

DRAFT Minutes of the 105th Meeting   
held at the Office of the

National Oceanic and Atmospheric Administration’s

Great Lakes Environmental Research Lab

1. State Road, Ann Arbor, Michigan

# 1.0 Call to order

The Coordinating Committee held its 105th meeting on 14-15 November 2018 at the NOAA Great Lakes Environmental Research Laboratory in Ann Arbor, Michigan. Mr. John Allis called the meeting to order at 1:00 p.m.

# 2.0 Introductions

Mr. Allis initiated a round table of introductions. The list of participants for the meeting follows. Those marked with an asterisk beside their name participated by teleconference and webex.

**Committee Members**

|  |  |
| --- | --- |
| **UNITED STATES** | **CANADA** |
| John Allis (USACE), Co-chair | Rob Caldwell (ECCC) Co-Chair |
| Jesse Feyen (NOAA) Member | Mike Craymer (NRCAN) Member |
| Keith Kompoltowicz (USACE) Secretary | Aaron Thompson (ECCC) Secretary |

**Executive Support Group**

|  |  |
| --- | --- |
| Sandra Eberts (USGS) ESG |  |

**Subcommittee Members and Associates**

|  |  |
| --- | --- |
| Arun Heer (USACE) | Derrick Beach\* (ECCC) |
| Bryce Carmichael\* (USACE) | Dorothy Durnford (ECCC) |
| Cary Wong\* (NOAA) | Etienne Gaborit\* (ECCC) |
| Chris Fisher (USACE) | Frank Seglenieks (ECCC) |
| Christine Fisher\* (USACE) | Hafiz Ahmad\* (ECCC) |
| Dan Martin\* (NOAA) | Jacob Bruxer (ECCC) |
| Daniel Roman (NOAA) | Jamie Dickhout (ECCC) |
| Deanna Apps (USACE) | Janelle Laing\* (DFO-CHS) |
| Derek Cusimano (USACE)? | John Mercuri (DFO-CHS) |
| Don James (USGS) | Terese Herron (DFO-CHS) |
| Drew Gronewold (NOAA) | Yin Fan\* (ECCC) |
| Eric Anderson (NOAA) |  |
| Eric Tauriainen (USACE) |  |
| Jeff Oyler\* (NOAA) |  |
| Jim Noel (NOAA) |  |
| Joeseph Smith (NOAA) |  |
| John Ellingson (NOAA) |  |
| John Walker (USGS) |  |
| Josh Loewel (USGS) |  |
| Keith Koralewski\* (USACE) |  |
| Laura Rear McLaughlin (NOAA) |  |
| Lauren Fry (USACE) |  |
| Mary Westcam (NOAA) |  |
| Matt Mclerron (USACE) |  |
| Philip Chu (NOAA) |  |
| Tim Calappi (USACE) |  |
| Tim Hunter (NOAA) |  |
| Tom Weaver (USGS) |  |
| Zoe Miller (USACE) |  |

# 3.0 Review of draft minutes and action items of the 104th meeting held in May 2018 in Montreal, Quebec (Kompoltowicz)

There were no substantial revisions to the minutes discussed at the meetings. All action items from the previous minutes were addressed or are ongoing. Mr. Kompoltowicz will accept further revisions until November 30th after which the meeting minutes will be finalized and uploaded to the Committee SharePoint site at <http://boards.ijc.org>. Presentations for the 104th meeting as well as other meetings are archived on the Sharepoint.

# 4. Committee Governance (All)

## 4.1 Formalizing the Committee

John Allis introduced the topic and the motivation for formalizing the committee and reviewed the status of the Memorandum of Understanding document. Draft copies of the document were distributed at the meeting. The Committee intends to discuss the document with the Executive Support Group to determine their level of support. This could be done individually with the executives or collectively with the ESG. It was decided that a joint call with the ESG would be arranged to discuss.

ACTION - Schedule a call with the ESG before the end of the calendar year. Made copies available to Sandra and Arun. Arun noted that a multi-agency.

**Ms. Rear McLaughlin asked if there was any reference to what we actually provide to the CC? Is there a reference to the IGLD in the MOU? Perhaps that will bring the project to forefront.**

## 4.2 Changes to Committee and Subcommittee Membership

Sandra Eberts will replace Robert Mason as the ESG member for the USGS and Chris Marshall will be the ESG member for DFO/CHS replacing Denis Haines. Changes to the Hydraulic Subcommittee, Derrick Beach will replace Jeanette Fooks as the Canadian Subcommittee Chair. Eric Anderson from NOAA will be added to the hydraulic subcommittee. Tom Weaver indicated that the USGS membership on the subcommittee is still to be determined. For the Hydrology Subcommittee Vincent Fortin has left ECCC and will be replaced Etienne Gaborit. Aijun Zhang from NOAA was removed from the Subcommittee. For the Vertical Control – Water Levels Subcommittee James Wilcox has left ECCC and therefore will be taken off. Cindy Jarema will also be removed. Rob Caldwell asked if the members of IGLD update team should be listed and acknowledged. Terese Heron and Laura Rear McLaughlin agreed.

