysing climate data. Specific experience in water resources will be an asset,
- (ii) Education: A degree in environmental science from a recognised university.

8. COMMENTS BY THE CONSULTANTS

8.01 The consultants are invited to make any comments on and suggestions for improvements to these TOR. The financial implications, if any, of the said suggestions/recommendations should be clearly indicated in the Financial Proposal.

WATER QUALITY MONITORING RESOURCES

BELIZE WATER SERVICES PERSONNEL

1. One (1) - Technical Specialist, BSc - Environmental Engineer
2. One (1) - Senior Lab Supervisor, AS
3. One (1) - Lab Analyst, AS.
4. One (1) - Operations Field Worker, Boat Captain

MAIN LABORATORY EQUIPMENT

| Qty | Unit | Item |
|------------|-------------|--|
| 1 | ea. | HACH DR 3900 Spectrophotometer without RFID |
| 2 | ea. | Hach DRB 200 Dual Block Digital Reactor, 30 x 16 mm vial wells |
| 6 | pk | Reactor Adapter, 16 mm to 13 mm, for TNTplus vials (5/pk) |
| 12 | ea. | HACH BODTrak II Respirometric BOD Apparatus |
| 1 | ea. | Sterilmatic 16" Autoclave |
| 1 | ea. | Ohaus Navigator XL Balance |
| 1 | ea. | Ohaus Moisture Analyzer MB45 |
| 1 | ea. | Mabe Refrigerator |
| 1 | ea. | Reichert Quebec Colony Counter, 110 Vac, 60 Hz |
| 1 | ea. | HACH Digital Colony Counter Pen |
| 2 | ea. | Thermo Scientific Precision Model 815 Incubators |
| 2 | ea. | Shel Lab Compact Incubators, SRI3 |
| 1 | ea. | Idexx Labs Quanti-Tray Sealer 2X (115 V) |
| 1 | ea. | Spectroline UV Viewing Cabinet |
| 1 | ea. | Spectroline Fluorescent UV Lamp (with 110 V AC Cord) |
| 1 | ea. | Replacement Bulb (for Fluorescent UV Lamp) |
| 1 | ea. | Vacuum Pump, Type 1, 0.02HP |
| 1 | ea. | Dessicator |
| 1 | ea. | Dampening Mount |

