IDA (Integrated Drainage Architecture): Sensitized Toxicology Monitoring and Programmed Channelization of Waste Water

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ABSTRACT—

This paper refers to the simplified yet effective idea involving planned channelization and grid management techniques in case of the drainage facility architecture. Addressing problems of existing or upcoming cities and smaller town by a network consisting of interconnecting pipelines of drainage, enabling maximum flow and shortest path. Defined algorithms and retrofitting features to existing plans that facilitates movement of wastewater in a phase-by-phase categorised and programmed way. It helps in the longer run to sustain existing systems for larger population pertaining to use of water resources, minimum fund utilization, fail-safe processes and segregated treatment of phased out drain water. Thereby relocating them to specially equipped facilities to enable cleansing of water as per wastes prevalent in them. It brings us out from a vague interconnected pipelining civil architecture to an era where information technology plays its vital role in turbulent flow regulations, toxicity monitoring, check gate systems, backflow prevention, anti-choking and clogging measures with pre-programmed algorithms and warning systems being interactive enough leading to drain water treatment in the most effective way possible with issued and indicated warnings. Here the actual objective is to find streamlined solution to targeted problem and not just generalize as the present system has proved to be ineffective even in case of minor torrential rains, roads overflowing, marshland contamination, land disposal pit as wastage, ineffective usage of sludge, and ill-programmed sewage treatment plants. It prevents mixing of household, medical, research lab discharges and industrial flux and provide a better interface to identify the degree of contaminations, where the system is categorised into various levels to segregate treatment based on algorithms that enable shortest path, maximum flow and safe discharge. This proposed project has a comprehensive solution in modules for all these problems and much more that are posed in intricate detail. This bring us to a complete enhancement of the existing pipeline network with minor modification to cater to the needs of Indian systems which can later be extrapolated to other larger effective systems of the world. This project would actively involve and integrate the Indian Regional Navigation Satellite System (IRNSS),Navigation Indian Constellation (NAVIC),GAGAN(GPS Aided Geo Augmented Navigation) Channelization Gateway Control Protocol(CGCP), Internet of things(IOT), Wireless Transmission Modules(WTM's), Safe Module Packaging and Placement(SMPP), Sensory Controlled Modular Frameworks(SCMF), Fail-Safe Backup Measures, Temporary Retracting, Immediate Complaint register and Grievance Redressal at nearest PWD Division. This bring a newer dimension towards effective computational advancements to handle Drain water.

It works on the key Principle of:
(STD^2):
Safely-Simplify and Segregate,
Track and Transport,
Detoxify and Dispose
It is the newly planned 6 stage process to enable completion of the requisite network for safe liquid waste disposal.

OBJECTIVES OF THE PAPER:

- To develop methodologies and present concept of planned sewerage systems and regulate waste water disposal.
- To take Liquid Waste, from various architectural pipelining systems to an effective and planned end-result.
- To determine the particular algorithms, software incorporations, pathways, modules and compatible retrofitted architecture to make planned drainage management a reality.
- To basically define the most improved and compatible waste water management systems available and their effectiveness in handing levels of segregated sewer wastes.
- Communication, transmission and positioning modules, microcontrollers and sensor probes to be brought into common grid for developing smart drainage architecture.
- Problems as such pose for humankind and need to be solved with innovativeness and brilliance which makes them reliable for the future, and the requirement lies in their implementation.

INTRODUCTION

The concept all started with immediate call and requirement for addressing solutions to menace created by present drainage network in urban areas. It has showcased age old

generic systems being utilized with little or no development resulting in complete ineffectiveness of liquid waste management. Overflow and complete system failure in case of minor natural calamities, frequent clogging of drains in cities, and severity of posed health hazards due to no end planning of where the waste water of mixed standards goes into from the major sewerage lines. This mixed phenomenon that has not been addressed needs some immediate technological overhaul that can be retrofitted with the existing systems to incorporate the STDsquare standards as mentioned and to be explained in detail later in due course.
The immediate sectors that need to be addressed to solve this pertaining problem are many, but broadly can be stated as per the key Principles referenced above:

Safety:

- Unmanned measure to be used to maximum extent possible due to safety reasons to prevent contaminations thereby minimizing human interaction with devices and only periodic checking as per requirement.
- Sensors connected by Xig-bees and Arkbird for transmissions.
- Each major node using microcontroller interface boards such as Raspberry Pi/Orduroid and Ti-Launchpad.
- Interfaces are executed in modular hierarchy.
- Monitoring present flow, density and maximum capacity per cross section in sewers.
- Use of simultaneous slave master mechanisms by I2C that brings about near field communication relay by neighborhood to or next module convey systems that connects it to major nodes to further upload statistical data to cloud database.

Simplify and Segregate-

Details of Database to be incorporated:
(i) IRNSS coordinate data for Indian bound systems, for i.e. Manhole /Starting/ Junction Location.

(ii) Leakage detection Overflow alert –Flow duration and Flow per cm-square cross section.

(iii) pH gradient index for acceptable limits by BNO55 analogue to digital transmission enabled integration.

(iv) IR Laser grid spectrograph /spectrometer readings from IR Spectroscope only at site initiation nodes.

(v) Density of flux in motion per cross sectional area of drain outlet.

(vi) Biological tissue monitor and threshold indication setting to indicate beyond permissible index of expected medical contaminants consisting of large parts of discarded tissues, blood, sputum, other harmful biological materials that lead to accelerated enrichment of sources during flow .

(vii) Non-Biodegradable scum abstraction level.

(viii)Heavy metal presence or absence with toxicity index.

(ix)Radioactive waste if any (Geiger absorbing-scope)measuring leakages or emission and alert to systems if even in trace quantities to prevent the later mixing of involved samples at larger water bodies even after treatment and need for warnings and indication in case a requirement of quarantine arises.

(x) Checkgate to prevent backflow and emergency release by side flow out of side outlet into sump pit at nearest location in case of sewer standard violations. These sump pits are temporary and need retrieval in maximum period of three weeks.

(xi) Later recollection of discarded waste after suitable mitigative measures undertaken.

(xii) Alternative detection module as part of dynamic grid system in calculated relay for data transmissions, common check-gate system and positioning aided by fail safe, long durability water proof batteries and only probe ends accessing the flowing wastewater preventing whole module to be submerged all the time but still confinement against liquid influx and precautionary steps against retained liquid damage needs to be undertaken.

Salient features at priori requirement:

- Convenient Battery module
- Miniature design
- Waterproofing
- Longer battery life
- Capsule format.

Working Procedure for (Inline Track and Transport):

(i) Once the simplification of this data is obtained and parameters of limit for regulation and exceptions are set, then the system set to function.

(ii) This functioning is on the basis of segregation that divides Types and Phases of liquid waste and assign it a level. Levels have particular channel procedures to enable destined transportation.

(iii) Targeted delivery of wastage to categorized wastewater treatment facilities in position to cater to treatment requirements to various types of wastes generated from different levels of sewers.

(iv) Tracking modules are incorporated in system that range with accuracy (<1m) range due to newly equipped GAGAN/ IRNSS facilitates indigenously developed and maintained in India over GPS and GIS facilities, easy to incorporate and suitable to operate at minimal costs .

(v) Allows us to address cleaning, blockage or clogging problems immediately to prevent function disruption by direct position information.

(vi) Cracks, crevices, mould formations, can be required in immediate response due to repeated alert system to prevent larger impacts.

(vii)Transportation is regulated as per parameters explained above in three phase.

(viii) Data Relay explained in sub-phases such as:

- Initiation to neighborhood node
- Intermediate node to intermediate node
- End node to sewage treatment-plants.
- Controlled, verified, regulated release into water bodies.
- A new dimension unleashed for regulated sewage flow.
- Detoxification nodes present at specified nodes at major inter-connection joint by use of particular reagents involving administered chemical combinations to be provided as input to neutralize toxin action.

Detoxify and Dispose Facilities:

Detoxify - Dispatch - Dispose
Detoxification based on pollutants and requisite anti – reagents to neutralize action up to the extent possible.
Sodium Sulphide action
Hydrogen /Peroxide bleaching
Inner Crest removed by peroxide forced backflow by methods used in boilers.
Action against secure biological tissue density for sewers line originating from medical facilities.

Decontaminants:

- Activated sludge action
- Aerobic Enrichment
- Phasing out non –soluble part for safe disposal.
- Controlled microbial ingress
- Check on whole system with specialized monitoring.

Action against heavy metals and related carcinogenic components enriching water with Arsenic, enriching, etc.
Corrosive reagents (to be prevented in order to prevent system damage in due course while treatment).

Use of hardware settlers
Heavy metallic influx to be settled and later phased meet before allowing to enter intermediate stages of treatment.
Specialized added stages to prevent these carcinogenic substances and those causing other related from to be prevented from entering the fresh water cycle again.

Dispatch:
Regulated flow with check values as shown standardized RCC and Aluminum gates.

Review of Literature:

- Existing systems of grid iron branch pipe-lining.
- Conventional drainage architecture.
- Short term planning
- Extreme load due to severe population explosion and rapid industrialization.
- Failure in layouts due to improper planning and natural calamities.
- Rapidly increasing outlets without proportionate increase in pipelining.
- Unregulated waste disposal of solids in open drains leading to frequent clogging.
- Unplanned proper destination leading to futile disposal attempts.
- Water body and marshland pollution.
- Unspecified design requirements.
- Unavailability of specified parameters for wastewater treatment plants.
- No targeted delivery mechanism.
- Lack of modernization and regulation by modern day computational systems being brought into utilization to this impending problem.
- Immediate call against pipeline stall or hazards.
- Designing an appropriate drainage algorithm.
- Construction, modification and retrofication of the existing system in use.

THEORY:

Waste water:
Waste water emerges after fresh water is used by human beings for domestic, commercial and industrial uses. The water that emerges after these uses contains, vegetable matter, oils used in cooking, oil in hair, detergents, dirt on the floor that is washed, soap used in bathing along with oils and greases washed from the human body. This water is referred to as "**Greywater**" or sewage .Water used to flush out toilets to evacuate human excreta and is called "Black Water" or Sewage.

Grey water is easier to purify as compared to black water, i.e. sewage. However, in India is to combine these two wastes to discharge into a public sewer which is very difficult to treat and it requires high amount of time and resources.

Carcinogens and Pollutants:
Water pollution is caused due to pathogens, inorganic compounds, organic material and macroscopic pollutants.
Bacteria are commonly found in water; it is when they start to increase in numbers that are above safe levels that water pollution occurs. Two of the most probable pathogen pollutants are Coliform and E. coli bacteria. Coliforms are present in the environment in safer levels and can be used for the detection of other pathogens in water. However, Water Filter Review reports that if coliforms increase in numbers, it can be dangerous for the health of the environment. The occurrence of E. coli bacteria indicates that water has been polluted with human or animal wastes.

Inorganic materials:
Heavy metals--arsenic, mercury, copper, chromium, zinc and barium, for example--though harmless in small amounts, act as pollutants, they end up in the water due to high industrialization or industrial accidents as pollutants, and they end up in the water due to high industrialization or industrial accidents.

Organic Materials:
These materials contain molecules and particles which have carbon as a component. One of the most frequent detected volatile organic chemicals is Methyl Tertiary Butyl Ether (MTBE).Although it is now one of the banned chemicals, it will surely take years before MBTE is thoroughly removed from polluted water systems. Water contaminated with this organic chemical can cause leukemia, lymphoma and tumors in testicles, the thyroid glands and kidneys.

