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July 5, 2015



**Central Pollution Control Board**  
**(Ministry of Environment Forests & Climate Change, Govt. of India)**  
**Parviesh Bhawan, East Arjun Nagar, Shahdara**  
**Delhi -110032**

**REQUEST FOR**  
**Expression of Interest**  
**(Global Invitation)**

Central Pollution Control Board (CPCB) is implementing a project "Upgradation of Water Quality Monitoring System for River Ganga (WQM)" under The World Bank assisted National Ganga River Basin Authority (NGRBA) programme being executed by MoWR, RD and GR.

The assignment "Real Time Data Qualification Services Contractor (Consultant) for CPCB" involves Real Time Water Quality Monitoring network of about 50 out of 100 stations in the Ganga states. The network would be developed on data purchase concept where monitoring system will be installed, commissioned and operated by vendors and the Central Pollution Control Board (CPCB) would purchase the validated real time water quality data. The system once it gets operational would help to identify the trends of a wide array of water quality indicators and sources of the pollution and their impact on the river water quality through an online system.

The validated real time data would be eligible for payment by CPCB and to ensure that the service provider for automatic water quality monitoring data provides the data that is representative and accurate, a quality assurance consultant will be appointed.

Detailed EOI notice, draft scope of work, other qualifications and terms & conditions for the consultant, may be downloaded from site: [www.cpcb.nic.in/Tenders.php](http://www.cpcb.nic.in/Tenders.php)

Interested Consultants may submit 'Expression of Interest' in an envelope clearly superscripted as "Real Time Data Qualification Services Contractor (Consultant) for CPCB, Delhi under NGRBA program" in one original and five copies to Suneel Dave, Additional Director & Incharge NGRBA Cell "Parivesh Bhawan", East Arjun Nagar, Delhi-110032, India Tel: +91 11 43102030 within one month from the date of publishing.

**CENTRAL POLLUTION CONTROL BOARD**  
**“Parivesh Bhavan”, East Arjun Nagar, Delhi-110032**

REQUEST FOR EXPRESSIONS OF INTEREST

**COUNTRY** : India  
**NAME OF PROJECT** : National Ganga River Basin Project  
**Loan No. /Credit No. /Grant No.:**Ln. 8065-IN/Cr. 4955-IN  
**Assignment Title** : Real Time Data Qualification Services Contractor  
(Consultant) for CPCB, Delhi

**Reference No.** (As per Procurement Plan): **NGRBA/PP 14-15/CPCB/C/05**

### **Background**

The Government of India, Ministry of Water Resources, River Development & Ganga Rejuvenation, has received financing from the World Bank toward the cost of the National Ganga River Basin Project (NGRB), and intends to apply part of the proceeds for consulting services.

The NGRB project includes a sub-component “**Upgradation of Water Quality Monitoring System for River Ganga (WQM)**”, and one of the packages under this program is development of a Real Time Water Quality Monitoring network of about 50 out of 100 stations in the Ganga states. The network would be developed on data purchase concept where monitoring system will be installed, commissioned and operated by vendors and the Central Pollution Control Board (CPCB) would purchase the validated real time water quality data. The network has been designed in a manner that once it gets operational it would help to identify the trends of a wide array of water quality indicators and sources of the pollution and their impact on the river water quality through an online system.

The validated real time data would be eligible for payment by CPCB and to ensure that the service provider for automatic water quality monitoring data provides the data that is representative and accurate, a quality assurance consultant is proposed to be appointed.

### **Scope of Work**

The Data Purchase Contract will involve the collection of Data from over 50 stations, and upto 20 Parameters per station in the Ganga Basin. In order for the CPCB to make payment for Data, the data will need to go through a data qualification process. This process will be managed by the Data Quality Assurance Service Consultant and is the subject of this REOI.

The Services of "Real Time Data Quality Assurance Service Contractor (Consultant)" will include responsibility for checking water quality data provided by the Data Purchase Contractor and qualifying the data based on a strict set of qualification rules set by CPCB. The scope of service shall also include regular visit to each monitoring station with the Data Purchase Contractor. The consultant will also be responsible for designing & building a computer software program that will analyze the data stream provided by the Data Purchase contractor and publish the results of the data qualification process on a website. The Consultant will be responsible for designing and establishing the website as per NIC guidelines.

The assignment would initially be for a period of 3 years, and could be extended for a further period of 2 years based on performance and mutual agreement.

The Central Pollution Control Board now invites eligible consulting firms ("Consultants") to indicate their interest in providing the Services. Interested Consultants should provide information demonstrating that they have the required qualifications and relevant experience in real time quality control, and the requisite experience in developing computer program(s) to help automate processes, such as data qualification as is required in this consultancy contract. Expertise in measurement of water quality in a highly polluted river (verification of parameters and adjusting according to calibration, data collection, data transmission and examining real- time data stream for missing data). Further details including the required number of Professionals and their experience may be seen in the ToR. The interested firms must provide information indicating their past experience in similar sectors, under the following heads:

### **Experience of the Firm**

- i. Number of years of experience in similar/related projects executed /under execution.
- ii. Number of successfully completed assignments of similar nature (Letter of Award from employer/ Project completion certificate be submitted).

### **Financial strength of the consultant.**

- i. Turnover figure of the last three years.
  - ii. Net profit figure for the last three years.
  - iii. Value of contracts in the area of expertise requested
- Name of the Associates, if any

The firms should specifically provide information showing their experience in real time water quality measurements with experience in quality assurance and

quality control program in highly polluted rivers. Consultants may associate with other firms in the form of a joint venture to enhance their qualifications.

The attention of interested Consultants is drawn to paragraph 1.9 of the World Bank's [Guidelines: Selection and Employment of Consultants \[under IBRD Loans and IDA Credits & Grants\] by World Bank Borrowers, January 2011](#) ("Consultant Guidelines"), setting forth the World Bank's policy on conflict of interest.

A Consultant will be selected in accordance with the Quality and Cost Based Selection (QCBS) method set out in the Consultant Guidelines. Further details & ToR may be obtained at [www.cpcb.nic.in](http://www.cpcb.nic.in) and also at the address below during office hours--12-00 to 16-00 hours (IST).

Expressions of interest must be delivered in one original and 5 copies to the address below within one month from the date of publication i.e by 4<sup>th</sup> August, 2015

**Central Pollution Control Board**

**Attn: Suneel Dave, Additional Director & Incharge NGRBA Cell**

**"Parvesh Bhavan", East Arjun Nagar, Delhi-110032, India**

**Tel: +91 11 43102030**

**Fax: + 91-11-22307078/22384025**

**E-mail: [ngrba.cpcb@gmail.com](mailto:ngrba.cpcb@gmail.com) & [ngrba.cpcb@nic.in](mailto:ngrba.cpcb@nic.in)**

Sd/-

Member Secretary, CPCB

## Terms of Reference

### 1. Introduction and Background

Ganga, rising in the northern most part of Uttarakhand (Gomukh), flows through Uttar Pradesh, Bihar and West Bengal and finally falls into the Bay of Bengal (Sagardweep). After traversing a length of 1450 km in Uttarakhand and Uttar Pradesh and 110 km in the boundary between U.P. and Bihar the river then enters Bihar and flows 445 km more or less through the middle of the State. The length of the river measured along the Bhagirathi and the Hugli during its course in West Bengal is about 520 km. The total length of Ganga is approximately 2525 km.



Sources: State boundaries (MLInfo Map, 2009), major lakes and rivers (RWDBII, CIA, 2006, and VMAP0, NIMA, 1997), populated places (GRUMP, CIESIN, Columbia University, IFPRI, the World Bank, and CIAT, 2004).

**Figure 1-1 The Ganges Basin**

The Ganga Basin has an area of approx. 8,61,404 km<sup>2</sup>. Ganga has a large number of tributaries. Some of these are of Himalayan origin having considerably large water wealth. The important tributaries within India are the Kali-east, the Ramganga, the Yamuna, the Gomti, the Ghaghara, the Gandak and the Kosi. The Yamuna although a tributary of the Ganga, is virtually a river by itself. Its major tributaries are the Chambal, the Sind, the Betwa and the Ken. The main plateau tributaries of the Ganga are the Tons, the Son, the Damodar and the Kasai-Haldi.

This Project will focus on the water quality of the Ganga main as well as tributaries and nallaø that flow immediately into the River Ganga.

### 1.1 Project Description

The activities of the CPCB related to the real-time collection and data communication involve two major components. The first component is a Data Purchase Contract, and the second component is the Data Purchase Audit Contract, also known as the Data Qualification Contract.

