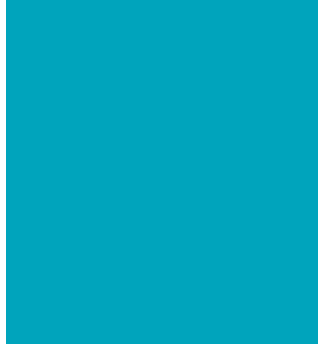
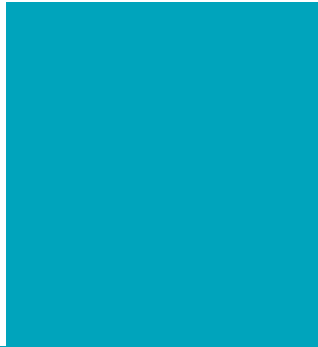


**Workshop on:**

# **Water conservation through Rainwater harvesting and Ground water recharge: Establishing Urban Planning linkages**



**AADA | GDA | CWAS-CRDF-CEPT**



**February, 2024**



# Objective of workshop

CWAS- CRDF CEPT University in partnership with Anjar Area Development Authority (AADA) and Gandhidham Development Authority (GDA) organized one day workshop on “**Water conservation through Rainwater harvesting (RWH) and Ground water recharge (GWR): Establishing urban planning Linkages**” for city’s Engineers, Builders and Architects as part of Water Security Project.



# Workshop Agenda...

## Water conservation through Rainwater harvesting and Ground water recharge: Establishing Urban Planning linkages

One Day Workshop

Organized by

Anjar Area Development Authority (AADA),  
Gandhidham Development Authority (GDA) and  
Center for Water and Sanitation (CWAS), CRDF, CEPT University

19<sup>th</sup> February 2024



Time	Session	Speaker
10:00 - 10:15	Introduction and welcome of dignitary	AADA and GDA
10:15 - 10:45	National water status in India- Issues and challenges; Findings of study on water security in Anjar and Gandhidham; Good practices examples	Ms. Upasana Yadav, CWAS-CEPT University, Ahmedabad
10:45 - 11:15	Technical aspects on Geohydrology and RWH /GWR in local context of Anjar and Gandhidham	Mr. Yogesh Jadeja, Arid Communities and Technologies (ACT), Bhuj
11:15 - 12:00	Role of Engineers, Builders and Architects in water sensitive urban planning and drinking water security at building and city scale	Mr. Lokendra Balasaria, Tree Walks, Ahmedabad
12:00 – 13.00	<b>Open discussion Q&amp;A and Wrap up</b>	
13:00 - 14:00	<b>Lunch</b>	
14:15- 15:30	<b>Site visit</b> Rainwater harvesting and ground water recharge structure in School Cluster, Adipur- Gandhidham	





- Session Speakers

## SESSION 1

### Water conservation through Rainwater harvesting and Ground water recharge: Establishing Urban Planning linkages

- *Key challenges faced by our cities due to changing climate*
- *Planning wisdom to resolve these issues*
- *Towards water secure and climate resilient cities – Anjar and Gandhidham*



**Upasana Yadav**  
Program Lead  
CWAS-CRDF-CEPT University

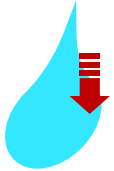
*Upasana is currently working as a Program Lead at CWAS. She has a Masters in Planning (Infrastructure) from CEPT University, Ahmedabad, and a Bachelors in Civil Engineering from MS University, Vadodara. She leads CWAS's work in implementation of city sanitation plans, WASH improvement planning tools, and innovative financing mechanisms like development impact bonds and blended finance mechanism, water security, performance assessment systems, public finance and business models.*

# Water security an issue of extreme urgency



**54%**

**Of India faces high to extremely high water stress**

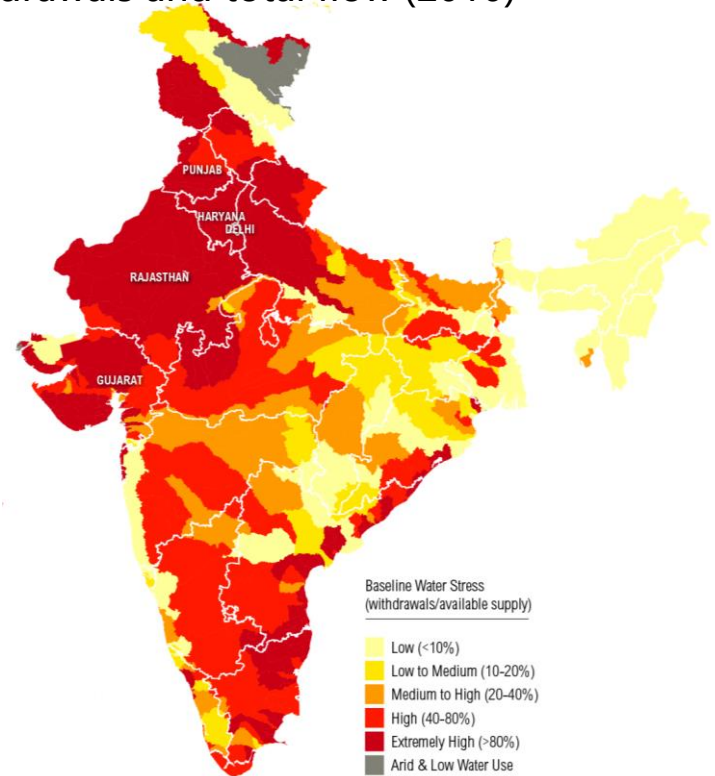


**21 cities** moving towards zero ground water level



**6%** predicted loss in gross domestic product (GDP) by 2050

Baseline water stress in India Ratio of total withdrawals and total flow (2010)



Source: Composite water index, 2018, Niti Aayog report

# Key challenges faced by our cities, today ...

Ironical situation-  
floods vs. water scarcity

On the one end there is **acute water scarcity** and on the other, the **streets are often flooded** during the monsoons



Depletion of local water  
resources

Depletion of groundwater levels



Distant water sources



Deteriorating Quality of Water  
Sources

Solid waste and untreated  
sewage dumping



Industrial pollution





# Key challenges faced by our cities, today ...

## Widening demand and supply gap



India's water demand will grow 24 percent by 2025 and 74 percent by 2050

Urbanization leading to surge in

- Domestic water demand
- Industrial water demand

## High Water losses



Water losses and leakages in pipes as high as 40-50% of total water supply

## Inequity in water supply



# Key challenges faced by our cities, today ...

## Lack of rainwater harvesting and groundwater recharge



## Non-maintenance of traditional harvesting structures



## Vanishing lakes and waterbodies




## Lack of demand management

### Water wastage



### Lack of water saving fixtures

**USING WATER EFFICIENTLY**  
By using fixtures that reduce the flow of water, a lot of it can be saved.

 Conventional taps 6-8 litres/min.	<b>VS</b>	Low flow taps (with aerators) 2 litres/min.
Conventional shower 12-15 litres/min.	<b>VS</b>	Low flow showers 6-9 litres/min.
Conventional WC 6-9 litres/flush	<b>VS</b>	Low flow dual flush WC 3 and 6 litres/flush

# Anjar and Gandhidham: The region has historically faced water crisis...

Chronically drought prone region with a frequency of once in every 2.5 years

- Over exploitation of ground water, which is further aggravated by salt water intrusion
- Dependent on Narmada Water

Frequent Urban flooding scenario in major parts of the cities



In Kutch, history has a habit of repeating itself

Rutam V Vora | Bhuj, March 28 | Updated On: Mar 28, 2019



The region is witnessing its worst drought in 30 years; 16 of its 20 dams have gone dry; there is drinking water but nothing for cattle; and yet, its people remain resilient

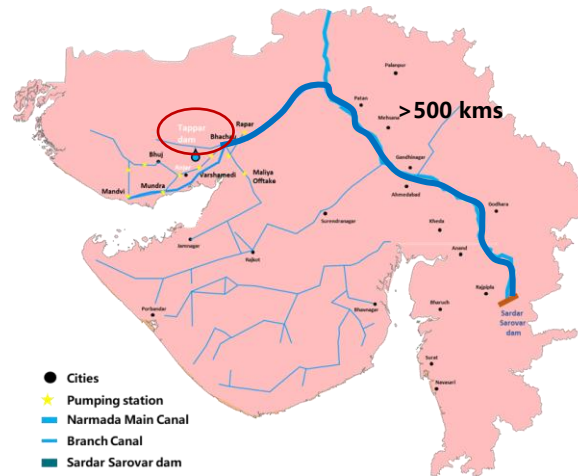


Photo from THE TIMES OF INDIA

Rains pound Gandhidham, Anjar towns in Kutch

TNN | Jul 12, 2020, 04:32 AM IST

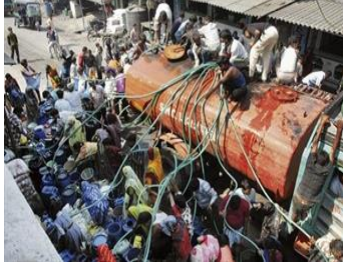
Rajkot: Heavy rain lashed Kutch's commercial city Gandhidham and Anjar on Saturday evening causing severe water-logging in many areas. However, the people welcomed the rain that gave them some respite from the humid heat.



Gujarat Braces for a Wet Weekend; Heavy Rain Alerts Issued over Kachchh, Jamnagar, Sabar Kantha, Surendranagar, Mahesana

By TWC India Edit Team - 22 July, 2022 - TWC India





## Safe Water Supply and Sanitation - Need of the hour ...

12% of India's population already living the

**DAY ZERO**

scenario with respect to water. "21 million are racing to reach zero groundwater levels, affecting access for 100 million people" --- NITI Aayog

The **AVERAGE** citizen receives **114 LPCD**

but

more than **40% CITIES** supply less than **100 LPCD**

**POOR SANITATION**

in India is estimated to cause **100,000 TONNES OF CO<sub>2</sub> LOSS** according to a World Bank study.

**98% CITIES ODF**

but by some estimates upto **80% OF WASTEWATER UNSAFELY DISPOSED**

# What is the role of town planning community ???

... especially in context of **climate vulnerability and resilience**

India is **7th most climate vulnerable**

country in the world due to its diverse ecology!

# Urban Planning Wisdom – Where do we stand today?

Then

Mohenjo-daro | Lothal



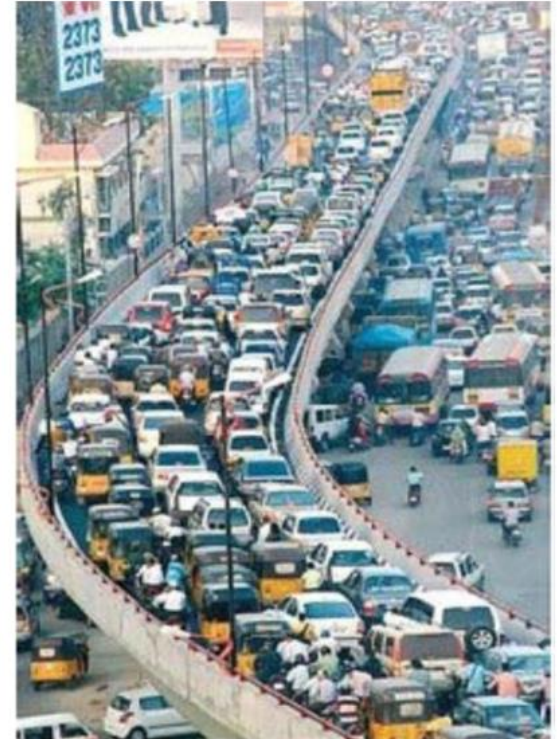
Now

???



# Conventional Urban Planning heavily focuses on land use management and networks...

- Land use and transportation planning (roads and parking) is the key core focus of city planning
- Key assumption that all infrastructure will follow the road network
- Not always the best suited for water, storm water and sanitation system, often lead to
  - Water demand to be met from distant sources
  - Keep on building more and more water infrastructure – regional imbalance
  - Ignoring hydrogeology and groundwater in mainstream planning
  - Lakes dry up then are taken over for development




# Emerging approaches of urban development

## Water sensitive urban design


Rainwater Falls on	Water Sensitive Urban Design Elements
Green Areas (Parks, Forest, etc.)	Retention Ponds, Detention Ponds
Roads / Green Streets	Bio Swales, Vegetated Filters, Gravel Filters along the Roads, Pervious Paving on Footpaths, Underground Storage Tanks (for RW and TWW storage) to use it for roadside Landscaping and Horticulture, Rain Gardens
Open Parking Lots	Bio Swales, Vegetated Filters, Gravel Filters, Pervious Paving
Open Land	Retention Ponds, Detention Ponds, Dry Swales
Water Bodies / Drains	Constructed Wetlands (to rejuvenate water bodies / lakes)

## Blue-Green infrastructure

### Blue green infrastructure




➤ In 2009, Toronto became the first city to mandate green roofs for all buildings with a plinth area more than 2,000sqm



➤ Paris plans to increase its green cover from 9.5% to 50% by 2030



➤ Berlin's Rummelsburg neighbourhood has done away with stormwater drains by implementing green roofs, rain gardens, bioswales and permeable pavements



➤ In 2020, Singapore launched a programme to plant one million trees by 2030

➤ Amsterdam has augmented its green cover by creating 'pocket parks'

➤ Jinhua in China has replaced a concrete floodwall at the confluence of three rivers with a 26-hectare wetland park without compromising flood protection

# Leading examples in residential societies and townships



**129 Weekend homes, Rancharda, Ahmedabad :** Rainwater harvesting systems developed as part of society landscaping



**Parikh House – A resident of Ahmedabad city :** Rainwater harvesting systems along ground water recharge structure (recharging existing bore well); water used for drinking purpose



**78@Gokuldham, Residential society, Ahmedabad :** Rainwater harvesting systems developed in alignment with storm water management system



**Torrent Pharmaceuticals campus:**

- Rainwater harvesting and ground water recharge for urban flood mitigation
- A system with sunken areas and bio-swales and ponds for RWH and recharge



# Some recent news on actions...

## AMC adopts 'Sponge City' plan to tackle urban flooding

Will Spend ₹250cr On Ecobloc Stormwater System, Develop Scheme For Flood Warning

Jignesh Parmar  
@timesgroup.com

Ahmedabad: In response to frequent waterlogging during monsoons, the civic body in Ahmedabad is adopting the concept of a 'sponge city' to mitigate urban flooding. A fund of Rs 250 crore from the National Disaster Management Authority (NDMA) has been allocated for implementing an urban flood management plan in the city. This plan includes several components such as lake interlinking, the installation of ecobloc stormwater management and infiltration tank systems in key waterlogging areas, and the development of a real-time flood warning system.

As a pilot project, the Ahmedabad Municipal Corporation (AMC) has selected the Bandhan Trikona area in Sola for the installation of ecoblocs along the road. Ecoblocs are modular polystyrene blocks that can be stacked together to create water reservoirs capable of storing, infiltrating, or reusing rainwater. A senior AMC official said, "Ecoblocs offer several advantages over conventional gravel infiltration ditches, including a significantly higher reservoir volume for rainwater (up to 97% compared to 40% for gravel)." The initial cost of implementing the

ecobloc system in Sola is estimated to be Rs 60 crore, he added. Ahmedabad currently has 115 waterlogging hotspots where water accumulates for up to four to five hours during heavy rains. "The majority of these hotspots are located in the South Zone, which includes areas like Maninagar, Behrampura, and Isanpur," adds AMC official.

The ecobloc sponge parks can direct stormwater to nearby gardens or water reservoirs. "The second project that will be undertaken is interlinking of lakes, in the newly developed South Zone. These include interlinking of seven major lakes like the Punia, Bedar, Mumatpura, Malkani Sarkhej, Sakri, Fatehwadi, Azadnagar and Kanajiyu lakes. A similar plan is being chalked out for seven lakes in the East Zone too," added the AMC official.

The AMC will also implement a real-time flood warning system and the real-time data will be broadcasted to citizens. The NDMA will release Rs 50 crore annually to support Ahmedabad's urban flood mitigation efforts. The proposed plan and the selection of a consultant responsible for its implementation have been presented to the standing committee for approval.