Macroscopic Pollution:
When macroscopic pollution is very large, visible items pollute the water. The first common pollutant is trash--paper, plastic or food waste. It is either thrown directly into the water or washed away through the rain into the water. Other types of macroscopic contaminants include hurdles, pieces of wood; metals; and even obvious things like wooden debris. This type of form of pollution is the most manageable; however, these pollutants must be removed in order to avoid loss of life in aquatic animals and pollutants upon the chemical breakdown of these objects

Wastewater Treatment Plan:

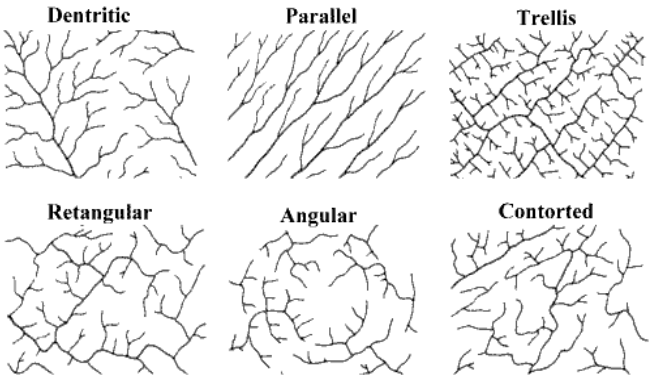
Water treatment plants use technologies to produce water that is safe both chemically and biologically, and that is appealing in terms of color, odour and taste. The controlling point for the water quality determination must be the consumer's tap and not the treatment facility, which means that the water quality must not be hampered during transmission, storage and distribution to the user. The treatment methods at the plant that includes aeration, coagulation and flocculation, sedimentation, filtration and disinfection. Some of the existing prevalent water purification & treatment technologies are listed below.

- **Capacitive Deionization (CDI)** is that technology where ions are removed from water by passing it through the spacer channel also with porous electrodes on each side.
- **Ozonation** is a chemical water that treats water based on the infusion of ozone into water.
- **Ultraviolet** technology uses the Ultraviolet light, just like sunrays to kill micro-organisms present in the water.
- **Reverse Osmosis (RO)** is a technology that removes a large amount of pollutants by pushing the water under pressure through a semipermeable membrane.
- **Terafil** is a burnt red clay porous media used for filtration & treatment of raw water into a clean form of drinking water, developed by Council of Scientific & Industrial Research (CSIR), Bhubaneshwar.
- **Filtration** methods that may include rapid/ slow sand filters remove dirt, rust, silt, dust and other a particulate matter that are used from water.

Reagents and Chemicals-

Chemicals used for removing specific wastewater contaminants, thereby enabling customers to meet their EPA mandated discharge permits, include:
Aluminum sulfate is one of the most versatile chemicals used in both the municipal and industrial markets. The use of aluminum sulfate surely includes in Potable Water Treatment and the use is for sure, Wastewater (clarification and phosphorus removal), Lakes and ponds (removal of excess nutrients, such as phosphates that actually contributes to algae growth…ultimately, this provides algae control) ,Paper mills ,Aluminum Chloride solutions are typically used in Chemical processing, Drinking water purification, Wastewater treatment and Pharmaceuticals. Chemical Solution Used by wastewater treatment plants include: Alum or aluminum sulfate, Sodium aluminate, Polyaluminum Chloride, Polymer (dewatering) and Sodium hydroxide. These chemicals offer numerous benefits which include effective coagulation and solids settling ,optimal phosphorus removal at the lowest dosage level ,improvement in ammonia removal in alkalinity-deficient wastewaters, optimization of UV disinfectants enables pH control and compliance without additional chemicals and algae control and prevention in lake water remediation.

Existing Layout Systems, an analogy:



Existing purification standards-

The standards and the type of technology along with a description of the purpose or intended function of the technology.

Organic Materials:
These materials contain molecules and particles which have carbon as a component. One of the most frequently detected softener reduces the quantity calcium and magnesium ions.

Adsorption/Filtration
This process occurs when liquid, gas or dissolved or suspended matter adheres to the surface of, or in the pores

of, an adsorbent media. Carbon filters are an example of this type of product.

- **Softeners**
  These systems incorporate a cation exchange resin that is regenerated with sodium or potassium chloride. The softener reduces calcium and magnesium ions and replaces them with sodium or potassium ions.

- **Ultraviolet Treatment**
  These systems use ultraviolet light to disinfect water (Class A systems) or to reduce the amount of non-disease causing bacteria in water (Class B).

- **Reverse Osmosis**
  These systems incorporate a process that uses reverse pressure to force water through a semi-permeable membrane. Most reverse osmosis systems incorporate one or more additional filters on either side of the membrane.

- **Distillers**
  These systems heat water to the boiling point, and then collect the water vapor as it condenses, leaving behind contaminants such as heavy metals. Some contaminants that convert readily into gases, such as volatile organic chemicals, can carry over with the water vapor.

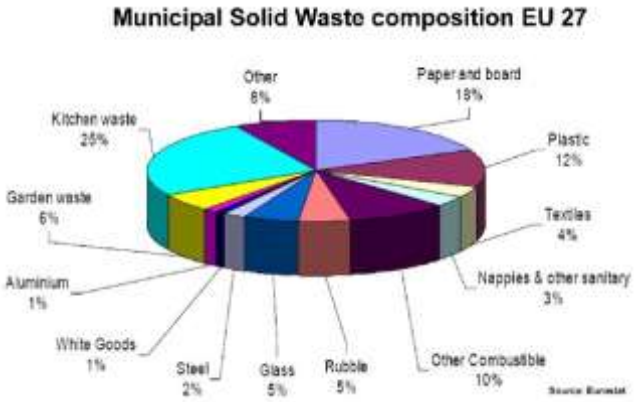
- **Shower Filters**
  These products attach directly to the pipe just in front of the homeowner's showerhead.

- **Treatment Systems for Emerging Contaminants**
  Systems covered by this standard include several types of point-of-use (POU) and point-of-entry (POE) systems that have been verified to reduce up to 15 emerging contaminants.

Composition of drainage water-

- The inorganic material that are soluble such as ammonia, road -salt, sea-salt, cyanide, hydrogen Sulphide, thiocyanates and thiosulfates and etc.
- Animals such as protozoa, insects, arthropods, small fish, etc.
- Macro- solids such as sanitary napkins, nappies, condoms, needle children's toys, dead animals or plants etc.
- Gases such as hydrogen sulfide, carbon dioxide, methane etc.
- Emulsions as paints, adhesives, mayonnaise, hair colorants, emulsified oils etc.
- Toxins such as pesticide, poisons, herbicides, etc.
- Pharmaceuticals and hormones.

Existing pollution Index or Rates of different water bodies-
Can be use specific (industrial, municipal, irrigational, ecological); Transform the vast and complicated water quality data into a simple number that is easily understood by all.



Water Quality Index calculation:

1. First select finite number of parameters and monitor water quality against the parameters.
2. Develop transformation function/curves and use them to transform the monitored values into Environment.
3. Assign relative importance values to the parameters and obtain weight values to the parameters.
4. **Aggregate the parameter values** -
a. Take a) sum or b) average or c) geometric mean or combination of these.
b. Or use maximum operator or minimum operator.
Obtain sub-indices and aggregate the sub -indices into WOI.

WQI Value	Rating of Water Quality	Grading
0-25	Excellent water quality	A
26-50	Good water quality	B
51-75	Poor water quality	C
76-100	Very Poor water quality	D
Above 100	Unsuitable for drinking purpose	E

River cleaning action Plans:

Steps required for river cleaning action plans are as follows-

- To take measures to determine and maintain environment flow.
- Rehabilitate and upgrade the existing sewage treatment facilities.
- Tackling industrial pollution.
- Tracking pollution coming from use of chemical fertilizers
- Create model cremation Ghats on bank of river
- Provide support to state for preparation of detailed projects Reports.
- Coordinate between various ministries of central government and concerned state governments.
- Establish National River Monitoring System.
- Communicating and public outreach activities.

Drain Installation Facilities:
Where any drain is constructed adjacent to or under or through structural part of any of the building, adequate measures must be taken to ensure that the trench in which such drain is laid in no way impairs the stability of this type of the building or else the stability of any other building or interferes with or affects any existing services.
Any drain shall be of such strength, having regard to the manner in which it is embedded or supported and that the maximum loads and forces that are there to which it may normally be subjected will be sustained by it and it shall where necessary be protected against damage.

The requirements:
(i) The minimum should always cover over the outside of the drain is not less than 300 mm or
(ii) Precast or cast-in-situ concrete slabs are placed over the drain, it is isolated from the crown of pipe by a soil cushion for not less than 100 mm thick and such slabs are wide enough and strong enough to prevent excessive superimposed loads being transferred directly to the pipes.

Any drain shall:
1. Be laid in a straight line between any points where changes of direction or gradients occur.
2. It is been laid with approved flexible joints which will permit surely joint movements to take place throughout the life of the drainage installation.
3. Withstand root penetration and not deteriorate when in contact with sewage pollutants or water, and will surely not cause any obstruction in the interior of such drain.

Inspection Chambers (IC) AND Manholes (MH):

Should be provided:

- At a position 1,20m within the boundary of the property, except in the case of individual houses where cleaning, washing and inspections eye must be provided;
- At the junction of a branch to a main drain where three or more soil fittings join the branch line;
- Where a main collecting drain changes direction and/or gradient;
- At both ends of a long flat grade;
- At both sides of a building under which it is necessary for a sewer to pass and
- At distances of 75m for a 100mm and 100m for a 150mm drain.

Proposed Systems, a plan for incorporation:

Implementation with Existing Systems by incorporating innovative newly developed system to enhance effectiveness and maximize utility:
1) **Non Electric Sewage Treatment Plant**
(At Household/Flat Levels):

FILTERPOD:
Filterpod is sustainable compared to the traditional septic tank as that of unlike the annual emptying requirement of a septic tank, the Filterpod emptying interval is 1 to 3 years, which gives good purity when we use a two staged one. The Filterpod sewage treatment plant was tested for the EN12566-3 at PIA, Aachen, Germany. This sewage treatment plant achieves 97% pollution reduction. These results are extraordinary and because it is a natural process, it never requires mechanical repair. This system is a 6 person sewage treatment plant. The simple treatment process is powered only by natural air currents and the air is 'chimney' through the unit by way of a low air inlet pipe at the plant and a high soil vent pipe. The Filterpod requires no electricity, saving over 1000 KW of electricity and 0.5 tonnes of CO_2 emissions taking place per year for a 3 bed. House, plus an extended emptying interval of between 1 and 3 years. Much cost effective and saves up to 2000 pounds yearly. The Filterpod is manufactured in recyclable HDPE polyethylene. It requires a septic tank in front of it and can also be added to an existing two stage septic tank to clean the effluent to Environment Agency total requirements for the discharge of wastes products to a ditch or stream. There is no electricity required, the emptying interval is for 3 years. It has a primary tank. The tank warranty is 10 years and it is easily installable.

2) **Three Stage Sewage Treatment Plant:**

FALCON:
This domestic sewage plant offers an extremely efficient and non-hindered means of disposal. The Falcon is a three stage sewage treatment plant. It is manufactured entirely from robust and corrosion free materials, it is incorporated uniquely and it has patented features to make sure simplicity and efficiency of the operation taking place whilst being able to consistently achieve the ever more stringent standards of discharge effluent quality being required by the Environment Agency. It is available in a range of sizes to suit almost any application through surely a single residential property, hotels and restaurants or a major industrial / commercial complex, the Falcon surely meets specific requirements of each and every individual situation. The Falcon treatment plants have a 25 year warranty on the tanks and a 2 year blower warranty. Falcon price also includes for a compressor failure alarm system as standard, which also forms part of the mandatory requirements. The Installation of the Falcon biodigester requires no specialist equipment and can be done out by any competent contractor, quickly and simply. Once installed, the Falcon sewage water plant is completely unobtrusive, even the largest plants. The Falcon wastewater treatment plant is of a single tank design and incorporates the Primary Settlement (PST) Biological Treatment (Biozone), and Final Settlement (FST) within the same structure, allowing delivery to the site as a whole unit to be given as a simple and straightforward given installation. No other tanks are required except for larger applications where a modular system is provided or where the additional treatment is required to meet more stringent effluent quality standards or where effluent re-use is proposed. The Falcon sewage polluted water treatment plant

has been designed to optimize aesthetic qualities of the final installation by ensuring that there should be minimum visual impact. The Falcon process is also designed in accordance with the requirements of BS 6297 standards.

All wastewater treatment plants do a similar job by use of some produce cleaner effluent than others but it is how they do their job that makes the difference thereby forcing us into a comparative analogy.

