K18-603

COOPERATIVE ENDEAVOR AGREEMENT
BETWEEN
THE CITY OF NEW ORLEANS
AND
DELTARES USA, INC.
NATIONAL DISASTER RESILIENCE COMPETITION PARTNER AGREEMENT

THIS COOPERATIVE ENDEAVOR AGREEMENT (the "**Agreement**") is entered into by and between the City of New Orleans, represented by Mitchell J. Landrieu, Mayor (the "**City**"), and Deltares USA, Inc., represented by Edwin Welles, President, ("**Deltares**" or "**Contractor**"). The City and Deltares may sometimes be collectively referred to as the "**Parties.**" The Agreement is effective the 24th day of April, 2018 (the "**Effective Date**").

RECITALS

WHEREAS, the City is a political subdivision of the State of Louisiana;

WHEREAS, Deltares is a non-profit independent institute for applied research in the field of water and subsoil resources whose address is 8601 Georgia Avenue, Suite 508, Silver Spring, MD 20910; and

WHEREAS, pursuant to Article 7, Section 14(C) of the Louisiana Constitution of 1974, and related statutes, and Section 9-314 of the Home Rule Charter of the City of New Orleans, the City may enter into cooperative endeavors with the State of Louisiana, its political subdivisions and corporations, the United States and its agencies, and any public or private corporation, association, or individual with regard to cooperative financing and other economic development activities, the procurement and development of immovable property, joint planning and implementation of public works, the joint use of facilities, joint research and program implementation activities, joint funding initiatives, and other similar activities in support of public education, community development, housing rehabilitation, economic growth, and other public purposes;

WHEREAS, the City was awarded $141,260,569 in National Disaster Resilience funds ("**NDR program**") made available by the Disaster Relief Appropriations Act, 2013 (Public Law 113-2, approved January 29, 2013) ("**Appropriations Act**") and awarded under the National Disaster Resilience Competition as CDBG National Disaster Resilience ("**CDBG-NDR**") grants from the United States Department of Housing and Urban Development ("**HUD**") and has selected Deltares to be a "Partner" under the NDR program to receive certain funds in order to implement the program as set forth below; and

WHEREAS, the City and Deltares desire to accomplish a valuable public purpose of (1) designing and implementing a sustainable surface and groundwater monitoring network to support subsidence reduction efforts and urban and water planning; (2) identifying existing knowledge gaps related to the City's soil and groundwater system, and analyzing the potential impacts the current state of those systems on surface and subsurface infrastructure; (3) conducting operational research related to the applicability of new sustainable drainage systems and best management practices for rainwater harvesting and stormwater treatment; and (4) designing and developing real-time control systems for tangible City environmental mechanisms and structures (e.g. pumps, gates) using weather and urban water forecasting to support optimal water management in New

Orleans.

WHEREAS, the City will provide Deltares with National Disaster Resilience grant funding in exchange for the aforementioned services.

NOW THEREFORE, the City and Deltares each having the authority to do so, agree as follows:

ARTICLE I – DELTARES' OBLIGATIONS

Deltares shall provide the following services listed below in accordance with Deltares's Partner Agreement with the City dated October 22, 2015 (attached as Exhibit B), Proposal entitled "Towards Resilient Groundwater and Subsurface Management in New Orleans" dated November 30, 2017 (Attached as Exhibit C), and Proposal entitled "Constructing a Surface/Groundwater and Subsidence Monitoring Network for the City of New Orleans dated November 16, 2017 (Attached as Exhibit D).

A. Water Monitoring Sensor Specification Services – Deltares will provide the following water monitoring sensor specification services:

1. Identifying appropriate parameters to measure and gauge, in consultation with the City. These may include: precipitation, water levels, water quality parameters, and subsidence of the soil surface.
2. Identifying appropriate instrumentation for installation for monitoring surface and groundwater parameters.
3. Producing a final report that shall include but is not limited to the following elements:

    a. comprehensive guidelines about the different types of sensors that might become part of a comprehensive water monitoring network

    b. guidelines about data collection time intervals. Installation methods, and appropriate sensor density

    c. databasing strategy for how data will be packaged for delivery and necessary metadata and QA/QC procedures

    d. information on the characteristics of existing monitoring efforts and suggestions to best enable this information to be brought into a comprehensive database.

B. Water Monitoring Databasing Services - Deltares will provide the following water monitoring databasing services:

1. Installing and set up a server to store water monitoring data; defining accessibility so that it can be queried by the City, the Sewerage and Water Board of New Orleans (the "**Board**"), and other key partners; and ensuring it is databased with appropriate metadata to allow for its utilization.
2. Providing a report on server system setup and guidelines for storing the data and a demonstration and written guidelines for City and Board personnel for accessing and utilizing the data.

C. **Water Monitoring Network Design and Installation Services** - Deltares will provide the following water monitoring network design and installation services:

1. Holding inception meeting with the City;
2. Organizing and holding strategy meeting with identified stakeholders to identify:
    a. Water monitoring objectives
    b. Monitoring metrics and methods and short and long-term storage and use of data;
    c. Reporting methods;
    d. Preliminary monitoring network design;
    e. Best practices to address practical issues arising from implementation of a water monitoring network;
3. Providing cost-benefit analysis of implementation of water monitoring network sites as compared to damage reduction benefits;
4. Designing final water monitoring strategy with possible inclusion of other environmental and ecological monitoring activities;
5. Supporting installation of preliminary water monitoring network, including exact field locations;
6. Installing at minimum 20 shallow observation wells and sensors at pumping stations, surface and groundwater observation wells;
7. Collecting and compiling initial 6 months of monitoring data; and
8. Preparing initial 6-month monitoring report and establishing annual reporting process thereafter.

D. **Subsidence Vulnerability Mapping Services** - Deltares will provide the following subsidence vulnerability mapping services:

1. Collecting and analyzing existing and planned geographical borehole descriptions and populating and storing data in City-accessible database;
2. Designing geographical borehole campaign resulting from data collected in Section D(1);
3. Arranging permissions and logistics to perform geographical borehole services at identified locations;
4. Conducting borehole campaign in collaboration with Tulane University following the U.S. Department of Agriculture ("**USDA**") soil classification system, with specific attention being given to long-term average highest and lowest groundwater levels based upon existing hydro-morphological soil characteristics. Borehole campaign services shall include, but are not limited to:
    a. Coring at minimum 63 boreholes of a depth of 6-15 feet;

b. Collecting 5 soil samples from each coring (total 315 samples) of most organic sequences, with organic content being determined by Tulane University soil laboratory; and

c. Measuring absolute elevation of every borehole using differential GPS- systems as well as groundwater level after coring

5. Developing a Phreatic Groundwater Level Map, Organic Matter Content Map, and a Subsidence Vulnerability Map using Geographic Information Systems and utilizing both existing and newly-collected borehole data. The Subsidence Vulnerability Map shall be based upon 6 geological cross-sections, with existing soil, elevation and drainage maps to extrapolate data between cross-sections;

6. Predicting current and future subsidence rates under normal circumstances and alternative scenarios, including but not limited to raised shallow groundwater levels and other groundwater management best practices;

7. Presenting subsidence and borehole campaign results at workshop with all relevant stakeholders, including analyzing all data and identifying and explaining ways to utilize the data and Subsidence Vulnerability Map.

E. Integrated Groundwater and Subsidence Modeling Services - Deltares will provide the following integrated groundwater and subsidence modeling services:

1. Holding inception meeting with the City;

2. Organizing identified stakeholder participation;

3. Collecting existing groundwater and subsidence data from the City and identified stakeholders and other entities, including but not limited to:

   a. Detailed surface elevation map;

   b. Detailed land use map;

   c. Depth, location, age and current state of stormwater drainage and sewer pipes;

   d. Depth, location, age and current state of drinking water transport pipes;

   e. Surrounding borehole and soundings data;

   f. Rainfall and evaporation data;

   g. Surface water levels and canal depths; and

   h. Depth and location of sheet pilings and underground constructions.

4. Conducting geological and sedimentology analyses in cooperation with the U.S. Geological Survey ("**USGS**"), the U.S. Environmental Protection Agency ("**EPA**"), the Board, and Tulane University;

5. Analyzing relevant subsidence data and determining geotechnical parameters in cooperation with USGS, the National Aeronautics and Space Administration ("**NASA**") and local consultants;

6. Designing and building citywide subsidence digital model between the Mississippi River and Lake Pontchartrain, for the purpose of scientific research with focus on

NDR-funded Gentilly Resilience District project area, providing data including but not limited to:

a. 3-D subsurface model using iMOD;

b. Groundwater –surface water-subsurface drainage interaction;

c. Rainfall intensity and groundwater level relationship;

d. Integrated groundwater, surface water, subsurface drainage and rainfall data to analyze both deep and shallow groundwater extraction;

e. GIS and decreased subsidence velocity data;

f. Infrastructure foundation depth data; and

g. NASA elevation data to verify model using "thousand extensometer" approach; and

h. licensing for use of iMOD software. iMOD and any other Deltares or Deltares Netherlands standard software as well as any amendments thereto made under this Agreement shall only be subject to the applicable standard license agreement. This Agreement and its terms and conditions shall not apply to iMOD and other Deltares and Deltares Netherlands standard software or to any amendments thereto made in the execution of this Agreement.

7. Presenting data and model to identified stakeholders and incorporating stakeholder input into finalized analysis and modeling.

F. **Knowledge Gap Services** - Deltares will provide the following knowledge gap services:

1. Conducting background research to identify all current knowledge related to subsidence, geology, hydrological boundaries, surface infrastructure and subsurface infrastructure in New Orleans;

2. Holding one-day stakeholder meeting at commence of project to discuss experience of 4 project organizations (The Water Institute, Louisiana Universities Marine Consortium, Tulane University and Deltares) and review of literature survey;

3. Drafting white paper outlining all current knowledge and future research and analysis needed to fill in identified knowledge gaps discovered during Sections F(1)-(2) of this Agreement.

G. **Green Infrastructure Applied Research Services** - Deltares will provide the following green infrastructure applied research services:

1. Mapping and classifying all existing public and private green infrastructure systems (e.g. rain gardens, permeable pavement) in New Orleans, including but not limited to collecting of data related to soil types, design, ecology, water and soil quality, estimated water quality effectiveness, building costs and maintenance costs;

2. Organize stakeholder workshop to discuss design, effectiveness, costs and public perception related to design and implementation of new green infrastructure systems;

3. Selecting and monitoring at least 10 existing rain gardens, collecting and analyzing data included but not limited to shallow groundwater levels, surface water levels, surface and groundwater inflow and outflow volumes, rainfall intensity, barometric

pressure, local soil and shallow geology conditions and water and soil quality conditions;

4. Organizing a minimum of 5 permeable pavement tests utilizing "infiltrometers" to determine amount and rate of rainfall infiltration during different type of rain storms;
5. Compiling data and literature and developing proposed design rules for the City to calculate, development and implement cost-effective water storage strategies and tactics; and
6. Organizing and holding stakeholder workshop to discuss all such data, reporting protocols, publication opportunities and public outreach efforts.

H. **Real-Time Control Services** - Deltares will provide the following real-time control services:

1. Conducting needs assessment and feasibility study to address the components, organization and performance of the City's current urban water management system via technical documentation, stakeholder interviews, field visits and data analysis;
2. Developing citywide pilot software application demonstration designed to streamline interactions between various stakeholders who all possess operational roles with respect to citywide urban water management. The pilot program demonstration shall include at a minimum, ways to import and process numerous monitoring data feeds and weather forecasts, running water management system model, running basic optimization algorithm to suggest potential optimal operation strategies under various characteristic conditions;
3. Preparing project report analyzing collected data and proposing plan of action to implement best practices based upon collected data; and
4. Organizing stakeholder workshop to present project outcome and proposed plan of action and next steps; and
5. Licensing for the software for the pilot-demonstration software application, expected to be Delft-FEWS software. Delft-FEWS software or any alternative software as well as any amendments thereto made under this Agreement shall only be subject to the applicable standard license agreement. This Agreement and its terms and conditions shall not apply to Delft-FEWS or the alternative software or to any amendments thereto made in the execution of this Agreement.

I. **Deliverables** – In addition to those listed above, Deltares will provide the following deliverables:

Water Monitoring Sensor Specification Services

1. Specifications report that outlines instrumentation, deployment, and databasing guidelines.

Water Monitoring Databasing Services

1. Server system for storing water monitoring data installed, fully operational, and accessible to the City and its partners; and
2. Report on server system setup and guidelines for storing, accessing, and utilizing the data.

Water Monitoring Network Design and Installation Services

1. Operational integrated groundwater monitoring network supported by all relevant stakeholders;
2. Groundwater monitoring process, installation and support;
3. Initial 6-month report and first annual report of all groundwork monitoring data;
4. Annual data analyses and reporting framework; and
5. "Lessons Learned" and "Best Practices" stakeholder workshop with focus on groundwater monitoring capacity building with local enterprises.

Subsidence Vulnerability Mapping Services

1. Dataset of all existing and planned borehole descriptions;
2. Groundwater level map depicting shallow drainage depth with explanatory text;
3. Organic matter content map of shallow surface water with explanatory text;
4. Potential subsidence vulnerability resulting from oxidation of organic matter under normal and alternative conditions with explanatory text;
5. Stakeholder workshop explaining and promoting Subsidence Vulnerability Map and related maps; and
6. Minimum of at least 1 popular scientific magazine/website paper or publication.

Integrated Groundwater and Subsidence Modeling Services

1. Well described time-dependent groundwater model for the City, capable of supporting scientific research into the effects of future groundwater management strategies and efforts, including but not limited to:

    a. Current and future estimates of surface coverage of groundwater levels and hydraulic heads based on a minimum of 5 identified scenarios;

    b. Outline of areas with high subsidence rates;

    c. Analysis of relationship between deep-rooted subsidence processes and shallow-rooted subsidence process using "thousand extensometer" method;

    d. Estimates of subsidence reduction by a minimum of 3 subsidence mitigation scenarios;

    e. Current and future infiltration and groundwater discharge fluxes;

    f. Groundwater flow directions;

    g. Shallow groundwater salinization patterns and rates with respect to salinization risks;

    h. Estimates of optimal safe groundwater levels with minimal or no groundwater flooding risk;

    i. Impact of surface water levels on groundwater levels;

    j. Relationship between draining or leaking underground infrastructure and ground water levels, including estimated impact of underground infrastructure

repairs; and

k. Estimates of effect of construction of multiple rain gardens on groundwater levels.

2. Established protocol for continuous improvement of groundwater model incorporating results of integral groundwater monitoring network(s).

Knowledge Gap Services

1. White paper including at a minimum the following chapters:

   a. Introduction (5 pages);

   b. Regional Hydrology/Geologic Context/Climate (10 pages);

   c. Subsidence, including basic processes, subsidence in coast generally, detailed geology of City/polders; groundwater usage and subsidence implications and measuring subsidence (15 pages);

   d. Surface Infrastructure, including description of basic concepts and pumping rates and history (5 pages);

   e. Water Quality, based upon existing sources and including inorganic contaminants (5 pages); and

   f. Path Forward, including 5-Year Plan, Actions and Knowledge Development.

Green Infrastructure Applied Research Services

1. Performance analysis of existing Green Infrastructure (GI) features, including detailed monitoring at 10 GI sites; and
2. User-friendly performance quantification tool.

Real-Time Control Services

1. Needs assessment and feasibility study report, taking into account the current situation and future developments;
2. Citywide pilot software application for demonstration purposes;
3. Project report including a proposed plan of action for next steps; and
4. Stakeholder workshop to present project outcome and potential next steps.

ARTICLE II – STANDARD OF CARE

Deltares hereby represents and warrants that it has the requisite skills and expertise necessary to perform the Services. Accordingly, Deltares shall be obligated to perform such services with the same degree of care, skill and diligence as would be ordinarily exercised by a competent practitioner of the same profession in which Deltares is engaged in providing similar services in major United States metropolitan areas under the same or similar circumstances. Deltares acknowledges and agrees that, at City's option, Deltares shall be obligated to re-perform, at no additional cost to City, any or all of the Services that fail to satisfy the foregoing standard of care.

ARTICLE III – REPRESENTATION AND WARRANTIES

A. Deltares represents and warrants that:

1. Deltares has not employed or retained any entity or person, other than a bona fide employee working solely for Deltares, to solicit or secure this Agreement nor has Deltares paid or agreed to pay any entity or person, other than a bona fide employee, any gift, commission, percentage, brokerage or any other such fee for the purpose of assisting Contractor in securing this Agreement. Deltares acknowledges its understanding that any gifts made or fees paid in contravention of this representation and warranty shall be considered bribery pursuant to City Code Section 70-509 and shall subject the offender to criminal penalties in addition to suspension from participation in City contracting for a period of not less than three years. The execution of this Agreement by Deltares's duly authorized representative shall be deemed a sworn statement by Deltares of its compliance with this representation and warranty, as required by City Code Section 46-51;
2. Deltares, through its duly authorized representative, has the full power and authority to enter into and execute this Agreement and, as such, this Agreement is legally binding upon and enforceable against Deltares in accordance with its terms;
3. Deltares is not under any obligation to any other party that would be inconsistent with or in conflict with this Agreement or that would prevent, limit or impair in any way its performance of any obligations hereunder;
4. Deltares has the requisite expertise, qualifications, staff, materials and equipment in place and available to enable it to fully perform the Services and Deltares, along with its employees, as required, and all sub-Contractors, if any and as required, possess all necessary permits, licenses, consents, registrations and/or certifications required under federal, state and/or local law to perform the Services;
5. As of the Effective Date of this Agreement, Deltares has no knowledge of any undisclosed fact that could materially adversely affect its condition (financial or otherwise), business operations or its ability to fulfill its obligations under this Agreement;
6. Deltares is not in breach of any federal, state or local statute or regulation applicable to Contractor or its operations;
7. Deltares's work shall be accurate and free from any material errors, except for software modeling and real time control software application set-up which are subject to specific set-up and testing criteria as set-out below in this paragraph. Deltares's duties as set forth in this Agreement shall at no time be in any way diminished by reason of any approval by City nor shall Deltares be released from liability by reason of such approval by City—it being understood that City, at all times, is ultimately relying upon Deltares's skill and knowledge in performing the Services. In the processes identified in this Agreement leading to 'software modeling' and 'real time control software application' set-up Parties will identify criteria for testing and acceptance of software modeling' and 'real time control software application' development activities - both for initial set-up and later maintenance to system and software – and test steps and expected outcomes. The design and construction of these tests may take the form of detailed Use Cases. As the development and maintenance activities proceed, client may modify these tests by mutual consent with Deltares. These tests shall be used to

determine the acceptability of the 'software modeling' and 'real time control software application' and shall be the sole standards for determining the acceptability of the model and software. Required corrective actions shall be limited to insuring the defined tests perform properly;

8. Deltares is bonded, if required by law, and fully and adequately insured to for the injury of its employees and any others incurring loss or injury as a result of the actions of Deltares or its employees or sub-Contractors in the performance of its obligations under this Agreement; and

9. Deltares has read and fully understands the terms, covenants and conditions set forth in this Agreement and is executing the same willingly and voluntarily of its own volition.

B. Reliance on Representations, Warranties and Covenants. All representations, warranties, covenants and agreements made in this Agreement are intended to material and shall be conclusively deemed to have been relied upon by the receiving party.

ARTICLE V - THE CITY'S OBLIGATIONS

A. Administration. The City will administer this Agreement through the Office of Resilience & Sustainability.

B. Access to Information. The City shall provide Deltares with all material and information reasonably necessary to allow Deltares to perform its obligations under this Agreement.

ARTICLE VI – CITY'S COMPLIANCE WITH PROCUREMENT LAWS, POLICIES AND PROCEDURES FOR FEDERALLY-FUNDED

A. Deltares acknowledges that the City must comply with all applicable federal, state, and local laws, and policies and procedures to procure federally-funded services, goods, or material and supplies subject to this Agreement.

B. Deltares further acknowledges and agrees that the City maintains the option to decide either to procure or to continue an existing agreement for any of the services, goods, or materials and supplies to be provided under this Agreement.

ARTICLE VII – COMPENSATION

A. Budget. The City will pay Deltares in accordance with the budget attached to this Agreement under Exhibit E. Specifically, Contractor shall invoice the City for payment upon completion of each task as specified in Exhibit E.

B. Maximum Amount Payable. The maximum amount payable by the City under this Agreement is $1,127,749.00.

C. Other Costs. Compensation shall be inclusive of all personnel costs, fringe benefits, equipment costs, travel costs, supply costs, publication costs, and indirect costs identified as those not directly incurred as a result of providing the services listed in this Agreement and deemed ineligible for federal modified total direct costs for on-campus research.

D. Detailed Invoices. As a prerequisite to payment, Deltares will provide to the assigned CDBG-NDR Project Manager upon completion of each task as specified in Exhibit E four (4) original invoices approved for payment by Deltares, four (4) copies of supporting documentation, four (4) copies of proof of payment and/or the general ledger, one (1) original copy of the budget

tracking statement, and one (1) electronic copy of the budget tracking statement, payment/general ledger, invoice and supporting documentation.

E. Detailed Deliverable Reports. As a prerequisite to payment, Deltares agrees to provide the assigned CDBG-NDR Project Manager upon completion of each task as specified in Exhibit E one (1) hard copy and one (1) electronic copy, PDF file preferred, of their deliverable report to be submitted with requests for reimbursement. The deliverable reports shall provide clear detail and documentation of the completed deliverable and generally report on Deltares's progress towards the schedule and deliverables in Exhibit E.

F. Truth-In-Negotiation. As of the Effective Date of this Agreement, Deltares represents and warrants that the rates charged City as set forth in this Article II for the performance of the Services are no higher than those charged Deltares's most favored customer for the same or substantially similar services. In the event Deltares's "most favored customer" rates are reduced during the term of this Agreement, Deltares shall be obligated to promptly notify City of such reduction in writing, and such reduced rates shall apply to any services provided on or after the date that Deltares first reduced such rates. City shall have the right to enforce this provision for up to one (1) year following the termination of this Agreement.

G. Budget Revision. Deltares understands and agrees to not exceed any approved budget line item **prior to** receiving, in writing, an approved budget revision from the City authorizing the excess. Deltares shall complete and submit a budget revision request for all budget revisions. **Budget revisions shall not increase the overall budgeted amount of the project.**

H. Budget Amendment. Any increase to the overall budgeted amount to a project will require an amendment to the contract and approved grant application. Deltares will complete and submit a written a request for an increase. Deltares shall receive written approval from the City prior to incurring additional expenses. Except as a result of budget amendment to increase a project budget, in no case shall the Program Administration and Delivery budget **be increased to exceed a maximum amount of $1,127,749.00 under this contract agreement.**

I. Payment Terms. Deltares agrees that payment for deliverables, in accordance with the indicated payment methods, does not constitute a final decision by the City about the allowability of that cost and does not constitute a waiver of any violation by Deltares of the terms of this agreement. Allowable costs shall be in compliance with 2 CFR Part 200 Uniform Administrative Requirements, Cost Principals, and Audit Requirements for Federal Awards.

Payment to Deltares's contractors and vendor are contingent on compliance with the procurement requirements provided for in 2 CFR 200.317 - 326, as applicable.

If the City determines that Deltares is not entitled to receive any part of the federal funds requested, Deltares will be notified in writing. Close-out of this project will not alter Deltares's obligation to return any funds due to the City as a result of later refunds, corrections or other transactions. Project close-out will not affect the City's right to disallow costs and recover funds on the basis of a later review or audit. Upon notice by the City to the Contractor of specific amounts due, Deltares shall promptly remit any excess payment of amounts or disallowed costs to the City.

E. No Payment for Services Beyond Scope of Agreement. Except as may be provided by laws governing emergency procedures, officers and employees of City are not authorized to request Deltares to provide additional services that would result in the performance of services beyond the scopes set forth in Article I of this Agreement, unless this Agreement has been amended in accordance with the terms of this Agreement to authorize such additional services and/or

expenditures. City shall not be required to reimburse Deltares for any services that are provided by Deltares that are beyond the scope of this Agreement, in the absence of a duly authorized executed amendment hereto. In addition, the City shall not be required to reimburse Deltares for any services and cost incurred that are not approved by the State OCD in the form of an approved grant application.

F. No Payments in Excess of Maximum Compensation. Officers and employees of City are not authorized to offer or promise to Deltares additional funding for the contract in excess of the maximum amount of funding set forth above. Additional funding for services provided under this Agreement, unless this Agreement has been amended in accordance with the terms of this Agreement to authorize such increase and the Department of Finance has certified the availability of such additional funding. Absent the prior duly authorized amendment of this Agreement and the necessary certification of the Department of Finance, City shall not be required to honor and will not remit to Deltares any offered or promised additional funding for any of the Services performed pursuant to this Agreement in excess of the maximum amount set forth above.

ARTICLE VIII - DURATION AND TERMINATION

A. Term. The term of this agreement shall be for 1 year from the Effective Date through April 24, 2019.

B. Completion of Work and Subsequent Agreement. Prior to the end of this Agreement, the City will review progress made by Deltares against the agreed upon scope of services to identify any remaining and/or additional tasks to achieve completion of the work. As a result of this review, the Parties will negotiate a subsequent agreement to achieve completion of the work.

C. The Parties understand and agree that all services contained within or potential services related to this Agreement must be completed by the end of the term of the CDBG-NDR grant agreement between HUD and the City.

D. Schedule.

a. Deltares will submit a proposed progress schedule to the City upon advance notice and request from the City. As a minimum, the schedules must include a description of the work completed during the reporting period, an update of the remaining work to be complete in the form of an estimate of the fee necessary to complete the balance of the work, explanation of any extra work completed beyond the scope of services along with documentation authorizing such services.

b. The City has the sole right to approve, reject, or require changes to all schedules relating to the performance of this Agreement **to the extent reasonably can be required considering Deltares available capacity**, including, without limitation, any proposed progress schedule and any requests for modifications.

c. The City may assess Deltares $1,000.00 per calendar day for each milestone that is not completed by the deadline in the approved schedule, without further notice to Deltares, to the extent the delay is caused solely by unreasonable acts or omissions of Deltares. Deltares may request extension to any milestone, said extension will not be unreasonably denied, withheld or delayed. The City may deduct this amount from payments due to

Deltares for services rendered under this Agreement up to a maximum amount for each phase equivalent to 10% of the total fee for that associated task.

E. Termination for Convenience. The City may terminate this Agreement at any time during the term of the Agreement by giving Deltares written notice of the termination at least 30 calendar days before the intended date of termination.

F. Termination for Cause. The City may terminate this Agreement immediately for cause by sending written notice to Deltares. "Cause" includes without limitation any failure to perform any obligation or abide by any condition of this Agreement or the failure of any representation or warranty in this Agreement, including without limitation any failure to comply with any provision of City Code § 2-1120 or requests of the Office of Inspector General. If a termination for cause is subsequently challenged in a court of law and the challenging party prevails, the termination will be deemed to be a termination for convenience effective 30 days from the date of the original written notice of termination for cause was sent to the challenging party; no further notice will be required.