# 5. Full Committee Updates

## 5.1 IGLD plan

A substantive update on plans to update the International Great Lakes Datum was discussed and is reported on during the Vertical Control – Water Levels Subcommittee report.

## 5.2 GLAM update

Arun Heer explained the IJC has a Great Lakes Adaptive Management committee supporting its Great Lakes Boards of Control. GLAM is interested in the work that is going on with the Coordinating Committee in particular the hydroclimate work, i.e. coordination of precipitation, runoff, etc. GLAM have just completed a report on the high water level conditions that occurred in 2017 on Lake Ontario. GLAM is looking at quantifying the impacts on various stakeholders in the system including municipal and irrigation, hydropower, and recreational boating. The 2017 GLAM report was just released to the public. There will be two annexes to that report released soon. The main finding of the report was that Plan 2014 did not exacerbate levels on Lake Ontario over and above what would have happened if the system was regulated using Plan 1958D. It is difficult to evaluate the impacts on some sectors. Additional performance indicators may be required. The GLMA efforts are long term.

# 6. Report from the Hydraulics Subcommittee

## 6.1 St. Clair and Detroit River flow coordination

### 6.1.1 History of Gauges and Ratings – (James)

Mr. James provided a historic summary of the ADVM gauges and the respective index rating developments on the Great Lakes connecting channels, specifically those on the St. Marys, St. Clair, and Detroit Rivers. The summary included activities from October 2008 to October 2018 and included details on the site selection process, data collection efforts, rating developments, and rating refinements that took place during this time period. Mr. James emphasized the difficulties that were encountered when working on a system as large as the Great Lake’s Connecting Channels, admitting that much of what was true for developing ratings on smaller rivers was not for the larger systems. These realizations made it necessary to tap into the expertise throughout the USGS to help identify issues and to make refinements to the processes for developing index ratings on large river systems. Through trial and error and many refinements over this ten-year period, Mr. James reported that there is now a high level of confidence in the index ratings. He reported that data used to create the ratings for the Detroit and St. Clair Rivers have been recomputed using WinRiver 2.18 and Qrev 3.43 and the new multi-linear ratings have been peer reviewed by the USGS, ECCC, and USACE.

### 6.1.2 Status of IVQ Ratings – (Loewel)

Mr. Loewel provided a summary of the re-computation of flows of the St. Clair and Detroit Rivers from 2008-2017. He showed that discharge measurements taken during 2017 and 2018 were plotting increasingly distant from the existing single velocity ratings and that this is likely due to the increased water levels during this period. At this point, a synoptic study was completed using a 3 day comprehensive data set that was collected on the rivers using crews from the USGS, USACE, and ECCC. Results showed that velocity AND water levels better defined the computation of discharge. Mr. Loewel stated that changing from a single to a multi-linear regression has lowered the departure of measured versus rated discharge, and adds another variable to the computation for future changes in water levels. With all measurements post processed through Qrev 3.43 to create a standardized data set, differences in pre and post discharge values were calculated and found to be minimal. Mr. Bruxer questioned the confidence that the team had in the new multi-linear ratings, that we have been confident in the past only to find problems. Mr. James replied that the way that the data is distributed gives him confidence that these are now good ratings. He stated that there is nothing further that can be done right now to make these ratings better and that he used large blocks of data for verification with all data plotting well.

### 6.1.3 Final Steps for Flow Coordination – (Calappi, Loewel)

Mr. Loewel provided an overview of how stage-fall-discharge rating equations are used to fill missing IVQ record. He described the frequency of missing IVQ data and compared it to the overall length of record. Minimal data outages exist; however, a single equation is used to fill all instances of missing record. Given winter stage-fall-discharge ratings are established, specifically for the occurrence of ice in the channel, one final pass through the data, specifically targeting winter outages of the IVQ, is recommended.

Additional analysis and multiagency collaboration is required for the Detroit River, specifically for winter stage-fall-discharge ratings, fewer gauge pairs on the Detroit River limit winter rating options compared to the St. Clair River.