-RBC

RBC's are three stage sewage treatment plants. The discs themselves can easily treat the sewage effluent after it has passed through a Primary Settlement Tank. The primary settlement tank settlement tank settles solids which forms sludge at the bottom of the tank. The bio-disc process involves allowing the polluted water to come in contact with bacteria which grow on the the biodiscs and digest the pollutants in the wastewater before discharge of the treated wastewater before discharge of the treated polluted water to the environment, usually a ditch or Rotating Biological Contactor (RBC) sewage treatment plant can all three stages stages housed in one tank or separate stages in different tanks, depending on the size of the plant. RBC consist of a series of closely spaced, parallel discs mounted on a motor-driven rotating shaft which supported just above the surface of the wastewater. The rotation is achieved via a motor gearbox and bearings on either end of the shaft and is constant, 24 hours per day. The activated sludge was distributed evenly to the three oxidizing basins and the wastewater was added into the basins at the same time. The concentration ratio of BOD5: N: P: S in the cultivation wastewater was maintained at 100: 5: 1: 1 in which the concentration of BOD5 was 300 mg·L–1 on average. The disks were then rotated for one day so that to allow microorganisms to be attached to the surface of the discs. In order to satisfy the nutrient needs of the microorganisms, 2/3 of the supernatant in the basins was replaced every day. COD of the newly added wastewater was 1 000–2 000 mg·L–1. After one week of operation, biofilms about 2-3 mm thick were formed. The biofilms had many nematodes and rotifers, which indicates that there was surely oxygen being supplied to the biofilm. After the biofilms were fully formed, the RBC was run continuously. The input wastewater had a pH of about 6–8 and also the flowing rate to the oxidation basins was 16 L·h–1 with a hydraulic retention time of 1.29 hours for the whole three-basin cycle. 90 L of pharmaceutical wastewater was mixed with 30 L of treated wastewater that remained in the 3 stages. Ambient temperature varied from 10°C to 16°C.

3) **Activated Sludge Method:**

VORTEX

Most sewage treatment plants struggle to work when they are under-loaded. There is a good rule of thumb is that if a plant is working below 50% of its design capacity, not enough 'food' is available from the toilet solids to either grow, or maintain, a working of the bacterial population. Vortex has solved a lot of this problem by having a simple hand-turned valve that can turn the amount of air required to either up, or to lower down, depending on the number of people using it. Such a Simple solution to a complex problem. It is the ideal sewage treatment system for 'ECO', sustainable and 'GREEN' sewage treatment non electric plant, is great in principle. The only electrical component is a small, external linear motor compressor which operates all the treatment plant process in the total stages. There are no pumps there, motors or any moving parts within the plant. It has a fail-safe alarm as standard.

The Incoming sewage is always screened to prevent accidental non-degradable products entering the plant digestion chamber. The innovative Vibrio-Screen allows organic sewage solids to enter the tank without problems. This is an advanced feature not found on other treatment plants.

Screened sewage is firstly aerated and a microbial 'soup' gets developed that digests pollutants and organic matter that is in the sewage. These beneficial microbes are constantly topped up with the microbes that settle out at the bottom of final settlement tank as part of sludge management system, ensuring a constant of the 'friendly bacteria' supply for treatment plant process taking place. There is no need of adding extra bacteria at all, as is the case with some other treatment plants. When the treated sewage enters the final settlement chamber, activated sludge bacteria which settles out at the bottom. These beneficial live microbes are constantly returned to the digestion chamber that mixes with raw sewage present there and it surely boosts up the performance of the treatment plant system.

The bacterial scum or crust that forms on the top of the effluent in clarification chamber is also able to be returned through a pipe to the digestion chamber.

Septic Tank Conversion Units:

BIOCUBE

The Biocube sewage treatment plant and septic tank conversion system is a guaranteed. It is also certified that the Domestic wastewater treatment system is also capable of a high level of phosphate reduction. The Biocube solves septic tanks soak away / drainage field problems by converting the septic tank to a full fledge sewage treatment unit. It requires testing to be carried out for over 38 weeks and once the sewage system has been installed and brought up to working level. One of the main functions of the Biocube Sewage Treatment Tank is to remove ammonia from the sample. The system is designed to "De-nitrify" the outgoing water. This is only possible in a 2 or 3 tank system. Minimal de-sludging of the sewage system is once per year. 'HOLIDAY MODE' feature surely helps in enabling the Biocube sewage system to be idle for up to 6 months without bacterial death Ideal for campsites, holiday remote toilets, etc. in case used for household purposes.

SYSTEM DESIGN:

Peripheral Communication and Network Design:

I2C/Multiple Slave master mechanism:
The Inter-integrated Circuit (I2C) Protocol is a protocol that is intended for allowing multiple "slave" digital integrated circuits ("chips") to communicate with one or more "master" chips. Just like the Serial Peripheral Interface (SPI), it only intends for very short distance communications within a single device. Like Asynchronous Serial Interfaces (such as RS-232 or UARTs), it requires two signal wires to exchange information.

Computational and Communication Modules:

- Near field communication by: NFC or wife under data packet transfer to adjacent nodes only.
  - -Water flow index.
  - -Abnormalities if any
  - -Warning for check is immediately conveyed to neighbor.
  - -Fixed at immediate have /establishments outlets.
- At major nodes, we use of a 5 GHz band with Arkbird receiver to communicate from major nodes around 2 to 4 kms in distance.
- ZigBee And Xbee communication from major nodes to nearby master module wirelessly over 2.6 GHz to installations of GPRS and generations of mobile telephone with an 8 bit encryption for direct upload of data to cloud client services as live feed with details of coordinate ,safety indices and warnings if any.
- This citywide database is monitored at certain location as nodal centers at central center of wastewater treatment plant and river release site with head office for networking, grievance redressal and maintenance or warning related help at central Public Work Department (PWD Headquarters – Regional)
- Implementing mobile data transmission protocols with incorporation of blade servers and cloud computing, convenience of maintaining a server as large for monitoring this database and enables regulating it.

Standards for the Sewage Treatment Plants:

Protocols regarding system setup:

STDsquare:

SAFELY-SIMPLIFY and SEGREGATE,
TRACK and TRANSPORT,
DETOXIFY and DISPOSE,
a newly planned 6 stage process to enable completion of the requisite network of safe liquid waste disposal.

END Devices:

1. Sensory Grid Checkgate(SGC):
2. Manhole Monitoring Array(MMA):
3. Drainage Choke Alert System(DCAS):
4. Anti-Contamination Warning(ACW):
5. Final Release Purity Index(FRPI);

Wastewater Post Treatment Characterization:
Define and State Categories:

Category 1:
Back into direct human usage system (bathing, agriculture, washing, etc.)

Category 2:
Post treatment water from certain facilities that need to be discharged into suitable water bodies for suitable natural actions and actions such as groundwater table recharge action, natural percolation, natural aging, aerobic decomposition and water senescence in lakes and other such facilities.

Category 3:
Wastewater containing high amounts of bodily fluids, biological wastes, medical discharge, communicable contaminants, etc.

Category 4:
Heavy water, Arsenic, cobalt Rich, with other heavy metals and absurd industrial pollutants along with hard water or heavy water discharge from coolant facilities in nuclear power Plants that may be exposed and may contain harmful levels of radiations and needs isolation from human establishments.

Category 5:
Absolute Toxins and Poison discharges, and immediately requiring far off safe quarantine from reachable facilities with non-human surveillance mechanisms and strictly kept confidential information about such sites to prevent intentional misuse , accidental leakages, ground leaching or curiosity driven explorations.

Sensors and Probes proposed to be involved in the making:

End device to be used before final discharge of category 2 into natural large water bodies for time-lapse automatic treatment for further cycling back as freshwater at a later stage.

Remote module for sample testing at manholes to manually verify system stability at specified Intervals:
1) Manti Lab MT-120 Digital Dissolved Oxygen Meter, DO Concentration Mode: 0 - 20 ppm (Initial Test)
2) Libelium – It based on Smart Water wireless sensor platform

Libelium launched a Smart Water wireless sensor platform to simplify the steps of remote water quality monitoring. Equipped with multiple sensors that measure a dozen of the most relevant water quality parameters, Waspmote Smart Water is one of the first quality-sensing platform to feature autonomous nodes that connect to Cloud server for real time water control. Waspmote Smart Water surely suits for potable water monitoring and treatment system, chemical leakage detection in rivers, remote measurement of the swimming pools and spas, and level of seawater pollution present.

The water quality parameters measured included pH, dissolved oxygen (DO), oxidation-reduction potential , conductivity ,turbidity, temperature and dissolved ions (Fluoride (Fluoride (F-), Calcium (Ca2+), Nitrate (NO3-), Chloride, Iodide, Cupric, Bromide, Silver (Ag+), Fluoroborate (BF4-), Ammonia (NH4), Lithium (Li+), Magnesium, Nitrite (NO2-), Perchlorate, Potassium , Sodium

Device Specification:

The Waspmote Smart Water platform is an ultra-low-power consumption sensor node designed for use in rough environment and deployment in Smart Cities in hard-to-access locations for detection and changes there and the potential risk to public health in real time.
Waspmote may use cellular (3G, GPRS, and WCDMA) and long range 802.15.4/ZigBee (868/900MHz) connectivity to send information to the Cloud, and can accommodate solar panel that charge the battery present to maintain the autonomy. Smart Water nodes are ready to deploy out of the box and sensor probes can be recalibrated or changed in field, with the kit provided by Libelium.

"Smart Water will be an improvement on existing water quality control in the terms of surely the accuracy, efficiency, and low operational costs. For municipalities, water quality detection and monitoring systems should be reliable, autonomous, and flexible," said David Gascón, CTO of surely the Libelium. "With Waspmote, a full Smart Water solution is now available at a price point ten times less than the current market solutions, for better management and use of water resources."

Applications:

- Potable water monitoring: Common chemical parameters include pH, nitrates and dissolved oxygen. Measuring O2 (or DO) is an important gauge of water quality. Changes in dissolved oxygen levels indicate the presence of microorganisms from sewage, urban or agricultural runoff or discharge from factories. A right level of ORP minimizes the presence of microorganisms such as *E. coli, Salmonella, and Listeria*. Levels of Turbidity below 1 NTU indicates the right purity of drinking water.

- Chemical leakage detection in rivers: Extreme pH or low DO values signal chemical spills due to sewage treatment plant or supply pipe problems.

- Swimming pool remote measurement: Measuring oxidation-reduction potential (ORP), pH and Chloride levels of water can determine if the water quality in swimming pools and spas is sufficient for recreational purposes.
- Pollution levels in the sea: Measuring levels of temperature, salinity, pH, oxygen and nitrates gives feedback for quality-sensing systems in seawater.
- Corrosion and limescale deposits prevention: By controlling the hardness of the water we can avoid the corrosion and limescale deposits in dishwashers and water treatment devices like heaters. Water hardness depends on: pH, temperature, conductivity, and Calcium (Ca+)/ Magnesium (Mg2+) concentrations.
- Fish Farming / Fish Tank Monitoring / Hatchery / Aquaculture / Aquaponics: Measuring the water conditions of aquatic animals such as snails, fish, crayfish, shrimps or prawns in tanks. Important values are pH, Dissolved Oxygen (DO), Ammonia (NH4), Nitrate (NO3-), Nitrite (NO2-) and water temperature.

- Hydroponics: Plants that take the nutrients directly from the water need a precise pH and Oxygen in water (DO) levels to get the maximum growth.

Waspmote Smart Water Technical Characteristics:

- Sensor probes measure more than 12 chemical and physical water quality parameters such as pH, nitrates (NO3), dissolved ions (Fluoride (F-), Calcium (Ca2+), Nitrate (NO3-), Chloride (Cl-), Iodide (I-), Cupric (Cu2+), Bromide (Br-), Silver (Ag+), Fluoroborate (BF4-), Ammonia (NH4), Lithium (Li+), Magnesium (Mg2+), Nitrite (NO2-), Perchlorate (ClO4), Potassium (K+), Sodium (Na+) dissolved oxygen (DO), conductivity (salinity), oxidation-reduction potential (ORP), turbidity, temperature, etc. Pollutants can be detected and treated in real-time, to ensure good water quality over an entire water supply network. Extreme pH values may indicate chemical spills, treatment plant issues, or problems in supply pipes. Low levels of DO may indicate the presence of microorganisms due to urban/agricultural runoff or sewage spills. ORP measures how well water sanitization is working.

