DRAINAGE AREAS(UP-FROM-GAUGE) IN CANADA: CREATING THE NATIONAL DATASET

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A GIS-based Hybrid Approach to Creating a National Dataset – Drainage Areas(up-from-gauge) in Canada

1. Hydrology and Water in Canada

2. National Drainage Area Frameworks in Canada

3. Drainage Areas versus Catchments, what's the difference?

4. Hydrometric Station Drainage Area(DA) project – Introduction, Objectives, Criteria

5. Striving for Level 1 Beta, some examples per Province/Region
   A. Yukon – Building off our legacy
   B. Leveraging off the work of our Provinces – Ontario and BC
   C. Decades of Collaboration - Prairies

6. Conclusions

Canada’s Hydrologic Diversity

- Canada’s hydrologic diversity is a reflection of its bio-physical diversity
- BC, most of Yukon, southwest Alberta – high runoff drains westward into Pacific Ocean, exceeding 3000mm annually in some coastal areas
- Prairies(Alberta, Saskatchewan, Manitoba) – runoff averages well under 200mm per year, flat fertile south where it can average < 50mm

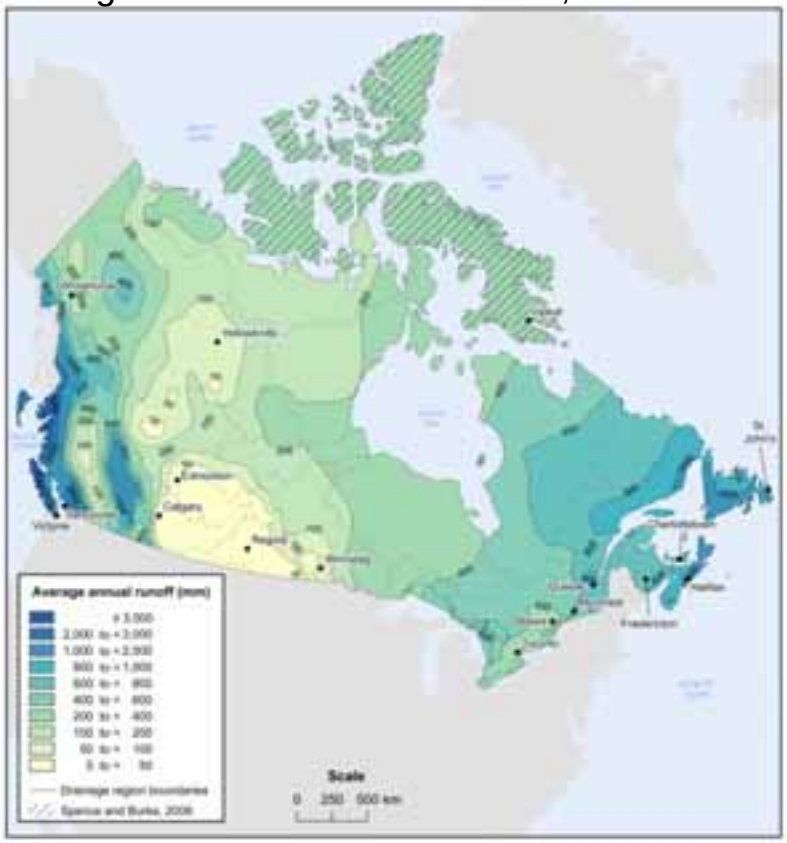
Canada’s Hydrologic Diversity

- Central and eastern Canada(the Canadian Shield) - annual runoff trends from 100mm in northwest to 800mm in southeast to over 1000mm along the Atlantic coast
- Northern Ontario – extensive wetlands surrounded by the Shield drain north to Hudson/James Bay
- Southern Ontario, southern Quebec – annual runoff ranges from 200mm in southwest to >600mm in the northeast
- Atlantic Provinces(New Brunswick, Nova Scotia, PEI, Newfoundland/Labrador) – runoff increases significantly from west to east, from 600mm in west to 2000mm along Atlantic coast
- Far north(Northwest Territories, Nunavut) – few data on runoff available but very low precipitation(100-200mm annually) so annual runoff is considered very low

Water Yields in Canada

- Canada is surrounded on three sides by the Pacific, Arctic and Atlantic Oceans, and has 243,000 km of coastline. This combined with Canada's topography and climate results in abundant freshwater resources
- However these freshwater resources are not evenly distributed across the country – they are available in different amounts and at different times throughout the year. Variation in water yield between regions in Canada is considerable.
- In general highest water yields are in Pacific coast, northern Quebec and Atlantic coast. And least water regions are in Prairies and north of Prairies
- Annual water yields highly variable particularly in the Prairies and this variability of flows is illustrated by the severe floods and droughts that occur in this region
- Annual water yield in Canada has shown there was a decrease from 1971 to 2004
- In Canada, areas of abundant water yield do not correspond with the highly populated regions of the country – 98% of Canadians live in the south but this area is responsible for only 38% of the water yield