The Data Purchase Contract will eventually involve the collection of data from around 100 stations, and up to 20 parameters per station in the Ganga Basin. The CPCB will not be responsible for the installation of equipment, nor the operation, maintenance and security of this equipment. The CPCB will purchase qualified data from the Data Purchase Contractor.

In order for the **CPCB (Client)** to make payment for data, the data will need to go through a data qualification process, which is the subject of the activity described in this document. The process will be managed by the **Data Qualification Services Contractor (Consultant)** for which the Terms of Reference are provided in following sections of this document.

## 2. Goal and Objectives of Data Qualification Contractor

The goal of the Data Qualification Contract is to qualify real-time water quality measurements as provided by the Data Purchase Contract. The process of data qualification is specified later in this document. Data that is qualified for payment will be processed through a data purchase computation by the **Consultant** and then provided to the **Client** for payment.

The **Consultant** will engage several objectives in order to accomplish the goal and the service. These objectives include, but are not limited to the following:

- Verify that parameters have been calibrated within the required time frame
- Verify that the parameters were adjusted according to the calibration
- Verify Data Timeliness for data collection (logging)
- Verify Data Timeliness for data transmission.
- Verify Measurement Representativeness
- Examine real-time data stream for missing data and/or artifacts.

These objectives are defined in the Description and Service Requirement to follow.

## 3. Scope of Services, Tasks (Components) and Expected Deliverables

The **Client** has developed a requirement for the measurement, collection, and delivery of real-time water quality conditions from numerous critical points along the River Ganga. Measurement points include select tributaries and nallaø that impact the River Ganga water

quality. The measurements will occur in the States of Uttarakhand, Uttar Pradesh, Bihar, and West Bengal.

This contract is being devised as a "data qualification service" contract whereby the **Consultant** will review data provided by the Data Purchase Contractor, which is being bid in a separate tender. The **Consultant** will be responsible for checking water quality data provided by the Data Purchase Contractor and qualifying the data based on a strict set of qualification rules set forth in this document. This service will require the **Consultant** to regularly visit each monitoring station with the Data Purchase Contractor. The **Consultant** will collect information that will be used in qualifying the data collected by the water quality stations. The **Consultant** will supply qualified technicians for the field visits along with all provisions required to support this activity, including, but not limited to, transportation, communication (i.e. mobile phones), computer equipment and supplies required to properly document the calibration and maintenance that will be performed by the Data Purchase Contractor. The **Consultant** will also be involved in confirming the calibration records from the Data Purchase Provider on the equipment that they use to calibrate/validate the sensors. The **Consultant** will not be required to make measurements, and will only serve as an observer for the purpose of recording the results of the field visits and using the results in qualifying data as it is provided by the Data Purchase Contractor. CPCB and NMCG officers may join the field visit at their discretion.

The **Consultant** will be required to maintain extensive documentation which will be managed by the **Consultant's** personnel and stored on a computer system that will be provided by the **Client**. This computer system will also receive data sent by the Data Purchase Contractor in real-time, so that the information can be processed, flagged, and qualified for payment. It is desirable if the **Consultant** can make the process of data qualification as automated as possible.

### 3.1 Task 1: Q/A, Q/C, and Compensation Model Development

The **Consultant** will devise a computer program that will employ the following criteria under 3.1 as listed below. This program will be written in an open architecture and belong to the **Client** once it is satisfactorily completed and tested by both the **Consultant** and the **Client**. The program will become the "intellectual property" of CPCB as a standalone program without restriction of use within CPCB,

#### 3.1.1 Data Qualification Process and Methodology

As mentioned earlier, the data qualification process will incorporate in-situ parameter validation/calibration, as well as data reception from the field into the offices of the **Client** by a prescribed time after measurement. The **Consultant** will be required to design, build, test, implement, and operate computer software program that will analyze the data stream provided by the Data Purchase contractor. The computer software program will evaluate all data received and qualify the data based on the following subsections of this section. This computer software program will reside on a computer that will be provided by the **Client**.

The **Consultant** will be receiving text files, on file for each transmission. It will be up to the **Consultant** to write a loader that will read these text files and put them into the

CPCB database. The **Consultant** will need to track the time that the data was received, as this is one of the qualifiers of data purchase. The **Consultant** will be required have the **Consultant's** information system enabled to receive data 24 hours a day, 7 days a week through the entire length of the contract.

### 3.1.2 Location of Equipment and Specifications

The tables indicating the location of the proposed stations and the parameters to be measured at each station are provided in Appendix A& B respectively.

All of these parameters will require an audit to qualify the data for payment qualification by the **Consultant**.

### 3.1.3 The Data Qualification Process

The data qualification process will consider several factors in order to be qualified for payment. Most of these factors will be confirmed during the 14-day self-validation check performed by the Data Provider Contractor. Other factors, such as timeliness, artifacts, changes in trends which draws question to the data, will be used to qualify or not qualify the data. If any one of the qualification criteria fails to be met, then the data point(s) will not be credited for payment.

The data qualification process shall include data checks as provided in the following subsections.

### 3.1.4 Data Completeness

For any given hour, at least 90% of the total possible qualified measurements must be available for purchase. If less than 90% of the qualified measurements are available purchase, then the **Consultant** shall disqualify all data for the entire network for that hour.

For any given hour, a minimum of 90% of the total possible number of stations must be either completely or partially reporting qualified data. If less than 90% of the stations are either completely or partially reporting qualified data, then the **Consultant** shall disqualify all data for the entire network for that hour.

For the purpose of the completeness requirement, a single daily cross-section measurement will count towards 24 hours of data for purchase.

### 3.1.5 Data Collection Timeliness

Data shall be measured and logged within a prescribed period of time in order to qualify for payment. The **Consultant** shall use Data Collection Timeliness as specified below as a means of qualifying each and every data point for payment.

#### 3.1.5.1 Fixed Stations



Fixed station measurements will be made within the hour. The measurements will be made  $\pm 5$  minutes of the hour in order to qualify for payment. The **Consultant** will use the logged data time stamp to make this determination. The **Consultant** will also be responsible for checking the in-situ data collection equipment for assigning the proper time stamp as part of the field checks for measurement accuracy.

#### **3.1.5.2 Cross-Section Stations**

Cross-section stations will be received at the data center within 60 minutes of the completion of the cross-section measurement. The cross-section will be made between the hours of 10am and 2pm local time. The measurement and collection of data shall be continuous throughout the measurement at a time interval no greater than every 2 seconds. The speed of the measurement platform shall be less than or equal to 2 km/hr. Data shall be received at the data center within 60 minutes of the completion of the cross-section measurement. The **Consultant** will inspect these criteria during the performance of cross-section measurements and disqualify measurements found to not meet the above criteria.

#### **3.1.5.3 Data Transmission Timeliness**

Data must be available in real-time otherwise it is considered unavailable for purchase. Data will be routed to the **Consultant's** computer system immediately by the Data Purchase Contractor. Data will be transferred by SFTP or HTTP POST, or similar technology that will allow data to flow over the network. The **Consultant** will make provisions to receive data by either of these methods and provide the Data Purchase Contractor the rights and information necessary to execute such transfers. The data will arrive in single files which will hold a single station measurement for one hour, or one cross-section in the case of cross-section measurements.

##### **3.1.5.3.1 Fixed Stations**

Fixed Stations must be available on the computer server and transferred to the NGRBA and Audit Contractors Servers within 15 minutes of the hourly observation to qualify for purchase.

##### **3.1.5.3.2 Cross-Section Stations**

Cross-section Stations must be available on the **Consultant's** computer server 60 minutes after the completion of the cross-section to qualify for purchase.

#### **3.1.6 Measurement Representativeness**

Measurement representativeness will be determined by the **Consultant** based on site inspections within three days of every six weeks. The site inspections will be coordinated with the Data Purchase Contractor prior to the inspection, though the Data Purchase Contractor is not required to join the inspections by the **Consultant**.

### 3.1.6.1 Fixed Stations

#### 3.1.6.1.1 Flow

In order to qualify for payment, the measurement must be representative of water conditions in the main channel of the river within two meters of the surface of the water. The main channel is defined as the portion of the river where the velocity of water is at a maximum. The measurement will be deemed non-representative if the velocity at the measurement point is less than 10% of that of the main channel.

#### 3.1.6.1.2 Depth

The continuous monitoring sensors shall perform measurements not closer than 0.5m of the surface and not closer than 0.5 m of the bottom of the channel. In the event the depth of water is less than 1.0 m, the measurement will be made in the middle of the range of depth. If the sensor is located outside of this range, the data shall not be qualified for measurement.

