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## **Water Exploration along the Paleo-channels of Mythical Saraswati River**

### **Abstract**

Legend of mighty Saraswati River has existed in India since the time immemorial. Saraswati Project was initiated by ONGC to provide drinking water from deep aquifers of relic paleo Saraswati in the water starved states of Rajasthan, Gujarat and Haryana in 2002. First exploratory well Saraswati-1 was drilled during 2006 in Jaisalmer district of Rajasthan and established existence of relatively less saline potable water in a deep aquifer within Mesozoic Lathi Formation, from depth interval of 460-500m. The well is producing 70,000 LPH water till date.

Haryana Saraswati Heritage Development Board (HSHDB) approached ONGC for tapping the ground water along the course of paleo-channels of relic Saraswati River, so that fresh water from deep aquifers is made available for the local populace of Haryana. ONGC agreed to participate in the program under its CSR initiative and drill 10 wells along the paleo-channels of River Saraswati.

Satellite remote sensing data, Digital Elevation Map, drainage pattern formed the basis of identification of 10 locations for ground water wells in northern Haryana. The locations identified by ONGC were further fine-tuned in consultation with HSHDB, keeping in view the local water needs.

At present, drilling of 10 wells has been completed. Log data has been analyzed and interpreted, and suitable aquifers have been identified. After activation of wells water sample are collected for quality testing and age determination through carbon dating. Few wells are producing good quantity of water (in the range of one lakh liter per hour) from multiple aquifers. This initiative of ONGC is expected to meet the water needs of the local population and evolve an insight into the age/ existence of relic Saraswati River.

### **Introduction**

Legend of Saraswati River has lived on in India since the time immemorial. The mention of mighty river Saraswati exists in all the ancient Indian literature including the Vedas, the Puranas, the Upanishads, the Ramayana and the Mahabharata. (Bhadra et. al., 2009) The river flowed in area between rivers Indus and Ganges, originated in Himalayas descended in to the Rann of Kutch after meandering through, Sindh and Bahawalpur Provinces of Pakistan. The river though dried up around 3500 B.P., is even today remembered in Hindu religious ceremonies, and cultural practices. On the bank of Saraswati river existed the ancient Harappan civilization. The paleo-channels of the river and remains/ artifacts of Harappan age are found in Haryana, Punjab, Rajasthan, Gujarat and in Pakistan as well.

A large part of the river course lies buried below sands of Thar Desert. (Gupta et al., 2004) The recent researches have revealed course of the now extinct river Saraswati below the Thar Desert. However many aspects of the Saraswati civilization still remain to be studied in detail.

### **Initial Saraswati Project**

Saraswati Project was initiated by ONGC under its CSR scheme, as early as 2002 to provide drinking water from deep aquifers of relic paleo Saraswati in the water starved states of Rajasthan. The aims and objectives of the project were to investigate following options to arrive at a variable project plan:

- Existence of situations similar to Libyan Great Manmade River (GMR) project and its exploration in drought prone arid/ semi-arid regions in western Rajasthan.
- Alternatively, identification of deeper aquifers for exploration of groundwater not tapped so far by State or Central Ground Water Agencies/Bodies.

After detailed consultancy-based studies in desert covered parts of Rajasthan, exploratory well Saraswati-1 was drilled in 2006 Jaisalmer district and established existence of relatively less saline potable water in a deep aquifer within Mesozoic Lathi Formation, from depth interval of 460-500m. The well produced 70,000 LPH water, and later the well was handed over to the local PHED Department for supply of water. The well is still under operation and produces water. (WAPCOS Report, 2006)