- Waspmote transmits sensor readings to the Cloud via 3G, GPRS, or WCDMA cellular connections; in the case of several nodes located in the same zone, Waspmote sends values to the Meshlium Internet Gateway via long range RF bands 868MHz and 900MHz. Sensor data is available in real time, even from sensor nodes situated in remote locations. CE / FCC / IC certification and quad-band cellular connectivity (850/900/1900/2100MHz). Waspmote supports any cellular connection provider, and is ready for deployment in any country in the world.

WASP MOTE:

- Ultra-low power (7µA)
- 110+ sensors integrated on 10 Sensor Boards
- 16 radio technologies:
  - Long range: 4G / 3G / GPRS / GPRS+GPS/ LoRaWAN / LoRa / Sigfox / 868 MHz / 900 MHz
  - Medium range: ZigBee / 802.15.4 / DigiMesh / WiFi
  - Short range: RFID/NFC / Bluetooth 2.1 / BLE
- Over the Air Programming (OTA)
- Encryption libraries (AES, RSA, MD5, SHA, Hash)
- Certified encapsulated line (Plug & Sense!)
- Industrial Protocols: RS-232, RS-485, Modbus, CAN Bus, 4-20mA

1) Smart Water

- Applications
- Potable water monitoring
- pH, ORP, Dissolved Oxygen (DO), Nitrates
- Chemical leakage for the detection in rivers
- Extreme pH values signal chemical spills, Dissolved Oxygen in the sample.
- Swimming pool remote measurement
- pH, Oxidation-Reduction Potential (ORP)
- Pollution levels in the sea
- Temperature levels, Conductivity Salinity, pH, Dissolved Oxygen (DO) and Nitrates
- Sensors
- pH
- Oxidation-Reduction Potential (ORP)
- Dissolved Oxygen (DO)
- Conductivity
- Temperature

2) Radiation

- Applications
- Monitor the radiation levels via wireless without comprising in the life of the security forces
- Create prevention surely and control radiation networks in the surrounding medium of a nuclear plant
- Measure the amount of Beta and Gamma in the radiation in specific areas autonomously
- Sensors
- Geiger tube [β, γ]
- (Beta and Gamma)

3) Prototyping Sensor

- Applications
- Prepared for integration of any kind of the sensor.
- Pad area
- Integrated circuit area
- Analog-to-Digital converter (16-bit ADC)

Over the Air Programming (OTAP)

The concept of Wireless Programming, commonly known as Programming over the Air (OTAP) has been used in the past years overall for the reprogramming of the mobile devices like as cell phones. However, with the new concepts of Wireless Sensor Networks, M2M and surely the Internet of Things, where the networks consist of hundreds or thousands of nodes, OTA is taken to a new direction surely, and for the first time it is applied using both mobile phone technologies such as 4G, 3Gand GPRS and unlicensed protocols such as WiFi.

Libelium implements OTAP with the 4G, 3G, GPRS+GPS and WiFi modules via FTP.

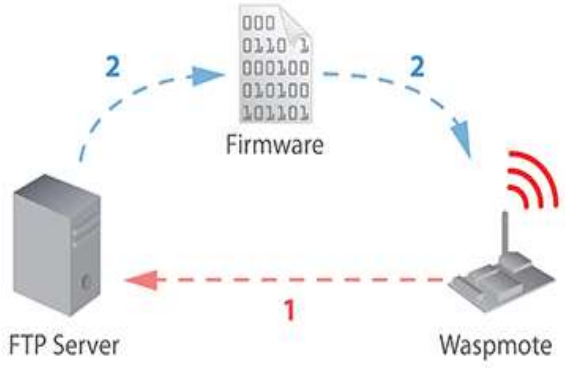
OTAP with 3G / GPRS / WiFi via FTP

a) Benefits

- Enables the upgrade or change of firmware versions without physical access.
- Upgrades the new firmware by querying a FTP server and for which helps to keep battery life.
- Enables to upgrade an entire network in few minutes

b) Steps

- Waspmote queries the FTP server for a new program version
- It checks if program name, path and version are correct
- Downloads the new program
- Reboots and starts with the new program



a) Topologies

Protocols which support FTP transmissions are directly connected to the Network Access Point

b) Storage System

Once the program is downloaded to Waspmote it is stored it in the 2 GB SD card.

c) Meshlium OTA-FTP plug-in

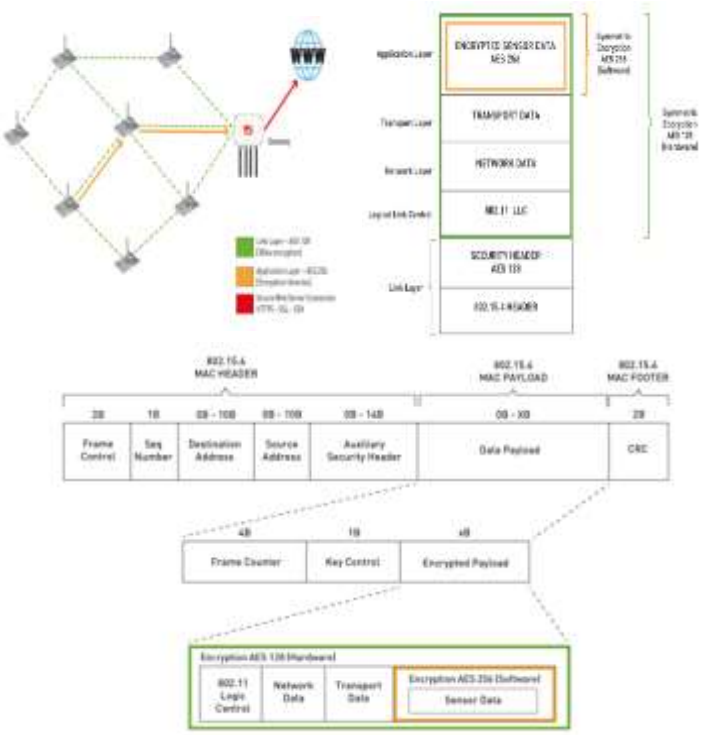
Meshlium the gateway of the IoT network, hosts the FTP server inside. The user interface of Meshlium, called Manager System, features a plug-in which permits to configure this FTP server automatically by attaching the program binary file to be used.

- The "point to point" encryption key is cyclically changed using again RSA encryption in a process known as key renewal.
- The third security technique is carried out in Meshlium - the Gateway- where HTTPS and SSH connections are used to send the information to the Cloud server located on the Internet. The two main cases of the usage of the Encryption Libraries for Waspmote are:

- Transmission of sensor data
- Key initial sharing and key renewal

Transmission of sensor data:

Information is also encrypted in an application layer via software with AES 256 using the key shared exclusively between the origins surely and the destination. Then surely the packet that is encrypted again in the link layer via hardware with AES 128 so that only trusted packets be forwarded, ensuring access control and improving the usage of resources of the network.



Each node might be storing thousands of different Public Keys of the nodes of the network in its SD card. So we can surely establish the real P2P encryption among any sensor and the Gateway and even between any sensor and any web or database server directly. The new Libraries are specifically designed to be used in the given Waspmote hardware sensor platform and then they are been distributed along with the Waspmote IDE which is distributed under an open source license.

Solar Powered

External and internal Solar Panel

Battery can be surely recharged using the internal or external solar panel options there (common USB-recharging is of course another option).The external solar panel is mounted on a 45º holder which ensures maximum performance of each outdoor installation. There is an option for the internal option, the solar panel is embedded on the front of the enclosure, perfect for the usage where space is a major challenge. The rechargeable battery has a load of 6600 mAh, what ensures nonstop working time during weeks where there is lower sunlight. A non-rechargeable battery option of extreme load (26 Ah) is also possible for projects where a solar panel cannot be used.

A. Installation: Fast deployment

Waspmote Plug & Sense! Counts with holders specially designed for the outdoor installations in street-lights and building fronts. Metal cable ties are surely provided to easily adjust the node surely with street light posts.

Installation can be done in minutes as you only need to tie the cables in the enclosure holders and then to the post. The node is secured once then just pressing the button on and the node will start automatically to send the data gathered from the sensors to the Gateway.

B. Data to the Cloud: It is fully compatible

The data gathered by the sensor by the Waspmote Plug & Sense! nodes is sent to the Cloud by Meshlium, Gateway router specially designed to connect the Waspmote sensor networks with the Internet via Ethernet and 4G interfaces.

Radio Technologies: High sensitivity and transmission power

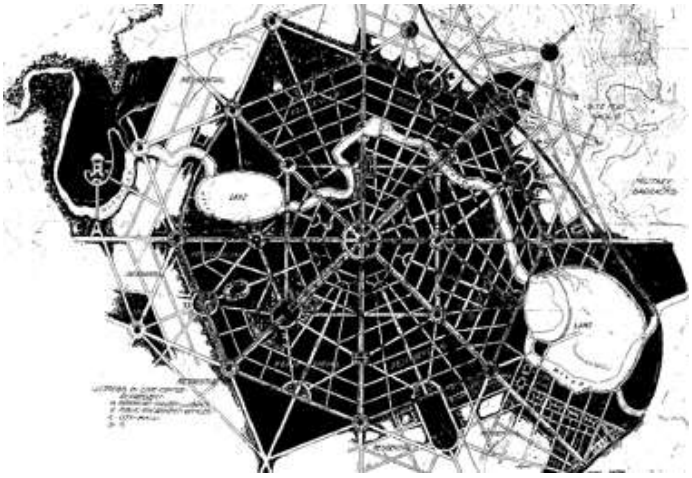
There are multiple radio options in order to communicate the sensor nodes with the Gateway. 802.15.4, 868 and 900 are used mainly in order to have local, start topologies. The WiFi is used to connect with any WiFi radio is used to send the sensor data to the Cloud without having an intermediate between gateways. The Sigfox & the LoRaWAN modules are built for IoT applications and get very long range links.

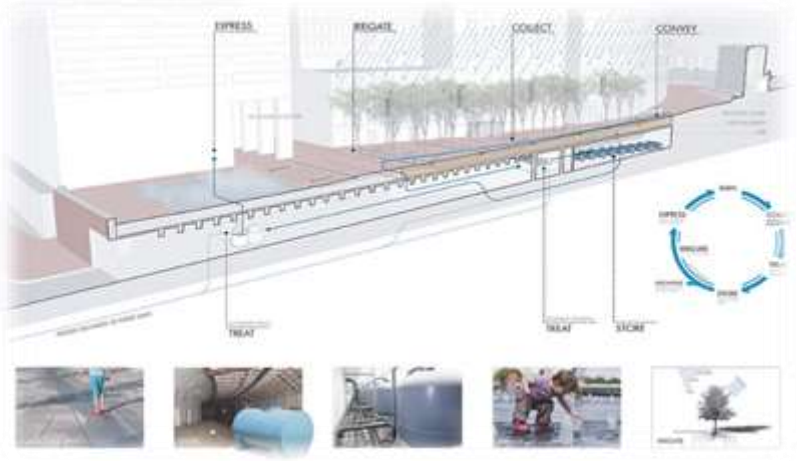
The complete list of the available radios are:

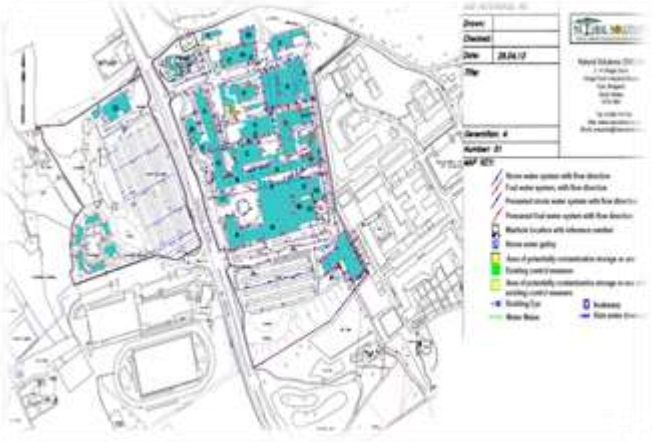
- 802.15.4 (2.4 GHz), 2 versions for Europe and world.
- RF (868 MHz)
- RF (900 MHz), 3 versions for US, Brazil and Australia
- WiFi (2.4 GHz)
- 4G, 3 versions: Europe/Brazil, US and Australia.
- Sigfox, 2 versions: Europe and US
- LoRaWAN, 2 versions: Europe and US