### SPOTS THAT REMAIN WATERLOGGED FOR 4-5 HOURS



Photo: Yousuf Chaudhri & Ananda Venkatar



CA CIRCLE

**AREAS WHERE WATERLOGGING OCCURS**  
**JOHNPUR:** PQC Road (S), Gala Gyrikhanna Road, BH Bopal Gam, Prematirth Di service roads near Shivra and Shyamal crossroads

**WHAT IS ECOBLOC?**  
 It consists of modular blocks that can be stacked together to form a reservoir to store, infiltrate or reuse rainwater. The ecobloc has many advantages over conventional gravel infiltration ditches

**ECOBLOC ADVANTAGES:**  
**GREATER STORAGE:** The ecobloc system can provide reservoir volume in excess compared to 30%-40% of standard gravel infiltrate  
**LONG SERVICE LIFE:** The made of durable plastic can withstand high load corrosion. Its service life to exceed 50 years

## CENTRE'S SUGGESTIONS

- Information on total water bodies and status of encroachment
- Water bodies be included in land records so that action be taken against encroachers
- Report checks on human activities on the catchment areas
- Water bodies to be included as integral part of town planning process
- State govt should ensure concurrent evaluation of the water bodies under repair, renovation, and restoration of water bodies scheme
- State should involve the user communities for keeping the water bodies encroachment free
- State should explore possibility of creation of new water bodies



Sarkhej Roza lake

### WATER BODIES UNDER VARIOUS JURISDICTIONS

Cities and towns	Water resources dept	Revenue dept
1,939	4,413	12,182
Panchayat dept		Total
25,604		44,138



### URBAN COUNT

Area	Lakes
Vadodara	625
Surat	330
Gandhinagar	61
Ahmedabad	60
Junagadh	18
Bhavnagar	12
Rajkot	9



### OUR WATER BODIES

Name of lakes	Area (hectares)
Sursagar	6.74
pura	2.24
Gotri	1.68
irsali	3.54
orwa	3.53
nath	0.48
larni	7.79
nath	5.39
ama	5.61
asna	3.58
jalja	7.64
rasia	1.29
hobi	2.41
abdi	3.79
Rani	3.46



Siddhanath lake

Area (hectares)	Lake Name
0.42	Masiya
4.68	Danteshwar
3.41	Ajwa Road
3.86	Kamlanagar
4.65	Atladara
1.23	Lal Baug
1.07	Manjalpur
0.77	Mohammed

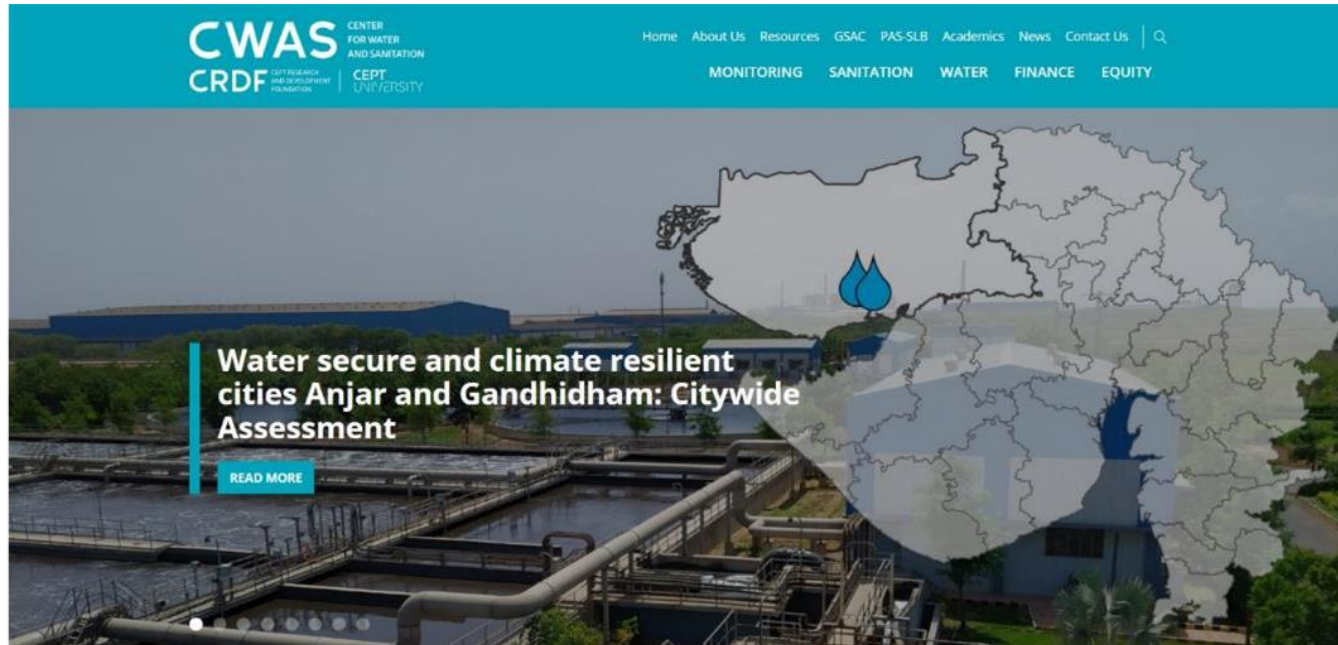


ar lake

**Areas where recharge wells can be constructed in existing ponds/ lakes**  
 ► Alkapuri, Gotri, Sevasi, Old Padra Road, Akota, Atladara, Manjalpur, Makarpura, Pratapnagar, Subhanpura, Gorwa, Refinery Road, Fategunj, Nizampura, Sama-Savli Road, Chhani Road

# Making our cities water secure – Anjar and Gandhidham

- Support to Anjar and Gandhidham for moving towards water secure and climate resilient cities
- Pilot Demonstration of rain water harvesting and recharge structures; urban flood mitigation by recharging excess runoff



[Link of the video](#)

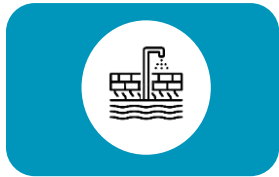
# Are the cities prepared for emergency situations...



The **surface water** is available from a **distance** of more than **500 km**



Any **breakdown** in bulk line/ transmission line or **less precipitation** in Narmada catchment may cause no supply or lesser supply



The cities also **depends upon ground water**, which is already showing **depleting trends** (Gandhidham ground water supply is also dependent upon Anjar's aquifer)



Cities needs to move towards water security

**Augmenting Own Water Resources**

# Geohydrological study conducted for understanding aquifer and watershed of cities...

## APPROACH FOR GEOHYDROLOGICAL STUDY

WATER SOURCE STUDY

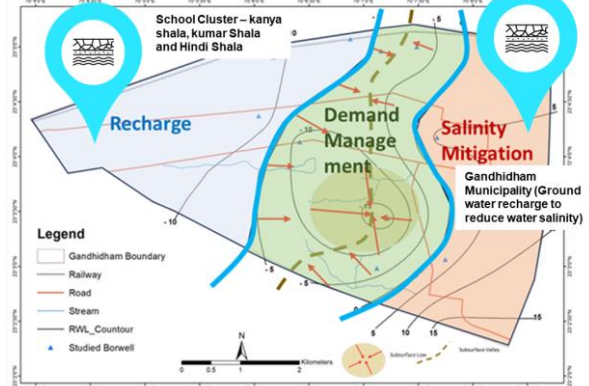
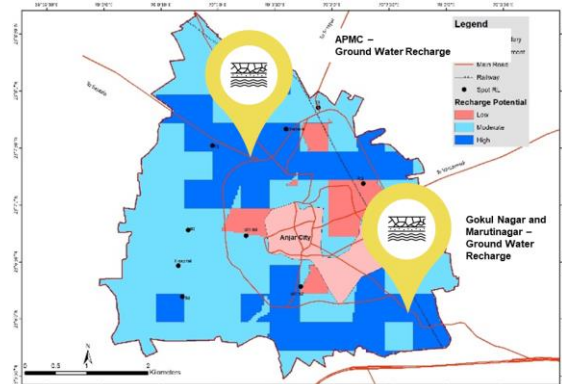
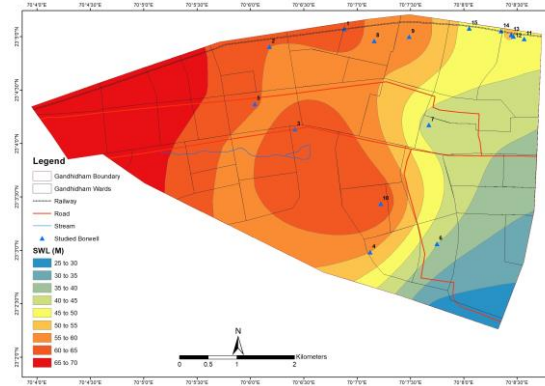
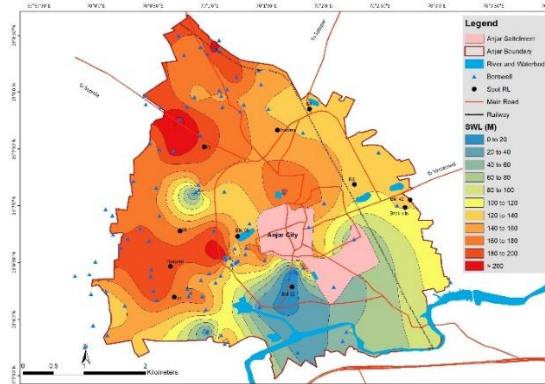


LITHOLOG AND AQUIFER STUDY WITH THEMATIC MAPS



IDENTIFICATION OF POTENTIAL RECHARGE ZONES

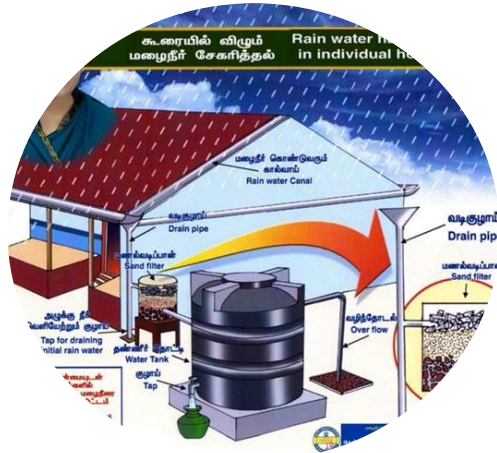
Ground water level and contour maps



Source: Developed by ACT for CWAS study

Pilots locations based on the geo -hydrological study . .

# Chennai showcases a holistic approach for water conservation through Rainwater harvesting and ground water recharge...



## Institutional Setup

An information centre on RWH was opened at Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) in year 2001

## Capacity Building

Training sessions were organized for Municipal Engineers, executive officers and Open house meets for Builders and Architects

## System dissemination

Various demonstration models were installed - Nochikuppam Slum, demonstration in schools and colleges, Government Buildings, Participated and exhibited RWH models

- Government of Tamil Nadu - **RWH mandatory for all public and private buildings** through an ordinance in 2001
- Amendments have been made in the **Groundwater Regulation Act**

Erection of hoardings displaying the importance and benefits of the Rainwater Harvesting



Bhavanisagar (Erode District)



Kuthalam (Nagapattinam District)



Mandapam (Ramanthapur District)

State government hosted a **dedicated website for RWH** which has full information regarding **techniques, legislations, technical information, success stories** etc. in **English and Tamil** language.

# Bengaluru city features a theme park displaying 26 different types of live Rainwater harvesting models...



- BWSB Created India's first **RWH theme park**
- **The objective of the theme park - awareness generation and showcasing a variety of technologies** which are live demo and interactive models
- The park is **spread over** an area of around **1.2 acres** in Jayanagar
- The park **showcases 26** different types of **RWH models**
- The park also demonstrate different **ground water recharge structure**, which can be used as **urban flood mitigation strategy** or **ground water recharging**



Install RWH measures to its own civil structures and residential premises of VVIP dignitaries



Created help desk and Technical support network

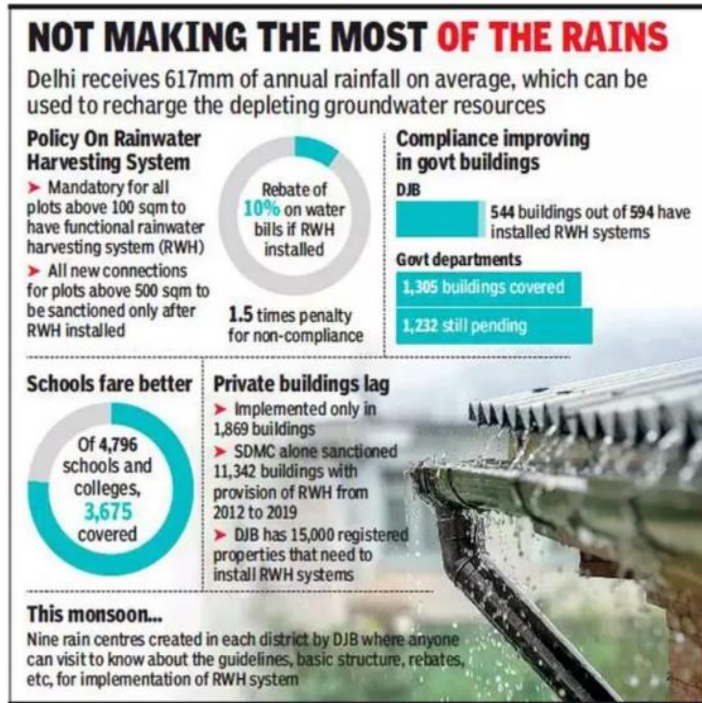


Conducted mass awareness programs - "Abhiyana Programme", etc.



Technical training to Plumbers/Contractor/Others for execution of RWH methods in scientific manner

# Delhi- Mandating Rainwater harvesting and Decentralized Waste Water Recycling Systems



- **Mandatory provision for Plot size of 100sqm and above**
- **Rain Water Harvesting Cell and Centers developed by Delhi Jal Board formed in 2020**
- **Financial Assistance Scheme for promoting Roof Top Rain Water Harvesting system**

To encourage and ensure installation of rooftop rainwater harvesting systems in houses and buildings over 100 sqm, the **Delhi government will now be giving financial assistance up to ₹ 50,000 and a rebate of 10% on water bills**

- **Developed Jal Shakti kendras and lists for newly empaneled RWH consultants and service providers with DJB for implementation of RWH**

# New urban development discourse for urban planners should be...

Town planners in India have made **urban development plans**, and helped in the implementation of large programs such as JNUURM, AMRUT, SBM and SMART Cities

Move from  
**Infrastructure**



to service delivery, gender responsive, equitable, climate responsive and resilient services



Infrastructure  
provision



Ensuring  
quality services  
and equity



Financing and  
Climate  
response



Digital  
monitoring



## SESSION 2

### Aquifer Mapping and Groundwater Management Planning Anjar & Gandhidham Kachchh

- *Understanding the city Water Resources – Anjar and Gandhidham*
- *Geology and aquifers of the two cities*
- *Groundwater Potential and Behavior including water quality*
- *Identifying potential initiatives based on the geology*



**Yogesh Jadeja**

Director  
Arid Communities and  
Technologies (ACT)

*Dr. Yogesh Jadeja is a founder director and trustee of Arid Communities and Technologies (ACT), a Bhuj-Kachchh based organization. He has total about 30 years of experiences of working on Ground water management aspects in Semi-Arid Regions of country. By profession he is a geologist and has completed his Masters and Doctorate from M S University, Baroda (Gujarat). He is the member of International Association of Hydrologist and also has given his services as Working Group member of Ground Water in Planning Commission (GOI).*

# Aims and Objectives...

## Aims:

1. Enhance the practical and action-oriented knowledge of city stakeholders on managing shallow aquifers in a scientific manner
2. Demonstrate the use of recharge wells as one of the means for shallow aquifer management.

## Objectives:

- To understand city's existing water sources and resources for domestic supply
- To study the flood and water shortages areas
- To understand geo-hydrological characteristics of city's different aquifers
- To understand traditional water management practices
- To identify recharge potential zones and frame respective groundwater recharge strategies
- To identify pilot locations for respective alternative techniques
- To inform stakeholders and educate for groundwater management strategy
- To set up institutional mechanism within city administration – Municipal Corporation

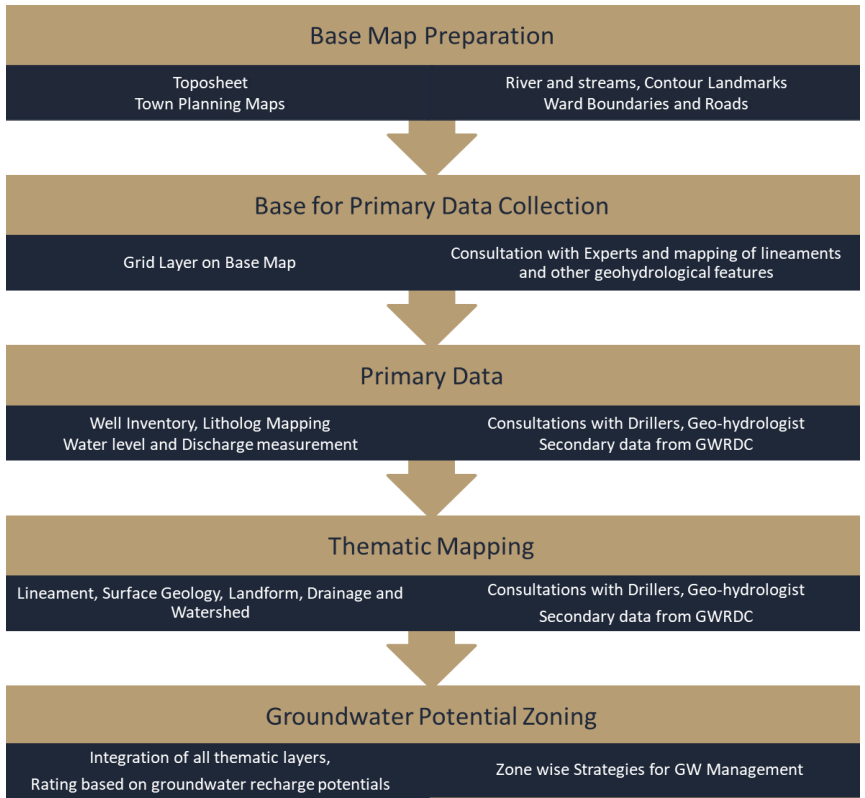
# Approach and methodology for conducting the study...



