

September 15, 2017

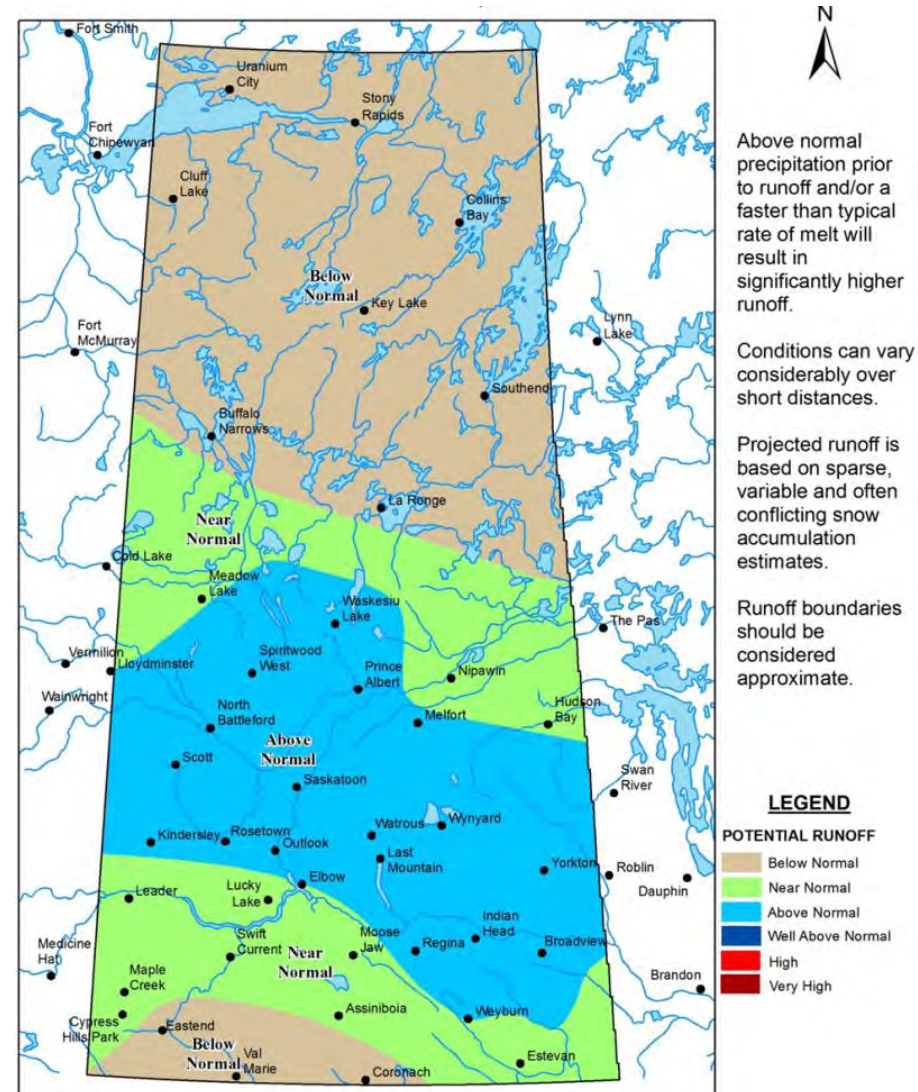
Presentation on Saskatchewan's Flow Forecasting and Operations Planning

Global Water Futures
Integrated Modelling Program for Canada
Kick-Off Workshop

Curtis Hallborg, P,Eng.
Manager of Flow Forecasting & Operations Planning

Flow Forecasting and Operations Planning (FFOP)

- **We provide:**
 - General flow and water supply forecasting services for the province.
 - More detailed forecasts for select locations.
 - Operating directives for the WSA's major reservoirs and the Qu'Appelle System.
 - Guidance on other systems.
- **Forecasting Products:**
 - Conditions at Freeze-up Report
 - Spring Runoff Outlooks
 - Saskatchewan River Basin 10-day Forecasts
 - Monthly Water Supply Outlook and Conditions Report



Current Tools - Saskatchewan River System

- Advantage of several days travel between alpine headwaters in AB and the SK Border
- No snowmelt or rainfall runoff modeling.
- Route daily observed flows in a spreadsheet.
 - Simple time lag method used with some smoothing.
- Liaison with SaskPower on operational decisions.
- Use HEC-RAS models to predict changes in stage at critical locations.
- Alberta Environment will provide their model outputs for large events.