### 3.1.6.2 Cross-Section Stations

The location of the measurement will include the latitude and longitude of the measurement as well as the distance from the left bank while looking downstream. If the river is braided, measurements will be made within each braid. The **Consultant** shall audit each and every cross-section measurements one per month. If the **Consultant** observes a failure in making proper cross-section measurements, the measurement will not qualify for payment.

### 3.1.7 Measurement Accuracy

All sensors will be subject to self-audit by the Data Provider Contractor. The **Consultant's** responsibility is to witness all self-audits and document these audits as part of the data qualification process. The Data Provider Contractor will be performing calibrations at each and every station no longer than every 14 days at which time the **Consultant** is required to be in attendance. The site inspections will be coordinated with the Data Purchase Contractor. The **Consultant's** technicians will be required to manage their own transport and logistics in arriving at the sites on time.

The audit will be made within the  $\pm 5$  minute time period of the measurement at the top of each hour and compared to the real-time data that will arrive on the **Consultant's** computer server as part of the Data Purchase Provider services.

### 3.1.8 Data Qualification Process

The **Consultant** shall evaluate all data delivered to the **Consultant** by the Data Provider Contractor.

### 3.1.8.1 Data Qualification

The consultant will assist in terms of providing technical specifications for procurement of servers and software by CPCB. This computer system shall also store all data provided by the Data Provider in a non-proprietary open relational database such as MySQL or PostgreSQL. This database will include all pertinent information that will be used for data qualification. This information includes the actual date/time of the incoming data from the data provider.

The Data Provider will provide a continuous stream of data to the **Consultant's** computer system through a secure FTP process and/or an HTTP POST process. Data will be delivered in the form of files, with each file containing data from a single station for a single transmission. The format of the data will be in a non-proprietary ASCII format, such as XML or SHEF. The **Consultant** shall be required to import these records into a selected database.

The **Consultant** shall develop a data qualification process to be used against the incoming data that has been delivered to the **Consultant** by the Data Provider. The data qualification process shall evaluate each data point and reject data from being qualified based on evidence of the following:

- Data being an artifact or a change in the data trend that draws doubt about the data quality
- Missing data, or data not arriving within the specified time window
- 14 day calibration/validation field visit missed for the station in question
- Parameters not being adjusted during the 14-day calibration/validation field visit

In the event an artifact is identified, or change in trend that casts doubt about the data, the Data Provider can get credit for the data if the Data Provider can prove beyond reasonable doubt that the data is correct within three weeks from the date of generation of monthly validation report.

### 3.1.8.2 Qualifying Data based on Regular Field Calibration/Validation

The Data Provider Contractor will be performing calibrations on all stations at an interval no longer than every 14 days. These calibrations, and adjustments to the parameters being calibrated, are one of several pieces of information used to qualify data for payment.

## 3.1.9 Calculation of Credit and Payment Due to the Data Provider

The Data Provider will be compensated based on each data point that is received that meets the data qualification process. The **Consultant** shall develop a process to use the audit results in conjunction with the data that has been delivered to the **Consultant** by the Data Provider. This process shall aggregate the qualified data so that it can be fed

into the data compensation model shown in Appendix C. The **Consultant** shall demonstrate this model to the satisfaction of the **Client** within 30 days of the bid award.

The data qualification process shall flag the data that was not qualified, with the flag indicating the reason the data was not qualified. Qualified data will be indicated with a qualified flag that can be readily used in aggregating the number of qualified data for payment. The **Consultant** shall demonstrate this software program that processes the data and use of the compensation model to the satisfaction of the **Client** within **30 days of the bid award**.

The calculation of credit and payment due to the Data Provider will be performed by the **Consultant** on a monthly basis. By the 15<sup>th</sup> of the following month, the calculation of credit and payment due to the Data Provider will be delivered by the **Consultant** to the **Client**.

### 3.1.9.1 Weight System for Data Credit

The calculation of credit will involve a weighting function, as some observations are of higher value to the **Client** than other observations. A weighting scheme has been devised which is included in the compensation model shown in Appendix C. There are five different weights and five observations in each of the weighting categories. The **Client** may reassign these weights at any time.

The observation priorities are provided in the following table.

Sensor Priority	
Sensor	Category
Ammonia	B
BOD	A
BTX	D
Chloride	B
COD	B
Color	C
DO	A
DOC	D
EC	A
Fluoride	C
Hydrogen Sulfide	D
Nitrate	C
Nitrites	C
pH	A
Potassium	C
Temperature	A

TOC	D
TSS	B
Turbidity	B
Water level	D

The weights that are associated with each category are defined in the following table.

Category	Weight (Relative Importance)
A	10
B	5
C	3
D	2

The weight of Category A being 10 means that it will be 5 times more valuable than observations in Category D, and twice as valuable than that in Category B. The **Consultant** shall apply different weights as directed by the **Client**. The **Client** may expand or collapse categories as will, in which case the **Consultant** shall include these changes in the compensation model.

### 3.2 Task 2: Data Visualization

The consultant is required to design, develop and implement a website for data visualization. The website will be able to display data as follows;

- Consultant will be required to maintain two databases. One database will be the raw data, the other database will be the qualified data for record. Raw data will be displayed in real time on the visualization system. The qualified data will appear on the website after the qualification process which is expected to occur within 15 minutes of receiving the raw data.
- Tabular reports of water quality data for selected stations and parameters
- Graphical presentation of water quality data by time and parameter at user selectable time intervals and parameter.
- Display and dissemination of water quality data on GIS platform showing user selectable water quality parameters at each station
- User selectable statistical analysis for user selectable time periods and parameters to include the following:
  - Average
  - Standard Deviation
  - Maximum
  - Minimum
  - Period of exceedance of user selectable thresholds and parameters
- Reports as follows:
  - Water Quality Reports by State
  - Daily reports as of a specific time (i.e. 10am)
  - Monthly reports of parameters

- Reports that compare current water quality to historical water quality
- Hotspot report
- Water quality index
- Special Kumbh Mela, Magh Mela Report

### **3.3 Task 3: Carry out Activities Related to the Description under 3.1**

Task 3 is the operationalization of the procedures outlined under Section 3.1 and requires all of the activities outlined there-in. This includes the preparation of reports listed under the deliverables section and regular communication between the **Client** and the **Consultant**, that will be initiated by the Consultant as required to perform the activities previously mentioned.

#### 4. Team Composition & Qualification Requirements for the Key Experts (and any other requirements which will be used for evaluating the Key Experts under Data Sheet 21.1 of the ITC)

The **Consultant** is expected to have at least 5 years of working experience in real-time water quality management with expertise in measurement of water quality in conditions similar to that of the Ganges River. The assignment is expected to be carried out by a team of experts and technical staff described below.

The staffing requirements of key personnel for this assignment will include a minimum of the following positions. The **Consultant** can increase the number of experts in order to adequately address the expertise that is required and to further strengthen their bid. The **Consultant** is encouraged to nominate experts that are multi-disciplinary and therefore cross-over the staffing requirements below to adequately meet the scope of work of the assignment.

##### **TEAM LEADER:**

The Team Leader will have a broad knowledge of all components of the consultancy and will be involved in managing all activities of the contract. The Team Leader will have direct and regular communication with the **Client** as well as the Data Provider Contractor. Excellent communication skills, both written and verbal, are required. The Team Leader will be expected to be at the at the **Clients** facility on a full-time basis.

##### Qualifications:

1. Minimum of 15 years experience in managing activities as described above.
2. Minimum of 10 years experience with the measurement of real-time water quality systems that have led to demonstrable knowledge of water quality in highly polluted rivers.
3. Extensive knowledge of manual water quality measurement procedures.
4. Extensive experience in analyzing water quality data in highly polluted rivers.
5. Strong written and verbal communications skills in English.
6. Minimum of MSc degree in Environmental Science, or a physical science that is related to water quality management. PhD is preferable.

##### **DEPUTY TEAM LEADER:**

The Deputy Team Leader will serve in the absence of the Team Leader. Though the Deputy Team Leader will be junior to the Team Leader, the Deputy Team Leader is expected to have considerable experience in the field of water quality monitoring, and in particular, in highly polluted river conditions. Excellent communication skills in English and Hindi, both written and verbal, are required. The Deputy Team Leader will be expected to be at the at the **Clients** facility on a full-time basis.

**Qualifications:**

1. Minimum of 10 years experience with the measurement of water quality that have led to demonstrable knowledge of water quality in highly polluted river conditions.
2. Extensive knowledge of manual as well as real-time water quality measurement procedures.
3. Extensive experience in analyzing water quality data in highly polluted river conditions.
4. Strong written and verbal communications skills in English and Hindi.
5. Minimum of Master's degree in Environmental Science or Engineering, including Water Resources Engineering with an emphasis on water quality monitoring.