## Methodology

- Aquifer Mapping
- Groundwater Recharge DPR

## Methodology for Aquifer Mapping



# Methodology for Shallow Aquifer Recharge DPR...

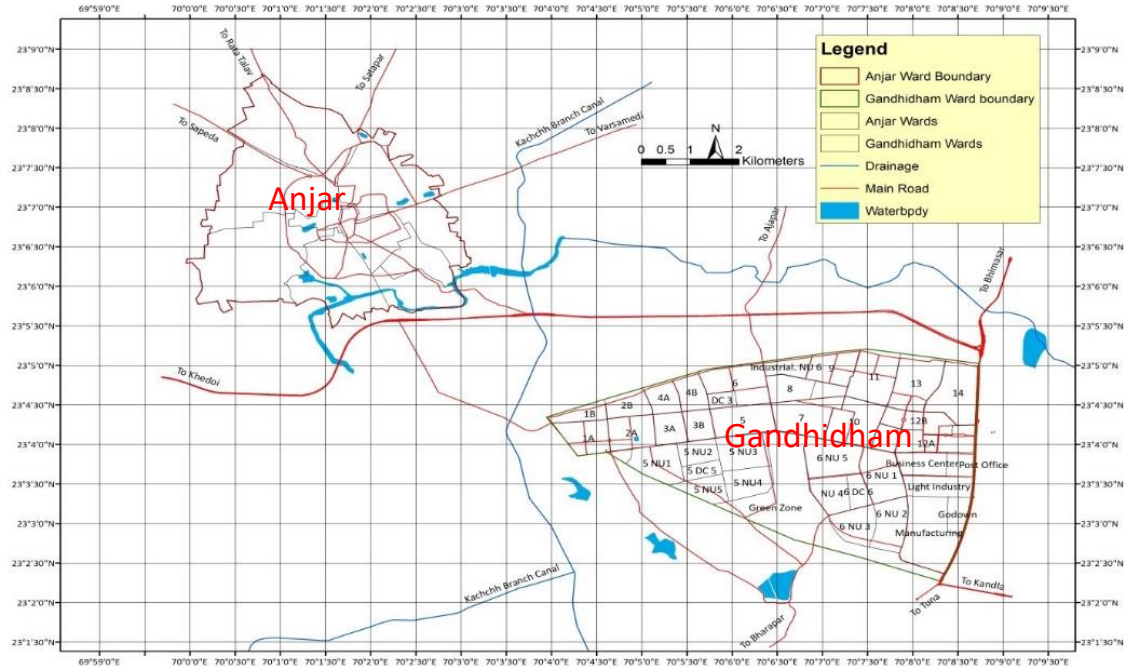
## Data Procurement and Analysis

Data Category	Sub Category	Type	Source / Method
Secondary	Demographic	Statistical	Municipality
	Ward wise distribution of Groundwater Water Sources	Statistical	
	Land use	Map	Remote Sensing Town planning
	Drainage and Topography	Map	SOI Toposheet DEM image
	Geology	Maps	CGWB Reports
Secondary	Groundwater Monitoring	Statistical	GWRDC
	Rainfall	Statistical	IMD Web site
	Primary	Well inventory	Water level
Litholog			In some cases, consultations with driller and hydrogeologists
Water logged areas		Locations	From wards engineers Mapping by field survey
			Field observation & consultations
	Land use mapping in selected pilot areas	Primary Surveys	



# Study city: Anjar and Gandhidham - Location and Demography...

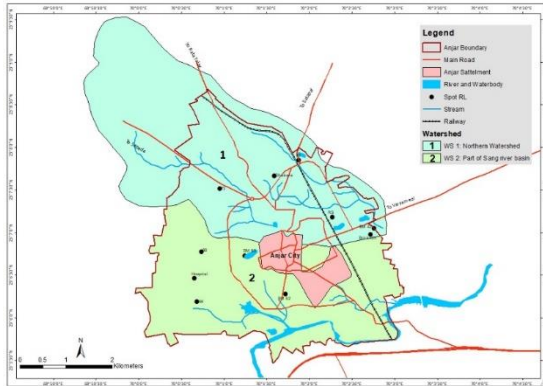
Demo. Details	Anjar	Gandhidham
Household	18906	54565
Population	87183	247995
Male	45172	131484
Female	42011	116508
SC	5619	Not Available
ST	465	



# Natural Water resources of the cities...

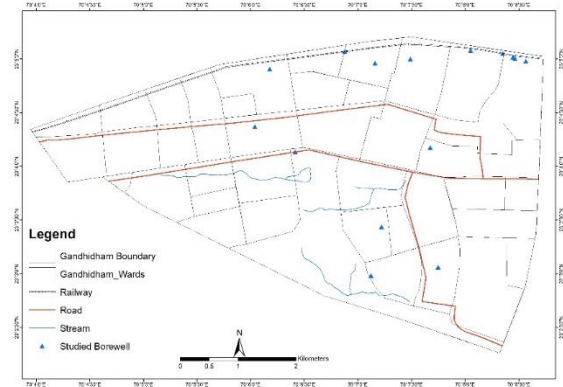
## Anjar

- Surface Water Resources
  - Tankas and Ponds – 09 Tank and Ponds
  - Rivers
  - Two Watersheds
- Groundwater
  - Deep Tube wells
  - Two aquifers
    - Shallow – Weathered Basalt
    - Deep – Sandstone

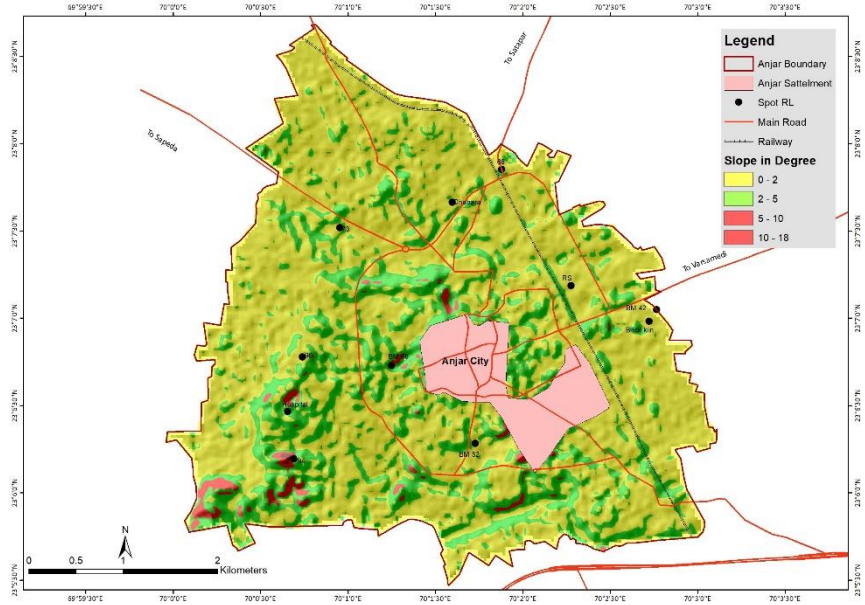
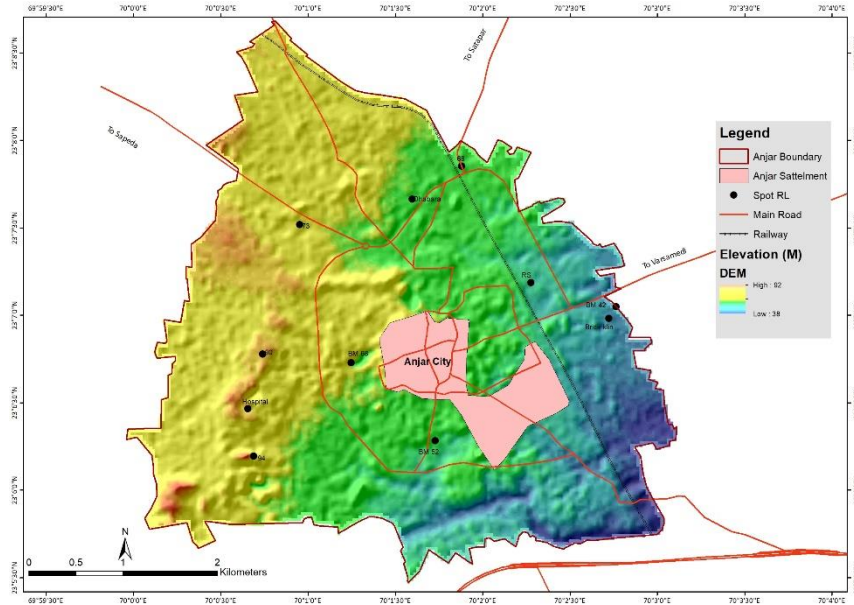


## Gandhidham

- Surface Water Resource
  - Tanks and Ponds
  - Three micro watershed
  - Small rivulets
- Groundwater
  - Shallow aquifers
    - Sand and Kankar mixture clayey strata
    - Weathered rocks - Murrum & Basalt

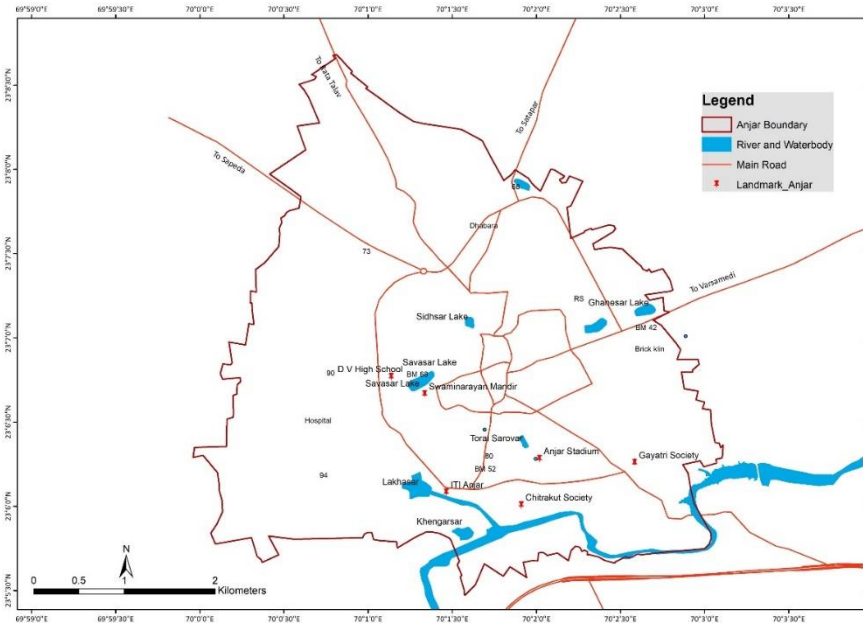


# Terrain – topography and Slope – Anjar...



Sr.No.	Slope Categorisation wise Computed Area in Anjar		Area (Hectare)
	Slope		
	Degree	Category	
1	0 to 2	Very Gentle to Level	1376.99
2	2 to 5	Gentle	493.5
3	5 to 10	Moderate	37.31
4	10 to 18	Moderately Steep	1.04
Total			1908.84

# Surface Water Resources...



Detailed study is still going on with senior citizens

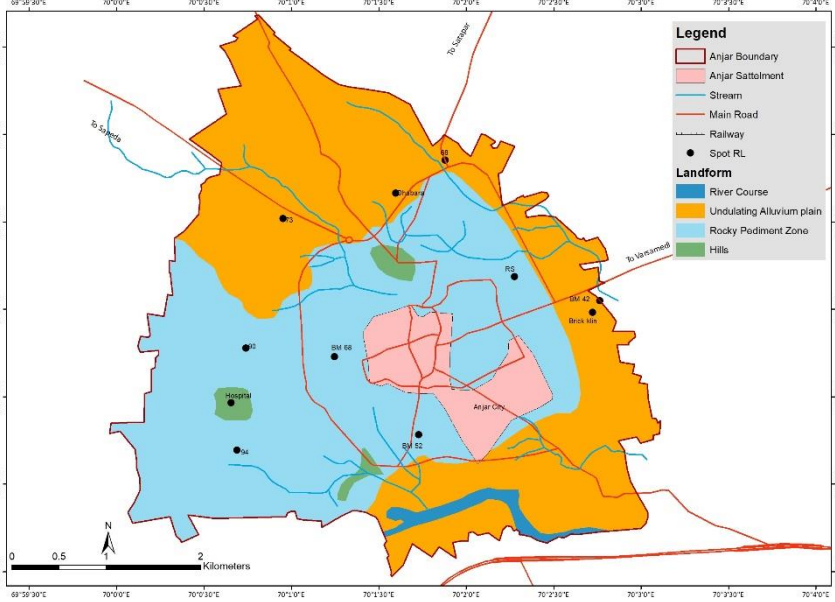
- Total 08 Traditional water bodies
- 01 Check dam also constructed on Sang river
- Savasar, Ganganaka, Bhadreswar temple water bodies were having step wells and open wells in surrounding areas
  - Gangasar kund, Ambaji Kund are some the examples
- Behind Public park one water body has completely disappeared from the city – known as ***suvavadi (used for pregnant ladies) valu Talav***
- One more water body between Ajapar and Jesal Toral Temple has also disappeared
- All water bodies were designed in cascade manner
  - Savasar-Siddhasar and one other
  - Suvavadi-Lakhnar-Khengarsar to Sang river



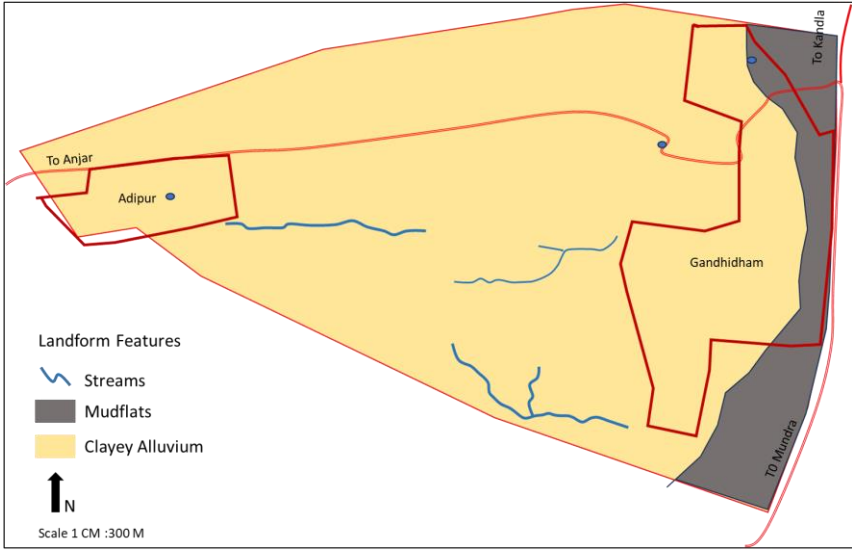


# Terrain – Landform and Watersheds...

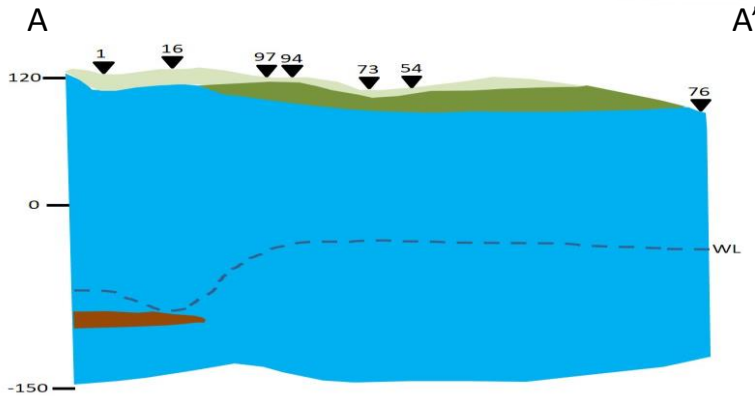
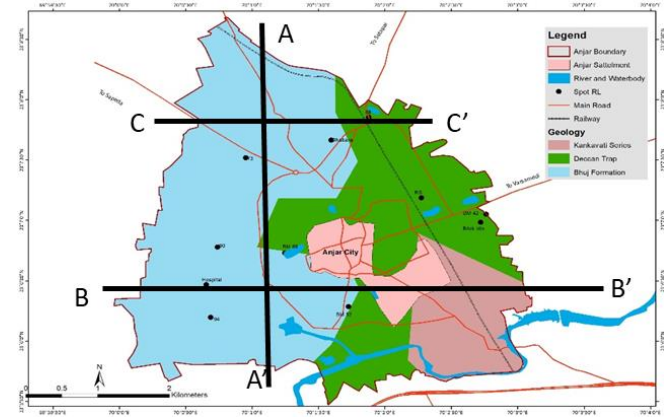
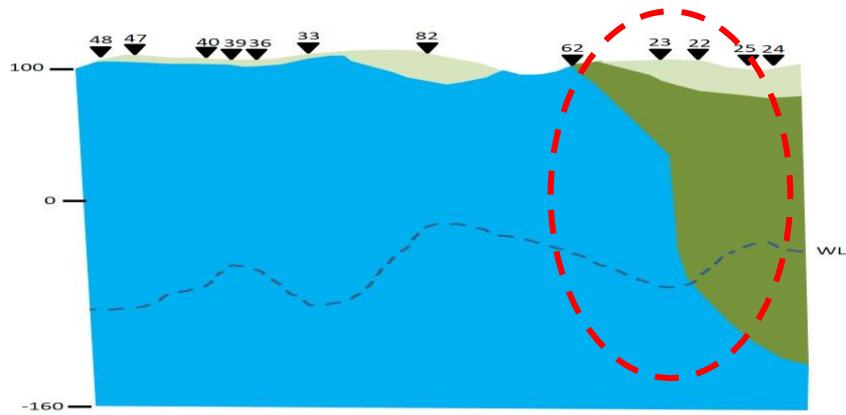
## Anjar