Average Annual Runoff in Canada, 1971 to 2004



Note(s): Data were derived from discharge values contained in Environment Canada, 2010, Water Survey of Canada, Archived Hydrometric Data (HYDAT) (www.ec.gc.ca/hydat/H2O/index_e.cfm?name=main_e.cfm)

Source(s): Spence C., and A. Burke, 2008, "Estimates of Canadian Arctic Archipelago Runoff from Observed Hydrometric Data," Journal of Hydrology, Vol. 362, pages 247 to 259.
Statistics Canada, Environment Accounts and Statistics Division, 2010, special tabulation.

National Watershed Frameworks in Canada, “Drainage Areas”

There are 2 distinct classification schemes for Drainage Areas at the national level:

1. **Water Survey of Canada(Environment Canada)**, aka Basin-Subbasin-Subsubbasin (or Major Drainage Area-Sub Drainage Area-Sub Sub Drainage Area)
2. **National Atlas of Canada(Natural Resources Canada)**, aka Ocean Drainage Area-Major River Basin

- 1922-1985: WSC Drainage Areas the only national DA framework
- 1985: NRCan Major River Basins
- 2003: National Drainage Area Framework(1:1Million) supports both WSC and NRCan definitions

Water Survey of Canada's (Environment Canada) Basin-Subbasin-Subsubbasins

- "The Water Survey of Canada(or, as it was known then, the Department of the Interior, Dominion Water Power Branch) first developed, in 1922, a ***Water Resources Index Inventory*** as a convenient and logical system ***for recording*** and filing ***water resources data***. It was ***designed for*** the storage of such information as the ***location of waterpower sites, waterpower developments, storage reservoirs, stream measurement stations, and meteorological stations***. The Water Survey of Canada delineations involved the division, sub-division and ***the sub-sub-division of Canada into suitably sized areas based on the drainage***, for administrative purposes. Although the boundaries are based on drainage, the intent was to ***include all of Canada's land mass and waters within this drainage area hierarchy*** to facilitate the identification of hydrometeorological sites. Therefore, the WSC drainage areas ***do not necessarily define individual river basins***, but can represent intervening areas along the coast or include islands."

01 – Maritime Provinces
02 – St. Lawrence
03 – Northern Quebec and Labrador
04 – Southwestern Hudson Bay
05 – Nelson River
06 – Western and Northern Hudson Bay
07 –Great Slave Lake
08 – Pacific
09 –Yukon River
10 – Arctic
11 - Missippi

National Atlas of Canada(Natural Resources Canada) Ocean Drainage Areas-Major River Basins

- "In ***1985***, the National Atlas of Canada produced a 1:7.5M-scale "5th Edition-National ***Atlas of Canada-Drainage Basins" map*** which ***depicts the drainage basins for many*** of the ***larger rivers of Canada***. The National Atlas basin ***hierarchy has 5 levels***, the ***first*** of which defines Canada's five ***ocean drainage areas*** and covers all of Canada's land mass and waters. The ***second*** level ***defines major river basins and intervening areas*** and also covers Canada's entire land mass, while the ***remaining three levels define important river basins without defining the intervening areas or islands***. The ***major criterion*** used to define a National Atlas basin was a ***mean annual discharge of at least 280m3/s at the mouth of confluence of the river***. (The exceptions to this are the Assiniboine, Qu'Appelle, Souris, Battle, Red Deer and Oldman rivers)."

Drainage Areas vs Drainage Basins
definitions, differences, distinctions

- Note the distinction made in the WSC and National Atlas datasets between Drainage *Areas* and Drainage *Basins*.
- ***Drainage Basin*** is an area that drains all precipitation received as runoff and base flow(from groundwater sources) into a river or stream system ***that has a common outlet***, such as a lake, ocean, or confluence of rivers.
- In contrast, a ***Drainage Area*** can enclose any arbitrary area and ***may or may not drain through a single outlet***.

