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Water Information Management System by Using Geographic Information Systems

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ABSTRACT

Purulia is the westernmost district of the State of West Bengal. As per 2001 census total population of the district is 2,535,516, out of which 90% are residing in rural areas. The percentage of Scheduled Caste and Scheduled Tribes are 18.29% and 18.27% respectively. Total number of Below Poverty Line (BPL) families in rural areas of this district is 43.65 %.

Due to its difficult socio and economic condition, the district is covered under the Backward Region Grant Fund, which is the national development program particularly aimed to redress regional imbalance in development and contribute towards poverty alleviation for backwards districts.

Percentage of total rural population covered by piped water supply scheme in the district is as low as 16.75%, even in comparison with the percentage of the overall West Bengal State, as 37.95%.

In absence of piped water supply scheme with sustainable source of water in most of the areas of the district, people of the area depend mainly on deep masonry wells / DTH hand tube wells. During summer most of the aforesaid sources are often dried up due to excessive lowering of ground water table rendering acute crisis of dirking water in the region.

Furthermore, 17 blocks out 20 blocks are reported to have areas being affected with fluoride contamination in ground water. As such it has become necessary to provide piped water supply schemes from available sustainable safe sources to mitigate suffering of local people from acute crisis of drinking water and fluoride contamination in ground water. The implementation of the piped water supply schemes will also contribute to sustainable development in the region. Thus the piped water supply scheme in the district was proposed with River Kumari carrying surface runoff water from Mukutmanipur Dam as source of water for the Project under Phase-I and Panchet Dam has been selected as source for Phase-II works.

The overall design calculations of the water supply facilities have been worked out based on water service level @ 70 lpcd with the projected population up to 2045, in accordance with the West Bengal Guidelines for Preparation of Piped Water Supply Schemes under Public Health Engineering Department.

Based on which the major components of the Project involve all civil, mechanical, electrical and instrumentation items including SCADA related to raw water intake-cum-pump house, approach bridge, raw water transmission main, water treatment plant, clear water pump house, 4nos. of intermediate booster pumping stations and clear water transmission main to 42 nos. of overhead reservoirs proposed in the project.

The Phase-I Project with source in River Kumari near Mukutmanipur Dam are covering the following blocks in Purulia district including Bulk supply to Purulia Municipality & left out area of Barabazar Block:

- Manbazar-I
- Purulia-I
- Barabazar
- Punch
- Arsha
- Bulk provision for Purulia Municipality

- Bulk provision for left out portion of Barabazar Block

Key Words: Region Grant Fund, SCADA

1.INTRODUCTION

Purulia is the westernmost district of the State of West Bengal.Due to its difficult socio and economic condition, the district is covered under the Backward Region Grant Fund, which is the national development program particularly aimed to redress regional imbalance in development and contribute towards poverty alleviation for backwards districts.

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. Brief about GIS (Geographic Information Systems)

Geographical Information System (GIS) & Remote Sensing is the backbone for urban planning and management. Essentially it seeks to integrate a large range of spatial and non-spatial information with respect to topography & other spatial information including- urban services, infrastructure and socio-economic information. With the help of satellite-based map and digital information all the required information are integrated in the GIS based urban management system. This not only helps to unify but also enable updating information as and when required with ease and accuracy. This information can also be made available to the citizens through web-based interface. This has specific importance in the context of utility networking, settlements where accurate representation of the ground scenario with that of the socio-economic conditions of the people is a necessity for planning.

A geographic information system (GIS) is a computer-based tool for mapping and analyzing geographic phenomenon that exist, and events that occur, on Earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies. Map making and geographic analysis are not new, but a GIS performs these tasks faster and with more sophistication than

traditional manual methods.

Geographic information system is defined as an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information.

Professionals and domain specialists in every discipline are become increasingly aware of the advantages of using GIS technology for addressing their unique spatial problems.

We commonly think of a GIS as a single, well-defined, integrated computer system. However, this is not always the case. A GIS can be made up of a variety of software and hardware tools. The

important factor is the level of integration of these tools to provide a smoothly operating, fully functional geographic data processing environment.

Overall, GIS should be viewed as a technology, not simply as a computer system

In general, a GIS provides facilities for data capture, data management, data manipulation and analysis, and the presentation of results in both graphic and report form, with a particular emphasis upon preserving and utilizing inherent characteristics of spatial data.

The ability to incorporate spatial data, manage it, analyze it, and answer spatial questions is the distinctive characteristic of geographic information systems.

Body of Paper

IMPORTANCE AND RELEVANCE OF THE PROJECT

Water is an essential natural resource for human existence. Water demand is directly proportional to the population of the State. Water demand continues to rise with rise in population. The demand already exceeds supply in many parts of the State. Public awareness about the importance of preserving water for ecosystem services in the rural areas had existed but its importance has been only recently emerged in the urban areas as during the 20th century. The present available water sources are not sufficient to meet the demand of enormously increasing population by the year 2050

Fresh water is a renewable resource, yet the supply of clean, fresh water is steadily decreasing. Public Health Engineering Department (PHED) aims to provide safe potable water to every person. To achieve this the raw water is pumped from various sources like river and bore wells, process the raw water and then distributed to the public through various service reservoirs present across the services area . Both quantity and quality of water is very much important for the department. Powerful software and measuring instruments can help in optimization of the water supply and improving service delivery to the public.

Water Supply System:

A water supply system or water supply network is a system of engineered hydrologic and hydraulic components which provide water supply. The water supply system is an integrated system from water intake to water utilization. A water supply system typically includes:

A. Drainage basin

b. A raw water collection point (above or below ground) where the water accumulates, such as a lake, a river, or groundwater from an underground aquifer. Raw water may be transferred using uncovered ground-level aqueducts, covered tunnels or underground water pipes to water purification facilities.

c. Water is treated at the Purification facilities to make it safe for human consumption. Treated water is transferred using water pipes (usually underground).

d. Water storage facilities such as reservoirs, water tanks, or water towers. Smaller water systems may store the water in cisterns or pressure vessels. Tall buildings may also need to store water locally in pressure vessels in order for the water to reach the upper floors.

e. Additional water pressurizing components such as pumping stations may need to be situated at the outlet of underground or above

ground reservoirs or cisterns (if gravity flow is impractical).

f. A pipe network for distribution of water to the consumers (which may be private houses or industrial, commercial or institution establishments) and other usage points (such as fire hydrants).

g. Connections to the sewers (underground pipes, or above ground ditches in some developing countries) are generally found downstream of the water consumers, but the sewer system is considered to be a separate system, rather than part of the water supply system.

STUDY AREA

The Phase-I Project with source in River Kumari near Mukutmanipur Dam are covering the following blocks in Purulia district including Bulk supply to Purulia Municipality & left out area of Barabazar Block:

- Manbazar-I
- Purulia-I
- Barabazar
- Punch
- Arsha
- Bulk provision for Purulia Municipality
- Bulk provision for left out portion of Barabazar Block

METHOLOGY AND PROCESS

1) **Preparation of Base Map:** The contactor shall carryout the Base Map preparation with reference to the latest high resolution satellite image.

2) **Property / Consumer House Hold survey and Data Integration**: Field Data Collection Work in spatial and non-spatial domains respectively through door-to-door consumer /property survey, for the final GIS map linked in Arc GIS platform.

3) **Topography Utility Network Survey:** Validation of existing road network and mapping of existing utility network on to base map and mosaic base filed data. This module comprises of topographical survey of road network using Total Station and Spot level equipment and capturing all water infrastructure details, contours, compiling and conversion of available information and data attaching information to the network details GIS format. Conversion of captured Spatial and corresponding attribute information to network details in GIS Shape File / Geo database format.

4) **Under Ground Utility Survey:** Collection of Exiting Utilities which buried under the ground to avoid any major damages during the execution. If required, carrying out Underground Utility network survey by using GPR (Ground penetrate Radar) & EPL (Electronic Pipe Locator). Conversion of captured Spatial and corresponding attribute information to network details in GIS Shape File / Geo database.

5) **Design Data of Water Supply and Sewer Network:** Geo referencing of Proposed, Existing Water Supply network with corresponding database on to the Base Map and Non spatial data of all the water supply appurtenances shall be assigned with the approved common database structure by the employer - PHED, Purulia, West Bengal.

