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  Good morning everyone.
  My name is Jennifer -- in Detroit district and I am your facilitator for today's meeting on tidal and water level datums workshop.
  Welcome everyone.
  We'll get promptly started at 9:00 a.m.
  Now, to go over a few best practices and virtual item to say ensure bandwidth and create an uninterrupteded audio experience we ask that you close any other tabs or applications or programs you may have open or running on your computer excessive use of bandwidth can cause choppy audio or loss of connection to the virtual session.
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  And advisement by taking part in this meeting you do give consent to be recorded.
  Today we will discuss and learn about the International Great Lakes Datum and the low water datum.
  There are presentations from NOAA's co-ops, the U.S. Army Corps of Engineers, natural resources Canada, environment and climate change Canada and others.
  Thank you.
  Our first speakers are Laura and Terese.
  >> [Multiple speakers] I can give your introduction here.
  Laura is chief the stakeholder services branch when NOAA's center for operational oceanographic products and services where she's also held various positions over the last 19 years.
  Laura is the U.S. co-chair of the vertical control water level subcommittee on Great Lakes basic hydro -- Terese is an engineering project supervisor for the Canadian hydrographic service tides.
  She has worked with tides and water levels since 2004.
  Terese is the Canadian co-chair water level subcommittee of the coordinating committee on Great Lakes basic hydr --
  >> Thank you, Jen.

Good morning everyone and welcome to the second day of the tide DA.
Today the focus turns to the Great Lakes.
My neighboring is Laura rear McLaughlin.
With me here today is my colleague Terese Herron.
We are pleased that you are here today to learn more about and discuss the updates to the International Great Lakes Datum or IGLD as well as the low water datum and learn about their impacts to the coastal navigation and shipping communities and industries.
>> The coordinating committee is a collaboration of the government of the United States and Canada for the purpose of agreeing on hydraulic and water level data that is required to manage the Great Lakes and St.
Lawrence river and also used for navigation.
We are the co-chairs as the vertical control of the coordinating committee for the past 8 years the subcommittee has been focussing on the IGLD update.
There are many factors to consider with this update and today's workshop is to bring some of these forward and have some discussion and obtain some feedback from you, the stakeholders.
Within the vertical control water level subcommittee there are a number of working groups focussing on different aspects of the update including seasonal gaging, global navigation satellite system, campaign or GNSS campaign for short, low water datum. We will get into some of these topics today.
>> We would like to take some time to thank or colleagues today.
Stakeholder participation is key to the success of the IGLD update.
Through our work together we are all contributing to achieving an IGLD update that meets the needs of the various communities represented here today. And we'd like to thank the participants listening in and participating today.
We hope you are ready to engage as the day continues.
Thank you.
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>> Thank you, Lauren and Terese.
Next we have Dr. Michael Craymer and Jacob Heck.
His office is in the NOAA Great Lakes environmental research laboratory in Ann Arbor Michigan.
Take it away Mike and Jake.
>> Thanks, Jen.
So Mike and I worked together on both of these presentations but I'll go ahead and present the overview of IGLD and about a half hour Mike will step in and cover the moving to and working in the international Great Lakes datum.
So first of all thank you everybody for -- for being here and listening in.
There's a lot of -- a lot of updates that are coming and a lot of material to get through.
And so I'll go ahead and jump right in.
And by the way, this is Jacob Heck speaking.
I don't know if that's showing up on anybody's screen.
So before I talk about IGLD let me back it up and focus on the fundamental aspects of datums and the purpose of a datum and why we have datums.

So if we start with this red dot here on the screen, and we want to find the coordinates of it, think of it as a bench mark we want to find the heighth of this point how do we do it what is the height of point.
And without any other information you can't -- it can be anything, it could be nothing. It's whatever you want it to be.
So this is where a datum comes in.
So if we say that datum A, that's our 0 line, treat it like 0, how you measure up from there, so if we reference this point to this datum, then the height of this point is 3.
Now, if we reference it to a different datum, say datum B, now, the point hasn't moved, it's in the same place and space we just reference it to a different datum.
And this is -- and when we do this we get a different height for it.
So height relative to datum B is 2.
So we may take for granted datums and we may not think about their importance as often as we should but this makes a big difference.
And when you think about large data sets that are on one datum versus another you bring them together and they're -- and you don't have the metadata associate with them, you don't know what datum they're on or if some things are one datum or some things are on another datum.
It just leads to all kinds of problems.
I know this was a pretty simple example here, but you can kind of see where that's going.
So the different types of datums Laura and Terese had mentioned a few datums that we are updating and focussing on.
But here's how things kind of work together here.
So if we're in the lakes and we want to look at mean water level, so that's that blue line up at the top and that's averaged over a certain amount of time and that's referenced to -- it could be referenced to several different things including well water datum or I do known as chart datum.
And that's that blue dotted line, the second from the top.
So the height above low water datum is that that little arrow right there.
Now, both of these needs to reference to a fundamental vertical data.
And that's where IGLD comes in.
So if you think of chart datum or low water datum being a reference for where things are in relation to low water, that needs to be referred to a fundamental vertical datum.
And again, that's where IGLD comes in.
So from that fundamental vertical datum we can get the height of the water above that datum.
We can also get the height of low water datum above that fundamental datum.
So even if we go through and change that fundamental vertical datum, the connection between everything will relatively be the same, it's just those absolute values that are going to change.
And on the far side we show a bench mark here, and that's how things are referenced.
So the -- we have the height of that bench mark, and from there we can refer to that as a way of getting into the datum, as a way of referencing a height above that fundamental vertical datum.

Change the slide.
So a little bit more about the International Great Lakes Datum.
This is a common height reference system for measuring water levels meaningful with each overall throughout the Great Lakes basin and waterways.
So this is the official vertical datum for water level measurements and navigation charts.
Not only in the lakes themselves but also in the connecting channels and the upper St. Lawrence, so all the way out to the Gulf of Saint Lawrence.
It's maintained on the coordinating committee on Great Lakes, a national committee that has representatives from both Canada and the United States and Laura and Terese talked about that a little bit in the introduction.
And IGLD about every 35, 25 to 35 years we need to update it because of a process known as gray -- glacial ice static adjustment.
And we're in the process right now of updating IGLD 2020.
So that is expected to come out here within the next couple years.
So a little bit about the coordinating committee.
It was formed back in 1953, and it's an ad hoc committee of federal experts on both sides of the border in Canada and in the U.S.
And these are the major agencies that make up its membership environment and Climate Canada, National Oceanic and Atmospheric Administration, USGS, fisheries and oceans Canada, natural resources Canada and the U.S.
Army Corps of Engineers.
So each one of these agencies has its own little focus area but we all need to work together for managing the water system at the underlying infrastructure that is the datum.
It's broken into four subcommittees, hydraulics, hydrology and the coordinated regulation and routing.
The vertical and water levels subcommittee.
This is the revising IGLD as well as standardizeg water level processing.
And that's what we're focussing on here today.
So currently we are working off of IGLD 1985.
And that replaced IGLD 1955 back in 1992.
So IGLD 55 was the first international Great Lakes datum, first one that the coordinating committee came together and worked on consistently.
Prior to that there were a variety of Great Lakes datums on both sides of the border.
Canada used their own set of datums here in the U.S. we used our own set of datums.
And even in the early days these were getting updated about every 30, 35 years because these --
this glacial ice static process was showing itself in the data and we had to update and keep up with that.
So there were some inconsistencyinconsistencies not only on the datums but the heights we used.
By switching over to IGLD we started using dynamic heights and I'll get to that in a little bit.
So IGLD 85 uses the same reference 0 as the North American vertical datum of 1988, that's the current geodetic vertical datum here in the U.S.

And that reference 0 is the tied gage out at the mouth of the St.
Lawrence river at father point Quebec.
So the surface was determined by levelling.
And you can see a map of some those levelling groups there on the slide but levelling is very time-consuming and cost prohibitive.
It required field crews to walk all that have distance.
So having to walk thousands of kilometers and make these measurements but also some other drawback to say levels too.
First of all the datum is only accessible where levelling exists where the bench marks where levelling off of that.
It's also susceptible to an accumulation of systematic errors.
Levelling is a technique that will continue to have an important role.
So over short distances levelling is very, very accurate but as you go across walk across thousands of kilometers across the region those little systematic errors start building up.
And we do see that in IGLD 1985 and NAVD 88 and that's one of the reasons for updating the datums the way that they are.
IGLD 1985 uses dynamic heights and there's also a hydraulic correctors that are applied to water levels in the lakes.
And what those do is they take a lake surface that may not appear flat due to a number of processes and it corrects them to all match what water level would be at at master water level gage.
We need to update IGLD every 25 to 30 or 35 years.
So during the last ice age there was a lot of mass from the ice that was sitting on top of the Hudson Bay region.
And as that ice sat there, it had -- it pushed the mantle material out of the way that was underneath it.
So that material all had to go somewhere.
And that's where we had these areas on either side of the ice sheet known as the bulge.
So the land popped up there and was down was pushed down underneath the ice.
But as that ice melted it's taken this process is still going on where that mantle material is flowing back to underneath where it had been pushed away from to begin with.
And that's causing that area that was known as the for bulge to be sinking and you can see that in the blue areas across that map that's there on the right.
So part of the basin is going down.
And then part of the basin that was directly underneath the ice sheet is going up.
And that's creating a tilt of about 7 millimeters per year from one side to the other.
That adds up over time.
That's 21 centimeters over 30 years.
And that really does become noticeable.
Here we see it in the water level time series also.
So these are you can see that when the datums came out on the left side of the figure that shows heights and IGLD 55 as time went on the different gauges drifted away from what was being shown at the master gage.