Current Tools - Prairie Runoff

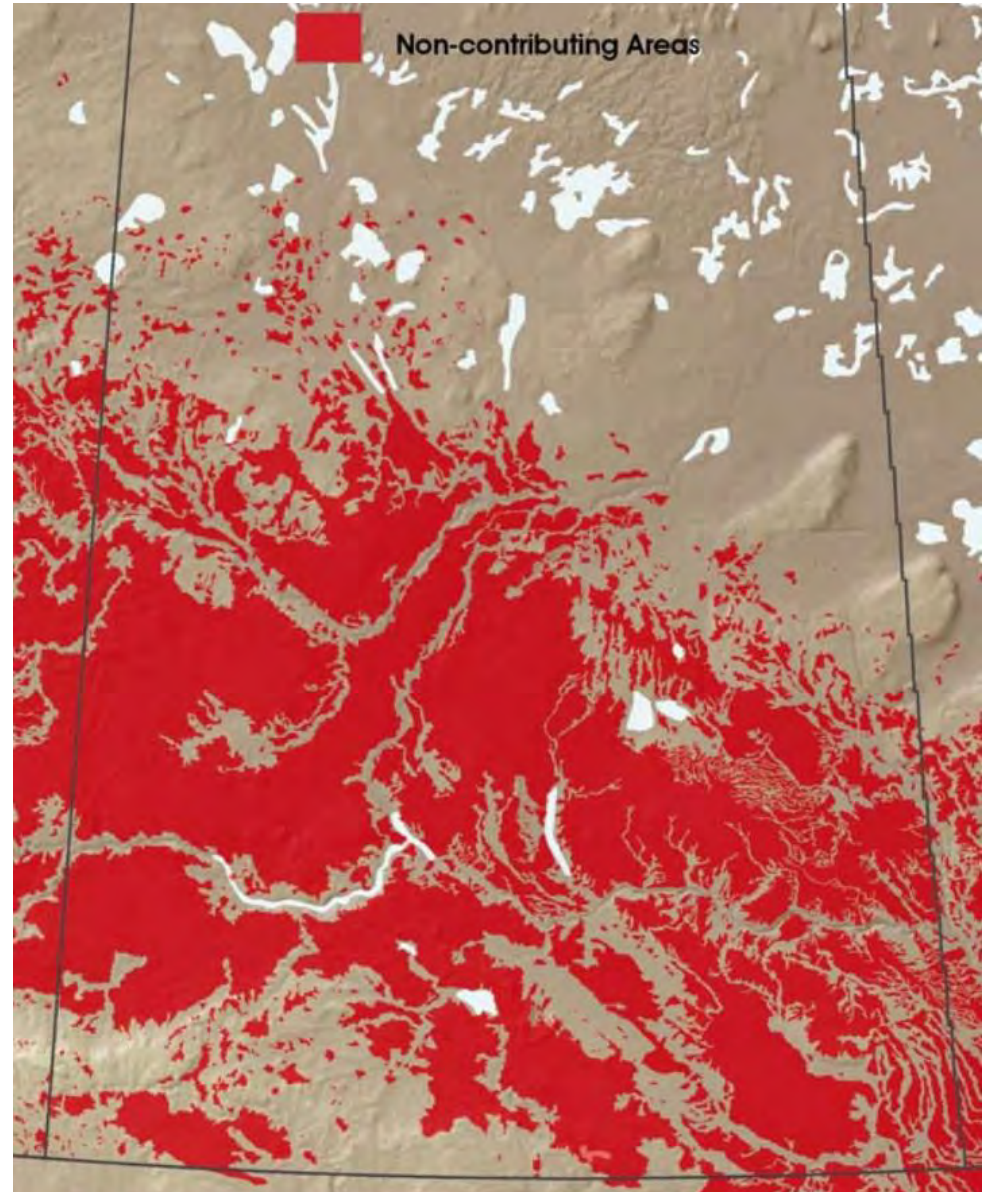
- No rainfall runoff modelling, just snowmelt
- Use simple empirical/regression relationships between snow water equivalent, antecedent conditions, and runoff volume and peak flow.
- May look at historically observed events to ballpark rainfall runoff events.
 - Very difficult due to basin 'memory' and spatial variation of precipitation inputs and antecedent conditions.