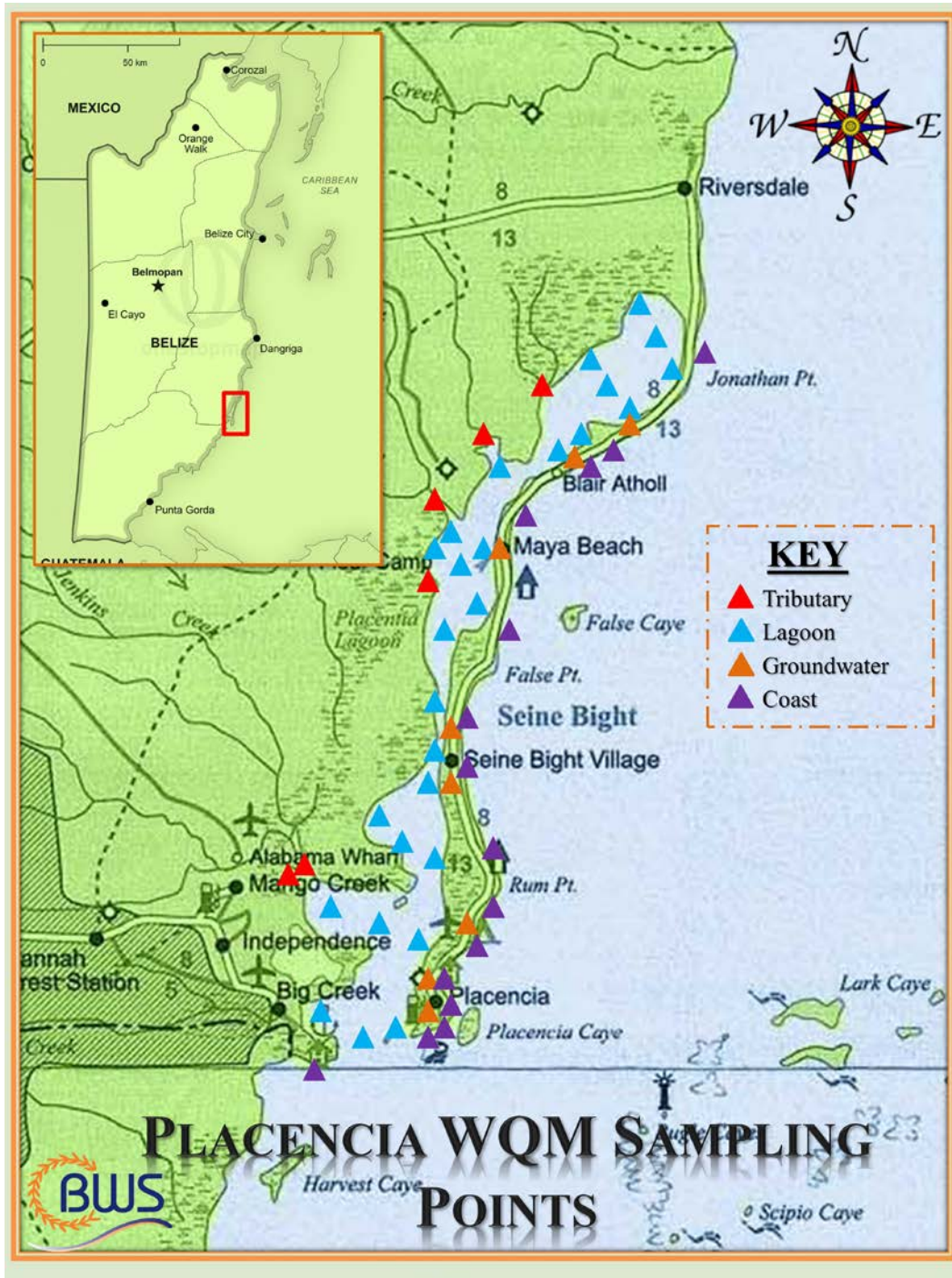
IN-SITU EQUIPMENT

| Qty | Unit | Item |
|------------|-------------|---|
| 1 | ea. | YSI EXO2 Handheld Display Meter |
| 1 | ea. | YSI EXO2 Multi-parameter Sonde (10 m depth with 10 m cable) |
| 1 | ea. | YSI EXO Conductivity/Temperature Sensor |
| 2 | ea. | YSI EXO ISE02 pH Sensor |
| 1 | ea. | YSI EXO Optical DO Sensor |
| 2 | ea. | YSI EXO Turbidity Sensor |
| 1 | ea. | YSI EXO Total Algae - PC Sensor |
| 1 | ea. | YSI EXO2 Central Wiper Sensor |
| 1 | ea. | YSI EXO Signal Output Adaptor |
| 1 | ea. | Garmin GPSmap 62stc |
| 1 | ea. | Hach Current Flow Meter Handheld Display |
| 1 | ea. | GeoTech GeoPump |
| 1 | ea. | Lamotte Van Dorn Water Sampler |
| 1 | ea. | Staff Gauge |
| 1 | ea. | Top Setting Wading Rod Kit |
| 1 | ea. | Rainwise Electronic Rain Gauge |
| 1 | ea. | Secchi Disk |
| 14 | ea. | Campbell Wellpoints |
| 1 | ea. | Posthole Digger |
| 1 | ea. | Machete |
| 1 | ea. | 8-lb Sledgehammer |

TRANSPORTATION EQUIPMENT

| Qty | Unit | Item |
|------------|-------------|--|
| 1 | ea. | Isuzu Dmax 4x4 Pickup Truck, Double Cab |
| 1 | ea. | Luna 20' Boat |
| 1 | ea. | Aluminum 25' Boat Trailer |
| 1 | ea. | Honda Boat Engine, 50 hp |
| 1 | ea. | Garmin Echo 150 Sonar Unit (installed on boat) |
| 2 | ea. | 5-gallon fuel containers |
| 4 | ea. | Life Jackets |
| 1 | ea. | Tow Hitch |

MAP OF SAMPLING BWS POINTS



BATHYMETRIC SURVEY REQUIREMENTS

1. INTRODUCTION

1.01 This document represents the specifications and requirements for the bathymetric survey of the Placencia Peninsula Lagoon surrounding coastal Caribbean Sea in Belize. The purpose of this survey is to provide bathymetry for numerical modelling and the siting of a wastewater outfall. As such, the collected bathymetry data needs to be accurate, reliable, and representative of the bathymetry of the lagoon surrounding coastal Caribbean Sea.