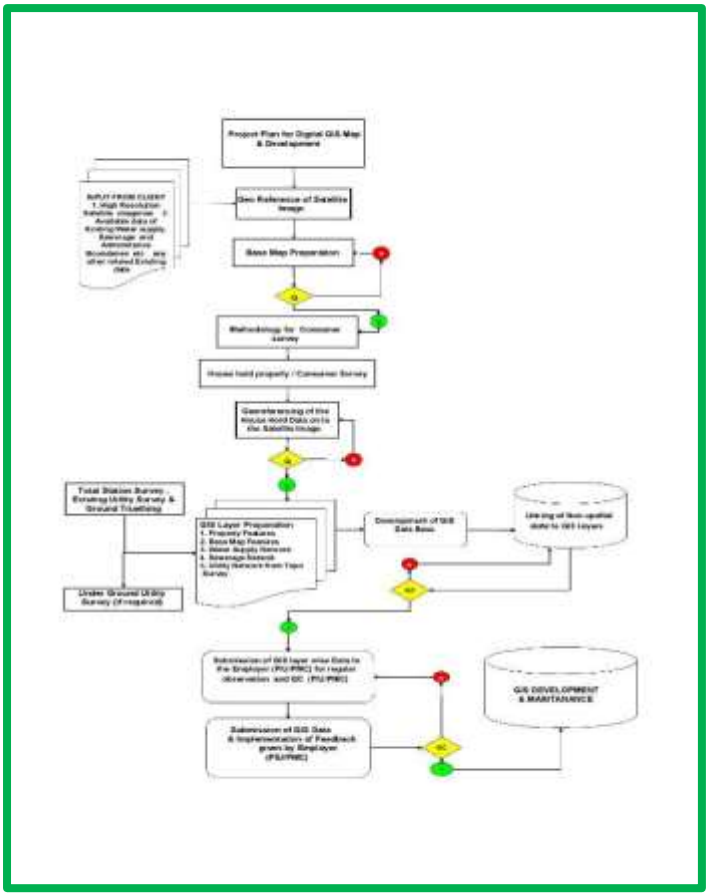
6) **Development of GIS Database:** The GIS developed thus shall be all-encompassing covering the entire scope for the water supply system development. Development of feature wise GIS database for non-spatial analysis of consumer and as well as utility infrastructure data of Water Supply, Topography, Road

Network and As-built data Feature wise database attributes for the entire network features with reference to the approved GIS database structure.

7) **As Built data:** Migration of the final approved as built drawing data of Water supply network distribution on to the GIS System after site verification with exact spatial locations of Latitude and Longitudes (Northing and Easting) and Non-Spatial information with reference to the GIS database structure by Geo referencing with the Satellite image.

8) **Module wise Web Based GIS Application development:** Water Information Management system would enable consolidation of data (at regular frequency) originating from all SCADA sites across the AOI, at the central site at a frequency as decided by PHED. The repository of the information from all SCADA installations across the project area would be named as Water Information Hub (WIH).

Process Flow Chart:



5. PREPARATION OF GIS BASE MAP:

5.1 SATELLITE IMAGERY:

Satellite Imagery is a picture of the earth taken from an earth-orbital satellite. Satellite images may be produced photographically or by on-board scanners. In the early 21st century satellite imagery became widely available when several companies and organizations offered affordable, easy to use software with access to satellite imagery databases. Satellite images have many applications in agriculture, geology, forestry, biodiversity conservation, regional planning, intelligence etc. which depending upon the resolution of the Image.

The resolution of satellite images varies depending on the instrument used and the altitude of the satellite's orbit. For Preparation of GIS Base map for the town Satellite Imagery will be used.

It is proposed to prepare base map by using 0.5 m or better high-resolution satellite image. This image would be used to map all roads, buildings and other natural features to prepare Base Map of the town.

Base map is to be used for Household Survey of whole town. Since all above tasks are to be completed within short time period.

5.2 Collection of Ground Control Points using DGPS:

Differential Global Positioning System (DGPS) is a computer-based system for storing, checking, manipulating, analysing and displaying data which are spatially referenced to earth i.e., geographically corrected. Geo referenced data define objects that have orientation and relationship in two- or three-dimensional spaces.

Satellite remote sensing data are an important source of spatial data of earth surface as an input to GIS, but in raw format it contains geometrical

distortions which make them unusable as geographically standard data sets. These geometric distortions may be in general caused by earth curvature, atmospheric refraction and panoramic distortion. The objective of the geometric correction is to correct for these distortions to produce an image geometric integrity of map. So that map represents surface such that any measurements made on the map agree accurately with the corresponding measurements made on the ground.

A map should conform to an internationally accepted type of cartographic projection. Therefore, in order to integrate remote sensing images as geographic data sets to GIS they must be geometrically corrected and transformed into the standard cartographic projection scale. So that it can be overlaid in perfect registration with other cartographic information's.

5.2.1 Survey Planning: · The total no of Ground control points (GCP) shall be planned in such a way that the GCP's to be collected shall be distributed the total ULB Area of Interest. Sharp and permanent features such as culvert corner shall be selected as GCPs which are present on the ground as well as on the satellite image. GCP shall be collected only after procurement of satellite image. Hard copy plots of the satellite Image chips on convenient scale shall be generated for planned GCP locations and shall be carried to field for post pointing. All the GCPs as well as Base station locations shall be post pointed on the image during the field work.

5.3 Geo-referencing of the Satellite Data:

Geo-referencing:

A raster image like Satellite data, Aerial Photography or Scanned Cadastral map is made up of pixels without any information about the spatial location.

Geo-referencing is the process of assigning coordinates (i.e. Latitude and Longitude) to an image. It is a process of scaling, rotating and translating the image to match a particular size and position. After getting the DGPS survey points, in Image processing software, Geometric correction will be done for the Satellite image.

a. Defining Projection System: Projection – Zone -UTM, Datum-WGS84, Units– Meters

b. Collecting Ground control points and Satellite image rectification RMS report generation

c. Registration of the Image into the new output file generated

5.5 COORDINATE SYSTEMS & MAP PROJECTION

5.5.1 Coordinate Systems: There are 2 types of coordinate systems:

1. Geographic Coordinate Systems
2. Projected Coordinate Systems

- A geographic coordinate system is a method for describing the position of a geographic location on the Earth's surface using spherical measures of latitude and longitude. These are measures of the angles (in degrees)

  decimal degrees (DD) 76.12

  degrees/minutes/seconds (DMS) 76° 30' 12" E

- A projected coordinate system is defined on a flat, two-dimensional surface. projected

coordinate system has constant lengths, angles, and areas across the two dimensions. A projected coordinate system is always based on a geographic coordinate system

Note: It is proposed to use UTM Coordinates system with the projection parameters of Datum - WGS84, Zone 45 North, Units – Meters

5.5.2 Map Projections: A map projection is a way to represent the curved surface of the Earth on the flat surface of a map. A good globe can provide the most accurate representation of the earth. However, a globe isn't practical for many of the functions for which it requires maps. Map projections allow users to represent some or the earth's entire surface, at a wide variety of scales, on a flat, easily transportable surface, such as a sheet of paper. Map projections also apply to digital map data, which can be presented on a computer screen. There is three main type of surfaces that globe can be projected on. These include:

i). Azimuthal

ii). Conical

iii). Cylindrical

Universal Transverse Mercator (UTM) is a 'pseudo cylindrical' conformal projection (it preserves shape). The UTM system divides the earth into 60 zones each 6 degrees of longitude wide. These zones define the reference point for UTM grid coordinates within the zone. UTM zones extend from latitude of 80° S to 84° N. In the Polar Regions the Universal Polar Stereographic (UPS) grid system is used. UTM zones are numbered 1 through 60, starting at the International Date Line, longitude 180°, and proceeding east. Zone 1 extends from 180° W to 174° W and is cantered on 177° W. Each UTM zone is divided into horizontal bands spanning 8 degrees of latitude.

5.6 Base Map:

A base map displays the fundamental data set, key physical features such as Buildings, roads, railway Network, rivers, neighbourhood, schools, other landmarks etc. used to render sector data more meaningful.

A good base map should easily answer the question "Where?" a particular attribute is on the map. The roads, landmarks and other places that are included in the map should be spatially related and correspond to the ground position. Displaying or analysing the base data with the sector data assists the user in making effective and well informed.

The geo-referenced base map shall serve as a foundation for different mapping.

Requirements where all other thematic maps may be overlaid for spatial analysis. Thus, it shall aid Planners in preparing master plan. It is important for the mapmaker and also the target custodians of this data to understand the procedural steps in the production of base maps, the hierarchy of the sources of data and the nature of the data, in addition to actual usage of the data itself.