## 6.2 Other continuous data production – status of gauges, preliminary data models

### 6.2.1 St. Marys River IVM – (James)

Mr. James reported that all 110 measurements at the St. Marys River ADVM location have been reviewed and new multi-linear ratings have been developed. Mr. James also noted that a new cross section is being utilized to collect measurements at and is the same location as the USACE and ECCC model section. Work still to be completed for this index rating include checking the period of record for migration errors and filling any gaps that he data set may have. Daily values will be compared between data sets with hourly hydro data being used to fill in missing data. Once the measurement file has been updated the analysis will be internally reviewed by the USGS and then externally by the USACE and ECCC.

### 6.3.2 Upper Niagara IGS – (Devries)

Mr. Thompson provided an update on the ECCC ADVM located in the Upper Niagara River. He reported that a retaining wall upstream of the meter collapsed into the river, changing the cross section and flow patterns in area and necessitating a change in location for the meter. Mr. Thompson noted that a new location had been identified near International Railway Bridge where a bottom mounted system will be installed. Once installed measurement collection for the new rating will begin.

### 6.3.3 Lower Niagara IVM – (McClerren)

Mr. McClerren presented an update on the lower Niagara index velocity meter, showing a location map of the meter and close4. proximity to Lake Ontario. Mr. McClerren noted that there have been 45 1-hour measurements collected to date that are being used to create the preliminary rating. He also stated that there is a still a need to capture measurements at the lower end of the curve and a set of overnight data that captures evening power plant operation.

### 6.3.4 St. Lawrence IVM – (McClerren)

Mr. McClerren presented an update on the St. Lawrence River index velocity meter showing a location map and noting that the meter is up and running and transmitting data. There have been 4 sets of measurements collected to date and the Detroit District is currently coordinating with USGS New York on collecting additional data. Mr. McClerren stated that he also reached out to USGS expert Dave Mueller for advice on boat speed. Due to the width of the measurement cross section and the time required to collect data, we inquired as to how fast you can drive the boat and still collect reliable data. It was determined that the increased speed at which the data was being collected was appropriate for this location and would have no negative effects on the results.

## 6.4 Data Collection Efforts: all channels

### 6.4.1 St. Lawrence – Long Sault Spillway – (McClerren, ECCC)

Mr. McClerren reported that USACE and ECCC field crews made measurements at the Long Sault spillway while the power plant was spilling. This was done to ensure ratings used by the power companies were accurate. Draft results that were presented showed estimated flow by the power plant was greater than flows measured by the field crews. While the results are still being analyzed it was suggested that the field crews be ready to collect additional data in the future when the opportunity presented itself.

### 6.4.2 2018 Board of Control Measurements – (McClerren)

Mr. McClerren reported that the USACE and ECCC crews collected discharge measurements at the International Railway Bridge and Welland Canal the week of 14 May. These measurements which are required by the Niagara Board of Control and collected on a 3 year cycle are used to verify ratings at the head of the Niagara River.

### 6.4.3 2019 Board of Control Measurements – (McClerren)

Mr. McClerren stated that USACE and ECCC crews will collect discharge measurements at the Niagara River Ashland Ave section. The Ashland Avenue gauge rating (AAGR) is used to determine the flow over Niagara Falls for purposes of the 1950 Niagara Diversion Treaty.

Mr. Caldwell suggested that Long Sault be added to our regular set of measurements. The field crew will coordinate with the St. Lawrence Board as far as letting them know when the crews will be in the vicinity.

## 6.5 Hydraulic Modeling

### 6.5.1 St. Marys River and Comp Works – (Calappi)

Dr. Calappi presented modeling results on the St. Marys Rapids Gate Optimization model. Modeling efforts focused on a series of gate movements at various gate starting points. Graphics were presented that showed the effects that these gate movements had on velocities in the St. Marys Rapids. Similar model runs are ongoing. It was agreed that the Superior Board needs to be involved to help determine “where do we go from here?”

Mr. Allis asked if there were ongoing efforts to help continue to answer the conveyance change questions in the St. Clair River. Mr. Calappi replied and gave an update on the sub-bottom data collected in St. Clair delta and how this will be used to help build a sediment budget of the river. He is currently working on the methodology to do this. Mr. Calappi also briefed the group on an X-band radar system that is currently set up on head of the river. This system will help us learn how sand moves through the system and to also help in determining a transport rate of the river.

# 7. Report from the Hydrology Subcommittee

## **7.1 General**

### 7.1.1 CC Data on website

Dr. Fry presented the current state of the Hydrology Subcommittee data sources portions of the Coordinating Committee website which now include the Beginning of Month Water Levels, historical averages of Beginning of Month Water Levels, Monthly Mean Water Levels, Historical Average of Monthly Mean Water Levels, and Monthly Residual Net Basin Supplies. Also presented were the headers for each of the files and corresponding French versions. Ms. Rear McLaughlin noted that the full name of NOAA as written in the header was incorrect and Mr. Caldwell questioned if there should be more meta-data included in the header of the files

## 7.2 Water levels

### 7.2.1 Available datasets

Dr. Fry presented the table of available water levels data and noted that the FVCOM is now listed as a possible data source in the future.