G. Termination for Non-Appropriation. This Agreement will terminate immediately in the event of non-appropriation of funds sufficient to maintain this Agreement without the requirement of notice and the City will not be liable for any amounts beyond the funds appropriated and encumbered for this Agreement.

ARTICLE IX - INDEMNITY

A. To the fullest extent permitted by law, Deltares will indemnify, defend, and hold harmless the City, its agents, employees, officials, insurers, self-insurance funds, and assigns (collectively, the "**Indemnified Parties**") from and against any and all claims, demands, suits, and judgments of sums of money accruing against the Indemnified Parties: for loss of life or injury or damage to persons or property arising from or relating to any negligent act or omission or the operation of Deltares, its agents or employees while engaged in or in connection with the discharge or performance of any Services under this Agreement; and for any and all claims and/or liens for labor, services, or materials furnished to Deltares in connection with the performance of work under this Agreement. This indemnity shall not include any claims related to the use of Delft-FEWS, iMOD or any other proprietary Deltares or Deltares Netherlands software by or on behalf of Indemnified Parties and those third party claims resulting from the use by or on behalf of Indemnified Parties, of the resulting models and operational system.

B. To the fullest extent permitted by law, the City will indemnify, defend, and hold harmless Deltares, its subcontractors, employees, officials and insurers, (collectively, the "**Indemnified Deltares Parties**") from and against any and all claims, demands, suits, and judgments of sums of money accruing against the Indemnified Deltares Parties related to the negligent use of Delft-FEWS, iMOD or any other proprietary Deltares or Deltares Netherlands software by or on behalf of Indemnified Parties and those third party claims resulting from the negligent use by or on behalf of Indemnified Parties, of the models and operational system resulting from the execution of this Agreement. For the purpose of this clause negligent use includes use for operational use or other non-scientific purposes. The City shall have the foregoing indemnity and/or liability obligations only if Deltares provides the City with: (i) a prompt written request for indemnification and defense in such claim or action; (ii) after admission of indemnification and liability, sole control and authority over the defense and settlement thereof; and (iii) all available information, assistance,

and authority reasonably necessary to settle and defend any such claim or action. The City shall not be responsible and shall not compensate Deltares for any attorneys' fees or other expenses or costs that Deltares incurs before and after Deltares' request for indemnification and defense.

C. Limitation. Deltares's indemnity does not extend to any loss arising from the gross negligence or willful misconduct of any of the Indemnified Parties, provided that neither Deltares nor any of its agents or employees contributed to such gross negligence or willful misconduct.

D. Independent Duty. Deltares has an immediate and independent obligation to, at the City's option: (a) defend the City from or (b) reimburse the City for its costs incurred in the defense of any claim that actually or potentially falls within this indemnity, even if: (1) the allegations are or may be groundless, false, or fraudulent; or (2) Deltares is ultimately absolved from liability.

ARTICLE X - INSURANCE

Except as otherwise noted, at all times during this Agreement or the performance of work required by this Agreement, Deltares will maintain the following insurance in full force and effect for the duration of the work under this Agreement:

A. Minimum Requirements:

The following insurance coverages shall be purchased and maintained in Deltares's name and shall apply on a primary basis and shall be non-contributory by the Owner. The total limit of insurance must be equal to or greater than the minimum acceptable limits indicated below. If any policies contain a deductible or self-insured retention, then the evidence of insurance for those policies shall disclose the deductible/retention amount.

1. Deltares shall purchase in its name and maintain insurance with a company or companies having at least an AM Best rating of A:VII (7) or acceptable to and approved by the Owner, and licensed to do business in the State of Louisiana. Such insurance as will protect them from claims which may arise out of or result from Deltares's services under the Agreement, whether such services be himself or by any subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of the them may be liable.
2. It is mandatory that within 10 days after the notification of the award of the Project, Deltares shall furnish to Owner the Professional Liability policy and Certificates of Insurance as required in this Agreement.
3. If any of the insurance companies providing any insurance coverage furnished by Deltares is declared bankrupt, becomes insolvent, its right to do business in Louisiana is terminated or it ceases to meet the requirements of this Agreement, Deltares shall, within 30 days thereafter, substitute another insurance company or companies acceptable to the Owner. The Owner reserves the right to mandate cessation of all services until the receipt of acceptable replacement insurance.
4. Deltares shall furnish the Owner satisfactory evidence that he has obtained in his name and has in force and in effect, and shall keep in force and effect for the duration of the Project, (except for Professional Liability insurance which shall be maintained for a minimum of 3 years after Substantial Completion or acceptance of the project, whichever is later, including all extensions of coverage as outlined herein) insurance policies protecting Deltares and/or the Owner against claims arising out of this Agreement.

B. Required Insurance Coverages:

1. Commercial General Liability ("**CGL**"): Insurance Services Office Form CG 00 01 or similar acceptable to the City, covering CGL on an "occurrence" basis, including products and completed operations, property damage, bodily injury and personal & advertising injury with limits no less than $1,000,000 per occurrence. If a general aggregate limit applies, either the general aggregate limit shall apply separately to this project/location or the general aggregate limit shall be twice the required occurrence limit.
    a. $2,000,000 Aggregate for projects valued under $5,000,000;
    b. $4,000,000 Aggregate for projects valued from $5,000,000 to $10,000,000;
    c. $5,000,000 Aggregate for projects valued from $10,000,001 to $25,000,000;
    d. $10,000,000 Aggregate for projects valued over $25,000,000.
2. Automobile Liability: ISO Form Number CA 00 01 or similar acceptable to the City covering any auto (Symbol 1, or Symbols 7, 8, 9), or if Contractor has no owned autos, hired, (Code 8) and non-owned autos (Code 9), with limit no less than $500,000 Combined Single Limit per accident for bodily injury and property damage. Higher limits may apply according to the particular project.
3. Workers' Compensation: as required by the State of Louisiana, with Statutory Limits, and Employer's Liability Insurance with limit of no less than $1,000,000 per accident for bodily injury or disease.
4. Professional Liability (Errors and Omissions): with limits no less than $1,000,000 per claim. Higher limits of coverage may be required for agreements for Architectural, Engineering, Contractor, or other professional services according to specific project needs or contract value.
    a. **Other Insurance Provisions.** The insurance policies are to contain, or be endorsed to contain, the following provisions:
        i. **Additional Insured Status. Deltares will provide, and maintain current, a Certificate of Insurance naming The City of New Orleans, its departments, political subdivisions, officers, officials, employees, and volunteers are to be covered as "Additional Insureds"** on the CGL policy with respect to liability arising out of the performance of this agreement. General liability coverage can be provided in the form of an endorsement to Deltares's insurance (at least as broad as ISO Form CG 20 10 11 85 or both CG 20 10 and CG 20 37 forms if later revisions used). The Certificate of Insurance, as evidence of all required coverage, should name the City of New Orleans Risk Manager as Certificate holder and be delivered via U.S. Mail to 1300 Perdido Street, 9E06—City Hall, New Orleans, LA 70112.
        ii. **Primary Coverage.** For any claims related to this contract, **Deltares's insurance coverage shall be primary** insurance as respects the City, its departments, political subdivisions, officers, officials, employees,

and volunteers. Any insurance or self-insurance maintained by the City shall be non- contributing to Deltares's coverage.

iii. **Claims Made Policies.** If applicable, the retroactive date must be shown and must be before the date of the contract or the beginning of work. If the coverage is canceled or non-renewed, and not replaced with another claims-made policy, Contractor must purchase "extended reporting" coverage for minimum of 5 years after the termination of this agreement

iv. **Waiver of Subrogation**. **Deltares and its insurers agree to waive any right of subrogation** which any insurer may acquire against the City by virtue of the payment of any loss under insurance required by this contract.

v. **Notice of Cancellation.** Each insurance policy required above shall provide that **coverage shall not be canceled, except with prior notice to the City of no less than 60 days.**

vi. **Acceptability of Insurers.** Insurance is to be placed with **insurers licensed and authorized to do business in the State of Louisiana with a current A.M. Best's rating of no less than A:VII**, unless otherwise acceptable to the City.

C. Other Requirements:

1. Deltares will provide the City's Risk Manager (at City of New Orleans Attn: Risk Manager, 1300 Perdido Street, Suite 9E06, New Orleans, LA 70112 – Ref.: **Gentilly Resilience District Monitoring and Analysis**) within 10 calendar days of the execution date by the City and at any other time at the City's request the following documents:
   a. Proof of coverage for each policy of insurance required by this Agreement;
   b. Copy of the fully executed Agreement;
   c. Copies of all policies of insurance, including all policies, forms, and endorsements; and
   d. Statements disclosing any policy aggregate limit.
2. Without notice from the City, Deltares will:
   a. Replenish any policy aggregate limit that is impaired before commencement of any work or continuation of any work under this Agreement;
   b. Substitute insurance coverage acceptable to the City within 30 calendar days if any insurance company providing any insurance with respect to this Agreement is declared bankrupt, becomes insolvent, loses the right to do business in Louisiana, or ceases to meet the requirements of this Agreement; and
   c. Notify the City's Risk Manager in writing within 48 hours of its receipt of any notice of non-renewal, cancellation, or reduction in coverage or limits affecting any policy of insurance maintained under this Agreement.
3. **Assistance to Those with Limited English Proficiency**. Deltares agrees to take all reasonable actions to communicate with persons who have Limited English Proficiency

(LEP) to ensure that such persons have meaningful access and an equal opportunity to participate in the program(s) and/or services funded under this Agreement.

ARTICLE XI - PERFORMANCE MEASURES

A. Factors. The City will measure the performance of Deltares according to the following non-exhaustive factors: work performed in compliance with the terms of the Agreement; staff availability; staff training; staff professionalism; staff experience; customer service; communication and accessibility; prompt and effective correction of situations and conditions; timeliness and completeness of submission of requested documentation (such as records, receipts, invoices, insurance certificates, and computer-generated reports).

B. Failure to Perform. If Deltares fails to perform according to the Agreement, the City will notify Deltares. If there is a continued lack of performance after notification, the City may declare Deltares in default and may pursue any appropriate remedies available under the Agreement and/or any applicable law. In the event of a notification of default, the City will invoice the defaulting contractor for any increase in costs and other damages sustained by the City. Further, the City will seek full recovery from the defaulting contractor.

ARTICLE XII – LIVING WAGES

To the fullest extent permitted by law, Deltares agrees to abide by City Code sections 70-801, *et seq.*, which requires payment of a wage to covered employees equal to the amounts defined in the Code ("**Living Wage**"). If Deltares fails to comply with the requirements of the Living Wage during the term of the Agreement, said failure may result in termination of the Agreement or the pursuit of other remedies by the City.

ARTICLE XIII - NON-DISCRIMINATION

A. Equal Employment Opportunity. In all hiring or employment made possible by, or resulting from this Agreement, Deltares (1) will not be discriminate against any employee or applicant for employment because of race, color, religion, gender, age, physical or mental disability, national origin, sexual orientation, creed, culture, or ancestry, and (2) where applicable, will take affirmative action to ensure that Deltares's employees are treated during employment without regard to their race, color, religion, gender, age, physical or mental disability, national origin, sexual orientation, creed, culture, or ancestry. This requirement shall apply to, but not be limited to the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. All solicitations or advertisements for employees shall state that all qualified applicants will receive consideration for employment without regard to race, color, religion, gender, age, physical or mental disability, national origin, sexual orientation, creed, culture, or ancestry.

B. Non-Discrimination. In the performance of this Agreement, Deltares will not discriminate on the basis, whether in fact or perception, of a person's race, color, creed, religion, national origin, ancestry, age, sex (gender), sexual orientation, gender identity, domestic partner status, marital status, physical or mental disability, or AIDS- or HIV-status against (1) any employee of the City working with Deltares in any of Deltares's operations within Orleans Parish or (2) any person seeking accommodations, advantages, facilities, privileges, services, or membership in all business, social, or other establishments or organizations operated by Deltares. Deltares agrees to comply with and abide by all applicable federal, state and local laws relating to non-discrimination, including, without limitation, Title VI of the Civil Rights Act of 1964, Section V of the

Rehabilitation Act of 1973, and the Americans with Disabilities Act of 1990.

C. Incorporation into Subcontracts. Deltares will incorporate the terms and conditions of this Article into all subcontracts, by reference or otherwise, and will require all subcontractors to comply with those provisions.

D. The City may terminate this Agreement for cause if Deltares fails to comply with any obligation in this Article, which failure is a material breach of this Agreement.

ARTICLE XIV - INDEPENDENT CONTRACTOR

A. Independent Contractor Status. Deltares is an independent contractor and shall not be deemed an employee, servant, agent, partner, or joint venture of the City and will not hold itself or any of its employees, subcontractors or agents to be an employee, partner, or agent of the City.

B. Exclusion of Worker's Compensation Coverage. The City will not be liable to Deltares, as an independent contractor as defined in La. R.S. 23:1021(6), for any benefits or coverage as provided by the Workmen's Compensation Law of the State of Louisiana. Under the provisions of La. R.S. 23:1034, any person employed by Deltares will not be considered an employee of the City for the purpose of Worker's Compensation coverage.

C. Exclusion of Unemployment Compensation Coverage. Deltares, as an independent contractor, is being hired by the City under this Agreement for hire and defined in La. R.S. 23:1472(E) and neither Deltares nor anyone employed by it will be considered an employee of the City for the purpose of unemployment compensation coverage, which coverage same being hereby expressly waived and excluded by the parties, because: (a) Deltares has been and will be free from any control or direction by the City over the performance of the services covered by this contract; (b) the services to be performed by Deltares are outside the normal course and scope of the City's usual business; and (c) Deltares has been independently engaged in performing the services required under this Agreement prior to the date of this Agreement.

D. Waiver of Benefits. Deltares, as an independent contractor, will not receive from the City any sick and annual leave benefits, medical insurance, life insurance, paid vacations, paid holidays, sick leave, pension, or Social Security for any services rendered to the City under this Agreement.

ARTICLE XV - NOTICE

A. In General. Except for any routine communication, any notice, demand, communication, or request required or permitted under this Agreement will be given in writing and delivered in person or by certified mail, return receipt requested as follows:

1. To the City:

Director

Office of Resilience and Sustainability

City of New Orleans

1300 Perdido Street

New Orleans, LA 70112

&

City Attorney

City of New Orleans

1300 Perdido Street, Suite 5E03

New Orleans, LA 70112

2. To Deltares:

Edwin Welles, Executive Director

Deltares USA, Inc.

8601 Georgia Avenue, Suite 508

Silver Spring, MD 20910

B. Effectiveness. Notices are effective when received, except any notice that is not received due to the intended recipient's refusal or avoidance of delivery is deemed received as of the date of the first attempted delivery.

C. Notification of Change. Each party is responsible for notifying the other in writing that references this Agreement of any changes in its address(es) set forth above.

ARTICLE XVI - ADDITIONAL PROVISIONS

A. Amendment. No amendment of or modification to this Agreement shall be valid unless and until executed in writing by the duly authorized representatives of both parties to this Agreement.

B. Assignment. This Agreement and any part of Deltares's interest in it are not assignable or transferable without the City's prior written consent.

C. Audit and Other Oversight. Deltares will abide by all provisions of City Code § 2-1120, including without limitation City Code § 2-1120(12), which requires Deltares to provide the Office of Inspector General with documents and information as requested. Failure to comply with such requests is a material breach of the Agreement. In signing this Agreement, Deltares agrees that it is subject to the jurisdiction of the Orleans Parish Civil District Court for purposes of challenging a subpoena.

D. Audit and Inspection. Deltares will submit to any City audit, inspection, and review and, at the City's request, will make available all documents relating or pertaining to this Agreement maintained by or under the control of Deltares, its employees, agents, assigns, successors and subcontractors, during normal business hours at Deltares' office or place of business. If no such location is available, Deltares will make the documents available at a time and location that is convenient for the City.

E. Choice of Law. This Agreement will be construed and enforced in accordance with the laws of the State of Louisiana without regard to its conflict of laws provisions.

F. Conflicting Employment. To ensure that Deltares's efforts do not conflict with the City's interests, and in recognition of Deltares's obligations to the City, Deltares will decline any offer of other employment if its performance of this Agreement is likely to be adversely affected by the acceptance of the other employment. Deltares will promptly notify the City in writing of its intention to accept the other employment and will disclose all possible effects of the other employment on Deltares's performance of this Agreement. The City will make the final determination whether Deltares may accept the other employment.

G. Construction of Agreement. Neither party will be deemed to have drafted this Agreement. This Agreement has been reviewed by the Parties and shall be construed and interpreted according to the ordinary meaning of the words used so as to fairly accomplish the purposes and intentions of the Parties. No term of this Agreement shall be construed or resolved in favor of or against the City or Deltares on the basis of which party drafted the uncertain or ambiguous language. The headings and captions of this Agreement are provided for convenience only and are not intended to have effect in the construction or interpretation of this Agreement. Where appropriate, the singular includes the plural and neutral words and words of any gender shall include the neutral and other gender.

H. Convicted Felon Statement. Deltares complies with City Code § 2-8(c) and no principal, member, or officer of Deltares has, within the preceding 5 years, been convicted of, or pled guilty to, a felony under state or federal statutes for embezzlement, theft of public funds, bribery, or falsification or destruction of public records.

I. Employee Verification. Deltares swears that (i) it is registered and participates in a status verification system to verify that all employees in the State of Louisiana are legal citizens of the United States or are legal aliens; (ii) it shall continue, during the term of this Agreement, to utilize a status verification system to verify the legal status of all new employees in the State of Louisiana; and (iii) it shall require all subcontractors to submit to Deltares a sworn affidavit verifying compliance with items (i) and (ii) above. Any violation of the provisions of this paragraph may subject this Agreement to termination, and may further result in Deltares being ineligible for any public contract for a period of 3 years from the date the violation is discovered. Deltares further acknowledges and agrees that it shall be liable for any additional costs incurred by the City occasioned by the termination of this Agreement or the loss of any license or permit to do business in the State of Louisiana resulting from a violation of this provision. Deltares will provide to the City a sworn affidavit attesting to the above provisions if requested by the City. The City may terminate this Agreement for cause if Deltares fails to provide such the requested affidavit or violates any provision of this paragraph.

J. Entire Agreement. This Agreement, including all incorporated documents, constitutes the final and complete agreement and understanding between the parties. All prior and contemporaneous agreements and understandings, whether oral or written, are superseded by this Agreement and are without effect to vary or alter any terms or conditions of this Agreement.

1. **Exhibits.** The following exhibits will be and are incorporated into this Agreement:
    - Exhibit A "HUD Compliance Provisions for Direct Grantee – Subrecipient Agreements and Professional Services Contracts";
    - Exhibit B "Partnership Agreement between City of New Orleans and Deltares, USA, Inc. dated October 22, 2015;
    - Exhibit C "Proposal: Towards Resilient Groundwater & Subsurface Management in New Orleans" dated November 30, 2017
    - Exhibit D "Proposal: Constructing a Surface/Groundwater and Subsidence Monitoring Network for the City of New Orleans" dated November 16, 2017
    - Exhibit E "Budget"

K. Jurisdiction. Deltares consents and yields to the jurisdiction of the State Civil Courts of

the Parish of Orleans and formally waives any pleas or exceptions of jurisdiction on account of the residence of Deltares.

L. Limitations of the City's Obligations. The City has no obligations not explicitly set forth in this Agreement or any incorporated documents or expressly imposed by law.

M. No Third Party Beneficiaries. This Agreement is entered into for the exclusive benefit of the parties and the parties expressly disclaim any intent to benefit anyone not a party to this Agreement.

N. Non-Exclusivity. This Agreement is non-exclusive and Deltares may provide services to other clients, subject to the City's approval of any potential conflicts with the performance of this Agreement and the City may engage the services of others for the provision of some or all of the work to be performed under this Agreement.

O. Non-Solicitation Statement. Deltares has not employed or retained any company or person, other than a bona fide employee working solely for it, to solicit or secure this Agreement. Deltares has not paid or agreed to pay any person, other than a bona fide employee working for it, any fee, commission, percentage, gift, or any other consideration contingent upon or resulting from this Agreement.

P. Non-Waiver. The failure of either party to insist upon strict compliance with any provision of this Agreement, to enforce any right or to seek any remedy upon discovery of any default or breach of the other party at such time as the initial discovery of the existence of such noncompliance, right, default or breach shall not affect or constitute a waiver of either party's right to insist upon such compliance, exercise such right or seek such remedy with respect to that default or breach or any prior contemporaneous or subsequent default or breach.

Q. Ownership Interest Disclosure. Deltares will provide the City with a sworn affidavit listing all natural or artificial persons with an ownership interest in Deltares and stating that no other person holds an ownership interest in Deltares via a counter letter. For the purposes of this provision, an "ownership interest" shall not be deemed to include ownership of stock in a publicly traded corporation or ownership of an interest in a mutual fund or trust that holds an interest in a publicly traded corporation. If Deltares fails to submit the required affidavit, the City may, after 30 days' written notice to Deltares, take such action as may be necessary to cause the suspension of any further payments until such the required affidavits are submitted.

R. Ownership of Records. Deltares shall maintain ownership of all data collected and all products of work prepared, created or modified by Deltares in the performance of this Agreement, including without limitation any and all notes, tables, graphs, reports, files, computer programs, source code, documents, records, disks, original drawings or other such material, regardless of form and whether finished or unfinished, but excluding Deltares's personnel and administrative records and any tools, systems, and information used by Deltares to perform the services under this Agreement, including computer software (object code and source code), know-how, methodologies, equipment, and processes and any related intellectual property (collectively, "Work Product"). Deltares shall also maintain all right, title and interest in any Work Product, including without limitation the right to secure and maintain any copyright, trademark, or patent of Work Product in Deltares's name. However, Deltares acknowledges that the purpose of the Project is for the benefit of the City of New Orleans, and therefore Deltares shall grant the City a no-cost perpetual license to utilize all Work Product in a manner to further the purpose of the Project, provided that the City takes all reasonable precautions to protect Deltares's intellectual

property and proprietary interests of the Work Product, subject to all applicable public records laws. Deltares' and Deltares Netherlands standard software as well as any amendments thereto made under this Agreement shall only be subject to the applicable standard license agreement. This Agreement and its terms and conditions shall not apply to the Deltares' and Deltares Netherlands standard software or to any amendments thereto made in the execution of this Agreement." The Contactor shall also be able present or publish materials deriving from its Work Product at its sole discretion, provided that Deltares provide the City with an advance copy for review and feedback at least thirty (30) days prior to presentation or publication.

S. Prohibition of Financial Interest in Agreement. No elected official or employee of the City shall have a financial interest, direct or indirect, in this Agreement. For purposes of this provision, a financial interest held by the spouse, child, or parent of any elected official or employee of the City shall be deemed to be a financial interest of such elected official or employee of the City. Any willful violation of this provision, with the expressed or implied knowledge of Deltares, shall render this Agreement voidable by the City and shall entitle the City to recover, in addition to any other rights and remedies available to the City, all monies paid by the City to Deltares pursuant to this Agreement without regard to Deltares's otherwise satisfactory performance of the Agreement.

T. Prohibition on Political Activity. None of the funds, materials, property, or services provided directly or indirectly under the terms of this Agreement shall be used in the performance of this Agreement for any partisan political activity, or to further the election or defeat of any candidate for public office.

U. Records and Reporting. Deltares will maintain all books, documents, papers, accounting records, invoices, materials records, payrolls, work papers, personnel records, and other evidence pertaining to the performance of services under this Agreement, including, without limitation, of costs incurred through 5 years. If this Agreement is terminated for any reason, Deltares will deliver to the City all plans and records of work compiled through the date of termination.

V. Remedies Cumulative. No remedy set forth in the Agreement or otherwise conferred upon or reserved to any party shall be considered exclusive of any other remedy available to a party. Rather, each remedy shall be deemed distinct, separate and cumulative and each may be exercised from time to time as often as the occasion may arise or as may be deemed expedient.

W. Severability. Should a court of competent jurisdiction find any provision of this Agreement to be unenforceable as written, the unenforceable provision should be reformed, if possible, so that it is enforceable to the maximum extent permitted by law or, if reformation is not possible, the unenforceable provision shall be fully severable and the remaining provisions of the Agreement remain in full force and effect and shall be construed and enforced as if the unenforceable provision was never a part the Agreement.

X. Special Conditions for HUD NDR Contracts. The "HUD Compliance Provisions for Direct Grantee – Subrecipient Agreements and Professional Services Contracts ," attached as Exhibit "A" to this Agreement, are expressly incorporated in the Agreement and will be effective, notwithstanding any provision of the Agreement or any incorporated documents, to the contrary, upon the City's notice to Deltares that the City intends to seek reimbursement from the NDR Program in connection with the work to be performed under this Agreement.

Y. Subcontractor Reporting. Deltares will provide a list of all natural or artificial persons who are retained by Deltares at the time of the Agreement's execution and who are expected to

perform work as subcontractors in connection with Deltares's work for the City. For any subcontractor proposed to be retained by Deltares to perform work on the Agreement with the City, Deltares must provide notice to the City within 30 days of retaining that subcontractor. If Deltares fails to submit the required lists and notices, the City may, after thirty 30 days' written notice to Deltares, take any action it deems necessary, including, without limitation, causing the suspension of any payments, until the required lists and notices are submitted.

Z. Survival of Certain Provisions. All representations and warranties and all obligations concerning record retention, inspections, audits, ownership, indemnification, payment, remedies, jurisdiction, and choice of law shall survive the expiration, suspension, or termination of this Agreement and continue in full force and effect.

AA. Terms Binding. The terms and conditions of this Agreement are binding on any heirs, successors, transferees, and assigns.

ARTICLE XVII - ELECTRONIC SIGNATURE AND DELIVERY

The Parties agree that a manually signed copy of this Agreement and any other document(s) attached to this Agreement delivered by email shall be deemed to have the same legal effect as delivery of an original signed copy of this Agreement. No legally binding obligation shall be created with respect to a party until such party has delivered or caused to be delivered a manually signed copy of this Agreement.

[The remainder of this page is intentionally left blank]

[SIGNATURES CONTAINED ON NEXT PAGE]

IN WITNESS WHEREOF, the City and Deltares, through their duly authorized representatives, execute this Agreement.

CITY OF NEW ORLEANS

BY: _____

MITCHELL J. LANDRIEU, MAYOR

Executed on this 26TH **of** April, **2018**.

Law Department

By: _____

Printed Name: _____

DELTARES USA, INC.

BY: Edwin Welles

EDWIN WELLES EXECUTIVE DIRECTOR

26-3402690

FEDERAL TAX I.D.

[EXHIBITS A – E CONTAINED ON FOLLOWING PAGES]

EXHIBIT A TO THE COOPERATIVE ENDEAVOR AGREEMENT
BETWEEN
THE CITY OF NEW ORLEANS
AND
DELTARES USA, INC.

HUD NDR COMPLIANCE PROVISIONS
FOR
DIRECT GRANTEE
CONSTRUCTION AND PROFESSIONAL SERVICES CONTRACTS

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44. LIMITED ENGLISH PROFICIENCY (LEP)

1. **EQUAL EMPLOYMENT OPPORTUNITY (Equal Opportunity Clause)**
(applicable to contracts and subcontracts exceeding $10,000)

During the performance of this contract, the Contractor agrees as follows:

A. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

B. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration without regard to race, color, religion, sex, or national origin.

C. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided by the Contract Compliance Officer advising the said labor union or workers' representatives of the Contractor's commitment under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

D. The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, as amended, and the rules, regulations, and relevant orders of the Secretary of Labor.

E. The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, as amended, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the Department and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and others.

F. In the event of the Contractor's noncompliance with the non-discrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be cancelled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, as amended, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

G. The Contractor will include the provisions of the sentence immediately preceding paragraph A and the provisions of paragraphs A through G in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, as amended, so that such provisions will be binding upon each Contractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the Department may direct as a means of enforcing such provisions, including sanctions for noncompliance. Provided, however, that in the event a Contractor becomes involved in, or is threatened with, litigation with a Contractor or vendor as a result of such direction by the Department, the Contractor may request the United States to enter into such litigation to protect the interest of the United States.

2. STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT SPECIFICATIONS

(applicable to contracts and subcontracts exceeding $10,000)

A. As used in these specifications:

(1) "Covered area" means the geographical area described in the solicitation from which this contract resulted;

(2) "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;

(3) "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.

(4) "Minority" includes:

(a) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

(b) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South America or other Spanish Culture or origin, regardless of race);

(c) Asian and Pacific Islander (all persons having origins in any of the original people of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(d) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

B. When the Contractor, or any contractor, at anytime, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract, in excess of $10,000, the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

C. If the Contractor is participating (pursuant to 41 CFR 60 4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in compliance with the provisions of any such Hometown Plan. Each Contractor or Contractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or contractors toward a goal in an approved Plan does not excuse any covered Contractor's or contractor's failure to take good faith efforts to achieve the Plan goals and timetables.

D. The Contractor shall implement the specific affirmative action standards provided In paragraphs G(1) through G(16) of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered construction Contractors performing contracts in geographical areas where they do not have a federal or federally-assisted construction contract shall apply the minority and female goals established for the geographic area where the contract is being performed. Goals are published periodically in the Federal Register in notice form and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

E. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

F. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

G. The Contractor shall take specific affirmative action to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

(1) Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

(2) Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organization's responses.

(3) Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source, or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore, along with whatever additional actions the Contractor may have taken.

(4) Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement have not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(5) Develop on-the-job training opportunities and/or participate in training programs for the area which expressly includes minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under G(2) above.

(6) Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on a bulletin board accessible to all employees at each location where construction work is performed.

(7) Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination, or other employment decisions including specific review of these items with on-site supervisory personnel such as Superintendents, General Foreman, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(8) Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Contractors with whom the Contractor does or anticipates doing business.

(9) Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

(10) Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer, and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.

(11) Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60 3.

(12) Conduct, at least annually, an inventory and evaluation of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

(13) Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

(14) Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

(15) Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction Contractors and suppliers, including circulation of solicitation to minority and female Contractor associations and other business associations.

(16) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

H. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (G(1) through G(16)). The efforts of a Contractor association, joint Contractor-union, Contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under G(1) through G(16) of these specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation shall not be a defense for the Contractor's non-compliance.

I. A single goal for minorities and a separate single goal for women has been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women,

both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

J. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any persons because of race, color, religion, sex, or national origin.

K. The Contractor shall not enter into any subcontract with any person or firm debarred from government contracts pursuant to E.O. 11246.

L. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause including suspension, termination, and cancellation of existing subcontracts as may be imposed or ordered pursuant to E.O. 11246, as amended.

M. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph G of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60 4.8.

N. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the government and to keep records. Records shall at least include for each employee, the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number where assigned, social security number, race, sex, status (e.g., mechanic, apprenticeship trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and location at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, Contractors shall not be required to maintain separate records.

O. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application or requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

3. **NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION**

(applicable to contracts and subcontracts exceeding $10,000)

A. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

B. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area are applicable to all the Contractor's construction work (whether or not it is federal or federally assisted) performed in the covered area. If the Contractor performs construction work in a geographic area located outside of the covered area, it shall apply the goals established for such geographic area where the work is actually performed.

With regard to this second area, the Contractor also is subject to the goals for both its federally involved and non-federally involved construction. The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60 4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60 4.3 (a) and its efforts to meet the goals established for the geographical area where the contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order, and the regulations in 41 CFR Part 60 4. Compliance with the goals will be measured against the total work hours performed.

C. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated starting and completion dates of the sub-contract; and the geographical area in which the contract is to be performed.

D. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is (insert description of the geographical areas where the contract is to be performed, giving the State, parish, and city, if any):

4. CERTIFICATION OF NONSEGREGATED FACILITIES

(applicable to contracts and subcontracts exceeding $10,000)

By the submission of this bid, the bidder, offeror, applicant or Contractor certifies that he/she does not maintain or provide for his/her establishments, and that he/she does not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained. He/she certifies further that he/she will not maintain or provide for employees any segregated facilities at any of his/her establishments, and he/she will not permit employees to perform their services at any location under his/her control where segregated facilities are maintained. The bidder, offeror, applicant or Contractor agrees that a breach of this certification is a violation of the equal opportunity clause of this contract.

As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employees which are segregated by explicit directive or are, in fact, segregated on the basis of race, color, religion, or national origin because of habit, local custom, or any other reason.

He/she further agrees that (except where he/she has obtained for specific time periods) he/she will obtain identical certification from proposed contractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the equal opportunity clause; that he/she will retain such certifications in his/her files; and that he/she will forward the following notice to such proposed contractors (except where proposed contractors have submitted identical certifications for specific time periods).

5. CIVIL RIGHTS

The Contractor shall comply with the provisions of Title VI of the Civil Rights Act of 1964. No person shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance.

6. **SECTION 109 OF THE HOUSING AND COMMUNITY DEVELOPLENT ACT OF 1974**

The Contractor shall comply with the provisions of Section 109 of the Housing and Community Development Act of 1974. No person in the United States shall on the grounds of race, color, national origin, or sex be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity funded in whole or in part with funds made available under this title. Section 109 further provides that discrimination on the basis of age under the Age Discrimination Act of 1975 or with respect to an otherwise qualified handicapped individual as provided in Section 504 of the Rehabilitation Act of 1973, as amended, is prohibited.

7. **SECTION 3 OF THE HOUSING AND URBAN DEVELOPMENT ACT OF 1968 - (Section 3 Clause)** (applicable to contracts and subcontracts exceeding $100,000 funded by Section 3 covered assistance)

A. The work to be performed under this contract is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u (section 3). The purpose of section 3 is to ensure that employment and other economic opportunities generated by HUD assistance or HUD-assisted projects covered by Section 3, shall, to the greatest extent feasible, be directed to low- and very low-income persons, particularly persons who are recipients of HUD assistance for housing.

B. The parties to this contract agree to comply with HUD's regulations in 24 CFR part 135, which implement Section 3. As evidenced by their execution of this contract, the parties to this contract certify that they are under no contractual or other impediment that would prevent them from complying with the part 135 regulations.

C. The Contractor agrees to send to each labor organization or representative of workers with which the Contractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the Contractor's commitments under this Section 3 clause, and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. The notice shall describe the Section 3 preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each, and the name and location of the person(s) taking applications for each of the positions, and the anticipated date the work shall begin.

D. The Contractor agrees to include this Section 3 clause in every subcontract subject to compliance with regulations in 24 CFR part 135, and agrees to take appropriate action, as provided in an applicable provision of the subcontract or in this Section 3 clause, upon a finding that the Contractor is in violation of the regulations in 24 CFR part 135. The Contractor will not subcontract with any Contractor where the Contractor has notice or knowledge that the Contractor has been found in violation of the regulations in 24 CFR part 135.

E. The Contractor will certify that any vacant employment positions, including training positions, that are filled (1) after the Contractor is selected but before the contract is executed, and (2) with persons other than those to whom the regulations of 24 CFR part 135 require employment opportunities to be directed, were not filled to circumvent the Contractor's obligations under 24 CFR part 135.

F. Noncompliance with HUD's regulations in 24 CFR part 135 may result in sanctions, termination of this contract for default, and debarment or suspension from future HUD assisted contracts.

G. With respect to work performed in connection with Section 3 covered Indian housing assistance, Section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450e) also applies to the work to be performed under this contract. Section 7(b) requires that to the greatest extent feasible (i) preference and opportunities for training and employment shall be given to Indians, and (ii) preference in the award of contracts and subcontracts shall be given to Indian organizations and Indian-owned Economic Enterprises. Parties to this contract that are subject to the provisions of Section 3 and section 7(b) agree to comply with Section 3 to the maximum extent feasible, but not in derogation of compliance with Section 7(b).

8. SECTION 503 OF THE REHABILITATION ACT OF 1973 (29 USC 793)

(applicable to contracts and subcontracts exceeding $10,000)

A. The Contractor will not discriminate against any employee or applicant for employment because of physical or mental handicap in regard to any position for which the employee or applicant for employment is otherwise qualified. The Contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified handicapped individuals without discrimination based upon their physical or mental handicap in all employment practices such as the following: employment upgrading, demotion or transfer, recruitment, advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.

B. The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor issued pursuant to the Act.

C. In the event of the Contractor's noncompliance with the requirements of this clause, actions for noncompliance may be taken in accordance with the rules, regulations, and relevant orders of the Secretary of Labor issued pursuant to the Act.

D. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices in a form to be prescribed by the Director, provided by or through the contracting officer. Such notices shall state the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified handicapped employees and applicants for employment, and the rights of applicants and employees.

E. The Contractor will notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of Section 503 of the Rehabilitation Act of 1973, and is committed to take affirmative action to employ and advance in employment physically and mentally handicapped individuals.

F. The Contractor will include the provisions of this clause in every subcontract or purchase order of $10,000 or more unless exempted by rules, regulations, or orders of the Secretary issued pursuant to Section 503 of the Act, so that such provisions will be binding upon each Contractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the Director of the Office of Federal Contract Compliance Programs may direct to enforce such provisions, including action for noncompliance.

9. SECTION 504 OF THE REHABILITATION ACT OF 1973, AS AMENDED

The Contractor agrees that no otherwise qualified individual with disabilities shall, solely by reason of his disability, be denied the benefits, or be subjected to discrimination including discrimination in employment, any program or activity that receives the benefits from the federal financial assistance.

10. AGE DISCRIMINATION ACT OF 1975

The Contractor shall comply with the provisions of the Age Discrimination Act of 1975. No person in the United States shall, on the basis of age, be excluded from participation

in, be denied the benefits of, or be subjected to discrimination under, any program or activity receiving federal financial assistance.

11. CERTIFICATION OF COMPLIANCE WITH AIR AND WATER ACTS

(applicable to contracts and subcontracts exceeding $100,000)

The Contractor and all contractors shall comply with the requirements of the Clean Air Act, as amended, 42 USC 1857 et seq., the Federal Water Pollution Control Act, as amended, 33 USC 1251 et seq., and the regulations of the Environmental Protection Agency with respect thereto, at 40 CFR Part 15, as amended.

In addition to the foregoing requirements, all nonexempt Contractors and contractors shall furnish to the owner, the following:

A. A stipulation by the Contractor or contractors, that any facility to be utilized in the performance of any nonexempt contract or subcontract, is not listed on the List of Violating Facilities issued by the Environmental Protection Agency (EPA) pursuant to 40 CFR Part 15, as amended.

B. Agreement by the Contractor to comply with all the requirements of Section 114 of the Clean Air Act, as amended, (42 USC 1857 c 8) and Section 308 of the Federal Water Pollution Control Act, as amended, (33 USC 1318) relating to inspection, monitoring, entry, reports and information, as well as all other requirements specified in said Section 114 and Section 308, and all regulations and guidelines issued there under.

C. A stipulation that as a condition for the award of the contract, prompt notice will be given of any notification received from the Director, Office of Federal Activities, EPA, indicating that a facility utilized, or to be utilized for the contract, is under consideration to be listed on the EPA List of Violating Facilities.

D. Agreement by the Contractor that he will include, or cause to be included, the criteria and requirements in paragraph (1) through (4) of this section in every nonexempt subcontract and requiring that the Contractor will take such action as the government may direct as a means of enforcing such provisions.

12. SPECIAL CONDITIONS PERTAINING TO HAZARDS, SAFETY STANDARDS AND ACCIDENT PREVENTION

A. **Lead-Based Paint Hazards**

The construction or rehabilitation of residential structures is subject to the HUD Lead-Based Paint regulations, 24 CFR Part 35. The Contractor and contractors shall comply with the provisions for the elimination of lead-based paint hazards under Subpart B of said regulations. The Owner will be responsible for the inspections and certifications required under Section 35.14 (f) thereof.

B. **Use of Explosives**

When the use of explosives is necessary for the prosecution of the work, the Contractor shall observe all local, state and federal laws in purchasing and handling explosives. The Contractor shall take all necessary precaution to protect completed work, neighboring property, water lines, or other underground structures. Where there is danger to structures or property from blasting, the charges shall be reduced and the material shall be covered with suitable timber, steel or rope mats.

The Contractor shall notify all owners of public utility property of intention to use explosives at least 8 hours before blasting is done close to such property. Any supervision or direction of use of explosives by the engineer does not in any way reduce the responsibility of the Contractor or his Surety for damages that may be caused by such use.

C. **Danger Signals and Safety Devices (Modify as Required)**

The Contractor shall make all necessary precautions to guard against damages to property and injury to persons. He shall put up and maintain in good condition, sufficient red or warning lights at night, suitable barricades and other devices necessary to protect the public. In case the Contractor fails or neglects to take such precautions, the Owner may have such lights and barricades installed and charge the cost of this work to the Contractor. Such action by the Owner does not relieve the Contractor of any liability incurred under these specifications or contract.

13. FLOOD DISASTER PROTECTION

This contract is subject to the requirements of the Flood Disaster Protection Act of 1973 (P.L. 93 234). Nothing included as a part of this contract is approved for acquisition or construction purposes as defined under Section 3(a) of said Act, for use in an area identified by the Secretary of HUD as having special flood hazards which is located in a community not then in compliance with the requirements for participation in the National Flood Insurance Program pursuant to Section 201(d) of said Act; and the use of any assistance provided under this contract for such acquisition for construction in such identified areas in communities then participating in the National Flood Insurance Program shall be subject to the mandatory purchase of flood insurance requirements or Section 102(a) of said Act.

Any contract or agreement for the sale, lease, or other transfer of land acquired, cleared or improved with assistance provided under this Contract shall contain, if such land is located in an area identified by the Secretary as having special flood hazards and in which the sale of flood insurance has been made available under the National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 et seq., provisions obligating the transferee and its successors or assigns to obtain and maintain, during the ownership of such land, such flood insurance as required with respect to financial assistance for acquisition or construction purposes under Section 102(a) of Flood Disaster Protection Act of 1973.

14. ACCESS TO RECORDS - MAINTENANCE OF RECORDS

The Department of Housing and Urban Development, the Comptroller General of the United States, or any of their duly authorized representatives, shall have access to any books, documents, papers and records of the Contractor which are directly pertinent to this specific contract, for the purpose of audits, examinations, and making excerpts and transcriptions. All records connected with this contract will be maintained in a central location by the unit of local government and will be maintained for a period of five (5) years from the official date of the final closeout of the grant.

15. INSPECTION

The authorized representative and agents of the Department of Housing and Urban Development shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records.

16. REPORTING REQUIREMENTS

The Contractor shall complete and submit all reports, in such form and according to such schedule, as may be required by the Owner.

17. CONFLICT OF INTEREST

A. No officer or employee of the local jurisdiction or its designees or agents, no member of the governing body, and no other public official of the locality who his/her tenure or for one year thereafter, shall have any interest, direct or indirect, in any contract or subcontract, or the proceeds thereof, for work to be performed. Further, the Contractor shall cause to be incorporated in all subcontracts the language set forth in this paragraph prohibiting conflict of interest.

B. No member of or delegate to Congress, or Resident Commissioner, shall be admitted to any share or part of this contract or to any benefit that may arise there from, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

18. ACTIVITIES AND CONTRACTS NOT SUBJECT TO EXECUTIVE ORDER 11246, AS AMENDED

(applicable to contracts and subcontracts of $10,000 and under)

During the performance of this contract, the Contractor agrees as follows:

A. The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor shall take affirmative action to ensure that applicants for employment are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

B. The Contractor shall post in conspicuous places, available to employees and applicants for employment, notices to be provided by Contracting Officer setting forth the provisions of this non-discrimination clause. The Contractor shall state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

C. Contractors shall incorporate foregoing requirements in all subcontracts.

19. **PATENTS**

A. The Contractor shall hold and save the Owner and its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the contract including its use by the Owner, unless otherwise specifically stipulated in the Contract Document.

B. License or Royalty Fees: License and/or Royalty Fees for the use of a process which is authorized by the Owner of the project must be reasonable, and paid to the holder of the patent, or his authorized license, direct by the Owner and not by or through the Contractor.

C. If the Contractor uses any design device or materials covered by letters, patent or copyright, he shall provide for such use by suitable agreement with the owner of such patented or copy-righted design device or material. It is mutually agreed and understood, that without exception the contract prices shall include all royalties or costs arising from the use of such design, device or materials, in any way involved in the work. The Contractor and/or his Sureties shall indemnify and save harmless the Owner of the project from any and all claims for infringement by reason of the use of such patented or copy-righted design, device or materials or any trademark or copy-right in connection with work agreed to be performed under this contract, and shall indemnify the Owner for any cost, expense, or damage which it may be obliged to pay by reason of such infringement at any time during the prosecution of the work or after completion of the work.

20. **COPYRIGHT**

No materials, to include but not limited to reports, maps, or documents produced as a result of this contract, in whole or in part, shall be available to the Contractor for copy-right purposes. Any such materials produced as a result of this contract that might be subject to copyright shall be the property of the Owner and all such rights shall belong to the Owner.

21. **TERMINATION FOR CAUSE**

If, through any cause, the Contractor shall fail to fulfill in a timely and proper manner his obligations under this contract, or if the Contractor shall violate any of the covenants, agreements, or stipulations of this contract, the Owner shall thereupon have the right to terminate this contract by giving written notice to the Contractor of such termination and specifying the effective date thereof, at least five (5) days before the effective date of

such termination. In such event, all finished or unfinished documents, data, studies, surveys, drawings, maps, models, photographs, and reports prepared by the Contractor under this contract shall, at the option of the Owner, become the Owner's property and the Contractor shall be entitled to receive just and equitable compensation for any work satisfactorily completed hereunder. Notwithstanding the above, the Contractor shall not be relieved of liability to the Owner for damages sustained by the Owner by virtue of any breach of the contract by the Contractor, and the Owner may withhold any payments to the Contractor for the purpose of set-off until such time as the exact amount of damages due the Owner from the Contractor is determined.

22. TERMINATION FOR CONVENIENCE

The Owner may terminate this contract at any time by giving at least ten (10) days notice in writing to the Contractor. If the contract is terminated by the Owner as provided herein, the Contractor will be paid for the time provided and expenses incurred up to the termination date.

23. ENERGY EFFICIENCY

The Contractor shall comply with mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Public Law 94-163).

24. SUBCONTRACTS

A. The Contractor shall not enter into any subcontract with any contractor who has been debarred, suspended, declared ineligible, or voluntarily excluded from participating in contacting programs by any agency of the United States Government or the State of Louisiana.

B. The Contractor shall be as fully responsible to the Owner for the acts and omissions of the Contractor's contractors, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by the Contractor.

C. The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind contractor to the Contractor by the terms of the contract documents insofar as applicable to the work of contractors and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the contract documents.

D. Nothing contained in this contract shall create any contractual relation between any Contractor and the Owner.

25. DEBARMENT, SUSPENSION, AND INELIGIBILITY

The Contractor represents and warrants that it and its contractors are not debarred, suspended, or placed in ineligibility status under the provisions of 2 CFR 200.213 (government debarment and suspension regulations).

26. PROTECTION OF LIVES AND HEALTH

The Contractor shall exercise proper precaution at all times for the protection of persons and property and shall be responsible for all damages to persons or property, either on or off the worksite, which occur as a result of his prosecution of the work. The safety provisions of applicable laws and building and construction codes, in addition to specific safety and health regulations described by Chapter XIII, Bureau of Labor Standards, Department of Labor, Part 1518, Safety and Health Regulations for Construction, as outlined in the Federal Register, Volume 36, No. 75, Saturday, April 17, 1971, Title 29 - LABOR, shall be observed and the Contractor shall take or cause to be taken, such additional safety and health measures as the Owner may determine to be reasonably necessary.

27. BREACH OF CONTRACT TERMS

Any violation or breach of terms of this contract on the part of the Contractor or the Contractor's contractors may result in the suspension or termination of this contract or such other action that may be necessary to enforce the rights of the parties of this contract. The duties and obligations imposed by the contract documents and the rights and remedies available there under shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law.

28. PROVISIONS REQUIRED BY LAW DEEMED INSERTED

Each and every provision of law and clause required by law to be inserted in this contract shall be deemed to be inserted herein and the contract shall be read and enforced as though it were included herein, and if through mistake or otherwise any such provision is

not inserted, or is not correctly inserted, then upon the application of either party the contract shall forthwith be physically amended to make such insertion or correction.

29. CHANGES

The Owner may, from time to time, request changes in the scope of the services of the Contractor to be performed hereunder. Such changes, including any increase or decrease in the amount of the Contractor's compensation which are mutually agreed upon by and between the Owner and the Contractor, shall be incorporated in written and executed amendments to this Contract.

30. PERSONNEL

The Contractor represents that it has, or will secure at its own expense, all personnel required in performing the services under this Contract. Such personnel shall not be employees of or have any contractual relationship with the Owner.

All the services required hereunder will be performed by the Contractor or under its supervision, and all personnel engaged in the work shall be fully qualified and shall be authorized or permitted under State and local law to perform such services.

No person who is serving sentence in a penal or correctional institution shall be employed on work under this Contract.

31. ANTI-KICKBACK RULES

Salaries of personnel performing work under this Contract shall be paid unconditionally and not less often than once a month without payroll deduction or rebate on any account except only such payroll deductions as are mandatory by law or permitted by the applicable regulations issued by the Secretary of Labor pursuant to the "Anti-Kickback Act" of June 13, 1934 (48 Stat. 948; 62 Stat. 740; 63 Stat. 108; Title 18 U.S.C. 874; and Title 40 U.S.C. 276c). The Contractor shall comply with all applicable "Anti-Kickback" regulations and shall insert appropriate provisions in all subcontracts covering work under this contract to insure compliance by the contractors with such regulations, and shall be responsible for the submission of affidavits required of contractors there under except as the Secretary of Labor may specifically provide for variations of or exemptions from the requirements thereof.

32. ASSIGNABILITY

The Contractor shall not assign any interest in this Contract, and shall not transfer any interest in the same (whether by assignment or novation) without prior written approval of the Owner provided that claims for money due or to become due the Contractor from the Owner under this Contract may be assigned to a bank, trust company, or other financial institution, or to a Trustee in Bankruptcy, without such approval. Notice of any such assignment or transfer shall be furnished promptly to the Owner.

33. INTEREST OF CONTRACTOR

The Contractor covenants that he presently has no interest and shall not acquire any interest direct or indirect in the above described project or any parcels therein or any other interest which would conflict in any manner or degree with the performance of his services hereunder. The Contractor further covenants that in the performance of this Contract no person having any such interest shall be employed.

34. POLITICAL ACTIVITY

The Contractor will comply with the provisions of the Hatch Act (5 U.S.C. 1501 et seq.), which limits the political activity of employees.

35. COMPLIANCE WITH THE OFFICE OF MANAGEMENT AND BUDGET

The parties agree to comply with the regulations, policies, guidelines, and requirements of the Office of Management and Budget, Circulars 2 CFR 200, as they relate to the use of Federal funds under this contract.

36. DISCRIMINATION DUE TO BELIEFS

No person with responsibilities in operation of the project to which this grant relates will discriminate with respect to any program participant or any applicant for participation in such program because of political affiliation or beliefs.

37. CONFIDENTIAL FINDINGS

All of the reports, information, data, etc., prepared or assembled by the Contractor under this Contract are confidential, and the Contractor agrees that they shall not be made available to any individual or organization without prior written approval of the Owner.

38. **LOBBYING**

The Contractor certifies, to the best of his or her knowledge and belief that:

1. No federally appropriated funds have been paid or will be paid, by or on behalf of the Contractor, to any person for influencing or attempting to influence an officer or employee of any agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with the awarding of any federal contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.

2. If any funds other than federally appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this federal contract, grant, loan, or cooperative agreement, the Contractor shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

39. **FEDERAL LABOR STANDARDS PROVISIONS**

The Contractor shall abide by the requirements of the Federal Labor Standards Provisions (form HUD-4010) as follows.

Federal Labor Standards Provisions

U.S. Department of Housing and Urban Development

Office of Labor Relations

Applicability

The Project or Program to which the construction work covered by this contract pertains is being assisted by the United States of America and the following Federal Labor Standards Provisions are included in this Contract pursuant to the provisions applicable to such Federal assistance.

A. 1. (i) Minimum Wages. All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by

regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under Section l(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of 29 CFR 5.5(a)(1)(iv); also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period.

Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under 29 CFR 5.5(a)(1)(ii) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its contractors at the site of the work in a prominent and accessible, place where it can be easily seen by the workers.

(ii) (a) Any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. HUD shall approve an additional classification and wage rate and fringe benefits therefor only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(b) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and HUD or its designee agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by HUD or its designee to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. every additional classification action within 30 days of receipt and so advise HUD or its designee

or will notify HUD or its designee within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB control number 1215-0140.)

(c) In the event the Contractor, the laborers or mechanics to be employed in the classification or their representatives, and HUD or its designee do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), HUD or its designee shall refer the questions, including the views of all interested parties and the recommendation of HUD or its designee, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

(d) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1) (ii) (b) or (c) of this paragraph, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

2. Withholding. HUD or its designee shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same prime Contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime Contractor so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees and helpers, employed by the Contractor or any contractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee or helper, employed or working on the site of the work, all or part of the wages required by the contract, HUD or its designee may, after written notice to the Contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment,

advance, or guarantee of funds until such violations have ceased. HUD or its designee may, after written notice to the Contractor, disburse such amounts withheld for and on account of the Contractor or Contractor to the respective employees to whom they are due. The Comptroller General shall make such disbursements in the case of direct Davis-Bacon Act contracts.

3. (i) **Payrolls and basic records**. Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in Section l (b) (2) (B) of the Davis-bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5 (a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section l(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs. (Approved by the Office of Management and Budget under OMB Control Numbers 1215-0140 and 1215-0017.)

(ii) (a) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to HUD or its designee if the agency is a party to the contract, but if the agency is not such a party, the Contractor will submit the payrolls to the applicant sponsor, or owner, as the case may be, for transmission to HUD or its designee. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a) (3) (i). This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal Stock Number 029-005-00014-1), U.S. Government Printing Office, Washington, DC 20402. The prime Contractor is responsible for the submission of copies of payrolls by all contractors. (Approved by the Office of Management and Budget under OMB Control Number 1215-0149.)

(b) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or Contractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be maintained under 29 CFR 5.5 (a)(3)(i) and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(c) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph A.3.(ii)(b).