EXISTING DRAINAGE GRID NETWORK SYSTEMS:

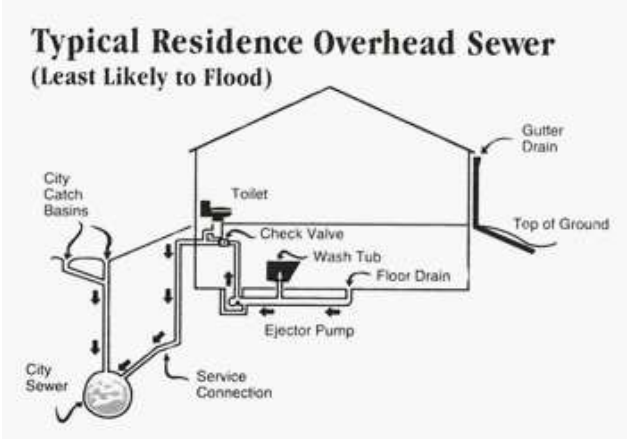
Background Analysis for incorporation.-





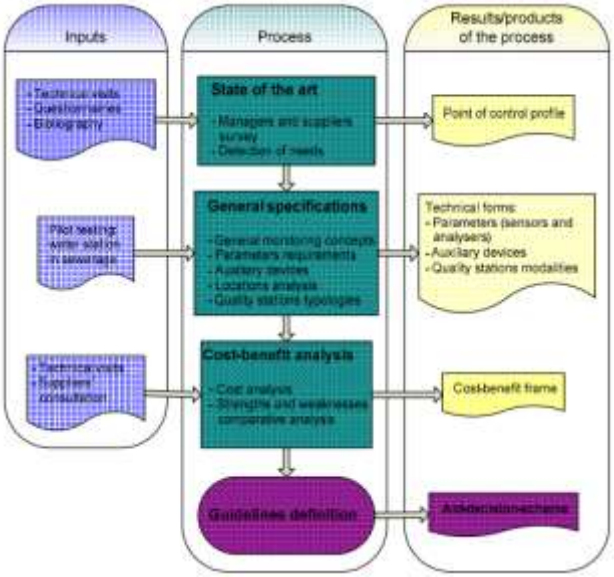


Required Checkgate model:



Sewer backups are typically due to heavy rains or over development in the area. Without the protection of a sewer check valve, the overburdened city sewer system can backup (ingress) into your residence, thus causing damage and distress for a property. The sewer check valve is primarily effective when a storm overwhelms the city sewer system.

Net quantity of sewage = Accounted quantity of water supplied from the water works + Addition due to unaccounted private water supplies + Addition due to infiltration − Subtraction due to water losses ⌊ Subtraction due to water not entering the sewerage system



Mathematical Models and Interpretations:

Models in Sewage Discharges:

The correct estimation of sewage discharge is require otherwise sewers might prove it inadequate resulting in overflow and also prove too large in diameter, which might make the system uneconomical and the hydraulically inefficient. So, before designing the sewerage system it is important to know the discharge or quantity of the sewage that would flew in it after completion of the project and at the end of design period.

Apart from this the accounted water supplied by the water authority that will be converted into wastewater, following quantities are considered during the estimation of the sewage quantity:

a. **Addition due to unaccounted private water supplies**
People who are using water supply from private wells, tube wells, hand-pumps etc. lead to the wastewater generation more than the water supplied by the municipal authority. Similarly, certain industries
Utilize their own source of water. The part of this water, after desired uses, is treated as wastewater and ultimately discharged into the drain. This quantity can be estimated by actual field observations.

b. **Addition due to infiltration:**
This is additional quantity due to groundwater mix in to sewers through faulty joints and cracks formed due to pipes. The quantity of the water mostly depends upon the height of the water table above which the sewer invert level. If water table lies below the sewer level, the infiltration can occur only after rain when water is going down through soil. The quantity of the water entering in sewage depends upon the permeability of the ground soil and it is very hard difficult to estimate boiler feed water.

c. **Subtraction due to water losses**:
The water reduces through leakage in distribution system of water and the house connections, does not able to reach consumers and hence, not appear as drainage. Subtraction due to water not entering the sewerage system contains certain amount of water is used for such purposes, which may not generate sewage, i.e. water consumed in industrial product, boiler feed water, water sprinkled over the roads, streets, lawns, and gardens, water used in air coolers, etc.

Net quantity of sewage: It is quantity of sewage production which is estimated by considering the addition and subtraction over the accounted quantity of water:

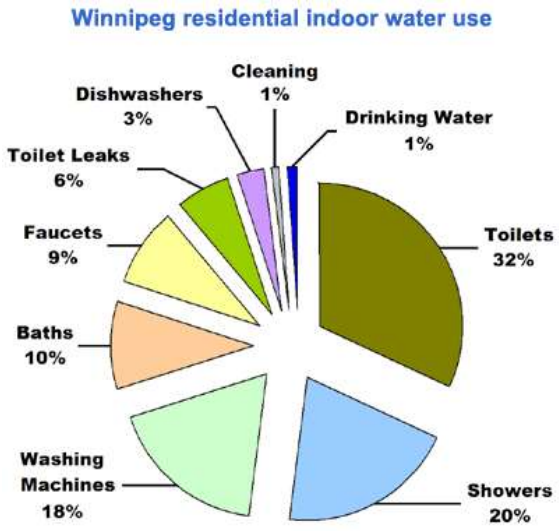
Generally75 to 80% of accounted water supplied is considered as quantity of sewage produced.

Variation in Sewage Flow:

The variation which occurred due to flow of sewage over annual average daily flow. The fluctuation in flow occurs from hour to hour and from season to season. If the flow is measured near its origin when the peak flow would be quite pronounced. The parameters would defer only if the sewage has to travel long distance. This is because of the time required in collecting sufficient quantity of sewage required to fill the drains and time required in travelling. As sewage drain in sewage lines, more and more sewage is mixed into it which continuous increase in the area being served by the sewage line. This also leads to reduction in the fluctuations occur in the sewage flow and the lagging period goes on increasing. For calculating design discharge following relation can be considered:

Daily maximum flow = Two times the annual average daily flow (representing seasonal variations)

Hourly maximum flow = 1.5 times the maximum daily flow (accounting hourly variations)
(= it is three times annual average daily flow).



Two features to be implemented for overall system monitoring and maintenance purposes:

Advanced Event Management (AEM)

The design of network operator in our mind, Advanced Event Management (AEM) also contains critical information regarding the state of the network at any point in time.

The increased visibility of critical events.
The actions based on real-time network conditions.
The automate routine tasks
"Playback" network state that:

The purpose of constructing is to increase system up-time through programming reactions which lead to network changes and used to minimize system by solving complex troubleshooting tasks.

Smart System Upgrade (SSU)

It performs network changes with minimum and no downtime. A customizable part of features Smart System Upgrade (SSU) including:

It accelerated System Upgrade (ASU), reduce device downtime. The insertion and removal of network elements in the network topology. Provide open and programmatic integration to all application and infrastructure components. It leds toward a continuous deployment model by minimizing the impact of network changes. The Wi-Fi works within no physical wired connection between the sender and receiver by using radio frequency (RF) technology – its frequency ranges between electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is generated that then is able to propagate through space.

NFC:
It has a short-range high frequency wireless communication technology that allow the exchange of data between devices over about a 10 cm distance. NFC has an upgrade of the existing proximity card standard (RFID) that includes the interface of a smartcard and a reader into a single device.

Blade Servers:

A blade is design as a self-contained server, which combined fits into an enclosure with other blades. Sometimes also known as a chassis, it enclosure provides the power, cooling, connectivity, and manage each blade server. The blade servers themselves contain only the core processing elements, constructs them hot- swappable. In other words, blades can be whatever you need them to be. The used blade savings of time, money, and energy costs to create a competitive advantage over all. It is design to optimize virtually any workload, it is managed by a consumer inspired Management platform that help to delivers unprecedented ease of use allowing you to deploy and help in managing your environment faster, at lower cost, and maximize productivity at any scale.

A blade server is a stripped down server computer with a modular design led to minimize the use of physical space and energy. Whereas on other hand a standard rack-mount server can function within (at least) a power cord and network cable, blade servers consist of many components removed to save space, minimize power consumption and other considerations, while still having all the functional components to be considered a computer. Unlike a rack-mount server, a blade server requires a blade enclosure. These are the major components for mainframe that hold the database and make a platform available for us to manage them.

The benefits of blade servers include as:

- Reduced energy costs
- Reduced power and cooling expenses
- Space savings
- Reduced cabling
- Redundancy
- Increased storage capacity
- Reduced data center footprint
- Minimum administration

Blade servers provides powerful computing solution, offering improvements in terms of modularity, performance and consolidation.

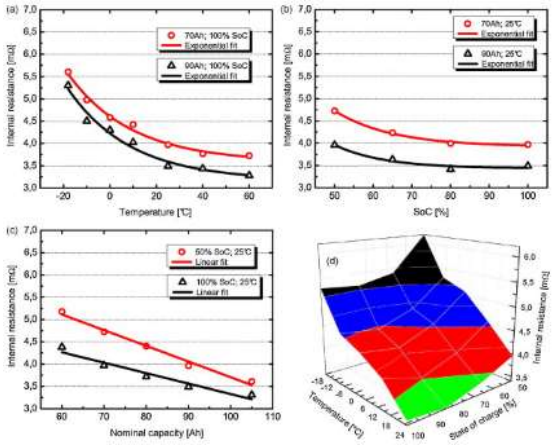
With Great Software, comes Really Large Hardware Storage and organization for handling servers are:

Cloud computing:
Cloud computing allows companies to consume compute resources as a utility -- as electricity -- rather than having to build and maintain computing infrastructures in one place. Cloud computing promises several important benefits for businesses and end users. Three of the main benefits of cloud computing includes: Self-servicing provisions: End users could spin up computing resources for almost any type of workload on demand. The on demand computing is a kind of Internet-based computing which provides shared processing resources and data to computers and other devices on demand. It is a unified model for enabling ubiquitous, on-demand access to a shared tool of configurable computing resources. The cloud computing and storage solutions provide users and enterprises with various capabilities to store and process their data in the third-party data centers. This relies on sharing of resources to achieve coherence and economies of scale, similar to a utility over a network.

The cloud computing is a model for enabling convenient, on-demand network access to provide a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management efforts .The availability of high-capacity networks and storage devices as well as the widespread adoption of hardware virtualization, service-oriented architecture, and autonomic and utility computing have a growth in cloud computing. Companies can scale up as computing needs increase and then scale down again as demands decrease.

BATTERIES (Waterproof and submersible if required):

Waterproof Lithium-Air Batteries:



Use of lightweight, high-energy batteries that can use the surrounding air as a cathode. Under development is single-use lithium metal-air batteries with rechargeable lithium metal-air batteries that can go for longer in between charges for around years.

Water power: The prototype battery made by Polypus uses lithium metal as the anode and salt water as the cathode to power on an LED. As the battery discharges, lithium ions start diffuse into the water, but the device doesn't affect the surrounding habitat.

Lithium-metal batteries try to approach the energy density of fuel cells without having the plumbing required for these devices; in theory and the maximum energy density is more than 5,000 watt-hours per kilogram, or more than 10 times that of present lithium-ion batteries. Lithium metal-air batteries are also very light-weighted because it's not need to carry a second reactant. Exposure to even traces of water rapidly degrades the material strength.