And this is on Lake Superior so the master gage would be Markette and as you go across the lake some areas the water level was going down and other areas were going up and updated the IGLD 85 and brought it back down to the same range as they were.
And over time those continued to drift again.
And that's -- that's an effective of GIA.
So I'm kind of side step here for a minute and talk about the geodetic vertical datum.
So I had mentioned NAVD 88 while that is being replace by the North American Pacific geodetic datum 2022, I know that was mentioned quite a bit yesterday too during the NTDE summit.
So we are expecting this to be completed and released in 2025.
Initially we had planned on a 2022 release date, but due to a number of factors outside of our control here at NGS, we had to push that back.
So the naming will stay the same but as we finish up the data collection right now we have to clean that data, process it, and then we should be all ready by mid-2025.
Instead of being a levelling based datum the way that NAVD 88 was, NAPGD 2022 is based on a model and the geode is being affected by data being collected across the region, a variety of satellite and airbornee gravity.
D.
Datum project.
So it's not dependent upon levelling.
You won't have that systematic error build up and you have it consistently defined everywhere.
So there are a number of benefits to moving to this geoide based datum.
The height will be determined through GNSS.
It's more efficient and more consistent nationwide.
And those GNSS heights will be referenced to the 2022 -- and I'll talk about -- here in a minute.
However like I said before local levelling will still be needed.
So levelling does not go away.
This is not a stop doing that.
The leveling will still be needed.
It will take on a different role but especially in the local sense leveling is still going to be extremely important.
NAPGD2022 will be time dependant so the coordinates will change as these changes happen and GIA is an example of that.
As the ground goes up then you're -- you can't say that this bench mark has a fixed height even though it has raised up with the ground around it.
So time dependency will play a big role.
NAPGD2022 will be compatible with the Canadian CGVD2013 that's their datum in place right now uses a very similar geoid model, still making some tweaks there, but the reference is the same and that's a geo potential value that closely represents -- means sea level all around America.
And we work together on choosing that.
Once the new geoid model is out for 2022 Canada is also expected to adopt that.

And both countries have been working together on developing this model in a consistent way.
And this is a good way to harmonize national vertical datums for international Joint Commissions, water initiative.
So as water flows from inland out to the sea, theres a consistent way of measuring that.
And IGLD2020 will be based on Napgd2022.
So I had mentioned NATRF 2022, this is on the gee owe --
geometric side.
The current horizontal datum is being replaced by NATRF 2022 this follows international standards.
And it has a direct connection with the international reference frame of 20220.
So everything ties together here.
So if you take this international frame and have it rotate with the North American tectonic plate that's effecteffectually NATRF 2022.
This will be a time dependant reference frame.
Coordinates will change due to interframe motion like GIA and other effects like that.
And velocities and actually more than just velocities how things move and change will be available at CACS and CORS stations, and in between those there will be a deformation grid available to fill in the gaps.
And NATRF 2022 -- what 2022 reference is.
So I think these are all coming together.
And NATRF 2022 will have realizations every five years these snapshots in time of where the network's at.
So it is time dependant and we have a way of keeping up with that.
So there will be first a shift and then after that coordinates will continue to change.
And this is where the heights are come putted.
So the heights get computed in NATRF 2022 and we applied the geoid model and get our heights in NATRF 2022.
Here's what this shift looks like.
So NATRF 2022 being a three dimensional geometric reference frame.
This is where we get our latitudes, longitudes and our ellipsoidal heights too.
And this is a that fundamental shift in where we go from accessing heights to levelling to accessing heights primarily through GNSS.
We work up on the topography and with GNSS we measure that little H, the height above that ellipsoidal, that closely proximate mates the shape of the earth without getting too complicated.
So the height between the ellipsoid, that is at that big H and that's our orthometric which is more important to us for height purposes than what the ellipsoidal height it.
And 2020 heights will be determined through this way primarily through GNSS and applying a couple model to say get our dynamic heights.
So a little H and N will get referenced to the same ellipsoidal and that's NATRF 2022 and from that we'll get our dynamic heights.
IGLD 2020 will be defined by these attributes here.

So there will be a reference 0 and that's the basis for all heights in the system the reference surface is the height above that 0 is represented, the reference epic that is the common time for references heights and water levels and these will be dynamic heights.
And hydraulic correctors those account for variations of water level across the lake.
So to dig in deeper with that, the reference zero will be the mean sea level around the coast of North America which matching the -- also the reference zero for the Canadian geodetic vertical datum of 2013, CGBD 2013.
The reference surfaced will be the NATRF 2022 geoid model which referenced everywhere not just at the -- around the coast.
So and this is defined everywhere not only where benchmarks are.
And the reference epoch will be 2020.0 and that's the same as central epoch for the 7-year water level observation period that's going on from 2017 to 2023.
I've gotten that question recently why isn't it available yet?
Well that represents the reference epoch and we need observations on both sides of the reference epoch before we can determine this.
So there's no way that this can be determined at this point.
Now, dynamic heights are as I showed that figure about the orthometric heights.
That's what surveyors typically use, what that is if you follow the plumb line through all these surveyses that you go through as you go up above the geoid it's that different through all of those surfaces.
That changes as you go across the lake because as you go from south to north you get convergence of these equapotential surfaces.
So an orthometric scales that geopotential value by a local value of gravity.
And so with geopotential think of that has it's potential energy per unit pass.
Per second squared and if you divide that by your gravity of meters per second square then you're left with a height.
And what a dynamic height does is it takes that geopotential value, it applies a common value of gravity.
So it applies a height to an equapotential surface which is very effective as using a lake surface as a reference.
And this has been used with all of the IGLD realizations.
I know like it's pretty complicated here, but here's a table of what those -- what the equations look like for determining these.
Now, ellipsoidal that's a geometric value.
Orthometric height that's the length of your line, the potential surfaces and that's represented by that H minus N or that C which is the geopotential number divided by the local gravity.
Dynamic height is very similar it uses a constant value normal gravity at 45 degrees and that makes a lake surface look consistent.
And then you get hydraulic correctors here.
So go through and make this even more complicated than what it is or what may seem to be or -- so the dynamic height should be the same at all gages on a level lake but that's not the case for a variety of reasons including occurrence, river discharge, temperature variations, prevailing winds.
And how that drawdown.

So this creates lake surface topography and even with IGLD 1985, some of what the hydraulic correctors were accounting for was the tilt and the leveled and the datum that had been determined by levelling.
So with IGLD 2020 that won't be the case.
So it should be a good model of lake fast topography that gets applied.
They adjust to agree with the single master gage on each lake.
And these are only used on water level heights.
So if you're on land or even on the connecting channels, connecting channels are supposed to be sloping surfaces.
So hydraulic correctors don't --
wouldn't improve on that the way that they do in an open lake.
So IGLD 85 hydraulic correctors account for a lot of more than the lake surface topography.
But the IGLD 2020 should be the lake surface topography.
And right now we're am liking this, trying to figure out the extent of hydraulic correctors for IGLD 2020.
And if they're small enough they may not be needed.
And the seasonal gaging network is being used to fill in the gaps between the permanent stations to provide a more accurate model.
So right now with the IGLD updates, we had a GNSS field campaign take place last year.
And that visited all of the benchmarks at all of the permanent and seasonal gauges on both the U.S. side and the Canadian side.
It was -- it went very smoothly for considering how big of a --
big of a campaign that was over 350 benchmarks were visited.
And right now we're processing that data.
So that will -- and that will be used for realizing the IGLD 2020 heights at the water level gauges.
Seasonal gauges continues throughout this year.
To finish gathering that 7-year time span of data.
And we have the hydraulic corrector working group right now investigating what -- to what extent hydraulic correctors will be used and need in IGLD 2020.
So and like I had said earlier once 2022 comes out since IGLD is built on top of that 2020 should be released around 2026.
So get 2022 out around mid-2025, give it about another year and IGLD 2020 should be out there and available.
I've got one more slide here on what that water level station network looks like.
I had mentioned the GNSS campaign that visit all of these and here's where it is.
And these stations are managed by NOAA by CHS and by other agencies including U.S. Army Corps of Engineers, ECCC, USGS, Canadian, seaway, U.S. sea way New York power authority, Ontario power, OPG.
And some of these are co-located with continuous GPS with cores in the U.S. and CACS in Canada.
We have, I think it was 17, 17 cores and 14 CACS at some of the key water level stations.
So those keep that direct connection with the global reference frame continuously.
And allows for continuous monitoring too.

So if you want more information you can go to the coordinating committee website, or email the coordinating committee inn --
info email address and for more information on 2022 and NAPGD 2022 you can visit the website we have a lot of material out there about that.
So I think we'll save questions for later.
And I will let Jen take it over.
>> Thank you, Jacob for that wonderful presentation.
And for handing it back.
And hopefully you know Mike and Jacob will stay to cover moving to and working in the IGLD.
So take it away, Jacob and Mike.
Thank you.
>> Mike, we don't hear you right now.
>> Sorry, I forgot to unmute the microphone.
>> Now, we hear you.
>> This is the second part of Jacob's and my's presentation.
We'll be talking about moving to IGLD and what to do to work in it.
First of all what's changing with IGLD 2020, Jacob's already reviewed these things the reference zero is changing we're using sea level around the coast of North America now.
We're using a geoid and also updating hydraulic correctors for IGLD 85 was representing a lot of that systematic error trying to get rid of it in the levelling and possibly also the letter datum's going to change.
So there's a number of things that are changing.
I'm going to talk here just about the vertical datum changes so the reference zero and the reference surface.
So we expect to see those heights draining by the amount shown in this reference zero what I'm the current U.S. datum which IGLD 85 is based on.
And the [indiscernible] 2013, the current Canadian datum which is going to be completely compatible really with the IGLD 2020 except 2020 we'll be using dynamic heights.
So here we're looking at the difference in orthometric heights which is really going to be the same in dynamic heights.
We can see that the 85 heights are going to be about 30 centimeters higher at the gage, the master gage here for the whole datum at -- and it will increase all the way up to about 65, 66 centimeters up here at Thunder Bay.
So right away we're going to see this change in heights coming purely from the change in datum.
And that's what I'm depicting here on the next slide is this change in datum.
This is similar to the slide that Jacob had shown.
And what we're seeing here right now is the current situation where we have a vertical datum, IGLD 85, we have different things that we want to reference to that datum.
The mean water levels, the low water datum, benchmark heights.
So all these we can determine the dynamic height of all of these things with respect to that vertical datum.