1.02 The survey requirements are based on requirements and specifications defined by the International Hydrographic Organization (IHO), the Canadian Hydrographic Service (CHS), the United States Army Corps of Engineers (USACE), and the National Oceanic and Atmospheric Administration (NOAA). The survey should be completed to the standards and requirements defined in this document, and also to the best practices defined by these agencies. Where there is uncertainty or ambiguity on the requirements of these specifications, proponents should make reasonable assumptions of the requirements based on the standards and approaches defined by these agencies.

2. SITE DESCRIPTION

2.01 The bathymetry survey area shall include the entire water body between Placencia Caye to the East of the Placencia Peninsula and Mainland Belize to the West; and from Riversdale in the North to 1 km South of the Placencia Peninsula. A map showing the approximate survey extent is provided in Figure 1 below. The rectangle shown in the figure is approximately 12.5 km x 22 km, or 275 km²; however, it is to be noted that the required bathymetric survey area is 164 km², while the terrestrial area is approximately 111 km².

2.02 From the limited available bathymetry, the Placencia lagoon is quite shallow, with a maximum water depth of approximately 6 m, and an average water depth of approximately 1-2 m. A map showing the bathymetry of Placencia Lagoon from a 2003 Belize Coastal Zone Management report will be made available.

3. SURVEY REQUIREMENTS

3.01 The IHO standards define several orders of data collection specifications based on different survey requirements. The survey requirements for this survey would be classified as an Order 1 survey.

3.02 “Order 1 hydrographic surveys are intended for harbours, harbour approach channels, recommended tracks, inland navigation channels, and coastal areas of high commercial traffic density where under-keel clearance is less critical and the properties of the seafloor are less hazardous to vessels (e.g. soft silt or sand bottom). Order 1 surveys shall be limited to areas with less than 100 m water depth. Although the requirement for seafloor search is less stringent than for Exclusive Order and Special Order, full bottom search may be required in selected areas where the bottom characteristics and the risk of obstructions are potentially hazardous to vessels. In required areas, appropriate sounding equipment and methodologies must be employed in order to ensure that all features greater than 2 m cubed in water depths up to 40m, or features representing 10% or more of the depth in areas deeper than 40 m are detected.”

3.03 Positions must be referenced to the World Geodetic System 84 (WGS 84) or the North American Datum 83 (NAD 83).

3.04 Whenever positions are determined by terrestrial systems, redundant lines of position shall be observed.

3.05 Standard quality assurance check techniques shall be completed prior to, during and after the acquisition of data. Satellite systems shall be capable of tracking at least five satellites simultaneously.

3.06 Whenever possible, shallow soundings shall be collected at high tide to maximise the in-land extents of the survey. The deeper sections of the survey may be surveyed at low tide to reduce downtime due to tides.

Horizontal Positioning

3.07 The horizontal positioning shall be provided by a Real Time Kinematic Global Positioning System, equivalent, or better. The minimum required accuracy of the horizontal positioning system shall be no greater than 1 m. The position error, at 95% confidence level, must be recorded together with the survey data.

Depth Soundings

3.08 The depth soundings shall be collected by a Single Beam Echo Sounder (SBES) The minimum required accuracy of the SBES shall be no greater than 0.1 m (95% confidence level) in water depths up to 40 m. The depth error, at 95% confidence level, must be recorded together with the survey data.

3.09 The “Bar Check” is the field procedure for calibrating the SBES and involves a metal cone or plate device lowered to a maximum depth of 60 meters and recording the true depth versus the measured depth and compiling a depth correction table that will be used later to correct the measured depths. This methodology should be used at least once a day and possibly at the end of the day to ensure that no problems occurred during the day. These sensors are to be factory calibrated according to the manufactures schedule and specifications or sooner if the data has become suspect.