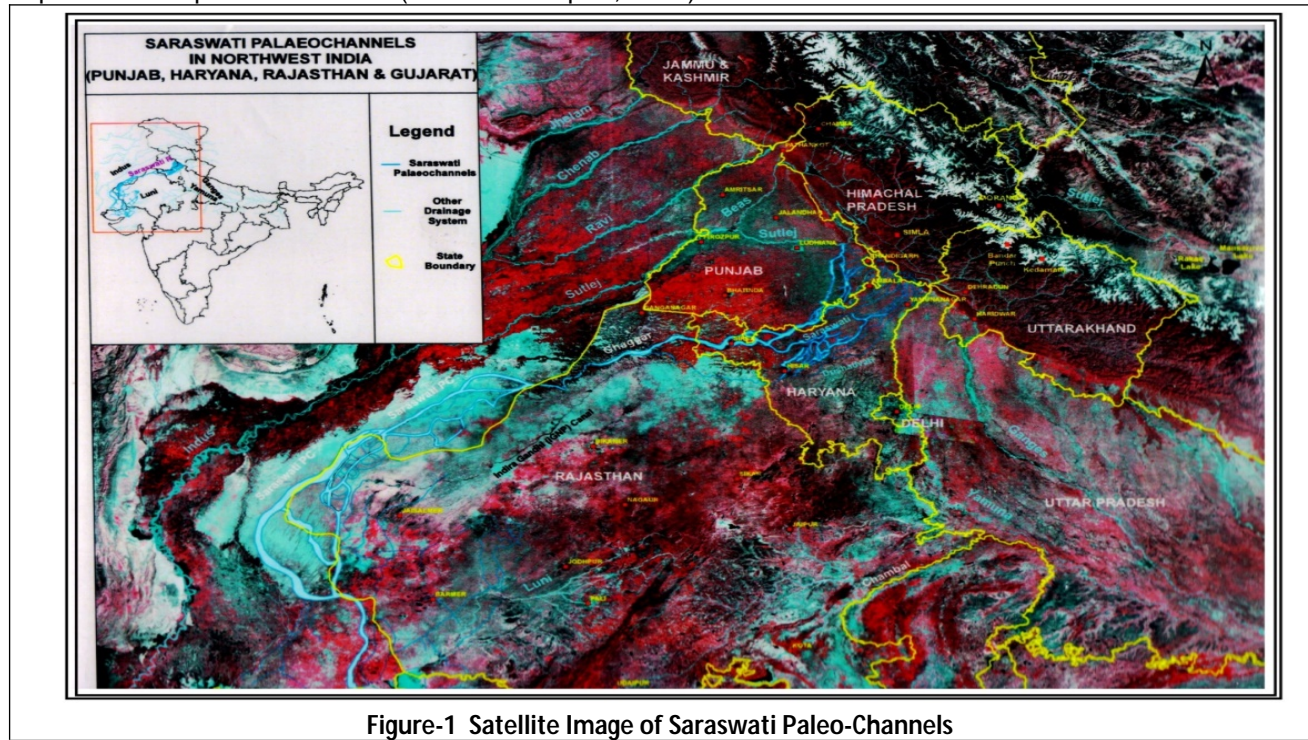


Figure-1 Satellite Image of Saraswati Paleo-Channels



Figure 2 Saraswat#1 Well Near Jaisalmer, drilled by ONGC in 2006 under Project Saraswati

### Rejuvenation of Saraswati Project

After successfully drilling first well under Saraswati project in 2006, there was very less activity in this project. Government of Haryana through Haryana Saraswati Heritage Board (HSHDB) is trying to promote, preserve, raise awareness, develop & restore Saraswati Heritage cites along the paleo-channels of Saraswati River.

Saraswati Nadi Shodh Sansthan, an NGO based in Haryana, and subsequently Harayana Saraswati Heritage Development Board (HSHDB) approached ONGC for tapping the ground water along the course of paleo-channels of relic Saraswati River, so that fresh water from deep aquifers can be made available for the local populace of Haryana. ONGC agreed to participate in the program under its CSR initiative and drill 10 wells along the paleo-channels of River Saraswati.

On the basis of available geospatial data and fresh interpretation of satellite remote sensing data, a compiled paleo-channel map of Haryana has been generated. Simultaneously, the Digital Elevation Map (DEM) data for Haryana were extracted from open-source ASTER GDEM dataset to infer lineaments and potential neo-tectonic imprints for reported drainage desiccation that resulted in Saraswati River extinction. These datasets formed the basis of identification of following 10 locations for ground water wells in select districts of northern Haryana.

S. No.	Well Name	District	~TD (m)
1	Well # A	Yamuna Nagar	400
2	Well # B	Yamuna Nagar	400
3	Well # C	Yamuna Nagar	400
4	Well # D	Yamuna Nagar	500
5	Well # E	Yamuna Nagar	500
6	Well # f	Kurukshetra	400
7	Well # G	Kurukshetra	400
8	Well # H	Kaithal	500
9	Well # I	Fatehabad	400
10	Well # J	Sirsa	400