But now we go and change our datum and we see that the datum moves up a in this case.
You can consider the old vertical datum to be IGLD 85 and the new vertical datum to be IGLD 2020.
And we can see that the heights are going to get smaller.
Nothing's changing actually with what we're measuring the heights to, the benchmark is still the same place the low water datum still the same place mean water level same place but the heights are all changing due to this change in vertical datum.
So in order to determine heights in IGLD previously we had to use leveling.
And that was very time-consuming as Jacob already mentioned and extremely costly actually.
It would take us many, many years to actually try to reproduce all that leveling around the Great Lakes these days, it would be millions of dollars.
So of course we can't afford to do that.
Now, when we moved to the in you datum, IGLD 2020, we couldn't readjust the entire leveling network but the problem with that is all of those observations are pretty old.
They date back to the'60s and '70s.
And so they're actually quite out of date.
The entire network is really pretty much out of date.
And known of those benchmarks not all of them at least had been main tainted -- maintained over time.
So those will have up to date heights, but the vast majority won't.
So the primary access for IGLD 2020 will actually be through GNSS, not leveling.
So GNSS will provide then really the most direct tie to the IGLD vertical datum R vertical datum to the geoid.
It will provide the highest accuracy to that datum.
There are different types of methods that are traditionally used.
You occupy a benchmark for a few hours and process the data using whatever tools you have and that gives you pretty reliable results on the centimeter level.
But also the real time kinematic, RTK.
They have their own network so permanent stations, CORS-like stations.
You should be able to get centimeter level type heights from that.
Now, we'll be providing guidelines on how to use GNSS with the new IGLD 2020, those guidelines will be pretty much identical to the guidelines for using GNSS with the new 2022.
The main thing using GNSS to get heights is that you need a good view of the sky that's pretty obvious here you're using the GPS satellites to get the data from the satellites to get your positions so you need to see those satellites and as many who have done leveling before know many benchmarks are not in places where you have a clear view of the sky.
Often they're right beside buildings or under trees or something like that.
So really you need to find a good location that's suitable for GNSS and these guidelines will help with that.
And but that means that you're still going to need to use local leveling in order to tie your gage or whatever else it is that you need IGLD heights on, you'll need to tie those to

a GNSS benchmark and normally one would establish one right near the gage or right near your project and then you can reference your leveling to that.
Actually probably want to use one or two GNSS benchmarks for redundancy.
Door.
So this slide is sort of repeating what Jacob had already shown how you get IGLD dynamic heights from GNSS.
So what GNSS is giving you is this green height here in the diagram it's the height above the referenced ellipsoid.
So once you get that from GNSS, this small H or ellipsoidal hide you can then remove the geoid height.
The geoid height comes from get models that will be provided.
They will be really defining the IGLD 2020 and NAPGD 2022 and then you simply subtract off that height you use a model to get a height at your point and subtract off that geoid height from your measured ellipsoidal height from GNSS.
That will give you the blue height, that's convert then to dynamic height using a gravity model.
And that model will begin be provided by the geodetic agencies.
So the main thing to remember when using GNSS to get heights orthometric or dynamic is that the GPS determined height, the H must be referenced to the same referenced ellipsoidal as the geoid height.
So you can't use -- and then use the geoid height with the new IGLD 2020 datum both of those will have to be in the same reference frame.
And we will be providing the conversion tools to go from ellipsoidal heights to dynamic heights so you don't have to do all these.
The two will be provided both online and desk top applications.
Okay.
So how do you get your ellipsoidal height from GNSS?
Well you could use your receiver manufacturer's software.
For those that actually go out and buy GNSS receivers to start doing -- start tying to IGLD 2020, but those manufacturers software usually is cost on the order of something like several thousand dollars.
So it's not inexpensive.
However, both our geodetic agencies in Canada and the U.S.
are providing free online GNSS processing services.
So you can use those to get your ellipsoidal heights.
You collect the data with your receiver so that data to our services and they will compute the ellipsoidal height for you.
In Canada we have our PPP service it's the Canadian spacial reference system it's a precise point positioning service that's used worldwide and its reference frame is really defined by the orbits.
So really computed in RTIF and transformed to whatever reference frame you need.
In this case 2020 it will be transformed into NATRF 2022.
OPUS is available in the U.S.
and using a more baseline methodology.
That uses data from CORS station.

As I said these tools are online.
And in addition we will be providing tools to convert ellipsoidal hide to dynamic heights.
So again you don't have to worry about that.
Now, of course to realize this new datum to start with when we go to release it in 2026 or 2027, we have to determine or rather update or determine the IGLD 2020 heights at all the water level gauges.
These are the gauges that are used to determine the water levels in IGLD 2020.
So we have done previous surveys that most of the CHS and NOAA gauges back since 1997.
But this past year we did another survey.
And it was really a much larger survey collaboration and contributions from the coordinating committee members.
The big campaign was led by both our geodetic agencies Canadian geodetic survey and national geodetic survey.
In this particular survey we occupied many more gauges than we did in past years.
We occupied benchmarks at most all of the gamings the Great Lakes the intersecting channels, St. Lawrence river.
We also included -- that's kind of a new addition to the network.
Included in these gauges are pretty much all the permanent gauges from CHS, environmental Canada, now, the U.S. Army Corps, the U.S. geological survey, both sea way corporations on both sides of the border, New York power authority and Ontario power generation.
We had 180 benchmarks not quite 180 gages we had a couple of gauges at some gauges.
So it wasn't quite 180 gauges but we had 180 benchmarks that we occupied.
Now, in addition to those personal pants in gages we also occupied what we called seasonal gauges these are gauges set out temporarily for one season and these were used mainly to help with the determination of hydraulic correctors.
And if you look on the nap here you can see the square similar bombs they represent the permanent gauges and the round dots are representing the seasonal gauges.
So we have just as many if not more seasonal gauges filling in between the permanent gauges.
This is to help really the entire network for the survey.
The survey involved occupying each bench mark twice for 24 hours each.
So we're doing quite a bit of occupation on these benchmarks really to get the highest accuracy we possibly can.
We want these gauges in this survey to really be the fundamental one the realizes IGLD so we wanted the best possible accuracy that we could.
If we noticed two occupations don't -- with each other we'll do a third as well.
Right now presently in the process of processing all that data to get the ellipsoidal heights.
So this is a couple of photos of typical set-ups on the Canadian side and measure side.
On the Canadian side we used what's called a -- anchored with chains and American side the tripods.
You don't have to measure the antenna height.

It's known.
This is a fixed height rod, a fixed height rod here as well on the tripod.
So we know exactly what that height is.
For the survey it involved as you can see from the --
whoops -- from the map here there's a lot of travel involved here to occupy all these gauges.
And so we estimated the amount of miles that the observers put on during the survey and we tallied it up and it was about 50,000 miles traveled on the U.S. side and 66,000 kilometers on the Canadian side.
So that's a lot of traveling and the observers were pretty exhausted at the end of the survey.
The survey lasted about six weeks.
We collected a total of about nine and a half thousand hours of observations both sides of the border.
So a total of about 19,000 hours of observations altogether.
So it's a lot of data that we collected and right now we're processing it all.
This is the repeatability between those double occupations of each bench mark.
We did this for quality control to see if any of the occupations might have had an issue with whatever multi path or something.
It often did happen where a ship would pull up right alongside our setup.
And so we had to repeat it another time when the ship wasn't there.
So what we see and actually it's quite remarkable the accuracy here is the repeatability, 92% are better than a centimeter.
And this is vertical.
Normally vertical is about three times worse than the horizontal.
But these days it's getting better with processing methodologies and software.
But we're seeing that repeatability is help a centimeter, 92% of the cases.
There's a few, but nothing major.
So we're quite happy with these results.
Right now we're processing it fully processing it with baseline software baseline processing software.
So we'll have the results ready probably in another couple of months.
Now, as far as working in IGLD is concerned one thing people have to realize now is that we're really dealing with a dynamic kind of datum.
Now, I'm not using the word dynamic here in the sense of dynamic heights that Jacob talked about, but more in the sense of the heights are changing time.
And these changes are happening because of -- so what we're doing is using a model to account for those -- we can use that model to promulgate the height to different epochs.
In fact the models really national models the U.S. is Campath theirs as we're computing ours.
And making sure that the overlap is going to be compatible with each other and collaborating on that actually right now.
So we're estimating this deformation model really nationally and using all of the permanentpermanent CORS stations for this.

These will be provided as grids and we'll be expecting -- we'll be providing tools to uses those deformation models but also expecting the commercial software providers to incorporate them within their software.
An example of the most popular one is ArcGIS so we're expecting those software developers to incorporate these deformation model.
The main advantage of the model is we can remove the effects of coastal motion almost entirely many local motions are a little bit more problematic because they aren't maybe represented fully in the national deformation model, but we can remove the vast majority of that crust motion.
We won't really need to update the IGLD in the future because of the effects of GIA. We'll be accounting for that and modelling that and removing that.
There might be other reasons to update IGLD in the future but it won't be because of really IGLA.
So here I'm showing an example of the effect of coastal motion on water levels in particular.
What we're looking at here are the differences in the water levels measured at gauges on Lake Superior.
We're looking at the difference of the gauges with respect to the gage of Markette.
And what we're seeing is the impact of crustal motion on those water levels.
So in the beginning the water levels were all consistent with each other on the lake as you'd expect them to be.
But then over time the measured water levels start going off.
They're not agreeing with each other and really looking at the relative water levels between gauges.
So those gauges that are experienced more crustal motion than Markette will see a large difference accumulating over time.
And what we're looking at here are the two largest gages [indiscernible] on the Canadian side.
So yeah we see this large accumulation of the effect of GIA, and then IGLD 85 was introduced we basically reset everything and now the water levels are agreeing with each other but then as time goes on once again the water levels start disagreeing with each other because of the impact of GIA.
But we can account for this now using a deformation model.
And that's what I've done on this next slide which shows exactly the same water levels but this time I've corrected them for crustal motion.
So it just shows how we can now remove that primary impact of GIA from our water level measurements and from our benchmark heights really.
So, of course, not everyone is going to be able to go out and do GNSS surveys some people have a very large amount of data of the older datums and going to need to convert those to the IGLD 2020 or maybe they don't need to maybe they could [indiscernible] 2020.
So to help with converting the large data sets to IGLD, we will be providing transformation grids.
We'll provide in the beginning transformation grids from the older IGLD datums both 55 and 85, and so what we've done in that survey we did last summer we made sure we

included lots of stations and almost all of them actually do have IGLD 55 and 85 heights on them.
So we have a good sampling as you recall from that map of the stations we occupied we have a good sampling and a good spacial distribution of points to really compute a fairly good transformation from the older datums.
Of course, the transformations not going to improve accuracy at all.
It's really going to be only as good as the accuracy of the heights in the old datum.
So plus a little bit of uncertainty coming from the transformation interpulation itself.
I will proving accuracy can only be done by doing direct ties to the new datum but it will be a way to transform large data holdings into the new datum with basically the same accuracy as before or the same amount of errors before.
So we're providing these transformations and they'll be ready for release you know, probably 2027.
Now, the reason we're talking about 2027 and not 2025 when the new North American datums come out is because we need to have those new datums those new NAPG 2022.
So we'll be doing them immediately after 2025 and giving ourselves a better time there to get these ready.
So we're providing tools to do all these con versus in addition to the GNSS processing tools we're also providing tools to convert to ellipsoidal heights to do the transformations.
In Canada we call our tool GPSH and in the U.S. it's called V datum.
So these will convert heights to orthometric and dynamic heights they'll be able to use those transformation to say transform between the older datums and new datums.
They'll also support batch processing so you can submit a large set of stations with older heights and get them transformed to the newer IGLD 2020.
And in addition to having online tools, there's also a desk top applications of both of those tools available.
In addition there's web services available.
So there's a rest APIs are available for boat of those GPSH and V datum tools.
I'm just showing on the right here.
That's the V datum tool.
And down here in the bottom is the GPSH tool that we have in Canada.
Now, in addition to us providing times we are planning on the commercial GUS tools to be available.
So the transformation grids are expected to be implemented in the GIS software as well as the geoid itself.
And the deformation model.
So in order to help these commercial developers get ready for the new datum, we held a geospacial software developer summit just late last year, November 30th and December 1st.
We had 19 federal and provincial participants, participants from 13 soft wear companies and representing commercial and open source software.
And most of these developers during that meeting they -- most of them did commit to having their transformation tools ready by actually 2025, because we're going to need these tools not only for IGLD 2020 but also --