The registered geo referenced image is used for delineation of study area and preparation of preliminary base map. Base map will be created by interpretation and digitization from the Satellite image. In this process layer name, line type and colour for each feature will be standardized. Following layers/information shall have been mapped from Satellite image. All Major Physical features with reference names such as Administrative Boundaries, Road network of Carriage Way, Right of Way, Rivers, canal and other water bodies, Buildings and Open Plots., Agriculture Area, Open Scrub Area and other Land use features. Landmarks.

Layer Structure and Symbology for Base Map shall be as under:

Base Map is prepared at scale 1:1000. Projection of Map is UTM, Datum is WGS 84 and UTM Zone No, Landmarks and road names are marked as available from secondary sources which include maps received from client and other

open sources. A reconnaissance survey shall be carried out to understand building typology on ground and mark more landmarks and road names. This shall be useful for Household survey team to identify correct location on ground to start survey.

5.6.1 Unique-ID Preparation

It is an absolute must to use unique asset IDs in our modern era of computers, databases and GIS, unique assets IDs play a critical role in reducing duplicate or confusing information about the assets and also is the first step to being able to integrating the GIS systems.

The Unique-ID consists of:

Block Number.

Village/DMA Number.

Property Boundary number - System Generated.

5.7 Quality Assurance:

8.7.1 Digital Quality Check:

- All Layers should be topologically clean and correct.
- All Buildings & plot boundaries are digitized correctly.
- All buildings should have unique-id.
- All Major roads and road curvatures are digitized correctly and road names are given properly.
- All Important landmarks marked correctly.
- All Polygon boundaries should meet exactly.
- All Polygons should contain exactly one label.
- Every feature should have attribute records.
- The data will be checked for completeness and displacement.
- Edge matching, symbology and layer checking.
- Should not have undershoots / overshoots.
- Dangling vertices shall get removed during this process.
- The attribute data has to be linked to the particular feature Point/ Line / Polygon.
- Quality checking of spatial and non-spatial data at every major activity should be maintained

5.8 Base Map for Household Survey:

Plan to carry out household survey Gram panchayat / Village-wise as Gram panchayat / Village boundary follow physical feature on ground. Division of whole Gram panchayat / Village in parts as per the shape and size of Gram panchayat / Village and make sure that all building nos., important features and landmarks are readable in print so that it becomes manageable for household survey team to carry in field. Each building in map is assigned with unique identity no. on map. Format of this unique ID consist Gram panchayat / Village part no. and serial no. Following is the method-

a. Gram panchayat / Village is divided in parts following roads which cut Grumantite area in parts.
b. Other roads which do not cut Gram panchayat / Village area completely are marked as inner roads in map. These roads shall be useful for survey team to identify location on ground.
c. Building in every part is assigned with a

unique no. Additionally, open plots found in current satellite image are also assigned with unique no this shall help survey team to fill up form for the recently constructed /under construction building in these open plots.

d. Agriculture areas and open scrub areas are also marked with different symbology

Quality Check has been done thoroughly at every step. Set procedure for finding out plots without numbers or having duplicate numbers. Find out plots with errors and correct them before creating topology.

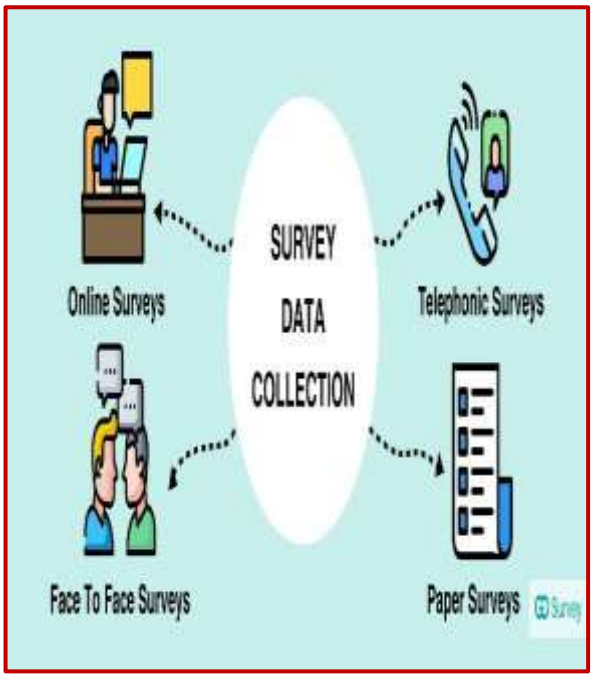
6. Consumer House Hold Data Integration:

The door-to-door survey of all properties whether connected to the network or un-connected and obtain the details in regard to name, address, number of resident members, categories of general residential households (independent housing, group housing connections and apartments), urban poor households, government housing, non-domestic, commercial, institutional, religious places, industrial and any other category of resident, consumers income status in the Service Area ,availability of water connection, metering status, estimated consumption levels, alternate water supply arrangements, existing sewerage system , willingness to pay, etc. The data collected from Door-to-Door household shall be geocoded to the building footprints from the digitized satellite image.

A complete door to door consumer survey to ground truth the footprints and the properties in the subproject area shall be carried out. It may happen that the satellite image may give one footprint but the footprint may be divided in several properties internally either horizontally or vertically. The foot print shall be divided to show clear distinction

Maps of all parts of Gram panchayat / Villages with the background of Satellite image shall be provided to Household survey team to start survey with reference to the approved consumer survey format.

- House hold properties have to be surveyed and spatially located on the map
- For the new properties or new subdivisions, it has to be updated in the map as well as the attribute data has to be collected.
- For the attribute data, enquiry has to be done to finalize the new data or verify the old data available with the agency
- The types of properties as per the consumer survey format will be considered as an attribute data.
- Survey form consists of fields which are important to link survey information with map in a later stage.



Adopting the following method to collect the Property consumer house hold data: -

1. Survey team shall identify the location to start survey.
2. In the selected part of Gram panchayat / Village, survey team shall identify each building on ground as marked in the Base map
3. Survey team shall write GIS ID no. using marker on building.
4. Each survey team is assigned a part in the Gram panchayat / Village along with the part

of Gram panchayat / Village map to complete survey in that part by visiting and interviewing each structure/house/household in the GIS Plot as per the approved Questionnaire

5. In absence of any road name in the town, each enumerator/team of enumerators identifies a corner of the part of the particular Gram panchayat / Village (starting point) and starts visiting each plot one by one in the lane.
6. As soon as information from a particular house/structure/household is obtained and recorded in the hard copy questionnaire form or digital handheld tab, an identification mark on the main door of the structure/house is written as an indicator of complete enumeration of the structure/house/households.
7. Immediately after completing all the structures/houses/households in a GIS plot, a tick mark is put in the map on that particular GIS plot as an indicator of completion of survey in that particular GIS plot ensuring coverage of each House / household /Structure in a GIS plot and minimizes chances of leaving any structure/house/households in the part/Gram panchayat / Village/area which uncovered.

6.1 Consumer Survey Field Data Quality Assurance:

At the end of day work and completion of survey in a part/Gram panchayat / Village, Housed survey team shall sit together and verify that each GIS plot in the base map is covered. If any property / Consumer is found not covered, enumerators assigned that particular part/Gram panchayat / Village are asked to revisit that house hold property to collect all the information again next day.

A three level data quality checks is being followed. At first level each supervisor is conducting 10 percent spot check and back check on each enumerator to observe and identify any gaps/discrepancy in data collection the same if found will be rectified by revisiting the GIS plot/area by the enumerators. In case Hand held Tabs are used for survey, every day 10 percent of filled in forms in soft version is converted to hard copy prints for field checks

Similarly in 2nd level project coordinator is also conducting random visit to check lapses/discrepancy in data/information obtained from the household/house and observe that all processes/methods of data collection are followed properly by the enumerators and supervisors. The coordinator is assigned to conduct 5 percent spot and back checks on select enumerators and supervisors on a particular day to keep constant vigil for maintaining good quality of data.

Third level of check engages survey director who conducts random check on enumerators and supervisors to make sure all the methods and norms of survey are fully complied while collecting information from each household/house/structure

After completion of consumer survey for a part of Gram panchayat / Village map, survey team shall sit and analyze the information collected, and seen the pattern of data collections/information and amend the rules and quality control measures, re- orient teams for data collections information's. Revisiting of house locked properties and non-cooperative houses hold properties to get the required information.

6.2 Training of Surveyors for House hold data collection:

Conducting training to all surveyors in multiple sessions using hard copy consumer survey form and hand-held digitized tablets.