3.10 The speed of sound in the water column shall be measured either directly, using a sound speed sensor, or indirectly calculated from conductivity, temperature and pressure measurements. In planning the measurement of sound speed profiles, the type of acoustic survey instrumentation as well as other potential uses for the sound speed data need to be considered.

3.11 Depth accuracy is to be understood as the accuracy of the reduced depths. In determining the depth accuracy, the sources of individual errors need to be quantified. All error sources shall be combined to obtain a Total Propagated Error (TPE). TPE results from the combination of all contributing errors, which include among other things:

- (a) Measurement system and sound speed errors.
- (b) Tidal measurement and modeling errors.
- (c) Data processing errors.

3.12 A statistical method for determining depth accuracy by combining all known errors shall be adopted and checked. The TPE, determined statistically at the 95% confidence level, is the value used to describe the depth accuracy achieved. The TPE shall be recorded together with the sounding value.

Survey Planning

3.13 The collection of bathymetry shall be completed using a systematic survey method. This involves data collection along pre-planned parallel lines at regular spacing. The main horizontal line spacing shall be 40 m, with perpendicular crossing lines completed every 100 m.

Establishing Control

3.14 Primary shore control points shall be established by ground survey methods to a relative accuracy of 1 part in 100,000 for a minimum of 2 permanent survey benchmarks. Establishment of these two benchmarks will be important for this phase and future phases of work.

3.15 When geodetic satellite positioning methods are used to establish such points, the horizontal error shall not exceed 10 cm at 95% confidence level with respect to WGS84. The vertical error shall not exceed 2 cm at 95% confidence level. Secondary stations for local positioning which will not be used for extending the control shall be located such that the horizontal error does not exceed 1 part in 10,000 for ground survey techniques or 50 cm at 95% confidence level, and the vertical error does not exceed 10 cm at 95% confidence level using geodetic satellite positioning.

Vertical Datum

3.16 All depths must be reduced to a low water datum, which can be defined as “a level where the water level will but seldom fall below it during the navigation season”. For this survey this will be Chart Datum, which is likely referenced to the Lowest Astronomical Tide (LAT) or Lower Low Water Large Tide (LLWLT).

Water Level Observations

3.17 Water level observations should be made throughout the course of a survey for the purpose of:

- (a) Providing water level reductions for soundings.
- (b) Providing data for tidal analysis and subsequent tidal constituent determination and prediction.
- (c) To establish the vertical datum, (both Low Water and High Water), of the area. For this purpose, observations should extend over the longest possible period, and not less than 29 days.

3.18 Water level heights should be observed so that the total measurement error at the gauging station, including timing and filtering errors, does not exceed +/- 5 cm at 95% confidence level. Independent water level measurement techniques should be used to verify the calibration and operation of the water level gauges. As a minimum, these are to be made at the beginning and the end of the tide gauge deployment and if possible at both high and low stage and more frequently during sounding operations.

Data verification and Quality Control

3.19 All calculations must be verified and counter-signed by an experienced hydrographer before the results can be used to further the acquisition of hydrographic data. The bathymetric data must be processed as soon as possible after it has been collected to analyse and verify the work.

3.20 To ensure that the required accuracy is achieved it is necessary to check and monitor performances. Establishing quality control procedures shall be a high priority. All related pertinent documentation should be preserved for further consultation.

3.21 Quality control for positioning involves monitoring the proprietary hardware/software quality indicators for accuracy, precision, signal strength, signal to noise ratio, cycle tracking and solution type. A position check by the survey vessel occupying or offset to a known ground position must be done at the start of a survey, periodically during, and at the end of the survey. Redundant lines of position or redundant satellites must always be observed. The use of a position monitor station to monitor position accuracy and system performance is desirable but often not practical. The use of two independent positioning systems along with ground position checks is also a very desirable situation.

3.22 A standard quality control procedure shall be to check the validity of soundings by conducting additional depth measurements. Differences shall be statistically tested to ensure compliance of the bathymetric data with the aforementioned survey standards. Anomalous differences shall be further examined with a systematic analysis of contributing error sources. All discrepancies shall either be resolved by analysis or re-survey during progression of the survey task.