and then when we have our transformations for IGLD ready they should also be implemented in a fairly straightforward way because we plan on using a common grid format for that.
So we're planning to provide both alpha and beta products to the developers.
We plan to have the alpha products out there year and beta products next year.
The beta products will be near final once just some small rereadjustments to the 2022.
Now, as far as the impact of updating IGLD, they can be wide ranging.
They can affect many operations and products and services throughout the Great Lakes region.
It really has an impact on the economic viability and safety of commercial and recreational navigation that includes charts ports and harbors and especially dredging of navigation changes particularly if low water datum changes.
Also the update will affect water level regulation and forecasting they'll have to take into account it's a new datum the heights will be different now.
It could affect coastal zone management and planning including the flood and erosion prediction response coastal structure design and so on.
Coastal habitat restoration under the Great Lakes restoration initiative could be affected.
Most of these things are using the old IGLD 85 or some of them and they'll have to realize that the water levels are now being provide in IGLD 2020.
So they will need to be updated.
A lot of the details of these things are being provide in the update plan and that's available on the coordinating committee website.
So what we're doing right now is really conducting these outreach efforts just like the one we're doing today, this is one of our biggest Wundt and the idea here is to inform everyone of changes that are coming and get feedback from you the stakeholders as to what you guys need to help you move to IGLD.
And finally, for more information this is basically the same slide that Jacob showed.
So you can go to our web site to look for the complete IGLD update plan.
We're in the process of updating that actually but you can see the object to form one that's there from a few years ago.
Okay.
Thank you.
Any questions or are we going to wait until the break?
>> Hello.
>> Hello.
>> This is Jen.
Yes, thank you, Mike for that terrific presentation.
We are you know, pretty early for our 10:15 to 10:30 break.
But we can still have that.
And we'll convene back here at 10:30 a.m. eastern time.
So thank you.
And do submit your questions in the chat.
And we will get those to our presenters.
Thank you so much.

>> All right.
Welcome back.
It's 10:30 so my name is Jeff, we're going to take a few moments here to address some questions that came from Jacob and Mike's talk there during the break.
So one of the questions is about slides being posted on the co-ops page and we've got plans for the slides and recordings to be posted but we got a question for you Mike that came in so I know you addressed it in the chat box but let's go over it real quick if you have a moment.
So when the new datum is published, IGLD 2020 and along with 2022 will surveyors be able to obtain nose dynamic heights on the fly with OPUS and GS OPUS or the CRS PPP when processing their data collection, is that part of the plan for those tools?
>> Yeah.
So on the fly I take that to mean included in the OPUS and PPP output.
And I can't speak for all of us.
I'll let Jake do that.
So for PPP we do provide ellipsoidal and orthometric heights.
Right now we don't provide dynamic heights but that's not to say we can't.
So if there's a demand for it we can certainly add dynamic heights as well to the output.
It's just a matter of a web services call to our GPSH tool and the PP tool can do that.
All our tools to communicate with each other they all have certain jobs they do and communicate with each other to do like transformations and that sort of thing.
So I would say probably yes that we would include ellipsoidal, orthometric and dynamic heights in the output of our PPP results.
>> And on the west side the way that it works right now OPUS will give you your ellipsoidal heights and orthometric heights but not your dynamic heights in the output right now but we do have tools available that would allow to you take it from orthometric or ellipsoidal into dynamic.
Now, as part of our modernizationmodernization effort we do have a project out there for determining dynamic heights from GNSS observations.
So I like Mike said probably yes.
I don't think we have anything out there written for sure but we are working on getting those pieces together and it just a matter of linking them.
So that's what it's looking like on our side.
>> Cool, thanks, gentlemen.
So there's a question I got that just like a little clarification, jack Riley if you're on there, you had referenced some thoughts or feedback on the water levels corrected for crustal motion and then there's an acronym Mike or Jacob you recognize it on one of your slides MAR --
>> That's Markette.
>> Yeah, okay
>> It was labeled on the figure, yeah.
>> Yeah.
Yep.

>> So did you have any thoughts on that, that was Jack's question, any thoughts on the anomalous, water levels corrected for crustal level motion for those Markette locations IGLD 55.
>> So I guess Jack must be refers to this here.
>> He was referring to TWOH and ROS.
>> So that one, TWH, maybe right there, the purple one.
Yeah, well, I'm not sure.
That's IGLD 55 and I don't think anyone's really bothered to go back in the history books for why that must have occurred.
This does look like there's a bit of a bias that might have occurred and could be because we're talking about six centimeters, that could be all kinds of reasons for that like maybe a shift of the gage house itself.
The gage itself.
That's what I suspect but we've never really gone back and dug out the history of these gauges to figure out why.
I just did this plot here last year it took me about ten minutes to generate this from the -- from the original one with the water levels.
I just applied the -- our custom motion model to the locations and generated this plot.
So I didn't really look into why the differences were occurring here.
We also had another large outoutlier about four or five centimeters I think it was -- that gage has a history of problems of being undermined by ice.
It's right on the shoreline.
And it does have an issue where sometimes it gets undermined a bit and they have to go back the next year and fix it.
So I think that's what happened in the case of -- but this one here yeah that's a curious one.
I've notice that had myself.
But you're welcome to go back in the records and research that one, I'd be curious to know.
>> Maybe Jack will dig through and get back to us, Mike.
Thanks, thanks for your thoughts on that.
So there's a question that came in from Roger at restore our waters international.
So his interest is in historic water level data and computations of net based and supply efforts used to manage water levels.
So his question is is there any organization doing research that we know of anyways doing research on differential and temporal changes over the approximately 135 years of water level observations using the deformation modelling tools to assess likely adjustments to those historic water level databases and how those changes will change the net basin supply estimates that are generated by the coordinating committee?
>> Well, I'm a geodosist, I don't know of anyone doing that, but others might know.
So I guess the issue would be if we could go back that far with our deformation model our crustal motion model, that would be extrapolating quite a lot into the past.
The crustal motion model that we're using is really current present day crustal motion.
So it's not guaranteed that that same motion occurred almost 200 years ago.

Likely has although there could be lots of local motions happening that we wouldn't know about.
But I guess it's better than nothing.
We can extrapolate right now.
Our crustal model is based on GNSS data going back to 2000 at least our Canadian one.
I shouldn't say that actually in 1994, we do have some high accuracy campaigns included in the crustal motion model just to fill in our network in Canada.
So any way it's, you know, it's pretty recent type of motion that we're looking at.
So extrapolating that back, you know, another hundred and, I don't know, 70 years or so, you know, there could be some certainly some errors there.
Not only just from the uncertainty and the velocities which would accumulate as you propagate and the propagation of errors to accumulate would be a fair large value of uncertainty going back that far.
Maybe they could shed some light on that.
>> Yeah, thanks, Mike.
So Roger there's maybe in roads there looking at someone contacting some folks to look more at water levels and I think Roger that kind of addresses your follow-up question already which Mike was talking about extrapolating so far back devalues some of the useful necessaries that have data.
He was kind of asking about the IGLD update shedding light on different GIA changes again way back in history before 1885, I think it's really the same kind of answer, Mike unless you had any --
>> Yeah I think in the world of GIA which occurs over thousands of years it's still pretty recent 200 years and so the GIA signal is probably not going to change much.
But still we're basing our motions that we're estimating on only data since about 200.
So it's not a whole lot of data.
We're extrapolating quite a ways back.
And just like I said the accumulation of random error on that extrapolated position could be pretty large.
So people could use it, but they'd have to bear that in mind that there would be a fairly high uncertainty propagating back that far.
We do provide certainty estimates too for our models.
>> Cool.
Thanks, Mike.
So there were a couple other questions so since we kind of took a little bit of time to address these questions that came in during the break.
We'll follow-up with those later it is just about 10:40.
So I'm going to turn things back over to Jen and I'm going to go on mute now.
>> Thank you so much, Jeff.
All right.
Next we have Sierra Davis, Sierra works with coops as an oceanographer.
>> I'd like to acknowledge his work and participation in this presentation.
So as you've heard from our other presenters this morning IGLD is the official data reference for water level managements and navigation products throughout the Great Lakes connects channels and the St. Lawrence river this is essential for unified and

internationally coordinated navigation and transportation, regulation, of lake and river flow through connecting waterways, nautical chart updates, lake level forecasting, coastal zone activities and more.
So in addition to what Jacob and Mike talked about this morning, the foundation of IGLD values are also based on mean water level surfaces determined for each lake.
And these average lake-wide surfaces are derived from water level measurements throughout this region by the United States and Canada.
The Great Lakes region is changing and the way we interact with these waters is also changing.
We want to ensure that the best product is available for our stakeholders so precise accurate and coordinate water levels are critical for IGLD.
So how are water levels obtained throughout the entire a Great Lakes region.
The United States and Canada use both permanent and seasonal water level gaging.
Permanent gauges are located in areas that are essential for daily operations areas of large commercial ton dnage and ports for example.
These are enclosed and house heat lamps which allows for year-round data collection even during the coldest months when waters freezes.
Seasonal gauges are used to help fill or data gaps between the permanent stations.
So for IGLD they'll likely improve likely be used to improve the resolution on the determination of hydraulic correctors which Jacob and Mike covered this morning.
Seasonal gauges are temporary typically installed for a single summer at different locations across the Great Lakes.
Factors considered for selecting seasonal gaging locations include filling data gaps for datum transformation and lake surface topography we've placed them at coasts and infrastructure, storm preparedness for harbors of refuge, proximity to benchmark location and other locations for spacial analyses.
On the slides you'll see for Canada they have 58 stations permanent water level network.
The United States we have 53 stations in our national water level observation network.
Canada also had 66 seasonal gauges and the United States had 54 throughout the Great Lakes during the IGLD data collection period.
On the right-hand side I also have pictures of these station types and acknowledgments to some of the agencies that helped to fund the seasonal gaging efforts.
So thank you to our partners.
The development of IGLD will use water level data from both permanent and seasonal water level gaging and on this slide we've summarized permanent and seasonal gaging with the wide variety of ways that resulting data are used.
On the left we illustrate the permanent gauges are essential for day-to-day operations as well as policy development, coastal management and long-term monitoring.
You'll hear this afternoon that these stations are also crucial in our review of low water datum.
On the right seasonal gauges which again, collect water level data during the summer months only they support the permanent gage network would filling in data gaps and again these stations will help us determine lake fast topography changes that could result from river discharge, prevailing winds temperature variations.

