

# WATER-RELATED DATA VISUALIZATION

## EXECUTIVE SUMMARY

This proposal offers Canada's expertise in water-related data analytics to the Government of India through the National Hydrology Project (NHP). Key features of this proposal are:

- An intermediate data analytics course for water-related data instructing and training them to use applications for data analysis
- The course would comprise up to 25 participants
- Participants would be mid-level water professionals with around 10 years' experience
- Training would be conducted at a partner location of Carleton University, Canada in Alberta.
- The training course to run for 2 weeks, from September 2019
- The course would include an assessment at the end of the program
- Graduates would form an Alumni network to provide ongoing learning opportunities to new participants (e.g. online learning / support tools)
- After course completion, Canada-India Centre will provide support to participants and their respective departments to deploy and maintain the applications

Outcomes of the proposed training programme are:

- Up to 25 water professionals receive broad understanding of visualization of water-related data from Canada and India
- Graduates will be able to use a few key data visualization tools and import water-related datasets for reporting purposes
- Strong alumni links will be established between Canadian and Indian water professionals on which to build future collaborations

Note: these numbers can be changed according to requirements, and courses may be repeated in subsequent years as required, subject to evaluation feedback from year 1 courses.

## BACKGROUND AND CONTEXT

The National Hydrology Project (NHP) is third in a series of projects under the Indian Ministry of Water Resources supported by the World Bank. The project will include four components: (A) Water Resources Data Acquisition System; (B) Water Resources information system; (C) Water Resources Planning and Operations; and (D) Institutional Capacity Enhancement.

The development objective of the NHP is to improve the extent, quality, and accessibility of water resources information and to strengthen the capacity of targeted water resources management institutions in India. In this project, there is a strong need to build capacity in Indian water sector, for professionals and their institutions. The NHP Management Unit has invited Canada, through Carleton University, to provide a proposal for capacity building work under the NHP.

## THE PROPOSAL

Carleton University has drawn upon extensive Canadian expertise in water-related data analytics for this proposal. Key departments which are directly involved are Department of Earth Sciences, Department of Computer Science, Centre for Analytics and Canada-India Centre for Excellence (CICE).

Based at Carleton University, CICE was established in partnership with the High Commission of India, Carleton University and the Indo-Canadian community with a mandate to address capacity development issues in India and Canada.

The training course in this proposal will be presented by leading researchers and practitioners in water-related data analytics. CICE offers a very successful two-week course, known as Short-term Course on Water-related Data Visualization, which would be adapted to address capacity related issues for Government of India officials. An outline of the content of this course is presented below. The Canada-India Centre for Excellence is considered a hub for expertise on Canada-India related capacity issues. It is a premier course of its type and provides participants with a broad but rigorous introduction to water-related data analytics.

The course is designed to cater for up to 25 participants, to allow maximum interaction and learning efficacy. Participants would be mid-level water professionals with at least 10 years' experience, drawn from various levels of government in India. It is not intended that this course provide a comprehensive coverage of all topics, but rather to provide an overview of the topics in a way that will bring all participants us to a common level that will prepare them for more advanced study.

We also plan to conduct a small 5-day capsule module in India (*at a mutually agreed location*). The objective of this program is to train the participants in basic analytical techniques and enable them to incorporate these learnings in their projects given in Canada. The program is designed as a mix of Lectures and Laboratory exercises. This will also help them grasp the techniques to be covered in Canada.

The candidates must bring a laptop with them to the lectures in India as well as Canada. This will help them work on the data sets and assignments given to them. The candidates are free to bring the most appropriate data sets (*from available resources within NHP domain*); this shall enable the instructor to run data exercises using Indian data as well.

At the end of the course, a formal assessment (examination) will be administered to assess the learning of the participants.

## COURSE OUTPUT

Introduction to data analysis and visualization tools. Participants will learn to import datasets into the tools and run basic visualization functions. Participants will leverage actual water-related datasets to reinforce concepts to deal with challenges unique to large, environmental datasets. Participants will be provided hands-on training to import data, perform critical tasks such as visualization and data representation

## TOPICS COVERED

Day 1	<p>Overview and introduction of widely used data visualization tools</p> <ul style="list-style-type: none"> <li>• 10AM – 12PM: MapWindow geographic information system software</li> <li>• Break and Lunch</li> <li>• 2:00PM – 4PM: How to retrieve of hydrologic time-series data</li> </ul>
Day 2	<p>Introduction to basic data visualization functions</p> <ul style="list-style-type: none"> <li>• 10AM – 12PM: Introduction to graphs and graphical visualization techniques</li> <li>• Break and Lunch</li> <li>• 2:00PM – 4PM: Introduction to digital filtering techniques</li> </ul> <p>Project 1 assigned</p>
Day 3	<p>Ways to use data and create graphic representation for <b>ground water recharge from streamflow data</b></p> <ul style="list-style-type: none"> <li>• 10AM – 12PM: Graphical techniques: <ul style="list-style-type: none"> <li>○ Base-Flow Index</li> <li>○ Hydrograph separation and analysis</li> </ul> </li> <li>• Break and Lunch</li> <li>• 2:00PM – 4:00PM: Graphical techniques (contd.) <ul style="list-style-type: none"> <li>○ Fixed Interval</li> <li>○ Sliding interval</li> <li>○ Local minimum</li> </ul> </li> </ul> <p>Project 1 review and update</p>
Day 4	<p>Creating a dashboard</p> <ul style="list-style-type: none"> <li>• Daily groundwater trends</li> <li>• Periodic groundwater trends</li> <li>• Discharge trends</li> <li>• Precipitation trends</li> </ul>
Day 5	<p>Site visit to <b>Environment Canada and Climate Change S&amp;T Laboratories</b></p> <ul style="list-style-type: none"> <li>• <b>Participants will see live demonstration to facilities work on determination of polycyclic aromatic compounds, heavy metals such as arsenic, lead and cadmium, and volatile organic compounds</b></li> </ul>
Day 6	<p>Assignments related to exploring ways to use tools with real data from Canada</p> <ul style="list-style-type: none"> <li>• 10AM – 12PM: 1 hr/team Project 1 Presentations by participants</li> <li>• Break and Lunch</li> <li>• 2:00PM – 4PM: 1 hr/team Project 1 Presentations by participants</li> </ul>
Day 7	<p>Site visit to <b>National Research Council's Data Analytics Centre</b></p>
Day 8	<p>Assignments related to exploring ways to use tools with real data from India</p>