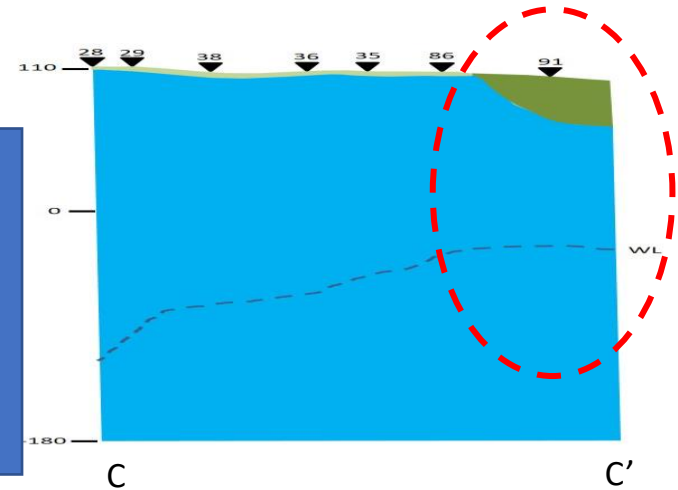
## Gandhidham



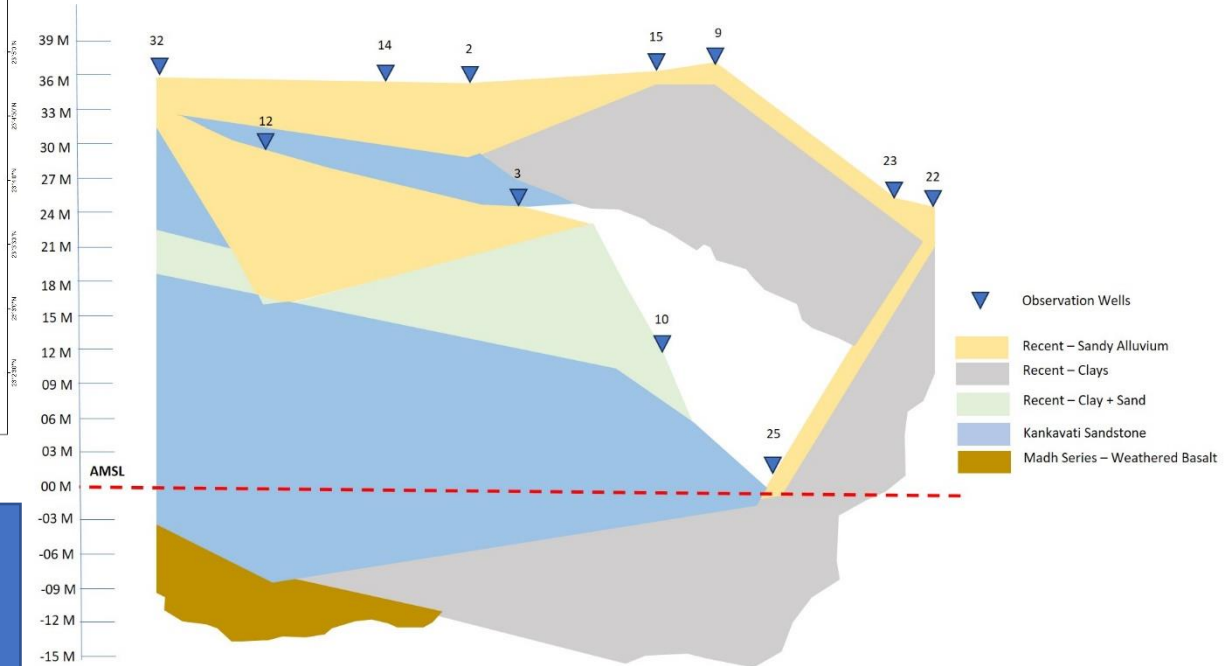
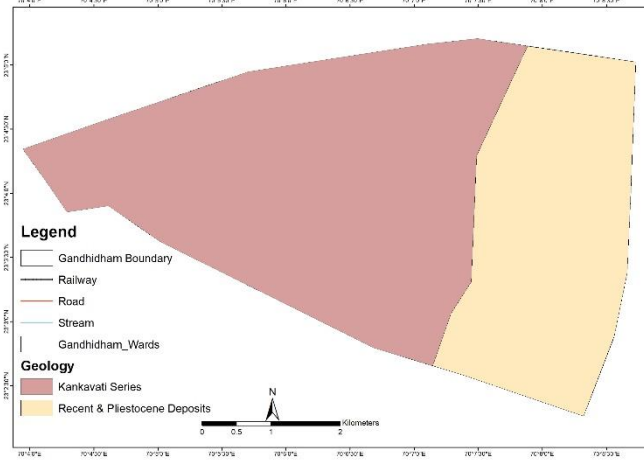
# Geology and Aquifers- Anjar...



- Water level is higher near Contact zone
- Water levels depth increase as we move away from Contact zone



# Geology and Aquifers- Gandhidham...

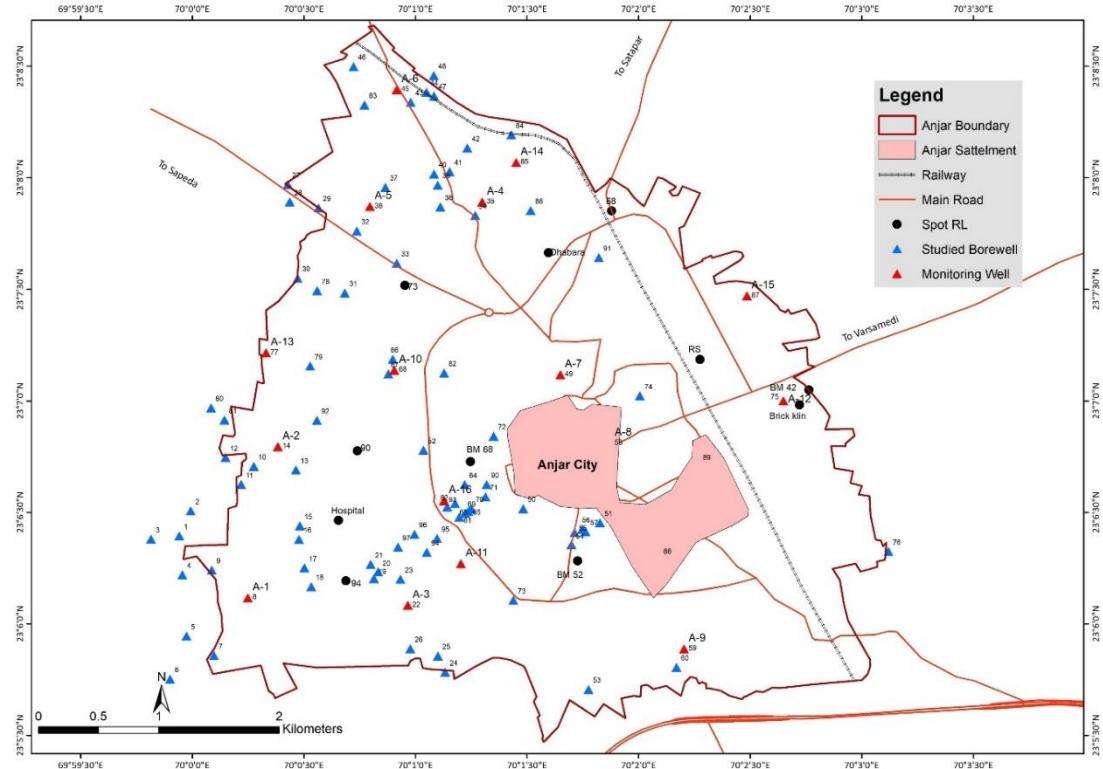


- Water level is higher near Contact zone
- Water levels depth increase as we move away from Contact zone

# Groundwater Potential and Behavior-Anjar...

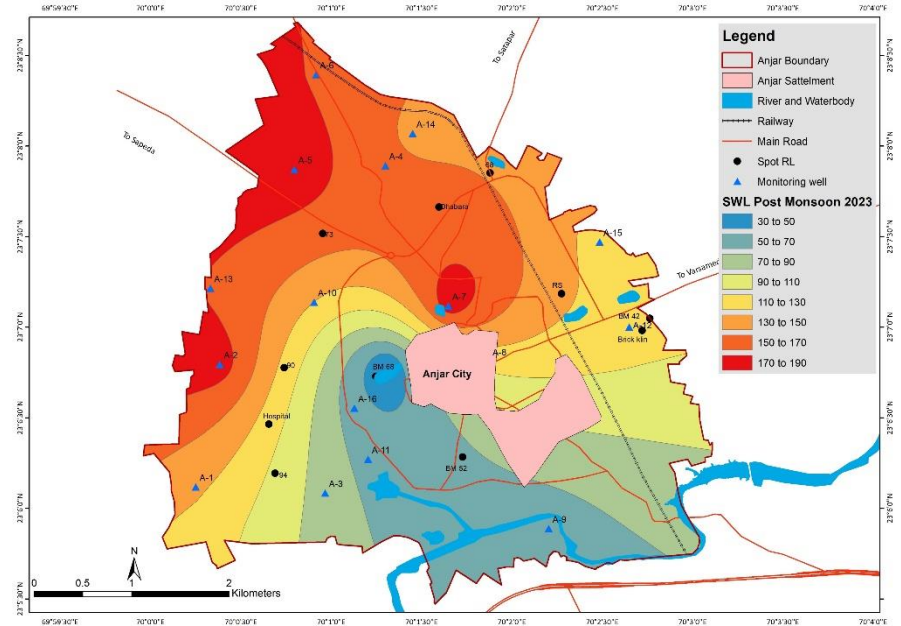
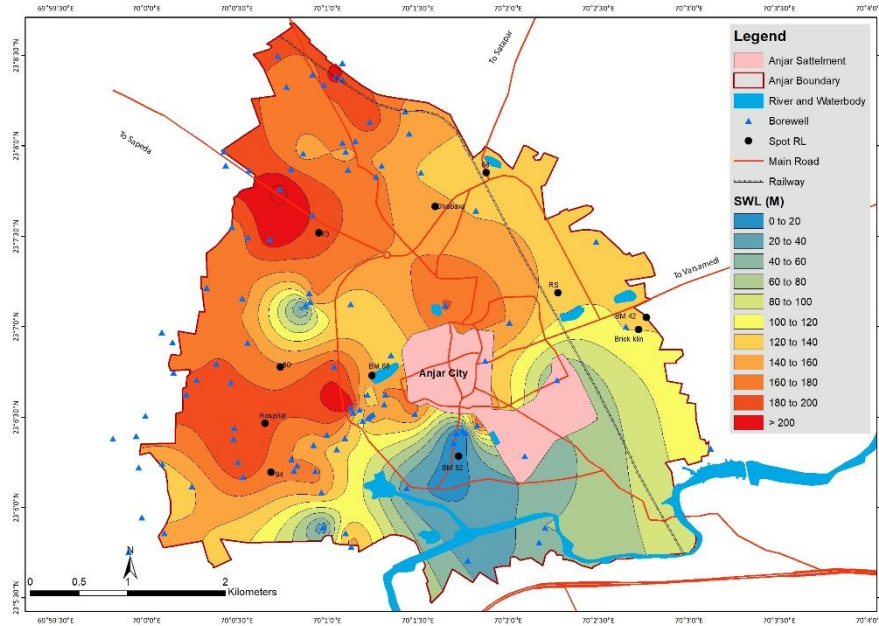
Aquifer and Groundwater Potential has been studied through well inventory and procuring lithologs from drilling locations

- **97 Wells** were studied
- **Litholog** measured from about **43 tube wells**
- Consultation with **four driller**
- Litholog from GWSSB



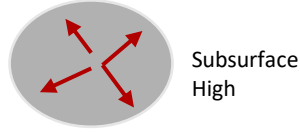
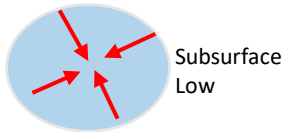
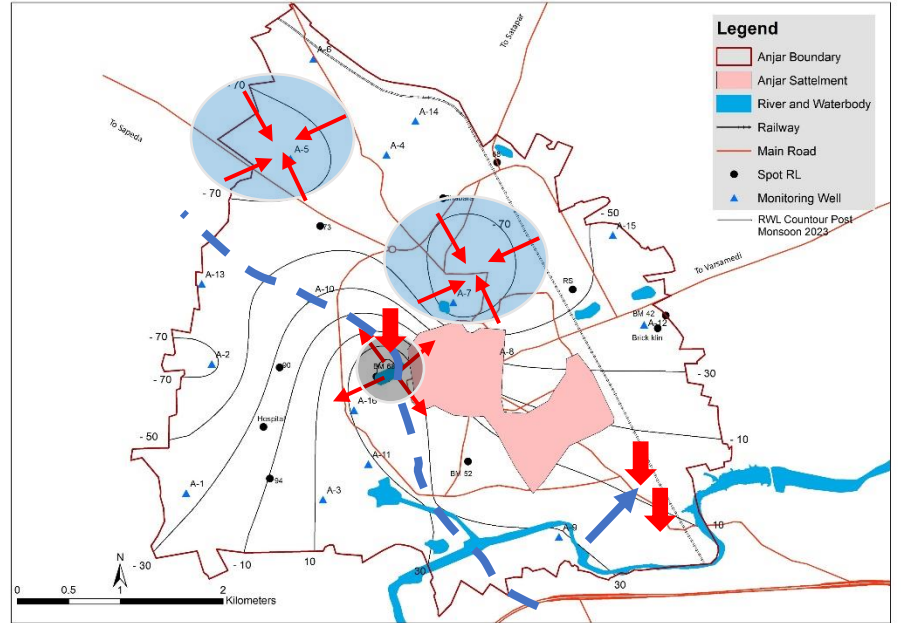
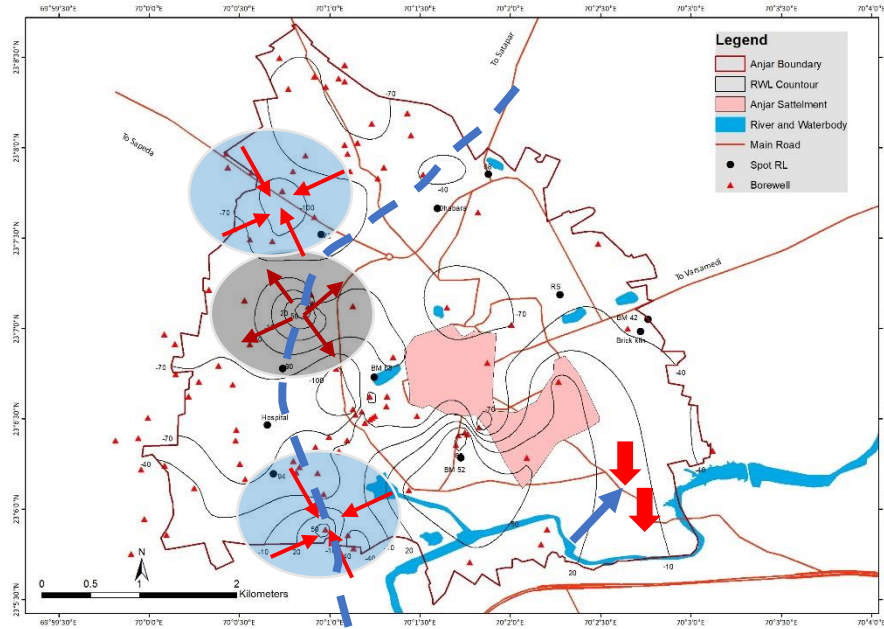
# Groundwater Potential and Behavior-Anjar

## Static water levels- Pre and Post Monsoon Changes...



# Groundwater Potential and Behavior-Anjar

## Groundwater Flow Direction- Pre and Post Monsoon Seasons...



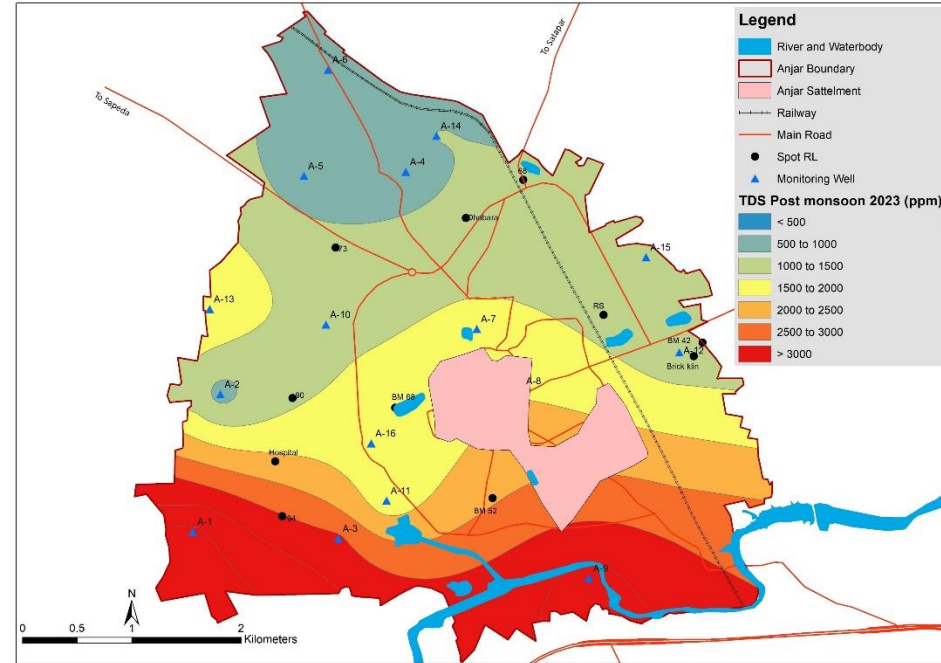
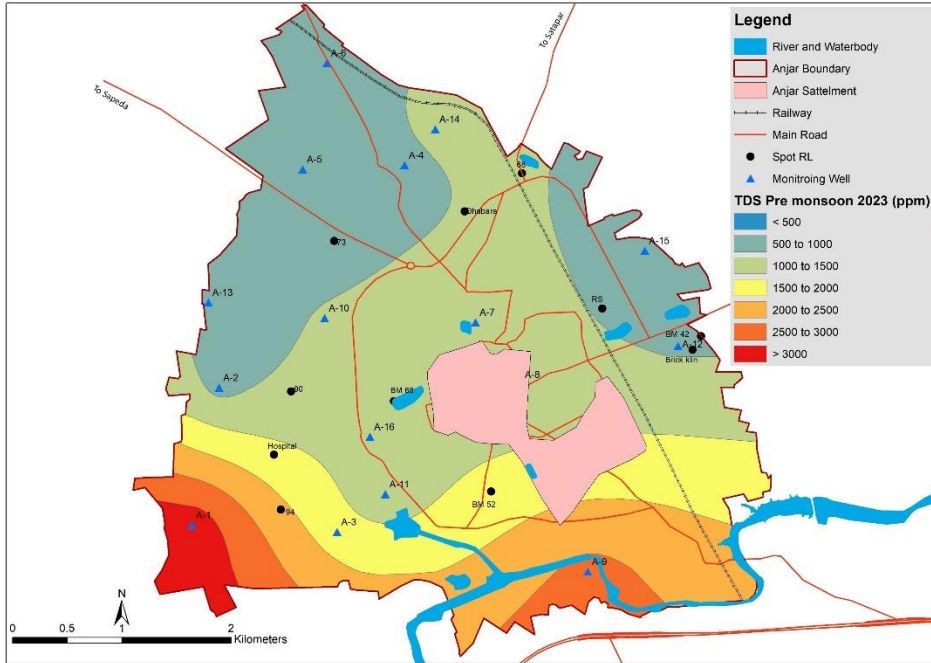
# Groundwater Quality- Anjar...