And as you learned the changes in sea surface topography currently that's accounted for through the use of hydraulic correctors and that might continue to be the case for IGLD 2020.
They also help us define and refine numeric models such as datum transformation tools describing V datum as well as the hydraulic resolution.
So the IGLD 2020 reference is the 7-year water level observation period from 2017 to 2023.
While collect water level data constantly throughout the year and continue to do so, we will be looking at this time period specifically for the IGLD 2020 development.
So for your spacial reference here's a map of all U.S. and Canadian permanent gaging stations of course the American flags represent gauges maintained and operated by the United States and the Canadian flags represent gauges maintained and operated by Canada.
So the following few slides I have just to illustrate how seasonal gauges have been spatially deployed year over year during the collection period.
The United States started in 2014, and we had seasonal gaging through 2021.
Canada started in 2018, and they have seasonal gaging running through 2024.
So you'll notice that some seasonal gaging actually takes place outside of the IGLD 2020 core epoch these additional years of seasonal gaging will likely help validate or refine the models and hydraulic corrector determinations.
Where these stations are located we have 2014, '15, '16, 17, '18, '19 '20, '21, '22, '23 and '24.
2024 is tentative.
Another reason we're taking a fresh look at water levels is we have these new technologes that will used to help -- satellite systems or GNSS survey data has been collected through on foot field campaigns as well as through permanent GNSS stations called CORS in the United States and CACS in Canada.
This positioning data will be used to update land movement very also city models in the region as well as to help tie IGLD 2020 to the new national spacial reference systems being developed now.
Transmission is also advancing as data collection is digital and more station are transmitting data by ghost satellites rather than by telephone and hard lines.
Our data ingestion as well as processing in QAQC have all become more streamlined with the utilization of modern and cloud based data storage programming scripts and software.
User tools have been developed to help with data conversions and thanes formation between datums.
Data retrieval and access has also improved through APIs and our web services.
Additionally, station hardware continues to improve with new technologies.
Some of our stations now have the ability to collect meteorological data and highly accurate microwave radar water level sensors are increasingly being used in the Great Lakes particularly for seasonal water level gaging.
Lastly, there have been station upgrades and new station installations on both the Canadian and U.S. sides of the Great Lakes.
Geodetic levels a field component.

Every water level station has an associate land-based benchmark network.
Our water level sensor heights are measured in relation to a primary land based bench mark through surveying leveling.
The stability that have primary benchmark and the water level sensor is checked by periodic leveling to other benchmarks from the network.
GNSS and leveling together not only determine and ensure sensor stability throughout water level data collection but it ultimately allows water level heights and water surface reference datums to be related to land based geoid datums.
When IGLD 2020 is released it will be tied to the now geoid based North American Pacific datum of 2022 by way of GNSS occupations at benchmarks.
So on the pictures that I have here on the left is a GNSS campaign data collection.
In the center we have the leveling survey campaign this was at Little Rapids in 2017.
In the upper right a hand field GPS helps with the positioning of benchmarks.
And lower right we have a seasonal gaging station which is a Canadian seasonal gage.
This flow chart explains the process from data acquisition to dissemination.
The first step is acquisition.
So shown on the left these stations both permanent and temporary contain -- sorry collect water level data and/or other environmental data.
The next step is the QAQC process this includes inspection of data through a combination of automated processes as well as human checks.
And these include identification of data outliers.
We look for something called flats so unchanged water level data for three or more hours.
We look for data gaps.
But in the Great Lakes we can only fill data gaps with observed data.
We don't do any kind of interpolation of mathematical filling of data gaps.
We also notify or operations teams immediately.
The following data our water level products can then be generated.
In Canada they have a three-minute high resolution data product and in the United States we have a six minute.
This is typically a product used for you know a real time navigation.
Hourly heights are calculated and used to produce daily and monthly means.
So our daily means help with regulation of lake levels and flow determinations monthly means are used for trends and forecasting.
And then we also have a yearly means which again, helps with trends forecasting and you know, studying climate impacts over time.
So overall these products come together and they support the computation of IGLD 2020.
They're also disseminated to the public through our web based applications and data APIs.
So this slide is just really to summarize.
We know and we can see in existing data that there have been water level and land elevation changes due to the glacial ice static adjustment and this requires a new and update IGLD.

We also have GPS and GNSS technology that will be used for more accurate water level measurement and allows 2020 to be tied to the modern myselfed NSRS.
Right now in our stage of developing IGLD 2020 we have almost completed our water level data collection.
We're in the year 2023 for our water level data collection.
And this data will be used to calculate updated mean water level surface values for each lake as well as to develop hydraulic corrector models if needed.
The data is also being reviewed to update low water datum or Great Lakes chart datum which you will learn about more this answer.
So this concludes my presentation.
I just wanted to put a few helpful links on this slide.
And we know the slides will be made available.
We have links to more information about the IGLD update including the coordinating committee website and our NOAA IGLD update web page.
If you're looking for geoid data I have links to Canada and geodetic survey websites.
Water level data we have CHS and co-ops.
And I wanted to add that we will be doing some web enhancements to you know, our water level data products.
And if there's anything that you as a stakeholder are looking for that will help with your -- your transition to IGLD 2020, we would love to hear about them in the chat.
We'll be taking notes of all of the suggestions.
So thank you for your interest in the IGLD update.
And I'd be happy to try and answer any questions with my other presenters at this time.
Thank you.
>> All right we've got -- this is Jeff back on here.
We've got at least one question Sierra, that came in a little bit earlier but it's probably best for you.
So this came in from Jack Riley his question is: What's the general heighth range of the mean water level variation in the foundational station gaging that is part of the IGLD epoch definition?
What's the general height range of the mean water level variation in that foundational stage gaging that is part of the IGLD epoch definition?
>> Gotcha.
Yeah.
So for the mean water level surface for the Great Lakes will be again we anticipate looking again at those master gaging stations Markette and lake superior harbor beach lake Michigan, lake shores St. Clair shores in lake St. Clair and Oswego and Ontario.
And so I did see Jack's question come through and I plotted up our water level data just from 2000 to the present.
And it looks like that -- the range in at least our monthly means throughout this time is anywhere from 1.1 meters to 1.8 meters.
So the mean -- the monthly mean ranges on each lake anywhere between 1.1 meters and 1.6, sorry, 1.8 meters.

So yeah, we're taking a look at exactly what water level data will be used in those mean water level surface calculations whether we're going to just use data say in the summer months where we also have our seasonal gaging, data available.
Yeah, to try and account for you know, identifying what is the most real mean water surface across each lake.
I don't know if that got to Jack's question.
>> Maybe I can add that we have another group looking at what we call hydraulic correctors and they're looking at the actual lake topography, lake surface topography.
That's really enough the variations of the mean water level that's the variations in the actual water levels coming from all kinds of things like river discharge and other things that Jacob mentioned.
So that is being studied right now.
And that will be very interesting to see how these lakes actually -- how the lake surface actually vares from location to location.
That's not really answering your question about the variations in the mean water level.
But any way just something else to bear in mind.
>> Cool.
Thanking Mike and Sierra there.
Jack commend it will be interesting to see how that change in the mean compared to the water level height range on a per range basis as well as the reference epoch and may regard this as the source uncertainty of what is the IGLD local water level datum short of augmenting with a model of on datum total water level is somehow tied to the GNSS reference frame.
And so we do have a few questions that we'd like to go over.
I'd like to read and kind of prompt our audience to go ahead and key in their thoughts, their responses into the chat box.
So just to clarify you know the purpose of session really is to solicit your feedback on the IGLD and any concerns or comments you might have about it.
So we're going to prompt I've got four questions go ahead and respond to them in the chat box.
The chat box that's labeled IGLD discussion chat.
You should see it on your screen somewhere.
And we're going to capture all those responses.
We may not go over all of them but once we get through the few questions we'll open it up to all of you to ask our experts here today any other questions you might have.
You can ask them those questions in that same chat box.
And I'll read them allowed for our expert -- a loud for our experts.
All right.
Let's start with our first question.
So you could see it there up on the screen.
So what tools do you use now to calculate IGLD heights?
Anything you use whether it's a CGS tool or product, an NGS tool, a NOAA tool, we're curious what you're using, it a you know, something you've developed, a spread sheet, a piece of software, anything.
Toss it in the discussions box and we'll see kind of what we see.

So we've got a few answers I'm not -- I guess everybody can probably see them.
The we've got quite a few.
The majority out of our answers people are using vdatum.
That's the NOAA VDatum tool.
It's a vertical transformation tool that's available vdatum NOAA dot gov I believe is the page it able as an online version you can use the web interface or download vdatum, use it on your PC to transform various different file formats.
There's software that can tap into VDatum and uses those grids that are available as part of the download.
At Mike -- if you remember Mike if you were on yesterday from co-ops he's got a comment here I'd like to read it.
So Mike's comment is a note that VDatum is just using the Milbert model included in the tool the transformations there were not created by the VDatum team.
So if you saw and heard Steven White talk yesterday you probably heard a little bit more about that.
So, yeah, most of our responses have VDatum.
Somebody had indicated they're using NOAA water level gauges.
So we got a comment from Jack Riley there he's interested in doing his own you know, grid math also.
But uncertain of the gravity data bin file format in VDatum.
Jacob, feel free to correct me if I'm incorrect or add something here if you're on Jacob.
So information about those gravity bin files can be found on the NGS web page on some of the geoid model specific pages, Jack.
So if you can't find that, look to send an email, reach out to Jacob Heck there or myself, Jacob if you had anything to add feel free on that.
But that's the best source of information on what's in those bin files is one or more of our geoid model pages do have some information on them on the usage of those.
>> Yeah, the same thing go check out our geoid web page.
There's a lot of information there about the geoid models including the current hybrid models that we use to go between 83 ellipsoidal heights and 88 type heights as well as the ex-geoids we call them that are leading into the development of 2022 including the data sets that go in them, the gravity values there so --
>> Okay.
So Jack clarified apparently there's some bin data files that I'm not familiar with, Jacob, maybe you are.
So the maybe you can see the IGLD 85 grav data bin and the grav direction I would assume grav direction bin GTX files do you have any thoughts on that, Jacob or maybe we'll -- we could follow-up with Jack.
>> This would probably be a good follow-up, and I think another symptom of why we need to go through the big modernization effort that we're working on.
Because we do have a variety ever tools out there on our website, they're there you can use them but maybe not as intuitive or as easy to find.
Yeah, if you go into our old geodetic tool kit that may be --
that's where that's at.
>> Okay.