Environment Canada's Perspective on Drainage Areas:

- Departmental
  - Reporting units for water/environmental issues
  - Presentation scale, 1:1million scale
- Water Survey of Canada
  - **Drainage Areas above hydrometric gauges**
  - Analytical scale, 1:50K or larger

Hydrometric Station Drainage Areas in Canada, “Catchments”

- **Drainage Areas above hydrometric gauges** - the common outlet in this case is at the ***point*** of the hydrometric gauge. The “catchment” is the boundary in which theoretically any drop of rain that falls will eventually make its way to this point(gauge)
- It is a big jump to go from national Drainage Area frameworks(used for presentation) to site-specific local “catchments”(used for analysis)
- Current Situation:
  - WSC has 8000+ hydrometric stations in Canada
  - WSC has hydrometric station DA values available for most stations, but do not have corresponding spatial definition(e.g. shapefile) available
  - Agriculture Canada(e.g. PFRA) is the authoritative source of DA values for WSC stations in the Prairies
  - Environment Canada, WSC is authoritative source everywhere else in Canada

Our Project
Hydrometric Station Drainage Area Project

- Station Drainage Area Delineation is the first step in watershed analyses and hydrologic modeling
- Traditionally upstream drainage area calculations for WSC stations available for most stations, but their corresponding upstream watershed boundaries are not
- **Project Goal** to make hydrometric station drainage areas BOTH area value and polygons available for water resource practioners and researchers
- **Effort** needs to be put on delineating watersheds for hydrometric stations lacking catchment boundaries on one hand, but also in verifying existing drainage areas
- Started by collating and reviewing “best available” hydrometric station “catchments” (upstream drainage areas up-from-gauge) in Canada
  - Prairies(PFRA), BC Regional Office, NWT Regional Office
  - Studies, projects
- Conducted qualitative assessment and defined acceptability thresholds(national standards)

Our Project
Hydrometric Station Drainage Area Project

Level 1 Beta Criteria:

1. Stations are ACTIVE WSC stations.
2. Stations are WSC DISCHARGE stations.
3. Upstream Drainage Areas are GROSS.
4. Drainage Areas delineated to either
   A) Natural Conditions or
   B) Actual Current Conditions.
   There has been no consensus this criteria, so both types of DA polygons are being delineated and accepted at this time.
5. Upstream Drainage Areas(up from gauge) are delineated/captured at 1:50K or 1:250K map scale at a minimum.
6. Drainage Area Polygons are delineated from the current location of station.

Level 1 Beta Priority:

1. RHBN stations and DA polygons
2. International Gauging(IGS) stations and DA polygons
3. Natural(un-regulated) stations and DA polygons
4. Regulated stations and DA polygons

Level 1 Beta General Rules:

1. One full DA polygon per station.
2. Basin-level metadata, so 1 metadata file per DA polygon.

Our Project
Hydrometric Station Drainage Area Project

- Working Group agreed that the best first-cut station-DA will be called the LEVAL 1 BETA stage, current target – 2230 WSC Active Discharge stations in Canada
- Everyone agreed that collection associated basin-level metadata will be very important, as data/tools/methods/etc will be varied across the country

➢ Nationally, this project is simply guided by the BETA LEVEL 1 Criteria/Priority/Rules. **Approach is** a **hybrid** one where data/tools/method for station-DA delineation may differ for each hydrologically unique region of the country if required.

➢ **No firm definition of data/tools/methods for station-DA delineation**, but **requirement to document these parameters** in each basin-level-metadata.

➢ So our final **results are a true hybrid product but with consistency**

Striving for Level 1 Beta:

Examples and Experiences by Province/Region

Yukon – Building off our legacy

History and Background

- Regional office still had good paper records for DA values and delineations, and station descriptions
- Old hardcopy topo maps from Dept. of National Defence and USGS Alaska Topo Series, from 1950s-1970s exist with pencil-line of interpretated DA delineation
- Old DA binders tracking topo mapsheets with station-DA area summations available and in great shape

DA Delineation, Initial Approaches and Considerations

- Use digitizer with old hardcopy topo maps and extrapolate/digitize DA pencil-lines
- Download current 1:50K CanVec, manually do “heads-up” digitizing of station-DA delineation from scratch
- Use Hydro1K to generate conceptual station-DA delineation, use as guide
- Use 90m Yukon DEM to generate conceptual station-DA delineation, use as guide

Status – Level 1 Beta

- 41 station-DA delineation completed
- 1 station-DA outstanding

Yukon – Building off our legacy

Beta Level 1 DA Delineation Method and Discussion

1. Capitalize on good records, used pencil-lined DA delineations from old 1:250K topo maps as conceptual guide for newer higher resolution DA delineations
   - All 120 hardcopy topo maps were scanned-in as TIF images(200dpi)
   - All scanned TIF map images were then georeferenced to its original projection/datum using the intersection of parallels and meridians as control points(6 controls per sheet, low RMS error)
   - GeoTIFs containing pencil-lines can now be used as guide when doing heads-up delineation
2. Acquire higher resolution 1:50K topographic GIS data layers(hydrography, elevation) to be used in new DA delineations
   - 1:50K CanVec
   - 1:63,600 Alaska DRG
3. Do manual "heads-up" delineation using GeoTIF and GIS layers
4. Create Basin-level metadata for <u>each</u> station-DA