Well Code	Owner name	Pre Monsoon										
		ANJAR										
		pH	Turbidity	TDS	Alkalinity	hardness	calcium	Magnesium	Chloride	Sulphare	Nitrate	Fluoride
A-1	Jayantibhai sorathiya	7.36	<1	3370	225	1080	264	102.06	1418	284.8	3.5	0.24
A-2	Naranbhai valibhai kapadiya	7.52	<1	852	80	360	96	29.16	265.88	89.6	15.8	0.4
A-3	Naranbhai maghibhai kapadiya	7.33	<1	1729	220	520	132	46.17	584.93	226.4	8.8	0.1
A-4	Jayantibhai mistri	7.17	<1	654	135	220	64	14.58	212.7	60.5	12.5	0.8
A-5	Dilipbhai dayabhai sorathiya	7.56	<1	586	160	275	60	18.23	159.53	74.4	18.4	0.6
A-6	Jigneshbhai sorathiya	7.58	<1	701	150	315	92	20.66	194.98	81.4	16.6	0.45
A-7	Sagarsa water suppliers	6.99	<1	1509	155	410	100	38.88	602.65	165.4	7.6	0.22
A-8	Anjar nagarpalika borewell	7.66	<1	1162	160	405	104	35.235	407.7	124.8	18.8	0.4
A-9	Shree radhe resort borewell	7.66	<1	2680	385	370	76	43.74	1134.4	175.5	6.8	0.35
A-10	Shamjibhai ahir	7.42	<1	1055	230	435	116	35.24	319.05	134.9	5.7	0.5
A-11	Behind the nayara petrolpump	7.36	<1	1219	220	550	104	70.47	354.5	174.6	25.5	0.3
A-12	Mohanbhai	7.23	<1	934	195	310	80	26.73	301.33	91.5	24.4	0.45
A-13	Lalji hirji ahir	7.21	<1	910	225	390	98	35.24	265.88	96.6	18.4	0.25
A-14	Jakhavadi	7.43	<1	1274	290	510	120	51.03	248.15	158.4	12.5	0.2
A-15	Ahir agro industries	7.51	<1	712	140	320	78	30.38	194.98	88.6	14.4	0.65
A-16	Kanjibhai valjibhai	7.43	<1	1369	290	480	92	60.75	460.85	144.8	10.5	0.4

Post Monsoon Sample have sent for chemical analysis

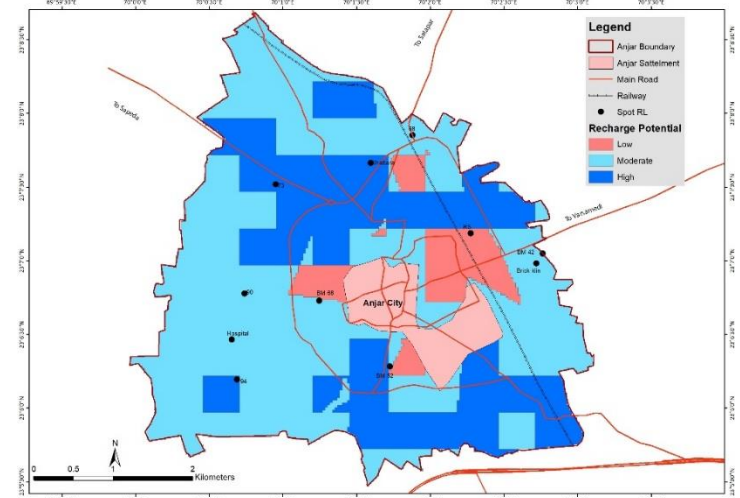
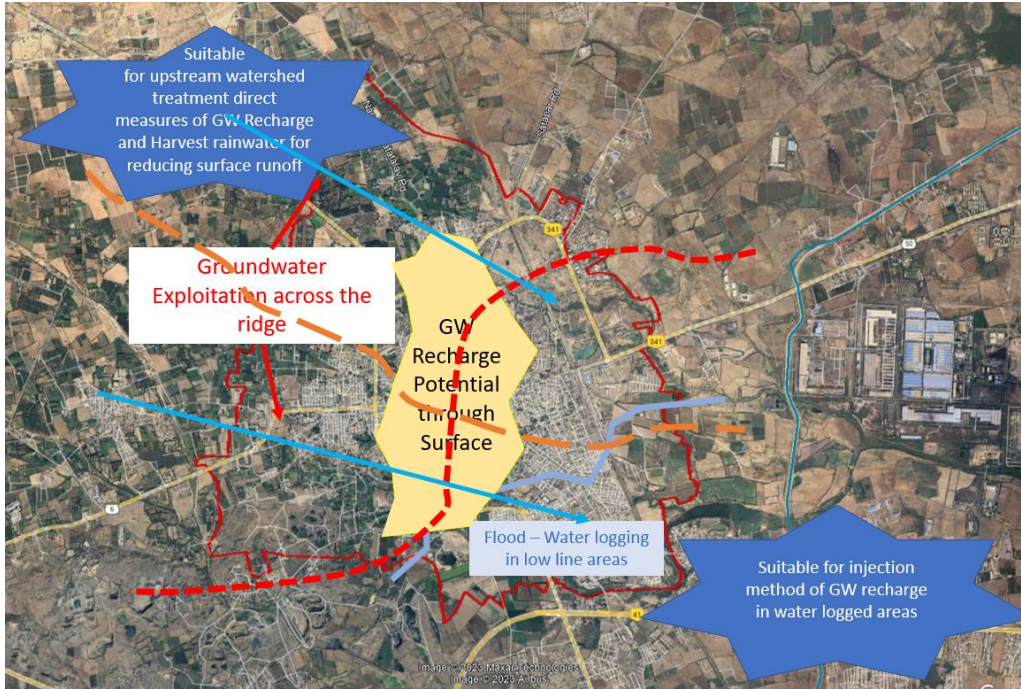
# Groundwater Quality-Anjar

## Total dissolved solids- Pre and Post Monsoon Seasons...





# Issues and Proposed strategy...



GW Category	Strategies
Good Potential	Development of Surface Recharge structure, Drinking water Source Development. Percolation wells and recharge beds in common plots/public places
Moderate Potential	Existing Well/Bore well recharge, Campus level Groundwater Recharge, Treatment in catchment area contributes water logging in low line areas. Injection method for GW recharge. Roof water use for GW recharge
Low Potential	Surface Water harvesting, develop buffer reserve for periodically recharge the groundwater in down-stream areas. Use public places for water conservation

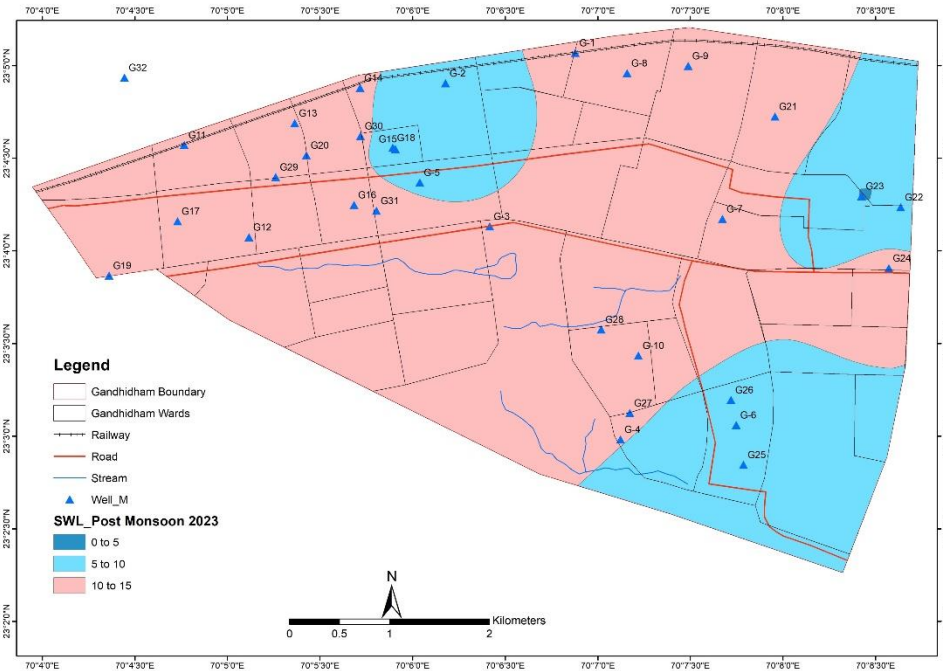
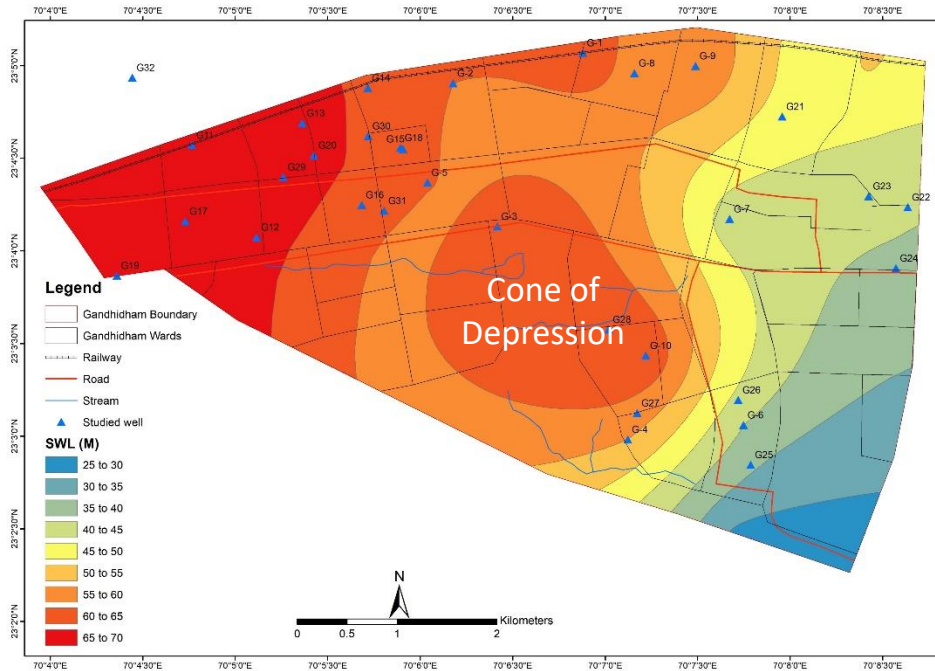
# Groundwater Potential and Behavior-Gandhidham...

Aquifer and Groundwater Potential has been studied through well inventory and procuring litholog from drilling locations

- 32 Wells were studied and established as observation wells
- Consultations with Drillers and Geohydrologist of GWRDC
- Litholog from GWSSB & some private corporate units
- Water Level measurement in borewells

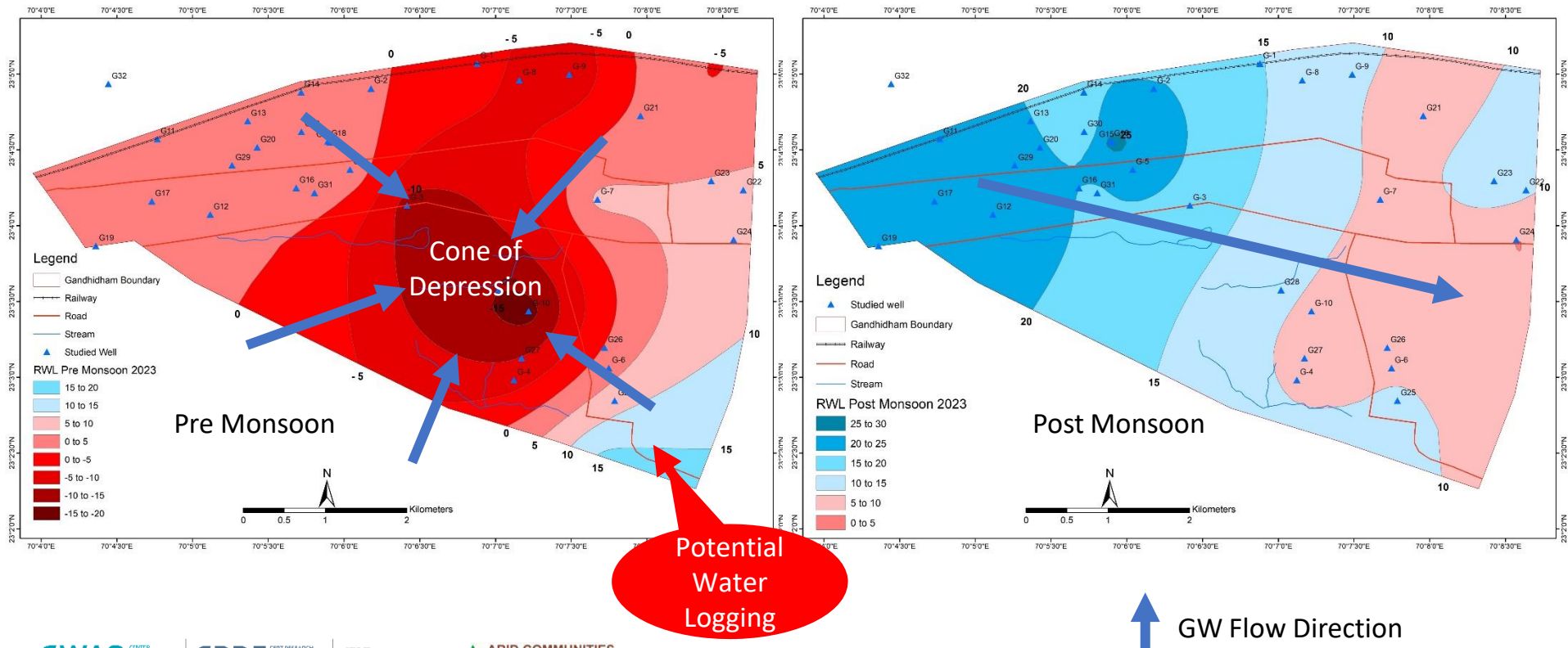
# Groundwater Potential and Behavior- Gandhidham

## Static water levels- Pre and Post Monsoon Changes...



# Groundwater Potential and Behavior- Gandhidham

## Groundwater Flow Direction- Pre and Post Monsoon Seasons...

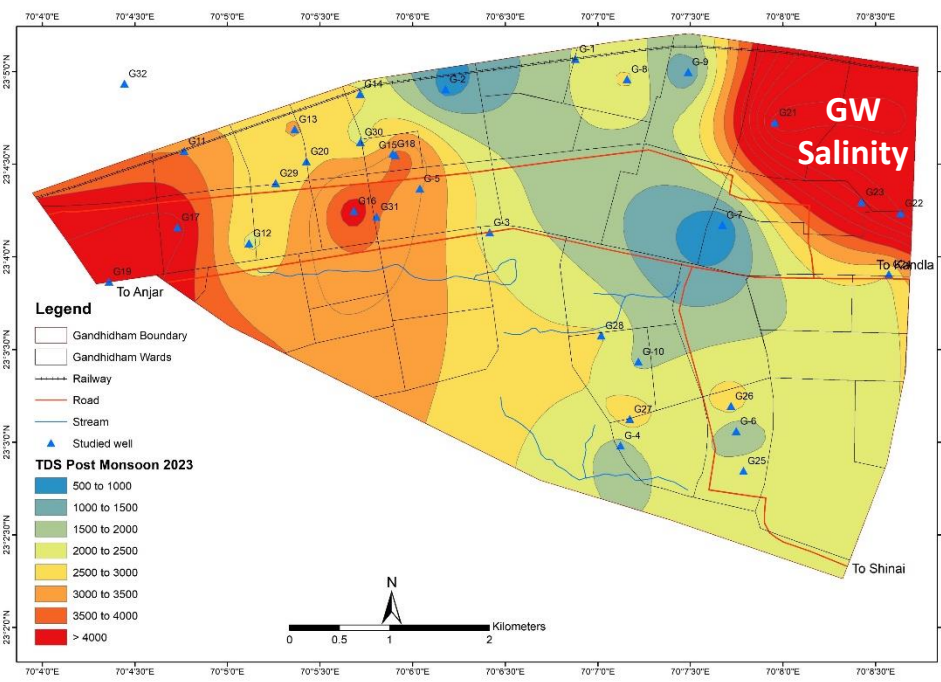
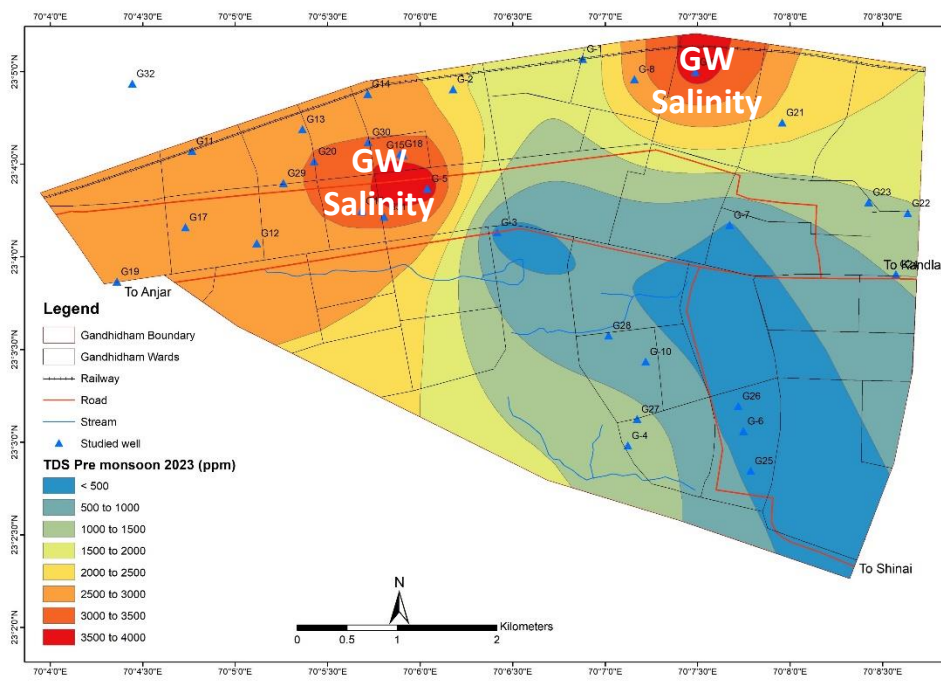