Go ahead, Mike.
>> Yeah, I can add something about what we're doing in Canada about this.
>> Yes.
>> Right now we don't really support IGLD 1985 because it was based on 88 and we never adopted 88 in Canada.
What we did was move to 2013 back ten years ago which is a geoid based datum and will be compatible with the new one the 2020.
We do have our tool that will convert or compute IGLD -- sorry not IGLD it will convert dynamic heights in 2013 which will be in 2025 identical to IGLD 2020 heights.
And yeah, heights in IGLD 2020.
So we don't have a tool for IGLD 85 but we do have a tool that will be used for IGLD 2020.
>> Okay, cool so --
>> [Multiple speakers].
>> Sorry, it's GPSH tool that I mentioned in the presentation.
>> That's kind of to clarify.
I think I stated in the beginning do you use an NGS tool or CGS tool.
So yeah, Mike's kind of keeping me in line here there's not exactly a tool --
>> IGLD 1985.
>> Right.
>> [Multiple speakers].
>> We do provide --
>> Yeah we do provide IGLD 85 heights on benchmarks around the Great Lakes.
>> Okay.
>> We don't have a tool to convert from ellipsoidal to IGLD 85.
>> Okay.
Cool.
And is that in the -- to find IGLD benchmarks around the lake is that going to be in the same like geodetic control map tool for any other.
>> Yes.
>> Okay, cool.
>> When you click on a station report you'll get all that.
You can select the datum you want both the geometric data and the vertical.
It would provide the IGLD 1985 height for those stations that were included in the IGLD 85 network.
>> Oh, okay.
All right.
So only for those -- yeah, that's the key there, it's only going to be --
>> Yes, exactly.
>> Yeah, great, great.
Okay.
Let me see.
We had a couple more responses here on this topic.
Okay, Mike, I see, so Mike kind of went over what he had typed in there.

But there was another comment from Mike -- at NOAA co-opposite so the VDatum he wanted to add that the VDatum team is still determining how to model the new IGLD datum into you know the future VDatum since it's a geodetic based datum co-opposite is going to be relying on experts within NGS to really create the model transformations that are all still being discussed but something that we are thinking ahead about and looking forward to.
>> Yeah, I guess that sort of goes back to the hydraulic correctors working group.
They're providing updating hydraulic correctors and will be providing a new hydraulic corrector model for the Great Lakes.
That will replace the older Milbert model used for IGLD 85.
We're connecting hydraulic correctors to be much smaller this time around.
The old 1985 hydraulic connectors tried to remove much of the air in the IGLD leveling network around each lake.
It doesn't remove all the air just the relative air around each lake.
>> Yeah and so we've got a follow-up question to the tool -- the link that Jeff Oiler shared if anyone sees that in IGLD discussion chat box, Jeff Oiler shared a link to an NGS tool.
>> Right.
>> And Eric has a question about that.
So the link provided there which is Jacob and Mike, if you're not -- if you didn't click it it's the dynamic HT or dynamic height program.
So the link Jeff provided which has that NGS dynamic and then apparently it also has -- yeah at the bottom it has a link to the IGLD 85 tool, the question is that going to result in different values or different conversions applied as compared to using VDatum or do they both use the same model for that transformation.
>> Not sure I understand the question.
So for IGLD 2020, we won't be using the Milbert model we'll be using a new one.
>> Okay.
>> Because that new IGLD 2020 datum will remove much if not all of the leveling systematic error.
That leveling systematic error was incorporate into the old Chemed.
So the new corrector model will have a new one and be provided I'm assuming VDatum will include that model so it will be a different correction there.
Mike -- had a note here.
That's important to realize.
And maybe we didn't clarify that enough in our presentations, but IGLD datum is really heights in IGLD are really only dynamic.
There's no such thing as orthometric IGLD heights.
So what we do is take the orthometric heights from the geodetic datum like navd 88 or 2022 and convert them to dynamic in order to get them into that IGLD 2020 framework.
And on top that have there are the hydraulic correctors which are needed for the water levels.
So, yeah, it's -- another one here [inaudible] another question.
>> Yeah, so Derek's question was really more about the current datums.
Let me reword it a little bit.

Basically he's wondering if and Mike maybe you're not too familiar with the website that Jeff shared, I've used it.
And I'll share my experience and maybe Jacob if you have any different experience let us know.
So if you're looking at the link Jeff Oiler shared earlier if you scroll to the bottom this is a link, another link, to the IGLD 85 height conversion tool right that's what it's called when you click the link.
What I think Derek is getting at if you use that tool if I key in a lat, long height am I going to get the same result from that tool versus in NOAA VDatum.
I'll put it this way Derek from my experience, yes, you're going to get the same results but I have not done extensive testing.
I know that the intent of our --
of our teams whether it's you know, the whoever is working on dynamic heights modelling, versus Steven White and his folks on VDatum the intent is for them to be using the same models using the same values and the same methods to get those same results.
But I've never experienced anything otherwise.
Would love to hear Jacob, if you have or anybody else who said well wait a minute I've seen an issue, let us know now.
We'd love to discuss it or maybe look into that.
>> Yeah, so with those two tools it should be the same.
And you've got me thinking -- I seem to remember helping somebody with this a couple years ago.
And right in that boundary between the connecting channel and the flat lake so in this case it was Detroit river coming into Lake Erie.
There may have been a little bit of a difference in where the boundary is as far as where the hydraulic corrector gets applied and where it does not.
So there may be little tweaks like that.
And this might be I'm wondering Jeff Oiler if you've had any experience with this, please let us know here.
So all of them the math is the same that I think just in some areas that the hydraulic corrector gets applied maybe where it shouldn't and especially near the connecting channels.
And even upstream inland a little bit.
So that's the only difference that I've noticed.
>> That -- I'd say the sail thing Jacob.
And Mike -- added here from his experience you know, you're going to get the same results in VDatum as with that website, why?
Because they use the same tool they're using the same data.
But the issue that I noticed maybe not an issue but the little I had I don't sink a see that I've noticed the boundary if you go to NOAA VDatum on our website in the online version you can see the boundary of where the IGLD transformation parameters are going to be applied if you key in longitude and latitude within that polygon and if you key in outside you'll get a no not available answer right outside the parameters but there is no visual on the old NGS tool that Jeff shared the link to.

And I think what happens is that polygon it's not exactly the same.
So you might get that incorrectly applied transformation out of the old IGLD 85 height tool.
It going to be very similar to VDatum, but let's see.
>> Yeah, it's how the kind gets applied and like Derek says in his recent comment here calling it a false hydraulic corrector that's probably a good way to think about it.
>> Yeah, yeah, definitely.
>> So, but in Jeff's comment here Milbert's model still fits well with the 91 epoch that's the national adjustment of NAP 88 was done especially on the western side of the Great Lakes.
So yeah, I suppose -- a lot of the questions that I've had come in have been on my side on the Lake Erie Detroit river, that side where there's a lot of population and a lot of construction activity going on.
But yeah, as you go across the lakes it may vary a little bit.
I do want to make one more comment, I want to make sure I was clear about that orthometric dynamic the difference between those heights, now, with IGLD 85, the leveling adjustment that was a part of that that did the definition for it, it was the same leveling adjustment that was done for NAVD 88.
The way that adjustment was done was the geopotential number side it was.
So that letter C that I had in some of those equations that's where there's the equivalency between 88 and IGLD 85.
Now, 88 can be realized as dynamic heights or orthometric heights generally it's orthometric heights but you can have a 88 height if you apply grift in that way.
And that's where theres that equivalency between them and 88 does not have hydraulic correctors in any case.
>> Yeah, so on that topic, right, and kind of akin to what we just talked about before right, maybe some of the boundary issues and where the datum applies, so and using IGLD 85, Jacob, you know, what about so we talked -- you mentioned I remember in your presentation earlier today the connecting channels but what about tributaries like the -- river upstream of Toledo well, it's a tributary of one of the Great Lakes is that an area where IGLD 85 applies?
>> It's a water surface and the basin and I'm going to say yes to that.
And I and where I really aware of that being the case is along the -- so along the [indiscernible] river that flows into the [indiscernible] river there's a series of dams.
Those were reference to IGLD 85.
So it's water level, of course inland like that.
Where you have knowing water there would be no hydraulic corrector but yeah, it's there's -- that -- that's a valid use of it.
>> Cool.
Yeah the key there is hydraulic correctors, no hydraulic correctors outside of lake right.
>> Right.
>> Cool.
We got some good feedback on there.
And let's look at our next question.
Did we -- all right, yeah, okay.

Cool.
So there we are.
It's up on the screen now.
So are you transforming between datums and what tools are you using any vertical transformations and what tools are you currently using.
As you look at that question just a follow-up from Paul you had mentioned the -- river up to the grain elevators yeah there's some grain elevators there I guess where there's some --
moving in and out.
So I'm looking at our question are you transforming between datums and what tools are you currently using, are you using commercial products, are you coming to the source, whether it's NGS or CGS tools every time.
Or maybe you're using one of the APIs that we have available.
I'm not aware, Mike, you could speak if CGS had some APIs or web-based tools that commercial software can tap into, but let us know what you're using there.
>> Yes, we do have web services but it's not documented.
So people that want to use it they contact our client services and then they let them know what the APIs is like.
>> Okay, interesting
>> That is being documented right now as I speak.
So hopefully that will be ready soon.
>> Okay, yeah, that's great.
>> Talking about transforming between vertical datum and geometrics.
>> Yeah, that's the focus of today's talk but I'm sure that's -- if somebody has a question or a comment geometric I'm sure we could address it.
Yeah the focus of to the was really vertical datums.
>> Right.
>> So there are web services available just not easily discoverable online just have to reach out to get the information but sounds like coming soon.
>> Yeah.
>> Cool, awesome.
So we got a couple comments, yeah, online interface of VDatum or other software that uses the VDatum grids, yeah, know of a couple different commercial softwares that could utilize or use those VDatum grids.
Comment from Derek, you know, they typically collect topography in NAVD 88 and convert it to IGLD 85 elevations or lower water datum depending on project needs.
From Mike for co-opposite all the seasonal gamings were put onto IGLD 85 using the Milbert model based on a link to a bench mark that had the 1991 adjustment so that they had the same zero reference frame as the active stations.
So those permanent stations, I guess is that -- I think that's what seasonal versus permanent is what Mike's talking about there.
>> All right so let's see what's our can we move to our next question there?
So talking about those transformations, what you're using and I think we got kind of a little bit of a thought from Jack Riley on VDatum but what would you like to see on a