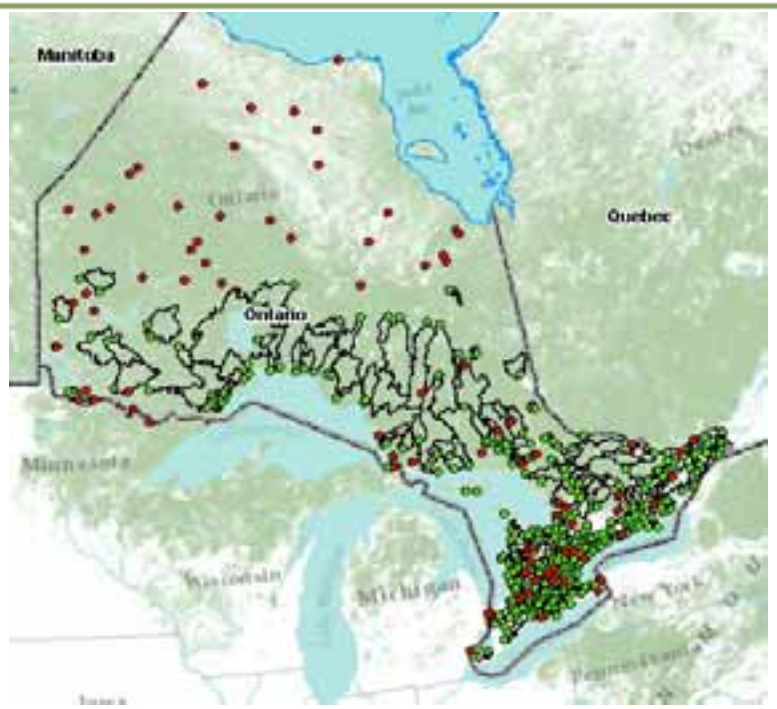
Results and Conclusions

- Scanning original topo maps with DA pencil-lines provided a great archive of originals for WSC
- Ability to confirm station coordinates leads to a more accurate DA delineation, plus having good records of older station descriptions gave us the ability to create station-DA delineation from previous location of gauge as well
- In the Yukon, delineating DA delineations over glacier/icefields were difficult and problematic. Resolved with using elevation contours from CanVec/DRG to determine height-of-land in the end.

Ontario – Leveraging off the work of our Provinces(desperately)

History and Background

- Previously, regional offices had good paper records for DA values and delineations
  - 1970s and prior - DA values were planimetered off hardcopy maps
  - 1980s – DA values were digitized in using a digitizer to calculate a DA value(but DA polygons were never kept)
- By early-mid 1990's, internal Program Review resulted in loss of paper records/maps for DA's, and loss of staff(expertise) in continued DA calculations, delineations or maintenance. Some instances where station-DA calculations even ceased.
- In 2000, Province of Ontario started Provincial Program(WRIP) to address immediate issues in water management(coincided with Walkerton water crisis)



Status – Level 1 Beta

- 377 station-DA delineation completed
- 96 station-DA outstanding

DA Delineation, Initial Approaches and Considerations

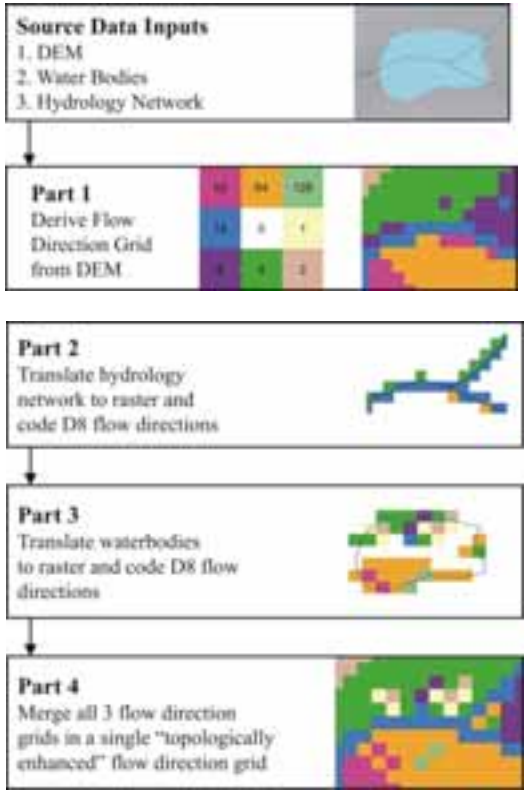
- Download current 1:50K CanVec, manually do "heads-up" digitizing of station-DA delineation from scratch
- Download current Province of Ontario 1:10K/1:20K Province of Ontario GIS data, either use high-resolution DEM and model out station-DA or use topographic map layers and manually do "heads-up" station-DA delineation from scratch
- Use HydroSHEDS(90m) to generate conceptual station-DA delineation, use as guide
- Acquire USA GIS data(e.g. NHD, WBD, NED) for transboundary station-DA delineations