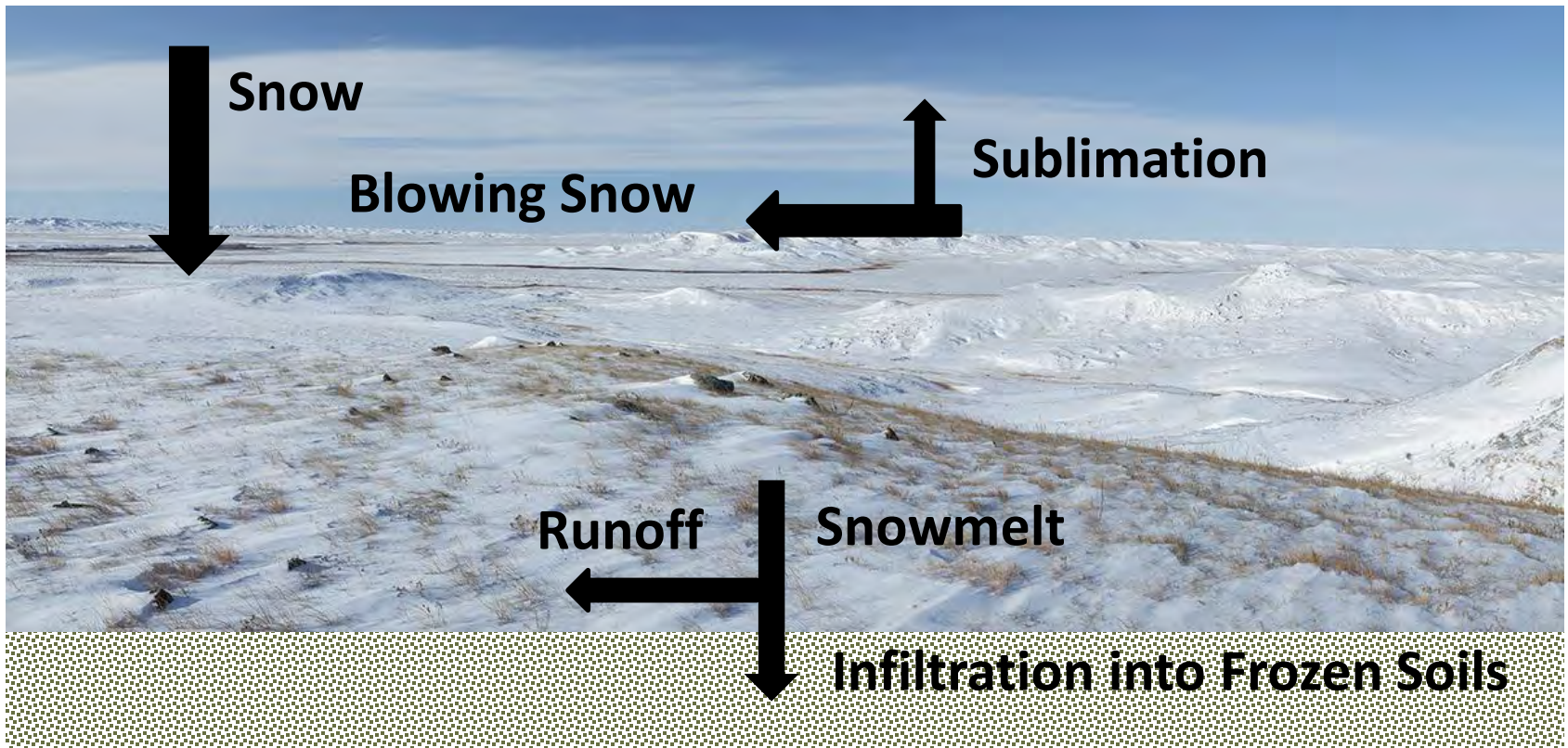
US Fish and Wildlife Service Map

Biggest Challenge

- Due to our generally flat post glacial landscape that is dominated by small internally drained regions, we have dynamic contributing drainage basins that are controlled by fill and spill processes.
- Off the shelf hydrologic models developed elsewhere in the world