**WATER QUALITY TECHNICIAN (6 Persons)**

The Water Quality Technicians will be performing regular field visits to the water quality stations and observing the calibration/validation process being performed by the Data Provider Contract. The water quality technicians will be based and stationed full time on the project, and may be assigned to field areas to facilitate their activities. Knowledge of water quality measurement techniques, water quality calibration and validation process is necessary. Knowledge of computer science and programming is very desirable. It is expected that these technicians will be working full-time on the project making station visits on a daily basis.

1. 2 years experience in computer programming and data handling through automated processes. The experience can be that acquired during the course of acquiring the degree mentioned below.
2. Minimum of MSc degree in Environmental Science, or Bachelor's in Environmental Engineering, or a closely related field.

**COMPUTER SYSTEMS APPLICATION PROGRAMMER:**

The **Consultant** will be responsible for operating and modifying computer code related to the collection, storage, display and dissemination of water quality data as directed by the **Client**. The Computer Systems Application Programmer will be based and stationed full-time at the CPCB Project Office. The Computer Systems Programmer will be required to develop an automated process to qualify data based on a set of inputs provided through the course of work. The programmer may also be called upon by the **Client** to provide analysis of data, which will largely consist of statistical analysis, such as analysis of variance. The computer systems application programmer must have expertise in data base management, computer operating systems, application programming, and web development. Must demonstrate knowledge and use of database language/systems and programming languages.



**Qualifications:**

1. Minimum of 5 years experience in designing, developing, and implementing computer system hardware and software to support Hydrological, Meteorological, and/or environmental measurement Systems.
2. Minimum of 5 years experience in performing statistical analysis on time series environmental data.
3. Minimum of Bachelors degree in Computer Science and/or Environmental Science or similar.

**ASSISTANT COMPUTER SYSTEMS APPLICATION PROGRAMMER:**

The **Consultant** will be responsible for operating and modifying computer code related to the collection, storage, display and dissemination of water quality data as directed by the **Client**. The Computer Systems Application Programmer will be based and stationed full time at the CPCB project office. The Computer Systems Programmer will be required to develop an automated process to qualify data based on a set of inputs provided through the course of work. The programmer may also be called upon by the **Client** to provide analysis of data, which will largely consist of statistical analysis, such as analysis of variance. The computer systems application programmer must have expertise in data base management, computer operating systems, application programming, and web development. Must demonstrate knowledge and use of database language/systems and programming languages.

**Qualifications:**

1. Minimum of 2 years experience in designing, developing, and implementing computer system hardware and software to support Hydrological, Meteorological, and/or environmental measurement Systems.
2. Minimum of 2 years experience in performing statistical analysis on time series environmental data.
3. Minimum of BSc degree in Computer Science and/or Environmental Science or similar.

**COMPUTER SYSTEMS WEB PROGRAMMER:**

The **Consultant** will develop and manage a web page to display all data received by the **Consultant**. The Computer Systems Web Programmer will be based and stationed full time at the CPCB project office. The web page will include time series plots, graphical tables, and tabular data. The data received is not limited to water quality parameters but also includes maintenance activities and reports developed from these activities. The WEB Programmer will provide changes to the web page as requested by the **Client**. The programmers should have expertise in data base management, computer operating systems, application programming, and web development.

Qualifications:

1. Minimum of 5 years experience in designing, developing, and implementing computer system hardware and software to support Hydrological, Meteorological, and/or environmental measurement Systems.
2. Minimum of Bachelor degree in Computer Science, Information Technology, Computer applications, or similar.

## 5. Reporting Requirements and Time Schedule for Deliverables

### 5.1 Data Qualification Model Development and Deployment

This deliverable is related to Task 1 as described in Section 3.

The data qualification model development, testing, and deployment will be produced over a minimum of 4 Phases. Phase 1 will be the development of a conceptual model that will include a block diagram of the logic to be used to satisfy all requirements and instances of the data qualification process. There will be a review of this phase and approval from CPCB prior to moving on to the Phase 2. This phase is to be completed within 30 days of contract signing. CPCB will provide final review within 15 days from the date of the Consultants submission of Phase 1 report. The Consultant will then make necessary changes and return as final within 7 days of CPCB's final review.

Phase 2 will be the custom computer model build based on the approved conceptual model developed under Phase 1. During this Phase, the **Client** can continue to request features, as the conceptual model is adjusted to meet the requirements of the consultancy. Phase 2 will be completed by the 3rd month after contract signing. CPCB will provide final review within 15 days from the date of the Consultants submission of the Phase 2 report. The Consultant will then make necessary changes and return as final within 7 days of CPCB's final review.

Phase 3 will be the testing phase during by which time **Consultant** shall have the Data Qualification Model developed and presented to the Client. During this Phase the Data Qualification Model will be tested to the extent possible with adjustments being made to the computational model as required by the **Client**. Prior to the start of Phase 3 the **Consultant** shall devise a simulated batch of data for 50 stations using 20 parameters for a period of 3 months. The qualification process will be exercised on the simulated data using different audit results. This Phase will exercise the use of the field audits, input into the system, and the resultant qualification of data. Phase 3 is expected to be completed by the 4<sup>th</sup> month of the Consultancy. CPCB will provide final review within 15 days of the Consultants submission of the Phase 3 report. The Consultant will then make necessary changes and return as final within 7 days of CPCB's final review.

Phase 4 will be the final deployment, with all elements deployed by the 5<sup>th</sup> month of the Consultancy. The system will then go online and be undergo additional testing as the Data Services Contractor shall install the necessary equipment.

## 5.2 Reporting of Activities

All visits to stations will be recorded, and put into the data base for review by the **Client**. Results of audits will be recorded and stored in a database. The result of the audits will be made available to the **Clients** described below, so that the **Client** can notify the Data Provider of the data qualification results. The **Consultant** will also provide quarterly reports as identified below.

## 5.3 Reporting and Storing Field Visits and Activities

Notes will be taken for every field visit, and any activity that may impact the audit, validation and calculation of credit due to the Data Provider. The **Consultant** shall record all activities, including, but not limited to the following:

- Date and time arriving at the Audit site
- Time of actual Audit (i.e. observation) by element
- General observations, including:
  - Condition of station
  - Notable observations of water level, condition (this will be refined by the **Client**)
  - Current Weather (Cloud cover, Temperature, rain/no rain, etc.)
  - Any other notable observations or general comments
- Date and time departing the Audit site

The **Consultant** shall provide a monthly report of all field visits and results of calibration/validation. The report is due no later than the 15<sup>th</sup> of the month which will describe the aforementioned activities for the month prior.

This report will be known as the "Monthly Maintenance Report".

## 5.4 Reporting and Storing Audits Database

The **Consultant** shall store the results of the audits in a database that will be accessible by the **Client** 24 hours a day, 7 days a week. Reports will be accessible that will allow the **Client** to review the results of any audits performed throughout the life of the contract. The **Consultant** shall develop a program that can access this database that will allow the **Client** to perform the following (at a minimum):

- Audit report of a user defined number of parameter(s) for a user defined number of station(s) for a user defined period
- Audit report of audit failures of a user defined number of parameter(s) for a user defined number of station(s) for a user defined time period.
- **Consultant** shall be required to perform reports on an "as-needed" basis at the direction of the **Client**.

The **Client** will use a web based interface that will be developed by the **Consultant**. This interface will NOT require the **Client** to acquire a license or pay any other fees for the access to the interface and/or the data/reports. The **Consultant** shall modify/customize in the web based interface as directed by the **Client**.

### 5.5 Reporting on Data Qualification Process and Recommended Payment

The **Consultant** will provide a quarterly report that is due no later than the 15<sup>th</sup> of the month after the close of a particular quarter. The end of the quarter is defined to be March 31, June 30, September 30, and December 31. The data qualification report will provide a spreadsheet that will identify the following:

- Number of hours the data reporting fell below 90% for all parameters
- Number of hours the data reporting fell below 90% for all stations
- The qualified data payments due by each station for the quarter
- The qualified data payments due for all stations for the quarter
- Any other reporting the **Client** may request

This report will be known as the "Quarterly Data Provider Payment Report".

### 5.6 Reporting and Storing Communication

All communication between the **Consultant** and the **Client** as well as communication between the **Consultant** and any other entity which involves the Audit Contract will be stored in the same database that the actual audits are stored. This communication includes audit disputes that may be registered by the Data Provider and brought to the **Consultant's** attention by the **Client**.