(d) The falsification of any of the above certifications may subject the Contractor or Contractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(iii) The Contractor or contractor shall make the records required under subparagraph A.3.(i) available for inspection, copying, or transcription by authorized representatives of HUD or its designee or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the Contractor or Contractor fails to submit the required records or to make them available, HUD or its designee may, after written notice to the Contractor, sponsor, applicant or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be

greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a Contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or contractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate that is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under 29 CFR Part 5 shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

5. Compliance with Copeland Act requirements. The Contractor shall comply with the requirements of 29 CFR Part 3 which are incorporated by reference in this contract

6. Subcontracts. The Contractor or Contractor will insert in any subcontracts the clauses contained in subparagraphs 1 through 11 of this paragraph A and such other clauses as HUD or its designee may by appropriate instructions require, and a copy of the applicable prevailing wage decision, and also a clause requiring the contractors to include these clauses in any lower tier subcontracts. The prime Contractor shall be responsible for the compliance by any Contractor or lower tier Contractor with all the contract clauses in this paragraph.

7. Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract and for debarment as a Contractor and a Contractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act Requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the Contractor (or any of its contractors) and HUD or its designee, the U.S. Department of Labor, or the employees or their representatives.

10. (i) Certification of Eligibility. By entering into this contract the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001. Additionally, U.S. Criminal Code, Section 1 01 0, Title 18, U.S.C., "Federal Housing Administration transactions", provides in part: "Whoever, for the purpose of . . . influencing in any way the action of such Administration..... makes, utters or publishes any statement knowing the same to be false..... shall be fined not more than $5,000 or imprisoned not more than two years, or both."

11. Complaints, Proceedings, or Testimony by Employees. No laborer or mechanic to whom the wage, salary, or other labor standards provisions of this Contract are applicable shall be discharged or in any other manner discriminated against by the Contractor or any contractor because such employee has filed any complaint or instituted or caused to be instituted any proceeding or has testified or is about to testify in any proceeding under or relating to the labor standards applicable under this Contract to his employer.

B. Contract Work Hours and Safety Standards Act. The provisions of this paragraph B are applicable only where the amount of the prime contract exceeds $100,000. As used in this paragraph, the terms "laborers" and "mechanics" include watchmen and guards.

(1) Overtime requirements. No Contractor or Contractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of 40 hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in subparagraph (1) of this paragraph, the Contractor and any Contractor responsible therefore shall be liable for the unpaid wages. In addition, such Contractor and Contractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in subparagraph (1) of this paragraph, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by the clause set forth in sub paragraph (1) of this paragraph.

(3) Withholding for unpaid wages and liquidated damages. HUD or its designee shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or contractor under any such contract or any other Federal contract with the same prime contract, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act which is held by the same prime Contractor such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or contractor for unpaid

wages and liquidated damages as provided in the clause set forth in subparagraph (2) of this paragraph.

(4) Subcontracts. The Contractor or contractor shall insert in any subcontracts the clauses set forth in subparagraph (1) through (4) of this paragraph and also a clause requiring the contractors to include these clauses in any lower tier subcontracts. The prime Contractor shall be responsible for compliance by any Contractor or lower tier contractor with the clauses set forth in subparagraphs (1) through (4) of this paragraph.

C. Health and Safety. The provisions of this paragraph C are applicable only where the amount of the prime contract exceeds $100,000.

(1) No laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation.

(2) The Contractor shall comply with all regulations issued by the Secretary of Labor pursuant to Title 29 Part 1926 and failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act, 40 USC 3701 et seq.

(3) The Contractor shall include the provisions of this paragraph in every subcontract so that such provisions will be binding on each contractor. The Contractor shall take such action with respect to any subcontract as the Secretary of Housing and Urban Development or the Secretary of Labor shall direct as a means of enforcing such provisions.

40. SOLID WASTE DISPOSAL ACT

The Grantee shall comply with Section 6002 if the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements listed below include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) AT 40 CFR part 247 containing the highest percentage of recovered materials, practicable, consistent with maintaining a satisfactory level of competition.

Applicability.(a)(1) This guideline applies to all procurement actions using federal funding and involving items designated by EPA in this part, where the purchase price of the item exceeds $10,000, the value of the quantity acquired by the preceding fiscal year exceeds $10,000. This guideline shall require that all solid waste management services procurements are conducted in a manner that maximizes energy and resource recovery. (2) This guideline applies to any public

agency using appropriated Federal funds to procure designated items, and to persons contracting with any such agencies with respect to work performed under such contracts. (3) The $10,000 threshold applies to public agencies as a whole rather than to agency subgroups such as regional offices or sub-agencies of a larger department or agency.

(b) The term *procurement actions* includes:

(1) Purchases made directly by a procuring agency or purchases made directly by any person (e.g., a contractor) in support of work being performed for a procuring agency using federal funds

(2) Any purchases of designated items made "indirectly" by a procuring agency, as in the case of procurements resulting from grants, loans, funds, and similar forms of disbursements of monies.

(c)(1) This guideline does not apply to purchases of designated items which are unrelated to or incidental to Federal funding, i.e., not the direct result of a contract or agreement with, or a grant, loan, or funds disbursement to, a procuring agency.

41. CONFIDENTIALITY

The Contractor shall comply with the Confidentiality regulations, per 24 CFR 574.440. Per 24 CFR 574.440, "the grantee shall agree, and shall ensure that each project sponsor agrees, to ensure the confidentiality of the name of any individual assisted under this part and any other information regarding individuals receiving assistance." The Contractor shall ensure all documentation and written agreements protect the confidentiality of all individuals/agencies funded or receiving any assistance under this grant.

42. REPAYMENT OF FUNDS

The Contractor acknowledges that funds provided through this Agreement are Federal funds administered by HUD and that all funds provided by this Agreement are subject to audit, disallowance, and repayment. Any disagreement with adverse findings by HUD may be challenged pursuant to Federal regulations, however, the Contractor shall promptly return to Grantee any and all funds that are found to be ineligible, unallowable, unreasonable, a duplication of benefits, or non-compliance, no matter the cause. This clause shall survive indefinitely the termination of this Agreement for any reason.

43. DUPLICATION OF BENEFITS

The Contractor shall not carry out any of the activities under this Agreement in a manner that results in a prohibited duplication of benefits as defined by Section 312 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 USC §5155). The Contractor must comply with HUD's requirements for duplication of benefits imposed by Federal Register notice on the City (81 Fed. Reg. 36564). The Federal Register notice requires compliance with the following HUD guidance documents: (1) the guidance published by HUD in the Federal Register on November 16, 2011 (76 Fed. Reg. 71060); and (2) the guidance document entitled "HUD

Guidance on Duplication of Benefit Requirements and Provision of CDBG Disaster Recover (DR) Assistance," issued on July 25, 2013.

44. LIMITED ENGLISH PROFICIENCY (LEP)

Assistance to Those with Limited English Proficiency. The Contractor agrees to take all reasonable actions to communicate with persons who have Limited English Proficiency (LEP) to ensure that such persons have meaningful access and an equal opportunity to participate in the program(s) and/or services funded under this Agreement.

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[EXHIBITS B, C, D. AND E CONTAINED ON NEXT PAGES]

EXHIBIT B TO THE COOPERATIVE ENDEAVOR AGREEMENT

BETWEEN

THE CITY OF NEW ORLEANS

AND

DELTARES USA, INC.

PARTNERSHIP AGREEMENT BETWEEN CITY OF NEW ORLEANS AND DELTARES USA

DATED OCTOBER 22, 2015

Deltares USA

October 23, 2015

Deltares USA
8070 Georgia Ave
Washington DC 20012

Re: Intent to Participate

This letter is to confirm the mutual intent of both the City of New Orleans and Deltares USA to collaborate and enter into an agreement, contingent upon the award of funds from the United States Department of Housing and Urban Development for the Community Development Block Grant National Disaster Resilience (CDBG-NDR) competition, to carry out eligible activities as provided in the City of New Orleans' CDBG-NDR application. This letter is to confirm the support of Deltares USA to specific activities proposed as part of the City's National Disaster Resilience Competition application as outlined below.

The City of New Orleans is seeking a partnership from Deltares USA for:

- Development of the Adaptation Support Tool (AST) for New Orleans
- Development of a regional groundwater monitoring system and subsidence reduction strategy
- Operational research on applicability of new sustainable drainage systems (SuDS) and best management practices (BMP's) for rainwater harvesting and storm water treatment in New Orleans.
- Real-time control of urban water management system (pumps, gates) using weather (especially rainfall) forecasting to support optimal anticipating water management in New Orleans. Feasibility, operational research, knowledge exchange

Deltares USA is an independent non-profit applied knowledge institute that provides a high standard of expertise and advice in the field of urban land & water management, working closely together with governments, businesses and research institutes, including The Water Institute of the Gulf in Baton Rouge. Deltares USA delivers economic added value, acting with social responsibility. As an institute, the success of Deltares USA depends on the extent to which its knowledge is applicable in and for society.

The City of New Orleans seeks top-level expertise on urban water planning, design and management to improve the safety of the city against flooding, the drainage situation of the city and the local water quality, would like to reduce land subsidence and water quality challenges and would like to strengthen the quality of the urban landscape with water. Deltares USA is able to provide the required expertise as a research partner and connected specialist advisor.

It is understood that this letter is only an expression of our intent and a binding agreement detailing the terms and conditions of the proposed partnership must be executed before the use of any CDBG-NDR funds, if awarded.

Karel Heijnen
Program Manager
Deltares USA

Signature of Partner Representative

Date October 23, 2015

PARTNERSHIP AGREEMENT
BETWEEN
City of New Orleans
AND
Deltares USA
FOR
Community Development Block Grant National Disaster Resilience Competition
(CDBG-NDR)

THIS AGREEMENT, entered this 22nd day of October, 2015 by and between the City of New Orleans (herein called the "Applicant") and Deltares USA (herein called the "Partner").

WHEREAS, the Applicant has applied for funds from the United States Department of Housing and Urban Development under the Disaster Relief Appropriations Act, 2013, Public Law 113-2, for the Community Development Block Grant National Disaster Resilience (CDBG-NDR) competition; and

WHEREAS, the Applicant wishes to engage the Partner to assist the Applicant in using such funds if awarded;

NOW, THEREFORE, it is agreed between the parties hereto, contingent upon the award of CDBG-NDR funds to the Applicant, that;

I. SUBRECIPIENT AGREEMENT/DEVELOPER AGREEMENT/CONTRACT

If the Applicant is awarded a CDBG-NDR grant from HUD, the Applicant/Grantee shall execute a written cooperative endeavor agreement or other agreement, as applicable, with the Partner, for the use of the CDBG-NDR funds before disbursing any CDBG-NDR funds to the Partner. If the Applicant and Partner are already engaged as parties to an existing agreement the parties will amend the relevant agreement to incorporate the scope and budget enclosed herein. The written agreement must conform with all CDBG-NDR requirements and shall require the Partner to comply with all applicable CDBG-NDR requirements, including those found in Disaster Relief Appropriation Act, 2013 (Public Law 113-2), title I of the Housing and Community Development Act of 1974 (42 USC 5302 et seq.), the CDBG program regulations at 24 CFR part 570, the Notice of Funding Availability for HUD's National Community Development Block Grant Resilient Disaster Recovery Allocation and any subsequent published amendments (the CDBG-NDR NOFA), and the Applicant's CDBG-NDR NOFA application.

II. SCOPE OF SERVICE

A. Activities

The Partner will be responsible for using CDBG-NDR funds to carry out activities in a manner satisfactory to the Applicant and consistent with any standards required as a condition of providing these funds. Such use will be in compliance with the CDBG-NDR NOFA, the Applicant/Grantee's application for CDBG-NDR assistance and the Applicant/Grantee's Grant Agreement for CDBG-NDR. Such use will include the following activities:

1

Program/Project Delivery

Activity #1 Development of the Adaptation Support Tool for New Orleans for use in collaboration between the City of New Orleans, Sewerage and Water Board of New Orleans, and citizen stakeholders throughout the city

Activity #2 Development of a regional groundwater monitoring system and subsidence-reduction strategy with local research partners the City of New Orleans (CNO), the Sewerage and Water Board of New Orleans (SWBNO), and Tulane University (Tulane) as well as regional research partners The Water Institute of the Gulf (TWIG)

Activity #3 Operational research on applicability of new sustainable drainage systems (SuDS) and best management practices (BMP's) for rainwater harvesting and stormwater treatment in New Orleans

Activity #4 Real-time control of urban water management system (pumps, gates) using weather (especially rainfall) forecasting to support optimal anticipating water management in New Orleans. Feasibility, operational research, knowledge exchange.

B. Project Schedule

CDBG-NDR funding is subject to strict statutory deadlines for expenditure. In accordance with section 904(c) of title IX of the Disaster Relief Appropriations Act, 2013, a Grantee is required to expend all CDBG-NDR funds within two years of the date that HUD signs the grant agreement. Consistent with this duty, the Partner is required to complete all CDBG-NDR assisted activities identified in section II.A above within 24 months unless the Applicant applies and is approved for an extension in which case the schedule will be adjusted in the subsequent final agreement.

The Partner agrees to implement the following:

No	Action	Lead persons	Time frame
1	Development of the Adaptation Support Tool for New Orleans	Karel Heijnert (Deltares USA) Frans van der Ven (Deltares) Melinda Nelson (SWBNO) Prisca Weems (CNO)	01/16-05/16
2	Development of a regional groundwater monitoring system and subsidence-reduction strategy	Karel Heijnert (Deltares USA) Roelof Stuurman (Deltares) Scott Finney (SWBNO) Prisca Weems (CNO) Mead Allison (TWIG) Alex Kolker (Tulane)	01/16-12/17
3	Operational research on applicability of new sustainable drainage systems (SuDS) and best management practices (BMP's)	Karel Heijnert (Deltares USA) Frans van der Ven (Deltares) Brad Klamer (SWBNO)	01/16-12/17

2

	for rainwater harvesting and stormwater treatment in New Orleans	Prisca Weems (CNO)	
4	Real-time control of urban water management system (pumps, gates) using weather (especially rainfall) forecasting to support optimal anticipated water management in New Orleans. Feasibility, operational research, knowledge exchange.	Karel Heikert (Deltares USA) Frans van de Ven (Deltares) Joe Becker (SWBNO) Katelyn Constanza (TWIG)	01/16-12/17

C. Staffing

Any changes in the Key Personnel assigned or their general responsibilities under this project are subject to the prior approval of the Applicant/Grantee.

III. BUDGET

[Note that the original proposed budget may be adjusted should H(H) award less than the amount requested in the application.]

No	Action	Budget
1	Development of the Adaptation Support Tool for New Orleans	$ 110,000.00
2	Development of a regional groundwater monitoring system and subsidence-reduction strategy	$ 130,000.00
3	Operational research on applicability of new sustainable drainage systems (SuDS) and best management practices (BMP's) for rainwater harvesting and stormwater treatment in New Orleans	$ 88,000.00
4	Real-time control of urban water management system (pumps, gates) using weather (especially rainfall) forecasting to support optimal anticipated water management in New Orleans. Feasibility, operational research, knowledge exchange.	$ 120,000.00

TOTAL BUDGET $448,000.00

The Applicant/Grantee may require a more detailed budget breakdown than the one contained herein, and the Partner shall provide such supplementary budget information in a timely fashion in the form and content prescribed by the Applicant/Grantee. Any amendments to the budget must be approved in writing by both the Applicant/Grantee and the Partner.

3

IV. SPECIAL CONDITIONS

A. CONVICTED FELON STATEMENT

The Applicant complies with City Code § 2-8(c) and no principal, member, or officer of the Applicant has, within the preceding five (5) years, been convicted of, or pled guilty to, a felony under state or federal statutes for embezzlement, theft of public funds, bribery, or falsification or destruction of public records.

B. NON-SOLICITATION

The Applicant has not employed or retained any company or person, other than a bona fide employee working solely for him, to solicit or secure the subject Agreement. The Applicant has not paid or agreed to pay any person, other than a bona fide employee working for him, any fee, commission, percentage, gift, or any other consideration contingent upon or resulting from the subject Agreement.

C. AUDIT AND OTHER OVERSIGHT

The Applicant will abide by all provisions of City Code § 2-1120, including but not limited to City Code § 2-1120(12), which requires the Applicant to provide the Office of Inspector General with documents and information as requested. Failure to comply with such requests shall constitute a material breach of the Agreement. The Applicant agrees that it is subject to the jurisdiction of the Orleans Parish Civil District Court for purposes of challenging a subpoena

V. SEVERABILITY

If any provision of this Agreement is held invalid, the remainder of the Agreement shall not be affected thereby and all other parts of this Agreement shall nevertheless be in full force and effect.

VI. SECTION HEADINGS AND SUBHEADINGS

The section headings and subheadings contained in this Agreement are included for convenience only and shall not limit or otherwise affect the terms of this Agreement.

VII. WAIVER

The Applicant's failure to act with respect to a breach by the Partner does not waive its right to act with respect to subsequent or similar breaches. The failure of the Applicant to exercise or enforce any right or provision shall not constitute a waiver of such right or provision.

VIII. ENTIRE AGREEMENT

This Agreement between the Partner and the Applicant for the use of CDBG-NDR funds, supersedes all prior or contemporaneous communications and proposals, whether electronic, oral, or written between the Partner and the Applicant/Grantee with respect to this Agreement. By way of signing this agreement, the Partner is bound to perform the agreements within this agreement or any HUD approved amendment thereof. Any amendment to this agreement must receive prior approval by HUD.

Date 10/23/2015

IN WITNESS WHEREOF, the Parties have executed this contract as of the date first written above.

[City of New Orleans]	[Deltares USA]
By	By
First Deputy Mayor/CAO, Andrew D. Kopplin	Executive Director, Edwin Welles

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[EXHIBITS C, D, AND E CONTAINED ON NEXT PAGES]

EXHIBIT C TO THE COOPERATIVE ENDEAVOR AGREEMENT

BETWEEN

THE CITY OF NEW ORLEANS

AND

DELTARES USA, INC.

PROPOSAL TOWARDS RESILIENT GROUNDWATER AND SUBSURFACE MANAGEMENT IN NEW ORLEANS DATED NOVEMBER 30, 2017

Deltares USA

In cooperation with:

Proposal

Towards Resilient Groundwater & Subsurface Management in New Orleans

For:

City of New Orleans

November 30, 2017

Contents

Annexes

1 Introduction

1.1 Background

Many of the physical risks and challenges that New Orleans faces are related to the city's physical geography. As a low-lying delta city, New Orleans is largely built on soft soils, which easily subside. With ongoing subsidence on the one hand and predicted increased intensity of rainfall events and hurricane systems on the other, the risk of flooding and subsequent societal disruption is increasing. Becoming more resilient to these disturbances means a new approach to groundwater and subsurface management for New Orleans. This new approach needs to be based on high-quality and fine-grained surface and ground water data.

In early 2016, New Orleans was awarded a grant of ~141 million dollars in the National Disaster and Resilience Competition. This grant enables the city to establish a Resilient District in the Gentilly neighborhood. Currently, subsidence of the soft soils in this area contributes to an increasing risk of floods. Limiting urban flooding, subsidence and making use of the soil characteristics to capture rainwater is key to making this neighborhood more resilient and less vulnerable to flooding. Installing green infrastructure is one way to reduce urban flooding and increase the infiltration of rainwater in the subsurface. Increasing groundwater levels would also reduce the decomposition of organic matter in the subsurface which causes subsidence. Both would mean a drastic redesign of the soil and water management in the city, which must be backed up by information on the groundwater and subsurface conditions. This information is largely lacking and, even if present, it is not readily available for the city. A major underlying aim of making Gentilly and thereby New Orleans, more resilient is to radically improve the level of information on geology, hydrology and soil characteristics in the city.

The benefits of acquiring a comprehensive understanding of the groundwater system in densely populated environments like New Orleans and Gentilly in particular, has been demonstrated in other regions around the world. Example of such project are provided in Annex A. This annex includes examples of projects worldwide where advanced groundwater modeling is applied to develop effective strategies and measures to support short-term and long-term flood risk and water resources management, subsidence control and impact mitigation. It is important to consider surface water and groundwater together when there is a strong interrelation between both systems as there is in the New Orleans area. In New Orleans adequate modeling tools are already available for simulating the surface water system and subsurface drainage system (pipes and pumps). Adequate models for the groundwater systems – that interact with both the surface water systems and urban drainage systems - are missing and need to be developed to ensure that impacts of water management measures can be simulated properly and designed to be effective.

This proposal describes projects designed to deliver groundwater and subsurface insights and data which will help planning initiatives that increase resilience and can then be used in the development of those same initiatives.

1.2 Project Components

Investing in knowledge of the subsurface will enable more effective decision making aimed at reducing the rates of subsidence and the occurrence of urban flooding by increasing the infiltration of water in the soil to capture excess rainwater. The subsidence rate and the infiltration

capacity are both determined by the phreatic – free and shallow - groundwater level. Currently there is no monitoring network designed to measure the phreatic groundwater level. The design and implementation of such a network is **project 1.1** in this proposal.

Once the phreatic groundwater level is known, the rate of subsidence can be calculated if the composition of the shallow and drained subsurface is known. Existing soil maps of the urban area give a first indication, but due to the large drainage depth, the information they provide is too shallow. The mapping of the shallow subsurface composition to estimate the future subsidence and the potential subsidence reduction is **project 1.2** of this proposal.

In addition to the shallow subsidence, the extraction of groundwater at greater depths (over 50 meters) is likely to contribute to subsidence as well. A major difference with the shallow subsurface component is the scale on which this happens (generally a smaller area is subsiding at greater rates) and the impacts of the subsidence. All structures, even those with deep foundations are impacted. **Project 1.3** therefore consists of the construction of a 3D deep groundwater-subsidence model. The set-up of this model will be in such a way it will also function as an effective repository for the data derived from projects 1.1 and 1.2, and any existing data that is relevant and can be used. Data from project 1.2 will also be stored at Tulane University. With the subsidence predictions from the model and from project 1.2, validation with existing subsidence satellite-based monitoring is possible.

Project 2 consists of a "white paper" study. This study needs to start at the onset of the overall project and will determine and document knowledge gaps in the understanding of soil conditions and groundwater dynamics in New Orleans, and the potential impacts of those gaps on surface and below surface infrastructure.

Project 3 is about lessons learned and focusses on existing rain gardens and permeable pavement that have been constructed over the recent years. We will evaluate the design, effectiveness and costs as an input for future efficient implementations.

Project 4 investigates the potential benefits of real-time control of urban water system using weather forecasting, the design of such system and the preparation of an implementation plan.

All results from the four technical projects need to be disseminated to a wide audience. This outreach aim is part of all projects. A potential audience includes, but is not limited to, the professionals working for the city of New Orleans, external professionals, and active community members of Gentilly and New Orleans. The groundwater model software and the pilot real-time control system software require licensed free software and any use of those system is the responsibility of the user.

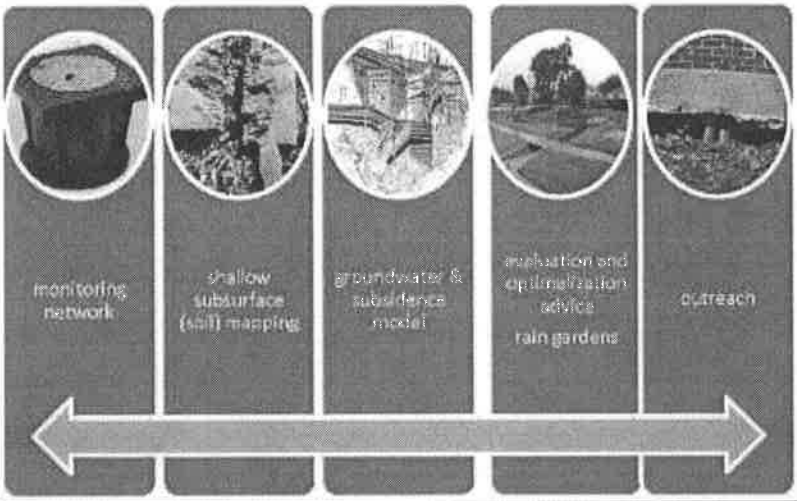


Figure 1 Summary of the steps and interrelations between the different subsurface related projects.

Figure 1 summarizes the steps and interrelations between the different subsurface related projects.

1.3 Two Scale Approach

The National Disaster and Resilience Competition grant enables the establishment of a Resilient District in the Gentilly neighborhood. For that reason, this project focusses on Gentilly, supporting its evolution towards a Resilient District. The increased flood risk and subsidence are unfortunately not limited to Gentilly, but occur in the entire urban area, across the City of New Orleans, and the Parishes of St Bernard and Jefferson. The results and experiences developed in this proposal will therefore be valuable for these areas too. This added value is incorporated in two ways:

1. Both the models and the monitoring network need information on boundary conditions that help explaining modeled and observed trends in groundwater and subsidence at the fringes of Gentilly. Therefore, supportive monitoring sites will be installed outside Gentilly in the Orleans, Jefferson and St Bernard Parish. The modeling realm will extend south beyond the City and as far as the north shore of Lake Pontchartrain, because deeper groundwater systems extend over large distances. The Gentilly area model will then be a nested model within this larger model, using the boundary conditions from the latter.
2. Results and experiences will be archived and published within the outreach components of this proposal and will be actively disseminated in the Parishes mentioned above.

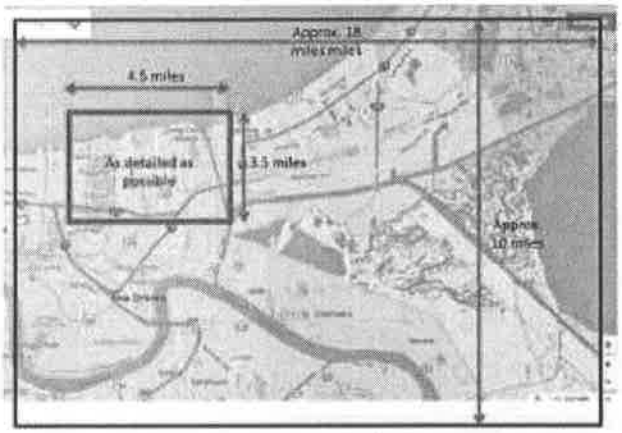


Figure 2 The '2 scales' study area of this proposal. The Gentilly area will be analyzed, monitored and modeled in detail, the surrounding New Orleans area at regional scale.

1.4 Partners

Southern Louisiana hosts some of the most active institutes and enterprises on subsurface characterization, green infrastructure and urban water. For this proposal, we will collaborate with the following regional institutes on the following topics:

- Tulane University, New Orleans, for subsurface and subsidence vulnerability mapping and ecology monitoring.
- The Water Institute of the Gulf, Baton Rouge, for production state-of-the-art white papers, subsurface and subsidence vulnerability mapping and operational water management.
- Waggonner and Ball Architects (New Orleans), for (green) design and outreach support.
- Eustis Engineering, New Orleans, for monitoring network installation and data gathering
- Deltares Netherlands for groundwater and subsidence modelling expertise.