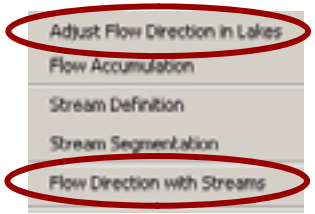
Ontario – Leveraging off the work of our Provinces(desperately)

Beta Level 1 DA Delineation Method and Discussion

1. Acquired Tools and Data from Ontario Min. of Natural Resources(Water Resource Information Program) to be used in new DA delineations
   - MNR **WRIP Toolbox** v. 3.0 for ArcGIS 9.2
   - MNR Water Flow Network(river network, waterbodies)
   - MNR **Enhanced Flow Direction Grid** v.2.0

     Kenny, F and Matthews, B, 2005. A methology for aligning raster flow direction data with photogrammetrically mapped hydrology. Computers and Geosciences.
2. WSC hired temp delineator to use MNR tools and enter all hydrometric stations as “pourpoints” to generate upstream DA results
   - Confirm/verify location of station, “pourpoints”
   - Begin automatic Delineation process
   - Visual verification of output DA polygon by tracing Water Flow Network(using ArcGIS Utility Network Analyst)
3. Minor station-DA post-processing once station-DA polygons completed. Create Basin-level metadata for each station-DA.





Ontario – Leveraging off the work of our Provinces(desperately)

Results and Conclusions

- **Highlight the foresight** that the **Province of Ontario** had in creating/maintaining suite of integrated hydrology and watershed datasets for the benefit of water resource managers/scientists at all levels(e.g. municiple, provincial, federal)
  - This makes our **station-DA results well accepted by the water resource community**. Acceptance of station-DA is very important because drainage area is a basic component to any hydrologic analysis.
  - Having a standard set of integrated hydrology and watershed data/tools provides consistency and **consistent result between between studies/basins/agencies**
- Our major **challenge in Ontario** is that our station-DA delineations are only **limited to the south-middle Ontario**. Currently and into the future…
  - Northern Ontario – currently Ontario MNR working on Far North initiative, we plan to leverage off this work/effort.
  - Transboundary(inter-provincial, international) – we plan to use the data/work coming out of the IJC Transboundary Basin Harmonization Phase 3+ to complete these, e.g. Rainy River Basin

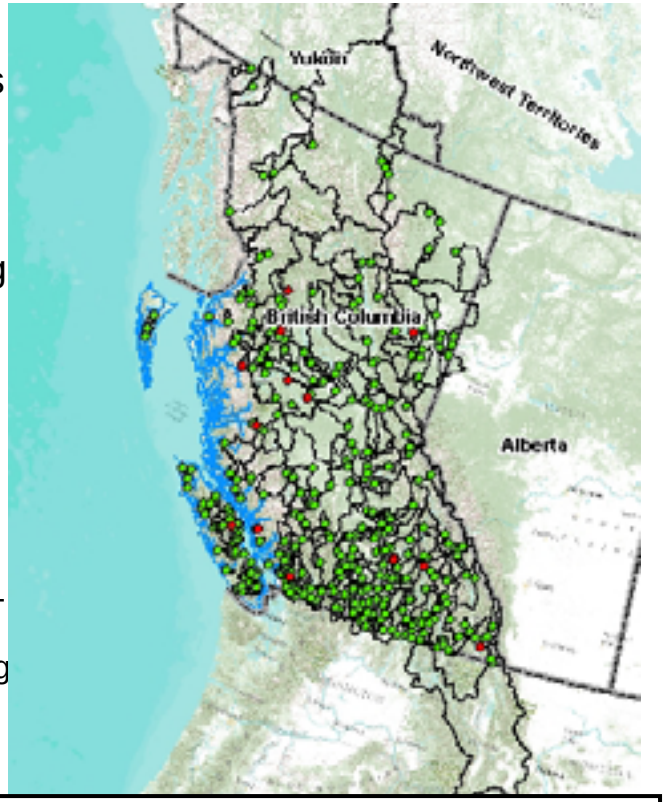
Method

- CDED
- Harmonized DEM
- Heads-up Digitization
- WBD - HUC12
- WBD - HUC12 and Harmonized DEM
- WRIP Tools

BC – Leveraging off the work of our Provinces(opportunistic)