The **Consultant** shall store the results of the audits in a database that will be accessible by the **Client** 24 hours a day, 7 days a week. Reports will be accessible that will allow the **Client** to review the results of any audits performed throughout the life of the contract.

The **Consultant** shall develop reports that the **Client** can access that will allow the **Client** to review all communication related to the **Consultant's** activities related to the Audit Contract. The **Consultant** shall add/change report format based on the input of the **Client** on an "as-needed" basis.

### 5.7 Summary of Reports Required and Deadlines for Report

The reports required by the **Consultant** are summarized as follows:

- Shall provide the complete specification of the server(s) and software (OS & RDBMS) within one week from the date of award of contract in consultation with IT Division, CPCB.
- Inception report providing details of the methodology and work plan be submitted within one month
- Phase 1 report due at the end 30 days.
- Phase 2 report due at the end of the 3<sup>rd</sup> month.
- Phase 3 report due at the end of the 4<sup>th</sup> month.

- Monthly Status Report based on station visited (station wise) due the 15<sup>th</sup> of the month following the month the audits took place.
- Monthly Validation Report due the 15<sup>th</sup> of the month following the month data was collected.
- Monthly Calibration Reports based on the information provided by the data service contractor. Report due the 15<sup>th</sup> of the month following the month the calibration was performed.
- Quarterly Data Provider Payment Report due the 15<sup>th</sup> of April, 15<sup>th</sup> of July, 15<sup>th</sup> of October and 15<sup>th</sup> of January, for the previous quarter.

## 6. Clients Input and Counterpart Personnel

The **Client** will provide office space for the Team Leader, Deputy Team Leader, and three IT related special lists at CPCB office building in Delhi. The equipment provided will include office space, desk, and chairs. The **Consultant** will be responsible for office supplies, personal computers; The **Consultant** will also be responsible for acquiring Internet access.

## Appendix A – Station List with Parameters to be measured

Table 2: Location wise parameters to be measure

Sr. No.	Station Code	Locations	Parameters																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Ammonia	BOD	BTX	Chloride	COD	Colour	DO	DOC	EC	Flouride	Hydrogen sulfide	Nitrate	Nitrites	pH	Potassium	Temperature	TOC	TSS	Turbidity	Water level
		<b>Uttarakhand</b>																				
1	UK1	Alaknanda after confluence mandakini DS Rudhaprag		☺			☺		☺		☺			☺		☺		☺		☺		
2	UK2	Bhagirathi River before confluence with Alaknanda		☺			☺		☺		☺			☺		☺		☺		☺		
3	UK3	Alaknanda after confluence Bhagirathi River		☺			☺		☺		☺			☺		☺		☺		☺		
4	UK4	US Rishikesh Luxmanjula	☺	☺			☺		☺		☺			☺		☺		☺		☺		
5	UK5	Barrage at Rishikesh	☺	☺			☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
6	UK6	Haridwar Barrage	☺	☺			☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
7	UK7	Bridge D/S Harkipodi	☺	☺			☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
8	UK8	Haridwar Nallah	☺	☺	☺	☺	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺		☺	
		<b>Uttar Pradesh</b>																				
1	UP1	Barawali Railways & Road Bridge	☺	☺			☺		☺		☺			☺		☺		☺		☺		
2	UP2	Madhya Ganga barrage	☺	☺			☺		☺		☺	☺		☺		☺		☺		☺		
3	UP3	Sukartal Ghat	☺	☺			☺		☺		☺			☺		☺		☺		☺		
4	UP4	Braj Ghat Road Bridge NH 24 Garmukhteshwar	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺

Sr. No.	Station Code	Locations	Parameters																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Ammonia	BOD	BTX	Chloride	COD	Colour	DO	DOC	EC	Flouride	Hydrogen sulfide	Nitrate	Nitrites	pH	Potassium	Temperature	TOC	TSS	Turbidity	Water level
5	UP5	Agricultural Drain below Brajh Ghat	☺	☺			☺		☺		☺			☺		☺		☺		☺		
6	UP6	Bridge at Anupshahr	☺	☺			☺		☺		☺			☺		☺		☺		☺		
7	UP7	Bridge Upstream of Narora	☺	☺			☺		☺		☺			☺		☺		☺		☺		
8	UP8	Barrage at Narora (Ganga)	☺	☺			☺		☺		☺			☺		☺		☺		☺		
9	UP9	Kachla Ghat Bridge Badaun	☺	☺			☺		☺		☺			☺		☺		☺		☺		
10	UP10	Ranganga (down-stream of Moradabad)	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
11	UP11	Ranganga at SH29	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
12	UP12	Bridge on River Ganga	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
13	UP13	Bridge on kali River at kanpur-Farrukhabad Road	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
14	UP14	Bridge at ghatia Ghat Farrukabad	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
15	UP15	Nalla at Kannauj 1	☺	☺	☺	☺	☺	☺	☺		☺	☺		☺		☺	☺	☺		☺		☺
16	UP16	Bridge SH21 down-stream of kannauj	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
17	UP17	Bridge SH40 down-stream of kannauj	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
18	UP18	Bridge in Bithur	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
19	UP19	Barrage up-stream Kanpur	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺

Sr. No.	Station Code	Locations	Parameters																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Ammonia	BOD	BTX	Chloride	COD	Colour	DO	DOC	EC	Flouride	Hydrogen sulfide	Nitrate	Nitrites	pH	Potassium	Temperature	TOC	TSS	Turbidity	Water level
20	UP20	Nalla at Kannauj 1	☺	☺	☺	☺	☺		☺		☺	☺	☺	☺		☺	☺	☺		☺		☺
21	UP21	Sismau nala	☺	☺	☺	☺	☺	☺	☺		☺		☺		☺	☺	☺	☺		☺		☺
22	UP22	Nallah at kanpur 3	☺	☺	☺	☺	☺		☺		☺	☺	☺	☺		☺	☺	☺		☺		☺
23	UP23	Nallah at kanpur 4	☺	☺		☺	☺	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺		☺
24	UP24	U/s Bathing Ghat Kanpur	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
25	UP25	Nallah at Kanpur 5	☺	☺		☺	☺		☺		☺	☺	☺	☺		☺	☺	☺		☺		☺
26	UP26	Bridge at Kanpur 1	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
27	UP27	Nallah at kanpur 6	☺	☺		☺	☺	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺		☺
28	UP28	Nallah at kanpur 7	☺	☺		☺	☺	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺		☺
29	UP29	Bridge 2 at Kanpur NH25	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
30	UP30	Nalla at kanpur 8	☺	☺		☺	☺	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺		☺
31	UP31	Nalla at kanpur 9	☺	☺		☺	☺	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺		☺
32	UP32	Bridge near Fatepur	☺	☺			☺		☺		☺		☺		☺		☺		☺		☺	
33	UP33	Bridge on Yamuba MDR 26B ( near Rajapur)	☺	☺			☺		☺		☺		☺		☺		☺		☺		☺	
34	UP34	Nalla on Yamuna in allahabad 1	☺	☺		☺	☺	☺	☺		☺		☺	☺		☺	☺	☺		☺		☺
35	UP35	Nalla on Yamuna in allahabad 2	☺	☺		☺	☺	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺		☺
36	UP36	Nalla on Yamuna in allahabad 3	☺	☺		☺	☺	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺		☺
37	UP37	Nalla on Yamuna in allahabad 4	☺	☺		☺	☺	☺	☺		☺		☺	☺		☺	☺	☺		☺		☺
38	UP38	Bridge on Yamuna NH27	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺



Sr. No.	Station Code	Locations	Parameters																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Ammonia	BOD	BTX	Chloride	COD	Colour	DO	DOC	EC	Flouride	Hydrogen sulfide	Nitrate	Nitrites	pH	Potassium	Temperature	TOC	TSS	Turbidity	Water level
39	UP39	Brudge on of tributary near nasa	☺	☺			☺		☺		☺		☺		☺		☺		☺			
40	UP40	Brudge DS of tributary near Sirsa	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
41	UP41	Bridge on Allahabad Bypass	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
42	UP42	Nalla at Allahabad 1	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺	☺	☺		☺		☺	
43	UP43	Nalla at Allahabad 2	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺	☺	☺		☺		☺	
44	UP44	Bridge Lord Curzon Allahabad Right	☺	☺			☺		☺		☺	☺		☺		☺		☺		☺		
45	UP45	Nalla at allahabad 3	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺	☺	☺		☺		☺	
46	UP46	Nalla at allahabad 4	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺	☺	☺		☺		☺	
47	UP47	Bridge on NH2 right	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
48	UP48	Bridge Near Kewataveer village	☺	☺			☺		☺		☺			☺		☺		☺		☺		
49	UP49	Bridge at SH74 US Varanasi	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
50	UP50	Bridge SH98 at Varanasi	☺	☺			☺		☺		☺			☺		☺		☺		☺		
51	UP51	Bridge at Ramnagar Road near Baranasi	☺	☺			☺		☺		☺			☺		☺		☺		☺		
52	UP52	Nalla at varanasi 1	☺	☺		☺	☺	☺	☺		☺	☺	☺		☺	☺	☺		☺		☺	
53	UP53	Bridge NH2 at Varanasi	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
54	UP54	Varanasi at Bathing Ghat 1	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	
55	UP55	Bridge on Tributary in Varanasi	☺	☺			☺		☺		☺			☺		☺		☺		☺		