# Groundwater Quality- Gandhidham...

Well Code	Owner name	Pre Monsoon										
		GANDHIDHAM										
G-1	Odhavram vastu bhandar	7.59	<1	1560	295	360	68	46.17	531.75	171.4	5.8	0.35
G-2	Darsh water supply	7.4	<1	2090	450	680	134	83.84	655.83	214.8	18.5	0.1
G-3	Rotry forest	7.74	<1	312	95	120	44	2.43	88.63	34.2	5.8	0.1
G-4	Sector 7	7.43	<1	1476	360	490	96	60.75	425.4	168.1	20.5	0.25
G-5	Shivam water supply	7.4	<1	3870	680	610	92	92.34	1524.35	314.8	5.5	0.1
G-6	Ganeshnagar society	7.8	<1	314	90	160	40	14.58	85.5	32.1	5.8	0.1
G-7	Shaktinagar	7.6	<1	462	107.5	210	60	14.58	141.8	35.2	20.5	0.4
G-8	Chavda mineral water	7.3	<1	2790	510	440	84	55.89	1081.23	277.4	12.4	0.3
G-9	Maheshwarinagar	7.64	<1	3780	625	520	80	77.76	1595.25	304.6	15.7	0.4
G-10	shisanjal beverages	7.53	<1	666	135	280	80	19.44	230.43	56.4	15	0.5

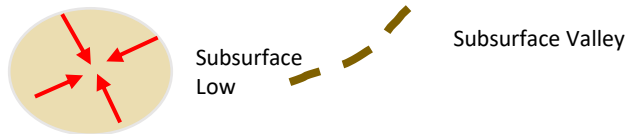
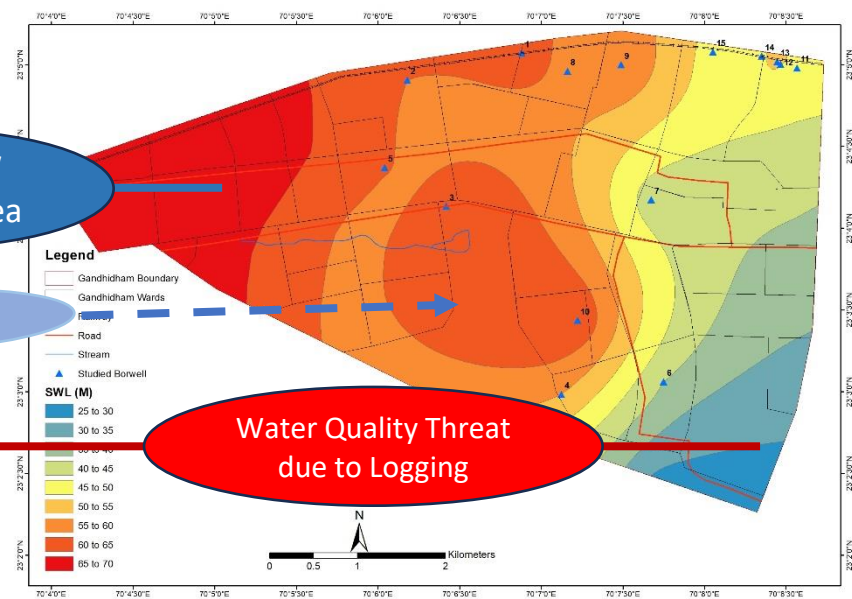
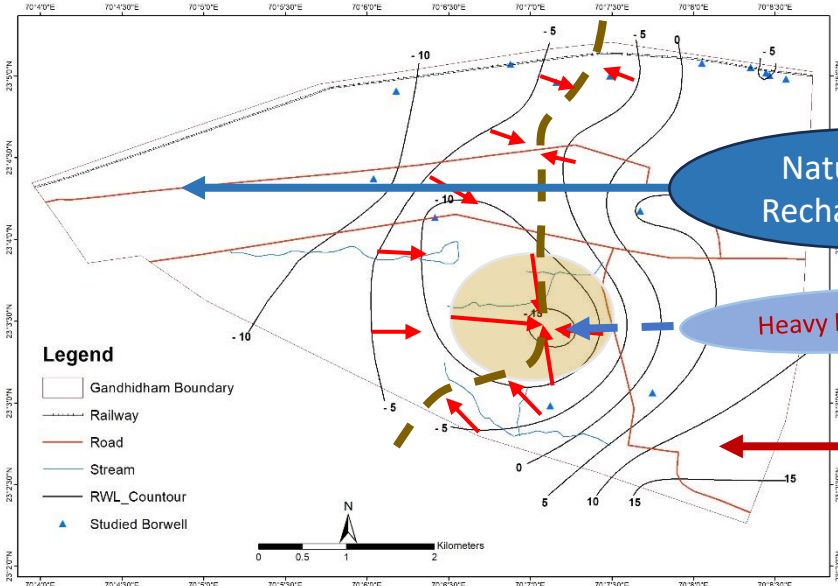
Post Monsoon Sample have sent for chemical analysis

# Groundwater Quality Behavior- Gandhidham...



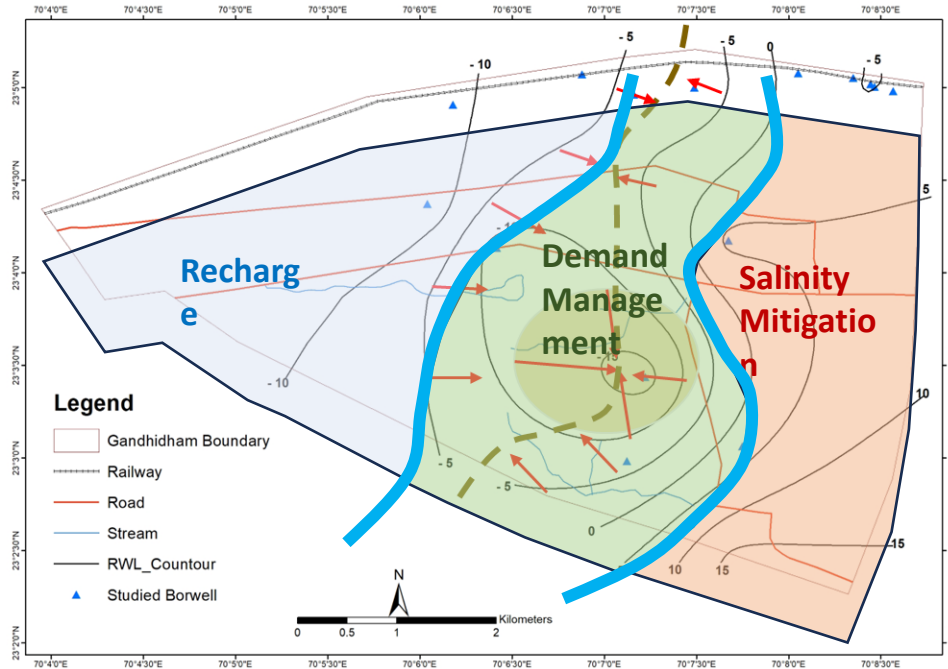
# Groundwater Potential and Behavior- Gandhidham

## Static Water Levels and Groundwater Flow Direction...



Water Level depth is shallow towards southeast and deep towards West

# Issues and Proposed Strategy- Gandhidham...

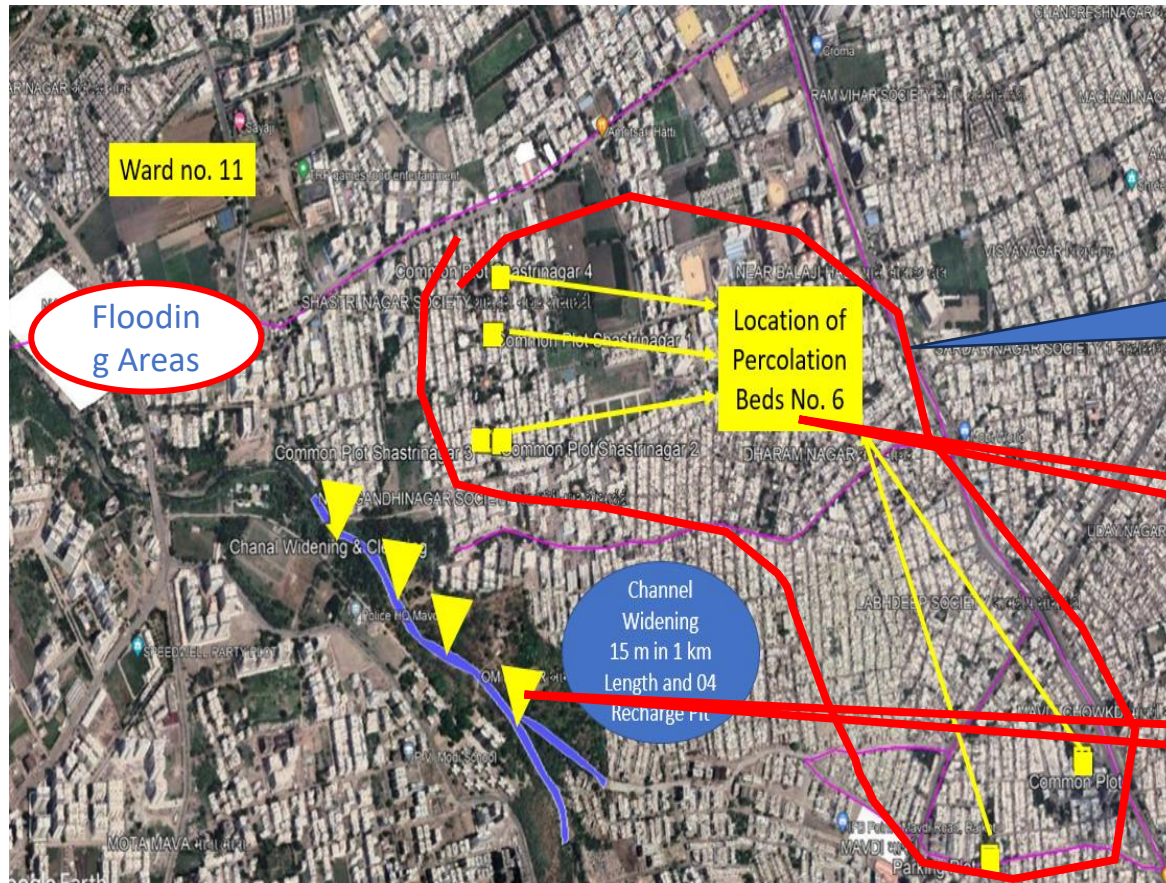




# Approach and Techniques for Rainwater Harvesting and Groundwater Recharge...

- Approaches
  - Urban Watershed
  - Integrated Approach for Campus Level Rainwater Harvesting
  - Micro level – Common Plot – Individual
  - Reuse of Existing Structures
- Techniques
  - Revival of existing Water bodies and its catchment
  - Recharge of existing defunct well/borewell through roof rain water
  - Campus level integrated Water harvesting and groundwater Recharge plans
  - Artificial Recharge Tubewells in ponds or channels
  - Recharge Pits
  - Roof rain water harvesting tanks – individual/common
  - Shallow aquifer recharge
  - Soil Aquifer Recharge
  - Common plot Recharge

# Urban Watershed Approach in City – Example of Rajkot City Ward no. 11



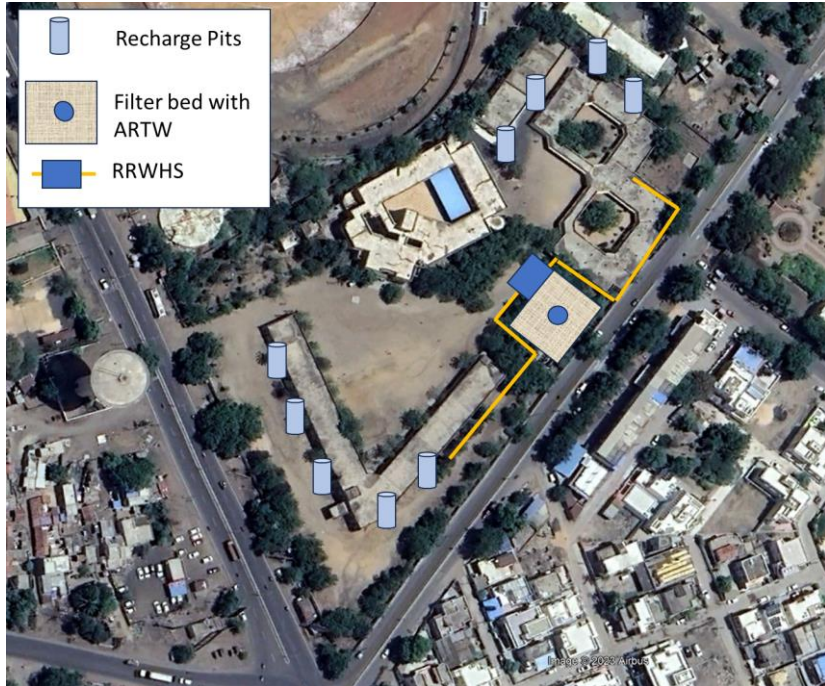
Delineation of Watershed Ridges based on landuse and infrastructure

Catchment Treatment

Drainage Line treatment

# Integrated approach-

## Campus level Integrated Water Harvesting and Groundwater Recharge...

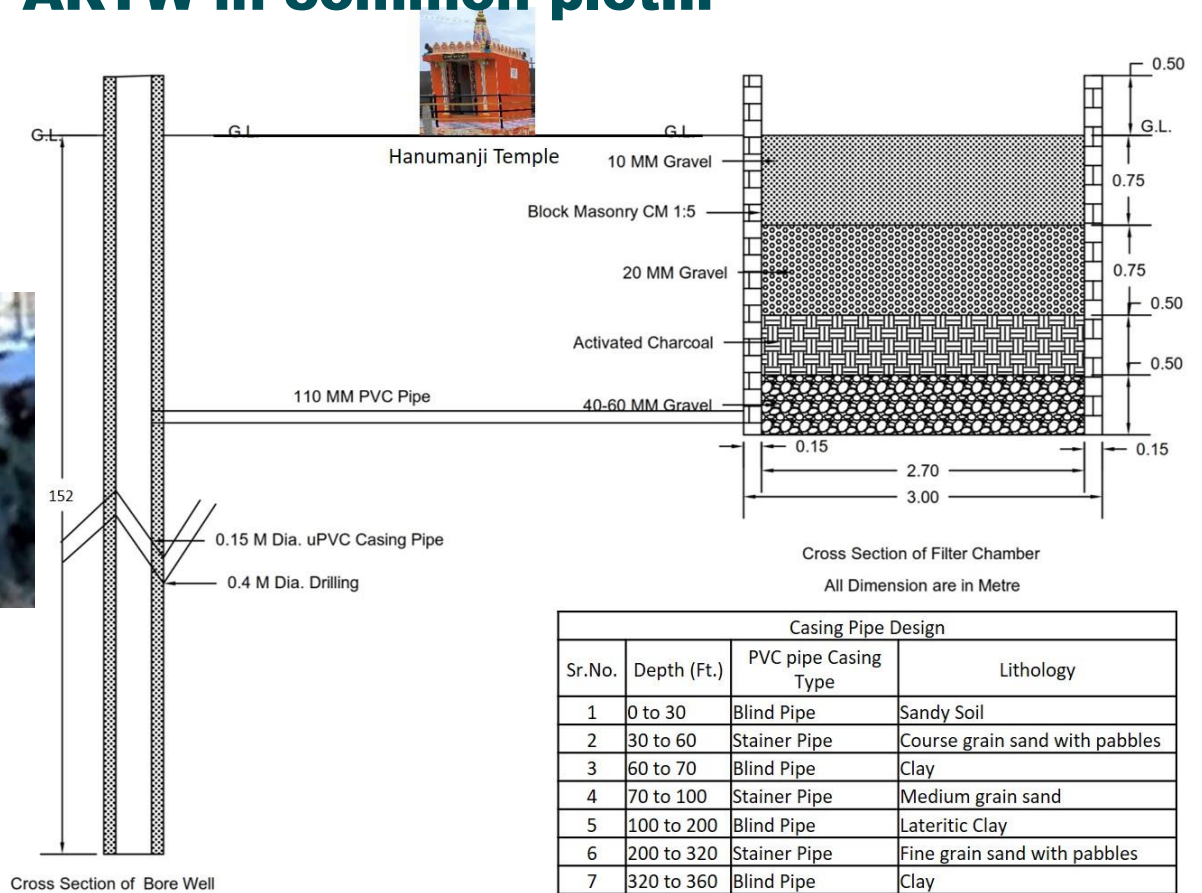
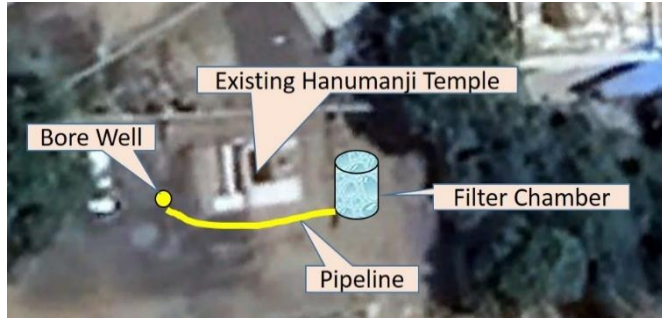


Example – Swami Vivekanand School Anjar



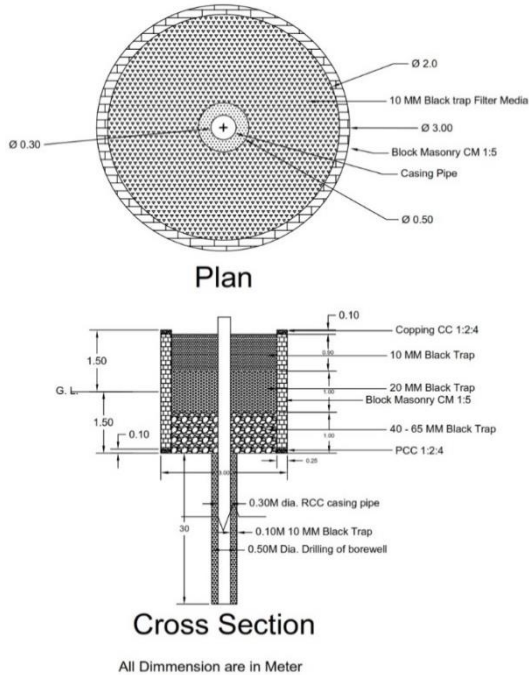
Example – Soil and shallow Aquifer Recharge Plan KJ Somaiya Trust Campus