History and Background

- Early-mid 1990s, internal Program Review results in some loss of records/maps, mostly intact due to commitment and continuity of key staff. But station-DA delineation is falling by the wayside.
- In contrast, early-mid 1990's – Province of BC embraces GIS, starts many new natural resource initiatives and begins making GIS data available in BC
- 1999-2000 – At EC, Senior Hydrologist and Scientific Data Manager inspires GIS scientist to develop an automated method for station-DA delineations for BC(a challenge she couldn't refuse!)
  - Opportunity to salvage current situation to not get worse as we have ongoing need for station-DA delineation
  - Opportunity to better connect hydrological time-series to the landscape, and the key was to accurately define upstream station-DA polygons(not just values) for scientific studies
  - Opportunity to use station-DA polygons in station network planning episodes of network retrenchment and growth



DA Delineation, Initial Approaches and Considerations (at that time)

- Find all topo maps with pencil-lines of station-DA delineations(from warehouses), inventory and start digitizing
- Buy 1:20K BC TRIM GIS data(7000+ mapsheets) and use as reference to do "heads-up" station-DA delineations
- Use 25m BC DEM to generate station-DA delineations
- Download and use Watershed Atlas from BC, at the time it was 1:50K BC Watershed Atlas, and do "something" with this for station-DA delineation

Status – Level 1 Beta

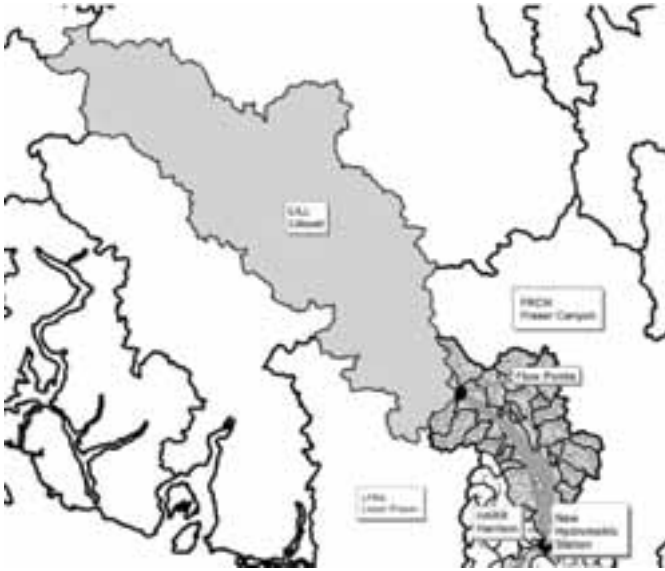
- 392 station-DA delineation completed
- 15 station-DA outstanding

BC – Leveraging off the work of our Provinces(opportunistic)

Beta Level 1 DA Delineation Method and Discussion

1. Acquired GIS Data from Province of BC
   - **1:50K BC Watershed Atlas**
2. Developed algorithm and tools for BC hydrometric station-DA delineation

   Kwan, J, Nash, J and Hamilton,S., 2001. Hydrological Applications of GIS: A New Approach. CWRA BC 2001 Annual Conference Proceedings.
   - Pre-processed various BC Watershed Atlas GIS layers for flow tracing and station-DA delineation abilities
   - **Created new hierarchical key**(RGT key) for each arc segment in the Streams layer(lwss). Essential to handling complex hydrology such as braided streams/etc
   - **Created inter-Watershed Group Flow Points** to find every location where there is flow between Watershed Groups, and assign upstream/downstream Watershed Group attributes.
3. Used new **Basin Delineation ArcView GIS tool** to enter all hydrometric stations as "pourpoints" and automatically generating station-DA polygons
   - Confirm location of station
   - Heads-up digitize "Terminal Downstream Arc"
   - Begin automatic Delineation process
     - Starts automatic tracing to find upstream streams(using pre-processed hierarchical key) until Watershed Group boundary
     - At Watershed Group boundary, see if any traced streams are "touching" any pre-processed flow points. If yes, then recursively accrue all upstream Watershed Groups until no more left
   - Geometrically construct 1 DA polygon per gauge



Canada

BC – Leveraging off the work of our Provinces(opportunistic)