### 7.2.2 Update on water levels and hydrological conditions

Ms. Dickhout gave a presentation on the recent hydrological conditions in each of the Great Lakes basins, focusing on the 6 months since the last meeting. Highlights for each lake are: Lake Superior level is very high, Beginning of Month level for November as the fifth highest on record, the big storm in October caused rapid rise in lake levels. Lake Michigan/Huron is above average and similar to last year since the summer. Lake Erie is very high, Beginning of Month level for November is second highest on record and the highest since 1986. Lake Ontario is near average, peak in 2018 was 58 cm less than 2017 peak, outflows remain high but less than 2017. Lake St. Lawrence is well below average because of outflows from Lake Ontario with record lows monthly means in April and September.

### 7.2.3 Water level gauge network for computing lake-wide averages (Fry/Bruxer/Seglenieks)

Dr. Fry presented results of an analysis looking at the possibility of using up to 8 gauges on Lake Erie instead of just the current 4. Statistics were computed using various gauge combinations resulting in an average bias difference of 0.2% between 4 and 8 gauge. It was suggested that perhaps there is no need gauge pairing logic but that we may be able to use all gauges available at any time.

## 7.3 Net Basin Supplies

### 7.3.1 Available datasets and coordination of NBS

Dr. Fry presented the table of available data and noted that the L2SWBM dataset is now listed as an available dataset.

### 7.3.2 Presentation on recent NBS comparison

Dr. Seglenieks presented the recent NBS values showing the range of the model estimates and the 95% range of statistical model. Most notable is the May value where the USACE-AHPS was well above the others. Further analysis was presented that showed this was a result of the runoff value where the AHPS value was much higher than the other two models. Interestingly, the statistical model also brought the range higher to meet the values from the AHPS value.

Doing a leave-one-out analysis, it was shows than when not using the AHPS value the statistical model range now covers the other two models. Looking at the daily runoff values there seems to be rise in the AHPS runoff value during April that is not seen in the other models or streamflow data from that time period. This analysis was done as an example of how the statistical model can be used to examine differences in the model. Dr. Seglenieks stressed that we are just starting to make these kind of analysis with the statistical model and we will need more experience in using the model and looking at the results before we can start drawing conclusions. But this kind of analysis does show promise of one day using the statistical model to agree upon coordinated values.

Action Item – Mr. Allis asked the Hydrology Subcommittee to develop a plan on how we will coordinate NBS, perhaps using the L2SWBM.

## 7.4 Evaporation

### 7.4.1 Available datasets

Dr. Fry presented the table of available data and noted that the L2SWBM dataset is now listed as an available dataset.

### 7.4.2 GLEN and vessel-based measurements

Ms. Fitzpatrick showed the current network and a sample of the data collected, they are also looking at processing data faster (only up to 2016 now), two papers now published on verifying data. Vessel data (Whitefish Bay) has been collected but not yet processed.

Mr. Allis asked how to compare data? Dr. Durnford noted the she is planning to incorporate GLEN data to compare to her models.

Dr. Gronewold mentioned that he wants a commitment and decision about making these stations operational, Mr. Bruxer asked how to do this. Jessie answered that this should be brought to steering group, maybe send letter of recommendation, however input is needed from the user community.

Action – Hydrology Subcommittee to document the benefits of these GLEN stations and bring forward to the Committee to discuss with the ESG.

### 7.4.3 FVCOM

Dr. Anderson gave a presentation. They are replacing current system GLCFS system (13 years), now have GLOFS and are upgrading to FVCOM (200 m coastlines, 30m tributary resolution, twice a day, forecast out 60 hours) calculating water level, lake level, ice. They have some validation using buoys, thermistor chains, and satellite based information. Ice forecasting is being evaluated, showing good model skill in Lake Michigan/Huron. Good evaluations with GLEN stations as far as latent heat flux and sensible heat flux. Putting the data out experimentally.

Mr. Thompson asked about Lake Ontario grid asking to see where it ends, Dr. Anderson answered that is now ends at Kingston.

## 7.5 Runoff

### 7.5.1 Available datasets (Fry)

Dr. Fry presented the table of available data and noted that the L2SWBM dataset is now listed as an available dataset.

### 7.5.2 GRIP-E update (Gaborit)

Dr. Gaborit presented on the first GEM-Hydro results for the GRIP-E project. He showed that with tuning the Nash-Sutcliffe coefficient increased and the bias was reduced.