Sr. No.	Station Code	Locations	Parameters																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Ammonia	BOD	BTX	Chloride	COD	Colour	DO	DOC	EC	Flouride	Hydrogen sulfide	Nitrate	Nitrites	pH	Potassium	Temperature	TOC	TSS	Turbidity	Water level
56	UP56	Tributary @ Rahwari	☺	☺			☺		☺		☺		☺		☺		☺		☺		☺	
57	UP57	Bridge NH 97 at Ghazipur DS	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
		<b>Bihar</b>																				
1	Bh1	Nallah at Buxer 2 SH13	☺	☺		☺	☺	☺	☺		☺	☺		☺	☺	☺		☺		☺		☺
2	Bh2	Nalla at Buxer 1	☺	☺		☺	☺	☺	☺		☺	☺		☺	☺	☺		☺		☺		☺
3	Bh3	Bridge at Buxer ( on Gnaga )	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
4	Bh4	Bridge on Ghagra near Manjhi	☺	☺			☺		☺			☺		☺		☺		☺		☺		
5	Bh5	Bridge near Danapur Patna 2	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
6	Bh6	Nallah in Danapur Patna 1	☺	☺	☺	☺	☺	☺	☺		☺	☺		☺	☺	☺	☺		☺		☺	☺
7	Bh7	Nalla in Patna 2	☺	☺		☺	☺	☺	☺		☺	☺		☺	☺	☺	☺		☺		☺	☺
8	Bh8	Bridge near Hajipur in Tributary	☺	☺	☺	☺	☺	☺	☺			☺		☺		☺	☺	☺		☺		☺
9	Bh9	Rajapul Nalla	☺	☺		☺	☺	☺	☺			☺		☺		☺	☺	☺		☺		☺
10	Bh10	Nalla in Patna 3a	☺	☺		☺	☺	☺	☺			☺		☺		☺	☺	☺		☺		☺
11	Bh11	Nalla in Patna 3b	☺	☺		☺	☺	☺	☺		☺	☺		☺	☺	☺	☺		☺		☺	☺
12	Bh12	Bridge Mahatma Gandhi right	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
13	Bh13	Bararighat Bhagalpur	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
		<b>West Bengal</b>																				
1	WB1	Farakka Barrage	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
2	WB2	Farakka STPs	☺	☺			☺		☺			☺	☺	☺	☺		☺		☺		☺	
3	WB3	Ganga river d/s of FTPs Farakka	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺

Sr. No.	Station Code	Locations	Parameters																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Ammonia	BOD	BTX	Chloride	COD	Colour	DO	DOC	EC	Flouride	Hydrogen sulfide	Nitrate	Nitrites	pH	Potassium	Temperature	TOC	TSS	Turbidity	Water level
4	WB4	Ganga u/s of outlet to natural river	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
5	WB5	1 River u/s of Ganga Nallah	☺	☺		☺	☺	☺	☺		☺		☺	☺	☺	☺	☺	☺		☺		☺
6	WB6	2 River u/s Ganga -Nallah	☺	☺		☺	☺	☺	☺		☺		☺	☺	☺	☺	☺	☺		☺		☺
7	WB7	Ganga River @Raghunathganj	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
8	WB8	Ganga River u/s of Azimganj	☺	☺			☺		☺		☺			☺	☺	☺		☺		☺		
9	WB9	Ganga River u/s of Juaganj	☺	☺			☺		☺		☺		☺		☺	☺		☺		☺		
10	WB10	Ganga River d/s Murshidabad (u/s Berhampore )	☺	☺	☺	☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
11	WB11	Ganga River d/s of Murshidabad ( d/s berhampore )	☺	☺			☺		☺		☺		☺		☺	☺		☺		☺		
12	WB12	4 River u/s Ganga-Nallah	☺	☺		☺	☺	☺	☺		☺		☺	☺	☺	☺	☺	☺		☺		☺
13	WB13	Ganga River @ Katwa	☺	☺			☺		☺		☺		☺		☺	☺		☺		☺		
14	WB14	Ganga River d/s of Nabadwip	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
15	WB15	Ganga River u/s of Tribeni	☺	☺			☺		☺		☺		☺		☺	☺		☺		☺		
16	WB16	Ganga River @ Transmission tower u/s of tribeni	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
17	WB17	Ganga River @ Chinsua	☺	☺			☺		☺		☺		☺		☺	☺		☺		☺		
18	WB18	Ganga River @ Champdani	☺	☺			☺		☺		☺		☺		☺	☺		☺		☺		

Sr. No.	Station Code	Locations	Parameters																			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Ammonia	BOD	BTX	Chloride	COD	Colour	DO	DOC	EC	Flouride	Hydrogen sulfide	Nitrate	Nitrites	pH	Potassium	Temperature	TOC	TSS	Turbidity	Water level
19	WB19	Ganga River @ Palta Water intake	☺	☺			☺		☺		☺			☺	☺	☺		☺		☺		
20	WB20	Nalla @ Barrackpore	☺	☺		☺	☺	☺	☺		☺		☺	☺	☺	☺	☺	☺		☺		☺
21	WB21	Ghat d/s of srirampore	☺	☺			☺		☺		☺			☺	☺	☺		☺		☺		
22	WB22	Nalla opposite Ghat d/s of srirampore	☺	☺		☺	☺	☺	☺		☺		☺	☺	☺	☺	☺	☺		☺		☺
23	WB23	Ganga River near Belgharia	☺	☺			☺		☺		☺			☺	☺	☺		☺		☺		
24	WB24	Nalla @ ballykhal	☺	☺		☺	☺	☺	☺		☺		☺	☺	☺	☺	☺	☺		☺		☺
25	WB25	Ganga River @ Bali Bridge	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
26	WB26	Nalla @Chitpur	☺	☺		☺	☺	☺	☺		☺		☺	☺	☺	☺	☺	☺		☺		☺
27	WB27	Ganga River @ Howrah Bridge	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
28	WB28	Ganga River @ vidyasagar	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
29	WB29	Nalla @ Hastings	☺	☺		☺	☺	☺	☺		☺		☺	☺	☺	☺	☺	☺		☺		☺
30	WB30	Nalla @ Shivpur	☺	☺		☺	☺	☺	☺		☺		☺	☺	☺	☺	☺	☺		☺		☺
31	WB31	Ganga River @ bata nagar	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
32	WB32	Ganga River near uluberia	☺	☺		☺	☺		☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
33	WB33	Rupnarayana @ Kolaghat	☺	☺			☺		☺		☺			☺	☺	☺		☺		☺		
34	WB34	Ganga River @ diamond harbor	☺	☺			☺		☺		☺			☺	☺	☺		☺		☺		
35	WB35	Ganga River near Haldia	☺	☺			☺		☺		☺			☺	☺	☺		☺		☺		

Highlighted stations were not finalized based on site survey. Alternate locations are being explored.