# Micro level Approach- ARTW in common plot...

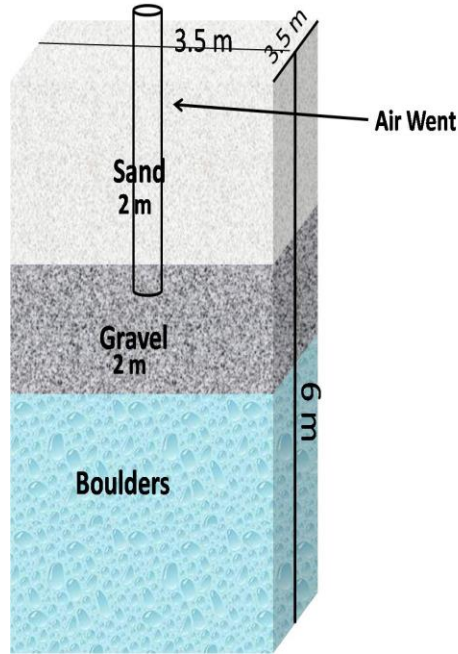


Casing Pipe Design			
Sr.No.	Depth (Ft.)	PVC pipe Casing Type	Lithology
1	0 to 30	Blind Pipe	Sandy Soil
2	30 to 60	Stainer Pipe	Course grain sand with pabbles
3	60 to 70	Blind Pipe	Clay
4	70 to 100	Stainer Pipe	Medium grain sand
5	100 to 200	Blind Pipe	Lateritic Clay
6	200 to 320	Stainer Pipe	Fine grain sand with pabbles
7	320 to 360	Blind Pipe	Clay
8	360 to 480	Stainer Pipe	Weathered Basalt
9	480 to 500	Blind Pipe	Weathered Basalt

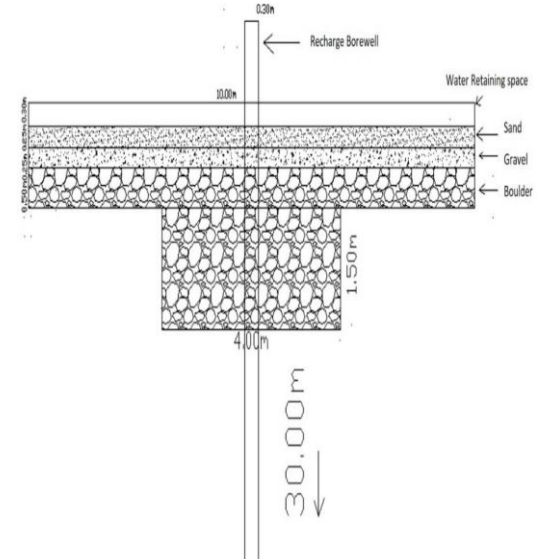
# Micro Scale- Individual GW recharge structures...



**Artificial Recharge Tube well**



**Recharge Pit**



**Percolation Bed**

## SESSION 3

### Rainwater Harvesting technologies

- *Role of Engineers, Builders and Architects in water sensitive urban planning and drinking water security at building and city scale*
- *Khambhati Kuva – a low cost and effective water conservation technique security*



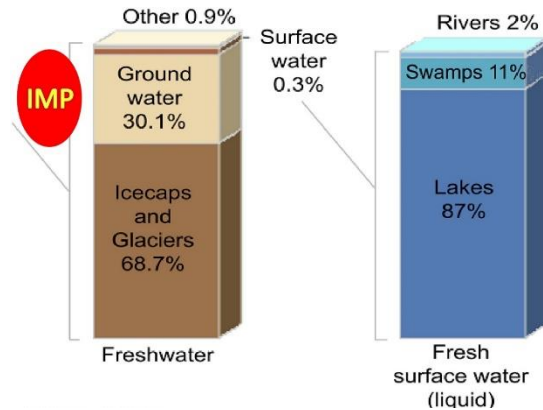
**Lokendra Balasaria**  
Eco Environmentalist  
Treewalks

*Architect, Urban and Regional Planner by profession, Lokendra Ji, is leading a ecological action based knowledge sharing and training platform – TREEWALKS, where in more than 2000 families are learning to lead a Eco life way of living. With Khambhati Kuva techniques and roof top rainwater harvesting, individuals/ families are helping ground water recharge with more than 150 crore liters of rainwater every year.*

# Ground and surface water – dependence on Rainwater...

Water can be categorized in two ways:

- Ground water (freshwater) which comprises of glaciers, icecaps and ground water
- Surface water (surface fresh water) which comprises of lakes, swamps and rivers.



## RAINS – the biggest source

AHMEDABAD HAS ABOUT 44 RAINY DAYS ANNUALLY

Avg Rainfall in Ahmedabad  
**800mm /per year**

A 500 sq.yds PLOT WOULD HAVE ABOUT 3.5 LAKH LITERS OF RAINFALL ANNUALLY

LOKENDRA BALASARIA


**QUANTITY**

# Water and Cities – correlating the existence...

Water plays a vital role in development. Humans have always lived close to water sources.

When any city fails to provide water, the situation turns to get challenging.

Historically, Fatehpur Sikri was abandoned just cause it exhausted its water sources.



**FATEHPUR SIKRI**  
THIS PLANNED CITY  
WAS BUILT IN 1571

Unluckily, just 13 years after completion, Akbar's capital exhausted its water supply and was abandoned

**RAJKOT**  
50 years back could pump out water from about 20 feet depth using hand pump

**Today**  
It pumps out water, that is very warm, from a depth of 2200 feet.  
And it also gets Narmada Water pumped from about 1000 kms away.

LOKENDRA BALASARIA

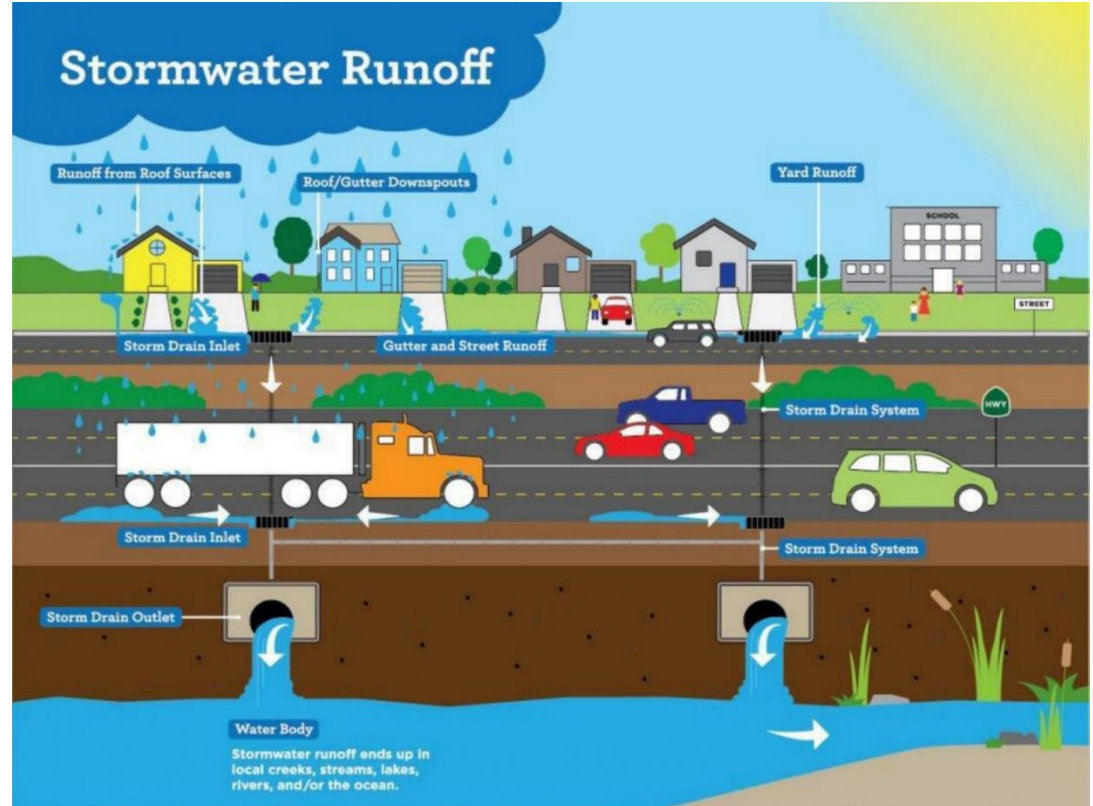
RWH-FEB-22



# Stormwater – boon or bane...

Rainfall is major source of water, however most of the water goes in the drains

Systematic way of wasting rainwater



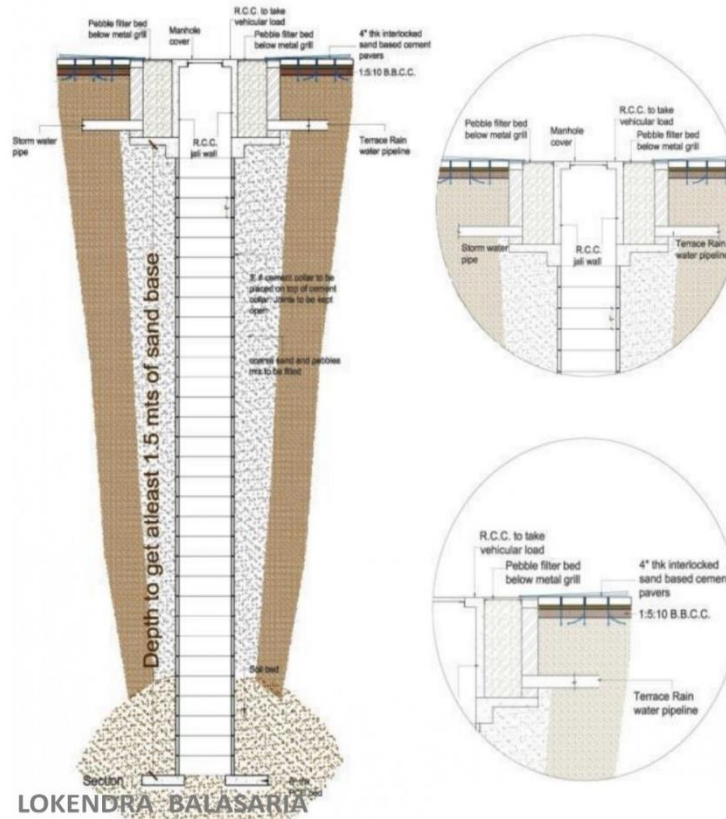
# Water scarcity – looming Indian Cities...

- Lack of water management is leading to water scarcity
- Many Indian cities are on the verge of becoming water scares or to encounter their “Day Zero”
- Cities need to focus on conserving rain water which can be stored and used throughout the year and excess water can be utilized in ground water recharge



# Water storing methods...

- There are several ways to do groundwater recharge.
- Most commonly seen methods are creating wells/borewells.
- These are the traditional practice, which not only stores water but also recharge the ground water



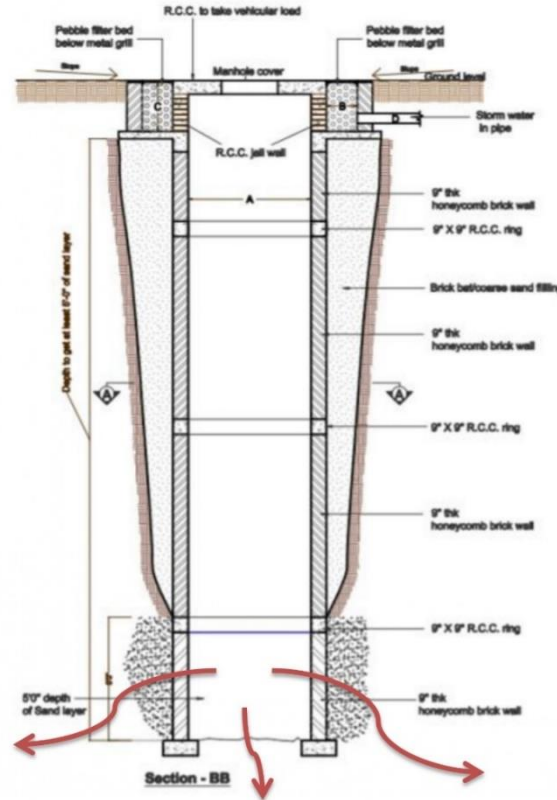
# Cost effective method for GWR - Khambati Kuva



Excavation for constructing Khambhati Kuva



Honey comb masonry work for water percolation



LOKENDRA BALASARIA

## KHAMBATI WELLS

WELL CAN BE 3 FEET TO 30 FEET IN DIAMETER

A 6 FEET DIA WELL CAN BE MADE IN ABOUT 10 DAYS TIME AND WOULD COST APPROX 1,00,000/- AND CAN TAKE ABOUT 25000 LITS OF WATER PER HOURS.

WATER PERCOLATED TO UPPER STRATA AND THEN FILTERS DOWN TO LOWER STRATA

WELLS DO NO NEED ANY MAINTENANCE AND NEED A MANUAL CLEANING OF THE FILTER BEDS AND THE WELL FROM INSIDE ONCE IN 3 YEARS

# Khambati Kuva...

Various stages of Construction of khambati kuva. The system works when the soil strata comprises of sand bed that absorbs the water and helps in recharging.



# Khambati Kuva...

Khambati kuva are cost effective method of water conservation

## KHAMBATI KUYA

TREEWALKS PROMOTES RAIN WATER HARVESTING FOR OUR CITY USING TRADITIONAL TECHNIQUES

FOR AHMEDABAD'S GEOLOGY, PROBABLY ONE OF THE MOST EFFICIENT, MINIMAL MAINTENANCE AND ECONOMICAL SOLUTION TO RAINWATER HARVESTING

BELOW IS PERFORMANCE AND COST CHART FROM ONE OF THE VENDORS

Well diameter	Percolation lit/hr	Approx cost Rs.
3 Feet	5000 to 7000	60000/-
6 Feet	15000 to 20000	105000/-
8 Feet	30000 to 35000	125000/-
10 Feet	35000 to 45000	210000/-
12 Feet	45000 to 60000	270000/-
15 Feet	80000 to 90000	330000/-
30 Feet	250000 to 300000	1000000/-



Chambers and Channels constructed for collecting rain water

# Article about Khambati Kuva in local newspaper...

## વરસાદી પાણી વહી જતું અટકે અને પુન:રિચાર્જ દ્વારા સમગ્ર વર્ષ દરમિયાન પૂરતા પ્રમાણમાં પાણી મળી રહે તેવો સંકલ્પ સેટેલાઈટની બીમાનગર હા. સો. જ્યાં 'ખંભાતી કૂવો' બન્યો છે, વર્ષે 23 લાખ લિટર વરસાદી પાણીથી બોરવેલ રિચાર્જ થાય છે

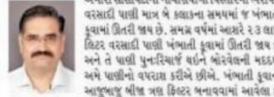
વર્ષ 2002માં બીમાનગર હાઉસિંગ સોસાયટીમાં સૌ પ્રથમ 'ખંભાતી કૂવો' તૈયાર કરાયો હતો



પણ ત્યાં સામાન્ય રીતે લોકો વપસા છે કે દરેક બ્લોકને વહી અને પાણીનો વિતરણ પૂર્ણ ઉપયોગ કરવો પોઈએ. બ્લોકના કબજાની જેટલી કિંમત છે તેટલી જ કિંમત પાણીની છે. કુદરતી રીતે મળતા પાણીનો જરૂરિયાત પ્રમાણે વપસા કરવો પોઈએ. બ્લોક કબજાના આધુનિક સુવિધાઓને અભિમત આપે છે ત્યારે પાણીનો ખચાડ અટકે તે જરૂરી છે. વરસાદી પાણી વહી જતું અટકે અને પોતાની સોસાયટીમાં પૂરતા પ્રમાણમાં પાણી મળી રહે તે સેન્ટ્રી શહેરની પરિષદ વિસ્તારમાં આવેલી બીમાનગર ડો-ઓર્ગેટિવ હાઉસિંગ સોસાયટીમાં પહોલો 'ખંભાતી કૂવો' વર્ષ ૨૦૦૨માં બનાવવામાં આવ્યો હતો. આ રિચાર્જ વાટ કરતાં સોસાયટીના વાઈસ ચેરમેન નિખીલાભાઈ શેકે કહે છે કે, અમારી સોસાયટીની સ્થાપના ૧૯૮૬માં થઈ હતી, જેમાં ૩૩૪ મકાન છે અને હાલમાં ૨૫૦થી વધુ પરિવાર રહે છે. સોસાયટીમાં પાણી પૂટી જવાનો પ્રશ્ન ઘણા સમય સુધી હતો ત્યારે અમારી સોસાયટીમાં દરેક સભ્યને પૂરતા પ્રમાણમાં પાણી મળી રહે તે માટે ખંભાતી કૂવો બનાવવાનું નક્કી કર્યું હતું. સોસાયટીમાં સેલેટ આક્ટિવેટ સ્પોન્ટેનિયસ બ્લોક દ્વારા ખંભાતી કૂવાની ડિઝાઇન તૈયાર કરવામાં આવી હતી ત્યારબાદ સોસાયટીના નીચાણવાળા ભાગમાં જ્યાં વરસાદી પાણી વહી જતું હતું ત્યાં અમે ખંભાતી કૂવો બનાવવાનું નક્કી કર્યું હતું. આ ખંભાતી કૂવો ૪૦ ફુટ ડીપ અને ૨૪ ફુટ પહોળાં છે. વર્ષ ૨૦૦૨માં આ ખંભાતી કૂવો રૂબા રૂબ મહિનાની મહેનત અને ૨.૫૦ લાખના ખર્ચ તૈયાર કરવામાં આવ્યો હતો. વરસાદી પાણીનું સોંપ જતન થાય ત્યાં સુધી સમગ્ર વર્ષ દરમિયાન પૂરતા પ્રમાણમાં પાણીનો વપસા કરી શકાય છે.