### 7.5.3 Streamflow forecast updates

Dr. Gaborit presented that they are working on a new streamflow forecasting system called HRDLPS (which is different from WCPS) as it uses SVS land surface scheme not ISBA, in analysis and forecast mode. They are working toward implementing it in GEM 5.0.

### 7.5.4 National Water Model

Dr. Gronewold informed the group that the National Water Model has been extended to cover the entire Great Lakes basin using a consistent hydrographic dataset for the Great Lakes basin. They are working on installing WRF-Hydro on regional super computers and testing it within GRIP-E.

## 7.6 Precipitation

### 7.6.1 Available datasets

Dr. Fry presented the table of available data and noted that the L2SWBM dataset is now listed as an available dataset.

### 7.6.2 GEM/CaPA reanalysis proj. and ensemble version of CaPA

Dr. Durnford Started by March 2019, probably won’t get started till after summer. Ensemble version of CaPA will give idea of reasonable values.

### 7.6.3 Update on merged MPE/CaPA anomalies

Dr. Noel presented that the IWI has funded a study to create anomalies (2003-2017) and it will be completed by June 2019. They will add netCDF to output choices instead of just CSV. They are working on backup redundancy plan at another NOAA climate center. Improvement in results using merged CaPA/MPE product compared to 95% stat model interval for all lakes but Superior.

## 7.7 NBS and water level forecasting

### 7.7.1 Available datasets

Dr. Fry presented the table of available data and noted that the 5 year forecast for power entities is now listed as an available dataset.

# 8. Report from the Vertical Control - Water Levels Subcommittee

## 8.1 Remembering a colleague

Jeff Oyler reported that on August 24 we lost a mentor, a colleague, and a friend, Dave Rigney. Please keep him in your thoughts.

## 8.2 Committee Overview Summary

Ms. Rear McLaughlin reported that the Vertical Control – Water Level Subcommittee met twice (in May (in person) and October over teleconference) since the last Coordinating Committee meeting in Montreal and they are meeting again today in person. She also reported that the working groups have been meeting regularly. The Outreach work group (WG) has met twice since May, the Low Water Datum WG met, the Binational guidelines for GNSS surveys WG meets every other week. The Seasonal Gauge WG has removed seasonal gauges for the year, the Gauge Histories WG has a mock-up of the histories reports and will meet in December. The standard operating procedures for seasonal and permanent WL gauges WG will meet in December. She also reported that another working group for data processing will be created.

Ms. Rear McLaughlin noted that a cost estimate has been compiled for the IGLD project. The Executive Committee asked that it be refined to include only what we need for the update (incremental costs), not what is covered under base funds.

Dr. Roman and Mr. Véronneau continue to work on geoid error analysis using leveling, GNSS and water level data and will report on that later this morning.

The subcommittee also intends to engage the IJC for possible funding through the IWI initiative. The plan is to approach the committee with a letter explaining why funding from IJC is important. Next call for proposals is in the spring and we are aiming for a submission then.

Lake Champlain will be included and the subcommittee is still formulating an approach to including it.

The subcommittee is also working on determining the actual benchmarks and water level gauges that are NECESSARY for the update from other agencies and entities, not just nice to include.

## 8.3 IGLD Working group updates

### 8.3.1 Seasonal gauging – (Herron/Rear McLaughlin)

Ms. Rear McLaughlin noted that out of 140 suggested seasonal gauge locations, NOAA will most likely occupy about 60 total. 20 stations were installed in 2018. NOAA will install about 21-24 locations in 2019, depending on proposals. Stations were paired with Canada during FY18 and the same will occur for FY19 gauges. NOAA completed analysis on stations installed last year with GLRI funds and plan to present the work at the American Geophysical Union conference in December in Washington, D.C. NOAA will perform a 4-hr GNSS at installation and a 24-hr occupation on removal.

Ms. Herron reported all 14 CHS seasonal gauges have been removed. She noted that instruments are calibrated on install/removal and 1-3 times during season. A 24-hr GNSS occupation was completed on install and at selected sites GNSS occupation was re-done in the fall (based on NRCan processing results). CHS has tentatively 11 sites planned for 2019 and they plan to do short (4-6 hour) GNSS occupation on install and 24-hour on removal.

### 8.3.2 GNSS Surveys and Guidelines WG – (Craymer/Roman)

Dr. Craymer reported that the Working Group (WG) meets biweekly. It began with preparing guidelines for GNSS surveys at seasonal gauges and for the IGLD GNSS campaign in 2020. An editing team has been formed to complete the guidelines before the 2019 field season begins. Dr. Craymer also reported that a letter was prepared on behalf of the CC requesting NOAA CO-OPS and CHS perform 24-hr GPS occupations during removal of the season gauges in the fall. This follows the requirements in the guidelines. Both CO-OPS and CHS are now performing 24-hr occupations during removal.