transformation tool, what are the weak points or what would you like to see out of VAUTD or something that would be you know, completely replacing it?
What would make it more user friendly to you, what would make it easier for you to go to you know the source and use that authoritative tool, let us know your thoughts on that.
I feel like the web service and API integration is really a good move on the part of both you know, all of the different NOAA offices and CGS, you know, I think that's a really good way to go than you know, our commercial partners can go ahead and you know integrate that into their tools.
Maybe make things a little more user friendly.
Allow folks to you know, keep within their work flow of whatever commercial product they're using.
So we were wondering what would you like to see in a transformation tool?
We would like to see a chat GPT-based transformation tool you just say here's where -- that's -- that's down the road.
I see -- I'm waiting there's a couple folks typing that's why I'm kind of waiting to see what they were going to say there.
Give them a moment to check their thoughts and let us know what they're looking at.
Looking back to see if there was anything that we kind of skimmed over.
No.
So comment from Derek the existing VDatum capability to do horizontal or geometric and vertical conversions would be nice to see moving forward with the new NSRS modernized datums and the low water datums.
So, yeah, something I think maybe Derek's getting at right is if you looking at NGS tools we have VDatum which handles primarily right started with vertical datums including the non-NSRS datums like your water level datum then we have another tool called [indiscernible] that deals with all NSRS specific datums and so there's kind of like two different tools get you the same answers but yeah, I hear from a lot of folks really be nice to see just one thing, one place to go.
But I see a few more -- oh let's see got one more comment on this topic from Jack Riley in addition to the tool fostering of the data as a product for use in user tools, right, like those published grids published standards any additional official algorithms on top of that, yeah, that's a good idea.
So example ortho from geodetic converted to height like what procedure is followed?
>> Yeah, actually I think you can find that in what's called the blue print documents for the new North American datums, the part 2 is on the vertical datum, 2022 and I think Jacob maybe you can chime in here but I think it does include there the algorithm for converting it to dynamic height.
It's pretty simple actually.
It might not seem like it.
Really what you need is a gravity model in order to compute the mean gravity at the point, mean graft along the plum line between the datum and the point on the surface.
And so you take that and you actually remove it from the orthometric height.
And then use the -- the what's it called normal gravity at 45-degree latitude.
It a constant.

So that's a fairly straightforward conversion but you need the gravity model to do it.
You need to get the gravity at your point in order to do that conversion.
So that's a bit of extra work there, a bit of extra data you need to include.
But any way check out the North American geopotential datum of 2022, the North America Pacific, the blueprint part 2, it's in the links on the slides.
>> I just added the link to the --
>> Oh there you go, yeah.
>> You can see you can get directly to it.
It's been a while since I've picked that document apart but I don't remember having it show how to go and get dynamic heights from all of the -- it explains where all of the -- all of the pieces to that set of equations comes from, but it doesn't spell it out.
>> Oh, okay.
>> From what I remember.
>> Maybe we should update it.
>> We already did that.
>> Ate -- it's a living document, Jacob, maybe it need a better update.
And then for the current datums if you're looking at that, something about moving between AVD 88 and dynamic heights, if you revisit the tool that Jeff Oiler shared the link for earlier there is a documentation link on that page that does break down what the tool is doing.
>> Oh.
>> The formula it's using there.
The other thoughts I had on this topic of right like the what was the phrasing Jack used data as a -- data as a product, so this doesn't exist for VDatum, right but I think it's a really good way to move for NOAA.
So NGS we have on github all of the -- I mean really everything you need to know to you know, recreate our tool called NCAT.
Remember maybe not remember but let me emphasize that NCAT the NGS coordinate conversion and transformation tool it does not support IGLD, right, that's what VDatum does, that's different but all of the source code for NCAT anything you'd need to know about NCAT and what formulas are being used for transformation, what grids, how they're being applied it's available on github.
So maybe that's a direction we need to look at NOAA for VDatum.
Just kind of tossing this out as a discussion topic.
I know that that has made at least two people really happy.
They were like hey how do you guys do this?
They called me and one of them I was -- he was familiar with github, he emailed me back welcome a couple of hours and was like man this is everything I needed to know.
Just a little point to share there.
Some more follow-ups on what you would like to see in a transformation tool from Frank -- sorry about that FRAIRNG you've got a name like mean.
He would ask for a transformation tool that would be easy to use for those of us that are not familiar with VDatum so a tool for the non-experts, I think what Frank is thinking of great idea.

In some aspect VDatum does a decent job of that, you can sort of do drag and drop you can click a point instead of having to key things in and get some transformations or conversions done that way.
Let's see I got a comment here.
From Mike -- co-opposite let me read this so to mirror yesterday's presentations one of the key things you need to do whenever you're working with vertical data is ensure or geometric data is ensure you have all the proper metadata based on your current work, your current survey, so that way you can transform to the future datums right, again.
Metadata really is key for that unity or being able to work and transform between datums and especially down the road working in that fourth dimension of time moving between epochs, you know.
Just looking at, okay, yeah, so that was most of the comments we got on what you would like to see in a transformation tool.
Again feel free to type in whatever any questions, comments but right now I want to you think about this: So what do you use the IGLD for?
What do you use the datum for?
It's a great time to tell us.
And let us know and maybe maybe the comments back from our experts will say wow, we never thought that have, or they might think oh, that's -- maybe that's not such a great idea, you know, but it's a great place to share what do you use the IGLD for and maybe you'll get someone he is to think of what they could use it for or what they shouldn't be using it for maybe.
So one comment we have is for nautical charting.
Right.
So the IGLD low water datum Jack Riley's there using IGLD for nautical charting.
And hopefully anybody using nautical charts on the Great Lakes familiar with that. So what do you use the IGLD for?
I know when I had -- there was a Jacob you could share, I can't remember the name of the organization, there was a state-based agency in Michigan, they would use IGLD heights for dock and shoreline permitting, right.
There you go.
Perfect example right there.
I can't remember what organization it was.
It was like Michigan State something environmental.
So there --
>> Go ahead, Jacob.
>> That echo Great Lakes energy.
>> Yeah, that's right.
You say the acronym, I don't remember it, but yeah.
Environment Great Lakes and something.
EGLE.
So a couple comments there.
So Derek you say start using IGLD for navigation channel surveys, dredging, structure design, presumably along the shore or within the water, right.
Water regulation and permitting and using those ordinary high water mark values.

Paul says marine terminal operational elevations.
Okay so, yeah, marine terminals operational elevation IGLD makes great sense.
Dave Wolf says most setbacks from the Great Lakes are pegged to IGLD so setbacks I guess permitting setbacks or construction, offsets or like that.
Setback requirements or minute setbacks.
Navigation Paul -- is saying the allowable draft under the vessel, right and the overhead clearance above marine vessels is one place they use IGLD for.
Frank says they're using IGLD as a reference for water levels for all water regulation plans used by the international Joint Commission Great Lakes regulation boards.
Yeah.
All of our folks kind of sharing they use it for the same thing right nose navigation channel surveys, dredging, water regulation, permitting, et cetera.
Looks like I think we kind of --
oh we got one more.
I think Mike was typing something in there.
>> I was just going to provide the link to our GPSH model.
>> Oh, okay, yeah.
That would be great.
>> I will help anyone today because we [inaudible] IGLD 1995.
>> Gotcha.
>> But it's the one where you will find the conversion or IGLD 2020.
>> Okay.
Okay.
So for the --
>> Our website's been down all morning because of the ice storm yesterday.
So it just came back online now.
>> Oh, didn't realize there was an ice storm up there.
Wow.
>> Yeah, well a lot of freezing rain.
A lot of trees down, branches down.
>> Oh, wow, oh, okay.
>> Power outages sporadically throughout the city.
>> Gotcha, gotcha.
>> Any way it's online now.
So that's the link to it.
It's a pretty simple web interface.
You can use the source and target and it will convert.
So by 2025, we'll have IGLD 2020 in there.
NAVGD 2022 as well.
>> Okay, awesome.
And that's GPSH.
>> That's right, yeah.
>> By CGS, cool.
All right.
So not seeing much else on what folks are using IGLD for.

So what questions do you have for us?
You know, is there anything you got on IGLD, whether it's highly technical.
I'm going to look back at a couple questions that we didn't get to, maybe we missed earlier.
We'll see.
But we're really interested in any way further questions you have for us while we're here, while we have the time.
>> Maybe I could add to that.
>> Yeah.
>> What they need from us as well.
>> Yeah, what do you need from us?
Especially as we moving towards new datums, what do you think you need, you know, to make your life efficient?
>> I think we're anticipating that you'll need these tools we've been talking about and they'll need to be update for IGLD 2020.
And with transformations from the older datums but we're wondering if there's anything else.
>> Sure.
And just to follow-up on a couple things from earlier.
Mike one of the questions that you had been talking about we had looked at Roger from restore our waters international he was saying thanks for your thoughts on you know, the whole long-term historic changes or you know, assessments.
He was just hoping that the coordinating committees hydrology working group will take up the challenges of.
>> Right.
>> Or pre historic GIA rates.
>> [Multiple speakers].
>> Go ahead.
>> And we're here to help with that, both NGS and conscious if you know, hopefully some other members of the CC will take that up or anybody else and we'd be happy to help with that.
I see there's another one here too, Paul Boyce.
>> Yeah, so Paul Boyce, will new vertical and water datums be rolled out at the same time?
>> Good question.
>> Yeah.
>> I can -- this is Laura, I'll jump in.
>> Go ahead, Laura.
>> I think Inc. The plan is for 2022 to roll out and then about a year later the new IGLD values will roll out.
Low water datum we'll talk about later this afternoon, but we're hoping that if we make changes that will roll out at the same time as IGLD 2020 as well.
So --
>> Okay, great, thanks, Laura.