typically don't work in the Prairie Pothole Region. They want to treat drainage area as a fixed variable and expect a basin to have a stream.



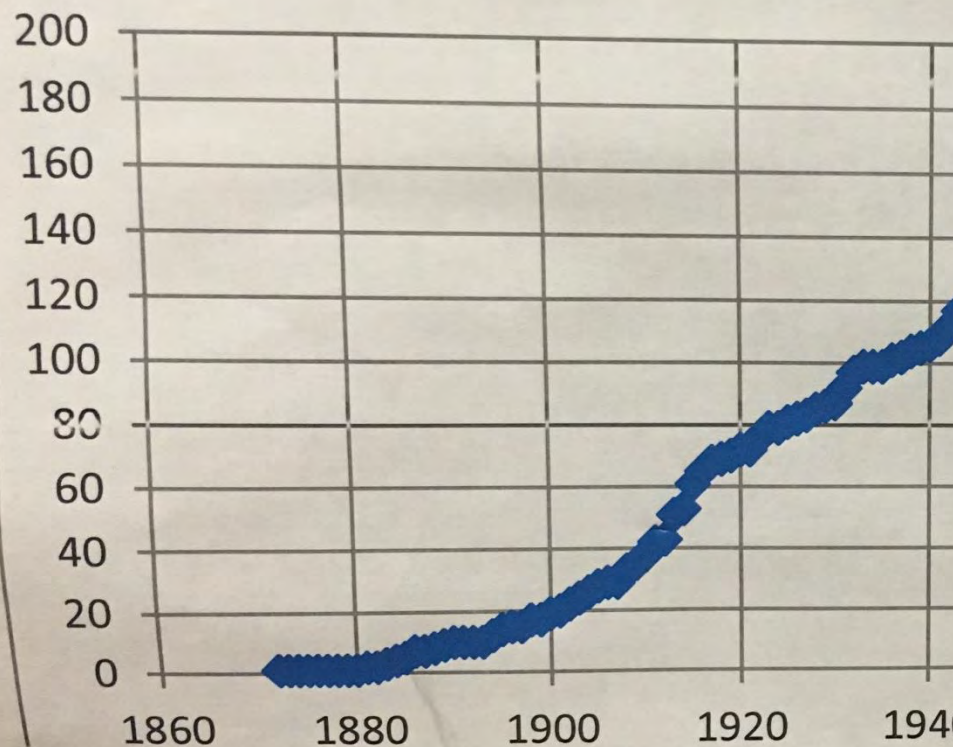
Challenges from Cold Region Hydrologic Processes



- Most hydrological models omit cold region processes altogether or take an overly simplistic approach to handling them.