The WG has also been analyzing the GNSS data collected at CHS seasonal gauges during both installation and removal to identify benchmarks poorly suited for GNSS observations. The WG identified a few sites that needed new benchmarks due to signal obstructions from mainly trees. CHS and CGS are in the process selecting new bench marks at a few of their sites for the 24-hr occupations during gauge removals. The WG will analyze the GNSS data collected at CO-OPS gauges as well.

The WG has more recently been focusing on planning for the major GNSS campaign in 2020 by first identifying and prioritizing the gauges to include. In addition to the permanent and seasonal gauges, the WG will be contacting the power corporations, Seaway authorities and other entities to request their participation. To support this effort, the GNSS and Outreach WGs are planning webinars to provide information on the datum update and the work that needs to be done for the GNSS campaign. CGS and NGS are also planning to provide GNSS training for participants in the campaign. The cost of the campaign is still being determined.  Dr. Craymer noted that, at the end of the update, more general guidelines will be prepared to assist with determining heights in the new geoid-based datum using GNSS for those that don’t participate in the 2020 GNSS campaign and for future monitoring of GNSS bench marks.

The Executive Committee asked if there were concerns regarding the GNSS method for determining heights in the new datum. Dr. Craymer pointed out the longer (24-hour) occupations can provide higher absolute accuracy with respect to the datum. However, the relative accuracy between sites is even higher with simultaneous 24-hour GNSS occupations as they can be adjusted together to remove any common sources of error.

### 8.3.3 Geoid update - (Véronneau/Roman)

Dr. Roman reported that he and Mr. Véronneau continue to refine the geoid update. Mr. Véronneau looked at 7 approaches in calculating mean water level and the best approach needs to be determined.

* + 1. Full 18.6 year tidal cycle (224 months)
    2. 7 year average centered at 2014 (Jan 2011-2017; 84 months)
    3. A 7-year average centered at 2014 using only summer months (June, July, August and September) (28 months)
    4. A one-summer average on the year of the GPS campaigns (4 months)
       1. Year 1997
       2. Year 2005
       3. Year 2010
       4. Year 2015

Mr. Véronneau noted a possible issue with Point Iroquois data as it’s 23 cm different. Mr. Véronneau also noted that geodesists were coming to an agreement to develop a common geopotential model.

Dr. Roman reported that minimizing errors will help determine the lake topography. He noted that as WL changes, the topography may change. Superior is the biggest issue. There is a need for quality in levelling, WL and other measurements as the key to defining water topography.

### 8.3.4 Low Water Datum - (Beach/Roche)

Mr. Beach reported that the WG met Feb 27, 2018 to develop a framework for calculating LWD. The WG is putting together references to support choosing a methodology. They are currently drafting up a discussion paper for the WG with the methodology to use. Mr. Beach and Ms. Roche (who is out on maternity leave) are confident they have a simple and quick way forward. The co-chairs will work on getting the white paper out to the task group in coming months.

### 8.3.5 Outreach – (Herron/Rear McLaughlin)

The outreach WG has met and is working on a one pager to give to stakeholders as well as a GIS web story with IGLD GNSS and BM information. Webinars are being planned for Jan/Feb 2019 about IGLD and the update and GNSS campaign.

## 8.4 Semi-Annual reports from both water level office on gauging networks and annual inspections

Ms. Rear McLaughlin gave an update of the NOAA water level network. USACE is still in the process of taking over the Blue Water Bridge ADCP. Field inspections for the year will be completed tomorrow. There will be no complete station maintenance deferral for fiscal year 2019. At 34 stations, they will receive limited stability leveling and basic maintenance checks only (station visit not to exceed 1 day). Remaining 19 stations will receive full maintenance visit. Great Lakes Online website will sunset on 12/4/18. All data currently available on GLOL will be available on CO-OPS website. Any comments can be sent to [nos.co-ops.commsteam@noaa.gov](mailto:nos.co-ops.commsteam@noaa.gov). Marblehead received a microwave water level sensor during the 2018 scheduled maintenance visit, and a dual pressure system will be added during the 2019 visit. The data will be compared and if successful will eventually replace the station that is showing beginning signs of failure.