### અમારી સોસાયટીમાં પાણીની સમસ્યા સર્જાઈ નથી જે અમારા માટે સારી વાત છે



અમારી સોસાયટીના નીચાણવાળા વિસ્તારમાં ભરપૂરું વરસાદી પાણી મળે છે કહાડના સમયમાં જ ખંભાતી કૂવામાં ઊંટની જાત છે. સમગ્ર વર્ષમાં આહાર ૨૩ લાખ લિટર વરસાદી પાણી ખંભાતી કૂવામાં ઊંટની જાત છે અને તે પાણી પુન:રિચાર્જ થઈને બોરવેલની મદદથી અમે પાણીનો વપસા કરીએ છીએ. ખંભાતી કૂવાની આનુભવ મીઠા નથા કિલ્લર બનાવવામાં આવેલા છે જેમાંથી ક્વોટી બહાર રહે અને વરસાદી પાણી કૂવામાં ઊંટની જાત છે. ખંભાતી કૂવો બનાવવા પછી અમારી સોસાયટીમાં પાણીની સમસ્યા સર્જાઈ નથી જે અમારા માટે સારી વાત છે. - **ખરેશભાઈ ભાટકે, સેક્રેટરી**

### પાણીમાં પહેલા 1400 ટીડીએસ હતું તે ઘટીને 500 થયું



ખંભાતી કૂવો બનાવ્યો ન હતા ત્યારે કોઈવાર પાણીની સમસ્યા થતી હતી ત્યારે સોસાયટીના દરેક સભ્યોએ વરસાદી પાણી વહી જાય નહીં પાણીનો સરપંચો ઘણાં મહેા અમારી સોસાયટીનો આ અનેવો પ્રયાસ છે. પાણી સાચવવાની આ પૂર્વી પદ્ધતિ છે જેનો અર્થ સોસાયટી ઉપયોગ કરે તે જરૂરી છે. પાણી છે તો બ્લોકનું કબજા છે તે સંભવી અમે પાણીનો વ્યય થતાં અટકે તથા દરેક પરિવાર પાણીનો કંડેસર ઉપયોગ કરે તે જરૂરી છે. ખંભાતી કૂવો બનાવ્યો તે પહોલો સોસાયટીના પાણીમાં ટીડીએસ ૧૪૦૦ હતું ત્યારબાદ પાણીના પુન:રિચાર્જને લીધે સોસાયટીના બોરવેલમાં આવતા પાણીનો ટીડીએસ અમારે ૫૦૦ થયો છે જે ખૂબ લાભદાયકી વાત છે. - **ભરૂણી ભાટકે, સોસાયટીના સભ્ય**



ખંભાતી કૂવાના કાચદા

- દર વર્ષે ખંભાતી કૂવામાંથી પાણીનું પૂરતું તેમજ ક્વોટી કહાડવામાં આવે છે
- ખંભાતી કૂવા ઉપર ક્લેજ પ્રોજેક્ટ થઈ શકે તે પ્રકારનો કોલેક્ટરનો સેલ બનાવવામાં આવ્યો છે
- સોસાયટીના દરેક સભ્યને ખંભાતી કૂવાને બાહોરવેલ સુધી મહેા તે પહોલો પાણીની ડી.કે.એમ.માં પહોલો જોવા મળે છે.
- ક્વોટી બોરવેલના પાણીના સતરમાં વધારો થયો છે
- વરસાદના પાણીના પુન:રિચાર્જને લીધે સમગ્ર વર્ષ દરમિયાન પાણી પૂરતા પ્રમાણમાં મળી રહે છે
- ખંભાતી કૂવાના પાણીના લીધે બોરવેલના પાણીની ડી.કે.એમ.માં પહોલો જોવા મળે છે.



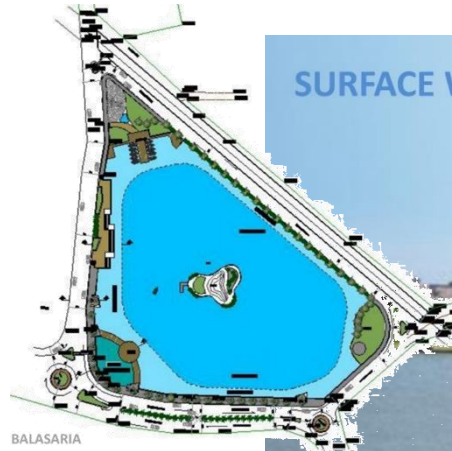
ગુજરાત સમાચાર plus THURSDAY 08 April, 2021

# Other Rainwater conservation/ ground water recharge practices...

Ground water recharge structures can be part of the landscape...

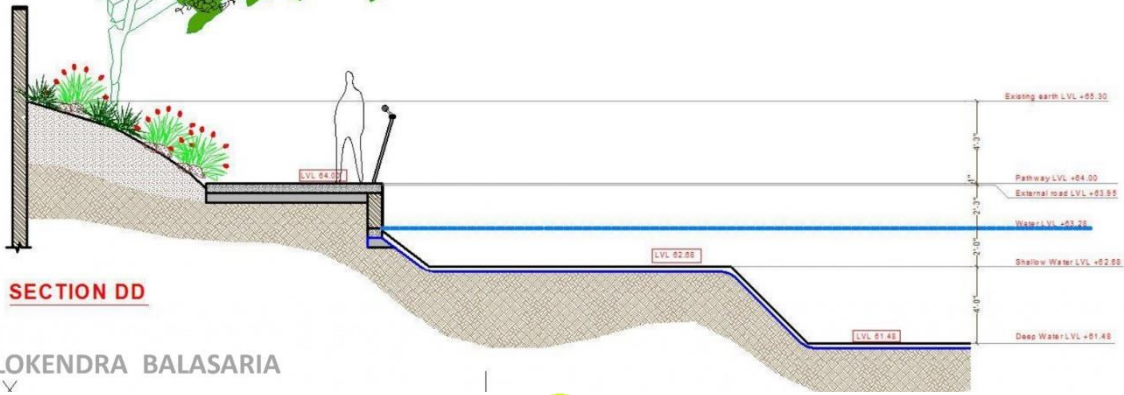
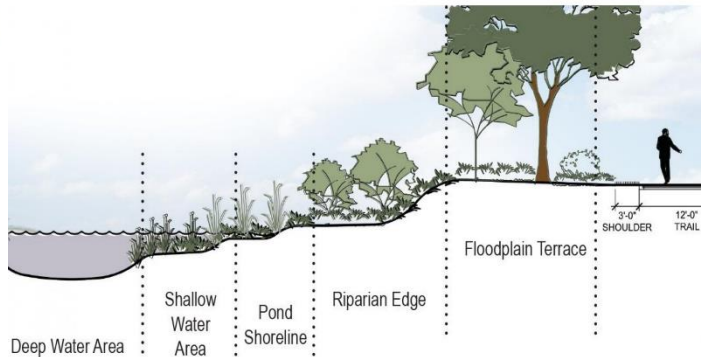
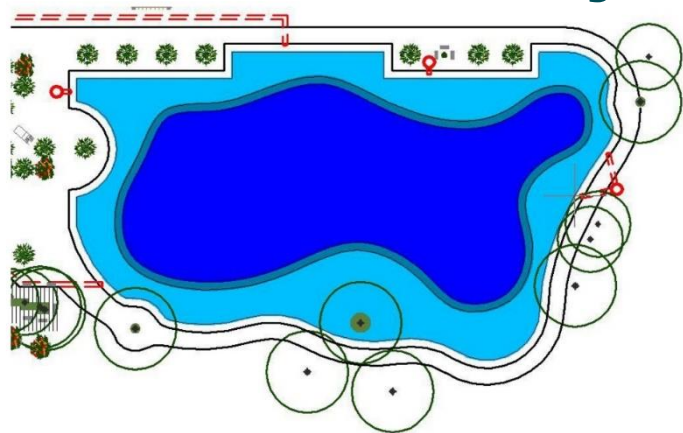


Surface water bodies plays an important role for ground water recharge...





# Surface water bodies edges can be developed in such way that it acts as filter bed for the waterbody...



LOKENDRA BALASARIA



LOKENDRA BALASARIA

# Elements to consider while doing RWH and GWR...

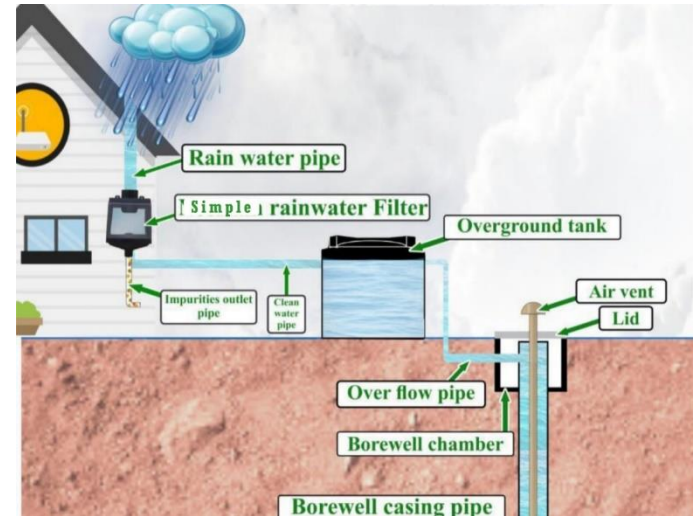
**Plumbing:** It plays major role in diverting roof top water into a storage tank and the overflow in GW recharge structure.



**Filter:** To avoid any suspended particles entering in tanks, its advised to have a filter in the downtake pipes. There are many such filters available in the markets.



**Storage Tank and GWR:** Water can further be stored in a storage tank, based on space availability of water demand



# Urban flooding mitigation strategies...

With climate change there is been change in rain patterns, this leads to water clogging in many urban areas.

To mitigate such situations and to utilize water, rain gardens can be an asset.

Storm water can be diverted in such rain gardens and these gardens can de designed in such a way that it can absorb the water and recharge and prevent floods.

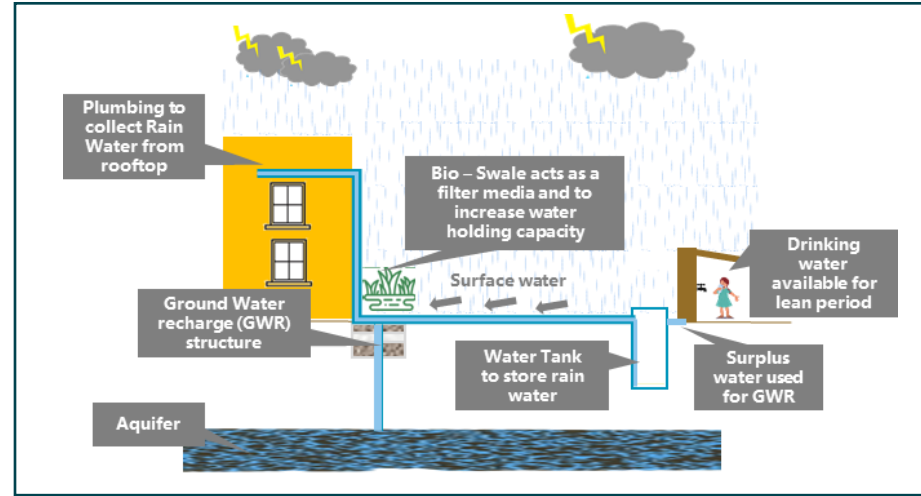




- Site Visit
- Workshop Discussion Points

# Site Visit...

- The workshop session was followed by site visit to the Gandhidham – School cluster
- The installed system, was explained to all the participants
- The system basically comprise – Plumbing to collect roof top rainwater, filter for separating big elements such as leaves etc., bio swale to increasing the water holding capacity and further filtration of surface water and storage tanks for providing water at the lean season
- The site visit summarized with open discussion and Q&A regarding the installed system



# Key Reflections from the workshop... (1/2)

- **Water security is crucial during climate change:** In the face of changing climate, it is very crucial that we conserve our natural water resources, which is available in the form of rainwater. Thus initiatives on augmenting own water resources is required to combat the climate change at local level.
- **Integrated water and town planning approach:** In order to develop water resilient cities in our nation, integrating water management and town planning is an absolutely necessary.
- **Collective Approach:** Stressed the significance of a collective approach involving every member of society to contribute to the mission for water security. A collaborative partnerships between governments, developers, non-profit organizations, and communities are essential for maximizing the impact of water conservation initiatives.
- **Technology and investment:** Simple and cost effective techniques are available which showcases successful rainwater harvesting and ground water recharge methods. The techniques must compliment the local ecosystem and retain the water balance.
- **RWH at different scales:** The RWH initiatives can be scaled up from individual household level to housing societies at community level and further from educational buildings to public/government buildings.

# Key Reflections from the workshop...(2/2)

## Workshop Impact:

- Gandhidham Development Authority (GDA) showed interest in developing RWH structure in their office premises (under construction)
- Rotary club members, active group in the two cities, discussed the possibilities of scaling up the initiatives at Community level
- Prominent developers and builders in the area connected for taking up initiatives into their upcoming housing projects.

## Suggestions by the participants:

- **Conduct more awareness workshops regularly:** Target different segments: residential communities, educational institutions, commercial establishments, government agencies. Continuous knowledge dissemination and capacity building efforts are required.
- **Leverage local festivals and public awareness campaign for citizen outreach :** Utilize festivals with mass participation e.g. Ramanavami. Integrate water conservation messages into cultural celebrations. Tap into collective community spirit for shared responsibility.
- **Establish a Rainwater Harvesting (RWH) Technical Cell by city authorities:** One-stop resource center for technical guidance and support. Provide advisory services on RWH system implementation. Facilitate widespread adoption of RWH across cities

# Glimpses of the workshop...





# List of Participants...

Sr.no	Name	Organisation/ Company name
1	Jadeja Ranjitsinh	Om Consultant, Anjar
2	Vivek R. Pandya	Pandya Consultancy, Anjar
3	Nirav G. Patel	JTP - AADA OFFICE
4	Tushar D. Pandya	Consulting Engineering
5	Yogesh Raval	Bharat Vikash Parishad, Anjar
6	Bharat Shah	Vice president of BJP Kutch
7	Akash Kodhrani	Matru Sparsh Hospital
8	Rtd. Rajesh Paleen	Rotary Club of Anjar
9	Dinesh C. Thacker	Anjar Gymkhana
10	Manoj C. Tikyani	GDA Adipur
11	Gayatri Gupta	GDA Adipur
12	Nitin Chonani	Neelkanth Engineer
13	Vijay Savla	NA
14	Manan N. Savla	Macon Consultants
15	Kuldeep K. Pandya	Mahadeo Consultant
16	Suresh Prajapati	Munthun Consultant
17	Deepen Pandya	Bharat Vikash Parishad
18	Hardik Anil Pandya	Ocean Consultancy
19	Parth Chandarana	Shree Consultant
20	Deepak Shethia	Deep Consultant
21	Kushal Sorathiya	Omkar Consultant
22	Anand pedva	Omkar Consultant
23	Hemant Shah	Ambaji Group
24	Prashant Goswami	Radhe Consultancy
25	Bhavyesh Buch	Sampada

Sr.no	Name	Organisation/ Company name
26	Pragnesh V. Vaghnani	P.V/ Engineers and Associates
27	Yogesh Jadeja	A.C.T
28	Jayantilal Gorsiya	A.C.T
29	Pravin Kerai	Anjar Nagarpalika Engineer
30	Zala Satyapalsinh P.	Anjar Nagarpalika Engineer
31	Rtd. Sunil Jobanputra	Anjar Rotary Club
32	Amit Chauhan	Bharat Vikas Parishad
33	Tejpal Lokhani	Anjal Nagarpalika S.I.
34	Rathod Keval B.	DEV Consultant
35	Devanshi	Studio Elementary
36	Khanjan	Brick Nest
37	Bhimji S. Chotara	Anjar Nagarpalika
38	Vikas	Sanghvi Homes
39	Manoj H. Ashav	M.A. and Associates
40	Gohil Tejas S.	Infinity Infra
41	Pratik H. Joshi	P.H. Joshi and Associates
42	B P Patel	GEB
43	Dhruvansh Harani	Studio Elementary
44	Amit Vyas	AADA
45	Chetan Acharya	AADA
46	Dipti Tanna	CWAS
47	Sohab Shaquib	CWAS
48	Nilesh Parmar	CWAS
49	Priyadarshini Choudhary	CWAS
50	Upasana Yadav	CWAS

# RAINWATER HARVESTING

## Catch the rain

Where it fall, When it falls  
to become

### Water Secure

## Conserve water

- To reduce freshwater demand
- To prevent urban flooding
- To improve groundwater levels and quality



# How



## WHERE?



Educational Buildings



Government Buildings



Parks and Gardens



Household /Society



Urban Flooding zone



4 RECHARGE Rainwater

2 STORE Rainwater

1 COLLECT Rainwater

3 USE Rainwater

## RESOURCES



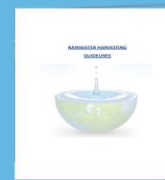
Urban Water security management toolkit



Water secure and climate resilient cities Anjar and Gandhidham: Citywide Assessment



Urban drinking water security in Gujarat



Rainwater harvesting guidelines



Interactive Dashboards on WASH

# THANK YOU

**CWAS** CENTER  
FOR WATER  
AND SANITATION

**CRDF** CEPT RESEARCH  
AND DEVELOPMENT  
FOUNDATION

**CEPT**  
UNIVERSITY

## About us

The Center for Water and Sanitation (CWAS) is a part of CEPT Research and Development Foundation (CRDF) at CEPT University. CWAS undertakes action-research, implementation support, capacity building and advocacy in the field of urban water and sanitation. Acting as a thought catalyst and facilitator, CWAS works closely with all levels of governments - national, state and local to support them in delivering water and sanitation services in an efficient, effective and equitable manner.



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