To solve problems is used a "protected lithium electrode." The device consists of a flat, rectangular piece of lithium metal which is overlaid on either side with a ceramic electrolyte material called as lisicon. The solid electrolyte tries to impermeable to water but lets lithium ions pass through. Another coating preserve the electrolyte from reacting with the lithium metal. And finally, the edges of the device are tightly sealed with an aluminum-polymer laminate.

The lamination provides a watertight seal, and it is flexible, so it doesn't create any type of strain when the electrode shrinks with use.
When the lithium-metal electrode is kept in water, lithium ions starts to leak out and react with oxygen dissolved in the water & with the water itself.

To build a lithium metal-air battery, the device is fitted/fixed with a gas-diffusion electrode similar to which is used for zinc metal-air hearing-aid batteries. When the battery treatment of water a great variety switched "On", the electrode draws of oxygen through membrane to react with the lithium ions. But unlike hearing the batteries, these devices won't start self-discharge over time. And because they are based on the fact of high-energy lithium metal, these batteries also last much longer and also lighter than zinc-air batteries.

The single use of batteries made by the company employee a piece of lithium metal about two centimeters squared and three millimeter thick and they had a storage capacity very close to that of the lithium-ion batteries in present laptops at most of one-fifth the weight. Lithium-metal batteries have the potential strength to be "transformational" for underwater applications

Water Treatment Chemicals:

For the chemical treatment of water a great variety of chemicals can be applied. Below, the different types of water treatment chemicals are summarized up:

Antifoams
Coagulants
Corrosion inhibitors
Disinfectants
Emulsions
Neutralizing agents
Oxidants
Oxygen scavengers
pH conditioners
Scale inhibitors
Algaecides

Algaecides are chemicals that will kill algae and red or green algae, when they are added to water. Examples are as copper sulphate, iron salts and the rosin amine salts and benzalkonium chlorides. The algaecides are mostly effective against the algae, but are not very usable for algal blooms for environmental reasons.
The problem with the algaecides is that they would kill all present algae, but they did not the toxins that are released by the algae prior to death.

Antifoams
Foam is like a mass of bubbles created when certain types of gases are dispersed into a liquid. Strong film of liquid that surround the bubbles, forming the large volumes of non-productive foam.
The cause of foam is a complicated to study in physical chemistry and but we already know that its existence presents a problems in both the operation of industrial processes and the quality of the finished products. When it is not held under control, foam could reduce the capacity of equipment and enhance the duration and costs of processes. Antifoam blends contain oils combined with small amounts of silica. They break down foam thanks to the two of silicone's properties which are- incompatibility with aqueous systems and ease of spreading. Antifoam compounds available either as powder or as an emulsion of pure product.

Emulsions
Antifoam Emulsions are aqueous emulsion of polydimethylsiloxane fluid. They have almost same properties as the powder form, the only difference is that they could also be applied in watery solutions.

Boiler water chemicals include chemicals that are used for the following applications such as:
· the Oxygen scavenging;
· Scale inhibition;
· Corrosion inhibition;
· Alkalinity control.

Coagulants:
When we refer to coagulants the positive ions with high valence are preferable. The aluminum and iron are applied, aluminum as Al2(SO4)3- and iron as either FeCl3 or Fe2(SO4)3-. One could also apply the relatively cheap in form FeSO4 condition that it will be oxidized to Fe3+ during aeration reaction.
Coagulation is very dependent on the doses of coagulants and the pH and also colloid concentrations. To adjust pH levels Ca(OH)2 is applied which act as co-flocculent. These doses usually vary lies between 10 and 90 mg Fe3+/ L but when salts are present ae higher dose needs to be applied fast.

Corrosion inhibitors
Corrosion is a indication that conversion of a metal into a soluble compound.
Corrosion can also lead to the failure of critical parts of boiler systems, deposition of corrosion products in critical heat exchange areas and have overall efficiency loss.
That is why corrosion inhibitors are often applicable.
Inhibitors are chemicals that can react with a metallic surface and giving the surface at very good level of protection. Inhibitors usually often worked by adsorbing themselves on the metallic surface and protecting the metallic surfaces by forming a film on it.

There are five different kinds of corrosion inhibitors. These are:

1) **Passivity inhibitors:** These cause a very high shift of the corrosion potential and force the metallic surface into the passive range. Examples of passivity inhibitors are as oxidization of the anions and such as chromate and nitrate and non-oxidizing ions such as phosphate. These inhibitors are the most effectively and consequently the most widely used.

2) **Cathodic inhibitors.** Some cathodic inhibitors such as compounds of arsenic and antimony are mainly worked by making of certain recombination. Other cathodic inhibitors, ions such as calcium or magnesium, may be precipitated as oxides to form a protective layer on the metal surface.

3) **Organic inhibitors**. This affect the entire surface of a corroding metal when present in certain amount of concentration. Organic inhibitors also protects the metal by forming a thick hydrophobic film on the metal surface. Organic inhibitors would be adsorbed to the ionic charge of the inhibitor and the charge on the surface.

4) **Precipitation inducing inhibitors.** These are compounds that also cause the formation of certain precipitates on the surface of the metal and thereby providing better protective film.
The common inhibitors are silicates and phosphates.

5) **Volatile Corrosion Inhibitors (VCI**). These are compounds which mainly are transported in a closed environment to the site of corrosion by volatilisation from a sources. Examples are such as morpholine and hydrazine solids such as salts of cyclohexylamine and hexamethylene-amine. On contact with the metal surface andthe vapour of these salts condenses and it is hydrolyzed by moist to liberate protective ions in compound.

Disinfectants

Disinfectants kill present microorganisms in the water.
There are various different types of disinfectants:
· Chlorine
· Chlorine dioxide
· Ozone
· Hypochlorite

Chlorine dioxide disinfection
ClO2 is used principal for the primary disinfectant for surface waters with smell and taste problems. It is an effective biocide at which concentrations as low as 0.1 ppm and over a wide pH range. ClO2 penetrates the bacterial cell wall and also reacted with vital amino acids in the cytoplasm of the cell to kill the organisms. The byproduct of this reaction is chlorite compound.
Chlorine dioxide disinfects according to the same principle as chlorine and however it opposed to chlorine and chlorine dioxide has no harmful effects on the health.

Hypochlorite disinfection
Hypochlorite is applicable in the same way as chlorine dioxide and chlorine. The hypo chlorination is a disinfection method that is not used widely anymore and act as an environmental agency proved that the Hypochlorite for disinfection in water bodies was cause of the bromate consistence in water.

Ozone disinfection
Ozone is a very strong oxidation medium with a remarkable short life span. It consists of oxygen molecules with some extra O-atom which form O3. When ozone comes in contact with odour and bacteria the extra O-atom breaks them down directly, by means of oxidation. The third O-atom of the ozone molecules and only oxygen will remain.

Disinfectants could be used in various industries. Ozone is mainly used in the pharmaceutical industry, for drinking

water preparation, for treatment of process water and for surface disinfection.
Chlorine dioxide is used for drinking water preparation and disinfection of piping.
Every disinfection technique has its own advantages and its own application field. In the table advantages and disadvantages are shown:

Flocculants
It promote the formation of flocs in water that contains suspended solids polymer are applied to make bonds formation between particles. These polymers have a specified effect, dependent upon their charges, their molar weight. The polymers are water-soluble and their molar weight lies between 105 and 106 g/ mol.
There can be many charges on one flocculent. There are cationic polymers, base on nitrogen, anionic polymers, base on carboxylate ions and poly-ampholytes, which carries both positive and negative charges.

Neutralizing agents (alkalinity control)
To neutralize acids and bases we use either sodium hydroxide solution (NaOH), calcium carbonate or lime suspension (Ca(OH)2) to increase the pH levels. We use diluted sulphuric acid (H2SO4) or diluted hydrochloric acid (HCl) to reduce pH levels. The dose of neutralizing agents is based upon the pH of the water in a reaction basin. Neutralization reactions cause a increase in temperature.

Oxidants
Chemical oxidation processes using (chemical) oxidants led to reduce COD/BOD levels, and to remove both organic and oxidisable inorganic components. The processes can help to completely oxidize organic materials to carbon dioxide and water, although it is not necessary to operate the processes to this level of treatments.
The wide variety of oxidation chemicals are available. Examples are-
· Hydrogen peroxide;
· Combined ozone & peroxide;
· Oxygen.

Hydrogen peroxide
Hydrogen peroxide is widely used and give thanks to its properties; it is a safe to handle, effective, powerful and versatile oxidant. The main applications of H2O2 are oxidation to bring out the corrosion control, organic oxidation, metal oxidation and toxicity oxidation. It is difficult pollutants to oxidize may require H2O2 to be activated with catalysts such as iron, manganese or other transition metal compounds.

Ozone
Ozone cannot be applied as a disinfectant; it can also act as removal of contaminants from water by means of oxidation. Ozone also purify the water by breaking up organic contaminants and convert it into the inorganic contaminants to an insoluble form that can then be easily filtered out. The Ozone system can remove at most twenty-five contaminants. Chemicals that can be oxidized with the ozone are as:
· Absorbable organic halogens;
· Nitrite;
· Iron;;
· Pesticides;
· Nitrogen oxides;
· Odorous substances;
· Chlorinated hydrocarbons;

Oxygen
Oxygen can also be used as an oxidant, for example to realize the oxidation of iron and manganese. The reactions that occurs during oxidation by oxygen are usually very similar.
the reactions of the oxidation of iron and manganese with oxygen are:
$2\ Fe^{2+} + O_2 + 2\ OH^- \rightarrow Fe_2O_3 + H_2O$
$2\ Mn^{2+} + O_2 + 4\ OH^- \rightarrow 2\ MnO_2 + 2\ H_2O$

Oxygen scavengers
Oxygen scavenging means preventing oxygen from allowing oxidation reactions. Most of the naturally occurring organics charge have a slightly negative charge. Due to that they could absorb oxygen molecules, because these carry a positive charge, to prevent oxidation reactions from taking place in water. Oxygen scavengers include organic products such as carbohydrazine, hydroquinone, methylethylketoxime but also the non-volatile salts, such as sodium sulphite (Na_2SO_3. The salts often also contains the catalysing compounds to increase the rate of reaction with dissolved oxygen for example cobalt chloride compound.

pH conditioners
The municipal water is often pH-adjusted, in order to prevent corrosion from the pipes and to prevent dissolution of lead mix into water supplies. During water treatment pH adjustments may also be require. The pH is brought up or down through addition of basics or acids in it. An example of lowering the pH is the addition of hydrogen chloride or in case of a basic liquid. An example of bringing up the pH is the addition of natrium hydroxide and in case of an acidic liquid.
The pH would be converted to approximately seven to seven and a half and after addition of certain concentrations of acids or basics. The concentration of the substance and the kind of substance that is added also depend upon the necessary decrease or increase of pH value.

Resin cleaners
Ion exchange resins needs to be regenerated after application and also after that they can be reused. But every time the ion exchangers are used serious fouling smell takes place. The contaminants that enter into the resins will not be removed through regeneration therefore resins need cleaning with corrosive chemicals.
Chemicals that are used are for example sodium chloride, potassium chloride, citric acid and chlorine dioxide.
Chlorine dioxide cleansing serve as the removal of organic contaminants on ion exchange resins. Priority to every

cleaning treatment resins should be regenerated.

Scale inhibitors

The Scale is the precipitate that forms on surfaces in contact with water as a result of the precipitation of normally soluble solids which act as insoluble as temperature increases. Some examples of scale are compound of calcium carbonate, calcium sulphate, and calcium silicate.

The scale inhibitors are surface active negatively charged polymers. If minerals exceed their solubility's and begin to merge, the polymers tries to attach. The structure for crystallization is changed and the formation of scale is prevented. The particles of scale combine with the inhibitor will than able to dispersed and remain suspended.

Examples of scale inhibitors are as follows phosphate esters, phosphoric acid and solutions of low molecular weight polyacrylic acid.

2 Localized case Studies:

Case1:

A International University setback on bank of two natural lakes at potheri village in the city of Chennai hosting degree students of over 20 countries with state of art architecture and teaching standards its green quotient has been appreciated by world powers but lies a hidden truth that disappoints the inner masses.

i.e. college students .