The android hand-held technician shall able to move the GPS Point to the exact spatial location of the property being surveyed and shall freeze the GPS Location once after being ensured.

After fixing the GPS location of the property, the enumerator shall capture the required information of the consumer details as per the approved consumer format During the sessions, explain each and every field of survey form to whole team with possible data details.

Explain the survey team that all GIS related fields with reference to map additionally; conduct practical training on ground and explained them how to identify the location and fill up all the forms accordingly both in hard copy and in Android tablet.

6.3 Verification and Updating of House hold Properties:

After Digitization of all physical features, printouts of all digitized vectors on satellite imagery are sent to field for verification. Based on the Data model as mentioned under to achieve a high degree of accuracy in the data, a field survey will be conducted to collect information on important landmarks, buildings etc. The field identification will be carried out for randomly selected, doubtful cases and for the features, which are difficult to interpret on Satellite image and assigning the unique numbers for newly marked buildings.

To verify the proof/ check plots of maps marked for incomplete features with reference to the ground, collect the information on features, especially man-made ones, available on satellite images, collection of names for important land marks, roads/ streets/ lanes/ by-lanes, areas, etc. or any other feature not captured in the ULB. Check the accuracy of some points on the ground randomly to meet the accuracy standards. The surveyors for field verification shall go round, street by street, to verify the features that are marked on proof plots.

6.4 Integration of Consumer House hold Survey data with GIS:

After receiving the Data in softcopy Excel format with Plot and Building ID (Unique ID will be given to Plot boundary where there is no building) information, linking will be done using Unique-ID as a primary key with the help of GIS Software.

Final database of all survey information shall be linked with map with reference to unique id

of building. Map and database shall be updated accordingly-

Whole process shall be done in GIS. Final output of this process shall be a shape file / Geo database file with all data fields. In addition to this, there will be other layers with attribute information like Roads, Water bodies, other land base features and utility network assets as identified through Total Station Survey and underground utility Asset survey. All these layers will have necessary attribute data link to them This shall be used for further data analysis and data modeling During the process, creating various types of thematic maps as per the project requirement to demonstrate data. Indicative data structure with layers, attribute details, fieldname, data type, etc.

Consumer house hold survey output shall be geometrically rectified with reference to the GIS Base Map / Satellite image with detailed consumer attributes

Fig: Showing the sample Base map in different with different Scales

PART MAP in 1:1000

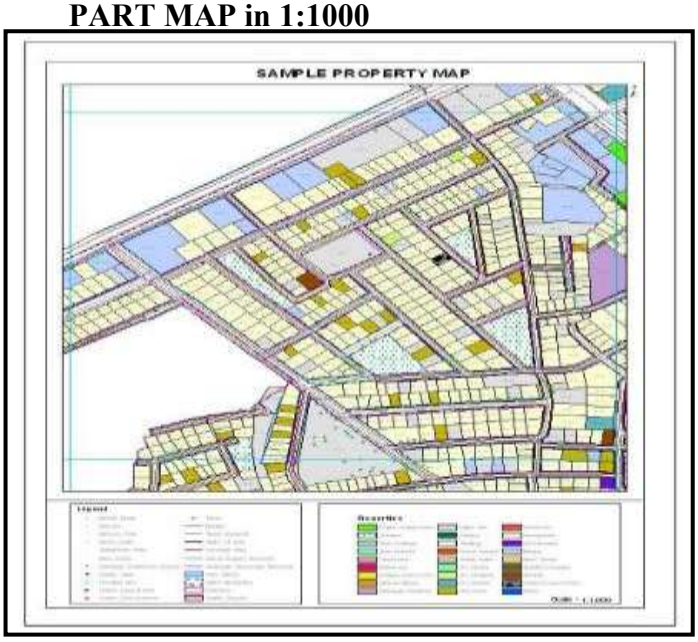
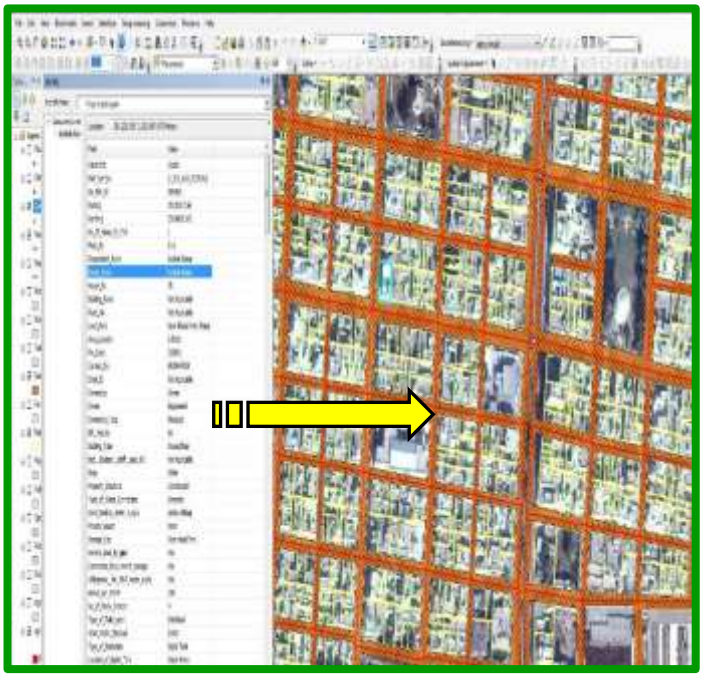


Fig:Shows the sample Consumer Data base linked to the spatial locations of the property

Fig: Sample property consumer / House hold surveyed data integrated in GIS.



7. TOPOGRAPHY SURVEY

A topographic survey is done to locate natural and man-made features on a particular parcel of land. The Topography survey is different in that the elevation of the surface of the land is surveyed and represented on the resulting map of the survey. The topo survey usually also includes any man-made features, like utility lines. The survey will show above ground improvements like buildings, utility poles, retaining walls, etc.

Topographic surveys are usually carried out in order to have an accurate record of the existing conditions of a parcel of land that is about to undergo some type of construction activity.

The elevation or differences in elevation on the surface is usually shown as contours. A contour line is a line that connects points of equal elevation.

Detailed Topographic surveys are the basis for detailed plans showing the site layout band utilities. The area to be covered by detailed surveys should be kept to a minimum to serve the requirements of the actual building area and should not be made where reconnaissance surveys will serve. Detailed topographic survey may be made by Plane table, Total Stations, GPS, and Laser Scanning Etc.

There are several kinds of utility surveys, but principally they can be dividing in to two major types. One type is performed for the layout of new systems, and the other is the location of existing system. Typical utilities that are located include communications line, electrical lines etc. The layout of new system can be described as a specialized type of route surveying, in that they have alignment and profile and rights of way similar to roads, rail roads, canals etc. Utilities are transportation in their own right. A great portion of utility surveys involves location of existing utilities for construction planning, facility alteration, road relocations and other similar projects. This is a very important part of the preliminary survey necessary for most of the projects

The objective of Total Stations is to collect spatial details along the roads on which the total station survey is being conducted including all the features such as roads, building foot prints, electric and telephone poles, manholes, trees etc.

Total station surveying - defined as the use of electronic survey equipment used to perform horizontal and vertical measurements in reference to a grid system. (Eg.UTM).

The accuracy of a topographic map is of critical importance. If the map created is not accurate it could cause conflicts in zoning and construction projects. Therefore, each survey is held to a certain degree of accuracy. Measures are taken to ensure that the error does not exceed a certain level, and corrections are made for random errors.