In the larger United States, we envisage cooperation with institutes that have the required key expertise to support this proposal, namely:

- USGS, water and subsidence team, for groundwater and subsidence modeling and data gathering.
- NASA-Jet Propulsion Laboratory, for SAR analyses and gathering.

Also, we will seek to engage relevant stakeholders, including local NGO's.

2 Regional Groundwater Monitoring and Subsidence Reduction Strategy (Project 1)

2.1 Monitoring Network for Surface Water, Groundwater and Subsidence (Project 1.1)

2.1.1 Problem Definition

"You cannot manage what you don't know" and "soft soil management need solid data", are two statements that highlight the importance of data for planning and policy development. Planning of (ground) water management and infrastructure must rely on basic data and information on (ground) water levels, and the groundwater-surface water-subsidence interaction. Also, regularly updated information on salinization and (ground) water quality must be part of the urban water management. Currently no shallow groundwater monitoring network exists. Subsidence monitoring is purely done from a geodetic viewpoint (mainly remote sensing based), but needs connection to ground observations of subsidence. The relationship between surface water levels and shallow groundwater needs to be investigated to assess the water storage capacity of the subsurface.

2.1.2 Objectives

The objective of this phase is to organize the process for the design and implementation of a sustainable monitoring network as a support tool for urban and water planning. The network should be designed in such a way it will remain operational for a longer time period (decades), forming an important legacy of the current grant. The monitoring network will not only provide important data, but its design and installation also provide a valuable experience that may be deployed in other soft soil areas within and outside the New Orleans urban area.

2.1.3 Activities

1. Inception meeting with the City of New Orleans
2. Stakeholder meeting:
    - Determine monitoring objectives (information needed). Main questions related to possible objectives have already been identified:
        i. Where, why and with what rate does subsidence occur?
        ii. Which groundwater regimes occur in subsidence-prone clay and peat deposits?
        iii. Conservation of wooden piles foundations. To what extent are wooden foundation piles being exposed above groundwater?
        iv. To what extent are groundwater levels influenced by water levels in the canals?
        v. To what extent are groundwater levels influenced by subsurface infrastructure such as leaking stormwater pipes?
        vi. To what extent do shallow groundwater levels and deep hydraulic heads interact?
        vii. Are groundwater levels influenced by Mississippi River or Lake Pontchartrain water levels?
        viii. What is the storm water storage capacity of local soil types?
        ix. Is there a salinization risk of freshwater-dependent land use functions along the Gentilly lake shore?
        x. How does sub-regional groundwater flow between the Mississippi River and Lake Pontchartrain?
        xi. Raising public awareness

- Determine reporting method (what kinds of results are required (what is the information need), what kind of graphics, how to report: via a website?).
- Determine monitoring methods, who collects what? Where are data stored? How is governance of the monitoring network arranged? How do we ensure its functioning on longer term?
- Design preliminary monitoring network (at first for each individual objective separately, then merge these components into one integrated monitoring network).
- Intervention and action taking, when and by whom?
- Practical issues (property owners, accessibility of sites, responsibility?)

3. Apply a cost benefit analysis (CBA) as input for final network design (monitoring costs vs. damage reduction benefits);
4. Determine (design) "final" monitoring network based on 1 t/m 3 and field logistics. Discuss this proposal with all relevant stakeholders.
5. Determine final monitoring strategy. This strategy is focused towards an integral monitoring network, including other monitoring activities such as ecology (Tulane);
6. Provide advice regarding the installation of monitoring network which will be done in accordance with any existing City specifications;
7. Functional design of web- based database using on-line water level monitoring which will also follow any exiting City standards;
8. Preparation of first monitoring report (after 6 months) and set-up for annual data analyses and reporting

2.1.4 Integral Monitoring

Groundwater, surface water, subsidence and salinization are all closely related. Therefore, the proposed monitoring network integrates different measurement devices. The focus will be in Gentilly, which will have the densest grid. Locations of supporting measurement locations will be proposed in neighborhoods surrounding Gentilly. The sensors and installation configuration will follow any requirements provided by the City. Data will be transmitted and stored according to City specifications if specifications are provided.

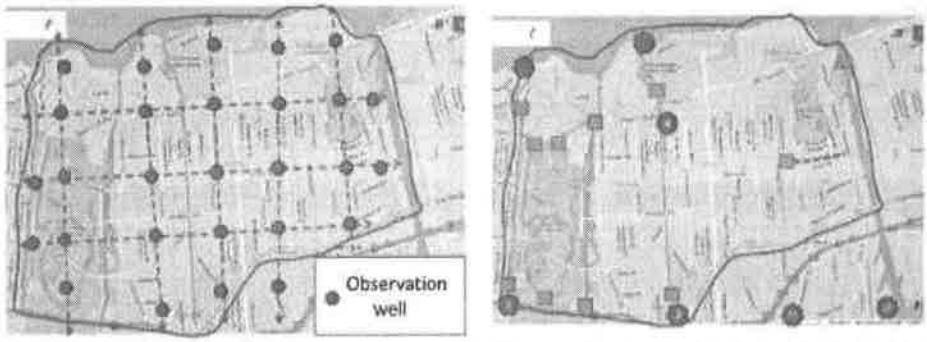


Figure 3 A preliminary design of an integrated monitoring network (ground levels, right) and surface water levels and surface water quality (left)

2.1.5 Deliverables

The project will provide the following deliverables:

- An operational integrated monitoring network supported by relevant stakeholders.
- Support for the design process and installation.
- First year data analyses and reporting.
- Framework for consecutive annual data analyses and reporting.
- A "lessons learned" and "best practices" workshop for soft soil areas outside Gentilly, with focus on capacity building with local enterprises.

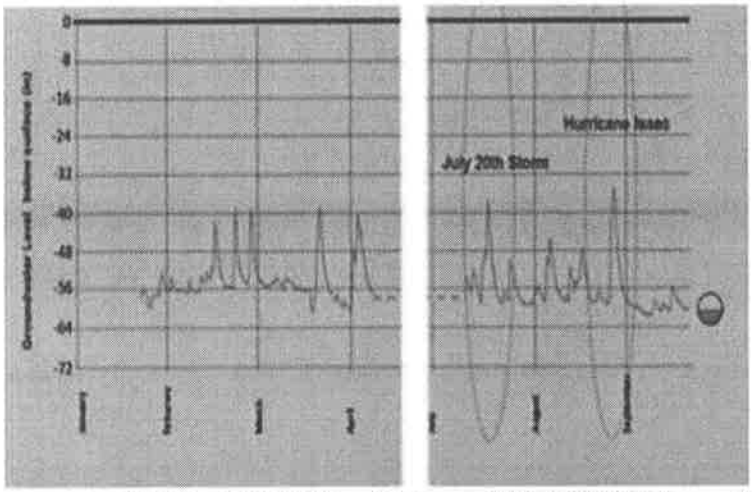


Figure 4 An example of high frequency time series of groundwater level fluctuation at 2200 Prytania Street (Garden district)

Figure 5 Example of urban groundwater observation well

2.1.6 Planning

This design process and installation takes 9 months, depending on the support of relevant stakeholders (City, SWBNO, and USACE). The overall project duration is 24 months.

2.1.7 Costs

The cost of the activities discussed in the previous sections has been summarized in the following table. The overall costs are estimated at $222,126. Please note all travel costs have been allocated to the item 'project management'.

Activity		Costs ($)
1	Inception	9,768
2	Stakeholder interaction & design	26,364
3	Cost benefit	9,012
4	Comments Final design	4,812
5	Final monitoring strategy	9,652
6	Support installation	16,095
7	Materials – ECT sensors, level sensors, protection covers etc	61,000
8	Installation (lump sum)	25,000
9	Data collection	12,000
10	First monitoring report	18,918
11	Lessons learned workshop	9,138
12	Project management	18,314
	Total (including installation)	**222,126**

The first monitoring report will be designed and compiled according to any existing City specifications and in a way the City or SWBNO administration or local consultants can continue producing the report in the future.

2.1.8 Summary

A complete summary and fact sheet of Project 1.1 is provided in Annex B.

2.2 Subsidence Vulnerability Map of New Orleans (Project 1.2)

2.2.1 Problem Definition

There is little understanding of what exactly causes land subsidence in New Orleans. There is also increasing scientific evidence processes in the shallow subsurface play an important role. This is well known from other delta cities around world with similar subsurface conditions as New Orleans such as Venice (Italy) or Amsterdam and Gouda (The Netherlands).

To determine the risk of shallow rooted land subsidence (upper 10-20 ft.), two types of data are required: (i) the phreatic groundwater level dynamics and (ii) the characteristics of the soft soils. For example, to establish the land subsidence provoked by organic matter decomposition at a location, we need to know what the organic matter content of the soil is, and how much of this organic matter is located above the phreatic (shallow) groundwater level (where decomposition takes place).
A comprehensive picture of the shallow hydrogeological situation and the phreatic groundwater level is currently missing in New Orleans (see also work package 1.1). The phreatic (shallow) groundwater system is complex due to the role of drainage pipes, sewage pipes and canals. Equally heterogeneous is the subsurface of New Orleans: the city is built on stacked river, swamp, lake and fossil beach deposits (see figure 6 below).

This work package produces three maps: i) a phreatic groundwater level map (and freeboard map, the drainage depth), ii) an organic matter content map, and iii) a subsidence vulnerability map, giving insight into current and future shallow subsidence. The subsidence vulnerability map is a combination of the former two maps and shows the areas which consist of soft soils and have a large freeboard which will cause subsidence. The map includes a prediction of the subsidence under business as usual conditions (figure below shows an example). The products of this work package will increase the awareness among inhabitants and professionals on this urgent issue. It may also be used for planning of infrastructure maintenance.

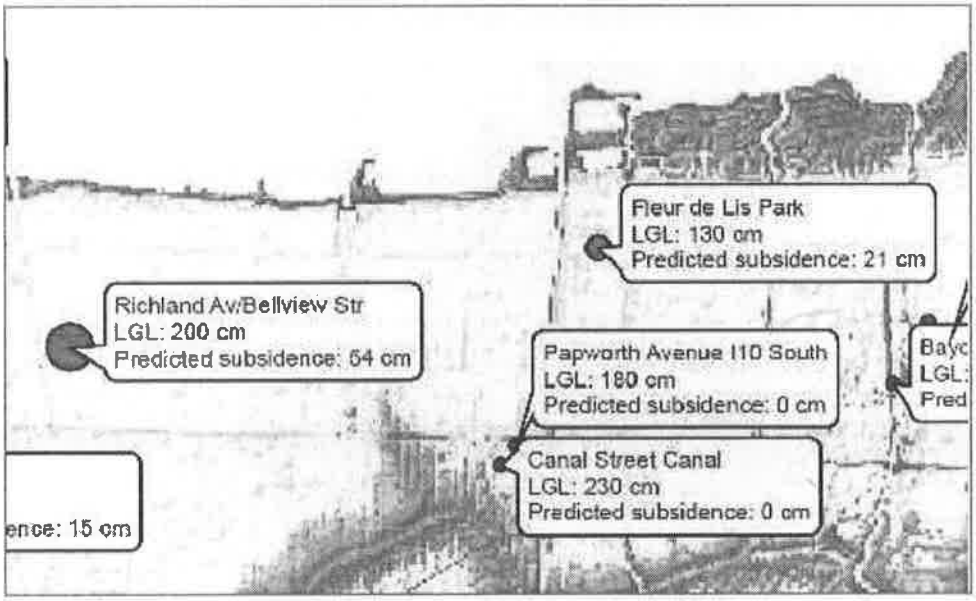


Figure 6 Example of a map showing predicted subsidence under business as usual conditions. Workpackage 1.2 will produce a similar map, but has the advantage that it will be fully 2D (not point-based as this example is).

2.2.2 Objectives

The objective of this phase is to map and classify shallow subsidence vulnerability and estimate future maximum shallow subsidence due to drainage in New Orleans under business as usual conditions. This mapping will support planning and asset management (underground pipes and infrastructure). The map will be based on a series of cross-sections.

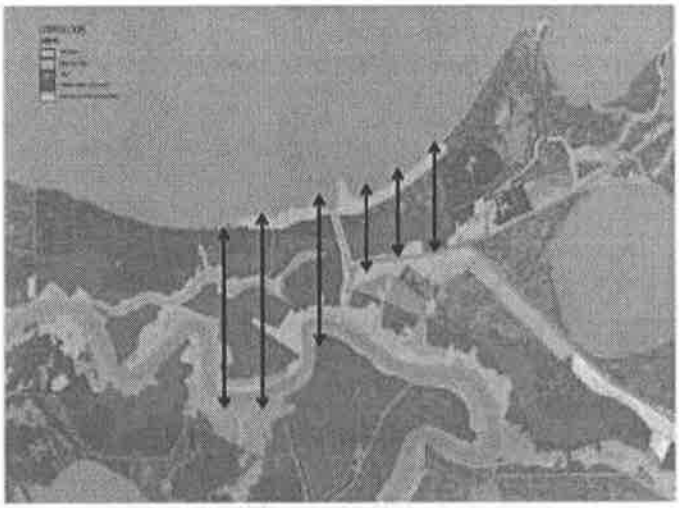


Figure 7 First estimate of locations transects

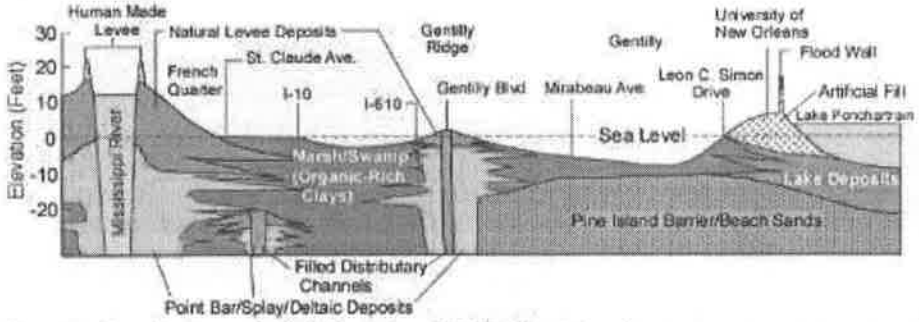


Figure 8 Example of transect with shallow geology (USACE) without information about organic contents and groundwater levels

2.2.3 Activities

1. Collect and analyze existing geological borehole descriptions (EPA/SWBNO, USACE, local consultants etc.), and as possible, those collected in other projects. We will store the data in an accessible database.
2. Design of a borehole campaign based on the soil map, elevation data, subsidence rate analyses and drainage (freeboard) map (derived from the results of work package 1). Our approach to map the city is to core along 6 transects, (see figure 7) making optimal use of existing borehole information. In New Orleans North East (between the Wetland Triangle and Lake Pontchartrain (3 transects, 6 boreholes each transect). Another 3 transects between the Mississippi and Lake

Pontchartrain (15 boreholes each transect). The boreholes will be 9-15 feet deep. Total 63 boreholes.

3. Arrange permissions to core at property which are not in a City owned right of way.
4. Borehole campaign: We will classify the soil following the USDA soil classification system. We will store the coring data in the Tulane Borehole database. Specific attention is being given to average (long term) highest and lowest groundwater levels as shown by hydro-morphological soil characteristics. The campaign will be executed by 3 experienced teams, each team consisting of 2 people from Deltares and Tulane and supervised by a licensed professional as necessary. By making mixed teams, experiences on soil classification systems will be exchanged, not only between the institutes, but also between senior and junior staff. At each coring we describe (1) lithology (geology), (2) actual groundwater level, (3) mean highest and lowest groundwater level based on soil characteristics (see photo), (4) organic material content.
5. From each coring, we will collect 5 soil samples (total 315 samples) of the most organic sequences. The organic content of these samples will be determined at the Tulane University soil laboratory (to be confirmed), using the established loss-on-ignition method. Organic content is an important factor to forecast subsidence as a result of organic matter degradation (oxidation).
6. At every borehole the absolute elevation will be measured using differential GPS-systems, as well as the groundwater level just after coring.
7. Using a Geographical Information System, the phreatic groundwater level map, the organic matter content map and, ultimately the subsidence vulnerability map will be constructed, using both the newly collected and existing borehole data (water level, organic content). The map will be based on the 6 geological cross sections. Existing maps, such as soil maps, elevation maps, and drainage maps will be used to extrapolate the data between the cross-sections.
8. The subsidence vulnerability map shows the prediction of subsidence under business as usual conditions. Alternative scenarios, such as raised shallow groundwater levels will curtail subsidence. The effects of the measures on future groundwater levels and subsidence will be assed in the GIS analyses.
9. Presentation of the results at a workshop with all relevant stakeholders, explaining the map and the opportunities/possibilities to use the map.

Optional (but not included in the current cost estimates)

- In addition, we could use some of the boreholes to install groundwater monitoring observation wells as proposed in work package 1.1.
- We could execute simple (Hooghoudt approach) infiltration tests, using the open boreholes, to support retention projects and rainwater gardens.

2.2.4 Deliverables

- Dataset of borehole descriptions.
- Freeboard map that shows the shallow drainage depth in New Orleans (in different depth classes), including explanatory text.
- Organic matter content map of the shallow surface of New Orleans (different classes), including explanatory text.

- Potential subsidence (vulnerability) as a result of oxidation of organic matter map of New Orleans under business as usual, including explanatory text. Subsequent maps may be produced based on different groundwater management scenarios (these maps will be mostly qualitative).
- Stakeholder workshop in which maps are being explained and promoted.
- Papers: at least one in popular scientific magazine/website.

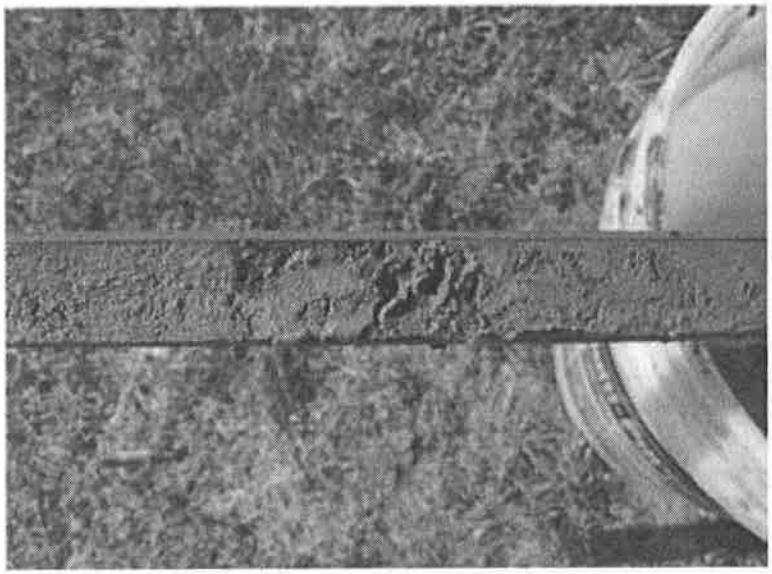


Figure 9 Based on soil characteristics we will determine the mean lowest groundwater level. Below this lowest groundwater level, the soil cannot oxidize and stays grey.

2.2.5 Planning

The results can be produced in 6 months, but timing is subject to field season conditions, such as weather.

2.2.6 Costs

The estimated total costs are $ 70,649. The results of the new EPA study will be included in this study and these extra data have reduced the overall costs by $5,000 compared to previous estimates.

No travel costs have been budgeted for this project component. It has been assumed that travel will be combined with the activities specified for project components 1.1 and 1.3.

A specification of the costs is provided in the table below.

Activity		Costs ($)
1	Collect, analyze existing shallow boreholes, storage database	7,158
2	Design borehole campaign	3,542
3	Logistics, permissions	4,486
4	Borehole campaign	22,784
5	Sampling and laboratory analysis	9,475
6	Borehole surveying & positions	4,000
7	Producing GIS maps	8,418
8	Subsidence forecast maps	4,502
9	Presentation results	3,536
10	Project management	4,750
	Total	**70,649**

2.2.7 Summary

A complete summary and fact sheet of Project 1.2 is provided in Annex C.

2.3 Integrated Groundwater – Subsidence Numerical Model (Project 1.3)

2.3.1 Problem Definition

From previous geodetic analyses, the subsidence of New Orleans is observed, albeit the cumulative subsidence at the surface. There are two human-induced components of this subsidence: the deeper groundwater extraction, mainly by industrial users, and the shallow subsidence as a result of drainage and loading of soft soils (see project 3). Currently there is no way how to disentangle these two components. Disentangling is necessary however, as they have a different scale of impact. Shallow subsidence is highly heterogeneous and occurs over the larger part of Gentilly (and other "organic soils" areas of New Orleans). Deeper rooted subsidence occurs only in smaller hotspots, but the impact is large as even construction with deep foundations will experience subsidence (levee systems, critical infrastructure, buildings). Currently it is not well understood what the contribution of deeper groundwater extraction is; let alone the prediction of the resulting subsidence. A recent study by Jones et al. (2016) confirmed this "deep subsidence" by groundwater abstraction: the highest subsidence rates are developing around the Entergy Michoud groundwater abstraction in New Orleans East.

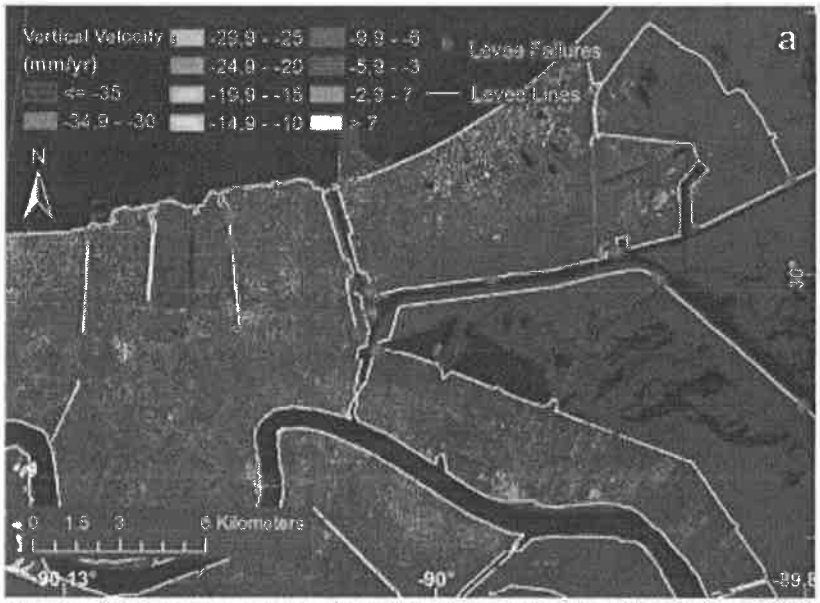


Figure 10 New Orleans, La., is the site of coastal subsidence and hurricane-induced flooding. (a) Red asterisks indicate the locations of levee failures during Hurricane Katrina in 2005. Pinkish and white shades on the map indicate the highest subsidence rates, as millimeters per year of vertical velocity. Credit: Jones et al. [2016]

The shallow groundwater level in Gentilly, and other parts of New Orleans, is strongly determined by unintended groundwater drainage into the storm drainage pipes and sewer pipes. These leaky pipes also recharge the shallow groundwater system, in addition to rainfall minus evaporation, with lost drinking water. Impermeable pavement causes huge amounts of surface runoff to be pumped into

Lake Pontchartrain during rainfall events. Our groundwater model will enable estimation of groundwater levels after the underground infrastructure is restored (no drainage, no loss of drinking water) and/or urban runoff is infiltrated into the subsurface (rain gardens), instead of drained or pumped away.

2.3.2 Objectives

The objectives of this study include:

Subsurface management:

- The model provides a framework to store subsurface and relevant surface data derived from projects. All collected data, maps, boreholes and drilling data will be stored in a City designated database or if necessary in our database.

Subsidence analysis, forecasting and management:

- The disentangling of the (NASA) subsidence measurement into "shallow" and "deep" components applying the "thousand extensometer method".
- The prediction of subsidence as a result of future groundwater abstraction.
- The prediction of subsidence in relation to management of the shallow groundwater level.
- To map the opportunities of storing water in deeper aquifers with declined hydraulic heads and estimate the reducing effect on "deep" subsidence.

Shallow groundwater analysis and management:

- To estimate increasing shallow groundwater levels after reparation of the underground infrastructure, and/or after construction of series of rain gardens.
- To understand the relation between the shallow and deeper groundwater system, including the consequences of changes in shallow groundwater management.
- To determine the future groundwater and subsidence situation in relation to climate change and sea level rise.

Salinization risk:

- To understand the groundwater interaction between Lake Pontchartrain and the urban area and to determine related urban salinization risks.
- To understand the salt water interaction with the vegetation root zone in time and eventually advice adaption strategies.

Urban flooding:

- Understanding the pumping regime of P4 and estimate P4 discharge reduction and groundwater levels after implementation of large number of rain gardens. In addition, the reduction of pumping costs, energy and CO_2 production can be estimated. This study will be performed in cooperation with project 4 (real time control).

The aim is to build an instrument that is supported by stakeholders and easily accessible and understandable for relevant stakeholders.

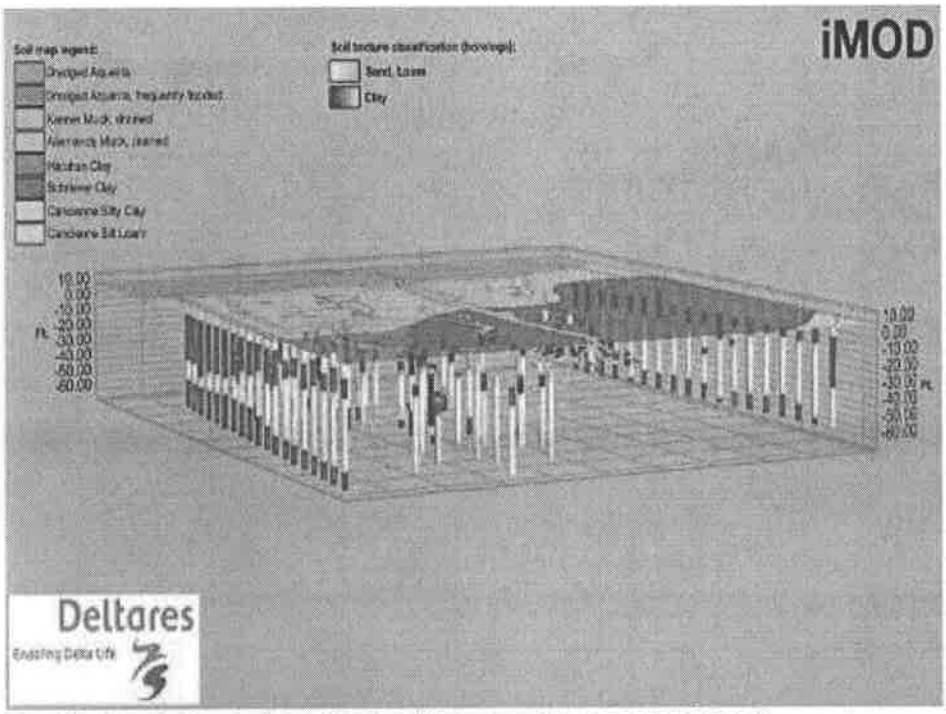


Figure 11 Example of how boreholes information will become available in our project (Mesabeau)

2.3.3 Activities

1. Inception meeting with the City of New Orleans.
2. Organizing stakeholder participation. Determination of scenarios (climate change, designed restoration or management scenarios).
3. Data collection: we intend to use only existing data, which will be compiled into a GIS-based information system including metadata according to standards. Existing data will be gathered from several organizations/databases.
    a. Detailed surface elevation map (to be delivered by NORA).
    b. Detailed land use map: street cover, buildings, green (to be delivered by NORA).
    c. Information of depth and location of storm drainage and sewer pipes. If possible the age and state of this system.
    d. Information about depth and, if available, state of drinking water transport pipes.
    e. Freely available borehole and soundings information.
    f. Available rainfall and evaporation data.
    g. Surface water levels and depth of canals.
    h. Location and depth of sheet pilings and underground constructions such as tunnels, basements.