Table-1 Proposed Depth of Wells along Paleo-channels of Saraswati

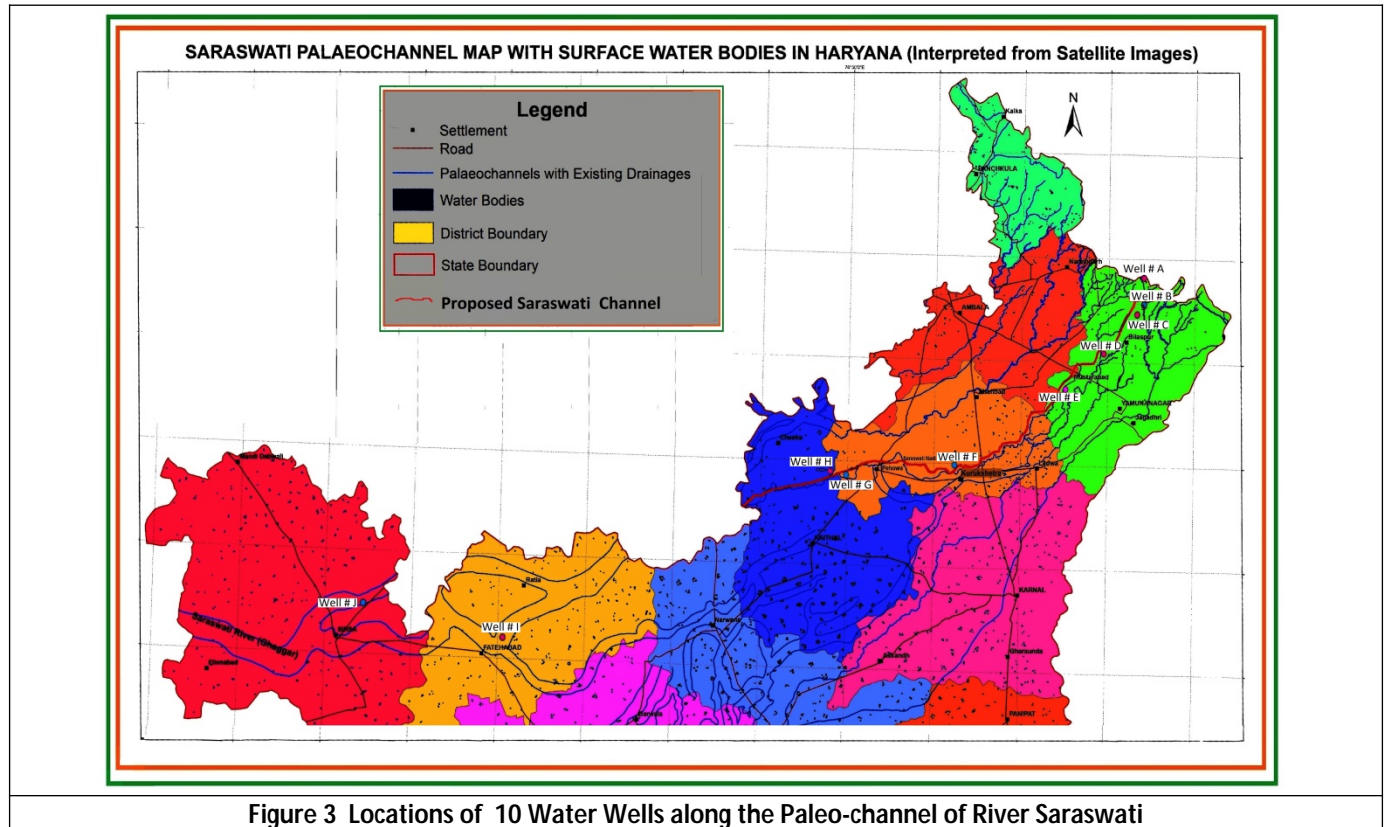


Figure 3 Locations of 10 Water Wells along the Paleo-channel of River Saraswati

The anticipated depth of the aquifers was determined on the basis of nearby exploratory wells of Central Ground water Board (CGWB) and other hydrology inputs. The locations identified by ONGC were further fine-tuned in association with HSHDB keeping in view of the local water needs. (Table-1)

## Project Implementation

ONGC is providing full financial support for drilling and completion of 10 water wells along the paleo-channels of Saraswati, through its implementing partner WAPCOS (Water & Power Consultancy Services). HSHDB will provide the land for drilling wells and power connections for operation of wells. Finally, the wells are to be handed over to HSHDB for their maintenance and end use. The following typical work flow for drilling of water wells have been adopted;

- Drilling of pilot hole
- Formation sampling
- Resistivity & Gamma ray log recording
- Reaming/ enlargement of hole
- Installation of Surface & sub-surface assemblies
- Suitable method of well activation
- Pumping/ Flow rate test
- Collection and analysis of water samples
- Installation of Submersible pump
- Construction of pump house & electricity connection
- Handing over Wells to HSHDB for upkeep & end use

Resistivity and Gamma ray logs were recorded in all the wells. Logs recorded in wells: A, B, D, H, F, G, H and J are displayed in Fig. 4. Multiple aquifers have been tapped in these wells for productivity.