7.1 Topography - Services to be Captured and described:

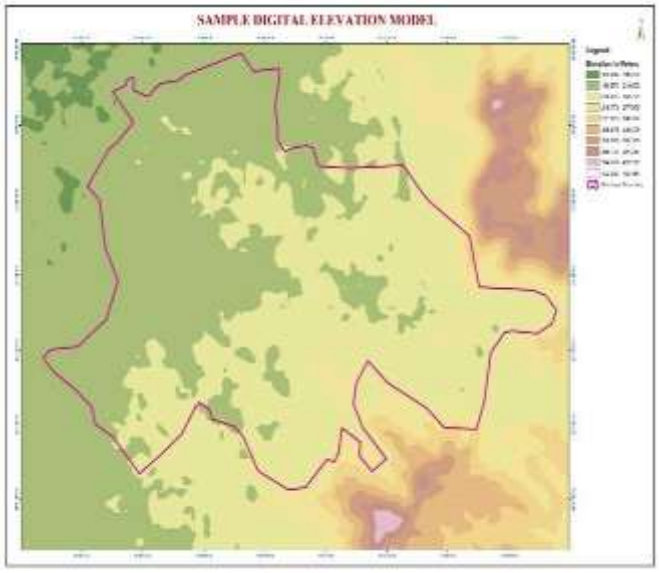
Topographic survey shall capture from the established control / traverse points. Complete topographical survey shall carry out for entire pipe line route and the transverse profiles (Strip survey) at every 30-meter interval along the pipe and spot levels at 5m x 5m grid in sewage pumping stations. Below listed topographical features were collected:

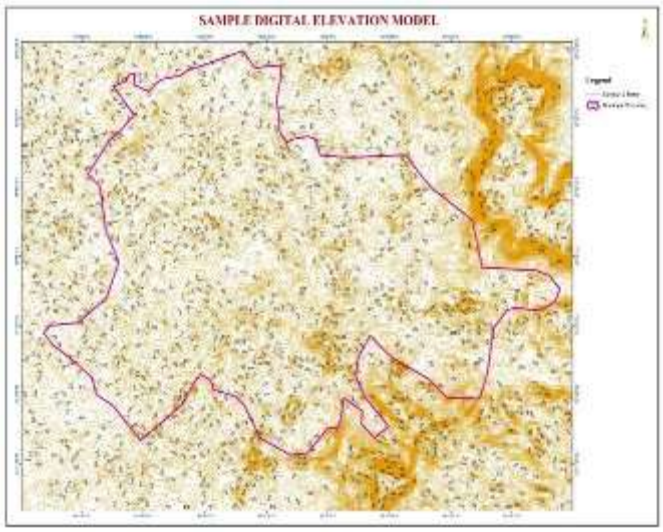
- Ground Levels
- Building Foot Prints
- BT Road
- CC Road
- WBM Road

- Katcha/Un mettled Road
- Foot path
- Divider
- Canal
- Culvert
- Drain
- Drain Chamber
- Boundary wall
- Fencing
- Earthen shoulder
- High Tension line
- Railway Track
- River
- Water bodies
- Electric pole
- Transformers
- Hand pump
- Public Taps
- Tube wells
- Public Convenience
- Vats and Bins
- Man hole
- OHSR, GLR& other Reservoir's
- Valves & Flow Meters
- Telephone pole
- Tree
- Land Marks
- Temple etc.

- Generation of accurate 0.5m contours by using the collected spot / Ground levels during the Survey
- Topographic survey output shall be geometrically rectified with reference to the GIS Base Map / Satellite image with attribute information with reference to the approved GIS database structure.

Fig: Sample Digital Elevation Models and contour generation w.r.t the Topographic Survey.





8. Integration of Proposed, Existing Water Supply and Sewer Network.

Superimposition of all existing, design, proposed water supply, Sewer network with reference to the base map. When combining GIS layers from different sources, there may be discrepancies in dataset, hence care must be taken to maintain consistency with respect to Output projection

parameters for proper registration amongst such layers.

The data shall be geometrically rectified with reference to the ortho rectified satellite image/ Base map and assigning the database as per the annexure - 2.

9. Development of GIS Database:

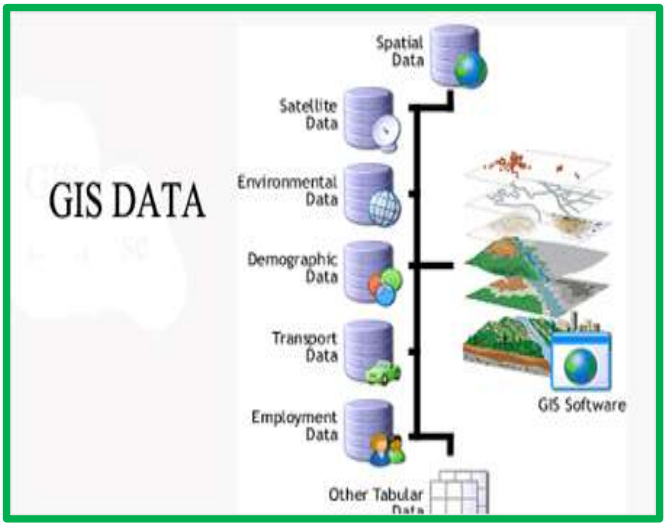
"GIS focuses on the analysis and synthesis of information, which relies heavily on the database components, which are often stored in separate tables, but are linked to graphic entities" GIS in concerned with features which have both spatial and attribute information

GIS Data maintained in attribute tables without a direct relationship to graphic element(s) representing their physical location. Therefore, a linear referenced highway network is required to allow the overlay and display of these data through use of dynamic segmentation. This section outlines the data and procedures necessary to create the underlying linear referenced GIS database as well as ensure compatibility between the database and Maintenance Division records.

Attributes are the characteristics of the map features and hold the descriptive information about the geographic features. Attributes are the non-spatial data associated with time and area entities. To collect this information of the study area field survey was carried at individual house and utility wise.

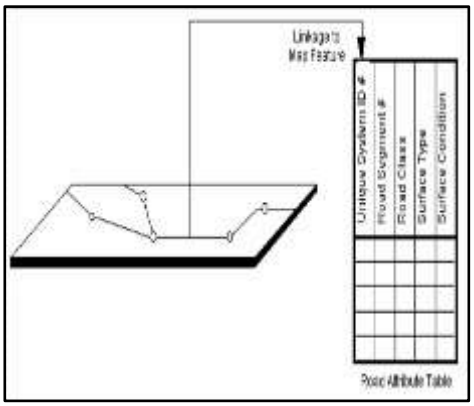
GIS in concerned with features—which have both spatial and attribute information.

A GIS "map" is actually a graphic and dynamic representation of information in a database.



9.1 Database:A database is a collection of information about related objects usually arranged in a tabular format. The headings across the top of the table are usually called fields and list the different types of attributes that are being catalogued for that database.

Tabular information is the basis of geographic



features, allowing visualizing, querying, and analyzing the data. In the simplest terms, tables are made up of rows and columns, and all rows have the same columns. The rows running across the table are called records, within each column/row cell is a specific value for that record and that attribute.

9.2 Joining non-spatial data to spatial Locations:

When the layers on map don't share a common attribute field, we can join them using a spatial join, which joins the attributes of two layers based on the location of the features in the layers.

One-to-one

Assumes that there is a direct match between all records in both databases

Suppose parcels feature attribute table and another attribute table that contains the names of parcel owners. The graphic below shows a one-to-one relationship. Each parcel has only one owner, so each record in the feature attribute table will relate to one record in the owner's attribute table. For this type of relationship, uses a table join.

9.3 Relating (linking) databases:

Unlike joining tables, relating tables simply defines a relationship between two tables. The associated data isn't appended to the layer's attribute table like it is with a join. Instead, you can access the related data when you work with the layer's attributes.

Relating allows viewing databases as separate physical entities yet still enjoying the benefits of associating two databases: a record selected in one database will also be selected in the linked database

This may help by reducing the visual size and dimensions of associated databases that result from joins.

One-to-many
Each record in source database may match with more than one record in the destination database
Many-to-one
Two or more records in the source database may match up with a single record in the destination database

The graphics below show both a one-to-many and a many-to-one relationship. On the left, one parcel can have many owners; therefore, the relationship is one-to-many. On the right, many parcels can have one owner, resulting in a many-to-one relationship

Fig: Sample feature wise database for Water supply pipeline line.

GIS DATA CREATION / INTEGRATION:

i. Migration of the final approved as built drawing data of Water supply network distribution on to the GIS System after site verification with exact spatial locations of Latitude and Longitudes (Northing and Easting) by Geo referencing with the Satellite image.
ii. The Non-Spatial attribute information of all the network system of water supply shall be fed in to GIS System as per the GIS data base structure.
iii. This system enables the identification of the consumers, spatial data, non-spatial data and for statistical analysis with the unique visualization.
iv. This provides a spatial dimension to the network systems of Water Supply and presentation of results in both graphic and

report format.

v. The GIS output shall be in shape file or Geo database file format. The same data shall be published on to the Web GIS along with the Base Map, Consumer House hold data, Topographic Utility details, Underground utility details and Network of pipe lines installations in Enterprise Web based GIS mode

vi. This application will cater to the viewing, analysis and utilizing the geographic information needs of the concerned departments. This should also play a role of decision support system for local body.

10. Quality Checking:

Checking of GIS Submissions and mapping works shall be carried out internally by the contractor firm for the completed activities at each of the stages and before submission of the deliverables to the client for examination and approval. The quality checks will be done by the Consultants/ client/ ULB in accordance with the specifications and necessary corrections/ feedback will be provided to the firm. The firm shall, on such request, provide detail documentation of procedure, make available to the client for the queries in any of the tasks.