Coming to the point of focus is based a sewage treatment system with a capacity to handle continuous load of 2 lakh individuals established at outskirts that presently handles a capacity of around 000 individuals with proper sewage treatment facilities with infixed systems and parameters treating water to the best standards possible before release into the nearby lake under proximity.

The catch: Medical College of same university and Machination labs with discarded contaminated human waste and heavy metals lead their daring to the same ponds and then the villagers around nearby locations with residents over 1 lakh have their untreated wastes partially disposed into same lake even after presence of some municipal aid.

Productivity parameters of noble efforts by university being affected in negative ways as resultant tends to:

- Mixed unaddressed contaminations.
- Resupply of same water after partial treatment from these lakes for certain activities.
- Available Facilities not being used to their optimal levels.

[ALL INSET PICTURES DIRECTLY PERSONALLY TAKEN FROM CASRE SITE]

CASE 2:
Broader concern to mega cities considering mis-management rather lack of technology and system coordination regarding recently conducted Chennai Floods.

Salient points highlighting the problem are:

The city, which witnesses that flooding in some localities was completely marooned. Schools and colleges were remain closed down for two weeks as civic authorities struggled with the flood waters. A population of more than one crore living in the greater Chennai metropolitan area suffered.

Helplessness was large on the faces of civic authorities, the police and politicians helped alike, as rain of over 1,000 mm pummeled Chennai in just two weeks. One major way this could have been seen is by proper drainage facility planning with heavy discharge possibilities.

The interconnection between storm water drains so that overflow from lakes and reservoirs would go straight into the sea without causing flooding on roads sides is a backup option of utilizing the full-fledged system in case of an emergency/calamity situation.

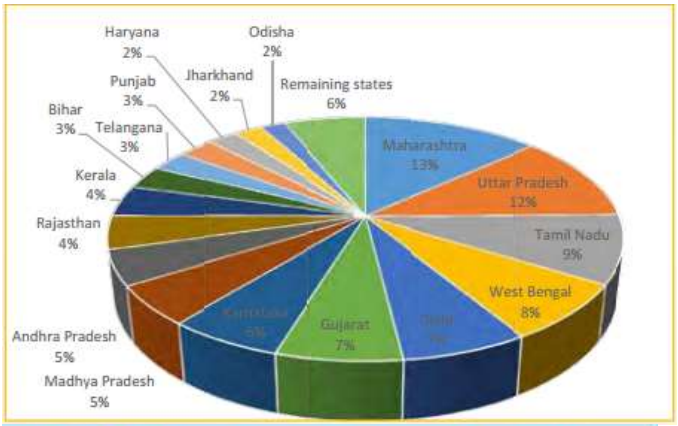
This targets connecting all outflow into one of the three main rivers that drain Chennai city — the Kosasthalayar, Cooum and Adyar rivers — as well as the Buckingham canal. For instance, overflow by the Porur lake would also connect into the Virugambakkam canal which in turn would overflow into the Cooum river and finally led to the Bay of Bengal. The series is almost close to 900 km of storm water drains in the city but both large and micro, were to be hooked up to ensure that water keeps flowing out of the roads during monsoon. Some citing have defects in flood mitigation plans, delay in disbursal of fund in system by the corporation and inadequate efforts to remove the crowd and utilities in drainage systems were among the major reasons.

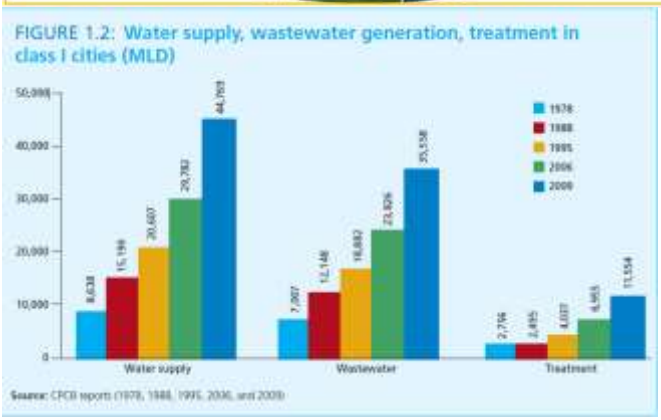
While several controversies have been doing rounds as far as Chennai floods are concerned, after a thorough analysis, even when the Union Ministry felt that overflow of dam water at wrong time and inadequate drainage system may have led to the Chennai flood massacre.

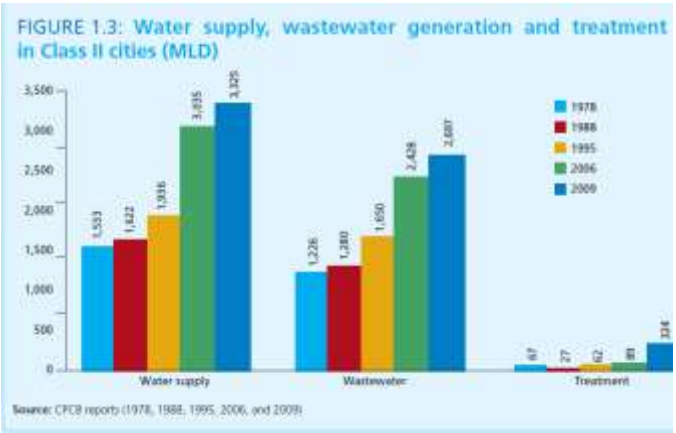
Had the opening of the overflowing water body avoided so if we have the drainage systems were adequate then state could have been saved from a big disaster. During the floods, when people walked on the roads, they were hit by a rapid influx of water, which does not happen with rain water alone.

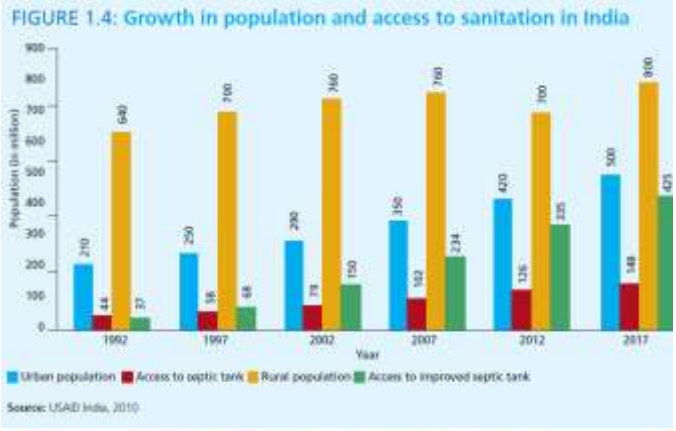
The Chennai flood assessment should have been done by the administration on the local levels, and people could have been evacuated beforehand. For cities the prone to disasters like floods, effective disaster response teams and adequate drainage systems is must. Proper urban planning also needs to be done to avoid another disaster similar to that of the Chennai rains.

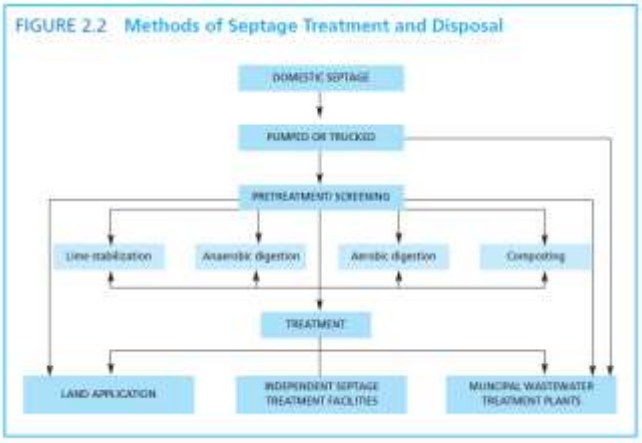
Tables, Programs And Sample App Analysis:











Sewage generation and treatment capacity in Class I cities and Class II towns (Sewage generation estimated on the basis of 2001 population)

City category & population	Number of cities	Sewage generation, MLD	Installed sewage treatment capacity, MLD	Capacity gap in cities having STPs, MLD (A)	Sewage generation in cities having no STPs, MLD (B)	Total capacity gap, MLD (A+B)	Planned treatment capacity, MLD
Class I cities having more than 10 lac population	38	13583	4472 (in 29 cities)	6135	2896	9031	1549
Class I cities having 5 to 10 lac population	32	3836	485 (in 13 cities)	1293	2058	3351	123
Class I cities having 2 to 5 lac population	119	4887	768 (in 34 cities)	804	3235	4039	4
Class I cities having 1 to 2 lac population	224	4818	522 (in 36 cities)	373	3323	3696	32.5
All the above Class I cities together	414	26164 (100%)	6047(23.1%) (in 112 cities)	8905 (32.9%)	11512 (44%)	20117 (76.9%)	1708.5 (6.5%)
Class II towns having 0.5 to 1 lac population	489	2965 (100%)	200 (=143*) (4.8%) (in 22 towns)	Nil	2822 (95.2%)	2822 (95.2%)	34.1 (1.15%)
All Class I cities and Class II towns	893	29129 (100%)	6190 (21.3%)	8905 (29.5%)	14334 (49.2%)	22939 (78.7%)	1742.6 (6.0%)

Cost Calculation Factors lifetime durability for utility, integration scope with existing scopes:

Using bottom up approach, lets consider a block level system.

Cost of module: SGC's

Households: 2500 per module (paid by customers who has to follow prescribed standards during internal drainage construction once + maintenance)

Extra Piping + added architecture: 12 lakhs (interacting +channeling)

MMA +DCAS-10000 per module per square kilometer, to be built on a phase by basis.

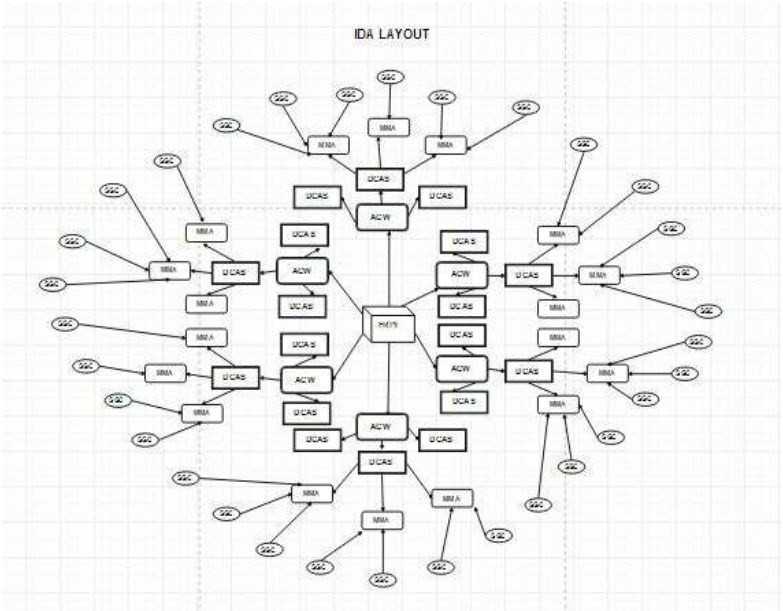
ACW +FRPI+New specialized water treatment plants –
City: 15 crores*3 =50 crores
(Planned on 10 year basis)

Total average cost per block /year - 20 lakhs.