Sparse Data Networks

Number of climate Stations
precipitation data - Prair



Prairies is the graveyard of hydrologic models



- There is hope through the development of modules to better handle prairie and cold region processes.
- Much of this is due to research at the U of S. over the past few decades.



Recent Changes in Flood Event Generation

- Prior to the summer of 2010, most major historical flooding events in the province had been snowmelt runoff generated.
- Beginning in 2010, we have experienced several large rainfall runoff generated floods:
 - **Maple Creek – June 2010**
 - **Good Spirit Lake – July 2010**
 - **Souris River – June 2011**
 - **East Central Sask. – June/July 2014**
 - **Arborfield – July 2016**
- Permanent shift in our hydroclimate???

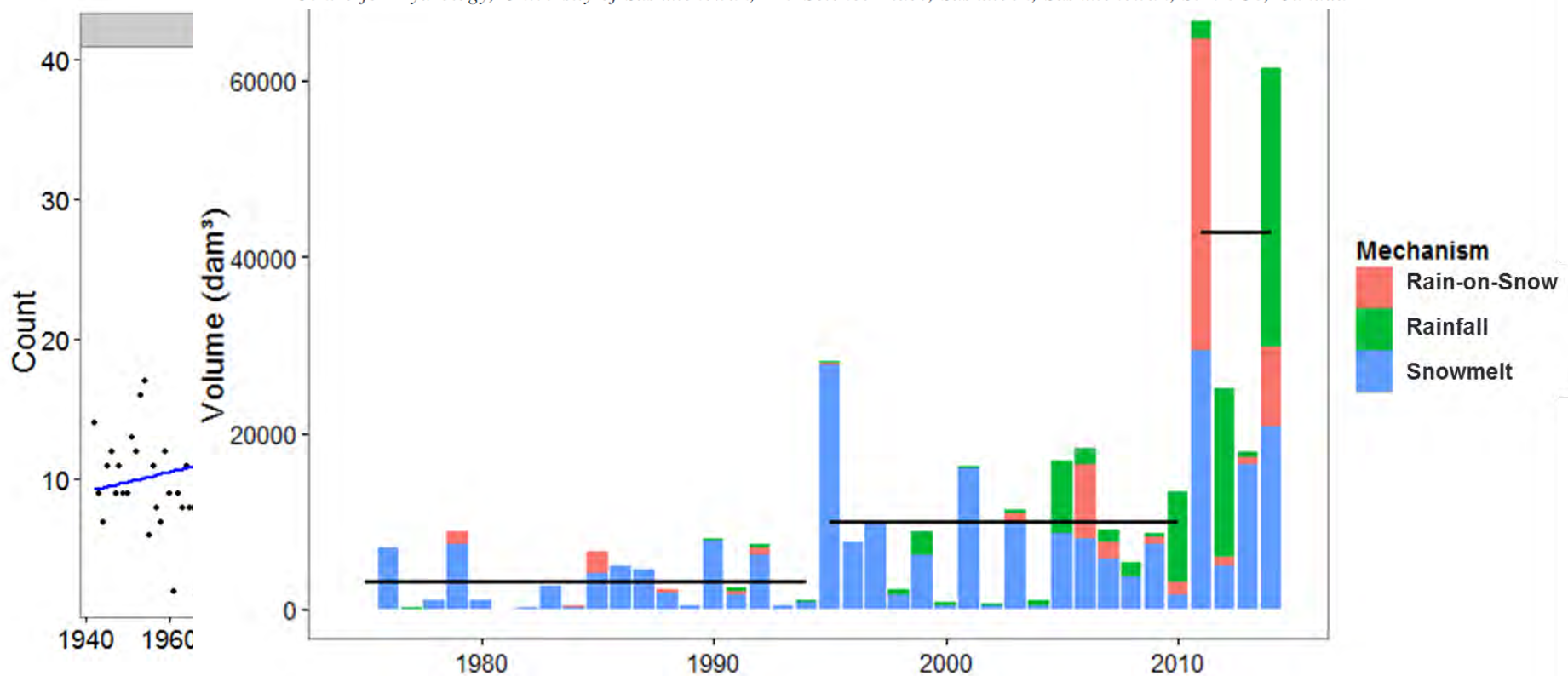
Why Do we Need to Worry About Rainfall Runoff?