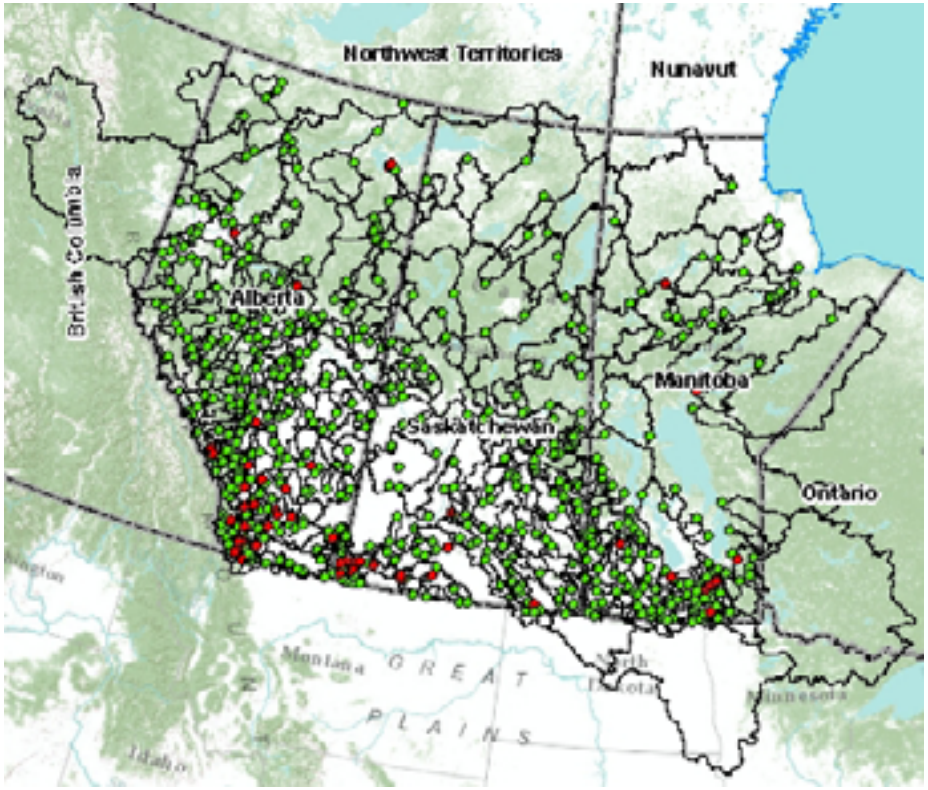
Results and Conclusions

- In BC, station-DA delineations which were **trans-boundary**, BC-Yukon/Alberta, BC-USA(Alaska, Washington, Idaho, Montana) were **not delineated** using the BC Basin Delineation automated method. In 2010, these trans-boundary station-DA delineations were completed using "heads-up" digitizing based on:
  - Yukon/Alberta: 1:50K CanVec hydrography and elevations
  - Alaska: 1:63,600 DRG
  - Washington/Idaho/Montana: 1:24K WBD-HUC12
  - BC: 1:50K BC Watershed Atlas
- For BC station-DA delineations, the scenarios which proved **challenging** were **glaciated landscapes, braided streams, and big lakes**.
- After creating 1:50K station-DA delineations in BC, recognized the need to modify/refine the 1:1Million WSC National Drainage Area Framework boundaries in BC to properly sychronize.
- **Highlight** the **investment** the **Province of BC** has made in the **spatial fabric for BC**, which has provided excellent building block for scientific applications such as ours. Also in **making geospatial data freely available**, this enables the use of their geospatial data for more than just making maps. Highlight the **foresight the Province of BC** had in investing in **rigorous data collection, robust data models for solid geospatial products/frameworks which users can build upon**. For us, this has led to **good acceptance of station-DA delineations by community**…until the next higher resolution, better product gets released by BC.
- In the **future**, we will need to re-delineate station-DA delineations using BC's current **1:20K Fresh Water Atlas**. FWA defines watershed boundaries by height-of-land and provides a connected network of streams and hydrologic features, where features are attributed by hierarchical key(144 character Watershed Code, broken into 21 levels) allowing for upstream/downstream flow tracing. FWA has over 3 million watersheds with an average area of 30 hectares each in BC.
- Possibly in the future, we would like to used high-res DEM to generate station-DA's in BC too, with its very applicable mountainous landscape.

Prairies – Decades of collaboration (Alberta, Saskatchewan, Manitoba)

History and Background

- 1975, at the request of the Prairie Provinces Water Board, PFRA(Agriculture Canada) formally accepted the on-going responsibility for delineation gross and effective drainage areas above gauging stations on streams covered by the Apportionment Agreement
- Over time, DA delineations were extended to all Alberta, Saskatchewan, Manitoba and portions of adjacent jurisdictions(BC, NWT, Nunavut, Ontario, USA)
- Agriculture Canada(PFRA) is the custodian of this database. DA delineation are made in consultation with the WSC and reps from Provinces of Alberta, Saskatchewan and Manitoba



Status – Level 1 Beta

- 690 station-DA delineation completed
- 64 station-DA outstanding

Prairies – Decades of collaboration (Alberta, Saskatchewan, Manitoba)