4. Geological and sedimentology analyses in cooperation with the USGS, EPA/SWBNO and Tulane University.
5. Analyzing relevant subsidence information. Determination of geotechnical parameters, in cooperation with USGS, NASA and local consultants (Eustis etc.).
6. Modeling activities: Building a delta City-wide model between Mississippi and Lake Pontchartrain, but focused on the NDRC Gentilly area. This implies that the Gentilly area will be modeled as detailed as possible, because streets and underlying leaking infrastructure are very important, and in future green-blue solutions (SuDs etc.) will be applied. In the Gentilly area we are aiming at horizontal grid cells of 15x15 feet. Subsidence as a result of deep groundwater extraction will be estimated, but the uncertainties will be large as geotechnical data from greater depth are lacking.
    a. Building 3-D subsurface model using iMOD. iMOD is an easy to use Graphical User Interface + an accelerated Deltares-version of MODFLOW with fast, flexible and consistent sub-domain modeling techniques. iMOD facilitates very large, high resolution MODFLOW groundwater modeling and also geo-editing of the subsurface. The model covers the entire city.
    b. Modeling groundwater – surface water-subsurface drainage interaction.
    c. Determine rainfall intensity groundwater level relation to determine optimal target groundwater levels without causing groundwater flooding.
    d. Integrated with subsidence modeling tool (during the first modeling phase only for subsidence caused by deep groundwater extraction, shallow drainage related subsidence is added in phase 2, either using GIS or numerical).
    e. Subsidence related to shallow processes will be analyzed in a GIS using the outcomes of project 1.2 (subsidence vulnerability map). For all characteristic shallow subsurface sequences, we will calculate decreased subsidence velocity as function of increased groundwater levels. The dynamics of shallow groundwater will be determined by the groundwater model.
    f. Verification of model using the "thousand extensometer" approach on SAR (phase 3). We would like to collect data of the depth of foundations (bridges, high and medium rise buildings, pylons etc.) and determine the subsidence using the recent NASA elevation velocity data.
7. Documentation, presentation to stakeholders.
8. Finalizing phase, incorporate stakeholder opinions.

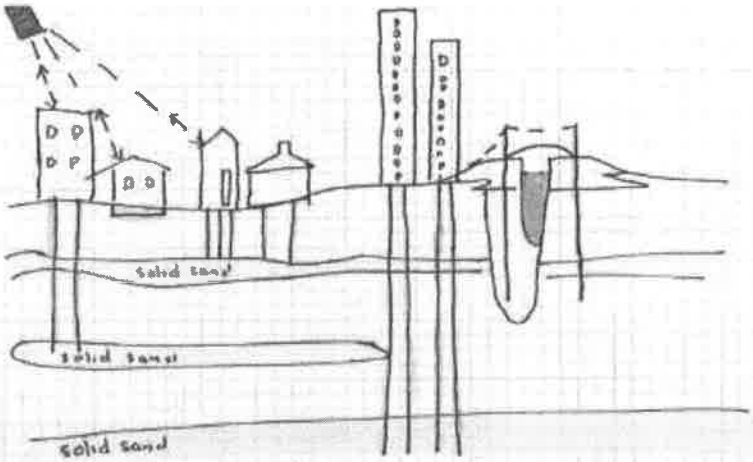


Figure 12 A visualization of the "thousand extensometer" method. The foundation depths of buildings, bridge piles etc need to be identified and the relative differences in subsidence need to be determined as measure by radar satellites

Please note our project will be improved when a drainage map of the Gentilly P4 catchment becomes available with the following legend: (1) impermeable pavement draining into sewer, (2) impermeable pavement draining into rain gardens, (3) roofs draining directly into sewer, (4) roofs draining into the street, (5) roofs draining into the garden, (6) green areas (incl. gardens), not drained, (7) green, drained, (8) surface water (connected, not connected).

2.3.4 Deliverables

A well described time-dependent ground water model for New Orleans, supported by (future) users and capable of analyzing and calculating the effects of (future) changes in groundwater management on the groundwater system and surface elevation. An additional deliverable will be a protocol for continuous improvement of the model by adding results of the integral monitoring network.

Detailed model results are:

- Surface coverage of groundwater levels and hydraulic heads (= deeper groundwater pressure) and estimates for the future based on 5 scenarios' (which are to be determined in cooperation with the stakeholders).
- Outline of areas with high subsidence rates.
- Deciphering between deep rooted subsidence processes (as a result of groundwater extraction) and shallow rooted processes (drainage and loading) using the thousand extensometer method to unravel the latest remote sensing (satellite data).
- Estimates of subsidence reduction by 3 subsidence mitigation scenarios.
- Current and future infiltration and groundwater discharge fluxes.
- Groundwater flow directions, which are also important in relation to salinization processes

- Understanding shallow groundwater salinization patterns and rates in relation to salinization risks (soil, trees etc.).
- Estimate of optimal (highest) safe groundwater levels with no groundwater flooding risk.
- Understanding the impact of surface water level on groundwater levels.
- Understanding the relation between draining or leaking underground infrastructure and groundwater levels. Estimates of the groundwater levels in case the underground infrastructure is repaired.
- Estimate of the groundwater effect when multiple rain gardens are being constructed.

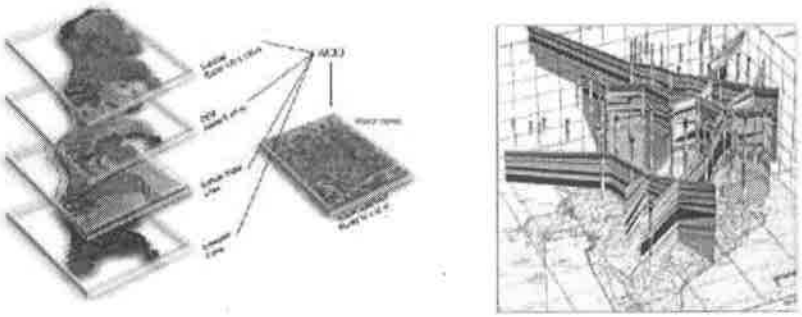


Figure 13 Examples of (hydro)geology data from The Netherlands stored in the framework of a groundwater model. A similar set-up is proposed for New Orleans.

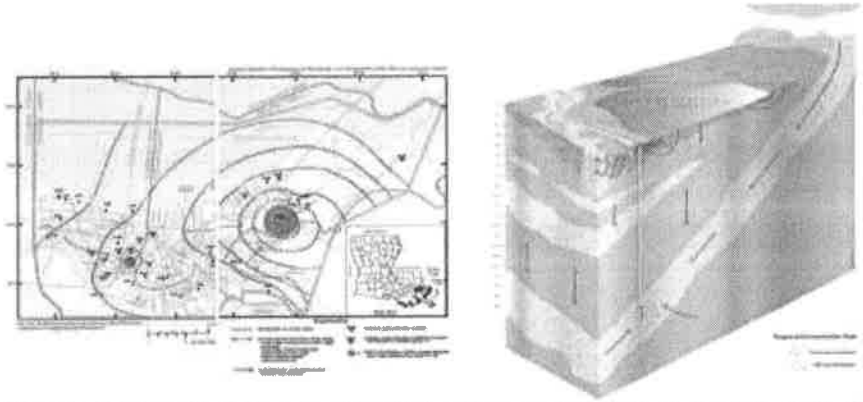


Figure 14 Deep groundwater is mainly recharged in the area north of Lake Pontchartrain. Near New Orleans hydraulic heads and groundwater flow are determined by pumping in New Orleans NE (amongst others Entergy).

2.3.5 Costs

The cost of the activities discussed in the previous sections has been summarized in the following table. The overall costs are estimated at $ 400,200. Please note that all travel costs have been allocated to the item 'project management'.

Activity		Costs ($)
1	Inception Meeting	23,914
2	Stakeholder participation	17,896
3	Data collection and storage	49,308
4	Geology and lithology analysis (construction of a detailed 3D subsurface model)	34,196
5	Collecting, storage and analyzing subsidence information	49,824
6	Groundwater model development	160,466
7	Documentation, presentations to stakeholders	22,920
8	Finalizing, incorporate stakeholder opinions	5,000
9	Project management	36,936
	Total	400,200

2.3.6 Summary

A complete summary and fact sheet of Project 1.3 is provided in Annex D.

3 Dealing with Knowledge Gaps - White Paper (Project 2)

3.1 Objective

The objective of ths phase is to identify the existing gaps in our understanding of the soil and (ground)water system of New Orleans, and the potential impacts of the system on surface and subsurface infrastructure.

3.2 Activity

Background research and production of a white paper on current knowledge and future work needed on subsidence, geology, hydrological boundaries, surface infrastructure, water quality etc. as it relates to the design of green and grey infrastructure.

- Based on a 1-day stakeholder meeting at the beginning of the project.
- Based on experience of the 3 project organizations, The Water Institute, Louisiana Universities Marine Consortium/Tulane University & Deltares.
- Based on a literature survey.

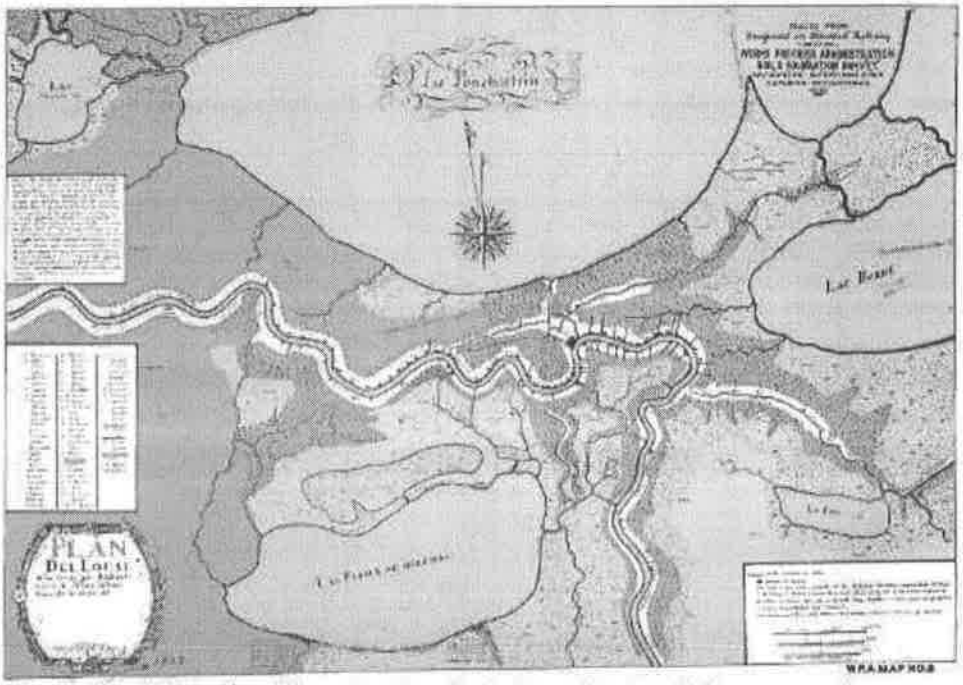


Figure 15 Historical information will be used to address the actual (ground-) water and soil processes, e.g. the distribution of "fresh water" cypress swamps and "salt water" marshes

3.3 Deliverables

A report is proposed to be provided including the following chapters:

1. Introduction (5 pages)
2. Regional hydrology/Geologic context/Climate (10 pages)
3. Subsidence (15 pages) -
    a. basic processes
    b. subsidence in coast generally
    c. Detailed geology of City/polders
    d. Groundwater usage, implications for subsidence
    e. Measuring subsidence
4. Surface infrastructure (5 pages)
    a. Description of basics
    b. pumping rates/history
5. Water quality (5 pages)
    a. Institute to assemble based on existing sources
    b. Inorganic contaminants
6. Path Forward – next 5-year plan, actions, knowledge development

3.4 Planning

The study will start as soon as possible. After the start, the draft final report will be delivered after 4 months.

3.5 Partners and Costs

The cost of the activities discussed in the previous sections has been summarized in the following table. The overall costs are estimated at $ 49,648. Please note that all travel costs have been allocated to the item 'project management'.

Activity		Costs ($)
1	Inception Meeting	4,069
2	Background literature review	19,292
3	Stakeholder meeting, presentations, interaction	3,045
4	Reporting	11,592
5	Draft report meeting	2,237
6	Final report	4,779
7	Logistics, materials etc.	786
8	Project management	3,848
	Total	**49,648**

3.6 Summary

A complete summary and fact sheet of Project 2 is provided in Annex E.

4 Applied Research on New Sustainable Drainage Systems – SuDS (Project 3)

4.1 Objective

The objective of this phase is to conduct operational research on applicability of new sustainable drainage systems (SuDS) and best management practices (BMP's) for rainwater harvesting and storm water treatment in New Orleans

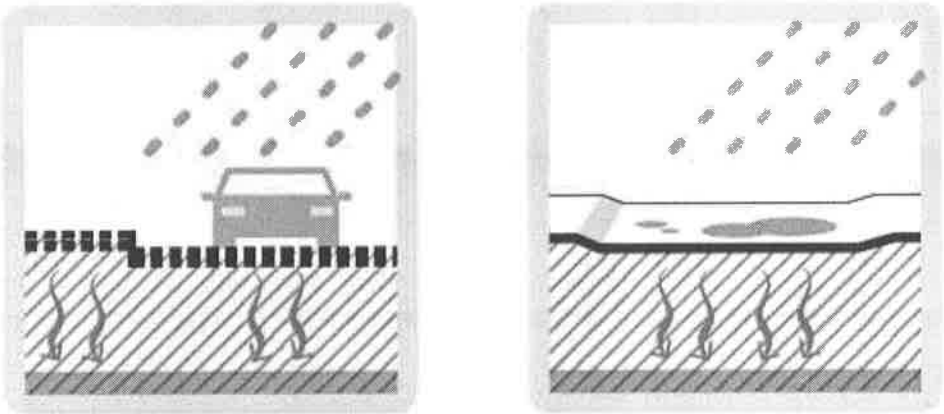


Figure 16 Visualization of permeable pavements and rain gardens.

4.2 Activities

1. Mapping, classification of all existing (private and public), or soon to be developed, SuDS (Rain gardens, permeable pavement) in New Orleans. Describe (soil type, design, ecology, water and soil quality, estimated water quantity effectiveness, building costs, maintenance cost etc.), classify and evaluate design by expert judgment (based on field visit).
2. Organize a half day workshop with stakeholders. The main discussion topics are design, effectiveness, costs and public perception. How can rain garden design be optimized?
3. Select and monitor 10 existing rain gardens. We will organize 2 "travelling monitoring networks". Any sensors will follow requirements or templates provided by the City. One network uses 3 sensors to monitor shallow groundwater levels (15 minutes interval), 2 sensors to monitor surface water levels at the inflow and outflow locations, to flumes to monitor volumes of inflow and outflow, 1 rain gauge, 1 sensor for monitoring barometric pressure. At each site also the local soil and shallow geology conditions will be determined. Water and soil quality conditions will be analyzed by a limited number of samples (groundwater, surface/rainwater, soil). Any installations or drilling will be conducted under the supervision of a licensed professional if required.
4. Organize 5 permeable pavement tests by using "infiltrometers" to determine how much and how fast (rain) water will infiltrate during different type of rain storms.

5. Literature study, data compilation and development of design rules for the New Orleans situation, including a simple instrument (tool) to calculate storage effectiveness and costs.
6. Reporting, publications and outreach workshop.

Figure 17 A first idea about monitoring rain gardens: red= groundwater well, blue discharge observations.

4.3 Planning

The duration will be 1 year.

4.4 Partners and Costs

The cost of the activities discussed in the previous sections has been summarized in the following table. The overall costs are estimated at $ 124,969. Please note that all travel costs have been allocated to the item 'project management'.

Activity		Costs ($)
1	Mapping, classification, performance evaluation of all existing SuDS in New Orleans	24,002
2	SuDS workshop, including organization and preparation.	11,564
3	Monitor 10 existing SUDS	54,216
4	Permeable pavement tests	9,586
5	Development of simple quantitative design tool, taking into account costs & benefits	9,510
6	Outreach workshop, publications, report	7,184
7	Project management	8,907
	Total	**124,969**

4.5 Summary

A complete summary and fact sheet of Project 3 is provided in Annex F.

5 Real-Time Control of Water System for Optimal Water Management (Project 4)

5.1 Introduction

The management of urban water systems is subject to various, and often conflicting, requirements. Hydraulic structures such as storage basins, pump stations, outfalls, weirs and gates must be controlled in such a way that the different requirements are met. Requirements may relate to minimum and maximum operating levels or flows and limitations to their rate of change, flood risk reduction, water quality and ecology, operation at minimum cost, and dealing with water management system component outages (planned/unplanned). This makes the control of a water management system a challenging task.

Greater New Orleans has an extensive water control system with 22 pumping stations and a number of water control gates. With this intricate water control system excess rainwater is drained from the city and, during drier periods, water levels can be managed in the various canal sections throughout the urban area. With sea level, land subsidence and the strive for better integrating water in the urban landscape, the water control system is quite complex. Operation New Orleans' urban water control is mainly aimed at avoiding urban flooding, and maintaining target water levels under drier period at minimum cost. Pumping stations are often controlled based on monitoring of local water levels near the pumping stations only.

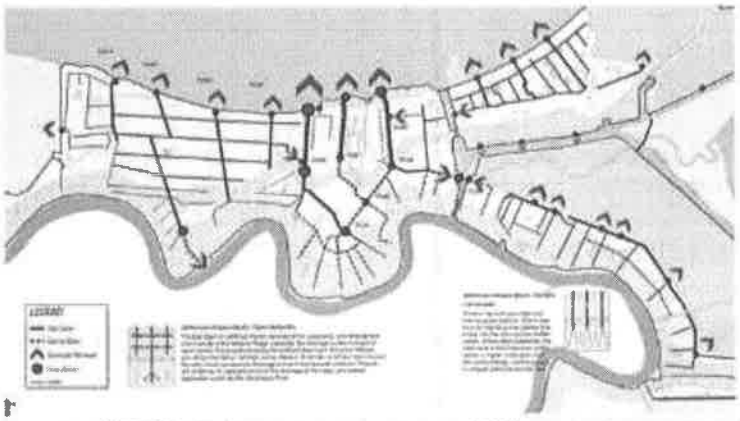


Figure 18 Overview of New Orleans' current water management system (ref. GNO Urban Water Plan)

Modern forecasting and real-control systems that use numerical weather forecasts (and their uncertainties) and water simulation models – besides real-time monitoring data – have proven to provide opportunity for significant cost savings in energy use by pumping stations with relatively minimal investments: no additional infrastructure has to be built if the existing system can be operated in a smarter way. This also offers opportunity to better serves other interests – environment, structure stability, shipping – in a more dynamic manner without compromising the primary function of the system: to avoiding flooding.

5.2 Objective

The objective of this applied research project is to investigate the potential benefits of operating city wide urban water forecasting and real-time control systems. The functioning and potential of such systems can be demonstrated by developing a working pilot application of a forecasting and model predictive control scheme. The project will also provide practical recommendations and a plan of how to fully implement and operate such system when proven to provide sufficient added value.

The study and pilot application will illustrate the rationale and potential methodology for real-time control of the urban water management system (pumps, gates) using weather (especially rainfall) forecasting to support optimal water management in New Orleans. The proposed work will include a feasibility study, operational research and knowledge exchange.

5.3 Approach

The project will include the following activities:

1. Needs assessment and feasibility study taking into account the current situation and future developments. This project component will first address the components, organization and (technical) performance of the current urban water management system via (technical) documentation, interviews with stakeholders in the city and potential data providers, field visits and data analysis. Previous assessments by the City will be the starting point for this inventory. The inventory will pay attention to aspects like…
   - current and future water management and operational objectives,
   - available infrastructure and monitoring systems,
   - relevant organization and procedures,
   - current and foreseen water management and operational issues and practices.

   A water system and system operation data analysis will be carried out to understand the current and anticipated future performance of the water management system.
   Subsequently, the potential benefits of developing a real-time forecasting and control system will be defined based on the inventory mentioned above and assessment, and how to implement such a system. The latter plan will provide advice on the design of a real-time forecasting and water control system, required monitoring system additions, organizational aspects, and a potential implementation process. These benefits include reduction of energy costs, improved system performance, avoided damage.

2. Development of a city wide pilot application for demonstration purposes. Besides offering demonstration capabilities, developing a pilot application can be instrumental in streamlining the technical communication between the various organizations having a role in operational water management. The demo application will:
   - Import and process a number of monitoring data feeds and weather forecasts,
   - Run a water management system model (when available and adequate).
   - Run a basic optimization algorithm to suggest an optimal operation strategy under characteristic conditions, and
   - Generate sample output for decision making and use by operators in the form of displays and report.

The pilot will be a working standalone software application developed with Delft FEWS. Delft FEWS a free available software platform that is widely used in the US and elsewhere in the world by forecasting agencies. The National Weather Service – including the Lower Mississippi River Forecast Center in Slidell - and the Tennessee Valley Authority are very active users in the US. Also the Water Institute of the Gulf in Baton Rouge actively uses the system.

3. Preparation of project report including a proposed plan of action for next steps.
4. Stakeholder workshop to present project outcome and potential next steps.

The project will be carried out in close cooperation with (all) organizations that currently have a role in operational water management in GNO. This is expected to create a common understanding and vision on the best way forward, both technical and organizational/operational.

5.4 Partners

The project will be implemented by the following organizations:

- Water Institute, for assessing the potential benefits of real-time control of New Orleans' urban water management system, and potentially hosting and supporting the operational pilot application.
- Deltares, for development of the pilot application of real-time control (support) system, and knowledge and technology transfer, and project coordination.

It is also intended to involve the Lower Mississippi River Forecast Center, National Weather Service, to provide weather forecasts and weather radar data, and to coordinate with NOAA's existing forecasting service.

There will be a thorough coordination (and where possible) involvement of technical staff from the SWBNO, and potentially the City of New Orleans and/or NORA.

5.5 Effort andPlanning

Please refer to Appendix G for a detailed specification of required effort.

The implementation time for this project is 7 months. The respective implementation times of the various tasks are:

- Task 1: month 1-4
- Task 2: month 3-6
- Task 3 & 4: month 7

5.6 Costs

The cost of the activities discussed in the previous sections has been summarized in the following table. The overall costs are estimated at $ 124,969. Please note that all travel costs have been allocated to the item 'project management'.

Activity		Costs [$]
1	Needs assessment & feasibility study	28,408
2	Development of pilot application	42,609
3	Reporting & publications	9,056
4	Stakeholder workshop	7,132
7	Project management	12,978
	Total	100,182

6.7 Summary

A complete summary and fact sheet of Project 4 is provided in Annex G.

6 Project Management

6.1 Project Organization

Deltares USA will be responsible for the overall project coordination, quality control and delivery. For Deltares USA, Claire Jeuken will be the project Manager with support from Ehab Meselhe of the Water Institute to provide technical leadership. Drs. Jeuken and Meselhe will work together to provide project updates to the City and to address any issues identified by the City.

For each Sub-Project, we identify a Sub-Project Manager who will work with Drs. Jeuken and Meselhe to ensure timely delivery of high quality projects. For each sub-project we have also identified the technical lead.

Activity		Project Manager	Project Technical Lead
Project management		Claire Jeuken	Ehab Meselhe
Activity		Sub-Project Manager	Sub-Project Technical Lead
1.1	Monitoring	Karel Heijnert	Roelof Stuurman
1.2	Subsidence map	Karel Heijnert	Gilles Erkens
1.3	Subsidence- groundwater model	Karel Heijnert	Roelof Stuurman
2	White paper: knowledge & knowledge gaps	Karel Heijnert	Roelof Stuurman
3	SuDS evaluation and optimization advice	Karel Heijnert	Roelof Stuurman
4	Real-time control	Edwin Welles	Francesa Messina

The technical management of the individual sub-projects will be relatively independent. Each month a concise overall project management report will be submitted that details project progress and planning, status of deliverables, and issues that need to be addressed. The project management report will be submitted by email within 1 week from the start of the month. The report will provide the input for a (proposed) monthly project coordination call.

At 3 or 6 monthly intervals (to be defined), in person meetings will be organized to discuss and demonstrate subproject deliverables and planning. These meetings are assumed to coincide with (sub)project meetings and field visits.

6.2 Context and Overall Coordination

It is foreseen that this project will be carried in close coordination with several other related projects: implementation of a real time forecasting system and the Interim Support to the City for review of the past flood events. Our Technical Lead, Ehab Meselhe, who is participating in all these projects will ensure technical exchanges between projects will occur as needed.

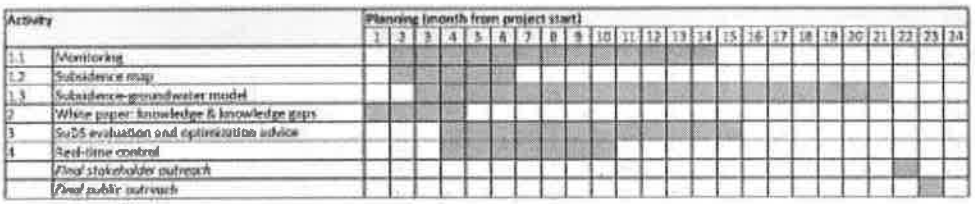
6.3 Overall Project Schedule

The planning diagram below shows the overall timeline and relations between projects. Upon project approval, we will immediately start with the "White Paper" study (project 2) to identify both existing knowledge and information, and knowledge gaps. These results will serve as input for all other projects.

The monitoring and subsidence mapping subprojects (subprojects 1.1 and 1.2) will start within 1 month. Some boreholes installed during the subsidence mapping activities will be used for monitoring. These projects will deliver essential information for the modeling study. Two months into the project, the modeling project (subproject 1.3) will start with the collection of existing data.

Three months into the project, we start the rain garden assessment (project 3) and the real time-control project (project 4). The rain garden assessment will produce valuable information about groundwater – rain water infiltration processes which can be used in subproject 1.3. Project 4 is relatively independent from the other projects.

The overall project will be wrapped up with outreach events for professional stakeholders and the public.



6.4 Overall Cost

The summary of the project costs is presented below.