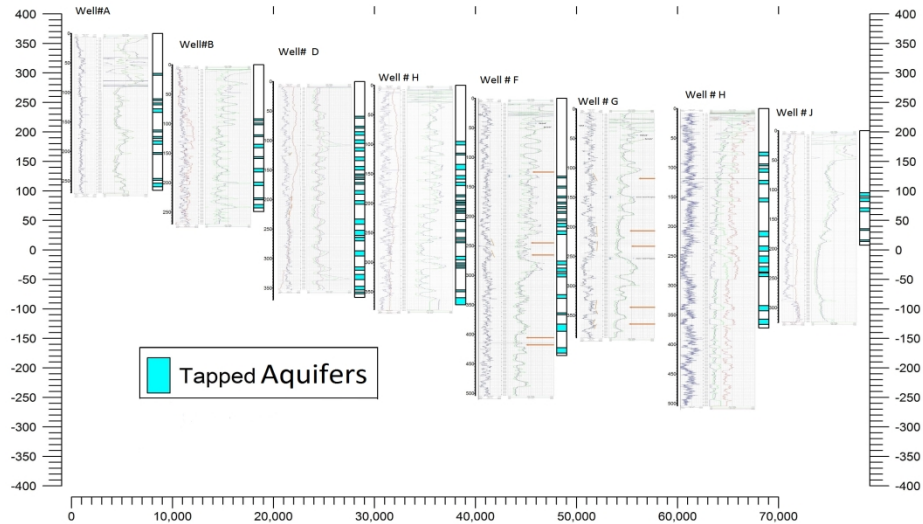


Figure-4 Display of Logs Recorded in 8 Wells

**Well Completion:**

After drilling of wells, well development takes place and compressor is applied to clean and activate the well. Upon activation, the well is kept under flowing condition till clear water starts flowing. Pump test is carried out to ascertain capacity of the aquifer.

At present drilling of 10 wells have been drilled and Geophysical logs have been recorded at all the locations. Log data was analyzed and interpreted, based on which, suitable aquifers have been identified. Compressors have been deployed for well activation.



Figure-5: Well # F, Near Kurukshetra under Development Stage

The following table gives an overview of performance of various well after activation.

Well	District	DD (m) Logged	Assembly (m)	Production of water from the Well (Liter Per Hour)
Well # A	Yamuna Nagar	270	266.6	12000 LPH
Well # B	Yamuna Nagar	270	249.6	44400 LPH
Well # C	Yamuna Nagar	343	325.6	105600 LPH
Well # D	Yamuna Nagar	368	366.6	91320 LPH
Well # E	Yamuna Nagar	417	395.6	112440 LPH
Well # F	Kurukshetra	500	436.6	92940 LPH
Well # G	Kurukshetra	439	425.6	109020 LPH
Well # H	Kaithal	500	372.6	112440 LPH
Well # I	Fatehabad	237	200.6	~46000 LPH
Well # J	Sirsa	328	194.6	40400 LPH

**Table-2 Flow Rates for Wells during pumping Test**

Water sample are collected by National Institute of Hydrology (NIH), Roorkee for water quality testing and age determination through carbon dating. Water samples are being analyzed for their potability and age.

On completion of the project the wells will be handed over to HSHDB, who shall be responsible for maintenance and end use of these water wells.

## Conclusions

ONGC conceptualized Saraswati Project in 2002 and drilled first well Saraswati#1 in 2006, producing 70,000 LPH less saline water.

Project Saraswati was restarted in 2015 by Frontier Basin, ONGC, wherein 10 water wells have been drilled by its implementing Partner WAPCOS and highly encouraging flow rates have been recorded.

All the 10 wells, drilled, logged and aquifers identified, well assemblies lowered and are under flowing condition and cumulative production from these wells is in range of 7,66,500 Liter Per Hour. These results are very encouraging as far as availability of water for water starved areas is concerned.

CSR initiative of ONGC is expected to meet the water needs of the local population and evolve an insight into the age/ existence of relic Saraswati River based on results of water quality and age analysis.

## Acknowledgement

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