- Increase in multi-day rainfall events and more rainfall runoff.

Hydrological regime changes in a Canadian Prairie basin

Stacey Dumanski, John W. Pomeroy* and Cherie J. Westbrook

Centre for Hydrology, University of Saskatchewan, 117 Science Place, Saskatoon, Saskatchewan, S7N 5C8, Canada



What is the Province Doing?

action area 5.1

**flood damage prevention and emergency response
in developed areas**

actions

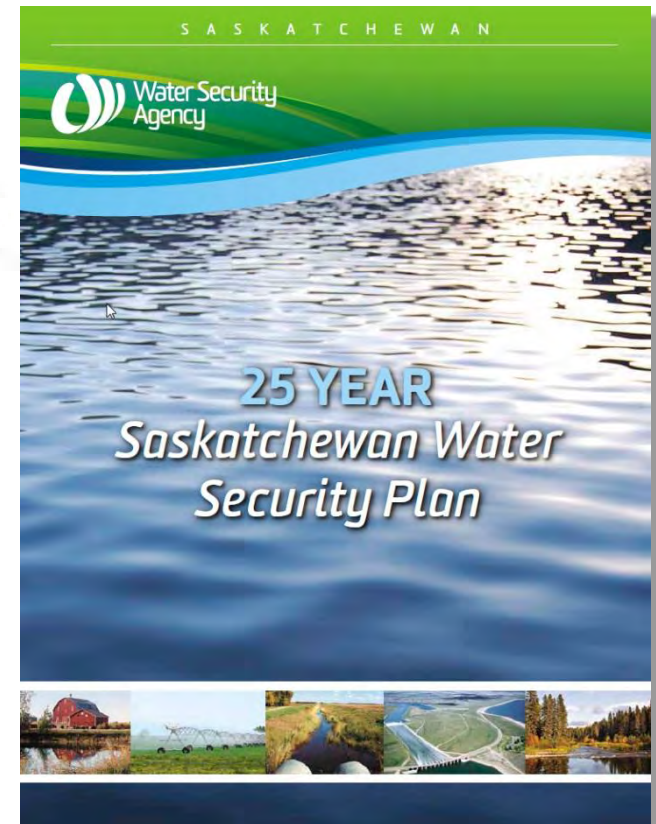
a. Develop improved flood forecasting tools (2016)

Step One

- New funding to flood forecasting in the 2014 Provincial Budget to improve flood forecasting functions, enabling the creation of a dedicated flood forecasting unit

Step Two

- Seeking expert advice



University of Saskatchewan Consultation

Key Points

- Most existing hydrological models do not include cold region processes.
- Even fewer models are able to simulate the fill and spill processes of the prairies.
- A physically based model is suggested rather than a statistically or conceptually based model.
- A separate reservoir simulation model is likely required.
- A data handling platform will likely be required.