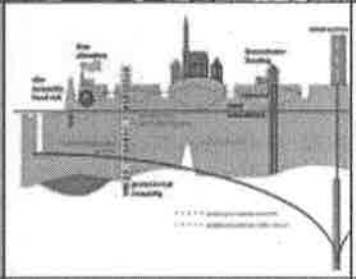
Project Component		Cost ($)
1.1	Monitoring	222,126
1.2	Subsidence map	70,649
1.3	Subsidence- groundwater model	400,200
2	White paper: knowledge & knowledge gaps	49,848
3.	SuDS evaluation and optimization advice	124,969
4	Real-time control	100,182
Total		967,774

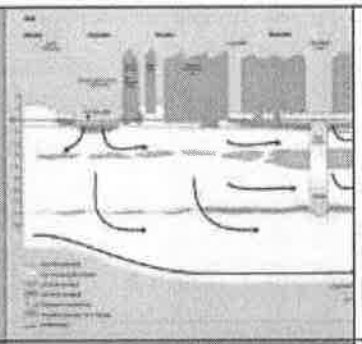
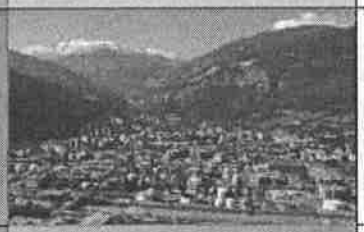
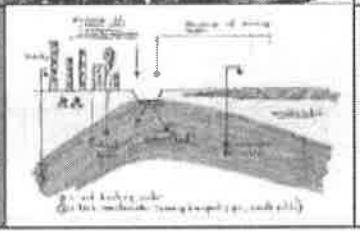
November 30, 2017

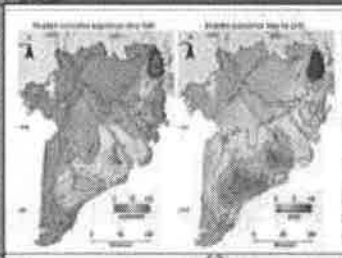
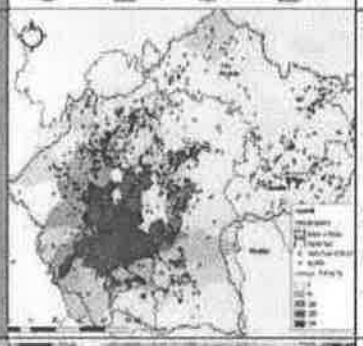
Annex A Reference Projects on the Relevance of Groundwater Modeling in Urban Areas

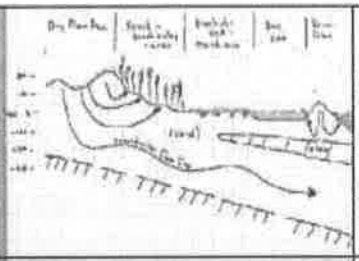
A series of projects are presented hereafter that provide examples of the application of advanced groundwater models like ModFlow used in the freely available groundwater modeling software platform iMOD. The studies demonstrate relevance of the use of advanced groundwater modeling – in conjunction with surface water and urban drainage system modeling - to assess urban water management issues and support water management strategy development and design.

In addition a number of more detailed descriptions have been included of the application of advanced groundwater models for urban water management.

Rotterdam Netherlands Urban & harbor groundwater model 2010 - present		The harbor area of Rotterdam is suffering large scale soil and groundwater pollution. A detailed model is built to control and manage the pollution plumes. The model is used to calculate flow directions and to design monitoring networks as input for a regional area approach.
Delft Netherlands Urban & Surrounding Area 2006-2008 2009 2015		Delft hosts one of the largest, and 100 years old, industrial groundwater extractions of the Netherlands. Because of raised groundwater taxes industry wants to stop pumping. A very detailed model is constructed to forecast urban (ground) water and geotechnical effects. In 2015 the model was used to estimate the effects of groundwater pumping along a new highway.
Utrecht Netherlands Urban & Surrounding Area 2014-present		At first the municipality asked for a groundwater model to manage groundwater pollutions (brown fields). Now the city is using this model for many new issues, like building projects, highway reconstructions etc.

The Hague, Netherlands City center model 2005-2008		The old town of The Hague is very vulnerable for low or high groundwater levels. Low groundwater levels can create damage of wooden piles; high groundwater levels can cause health impacts or construction damages. A groundwater model has been constructed including all subsurface building like tunnels parking basements etc. The model is used to estimate and prevent negative effects of newly designed (subsurface) spatial infrastructure.
City of Visp Switzerland City and river basin model 2016-present		The city needs to understand the relation between groundwater and river levels and several types of subsurface use in a time of climate change. This use (subsurface building, thermal systems etc.) is rapidly growing. The model is used to determine risks and opportunities.
Kuwait Neighborhood model 2017-present		The City of Kuwait is expending. We analyze the impact of transformation of desert into urban area. What will become the groundwater situation, and how can we reduce groundwater related risks?
Jakarta Indonesia Urban groundwater and subsidence model 2015 - present		Jakarta is sinking due to extensive deep groundwater extractions. A geological subsurface model has been constructed on the base of archive research. With the use of a detailed groundwater model, scenarios are computed and analyzed to understand the relation between subsidence and groundwater extractions to support management processes.
India Delhi Ganges Basin 2016-present		The Ganges river is polluted and suffers low environmental flow during the dry period. Together with many local stakeholders, a basin wide groundwater model has been constructed to determine a future water strategy to improve the river system and the major cities.

Singapore Harbor island model 2016-present		Singapore has constructed new sand built islands. We have developed groundwater models and monitoring networks to determine the future fresh groundwater bodies in this salt environment. The opportunities for sustainable use of this fresh water lens have been analyzed.
Mekong Delta and Ho Chi Minh City Viet Nam 2016-present		The Mekong delta and Ho Chi Minh City have both seen a large increase in groundwater extraction and use over recent decades. To model the impact of this increasing groundwater use on subsidence, urban flooding and salinization of the Delta and the cities in the future, a full 3D groundwater model was created, coupled to a subsidence module.
Mexico City Mexico 2017-present City model		Mexico is facing enormous water challenges such as flooding, water pollution, water scarcity, poor water management and lack of long-term strategic water goals. It is estimated that 70% of the drinking water provision in Mexico City is provided by groundwater. The project aims to restore the water system of water and marsh system Xochimilco in a way that it can cope with climate change and the socioeconomic challenges that are pressuring the water system.
Mirabeau, New Orleans USA Neighborhood scale 2016 - present		An advanced groundwater model has been developed to support the design of an approximately 900x900 feet rain garden in a polder situation. The model has been applied to understand the local groundwater situation and the interaction with climate and surface water. In this area groundwater is completely drained by leaking subsurface sewer and storm drainage pipes. To design effective storm water management measures, a thorough understanding of the groundwater system is essential.

Long Beach Island NY, USA 2016		During the Rebuild by Design study Living with the Bay, a detailed time dependent groundwater model was developed. The objective was to analyze the effect of sea level rise, including storm on the groundwater levels and flow of Long Beach. The results showed that this barrier island is extremely vulnerable for groundwater flooding and related problems.
California USA 2016		A quick scan 50 x 50 m grid model of the whole state of California was developed. The objective was to show the fast calculation aspects of iMOD. This state was selected because of the drought issues. The model development is in progress.
Miami Beach 2018 (?) *Proposal phase*		We are contacted by public works of Miami Beach. The city is suffering groundwater flooding during moon tides and storm tides. Sea level rise is an enormous threat. An iMOD model can be used to determine the effectiveness of proposed flood management solutions.
Lower Manhattan New York, USA 2018 (?) *Proposal phase*		The Big U (rebuild by Design) organization contacted us about possible threats of sea level rise by groundwater transport. The Big U can protect for tidal storm flooding, but will not stop the impact on groundwater by rising sea level. Engineers are concerned about the impact on subsurface infrastructure. We proposed an iMOD study to analyze these risks (e.g. heave, corrosion by salt water).

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Annex B Summary and Fact Sheet – Project 1.1

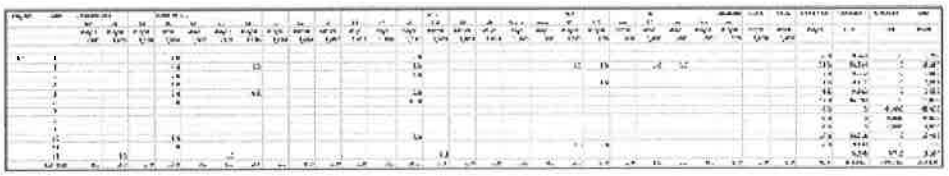
Project 1.1: Monitoring Network for Urban Surface Water, Groundwater and Subsidence	
Objective	Organizing process, design and implementation of a sustainable monitoring network as a support tool for urban and water planning. The network should be designed in such a way that it will remain operational for a longer time period (decades), forming an important legacy of the current grant. The monitoring network will not only provide important data, but its design and installation also forms a valuable experience that may be deployed in other soft soil areas within and outside the New Orleans urban area.
Deliverables	• An operational integrated monitoring network supported by all relevant stakeholders. • Integration of groundwater, surface water, salinization, subsidence and water dependent ecology monitoring • Supporting the process and installation. • First year data analyses and reporting. • Framework for consecutive annual data analyses and reporting. • A "lessons learned" and "best practices" workshop for soft soil areas outside Gentilly, with focus on capacity building with local enterprises.

Specialist	Role	Organization	Day rate
Claire Jeuken	Project management	Deltares USA	$ 1,800
Ehab Meselhe	Project coordination	Water Institute	$ 2,048
Roelof Stuurman	Technical lead, urban water, integrated water systems	Deltares	$ 1926
Karel Heijnert	Project management	Deltares	$ 1926
Gilles Erkens	Subsidence expert	Deltares	$ 1616
Hülte Bootsma	Junior hydrogeologist (MSc)	Deltares	$ 1032
To be determined	Ecology & geology experts	Tulane University	$ 1600
Ramiro Diaz	Senior Architect	Waggonner Ball	$ 1440
To be determined	Senior Designer	Waggonner Ball	$ 960

	Activity	costs	planning	Performance	partners
1	Inception phase	4 days Stuurman 2 day Bootsma Materials	Start 1 month after official assignment. WEEK 1	1.1 inception meeting City, SWBNO. 1.2 Inception memo (input workshop)	Deltares,
2	Stakeholder interaction & design 1. Organization workshop 2. Workshop 3. Design network & reporting 4. outreach	4 days Stuurman 2 days Erkens 1 day Diaz 2 days San. Design 1 day Tornqvist 2 days Tulane eco 9 days Bootsma	Workshop: WEEK 6/7 Design: WEEK 8-12 Outreach: WEEK 13-14	2.1 realization 1-day workshop. 2.2 design report (where, why, how etc.) 2.3 outreach brochure	Deltares, Waggonner Ball, Tulane University (geology, ecology)

Activity		costs	planning	Performance	partners
3	Cost benefit	2 days Stuurman 5 days C/B specialist	WEEK 14-16	3.1 cost-benefit memo	Deltares
4	Comments Final design	2 days Stuurman 1 days WB SD	WEEK 18-22	4.1 comments memo, answers and distributed to all stakeholders.	Deltares
5	Final monitoring strategy	3 days Stuurman 0.5 day Erkens 3 days Bootsma	WEEK 22-24	5.1 Final monitoring strategy report	Deltares
6	Support installation	3 days Stuurman 10 days Bootsma	WEEK 30-32	Memo with final (exact) field locations, Detailed sediment observations.	Deltares
7	Materials (sensors)	ECT sensors, level sensors, Protection covers etc. $61.000		Sensor redemption period is approx. 5 years	Market Schlumberger or other firm
8	Installation costs	Local consultant (preferably Eustis)		20 shallow observation wells installed. Sensors installed at pumping stations, surface water and groundwater observation wells.	Eustis, only shallow observation wells (9-12 feet)
9	Data collection and first 0.5 year report	Local consultant (preferably Eustis)	WEEK 32- 84 0.5 year report at WEEK 70	9.1 Excel with 0.5 year data, including graphics and short report 9.2 Excel with 1 year data	Local, first time with support Deltares
10	First monitoring report	5 days Stuurman 6 days Bootsma	WEEK 86- 94	10.1 report with presentation and analyses of monitoring results 10.2 User guide for monitoring network management and yearly reporting	Deltares, Waggonner Ball
11	Lessons learned workshop	1 day Sen. WB 2 days SD WB 3 days Stuurman	WEEK 102-104	11.1 Final workshop organized and executed, 11.2 Outreach memo with results	Deltares, WB
12	Project management	2 days Jeukan 1 day Heijnart 1.5 days Messeha Travel costs			

A specification of the project cost is provided in the table below.



Project costs per partner:

- Deltares USA $ 3,600
- Water Institute $ 3,072
- Deltares NL $ 95,258
- Waggonner & Ball $ 7,680
- Tulane University $ 4,800
- Local consultant (Eustis) $ 37,000
- Equipment $ 61,000
- Travel costs $ 9,716

Annex C Summary and Fact Sheet – Project 1.2

Project 1.2: Subsidence vulnerability map of New Orleans	
Objective	To map and classify shallow subsidence (i) vulnerability and (ii) estimate future maximum shallow subsidence due to drainage in New Orleans under business as usual conditions, (iii) to support planning and asset management (underground pipes and infrastructure). The map is based on a series of cross-sections, existing shallow boreholes (SWBNO, EPA) and additional new corings.
Deliverables	• Dataset of borehole descriptions, with ambition to eventually grow to an urban open geology and groundwater database. • Groundwater level map that shows the shallow drainage depth in New Orleans (in different depth classes), including explanatory text. • Map with groundwater level contours and flow directions of shallow groundwater,. • Organic matter content map of the shallow surface of New Orleans (different classes), including explanatory text. • Potential subsidence (vulnerability) as a result of oxidation of organic matter map of New Orleans under business as usual, including explanatory text. Subsequent maps may be produced based on different groundwater management scenarios (these maps will be mostly qualitative). • Stakeholder workshop in which maps are being explained and promoted. • Papers: at least one in popular scientific magazine/website.

Specialist	Role	Organization	Day rate
Claire Jeuken	Project management	Deltares USA	$ 1,300
Ehab Meselhe	Project coordination	Water Institute	$ 2,048
Roelof Stuurman	Technical lead, urban water, integrated water systems	Deltares	$ 1826
Karel Heijnert	Project management	Deltares	$ 1826
Gilles Erkens	Subsidence specialist, (shallow) geology	Deltares	$ 1616
Torbjörn E. Törnqvist	Geologist, expert shallow geology of Louisiana	Tulane	$ 1600
To be determined	Junior geologist/ geo assistance	Tulane	$ 400
To be determined	Senior designer: mapping, drawing	Waggonner Ball	$ 960
To be determined	Intern	Waggonner Ball	$ 640

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	Activity	costs	planning	Performance	partners
1	Collect, analyze existing shallow boreholes descriptions. Storage database	1 day Stuurman 2 days Erkens 5 days geo assist	Start 4 weeks after assignment WEEK 1-4	Assessable database with collected shallow boreholes	Deltares, Tulane
2	Design borehole campaign	1 day Stuurman 1 day Erkens	WEEK 5-6	Map with potential coring sites	Deltares, Tulane
3	Logistics, permissions	1 day Stuurman 4 days WB assistance	WEEK 6-8	Table with location and site owners and permissions.	Deltares, Waggoner Ball
4	Borehole campaign	4 days Stuurman 5 days Erkens 15 days Tulane Materials ($ 1000)	WEEK 12-14	60 boreholes (6-15 feet) • Organic matter, • Lowest groundwater level, • Lithology	Deltares, Tulane
5	Sampling and laboratory analysis	1 day Tornqvist Analysis 315x$25 ($ 7875)	WEEK 14-18	Table with result of 315 samples (organic content, pH)	Deltares, Tulane
6	Determination absolute level boreholes, incl. GPS coordinates	Materials ($ 4,000)	WEEK 12-14	Table with all borehole characteristics (location, depth absolute surface level)	Local consultant
7	Producing GIS maps	5 days Sen. Des WB 1 day Erkens	WEEK 20-24	• % org. matter above lowest groundwater level, • Groundwater level contours map, • Actualized soil map, • Drainage depth	Deltares, Waggonner Ball
8	Subsidence forecast map	1 day Erkens 1 day Stuurman 1 day Sen. des WB	WEEK 20-24	Map with estimated future subsidence, based on borehole information.	Deltares
9	Presentation results	1 day Erkens 2 day WB drawing	WEEK 26	• Brochure, • Article (see below) • 0,5 day public presentation	all
10	Project management	1 day Jeuken 1 day Stuurman 1 day Meselhe			

Deltares NL will support this project from their own resources by adding $ 10,000 to support activity 9.

A specification of the project cost is provided in the table below.

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Project costs per partner:

- Deltares USA $ 1,800
- Water Institute $ 1,024
- Deltares NL $ 35,110
- Waggonner & Ball $ 10,240
- Tulane University $ 18,475
- Local consultant $ 4,000

Annex D Summary and Fact Sheet – Project 1.3

Project 1.3: Integrated Groundwater – Subsidence Numerical Model	
Objectives	*Subsurface management:* • The made software provides a framework to store subsurface and relevant surface data derived from projects. All collected data (maps, boreholes and drilling data) will be stored in the database. *Subsidence analysis, forecasting and management:* • The disentangling of the subsidence measurements (by NASA) into 'shallow' and 'deep' components applying the 'thousand extensometers method'. • The prediction of subsidence as a result of future groundwater extractions (including reduced pumping). • The prediction of subsidence in relation to management of the shallow groundwater level. • To investigate the opportunities of storing water in deeper aquifers with reduced hydraulic heads and estimate the diminishing effect on 'deep' subsidence. • *Shallow groundwater analysis and management:* • To estimate increasing shallow groundwater levels after repairing the underground infrastructure, and/or after construction of multiple rain gardens. • To understand the relation between the shallow and deeper groundwater system, including the consequences of changes in shallow groundwater management. • To determine the future groundwater and subsidence situation in relation to climate change and sea level rise. *Salinization risk:* • To understand the groundwater interaction between Lake Pontchartrain and the urban area and to determine related urban salinization risks. • To understand the interaction between salt groundwater and plant roots over time and eventually advise adaption strategies. *Urban flooding:* • Understanding the pumping regime of PS and estimate PS discharge reduction and groundwater levels after implementation of multiple rain gardens. In addition the reduction of pumping costs, associated energy consumption and CO_2 production can be estimated. This study will be performed in cooperation with project 4 (real time control). The aim is to build an instrument that is supported by all relevant stakeholders and easily accessible and understandable for stakeholders.
Deliverables	A well described time dependent groundwater model for New Orleans, supported by (future) users and capable of analyzing and calculating the effects of (future) changes in groundwater management on the groundwater system and surface elevation. An additional deliverable will be a protocol for continuous improvement of the model by adding results of the integral monitoring network. Detailed model results are

	• Surface coverage of groundwater levels and hydraulic heads (= deeper groundwater pressure) and estimates for the future based on 5 scenario's (which are to be determined in cooperation with the stakeholders) • Identifying areas with high subsidence rates. • Unraveling between deep rooted subsidence processes (as a result of groundwater extraction) and shallow rooted processes (drainage and loading) using the thousand extensometer method to decipher the latest remote sensing (radar satellite data). • Estimates of subsidence reduction following 3 subsidence mitigation scenario's. • Mapping current and future infiltration and groundwater discharge fluxes. • Mapping groundwater flow directions, which are also important in relation to salinization processes and/or risk analyses in relation to soil- and groundwater pollution sites; • Understanding shallow groundwater salinization patterns and rates in relation to salinization risks (soil, trees etc.). • Estimate of optimal (highest) groundwater levels with no groundwater flooding risk. • Understanding the impact of surface water level changes on groundwater levels. • Understanding the relation between draining or leaking underground infrastructure and groundwater levels. Estimates of the new groundwater levels if the underground infrastructure is repaired. • Estimate of the groundwater effect after construction of multiple rain gardens.

Specialist	Role	Organization	Day rate
Claire Jeuken	Project management	Deltares USA	$ 1,500
Enab Meselhe	Project coordination	Water Institute	$ 2,048
Roelof Stuurman	Technical lead, urban water, integrated water systems	Deltares	$ 1926
Karel Heijnet	Project management	Deltares	$ 1926
Gilles Erkens	Subsidence specialist, (shallow) geology	Deltares	$ 1616
Henk Kooi	Senior groundwater specialist	Deltares	$ 1616
Frans Roelofsen	Medior modeling expert		$ 1306
Gualbert Oude Essink	International expert fresh-salt groundwater interaction	Deltares	$ 1926
Marc Hijma	Geologist with Mississippi Delta experience	Deltares (former Tulane University)	$ 1616
Gerrit Hendriksen	IT- and GIS specialist		$ 1616
Huite Bootsma	Junior hydrogeology	Deltares	$ 1032
Torbjörn E. Törnqvist	Geologist (professor)	Tulane	$ 1600
To be determined	Junior geologist/ geo assistance	Tulane	$ 400
To be determined	Expert	NASA	$ 1600
To be determined	Expert	USGS	$ 1600

	Activity	costs	planning	Performance	partners
1	Inception meeting with City and SWBNO, including project preparation and writing a detailed starting report: modeling approach, data handling etc.	4 days Stuurman 5 days Roelofsen 2 day Hendriksen 2 days Kooi 1 day Erkens 1 day Törnqvist	Project starting within 4 weeks after assignment. WEEK 1-4	Starting report	Deltares, Tulane, USGS
2	Stakeholder participation	2 days Stuurman 1 day Erkens 2 days Roelofsen 1 day Hendriksen 2 days USGS 2 days NASA 1 day Törnqvist	WEEK 6-7	• Organizing 1-day workshop • Workshop realization • Extended starting report with comments and advices stakeholders • 1 pager with vision and project description	Deltares, Tulane, USGS, NASA
3	Data collection and storage	2 day Stuurman 6 days Hendriksen 10 days Marc Hijma 25 days Geo assist. 1 day Törnqvist 5 days USGS	WEEK 1-12	GIS database with maps and subsurface information	Deltares, USGS, Tulane
4	Geology and lithology analysis (construction of a detailed 3D subsurface model)	1 day Stuurman 5 days Marc Hijma 5 days Roelofsen 1 day Törnqvist 5 days USGS Data acquisition ($ 9000)	WEEK 6-16	3-D hydrogeological model of shallow (Holocene) layers and deeper hydrogeological built-up.	Deltares, USGS, Tulane
5	Collecting, storage and analyzing subsidence information (including 'thousand extensometer' analysis	10 days NASA 10 days Hendriksen 1 day Törnqvist 24 days Geo assist. 4 days Gilles Erkens	WEEK 10-24	• Database with all collected and estimated (subsidence) relevant geotechnical data; • Data analysis	Deltares, NASA
6	Modeling activities	Construction and calibration basic GROUNDWATER MODEL 25 days Roelofsen 25 days Boobsma Adding SUBSIDENCE MODULE 5 days Kooi 3 days Erkens	WEEK 20-60	• Understanding phreatic groundwater levels now and in the future, • Understanding fresh salt water interaction in shallow groundwater along Gentilly's Lake Pontchartrain shoreline and the	Deltares,

	Activity	costs	planning	Performance	partners
		Improving drainage module 5 days Kooi *Adding FRESH-SALT density flow* 10 days Oude Essink *Calculating 10 scenario's* 10 days Kooi 10 days Roelofsen 5 days Oude Essink *MODEL TRANSFER* 3 day Roelofsen *MODELING COURSE* 5 days Roelofsen 2 days Kooi 1 day Stuurman *SYNCHRONIZATION* 5 days Stuurman		(actual and future) risks for vegetation and infrastructure • impact groundwater abstraction on subsidence, but also the effect of reduced pumping; • impact phreatic groundwater management on subsidence; • effect of green infrastructure on groundwater and storm drainage discharge at P4; • 3-day modeling course in New Orleans	
7	Documentation, presentations to stakeholders	5 days Roelofsen 2 days Kooi 1 day Stuurman 2 day USGS 2 day NASA 1 day Törnqvist 2 days Erkens	WEEK 60-68	• Realization second stakeholders workshop; • MANUAL: making the model accessible for all future users; • Report, brochures, ppt's • 0.5 day public meeting • 0.5 day public meeting	Deltares, NASA, USGS, Tulane University
8	Finalizing, incorporate stakeholder opinions	Materials ($ 5,000)	WEEK 69-78	Report, brochures, ppt's	
9	Project leader & quality control	2 days Jeuken 6 days Stuurman 2 days Heijnert 2 days Kooi 2 days Masetha Travel costs ($ 12,528)	WEEK 1- 78		Deltares
	Total	$ 400,000	Duration 1.5 year		

Deltares NL will support this project component by adding $ 20,000 to support activity 6, subsidence calculations

A specification of the project cost is provided in the table below.

Project costs per partner:

- Deltares USA $ 3,600
- Water Institute $ 4,096
- Deltares NL $ 297,978
- Tulane University $ 29,200
- USGS $ 22,400
- NASA $ 22,400
- Data acquisition $ 8,000
- Travel costs $ 12,526

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Annex E Summary and Fact Sheet – Project 2

Project 2: Dealing with Knowledge Gaps – White Paper	
Objective	Identifying the existing gaps in our understanding of the soil and (ground)water system of New Orleans, and the potential impacts of the system on surface and subsurface infrastructure
Deliverables	A report is proposed to be provided including the following chapters: • Introduction (5 pages) • Regional hydrology/Geologic context/Climate (10 pages) • Subsidence (15 pages) – Basic processes – Subsidence in coast generally – Detailed geology of City/polders – Groundwater usage, implications for subsidence – Measuring subsidence • Surface infrastructure (5 pages) – Description of basics – pumping rates/history • Water quality (5 pages) – Institute to assemble based on existing sources – Inorganic contaminants • Path Forward – next 5 year plan, actions, knowledge development • All contribute ideas, group discussion to identify key components

Specialist	Role	Organization	Day rate
Claire Jeuken	Project management	Deltares USA	$ 1,800
Ehab Meselhe	Project coordination	Water Institute	$ 2,048
Roelof Stuurman	Technical lead, urban water, integrated water systems	Deltares	$ 1826
Gilles Erkens	Subsidence specialist, (shallow) geology	Deltares	$ 1616
Denise Reed	ecology	The Water Institute	$ 2048
Mead Alison	Geology, sedimentology	The Water Institute	$ 2048
Research scientist	Earth sciences	The Water Institute	$ 1360
Research Associate	Earth Sciences	The Water Institute	$ 954
Alex Kolker	Coastal systems and biogeochemistry.	Louisiana Universities Marine Consortium & Tulane University	$ 500

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	Activity	costs	planning	Performance	partners
1	Inception meeting with City etc. Better understand their expectations (0.5 day)	0.5 day Stuurman 0.5 day Alsen 0.5 day Kolker 0.5 day Mesalbe 0.5 day Erkens	Start 2-4 weeks after assignment. WEEK 1	1. Inception meeting memo	all
2	Background literature review (incl. consultation other organizations specialists)	$ 22,145 2 day Stuurman 0.5 day Alsen 12 days Kolker 5 days res. Scientist 1 day Erkens	WEEK 2-10	None (later during workshop and report)	all
3	0.5-day stakeholder meeting (incl. preparation). Presentations, interaction	0.5 day Stuurman 0.5 day Alsen 0.5 day Kolker 0.5 day Erkens	WEEK 12-14	3.1 organization and accomplishment of workshop, 3.2 memo report with workshop results distributed to all participants	all
4	reporting	1 day Stuurman 2.0 days Kolker 5 days Res. Assoc. 1 day Erkens	WEEK 14-20	4. concept-report	all
5	Concept-report reading (0.5 day)	0.5 day Stuurman 0.5 day Alsen 0.5 day Kolker	WEEK 22	5.1. participation meeting 5.2 additional knowledge exchange	all
6	Final report	0.5 day Stuurman 4 days Kolker 1 day Erkens Materials ($ 200)	WEEK 26	6.1 final report 6.2 Public outreach summary	all
7	Logistics, materials etc.	Materials ($ 780)			
8	Project management	1 day Jeuken 1 day Mesalbe			Deltares USA Water Institute

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A specification of the project cost is provided in the table below.