The firm shall submit GIS Layer wise data to the employer for regular observations and feedback.

Fig: Sample feature wise database for Water supply pipeline network.

12. Water Information Management System (WIMS)

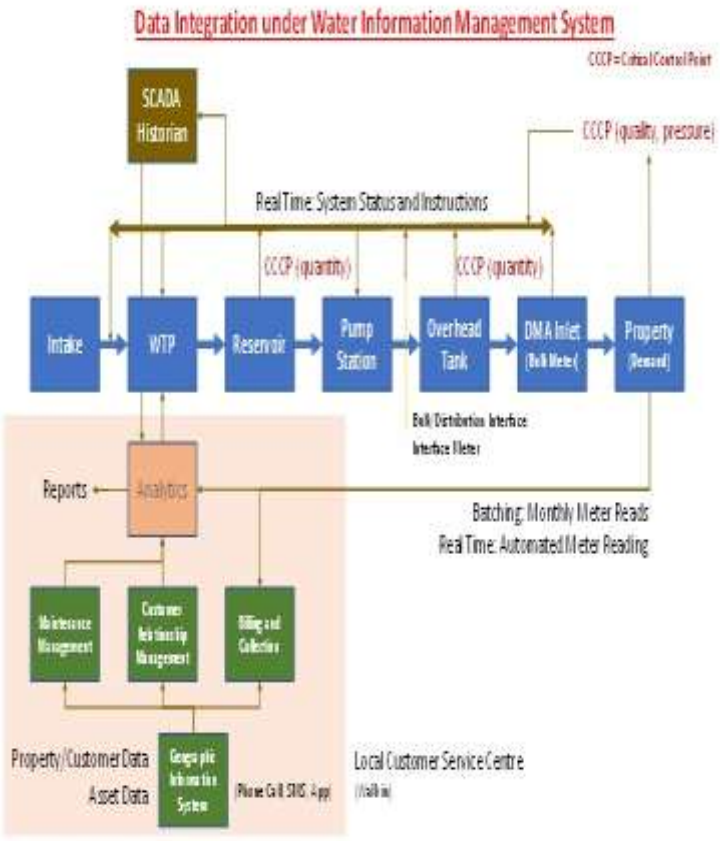
Detailed technical, functional and system requirement for the WIMS should be formulated by the System Integrator in consultation with department based on this section. General features of WIMS solution are described below.

- Integrate data from nearly any kind of data source to view relationships, patterns and correlations and to help bridge the gap between the physical world of control systems and the realm of business decisions.
- View the contextual relationship between systems, such as pipes that are connected to a particular pump, which enable users to foresee the potential impacts of events on multiple systems.
- Provide integrated data visualization, real-time collaboration, and deep analytics capabilities.
- Add and remove systems and devices without being concerned about compatibility.
- Set up business rules that can provide alerts when certain conditions are true.
- Identify correlations and patterns by comparing data in current and historical reports.

- Addressing leaks and other water loss issues related to aging infrastructure that requires greater visibility into what is happening throughout the water network by using existing information from a utility's hydraulic model, SCADA systems, asset management systems and meter data.

- Provide quality and quantity auditing in water supply systems for further analysis and optimization, rationalization and improving service delivery.
- Provide a rule-based data flow directing data into a structured format that can be used for analytics, reports and measuring key performance indicators (KPIs).
- Provide a web-based, configurable interface that is specific to the user's role and needs so that everyone in the organization can see and collaborate on the same data in their own way. The ability to collaborate should allow synchronization of effort, audit trails, collaboration, and group decision making. It should also help decision makers consolidated information that helps them anticipate, rather than react to problems.
- Provide integration of all field instruments, data collection at centralized server, integration of GIS mapping for underground utility piping, transfer of all data to the Website of WBPWSP(PURULIA)-PMU for providing the visibility to all users.
- Maintain centralized user registry to hold user profiles and roles to accommodate various roles of the department and share information on need-to-know basis for effective management, planning and redressal of the situational demands like supply, corrective maintenance and planning activities including near real time information flow for accurate reporting.
- Provide advanced analytics and reporting capabilities that provide real-time feedback on the status of the water supply, enabling engineers to make timely modifications to the water distribution patterns.
- Informed decision of future water network planning by understanding the best route, best source, distribution segmentation of network to meet demand through Analytics.
- Mobile application for decision makers to have real time information on the move.
- Allow visualization of KPI's related to water systems on Geo Map with performance, capacity, demand, trend, forecast, status etc. in near real time world.
- Create capability of periodic calculation function using pipe network data (dimension, friction factor, length) and measured data (flow and pressure). The results would also be displayed on the GIS-MAP by color coding distributions or numerical labeling. The pipe network data of GIS shall be edited and set virtual measurement points. With them, the pipe network data for calculation shall be generated.
- The system shall also support water outage simulation function. The function simulates water outage by specifying arbitrary shutdown points. The function also displays water outage regions and affected areas/customer meters by the water outage on GIS map and displays/suggests operation valves to minimize water outage regions.

Figure 1: Water Information Management System



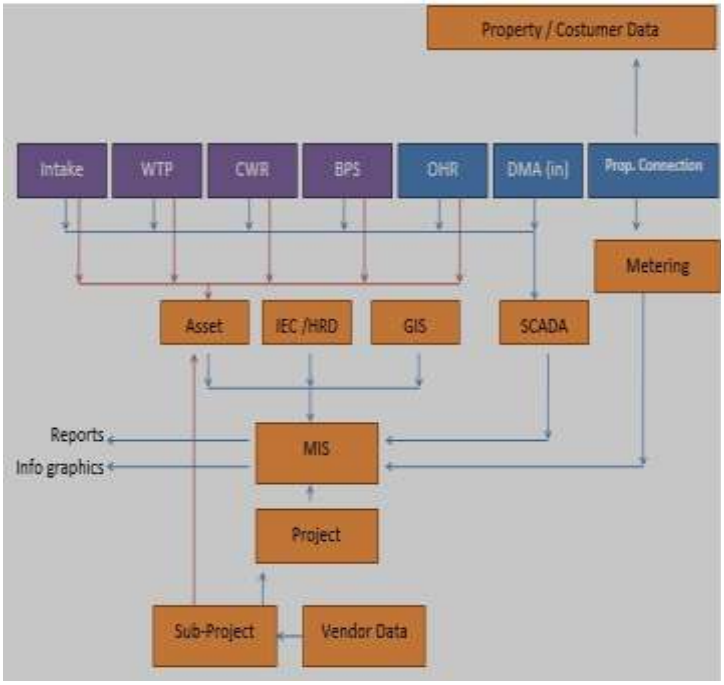


Figure 2: Flow Diagram

The SI shall deploy WIMS to support the following goals:

1. To provide an integrated near real-time view of water assets in the project area on a geo-spatial map.
2. To provide a single version of the truth to various hierarchies within the organization and thus move the organization's energy from data mining to problem solving.
3. To convert data into actionable insight through business analytics & predictive analytics algorithms.
4. To allow "management by exception" through events and incidents rather than passive monitoring.
5. To allow the organization to focus on proactive management using predictive analytics.
6. To allow the organization to design and integrate more complex features without requiring major rework of the basic architecture.
7. To provide capability to integrate financial KPIs to drive the organization to better fiscal balance.
8. To allow water engineers to refine underlying equations that govern KPIs such as water supply by zone rather than giving static view.
9. To create executive analytical dashboard.
10. To provide ability to drill down into the history to see values and trends of each asset.
11. To model how assets are connected to each other and their state. Historical asset information and trends can be shown and investigated online.
12. To maintain adequate audit trails; data to be accurate, real-time (periodic intervals) and secure.
13. To provide ability to do ad hoc reporting and to build report based on multidimensional factors.
14. To provide the ability to integrate data from external open sources.
15. To provide ability to have Standard Operating Procedures kicked off automatically by the system so as to ensure problem situations are addressed automatically and quickly.

12.1 Proposed System Schematic:

The proposed system schematic is shown in the figure and described as follows:

- WIMS Connector Utility should be deployed on SCADA Station or a standalone PC connected to SCADA PC through LAN. However, the connectivity of WIMS Connector Utility with WIMS application would be through OPC-UA interface using public network in secured manner.
- Different modules of WIMS application would be accessible from remote PC using the standard browsers for monitoring, configuring and reporting features.
- WIMS Mobile Application would be running on Android and iOS phone connecting to WIMS application.