3.23 Check lines crossing the regular lines shall always be done to confirm the accuracy of the positioning, the depth measurement and other depth corrections. They shall be run as close to perpendicular to the principal lines as possible. The differences between principal lines and check lines shall fall within the limits of the survey order. If possible, check lines shall be collected using an independent system, different survey vessel and/or time and on a rough bottom. Check lines crossing the principal sounding lines shall always be run to confirm the accuracy of positioning, sounding, and depth corrections. Check lines shall be spaced so that an efficient and comprehensive control of the principal sounding lines can be done. As a guide, it may be assumed that the interval between check lines shall normally be no more than 4 times that of the principal sounding (100 m).

Data Attribution

3.24 To allow a comprehensive assessment of the quality of survey data it is necessary to record or document certain information together with the survey data. Such information is important to allow exploitation of survey data by a variety of users with different requirements, especially as requirements may not be known when survey data is collected. The process of documenting the data quality is called data attribution; the information on the data quality is called metadata. Metadata shall comprise of information on the following:

- (a) The survey in general (e.g. date, area, equipment used, name of survey platform, etc.).
- (b) The geodetic reference system used, i.e. horizontal and vertical datum; including ties to WGS 84 if a local datum is used.
- (c) Calibration procedures and results.
- (d) Sound velocity.
- (e) Tidal datum and reductions.
- (f) Accuracy achieved and the respective confidence levels.

3.25 Metadata shall preferably be in digital form and an integral part of the survey record. If this is not feasible, similar information shall be included in the documentation of a survey such as the final field report.

Point Data Attribution

3.26 All soundings should be attributed with a 95% statistical error estimate for both position and depth. Although this should preferably be done for each individual sounding, a global estimate will be provided for an entire dataset and the worst-case survey error must be shown. In the case of positions, they shall be qualified by analysing redundant lines of position (terrestrial systems) or independent positioning check (satellite systems); in the case of depth observations, they could be qualified by analysing redundant depths observed at, for example, check line crossings.

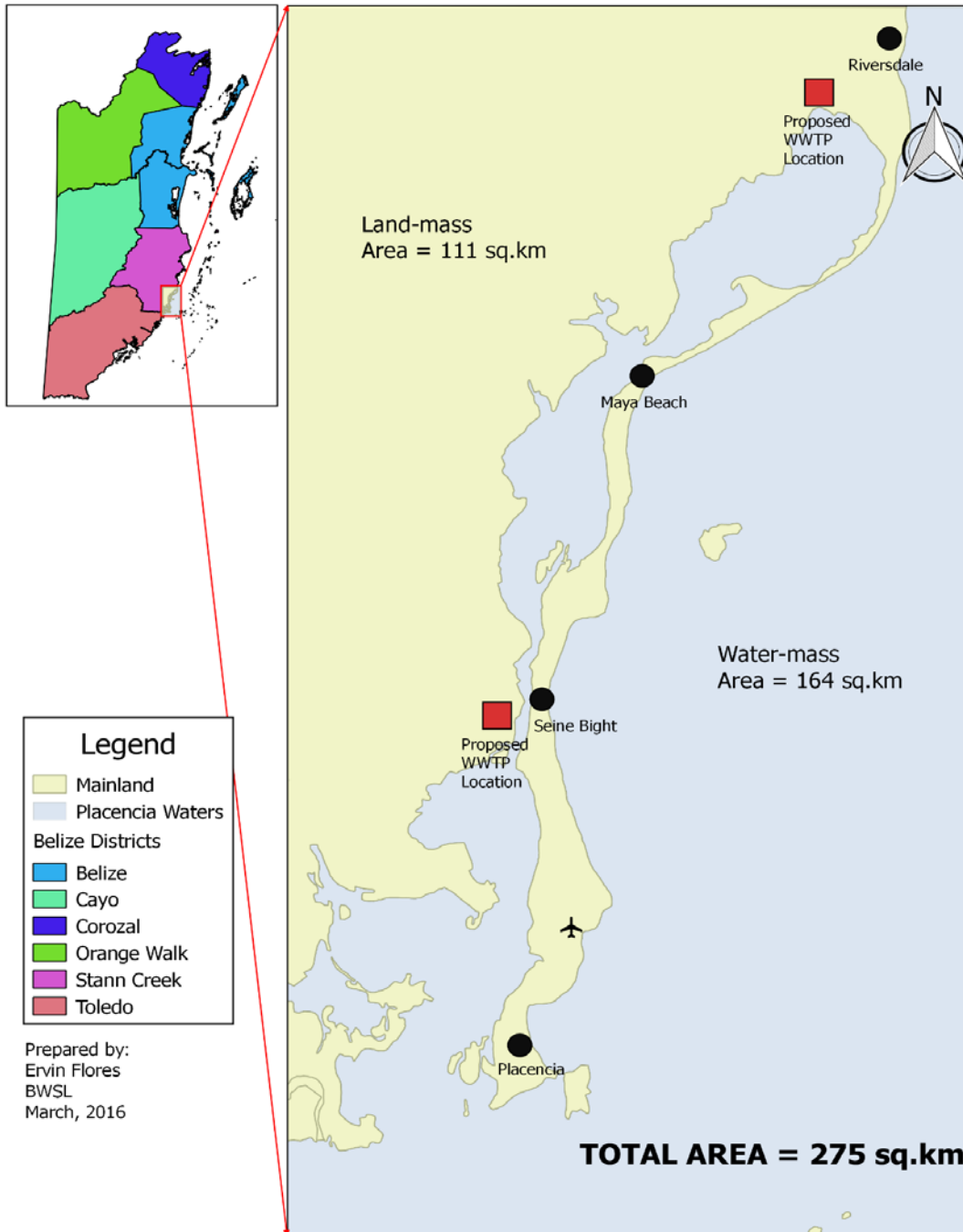
3.27 It is understood that each sensor (i.e. positioning, depth, heave, pitch, roll, heading, seabed characteristic sensors, water column sensor parameters, tidal reduction sensor, data reduction models etc.) possesses unique error characteristics. Each survey system shall be uniquely analysed to determine appropriate procedure(s) to obtain the required spatial statistics.