## Appendix B: Stations List with Location

List of RTWQM Station locations						
Sr. No	Locati on Code	Site	As per site Survey			Agencies requested for NOC
			Latitude	Longitude	Location	
<b>Uttarakhand</b>						
1	UK1	Alaknanda after confluence Mandakini d/s Rudhaprag	30.274184°	78.963178°	Under construction bridge about 2 km downstream (d/s) Rudraprayag nearby Rudraprayag bypass	Letter had been written to NHAI which suggested PWD/BRO as permitting authority.
2	UK2	Bhagirathi River before confluence with Alaknanda	30.147058°	78.597554°	CWC station site on Bhagirathi up-stream (u/s) of Devprayag	CWC
3	UK3	Alaknanda after confluence Bhagirathi River	30.139226°	78.59721°	CWC station site Downsteam Devprayag-after confluence Bhagirathi and Alaknanda	CWC
4	UK4	US Rishikesh Luxmanjula	30.128138°	78.331134°	Bansidhar vihar, B.D. Somany memorial guest house site	Satynarian Temple Trust
5	UK5	Barrage at Rishikesh	30.07447°	78.290312°	Park near by Rishikesh Barrage	Jal vidhud nigam
6	UK7	Bridge d/s Harkipodi	29.970861°	78.183842°	Dam kothi site on Ganga Nahar	Rajya sampati vibhag
7	UK8	Hardwar Nallah	-	-	Jagjeet STP outlet drain within campus	Jagjeet STP authority
<b>Uttar Pradesh</b>						
1	UP1	Barawali Railway & Road Bridge	29°38'8"	78°6'2"	Balawali Railway Bridge on River Ganga	Railway authority
2	UP2	Madhya Ganga barrage	29°22'26"	78°02'27"	Madhya Ganga barrage, Bijnor	State Irrigation Deptt./Madhya Ganga Nahar Nirman Authority, Bijnor, U.P
3	UP3	Sukartal Ghat	29°29'31"	77°59'25"	Bridge on Sukartal Ghat at Ban Ganga after confluence (a/c) Saloni river and before confluence (b/c) to River Ganga	PWD
4	UP4	Braj Ghat Road Bridge NH 24 Gharmukteshwar	28.76269°	78.14559°	Braj Ghat Road Bridge on NH 24 at Gharmukteshwar on River Ganga	NHAI
5	UP6	Bridge at Anupshahr	28.36452°	78.27184°	Road Bridge on River Ganga at Anupshahr about 1 km u/s of bathing Ghat	PWD
6	UP7	Bridge Upstream of Narora	28.246708°	78.368286°	Rajghat Railway Bridge on River Ganga	Railway authority
7	UP8	Barrage at Narora (Ganga)	28.190361°	78.395345°	Barrage at Narora on River Ganga	State Irrigation Deptt.

8	UP9	Kachla Ghat Bridge Badaun	27.931056°	78.855289°	Road bridge on River Ganga near Kachla Ghat, Badaun	PWD
9	UP10	Ramganga (d/s of Moradabad)	28.5535°	79.04748°	Bridge on Ramganga (d/s of Moradabad) at Shahbad on MDR53W	PWD
10	UP13	Bridge on Kali River at Kanpur-Farrukhabad Road	27°10'64.1"	79°40'60.5"	Bridge at Khudaganj, Kannauj d/s of River kali on bridge at Khudaganj, Kannauj	PWD/U.P State Bridge Corporation
11	UP14	Bridge at Ghatia Ghat Farrukhabad	27°23'92.4"	79°37'62.5"	Ghatiya ghat bridge , Farrukhabad on River Ganga	PWD/U.P State Bridge Corporation
12	UP16	Bridge SH21 DS of Kannauj	27°00'45.06"	79°59'19.47"	Manimau bridge (Mehendi ghat), Kannauj on River Ganga a/c Ram Ganga & River Garra	PWD/U.P State Bridge Corporation
13	UP17	Bridge SH40 DS Kannauj	27.497972°	79.696139°	Allahganj bridge, Farrukhabad on River ramganga	PWD/U.P State Bridge Corporation
14	UP18	Bridge in Bithur	26°36.010'	80°16.446'	Pariyal bridge on River Ganga b/w Laxshman ghat & Hnuman ghat near Dhruv Teela, Bithoor, Kanpur	PWD/U.P State Bridge Corporation
15	UP19	Barrage U/s Kanpur	26°30.482'	80°18.991'	Ganga Barrage bridge, Kanpur on River Ganga	State Irrigation Deptt.
16	UP21	Sisamau nala	26°29'28.7ö	80°19'58.6ö	Sisamau nala (Near Power House and Tafco company)	U.P Jal Nigam, Allahbad
17	UP24	U/s Bathing Ghat Kanpur	26°22.568'	80°29.549'	River Ganga d/s Kanpur; Deorighat (Maharajpur)	State Irrigation Deptt.
18	UP26	Bridge at Kanpur 1	26°27'42.01" / 26°28.339'	80°12'34.73" / 80°22.719'	Railway bridge culvert at Bhauti on river Pandu / New Road-bridge on R. Ganga b/w Shuklaganj & Kanpur	Railway authority / PWD
19	UP29	Bridge 2 at Kanpur NH25	26°22'14.1"	80°18'25.08"	Bridge on River Pandu (d/s of Kanpur), Bhingave (Hamirpur Road), Kanpur.	NHAI
20	UP32	Bridge near Fatepur	26.05487° / 26.19909°	80.90952° / 80.53726°	Bridge on River Ganga at Ansi, Fatehpur / Bridge on river Pandu, Fatehpur	PWD
21	UP34*	Nalla on Yamuna in Allahabad 1	25.41701°	81.9008°	Jhunsi Nala (2.5mx0.5m);After Sangam at Allahbad	U.P Jal Nigam, Allahbad
22	UP38	Bridge on Yamuna NH 27	25.42869°	81.8612°	New bridge ( on NH) at Allahbad on River Yamuna	NHAI
23	UP39	Bridge on tributary near Panasa	25.2422°	82.01928°	Bridge on river Tones at Meja (Allahbad)	NHAI

24	UP40	Bridge DS of tributary near Sirsa	25.271°	82.093°	Pontoon bridge, Sirsa (Allahbad) on River Ganga	PWD
25	UP41	Bridge on Allahabad Bypass	25.58831°	81.5469°	Bridge on River Ganga at Sringerpur.	NHAI
26	UP44*	Bridge Lord Curzon Allahabad Right	25.50754°	81.8658°	Ganga bridge, Phaphamau	NHAI
27	UP46*	Nalla at Allahabad 4	25.3899°	81.90133°	Mawaiya nala (2.5mx0.5m) at Allahabad	PWD
28	UP53	Bridge NH2 at Varanasi	25°19'17.8"	83°02'05.9"	Railway Bridge at Rajghat (Malva bridge), Varansi on River Ganga	Railway Authority / CWC
29	UP54	Varanasi at Bathing Ghat 1	25°20'31.5"	83°01'22.5"	Barrage on river Varuna 5-6 Km up stream/before confluence with River Ganga.	State Irrigation Deptt.
30	UP55	Bridge on Tributary in Varanasi	25°30'24.6"	83°08'27.5"	Bridge on river Gomati b/c to Ganga at Rajwari, Varanasi U/s of River Gomati b/c to River Ganga	PWD / U.P State Bridge Corporation
31	UP56	Tributary @ Rajwari	25°03'21.72"	83°11'57.6"	Bridge on Devkali Pump canal (Chaudhary Charan Singh Pump Canal), Jauhar ganj, Saidpur, Ghazipur D/s of River Ganga a/c River Gomati	State Irrigation deptt.
<b>Bihar</b>						
1	Bh3	Bridge at Buxar (on Ganga)	25°31'13.43"	83°54'0.57"	Chausa water intake point	Bihar Rajya Jal Parishad
2	Bh4	Bridge on Ghagra near Manjhi	25.822952°	84.579596°	Rail bridge or the road bridge on Ghagra near Manjhi	PWD/ Bihar Rajya Pul Nirman Nigam Ltd/ Indian Railways
3	Bh5	Bridge near Danapur Patna 2	25°39'21.51"	85° 5'52.05"	Digha Ghat Rail Bridge (Under Construction)	PWD/Bihar Rajya Pul Nirman Nigam Ltd / Indian Railways
4	Bh7	Nalla in Patna 2	25°38'26.35"	85° 6'19.31"	Kurzi Nalla @ MPS	Bihar Rajya Jal Parishad
5	Bh8	Bridge near Hajipur in Tributary	25.692678°	85.194731°	Bridge on Ghantak river @ Hajipur	Indian Railways/ PWD/ Bihar Rajya Pul Nirman Nigam Ltd, Patna
6	Bh9	Rajapul Nalla	25°37'24.66"	85° 7'28.59"	Rajapur old pump house near pantaloon	Bihar Rajya Jal Parishad
7	Bh10	Nalla in Patna 3a	25°37'19.81"	85° 8'1.11"	Mandiri Nalla near pumping station	Bihar Rajya Jal Parishad
8	Bh11	Nalla in Patna 3b	25°37'19.60"	85° 9'1.59"	Anta Ghat, drainage pumping Station	Bihar Rajya Jal Parishad
9	Bh12	Bridge Mahatma Gandhi right	25°36'48.57"	85°12'18.68"	Inland Water Authority jetty	Inland water ways authority, GOI
10	Bh13	Bararighat Bhagalpur	25°16'26.54"	87° 1'37.30"	Vikramshila Sethu	PWD/Bigar Rajya Pul Nirman Nigam Ltd., Patna/NHAI