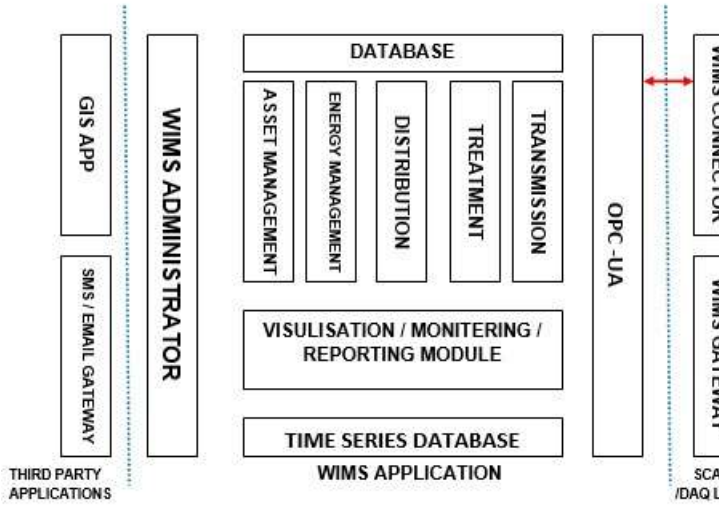


Figure 3: System Architecture

12.2 Benefits of Integrated Water Information Management System:

1. Accountability of Water is improved - Total accountability in Water production and Water distribution system.
2. Equitable distribution of water can be achieved through out the supply area.
3. Demand management can be implemented successfully based on online information and historical data availability.
4. Continuous assessment can ensure water Quality & Quantity.
5. Optimization of plant machinery and chemical usage is improved.
6. Improvement in Pumping efficiency
7. Improves quality of service.
8. Continuous monitoring and display of network flow status and supervisory controls.
9. Continuous monitoring of overflows, leakages, Unaccounted for Water (UFW) at various stages of distribution to control wastage.
10. In-time decision is possible based on automated periodic reports and trends.
11. Manpower usage is reduced for data collection and accurate data availability for remedial measures.
12. Proper maintenance schedule for water production plant can be achieved.

12.3 Scope of WIMS Work

The SI shall be required to develop a platform for the scope of services as below.

- Design, installation, testing, deployment, integration and maintenance of centralized Water Information Management System (WIMS) and Project Progress Monitoring System (PPMS).
- Development/customization, testing and deployment of WIMS connector utility on WBPWSP (Purulia)-PMU portal as downloadable windows setup and installation, configuration, integration & maintenance of the connector utility for various SCADA locations with WIMS.
- Data Acquisition (DAQ) locations and its configuration and integration with WIMS.
- Establish and maintain network connectivity of various SCADA and DAQ locations with WIMS.
- Creation of WBPWSP (Purulia)-PMU Smart Analytics Platform.
- Development, Testing, implementation and publishing of WIMS Mobile Application.
- WIMS should provide an integrated view of water movement for the entire project area from WIH at WBPWSP (Purulia)-PMU office including Water Transmission, Water Distribution, Water Leakage, Water Treatment, Water Quality, Pumping Station, etc.
- WIMS shall support unlimited tag database storage including the sensors/tags/WIMS gateway installed and integrated in the proposed solution by WBPWSP (PURULIA).
- Customization and integration of all the proposed software solution supplied under this project as per the client requirement.
- The proposed solution should provide a web-based interface access for unlimited number of users.

- SMS gateway and email gateway for integration with software solution should be provided by the SI.
- The proposed system should be built around OPC-UA architecture, and the generic control is proposed for leveraging full power of OPC-UA based connectivity. In current scenario, whereas SCADA or device are connected to WIMS using Gateway or WIMS Connector Utility, it may be possible that two-way connectivity (i.e. read and write of parameters) are not available in the available interface. However, WBPWSP (Purulia)-PMU propose to use the leverage of control facility using the WIMS solution.
- The proposed software solution should be scalable to expand the project area / Area of Interest (AOI) through customized integration tools.
- Integration of new devices has to be undertaken / feasible as and when required.
- The SI has to undertake survey at SCADA locations to assess actual site condition and requirement like network connectivity, electricity availability, Connectivity between sensors and master SCADA etc.
- The proposed solution (hardware and software) shall be IPv6 Compliant and shall be vendor agnostics so that any future additions for any other systems/solutions will not have any impact on overall WIMS implementation.

The scope of services will specifically include the following outputs:

12.4 Development of Water Information Hub:

This includes supply and installation of the requisite Server Site Hardware and related software. The SI will have to do proper sizing and undertake supply, installation &commissioning, testing, certification and maintenance of software licenses and IT infrastructure required for GIS implementation.

Web Enabled Portal:

The Web GIS based Portal has to be developed using the industry standard technology and development tools and shall facilitate universal accessibility through the internet. The application shall be intuitively designed to facilitate an easy to use ergonomic design interface for hassle free operation and information access. The Application shall have the following broad features.

- Should be COTS based solution from reputed OEM based proven industry standard commercial off-the-shelf (COTS) technology and should exist in the market for past 5 (five) years. OEM self-certification with proof to be furnished.
- Design of the website as per the GIGW guideline of Govt. of India.
- Rich User Interface (Web 2.0) based on framework like Bootstrap. Should support HTMLS, CSS3, Java Scripts Framework like JQuery and other futuristic frame works on Secure Socket Layer (SSL).
- The proposed deployed GIS and image processing/analysis software on which the customized application needs to be developed, should be 8 core based and should run as a native 64-bit application and should support Windows 64-bit and Linux operating system 64-bit.
- Compatible to all the browser like Chrome, Mozilla Firefox, Internet Explorer, Safari, Opera. Should support Video Content without Plug-in. Support to Search Engine Optimization.
- User-friendly System with logically organized navigation controls for easy information accessibility.
- Customized Portal views for Administrative and Public users
- Web portal should be free from program error or any vulnerabilities such as malwares/ Virus/ Spams.
- Support virtualization, encryption and compression features
- Integration of WIMS of different thematic layers and Base Map (High Resolution Satellite Image, Topographic Maps, Hybrid maps) from Google maps, Bing maps etc.

- Table of Content (ToC) based organization of Spatial Data Layers.
- GIS toolbar for Spatial Data Management (Pan, Zoom, Scale, Measurement – Distance/ Area, Identify/ Information Window, Search)
- Query Builder interface for execution and generation of attribute (geo-spatial queries) on Area of Interest (AoI) along with generation of information on sidebar for each query (e.g. On selection of a particular AoI, an information panel displaying the administrative officers of the area concerned plus socio-economic data is also expected to be popped up) for Decision Support.
- Generation of Map based reports at the user end
- Integrated with standard email and instant messaging services
- Social Media integration and interactivity Language (Java /.Net / NodeJS / PHP/ Industries standard database /RDBMS / MySQL / Postgre SQl).

12.5 WIMS Modules

The aim of this Package is to give PHED the ability to have a cross-sectional view across all its subsystems. The system should enable the department with complete water accounting right from source (reservoir) till distribution. This will give department the ability to analyze losses at each stage and take remedial measures based on severity of the situation.

Various modules to be developed under WIMS are described in brief below. All the modules should be integrated into single centralized application. Functionalities listed within each module may also extend to other modules based on the requirements to be finalized in consultation with the Department.

12.5.1 Water Transmission System Module:

- This shall include both raw water as well as clear water transmission mains. Water transmission mains will have various meters and sensors installed on the line viz. flow meters, pressure sensors, energy meters etc. The reading from these meters and sensors are transferred on real-time basis to local master SCADA system to which these meters and sensors are connected.
- The SI is required to capture all data from flow meters, pressure sensors, level meters, pH sensor, etc. to SCADA central server without any data loss in transfer of data from local SCADA to WIMS.
- The Water Information Hub, shall have a web-based MIS reporting to support online monitoring, trending, historical reporting with daily, monthly, peak hours-based aggregation as well as exception reporting.
- The data to WIMS should be synchronized with Local SCADA using periodic update through Network. The SI should use OPC UA (Open Platform Communication – Unified Architecture) for periodic update.
- The data would be stored in the central database / Big Data Platform. The streaming analytics should be possible here with in-memory visualization capability with full set of data mining, predictive modeling and forecasting capabilities.
- The module should allow visualization, monitoring, controlling, and reporting for various components.
- The module should leverage facility of node/location/station categories along with tag categories and attributes available in Tag Management module to generate new visualization components / reports/ analytic screens.