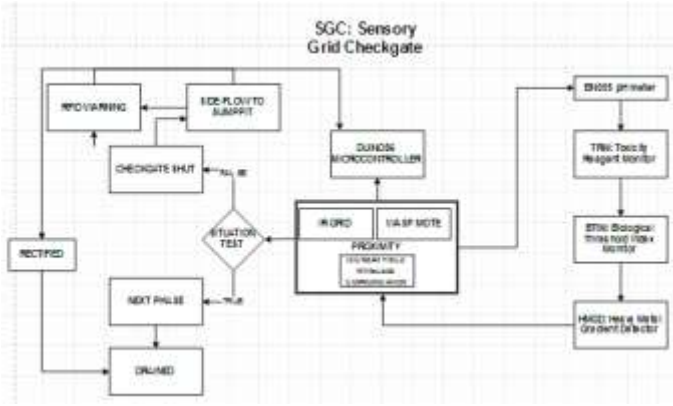
Design of Specified Modules:

1. Sensory Grid Checkgate(SGC):
2. Manhole Monitoring Array(MMA):
3. Drainage Choke Alert System(DCAS):
4. Anti-Contamination Warning(ACW):
5. Final Releaseable Purity Index(FRPI);

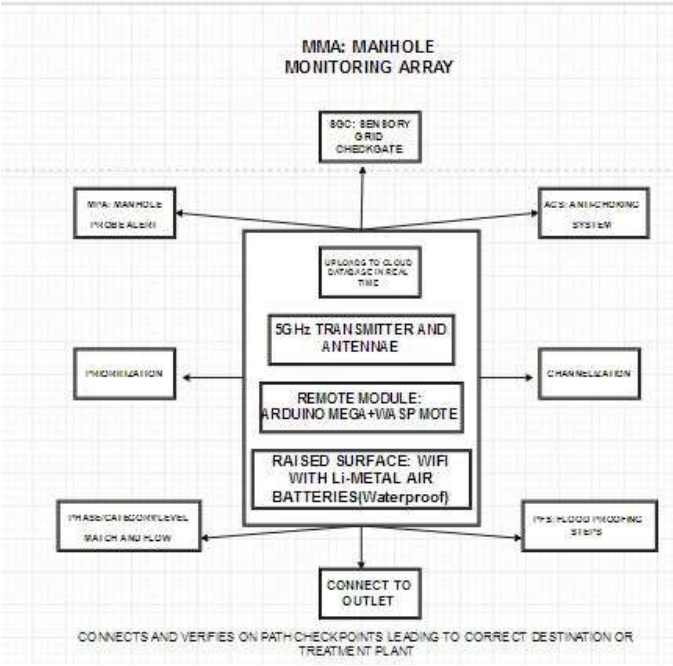
Modular Webs: Blueprint of system design.



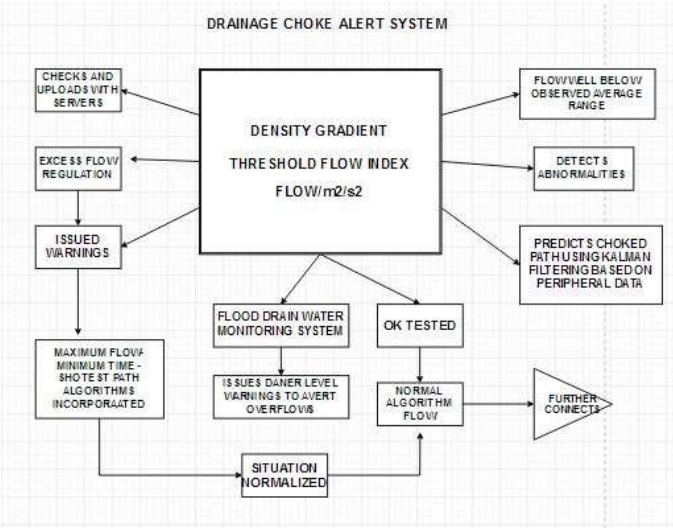
SGC: SENSORY GRID CHECKGATE



MMA: MANHOLE MONITORING ARRAY

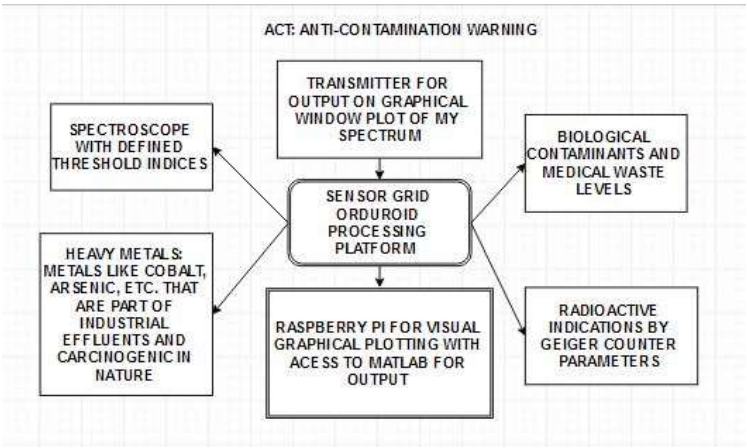


DCAS: DRAINAGE CHOKE ALERT SYSTEM



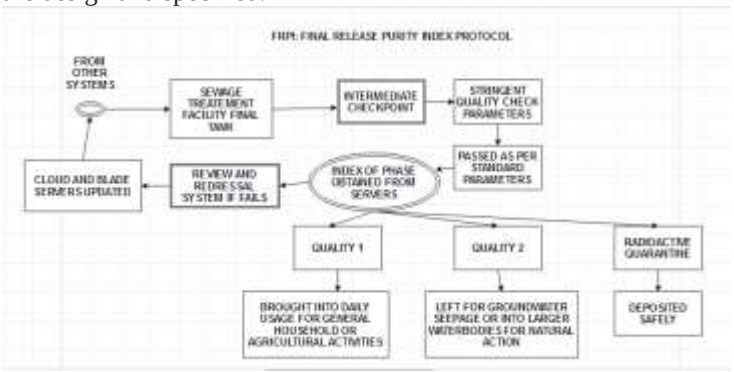
ACW: ANTI CONTAMINATION WARNING

Submodule present before water from connecting drain reacts stage 1(level category) water treatment plant /facility.

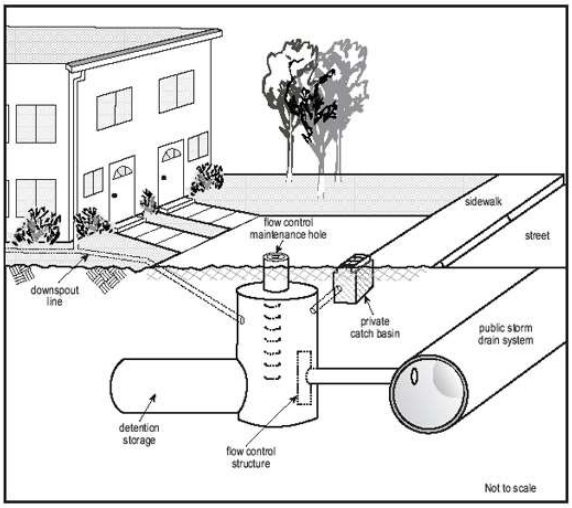


FRPI: FINAL RELEASE PARITY INDEX PROTOCOL

Standards set by PWD department Indian Standards Water index final rechargeable parity index and in terms with WHO parameters as input and regulations.
Protocols based on which standards of other four modules are design and specified.



Flowchart and Block-Diagrams:



Significance at Present Scenario and Analysis for Implementation:

- Sewers and Drains are baseline of waste disposal in liquid form from outlets of each civic establishment from a society.
- They are built and planned along with city planning to sustain an exponential exception of population over a period of valid expansions.
- Once constructed, be it any city of India, closed or open severs and their discharge centers keep on getting repaired or maintained due to the degree of civil engineering standards involved and frequent acts of nature and other developed proposals.
- This idea being proposed by this paper has something similar but much beneficial in its ambitious to make this network not so helpless rather self –reliant, regulation, smart and controlled.
- This levels to immediate addressing to problem and going into steps of actions with targeted goals to smoother the channelized sewage water discharge system.
- This comes with a hope with a precise end location for every discharge in drains which end up in a particular treatment requested, evaluated on basis of the IDA modules.

Scopes for Further Research and Improvement:

- ❖ As time progress, size of IC's and microcontrollers decrease, increase in computational power but there is also requirements for immediate consideration for cost reduction.
- ❖ Simpler modules for ester implementation.
- ❖ Innovation, advancements, technology targeted improvements in sewage treatment plants.
- ❖ Reagents to be available as replenish able modules for toxicity neutralization at site of origin.
- ❖ Developments regarding radioactive confinement against radiation contamination.
- ❖ Pre-planned layout for upcoming cities, towns and other civics establishments.

Conclusion:

- This project may to an extent bring about newer dimensions into liquid waste managements, sewer maintenance, segregation of wastes, proper treatment and with a completely green and ecofriendly approach.
- All being incorporated a need being addressed, treated safe sludge used as manure, optional utilization of sewage treatment plant facilities mutual cooperation with a concern for earth safe water being or later being rephrased back into supply .With a local inspiration for preventing a nearby lake from getting damaged, making better quality to be made available, utilizing available technology and supplemented facilities to get best of whatever we have got.

Saving water and putting them into security and proper utilization in all frames, aims towards a green and sustainable future, "A step toward the essence of life".

Glossary:

Activated sludge

Oxygen dependent biological process that serves to convert soluble organic matter to solid biomass, that is removable by gravity or filtration.

Advanced water treatment
The level of water treatment that requires an 85-percent reduction in pollutant concentration, also known as tertiary treatment.

Advanced Wastewater Treatment
Any treatment of sewage water that includes the removal of nutrients such as phosphorus and nitrogen and a high percentage of suspended solids.

Assimilation
The ability of water to purify itself of pollutants.

Assimilative Capacity
The capacity of natural water to receive wastewaters or toxic materials without negative effects and without damage to aquatic life or humans who consume the water.

Biochemical Oxygen Demand (BOD)
The amount of oxygen (measured in mg/L) that is required for the decomposition of organic matter by single-cell organisms, under test conditions. It is used to measure the amount of organic pollution in wastewater.

Bioremediation
The biological treatment of wastewater and sludge, by inducing the breakdown of organics and hydrocarbons to carbon dioxide and water.

Chemical Oxygen Demand (COD)
The amount of oxygen (measured in mg/L) that is consumed in the oxidation of organic and oxidisable inorganic matter, under test conditions. It is used to measure the total amount of organic and inorganic pollution in wastewater. Contrary to BOD, with COD practically all compounds are fully oxidized.

Coliform bacteria
Bacteria that serve as indicators of pollution and pathogens when found in water. These are usually found in the intestinal tract of humans and other warm-blooded animals.

Coliform index
A rating of the purity of water based on a count of coliform bacteria.

Cryptosporidium
A microorganism in water that causes gastrointestinal illness in humans. It is commonly found in untreated surface water and can be removed by filtration. It is resistant to disinfectants such as chlorine.

Cultural eutrophication
Decline of the oxygen rate in water, which has serious consequences for aquatic life, caused by humans

Effluent
The outlet or outflow of any system that deals with water flows, for an oxidation pond for biological water purification. It is the product water of the given system.

Eutrophic
Referring to water that is rich in nutrients such as nitrogen and phosphorous.

Flux
The rate at which a Reverse Osmosis Membrane allows water to pass through it.

Gray Water
Domestic wastewater composed of wash water from kitchen, bathroom, and laundry sinks and from tubs, and washers.

Injection
The introduction of a chemical or medium into the process water to alter its chemistry or filter specific compounds.

Putrefaction
Biological decomposition of organic matter; associated with anaerobic conditions.

Qualitative water assessment
Analyses of water used to describe the visible or aesthetic characteristics of water.

Quantitative water assessment
Use of analyses of water properties and concentrations of compounds and contaminants in order to define water quality.

Reserve Capacity
Extra treatment capacity built into wastewater treatment plants and sewers to be able to catch up with future flow increases due to population growth.

Sewage sludge
Sludge produced in a public sewer.

Sewerage
The entire system of sewage collection, treatment, and disposal.

Sludge
A semi-solid residue, containing microorganisms and their products, from any water treatment process

Toxic water pollutants
Compounds that are not naturally found in water at the given concentrations and that cause death, disease, or birth defects in organisms that ingest or absorb them.
Transmission lines
Pipelines that transport raw water from its source to a water treatment plant.

THM
Trihalomethanes. Toxic chemical substances that consist of a methane molecule and one of the halogen elements fluorine, bromine, chlorine and iodine attached to three positions of the molecule. They usually have carcinogenic properties.

Wastewater infrastructure
The plan or network for the collection, treatment, and disposal of sewage in a community.

Water monitoring
The process of constant control of a body of water by means of sampling and analyses

Zero discharge water
The principle of “zero discharge” is recycling of all industrial wastewater. This means that wastewater will be treated and used again in the process. Because of the water reuse wastewater will not be released on the sewer system or surface water

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