DA Delineation, Considerations

- Drainage area of streams in regions subjected to glacial transformation and deposition often difficult to determine. In the Prairies, great fluctuations of drainage basin boundaries have been observed in dry and wet years and in different seasons of the year
- In Prairie watersheds, not all surface runoff reaches the main stream. Some runoff is caught in major depressions(sloughs and/or lakes) from which there is no drainage to the main stream even under extremely wet conditions(e.g. dead drainage areas). This situation is common on the Canadian Prairies.
- **Contributing drainage areas on Canadian Prairies fluctuate by year, by season, and by event because of the glacial landscape and the climate**(Stichling and Blackwell, 1957), hence the need/proposal for fluctuating drainage area concepts
- **Two drainage area concepts**(restated by Godwin and Martin(1975), **results in two types of station-DA delineations over the Prairies**.
  - **Gross Drainage Area** - The gross drainage area of a stream at a specified location is that plane area, enclosed by its drainage divide, which might be expected to entirely contribute runoff to that specified location under extremely wet conditions. The gross drainage boundary is the drainage divide (i.e. the height of land between adjoining watersheds)
    - **Generally, a gross drainage boundary is solely on topography**
  - **Effective Drainage Area** - The effective drainage area is that portion of a drainage basin which might be expected to entirely contribute runoff to the main stream during a flood with a return period of two years. This area excludes marsh and slough areas and other natural storage areas which would prevent runoff from reaching the main stream in a year of 'average runoff'.
    - **Effective drainage boundaries are more conceptual because they pertain to natural average runoff(approx. the 2-year flood event) and are based more on hydrologic factors rather than on topography**

Prairies – Decades of collaboration (Alberta, Saskatchewan, Manitoba)

Beta Level 1 DA Delineation Method and Discussion

1. PFRA(Agriculture Canada) station-DA delineations

   PFRA Hydrology Division, 1983, The Determination of Gross and Effective Drainage Areas in the Prairie Provinces, Hydrology Report #104, Agriculture Canada, PFRA Engineering Branch, Regina, Saskatchewan, 22 pp

   - Station-DA delineations are editted using "heads-up digitizing" based on digital NTS maps and/or ortho-rectified images as primary reference(1:50K or 250K). Sometimes digital 1:20K topographic maps and orthophotos were used to update/delineate basin delineations, if available(e.g. Manitoba).
2. Continue decades of collaboration with Agriculture Canada(PFRA) by acquiring a copy of WSC station-DA delineations from their database
   - Query PFRA's cascading network of incremental drainage areas to output **1 full-DA delineation per station**
   - For national consistency, requested **Gross station-DA** polygons
   - All source data/linework from **PFRA Watersheds, version 8.0**
   - Product-level metadata available but basin-level metadata not available.

Results and Conclusions

- Because of Prairie landscape, **cautious to use DEM approach** for station-DA delineation
- Agriculture Canada(PFRA) database contains more than what we need for Level 1 Beta at this time, we will continue to rely on this as we progress the national project beyond Level 1 Beta.
  - Upstream station-DA delineation from previous location of gauge
- Discovered **some synchronization issues between PFRA and WSC** which will need to be ironed out. Example - if WSC moves its station(new coordinates) sometimes PFRA DA delineation is not updated, DA delineation up-from old location of station. Example – if PFRA updates a station-DA delineation and re-calculates its DA value, sometimes this is not properly updated into WSC Hydat/Hydex database.
- **Future** – we will **update** our station-DA delineations using **PFRA Watersheds version 9.0** currently being worked on

Conclusions

- We are now **78% complete for Canada** (1745 of 2230 station-DA polygons completed)
- Station-DA delineation was a hardsell for some because people think Drainage Areas are already done in Canada, and for those who know better and need station-DA "catchments", they seem resolved to delineating station-catchments adhocly as needed for their scientific studies. In retrospect, our project has seen success because
  - Key champions(*who happen to be managers*) kept up their support
  - simply good like-minded people in the Working Group both within EC but more importantly outside our Department continued their participation and support
- Reaching Level 1 Beta is only first step, we need to remove "beta" and publish all Level 1 station-DA polygons to public web…hopefully soon to come
- To remove "beta", the next stage will be QC'ing the Level 1 Beta, which includes:
  - In-house QA Screening
  - Reconciling new GIS-generated DA polygon Areas into WSC Hydat/Hydex database

Conclusions

- Looking back, we are now **78% complete for Canada** (1745 of 2230 station-DA polygons completed) for Level 1 Beta, **so how well did we do?**
  - A look at Percent Area Difference to WSC Hydat/Hydex Database published DA values for comparison:
    - **80% of Level 1 Beta station-DA polygons** are **< 5% area difference** to currently published station-DA values
    - **5% of Level 1 Beta station-DA polygons** are **between 5-10% area difference** to currently published station-DA values
    - **7% of Level 1 Beta station-DA polygons** are **> 10% area difference** to currently published station-DA values
    - **8% of stations** have **no published DA value** in Hydat/Hydex. But now we have both a DA value and a DA polygon!
- We are close but not yet finished!

THANK YOU

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