12.5.2 Water Treatment System Module:

The process starts from intake to the WTP and the module would be used for monitoring, controlling and analysing the water treatment system/ water quality data (key parameters like pH, turbidity, dissolved oxygen, water levels in intake/WTP). There should be automated periodical synchronisation of data from the SCADA locations. The module should also allow integrating water quality data acquired

using offline instruments by interoperability standard such as XML / CSV through a web interface.

- Water quality and leakage management is required:
  - To ensure right quality of water to be distributed daily to the public
  - To ensure right quantity of water daily to the public at the right time
  - To reduce cost per unit water by reducing water losses due to overflows, leakages.
- Ensure water quality by monitoring following, using sensors and other devices:
  - Monitoring of turbidity, pH & chlorine levels at Water Treatment Plants
  - Monitoring of contaminations, mineral content, anti-oxidants etc. in water
  - Monitoring of chlorine level at Service Reservoirs
  - Timely trigger to plant personnel on how much local chlorine boosting to be done in case of Chlorine decay during distribution
  - Monitoring of cleaning up of reservoirs and alert in case of failure in cleaning
  - Real time alarms and SMS notifications in case of exceptions

12.5.3 Water Distribution System Module:

- WIMS for water distribution system will include:
  - Ensuring right quantity of water supply to the public.
  - Monitoring distribution of water from sensors/meters installed at zone level.
  - Monitoring Reservoirs are fully filled to their capacity.
  - Monitoring of inflow, outflow & water level at plants and reservoirs
  - Monitoring of schedule adherence and duration adherence of water distribution
  - Timely trigger to plant personnel in case of deviations/abnormalities
  - Monitor filling up of tanks in relation to the demand in service areas
  - Measuring flow / pressure variations in pipelines for leak detection
  - Managing demand variations with the help of historical data and distribution patterns
  - Real time alarms and SMS notifications in case of exceptions
- The module should allow visualization, monitoring, controlling, and reporting for various components.
- The module should leverage facility of node/location/station categories along with tag categories and attributes available in Tag Management module to generate new visualization components / reports/ analytic screens.

12.5.4 Energy Management System Module:

This module includes collecting various useful data for computing performance, energy consumption, maintenance etc. from various devices such as Circuit Breakers, IEDs, Relays, MCC, PCC Panels, Transformers used to drive various Pumps-Motors and Valves-Actuators.

12.5.5 Asset Management System Module:

Asset Management tracks the inventory details of all equipment, networks and appurtenances throughout their lifecycle. Once an asset is deployed, Asset Management records all maintenance schedule / activity and enables IT to perform regular audits.

- Asset management software provides the capability to define assets of various types. System administrators shall be able to modify/add attributes to already existing asset types and create new ones along with their set of attributes.
- Water engineer should be able to set high and low thresholds for each asset. Multiple thresholds should be allowed based on time of day. When water levels fall below or exceed the thresholds, suitable alerts should

be generated. These alerts should be displayed on the same dashboard and sent by SMS to appropriate engineers. Severity of alerts should be programmable based on duration of event or extremity of event.

- Asset module shall be fully integrated with the software events correlation/ workflows / rules engine and shall allow defining various triggers based on specific assets, asset types, asset groups and assets attributes.
- Software shall enable assets to be displayed on maps with their corresponding GIS locations like flow meters, pressure sensors, level sensors etc. Asset status shall be reflected by different icons on the GIS map. It should be possible to associate assets with other assets and sensors. Software should provide an easy method of searching and locating assets. SI has to ensure mapping of GIS locations of all new assets installed during the project period.
- ftware should support a tool to import external information in .CSV or other popular formats into an asset database. If a specific asset in not defined, the tool shall create it based on asset type information – asset types shall be preconfigured.

12.5.6 DAQ (Data Acquisition) Module

DAQ module would serve as a core engine for the real time & historical process data connectivity with remote SCADA and device locations. (Secondary source of Information). This module would work as Integration Interface based on various industry-standard communication protocols for automation and communication. This module would use OPC-UA for data acquisition to ensure secure and web-based connectivity with existing SCADA on various remote locations. This module would also expose OPC-UA Server Interface for all mapped SCADA tags. The readings of sensors/meters shall be transferred using some communication medium that transfers data back and forth between data conversion and data control. The communication medium could be Wi-Fi / GPRS / LTE / CDMA /VSAT/Point to Point Leased Line/
LoRa Network technology etc. The data to the Central Server shall be synchronized with Local SCADA using periodic update on WAN Network / Public Network. The solution provider should use OPC UA for periodic update.

12.5.7 WIMS Administration & Management Module

- This would be serving as administration and management module for the entire WIMS application.
- This should be support backup, scheduling and restore feature.
- This should allow export/import of Data and Configuration data for all, Visualization /Reporting / Monitoring component as well as device configuration data for all sites. This should be in either of CSV / Excel/ XML format.
- The system should support tag database storage 1,00,000 tags. It is expected that real-time time series data as well as alarm and event data should be stored for last 2 years (as historian database) and MIS reporting parameters should be supported for 10 years. However, there should be facility for archiving the tag values in some storage media in case it is to be retrieved from the storage for later usage.
- There should not be any limit on the number of tags to be configured in the system and the number of users to be allowed in the system.

12.5.8 Consumer Management Module

This module will maintain database of all house property connections. Each property connection will be identified with a unique customer ID which will be linked with other relevant assets and basic user information such as Name of Contact Person, Address, WS Zone / OHR / DMA from which served, Contact

Details (Cell Number, E-mail ID), Connection date including date of installation of meter, Type of connection (Domestic / Commercial / Institutional etc.), Meter number including (monthly) consumption data, etc.
This module should also facilitate grievance redress and customer feedback. The analysis the usage, theft, illegal connection can also be monitored using the database. The GIS utilities linked with the property connection will enhance the features like cluster demand and planning for need-based services can be designed.

12.5.9 Analytical Reporting:

WIMS should provide streaming data analytics, integrated data visualization, real-time collaboration, and predictive analytics and hierarchical demand forecasting capabilities. It should provide:

- A streaming analytics interface should direct large quantities of streaming data into a structured format that can be used for reports and key performance indicators (KPIs)
- The streaming analytics should be able to interface with gateways to collect real time data and also provide advance analytics with real time model scoring capabilities on the gateway to generate actionable events such as water quality condition, sensor degradation, pump efficiency degradation etc.
- It should bring events to the surface and should alert action when needed.
- It should provide a web-based, configurable interface that is specific to the user's role and needs so that everyone in the organization can see and collaborate on the same data in their own way.
- This ability to collaborate should allow synchronization of effort, audit trails, collaboration, and group decision making.
- The analytical insights should help decision makers in consolidation of data to anticipate and plan, rather than react to problems.
- It should provide analytics with real time performance metrics around water transmission, Reservoir performance, water distribution supply / demand balance, water treatment plant operations, pumping efficiency etc.

Examples of Analytical Reports are:

a) Top10 maintenance spend Assets
b) Top10 failure types (No. of failures and Amount spent in Rs.)
c) Mean Time to Repair
d) Mean Time Between Failure
e) Work orders delayed due to parts not available
f) Frequency and types of water quality issues triggered
g) Comparative assessment of pump efficiency across locations
h) Measure flow / pressure variations in distribution networks

12.60

Conclusion: Water Information Management system would enable consolidation of data (at regular frequency) originating from all SCADA sites across the AOI, at the central site at a frequency as decided by PHED. The repository of the information from all SCADA installations across the project area would be named as Water Information Hub (WIH).

The selected bidder shall be responsible for Supply, Installation, Testing, Deployment, Integration and Maintenance of Centralized Integrated Water Information Management System- Software (WIMS) and supply of necessary third-party enterprise level, perpetual licenses and Library component required for integration purpose (if required). The successful bidder would be required to study, the functional needs of the PHED department and undertake customization of the WIMS software.

BIOGRAPHIES

Rama mohan chakala is a research schlor in civil engineering department jagannath university jaipur.

Mr.Hemant Kumar Agrawal, working as head of department of civil engineering at Jagannath University Jaipur. He is Graduate from Rajasthan Technical University, Kota with honors in 2014, and Masters with gold medal in 2017 published 5 papers in national conference and 20 papers n online journals. Teaching experience: more than 10 yrs in well known institute of Rajasthan. He is expert in various subjects of civil engineering. Delivered more than 10 technical lectures in various Govt. and private institute on the subject of Concrete & earthquake resisting buildings. Present various papers in seminars organized by various institutes.