Recommendations for Saskatchewan Hydrological Modelling

A Report to the Saskatchewan Water Security Agency

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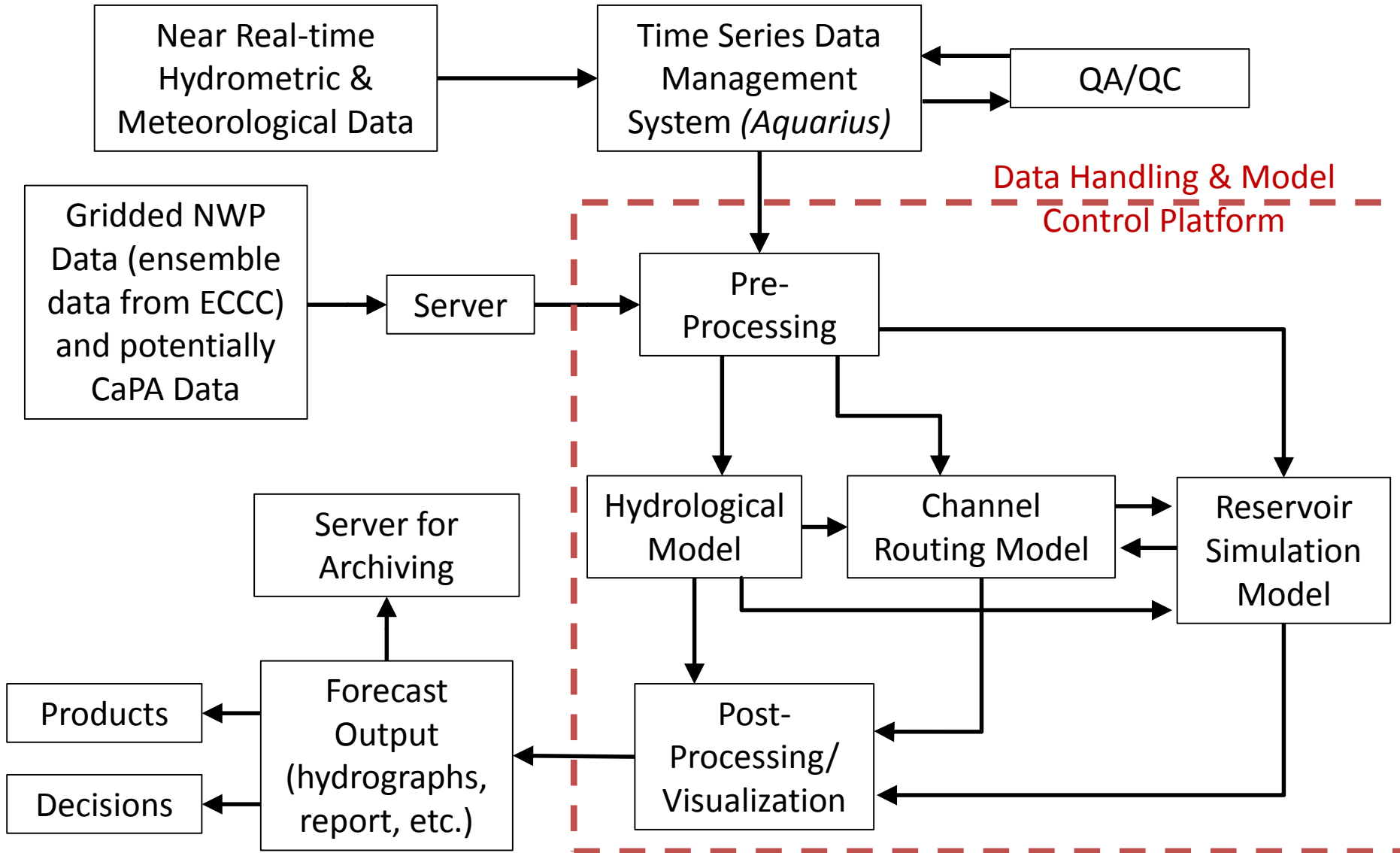
S7N 5C8

November 30, 2016



Global Institute for
Water Security

What a Modern Flow Forecasting System at the WSA Might Look Like



Final Thoughts

- **Stakes are High** - Property, Lives, and Reputations are on the line
- We have a real opportunity here to build a system that is state of the art to serve the citizens of Saskatchewan well.
- Developing a modern system will be very **challenging but possible**.
- **The system will not be perfect.**
 - *"Essentially, all models are wrong, but some are useful."* George Box

**The best time to plant a tree
was 20 years ago.**

The second best time is now.