Project costs per partner:

- Deltares USA $ 1,800
- Water Institute $ 20,766
- Deltares NL $ 17,080
- LUMCON $ 10,000

Annex F Summary and Fact Sheet – Project 3

Project 3: Applied Research on New Sustainable Drainage Systems (SUDS)	
Objective	Operational research on applicability of new sustainable drainage systems (SuDS) and best management practices (BMP's) for rainwater harvesting and storm water treatment in New Orleans. Clarify costs & benefits. Define optimal design solutions taking into account soil/subsurface, installation and maintenance costs and benefits.
Deliverables	• Performance analysis all existing SUDS, including detailed monitoring at 10 SUDS. • Realization user-friendly performance quantification tool.

Specialist	Role	Organization	Day rate
Claire Jeuken	Project management	Deltares USA	$ 1,800
Ehab Meselhe	Project coordination	Water Institute	$ 2,048
Roelof Stuurman	Technical lead, urban water, integrated water systems	Deltares	$ 1926
Karel Heijnert	Project management	Deltares	$ 1926
Reinder Brolsma	SUDS specialist (PhD)	Deltares	$ 1616
Huite Bootsma	Junior hydrologist (MSc), monitoring and calculations	Deltares	$ 1032
Dana Brown	SUDS design expert	Dana Brown	$ 1154
Ramiri Diaz	Sen. Architect, support governance, organization, drawings	Waggonner Ball	$ 1440
Torbjörn E. Törnqvist	Geologist (prof), quality control soil characteristics	Tulane University	$ 1616

	Activity	costs	planning	Performance	partners
1	Mapping, classification, performance evaluation of all existing SuDS in New Orleans	5 days Stuurman 10 days Bootsma 4 days Brolsma 1 day WB/Ramiro Diaz	Start 4 weeks after assignment WEEK 1 -10	1.1 visit and documentation all existing NO SUDS; 1.2 analyze hydrological benefits; 1.3 analyze installation and maintenance costs; 1.2 SUDS performance report,	Deltares, Tulane, WB, Dana Brown
2	1 day SuDS workshop, including organization and preparation. "Experiences with SUDs. Can we improve SUDs"	2 days Stuurman 2 days Brolsma 1 day Tulane 2 days WB/Ramiro Diaz	WEEK 12-14	2.1 organization and performance workshop 2.2 report with workshop results	Deltares, Tulane, WB.

	Activity	costs	planning	Performance	partners
3	Monitor 10 existing SUDS	Analysis: 2 days Stuurman 10 days Bootsma 9 days Brolsma Equipment: sensors ($ 13,000) Local consultant: installation ($ 12,500)	WEEK 8-60	3.1 detailed hydrogeological analysis (boreholes etc.) and description of 10 SUDS locations 3.2 detailed monitoring and analysis of 10 SUDS, 3.3 Report	Deltares, WB, Tulane, Eusits
4	5 permeable pavement tests	5 days Bootsma 1 day Stuurman Local consultant: field tests ($ 2,500)	WEEK 14-18	4.1 performance 5 tests, 4.2 analysis results and report	Deltares, Eusits
5	Development of simple quantitative design tool taking into account costs & benefits	5 days Bootsma 1.5 days Brolsma 1.0 day Stuurman	WEEK 50-70	5.1 practical hydrological design advices for New Orleans, 5.2 Simple tool to calculate effectiveness	Deltares
6	Outreach workshop, publications, report	1 day WB/Diaz 1 day Brolsma 4 days Bootsma	WEEK 70-78	6.1 organization and performance outreach workshop 6.2 publication 6.3 compact and practical SUDS design report focused on quality and quality aspects	all
7	Project management	1 day Jauken 0.5 day Hejnert 1 day Maselho			

A specification of the project cost is provided in the table below

Project costs per partner:

- Deltares USA $ 1,800
- Water Institute $ 2,048
- Deltares NL $ 81,665
- Waggonner & Ball $ 5,760
- Tulane $ 1,600
- Local consultant $ 15,000

- Equipment (sensors) $ 13,000
- Travel costs $ 4,096

November 30, 2017

Annex G Summary and Fact Sheet – Project 4

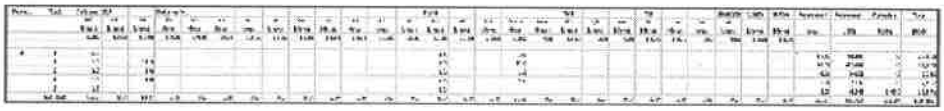
Project 4: Real-Time Control of Water System for Optimal Water Management	
Objective	The objective of this applied research project is to investigate the potential benefits of operating city wide urban water forecasting and real-time control systems. The functioning and potential of such systems should be demonstrated by developing a working pilot application of a forecasting and model predictive control scheme. The project will also provide practical recommendations and a plan of how to fully implement and operate such system when proven to provide sufficient added value. The study and pilot application will illustrate the rationale and potential methodology for real-time control of the urban water management system (pumps, gates) using weather (especially rainfall) forecasting to support optimal water management in New Orleans. The proposed work will include a feasibility study, operational research and knowledge exchange.
Deliverables	• Needs assessment and feasibility study, taking into account the current situation and future developments (report) • A city wide pilot application for demonstration purposes (software application) • Project report including a proposed plan of action for next steps. • Stakeholder workshop to present project outcome and potential next steps.

Specialist	Role	Organization	Day rate
Edwin Welles	project leader, water management specialist	Deltares USA	$ 1,600
Ben Balk	Forecasting and operational water management system specialist	Deltares USA	$ 1,360
Ehab Meselhe	Senior specialist hydraulic modeling and water management specialist	The Water Institute of the Gulf	$ 1,600
Francesca Messina	Specialist operational water management	The Water Institute of the Gulf	$ 1,200

Activity		Costs	Planning	Performance indicator	Partners
1	Needs assessment & feasibility study	Welles 6 days Meselhe 4 days Messina 11 days	Month 1-4	1.1 Needs assessment & feasibility report 1.2 Stakeholder meetings 1.3 Business case	Deltares USA TWIG
2	Development of pilot application	Welles 1 days Balk 17.5 days Meselhe 1 days Messina 12 days	Month 3-6	2.1 Pilot application for demonstration and outreach purposes (software application) 2.2 Stakeholder and outreach meetings	Deltares USA TWIG
3	Reporting & publications	Welles 2 days Balk 1 days	Month 7	3.1 Project report 3.2 Publication materials	Deltares USA TWIG

Activity		Costs	Planning	Performance indicator	Partners
		Messina 2 days Messina 1 days			
4	Stakeholder workshop	Wales 1.5 days Bali 1 days Messina 1.5 days Messina 1 days	Month 7	4.1 Stakeholder workshop	Deltares USA TWI2
5	Project management & quality control	Wales 2.5 days Messina 1 days Travel costs	Month 1-7	5.1 Concise monthly progress reports (7)	Deltares USA TWI2

A specification of the project cost is provided in the table below.



Project costs per partner:

- Deltares USA $ 48,120
- Water Institute $ 48,352
- Travel costs $ 6,430

[EXHIBITS D AND E CONTAINED ON NEXT PAGE(S)]

EXHIBIT D TO THE COOPERATIVE ENDEAVOR AGREEMENT

BETWEEN

THE CITY OF NEW ORLEANS

AND

DELTARES USA, INC.

PROPOSAL CONSTRUCTING A SURFACE/GROUNDWATER AND SUBSIDENCE MONITORING NETWORK FOR THE CITY OF NEW ORLEANS DATED NOVEMBER 16, 2017

Deltares USA

Enabling Delta Life

CONSTRUCTING A SURFACE/GROUNDWATER AND SUBSIDENCE MONITORING NETWORK FOR THE CITY OF NEW ORLEANS

November 18, 2017

Prepared for the City of New Orleans

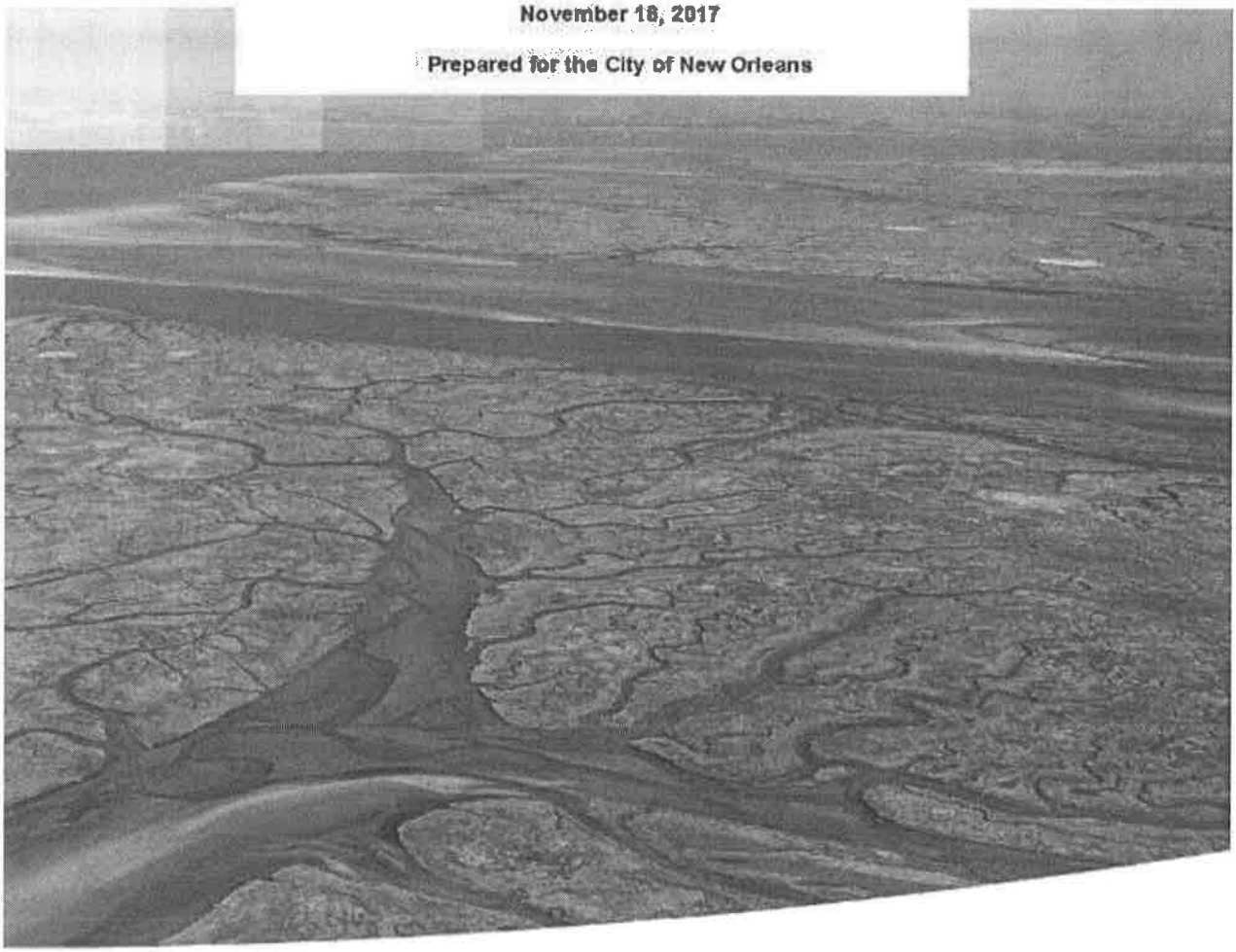


Table of Contents

1 Introduction

The City of New Orleans is moving forward in late 2017 and beyond in awarding construction projects that will lead to infrastructural improvements in the water supply and wastewater/sewer network overseen by the Sewerage and Water Board (SWB). The opportunity now exists to begin framing a monitoring system that can be utilized to (1) monitor system performance, (2) identify possible hazards to the populace and infrastructure, and to (3) serve as calibration and validation datasets for the application of real-time forecasting and other numerical models to optimize future system performance, and to provide advance information about flooding risks associated with rainfall events.

Deltares USA, working with our partner The Water Institute of the Gulf, has been asked to scope out a phased proposal to carry out these activities. The most pressing need (Phase 1) is to develop a set of instrumentation and deployment guidelines. As the City is already awarding contracts to construction firms who will be carrying out street-level and subsurface improvements to the drainage (wastewater and sewer) and water supply network, the opportunity exists to install gauges at these sites that can monitor surface and groundwater parameters. As multiple firms will be employed in these activities, and the associated deployment of monitoring instrumentation, it is imperative they maintain continuity in (1) instrumentation used, (2) programming instructions for instruments to collect time series at synchronized intervals, (3) methods of installation to ensure gauge comparability from station to station, and (4) optimal sensor density (number of sensors at a site) and location parameters (e.g., depth of emplacement, etc.). It is envisioned that this station network will provide the "backbone" of what will evolve, with time, into a comprehensive monitoring network to serve the City and SWB's needs.

The results of this project will be used in any follow-on projects which require installation of measurement devices, such as the Resilient Groundwater Management project proposed for the Gentilly District.

1.1 This Document

Phase 1 is fully scoped and budgeted in the present document. Subsequent phases are outlined conceptually and budgeted using a range of values. This approach was taken because, until Phase 1 is conducted, the number of sensors in the network is defined, and the City and SWB's plans for network design for real-time forecast modeling are constrained, the exact setup of the databasing hardware cannot be well defined.

Databasing is outlined in Phase 2 below. This phase is scoped to allow our partner, the Water Institute, to serve as a temporary repository and manager for the data produced by the instrumentation installed by the outside companies according to the specifications defined in Phase 1. Two possible Phase 2 projects are outlined below – a lower-cost (Basic) approach where the server and databasing is a manual procedure, and a more real-time model-compatible (Automated) approach. Each server-databasing design is budgeted only as an estimated cost range. This is done due to remaining uncertainties about the size of the databasing project that arise from (1) only three of the six hazard mitigation projects are at the 90-100% design phase (e.g., Pontilly, Mirabeau, and Orleans & Broad) and it is not possible to scope the size of the others until the projects design is further along, and (2) the City requests that existing monitoring efforts (e.g.,

BCG Engineering, Inc. piezometer network and SELA/Quick) be incorporated into the databasing and, until these entities have been consulted, it is not possible to ascertain their network characteristics and how their sensors would be put into the database since it will likely not follow guidelines setup in Phase 1.

A third and final phase (Phase 3) is outlined briefly below, but not costed out, as it is dependent on availability of funding, identification of need by the City, and cross-fertilization of other subtasks in the overall Deltares-Water Institute proposed statement of work. Phase 3 would be the design of an integrated water monitoring network for the City that could serve multiple needs including real-time forecast modeling, monitoring water quality, and optimizing system performance. Phase 3 would also be the vehicle for contracting the Water Institute to maintain the sensor network beyond the 12 months that compose Phases 1 and 2.

2 Phase 1 – Sensor Specifications

The goal of this phase is to identify appropriate instrumentation for installation for monitoring surface and groundwater parameters. In concert with identifying instrumentation, appropriate parameters to gauge will be identified. These parameters will be determined in consultation with the client, but may include:

- Precipitation
- Water levels (surface in canals and other localities, and groundwater in drilled wells)
- Water quality parameters (key parameters might include nutrients, pollutants, salinity, turbidity, etc.)
- Subsidence of the soil surface

The intent is to provide comprehensive guidelines about many different types of sensors that might become part of a comprehensive monitoring network, even if the focus of the six hazard mitigation projects that are the near-term focus is only on a subset of these parameters (e.g., groundwater). Guidelines will also be provided to the client about data collection time intervals (programming instructions), installation methods, and appropriate sensor density. A databasing strategy will also be outlined, both in determining how data will be packaged for delivery (see Phase 2 below) and necessary metadata and QA/QC procedures to be passed to the contractors. Information will also be provided on the characteristics of the existing monitoring efforts being conducted by BCG and SELA, and suggestions to best enable this information to be brought into the database created in Phase 2.

This phase will be carried out internally within the Deltares-Water Institute team to produce a report to the City of New Orleans as a final deliverable. It is anticipated that a kickoff meeting and a second scoping meeting will be needed with City and SWB personnel to select monitor parameters and scope construction contractor firm needs and limitations.

3 Phase 2 – Databasing

In the formative stages of the water monitoring network for the City of New Orleans, the Deltares proposes our partners at the Water Institute serve as the repository for data collected by the gaging installed by outside contractors to the City and existing sensors

installed by BCG and SELA (Phase 1). This will ensure consistency and comparability of parameter data sets, and consistency of their storage and associated metadata. It is anticipated that this server system and all the data stored to date will eventually be transitioned to the City of New Orleans and SWB for internal housing, operation and management, and utilization.

As this task is open ended at this time, we describe two approaches and provide costs for two approaches. We will work with the City to determine the appropriate path. We call these two approaches the Basic Server Approach and the Automated Server Approach.

We propose the system we will develop reside at the Water Institute for the first year, the duration of Phase 2. By the end of Phase 2, the determination of the Phase 3 activities will need to be completed as the Team will need to know if the Phase 3 activities will be to transfer the System to the City or SWB or other third party, or continue to maintain it.

3.1 Phase 2 – Basic Server Approach

The Deltares-Water Institute team will acquire a server to store data and will define accessibility so that it can be queried by our partners – City of New Orleans and SWB. The Team will also ensure it is databased with appropriate metadata to allow for its utilization. The system will be installed and made fully operational and ready to receive data by six months into this Phase. After the development is complete, the system will be able to receive data. An interim deliverable on Phase 2 will be a report on server system setup and guidelines for storing the data after month six of this phase. As part of this interim deliverable, there will also be a demonstration and written guidelines for City and SWB personnel – "a how to guide" – for accessing and utilizing the database. A final deliverable will be produced at the end of 12 months of this phase that will include a report on the data stored up to that point, its architecture, and suggested work plan options for a Phase 3. Capital expenses are included in the Phase 2 range estimate to purchase the server hardware and firmware for the project.

The Basic server approach assumes a mainly manual system design. Sensors installed by the construction contractors would be entirely independent. That would mean either sensors that were totally manual and could only be read and data collected by contractor personnel visiting the gauge site, or that they are programmable and capable of self-recording time series data collection. The latter would still require that contractor personnel visit the site.

3.2 Phase 2 – Automated Server Approach

The Automated Server approach differs from the Basic Server approach in (1) the level of automation of the process of getting the data from the sensor to the server, and (2) the real-time availability of the data to users or to be captured by real-time models for forecasting purposes. To accomplish this automation, each sensor has to be equipped to upload data automatically to the Cloud or other service that the server can be equipped to capture (recommendations for how to do so will be provided in Phase 1). This requires additional power (battery/solar) and additional computing hardware at the sensor array. In the case of some sensor types, networks arrays can be created to reduce costs where a central "brain" controls and uploads data from multiple individual

gaging stations. Additional sophistication (hardware and programming) is required at the server to properly ingest this information stream and then create a web template where the data can be projected for analysis or export by users.

The additional expenses of this automation are balanced in part by a reduced requirement for personnel to visit each gauge site. A reduced schedule for maintenance could be followed, and, sensor failure could be ascertained immediately (due to an interruption in it being received at the server) to reduce the time that gauges were down for hardware failure. Budgeting for the automated approach is for the server-end hardware and software and does not include automation hardware and software at the sensor-end. It is anticipated these costs will be assumed by the firms installing the sensors.

4 Phase 3 – Complete Network Design

This envisioned future phase would involve the Deltares-Water Institute team designing a comprehensive water monitoring network for the City of New Orleans and SWB. This could be utilized by the client for such purposes as to (1) provide data to real-time forecasting models that can predict flooding and other hazards, (2) monitor water quality to identify possible hazards in wastewater, (3) examine loss in supply water in the system to pinpoint location and volume, and (4) quantify ground subsidence patterns at a block-level to identify risks to future SWB infrastructure and to the surrounding neighborhoods. The Phase 3 effort would also involve funding to either continue the operation and maintenance of the data management effort setup in Phase 2 in house at the Water Institute, or to transition it to the City and SWB at an agreed upon date.

5 Schedule

Task	Planned Delivery
Phase 1 – Specifications Report	60 Days from Contract Start
Phase 2 – Start	End of Phase 1
Phase 2 – Demonstration to the City	8 months from Contract Start
Phase 2 – Final Report	14 months from Contract Start
Phase 3 – Design and Support	TBD

6 Costs

This project will be executed as a time and materials contract with the follow anticipated costs using the rate table below. We provide detailed costs for Phase 1, and estimates for the two Phase 2 options. Phase 3 is not estimated.

Activity	Cost
Phase 1	$39,975
Phase 2 – Basic Server	$60,000 to $90,000
Phase 2 – Advanced Server	$90,000 to $120,000
Phase 3 – Design and Support	TBD

(Rate table next page)
Phase 1 Detailed Rate Table

Labor Category	Rate	Anticipated Hours	Cost
Deltares – Project Manager	$195	5	$975
Water Institute – CEO	$265	2	$530
Water Institute – Senior Project Director	$265	34	$9,010
Water Institute – Research Scientist II	$165	104	$17,160
Water Institute – Research Scientist I	$145	40	$5,800
Water Institute – System Administrator	$125	40	$5,000
Travel			$1,500
Total			$39,975

[EXHIBIT E CONTAINED ON NEXT PAGE(S)]

EXHIBIT E TO THE COOPERATIVE ENDEAVOR AGREEMENT

BETWEEN

THE CITY OF NEW ORLEANS

AND

DELTARES USA, INC.

BUDGET

Task		Deliverable(s)	Budget per Deliverable
Activity A: Water Monitoring Sensor Specification			
1	Sensor Specifications	Specifications report that outlines instrumentation, deployment, and databasing guidelines	$39,975
		Activity A total:	**$39,975**
Activity B: Water Monitoring Database			
1	Server for Data Storage	Server system for storing water monitoring data installed, fully operational, and accessible to the City and its partners	$100,000
2	Server Systems Report	Report on server system setup and guidelines for storing, accessing, and utilizing the data	$20,000
		Activity B total:	**$120,000**
Activity C: Water Monitoring Network Design			
1	Project Inception	Memo detailing notes from inception meeting with City and key partners	$10645.73
2	Stakeholder Interaction & Design	List of workshop participants, Design Report, and Outreach Brochure	$30934.51
3	Cost-Benefit Analysis	Cost-benefit memo	$9821.79
4	Comments on Final Network Design	Comments memo distributed to all stakeholders	$5244.39
5	Final Monitoring Strategy	Final monitoring strategy report	$10552.00
6	Installation	Memo with final field locations; 20 shallow observation wells installed; sensors installed at	$111272.25

		pumping stations, surface water and groundwater observation wells	
7	Data Collection	Spreadsheets with 0.5 year and 1 year data, including graphics and short report	$13078.29
8	First Monitoring Report	Report with presentation and analyses of monitoring results and User Guide for monitoring network management and yearly reporting.	$20617.92
9	Lessons Learned Workshop	List of participants and Memo with results of final workshop with stakeholders	$9959.12
		Activity C total:	**$222,126**
Activity D: Subsidence Vulnerability Maps			
1	Storage Database and existing borehole analysis	City-accessible database with collected shallow boreholes	$7673.95
2	Design Borehole Campaign	Map with potential coring sites and table with location and site owner permissions	$8606.66
3	Borehole Campaign	Installation of 63 boreholes (6-15 feet) and table with all borehole characteristics (location, depth, absolute surface level)	$28714.59
4	Sampling and Laboratory Analysis	Table with result of 315 samples (organic content, pH)	$10157.96
5	Subsidence forecast maps	Map with estimated future subsidence based on borehole information, organic matter content map, and groundwater level contours map	$11704.97
6	Presentation of Results	Slides, notes, and list of participants from half-day workshop	$3790.87
		Activity D total:	**$70,649**
Activity E: Integrated Groundwater and Subsidence Model			
1	Inception Meeting and Initial Report	Initial Report detailing modeling approach, data handling, etc.	$26345.53
2	Stakeholder Workshop	Project 1-pager with vision and project description; notes and list of participants at one-day workshop	$19495.30
3	Data Collection and Storage	GIS database with maps and subsurface information	$54321.54

4	Geology and Lithology Analysis	3-D hydrogeological model	$37606.88
5	Subsidence Data Analysis	Database with all collected and estimated relevant geotechnical data, including subsidence	$54890.01
6	Modeling	Groundwater model and results of ten scenario calculations (effects of sea level rise, climate change, groundwater pumping, green infrastructure, drainage improvements, etc)	$176781.88
7	Documentation and Stakeholder Presentation	Groundwater Model User Manual, Public Presentation Materials, List of participants and notes from stakeholder workshop	$30758.85
		Activity E total:	**$400,200**
Activity F: Knowledge Gaps Report			
1	Inception Meeting and Stakeholder Workshop	Memo detailing notes and participants from inception meeting with City and stakeholder workshop	$7,114
2	Draft Concept Report	Draft Concept Report, including background literature review	$30,884
3	Final Report	Final report, inclusive of all City and stakeholder feedback	$11,650
		Activity F total:	**$49,648**
Activity G: Green Infrastructure (GI) Applied Research			
1	Mapping and Evaluation of Existing GI projects	Documentation and performance report of existing GI projects in New Orleans	$25844.00
2	GI Stakeholder Workshop	Report with participants and notes from one-day GI workshop	$12451.46
3	Monitoring & Testing	Report with locations and performance analysis results of 10 GI projects and 5 permeable pavement tests	$68698.39
4	Design Recommendations	Memo with practical hydrological design recommendations and a simple tool to calculate effectiveness	$10239.83
5	Final Report	Simple and practical final report with GI design recommendations, to be shared with local stakeholders	$7735.33
		Activity G total:	**$124,969**

Activity H: Real Time Control Pilot Study			
1	Needs Assessment & Feasibility Study	Needs Assessment and Feasibility Report	$32635.78
2	Pilot Software Application Development	Pilot software application for demonstration and outreach purposes	48949.07
3	Reporting & Publications	Final project report and publication materials	10403.75
4	Stakeholder Workshop	Notes and list of participants from stakeholder workshop	8193.41
		Activity H total:	**$100,182**

Total Budget: **$1,127,749**

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[END OF AGREEMENT]