	<ul style="list-style-type: none"> <li>• 10:00AM – 12:00PM: Review data sets from India</li> <li>• Break and Lunch</li> <li>• 2:00PM – 4:00PM: Examine data compatibility issues with Indian hydrology datasets vs. American and Canadian datasets compatible with GWToolbox</li> </ul>
Day 9	<p>Criteria for tools selection based on requirements</p> <ul style="list-style-type: none"> <li>• 10:00AM – 12:00PM: How to develop a framework for selection of data tools selection</li> <li>• Break and Lunch</li> <li>• 2:00PM – 4:00PM: Draft framework for data tools selection for Indian context and budgets</li> </ul>
Day 10	<p>Ways to register and download/ deploy tools</p> <ul style="list-style-type: none"> <li>• 10:00AM – 12:00PM: Presentation by Canadian IT infrastructure experts on key requirements for tools installation</li> <li>• Break and Lunch</li> <li>• 2:00PM – 4:00PM: Overview of commercially available cloud-based platforms and various ways to install tools for scalable deployment</li> </ul>

## CANDIDATE ASSESSMENT

Canada-India Centre will review candidates' profiles and experience prior to selection for the program. The candidates must be able to demonstrate basic knowledge of datasets and some experience with data visualization (e.g. creating excel charts). In general, this program will be open to officials with ten years of professional experience. Data analytics experience is not required but an asset.

## SELECTION OF TOOLS

Prior to program delivery, Canada-India Centre will conduct an orientation session to understand the needs of the participating engineers (i.e. their work environments and data visualization requirements). This will inform the instructors to focus on relevant data visualization tools that can be used by the participants in their work environment.

## POST TRAINING – REVIEW

1. On site-evaluation by the experts can be done four after the training in Ottawa
2. Visits from Canadian expert(s) can be organized for site locations. During the visits, experts can help participants with integration of datasets and the newly learned tools.
3. Canadian experts can be available on call to address issues and concerns by participants from India
4. If the department (of the Engineer) is interested, under the project Canada-India Centre can also help in deployment and maintenance of the tools.

Above services are offered at an additional fee (to be discussed later).

## PROGRAM FEE

The revised cost of the Program is C\$ 4,175 (~ USD 3,156) per candidate for a batch size of up to 25 participants. This costing has been done for a cohort (or batch) of minimum 20 and maximum 25 in a class. Price for a cohort (or batch) size of below 20, will have to be re-negotiated.

The cost includes the following:

- Airport pick-up and drop-off
- Course modules and courseware (India and Canada)
- Technology tools
- Laboratory exercises
- Networking opportunities and site visits

The following are not included:

- Airfare & visa fee (NHP nominees)
- Airfare & Accommodation for instructor to deliver 5-day course in India
- Personal expenses of the nominees
- Accommodation in Canada (*approx. CAD 70 per person per day in a campus environment, subject to availability*)
- Food / Meals in Canada (*approx. CAD 115 per person per day*)
- Health insurance/travel insurance for nominees coming to Canada

## PROPOSED DATES

This course shall be offered in Calgary, Canada.

The most probable date for this program to begin is 16<sup>th</sup> March 2020 and shall end on 27<sup>th</sup> March 2020. The latest arrival date shall be 15<sup>th</sup> March 2020 and earliest departure can be on the night of 27<sup>th</sup> March 2020.

*We require a lead time of up to 45 days to prepare and be ready for the group. The work can commence only after work order has been issued by the office of NHP.*

## CERTIFICATE

Upon successful completion of the training program, participants will receive a certificate of completion from the Global Academy at Carleton University.

**Potential Tools:**

- **Groundwater Toolbox: A graphical and mapping interface for analysis of hydrologic data**
  - (link: <https://water.usgs.gov/ogw/gwtoolbox/>)
- **Ground-Water Hydrograph Analysis Toolbox**
  - <https://gwhat.readthedocs.io/en/gwhat-0.2.5/>

**Potential Instructors:**

- Dr. Stephan Gruber - Professor and Canada Research Chair in Climate Change Impacts/Adaptation in Northern Canada
- Dr. Scott Mitchell – Co-director of Carleton’s Geomatics and Landscape Ecology Laboratory
- Dr. Derek Mueller – Associate Professor, Specialization: Remote sensing and environmental modelling
- Dr. Murray Richardson - Geographic Information Systems and Remote Sensing, physical hydrology and the bio-geosciences
- Dr. Yogendra Chaudhry – Environment expert with wide area of interest in Hydrology and Water systems and large experience in Canada and India.

## Get in touch with us

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