Deliverables

3.28 All documentation, raw water level data, processed data including hourly height, high/low data, computed datums, bench mark photos and details, digital photographs, and other reports (as listed above) as required, shall be forwarded within 15 business days of the removal of the water level stations.

3.29 In addition to the collected survey data, map, charts, or drawings at an appropriate scale must be provided. These figures must appropriately display the collected bathymetry data in a clear and understandable.

MAP OF PLACENCIA BATHYMETRIC AREA



DESIGN AND MONITORING FRAMEWORK

| Narrative Summary | Objectively Verifiable Indicators | Means of Verification | Assumptions / Accountabilities |
|---|--|--|--|
| 1. IMPACT: Effective wastewater management system implemented in Placencia. | Improvement in coastal water quality in the Placencia Peninsula by 2022. | 1. BWS Water Quality Reports. 2. Environmental Surveys. | Financing for capital project available. |
| 2. OUTCOME: Enhanced capacity of BWS to undertake efficacious designs for a centralised wastewater management system for the Placencia Peninsula. | Recommendations for siting of wastewater discharge management facilities accepted by GOBZ and other major stakeholders by December 31, 2018. | 1. CDB Country Supervision Reports. 2. Minutes of Belize cabinet meetings. | Financing for the design consultancy is available. |
| 3. OUTPUTS: Completed Nutrient Fate and Transport model for the Placencia Peninsula. | NFT Model completed by consultants and accepted by GOBZ by December 31, 2018. | 1. Consultant's Reports. 2. Project Coordinator's (PC) Reports | Consultant's designs accepted. |
| 4. ACTIVITIES / INPUTS | \$'000 | | |
| Item | CDB | GOBZ | Total |
| Professional Fees, Expenses and Contingencies | 996 | - | 996 |
| Project Management, Workshops and Contingencies | - | 179 | 179 |
| Total Project Cost | 996 | 179 | 1,175 |
| Percentage | 85 | 15 | 100 |
| | | 1. Consultant's contract. 2. Monthly Progress Reports from PC. 3. CDB Supervision reports. 4. CDB disbursement Records. | |