Ms. Herron gave an update on the CHS water level network. She noted that up to 20 stations are now getting cell over IP in real time. There is a national upgrade underway to run the same equipment and same sensors across the country. Some challenges with this as one size (infrastructure and electronics) does not fit all. Great Lakes non-tidal requirements are different. Annual inspections were completed at all 34 stations. Issues at Bar Point with intakes have been investigated and will require operational changes. Michipicoten is on the schedule for replacement in 2019. Burlington has issues with organic matter in intake and well, having to clean every 2/3 years. Location is in too shallow an area, not top priority to relocate as other gauges are more critical, plan for several years down the road. Sault Ste. Marie had an issue with bats after the roof developed a hole this has been cleaned up by an environmental company. Port Weller is experiencing erosion in back yard, currently working with DFO Real Property to get shoreline protection. CHS is nationally working to develop a database and data management system to have predictions, observations, forecasts, and metadata on one database. The goal is to roll out by January 2019.

## 8.5 Semi-Annual reports from both Geodesy offices on CORS and CACs (Craymer/Roman)

Drs. Craymer and Roman reported on the status of the CACS and CORS at Great Lakes gauging stations. There are currently a total 13 Great Lakes CACS stations in Canada, including Pointe-au-Pere, that are operated jointly by CHS/CGS. Six of the CACS were upgraded from GPS-only Trimble NetRS receivers to GNSS-capable Trimble NetR8 or NetR9 receivers. In the U.S., there are a total of 14 Great Lakes CORS stations. Seven of those are in Michigan where the Michigan DOT has taken over their ownership and operation and has upgraded all from GPS-only Trimble 5700 receivers to Leica GNSS receivers. They have plans to install four more new CORS in Little Rapids, Menominee, Holland and Ft. Wayne. CO-OPS/NGS has also upgraded their Trimble 5700 receivers to GNSS-capable Septentrio PolaRx5 receivers at six of their seven CORS.

Both Canada and the U.S. are planning to keep their existing GPS antennas to maintain continuity in the CACS/CORS time series for more accurate velocity estimation but will consider upgrading later. Dr. Craymer explained that replacing an antenna usually introduces a vertical offset in the time series that would reduce the accuracy of the velocity estimation. Although neither CGS nor NGS are processing GNSS data yet, Dr. Craymer reported that the Bernese GNSS Software used by CGS is capable of processing GNSS but that they are still investigating the proper processing methodology. CGS is also testing the mixing of different types of antennas with different kinds of receivers looking for any biases.

Dr. Craymer reported that CGS has used all CACS, CORS and high accuracy GPS campaign data in the northern half of North America to compute a crustal velocity model (grid) for the entire region. The vertical component used a GIA model to more accurately interpolate between the sparsely distributed CACS stations in Canada. The velocity model is used to propagate coordinates from one epoch to another (usually to some adopted reference epoch). CGS is planning to update their velocity model next year using data up to the end of 2018, some commercial RTK stations to densify the network of CACS in Canada, and newer GIA models. Dr. Roman noted that NGS is completing their “repro2” reprocessing and generating new coordinates and velocities for of all of their ~2000 CORS stations. Once completed, they will reprocess all of the IGLD campaigns. In the meantime, they are collecting leveling ties between the GPS bench marks and the gauge reference mark. Dr. Roman reported are also making plans to develop a crustal velocity model.

## 8.6 Signing of IGLD document

The VC-WL subcommittee feels the Executive Support Group should sign off on the IGLD plan in order to give it more ‘clout’ and show support. Questions remain whether all the agencies are going to sign. Almost all agencies are involved or will be involved in the update. The plan only says ‘this will happen as resources are available’ and doesn’t bind any agency to specific requirements but will allow agencies to take this document to upper level management to apply for funding. This would be consistent with the Coordinating Committee’s role to make recommendations and give advice on how to deliver on projects. The Executive Support Group can sign off to acknowledge that this is the joint plan that we’ve put together.

**Action** items:

1. Get ESGs to sign to IGLD document
2. Separate regular maintenance costs from incremental IGLD update costs

# 9.0 Report from the Coordinated Great Lakes Regulation and Routing Model Update Subcommittee

Zoe Miller from the USACE provided a presentation on work underway to update the Coordinated Great Lakes Regulation and Routing Model. The model is a tool to simulate the water levels and outflows of the Great Lakes given net basin supplies. It takes into account the regulation of Lake Superior and Lake Ontario is its calculations and is a good tool for forecasting future water levels and to assist in decision-making. The model was developed collectively by the Coordinating Committee but in its present state has limitations due to outdated coding, difficult data format requirements. An update of the model is currently being undertaken to improve the models functionality, operability with different data sources and modern coding. Ms. Miller reported that the mid-lakes component of the model has been recoded using Python. The model is being made more modular and a flexible data handler is being developed to allow the model to accept data more easily and also output data into more formats. Initial testing of the new model has been promising. Future work will include the development of modules to simulate Lake Superior and Lake Ontario Regulation. Mr. Heer asked what the model can do? Mr. Bruxer replied that for example GLAM can use it to explain how changes in net basin supply propagate into water levels. Dr. Gronewold noted that this project was funded through an International Watershed’s Initiative submission to the IJC and thanked them for the support. He asked what the CC had in mind in regards to making the model available to the public? There was a general consensus that we do want the model to be made available to the public and that the modularity of the model will be a benefit to many researchers.