West Bengal						
1	WB1	Farakka Barrage	24.801736°	87.922002°	Farakka Barrage, West Side	Farakka Barriage project, Ministry of water resources
2	WB2	Farakka STPS	24.759521°	87.907768°	Bridge just before Ganga (North-West Side) on Farakka Super Thermal Power Station outlet (d/s).	NTPC/Farakka Barriage project, Ministry of water resources
3	WB3	Ganga River d/s of FTPS Farakka	24.727377°	87.911866°	Bridge on Ganga at Anuppur	Farakka Barriage project, Ministry of water resources
4	WB4	Ganga u/s of outlet to natural river	24.540796°	88.032904°	Bridge on Ganga u/s of the mother river in dug-out canal	Farakka Barriage project, Ministry of water resources/CPWD/ NHAI
5	WB5	1 River u/s of Ganga- Nallah	24.505353°	88.030081°	First Influent Stream from Weast on Bridge over NH34	NHAI / Irrigation deptt.
6	WB6	2 River u/s Ganga-Nallah	24.482371°	88.055535°	Second influence stream from West	PWD/ Irrigation dept / Local Panchayath
7	WB7	Ganga R @ Raghunathganj	24.460066°	88.070149°	Raghunathgunj Bridge	PWD / Jangipur municipality
8	WB9	Ganga River u/s of Jiaganj	24.124984°	88.155039°	Rail bridge near Ajimgunj/Giaganj	Indian Railway & Local Panchayath
9	WB10	Ganga River d/s Murshidabad (u/s Berhampore)	24.100378°	88.244281°	Road Bridge after at Murshidabad, Behrampore	PWD/ Irrigation Dept / NHAI
10	WB11	Ganga River d/s of Murshidabad (d/s berhampore)	24.061719°	88.227575°	Ganga watercourse d/s of Murshidabad /Bridge if construction get completed	Inland water way authority and Loca Panchyat / PWD or Irrigation Dept, if bridge construction is completed
11	WB12	4 River u/s Ganga-Nallah	23.435085°	88.105100°	River Ganga	Inland Water Way Authority and Local Panchayath
12	WB13	Ganga River @ Katwa	23.649902°	88.137741°	Katwa	Inland Water Way Authority and Local Panchayath
13	WB14	Ganga R d/s of Nabadwip	23.386278°	88.365686°	Ganga R d/s of Nabadwip	PWD
14	WB15	Ganga R u/s of Tribeni	23.069457°	88.459004°	Ganga R u/s of Tribeni	Local Panchayat, Rukeshpur/Sieja-Kamalpur Grama Panchayat
15	WB16	Ganga R @ transmission tower u/s of Tribeni	22°57'58.02"	88°24'32.61"	Water intake point of PHE near Iswar Gupta Sethu	PHE, West Bengal
16	WB17	Ganga R @ Chinsura	22.906974°	88.404614°	Ganga R @ Chinsura	Indian Railway



17	WB18	Canal @ Champdani	22°48'26.61"	88°21'53.63"	Road bridge on Canal at Champdani (down stream location)	PWD, Hoogly
18	WB19	Ganga River @ Palta Water Intake	22.785836°	88.339283°	Palta Water Intake point on Ganga River	Kolkatta Muncipal Corporation (KMC)
19	WB20	Nalla @ Barrackpore	22.769531°	88.339212°	Nalla at Barrackpore	Barrackpore Municipality
20	WB21	Ghat d/s of Srirampore	22.725772°	88.356118°	Ghat d/s of Srirampore	Rishra Municipality / M/s Hastings Jute Mill, Rishra, W.B
21	WB22	Nalla opposite Ghat d/s of Srirampore	22.726286°	88.364131°	Inside Nullah (Khardah Seasonal Pump house) opposite to Sreerampore	Irrigation Deptt.
22	WB23	Ganga River near Belgharia	22.670951°	88.359732°	Intake pumping Station of KMDA at Belgharia	KMDA & Dum Dum Municipality
23	WB24	Nalla @ Ballykhal	22.655029°	88.347635°	Bally Khal Bridge	PWD/Kolkata Muncipal Corporaation/ Irrigation Department
24	WB25	Ganga River @ Bali Bridge	22.653188°	88.354413°	Bally Bridge	NHAI / Railway authorities
25	WB26	Nalla @ Chitpur	22.607483°	88.369767°	Nullah (Circular canal) at Chitpur	Kolkata Muncipal Corporation / Irrigation Department
26	WB27	Ganga R @ Howrah Bridge	-	-	Millennium Park	KMDA/ Kolkata port trust
27	WB28	Ganga River @ Vidyasagar	22.558658°	88.325696°	Vidyasagar Setu, Shibpur	Hooghly River Bridge Commissioners
28	WB29	Nalla @ Hastings	-	-	Nullah (Adi Ganga/ Tolly Nalla) at Hestings	Kolkata Muncipal Corporation
29	WB30	Nalla @ Shivpur	22.558416°	88.277595°	Nullah at Shibpore	PWD / Howrah Municipal Corporation
30	WB31	Ganga River @ Bata Nagar	22.516251°	88.219365°	Ganga at Batanagar	Maheshtala Municipality / Bata India Ltd
31	WB32	Ganga River near Uluberia	22.270497°	88.075837°	Ganga at Uluberia	Uluberia Municipality
32	WB33	Rupnarayana @ Kolaghat	22.26052°	87.53456°	On the left bank of the R. Rupnarayan near to the Hotel Sonal Bengla	PWD / Hotel Sonal Bengla authorities
33	WB34	Ganga River @ Diamond Harbor	22°11004	88°112337	Kolkata Port Trust ( KoPT) Jetty	Kolkata port trust
34	WB35	Ganga River near Haldia	22.01440°	88.054240°	Fire station, Oil Jetty No.2	Kolkata port trust

## Appendix C – Payment Description and Worksheet

Sensor-hour Purchase Plan					Category Totals		
Sensor Category	Sensor Weight	Qty of Sensors	SW*QS	Hourly Sensor Rate	Hourly	Daily	Yearly
a	10	10	100	\$ 2.85388128	\$ 28.54	\$684.93	\$2,50,000.00
b	5	10	50	\$ 1.42694064	\$ 14.27	\$342.47	\$1,25,000.00
c	3	10	30	\$ 0.85616438	\$ 8.56	\$205.48	\$75,000.00
d	2	10	20	\$ 0.57077626	\$ 5.71	\$136.99	\$50,000.00
Totals	20	40	200	\$ 5.70776256	\$ 57.08	\$ 1,369.86	\$ 5,00,000.00
<b>Bid Annual</b>	<b>\$ 5,00,000.00</b>						
<b>Bid Daily</b>	<b>\$ 1,369.86</b>						
<b>Bid Hourly</b>	<b>\$ 57.08</b>						
Sensor A	((B/365)/24)/(Qa*Wa+Qb*Wb+Qc*Wc+Qd*Wd)*Wa						
Sensor B	((B/365)/24)/(Qa*Wa+Qb*Wb+Qc*Wc+Qd*Wd)*Wb						
Sensor C	((B/365)/24)/(Qa*Wa+Qb*Wb+Qc*Wc+Qd*Wd)*Wc						
Sensor D	((B/365)/24)/(Qa*Wa+Qb*Wb+Qc*Wc+Qd*Wd)*Wd						
<b>Legend</b>							
Total Budget = B							
Sensor Weight= W							
Sensor Quantity=Q							
Category A= a							
Category B=b							
Category C=c							
Category D=d							

The spreadsheet above provides a method to calculate a data purchase for four different price categories. The cells in red are to be completed by the **Client**. The uppermost part of the spreadsheet indicates the Sensor Category in column 1. The sensor category weight is indicated in column 2. The sensor category weight is a measure of the value of the category. For instance, sensor category 'a' has a weight of 10. Sensor category 'b' has a weight of 5. This means that the measurements (sensors) belonging to category 'a' will be purchased for twice the amount of the measurements in category 'b'. The **Client** can change the weights of the sensors as necessary, and would likely do so if the relative value of the data to the **Client** changes over time. The Quantity of sensors is indicated in the column 3, which is the total number of sensors that belong to this category. The user of this spreadsheet would fill out all of the items in red, including the final cell in red which is the bid price on an annual basis. After these cells are completed, a price will be calculated for each sensor measurement-hour in a given category. Very simply, this hourly compensation rate will be multiplied by the number of qualified sensor hours in the given category to arrive at the compensation for the data purchase.