PERFORMANCE RATING SYSTEM

| Criteria | Score | Justification |
|----------------------|--------------|--|
| Relevance | 4 | Placencia is a major economic earner in Belize through its tourism services. It is also one of the most environmentally sensitive regions of Belize. The proposed consultancy is essential for the development of solution, which will prevent pollution of the natural environment. It is consistent with CDB's Strategic and Corporate Objectives, and SDF 8 Themes. |
| Efficacy | 4 | The TA forms a fundamental building block for the design of a wastewater management system. It will facilitate the determination of the optimal locations for the treatment facility and final effluent disposal, by providing the baseline information and modelling tools to be used by design consultants for the Placencia Wastewater Management System. |
| Efficiency | 4 | The expected cost of the consultancy has been based on current professional rates, and given the expected level of capital investment, is considered reasonable. |
| Sustainability | 3 | The model produced will incorporate climate change and variability considerations. |
| Overall Score | 3.75 | Highly Satisfactory |

APPENDIX 4

BUDGET

(USD)

| Item | CDB | GOBZ | Total |
|---|----------------|----------------|------------------|
| Professional Fees, Expenses and Contingencies | 996,000 | - | 996,000 |
| Project Management, Workshops and Contingencies | - | 179,000 | 179,000 |
| Total Project Cost | 996,000 | 179,000 | 1,175,000 |
| Percentage | 85 | 15 | 100 |

PROCUREMENT PLAN

I. General

1. Project Information:

Country: Belize
Borrower: GOBZ
Project Name: Placencia Nutrient Fate and Transport Study
Project Executing Agency: Belize Water Services Limited

2. **Bank's Approval Date of the Procurement Plan:** December 8, 2016

3. **Period Covered by this Procurement Plan:** December – July 2018

II. Goods and Works and Non-Consulting Services: N/A

III. Consulting Services:

1. **Reference to (if any) Project Operational/Procurement Manual:** CDB's Guidelines for the Selection and Engagement of Consultants (October 2011).

2. **Any Other Special Procurement Arrangements:** A waiver of CDB's Guidelines for Procurement related to the project has been approved by BOD, where Country eligibility shall be extended to all countries eligible under EIB-funded projects.

Procurement Packages with Methods and Time Schedule:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---------|--|----------------------|------------------|-----------------------------|-----------------------------------|--------------------------------------|
| Ref No. | Assignment (Description) | Estimated Cost (USD) | Selection Method | Review by Bank (Prior/Post) | Expected Proposal Submission Date | Comments |
| 2. | Nutrient Fate and Transport Study - Belize | | QCBS | Prior | March 2017 | EOI and RFP subject to prior review. |

IV. Executing Agency Capacity Building

1. CDB to provide a procurement capacity building support in the form of access to the CDB's e-learning module on selection and engagement of Consultants.

This information is withheld in accordance with one or more of the exceptions to disclosure under the Bank's Information Disclosure Policy.

V. Summary of Proposed Procurement Arrangement

| Project Component | CDB (USD'000) | | | | | | | | | | NBF | | Total Cost |
|----------------------------|------------------|-----|-----------|-----|----------|----|----|------|-----|-----|---------|-------------|------------|
| | Primary | | Secondary | | Other | | | | | | Country | Institution | |
| | ICB | NCB | RCB | LIB | Shopping | DC | FA | QCBS | CQS | SSS | | | |
| 1. Consultancy Services | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2. Project Supervision | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3. Administrative Support | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Total Project Costs | | | | | | | | | | | | | |

- | | | | |
|-----|-----------------------------------|------|----------------------------------|
| CQS | Consultant Quality Selection | NCB | National Competitive Bidding |
| DC | Direct Contracting | QCBS | Quality and Cost-Based Selection |
| EOI | Expression of Interest | RCB | Regional Competitive Bidding |
| FA | Force Account | RFP | Request for Proposal |
| ICB | International Competitive Bidding | RFQ | Request for Quotation |
| IDC | Interest During Construction | SSS | Single-Source Selection |
| LIB | Limited International Bidding | | |
| NBF | Non-Bank Financed | | |

This information is withheld in accordance with one or more of the exceptions to disclosure under the Bank's Information Disclosure Policy.