# 10.0 Next Meeting

The next meeting will be held in Ottawa at the IJC office on May 14-15th. Mr. Thompson reminded the subcommittee chairs to provide their written subcommittee reports for inclusion in the minutes by the end of the calendar year (December 2019).

***Action***: Subcommittee co-chairs to provide their meeting reports to Aaron Thompson by December 31, 2019.

# 11. Glossary of Abbreviations

|  |  |  |  |
| --- | --- | --- | --- |
| ADCP\* | Acoustic Doppler Current Profiler | ISEE\* | Integrated Social Economic Environmental |
| ADH\* | Adaptive Hydraulic Modeling System | ISO | International Standards Organization |
| ADVM\* | Acoustic Doppler Velocity Meter | IVQ\* | Index-Velocity Flow |
| AVM\* | Acoustic Velocity Meter | IWI | International Watersheds Initiative |
| BAMS | Bulletin of the American Meteorological Society | L2SWBM | Large Lake Statistical Water Balance Model |
| BIGS | Binational Interest Gauging Stations | LWD | Lower Water Datum |
| CACS | Canadian Active Control System | MIDOT CORS | Michigan Department of Transportation – Continuously Operating Reference Station |
| CaPA | Canadian Precipitation Analysis | MOU | Memorandum of Understanding |
| CC | Coordinating Committee | MPE\* | Multisensor Precipitation Estimator |
| CCMEP | Canadian Centre for Meteorological and Environmental Prediction | MSC | Meteorological Service of Canada |
| CGS | Canadian Geotechnical Society | NAPGD2022 | North American-Pacific Geopotential Datum of 2022 |
| CHS | Canadian Hydrographic Service | NAVD88 | North American Vertical Datum of 1988 |
| CMC | Canadian Meteorological Centre | NBS | Net Basin Supply |
| CoCoRaHS | Community Collaborative Rain, Hail and Snow Network | NEMO\* | Nucleus for European Modelling of the Ocean |
| CO-OPS | Center for Operational Oceanographic Products and Services | NGS | National Geodetic Survey |
| CORS | Canadian Operational Research Society | NHDPlus\* | National Hydrography Dataset Plus |
| DFO | Fisheries and Oceans Canada | NHN\* | National Hydrographic Network |
| ECCC | Environment and Climate Change Canada | NOAA | National Oceanic and Atmospheric Administration |
| eNAV\* | Electronic Navigation | NOS | National Ocean Service |
| ESG | Executive Support Group | NRCan | Natural Resources Canada |
| FVCOM\* | Finite Volume Coastal Ocean Model | NYPA | New York Power Authority |
| GEM\* | Global Environmental Model | OPG | Ontario Power Generation |
| GIA\* | Glacial Isostatic Adjustment | OPUS\* | Online Positioning User Service |
| GLAM | Great Lakes Adaptive Management | OWAQ | Office of Weather and Air Quality |
| GLEN | Great Lakes Evaporation Network | RMA2\* | Resources Modelling Associates 2 |
| GLERL | Great Lakes Environmental Research Laboratory | RTK\* | Real-Time Kinematic |
| GLONASS\* | Global Navigation Satellite System | SFD/SFQ\* | Stage-Fall Discharge |
| GLOS | Great Lakes Observing System | SOP | Standard Operating Procedure |
| GLRI | Great Lakes Restoration Initiative | UNAVCO | University NAVSTAR Consortium |
| GNSS\* | Global Navigation Satellite System | USACE | United States Army Corps of Engineers |
| GRIP-E | Great Lakes Runoff Intercomparison Project for Lake Erie | USGS | United States Geological Survey |
| H2D2\* | Hydrosim2-Dispersim2 | VC-WL-SC | Vertical Control – Water Levels Subcommittee |
| IGLD | International Great Lakes Datum | WG | Working Group |
| IGS | International Gauging Stations | WL | Water Level |
| IJC | International Joint Commission | WRF-Hydro\* | Weather Research and Forecasting Hydrological Model |
| ILO-SRLB | International Lake Ontario – St. Lawrence Board | WSC | Water Survey of Canada |

The asterisk (\*) indicates a modelling program or method.