So the low water datum or LWD is still kind of if as Laura mentioned there, but that would be the hope, that would be the goal is that everything would roll out at the same time there, Paul.
There was one comment just from earlier from Derek he just wanted to chime in that it would be beneficial to the hydrographic surveying community if computing dynamic heights was possible on the fly.
So within CSRS, PPP and with OPUS, probably.
We talked about that earlier on there, there was a question about that Mike and Jacob had addressed.
>> But I think someone also I can't remember who now asked about on the fly for hydrographic surveys.
And so I took that to mean actual real time dynamic heights.
>> Yeah.
>> That's a good question actually.
I'm not sure.
It depends on what kind of RTK service you're using, if you're setting up your own.
I'm not sure the tools are there to do that actually.
The commercial RTK services, they do build in transformations from ellipsoidal to orthometric heights in their controllers, theirdata controllers.
Whether or not they would build in a gravity model to transform to dynamic heights is another question.
I think it would really depend on the demand.
They wouldn't go out and do any extra work unless there was a benefit to them to do it.
But you know, if enough people lobby them, I'm sure they would do it.
It's you know, not an onerous thing to do.
It's just another gravity model in this case instead of like a geoid model to get orthometric heights.
So yeah, I think it really depends.
It would be nice to have that, but I think it's kind of out of our hands and more in the hand of the RTK developers or providers, services.
>> Yeah, probably the commercial partners maybe not necessarily providing the network services but the hardware, the hardware and software that you --
>> Yeah.
>> Are network services, you know, any real time network that's broadcasting, you know, geometric positions right that you're going to get a ellipsoidal height from you can applied that gravity model that Mike talked about, but if there's no way to do it, right then you can't.
It's kind of a niche market the hydrographic community especially in the Great Lakes but boy that would be really interesting to see some development like that.
>> I think probably third party developers can do that by adding an additional module in the data controllers.
>> Yeah, yeah, you know, there's at least, yeah, at least two companies I usually avoid company names without my disclaimer but I'll say two large name brand surveying companies that I've used their equipment have SDK or software development kit

options that customers can purchase or even contract directly with someone to build an additional feature set.
And then what happens if you build it or some of your team builds it and it's really great, there's even the option of them you know, integrating it and they pay you for it, you know.
>> Right.
>> At least one of them.
So, yeah, there's really might be a really cool option there if you're really looking for on the fly like Derek said and Mike presumed which is real time.
>> Yep.
>> Yeah, that would be really interesting.
One more comment there from [inaudible] say we really do need to continue working together and communicating, that's what today and yesterday have been all about so far.
I think it's been good.
I think so anyways, really great to see that we've got attendance from a lot of different organizations.
And let me see now.
We've got just something come in here though.
Okay, let me -- yeah, let me read this so here's a question, comment from Jack Riley.
So he stepped away for a moment but I don't think we have discussed this.
So yeah let's address it here.
So Jack's saying my understanding of the ordinary high water mark is that it's somewhat ad hoc datum based on nominal high water shoreline based on debris observations, right.
So typically that's, yeah, that goes into it.
And then charted heights that would normally reference a high water datum elsewhere like in tidal areas mean high water, right.
So charted areas that would normally reference a high water datum elsewhere use low water datum not ordinary high water datum in the Great Lakes.
Jack, I'm not sure if I'm picking up everything you're laying down, but Mike, Jacob, Sierra, Terese, chime in if you're following there.
>> Hey, Jack, this is Laura.
I think what you're asking like nautical charts normally use mean low water level as their chart datum.
I think what you're asking is like bridge heights or on coastal charts are referenced to mean high water.
So I don't know if that's what you're asking about like the bridge height clearance or not.
On charts in the Great Lakes.
But nautical charts on the Great Lakes are reference to low water datum.
>> And then to go back to that -- the first part of what you said, Jack, the ordinary high water mark is that it's somewhat you know, an ad hoc datum.
I wouldn't call it that.
I mean depends on the state, there's how many states along the Great Lakes, I don't know whatever the number is.

Each state really has their own legal procedures and all that for defining it.
And so some do have a numeric value in you know, IGLD 85, or maybe even in NAD 88 where they say this is the elevation of the ordinary high water mark but where did that come from, right, yeah it comes from looking at those debris lines or other physical evidence.
I wouldn't really call it ad hoc though depending on the state just to go back to the first part of your question or comment.
Question or comment here from Derek so each lake has a published state elevation and then a USAS elevation which is in IGLD height upstream.
So upstream from the lake ordinary high water is subjective oh, yeah, once you move up to a tributary, yeah, for sure that's a whole --
repairing situation or repairing rights are completely different.
But a comment from Derek back to those on the fly dynamic heights we were discussing so really thinking at that dynamic heights on the fly in IGLD values would probably only greatly benefit USACOJ. Big organization, you know, work with your commercial partners you buy software and hardware from you other know.
I'd also be open to talking to sharing what I know about the SDKs at major companies, Derek.
If you want to discuss that anytime let me know.
I've talked about it with at least one other person who's looking at trying to integrate their open features into a certain commercial software.
Yeah, Dave Wolf, same thing back to ordinary high water mark seems to be a more subjective elevation.
There's a big difference between land rights and technical sides so legal versus technical aspect of ordinary high water mark.
So again every state along the lakes is different just like along the tidal coastal areas, right.
All 8 have different --
different regulatory purposes.
Let's see.
But Laura had a question follow-up there David Wolf, you had something about setbacks.
And are those setbacks relative to IGLD 85 and we're curious are they codified in state regulations.
David Wolf you mentioned setbacks from the shoreline.
Real curious about that if you could follow-up.
Let's see and then Jeff Oiler has shared a link to the Detroit's district's information page on the low water mark and low water datum.
This is a great page too.
I've shared it with other people who had questions.
Lost my train of thought there.
It's a great deposit that Detroit direct has put together.
Really applaud this page because it has been something simply that I've been able to email at least a few different people and oh yeah that's the kind of information I was looking for.

So Laura Dave Wolf not really sure historically how those were established but surveys of plats indicate those setbacks.
So sounds like he's done some boundary or real property surveys along the lakes.
But comment also on that topic from Roger at restore our waters, so he thinks that Dave your comments about setbacks are largely in the high erosion risk areas maybe not in some of the more typical beach like portions of the lakes.
So high erosion risk areas where a lot around Michigan, a little bit in northern Pennsylvania, those are the areas that I know of.
But that's all I really know of.
Let's see.
Keeping an eye on time.
We got about 9 minutes until our break.
Just looking at the schedule there, okay.
Yeah, thanks for clarification on that, Dave.
Really appreciate your comment on that too, Roger.
That's interesting there.
We've got a few typing here.
So I'll give that a minute while I look back out our questions, see if there's anything that we've I don't see much that we skipped over.
Just to again though highlight one of those links that was shared it was a pdf, Jacob Heck shared a blueprint document, those are joint effort documents between NGS and CGS, again this great 53 pages of awesomeness there all the future geopotential vertical dame.
A couple comments -- said is there a long-term trend in the water level in the Great Lakes?
Sierra, that might be a good one for you.
So is there a single long-term trend in water levels in the Great Lakes, or is it more variable?
>> Yeah, that the a good question.
I would say overall it's more of variable.
We do know that we see some trends due to those effects of GIA.
Yeah.
If others have thoughts on this, lawyer remarks Jacob, that you want to jump in.
Kind of lake to lake.
I'm not sure if there are any long trends, long-term trends lake to lake.
That's something we'll be diving into looking into the water level data for IGLD 2020.
Yeah, in the lakes a lot of what we see is meteor logically driven.
Jeff just made the comment.
That's where we see a lot of the change in our lake levels.
.
>> Yeah, I think really the answer is no there's is no single long-term trend.
I'm not the expert but Sierra it kind of sound like what your experience has shown it's definitely more dependant on other at months spur Rick and earth processes right (.
Roger said clearly FEMA's flood zone delineations are highly affected by elevation determinations.

And so I know there was a question yesterday, I believe I recall about new datums and FEMA firms and all that.
And there was a rep from FEMA region 6 I believe yesterday who I reiterated this somewhat clearly I just want to reiterate it because people ask it a lot when we talk about new datums whether it's IGLD 2022 or IGLD 85 and IGLD 2020 forth coming on the Great Lakes.
They say is FEMA going to update all these maps they just start -- not just started but recently just started revamping the coastal Great Lakes maps right with VE zones, right, velocity impacted zones.
People are saying so are they going to upgrade everything with new datums.
The answer is no.
You know, the reason they're not is what the FEMA rep had indicated yesterday is every firm that gets published and finalized is required to go through a community review process, okay.
Anytime it's changed significantly enough you know, requires that community review.
A datum change or datum transformation of the data on the map is a significant enough enough change that requires a community review.
So you would have to imagine that FEMA scheduling and organizing community reviews of every firm across the country would really be implausible if not impossible to do in conjunction with new datums rolling out.
So, yeah, there are delineations highly affected by elevation determinations, yes, but it's --
is the land changing right the contours of the land changing, probably not to much, it's more a macro scale not necessarily a micro scale.
Yeah just a comment of mine kind of following up from what the FEMA rep had shared yesterday in the chat.
So question there from Jack would the ordinary high water mark be the same as the co-opposite quote unquote high water datum computed over 2017 to 2023?
I'm not sure if Laura or Sierra, you'd be familiar with that, the co-opposite HWD or I presume high water datum.
>> I think what you're getting at, Jack, is asking if the epoch that we're collecting the water level the 2017 to 2023 data set is going to be used to calculate the ordinary high water mark, is that what you're asking maybe?
In that case the conversation about ordinary high water mark is ongoing.
And that is actually a calculation that Army Corps owns.
And so we're working with them to decide what we're going to do with ordinary high water mark in the same vein that we're talking about low water datum.
So I hope that answers your question.
And so, no.
And so no, that seven year --
that seven year average is not going to equal ordinary high water mark.
>> Thanks, Laura.
Yeah, I hadn't heard of the co-opposite -- co-ops water data.
We're coming up on 12.

And I just of the wanted to close the questions with a comment from Mike again because he's kind of rolling up what we just said but he worded it rather eloquently.
Looking at water level trend co-ops does not compute sea level trends in the Great Lakes since it does not have an association with global sea level change like we do in the coastal environments right.
So it's dynamic environment that is really controlled by the GIA, the glacial static adjustment that we had been talking about Jacob mentioned an Mike mentioned earlier and not sea level rise and change.
So the VASHTH we -- variability we see is based on again meteorological functions and that ground motion vertical land motion or VLM.
It's 11:59.
Sound like everybody's wrapping up.
If there's anything else, Jen do I need to turn anything over to you if you wanted to close us out for lunch.
>> Yes, thanks, Jake.
Jeff, thank you so much.
Yep, as they said we are on the lunch hour.
So we will be back here at 1:00 p.m. eastern.
There are links until then in the link box to IGLD resources and we'll have more presentations and breakout session this afternoon.
So enjoy.
: : : : : : :
>> Hey Derek if you can hear me go ahead and enable the microphone at the top of your screen.
>> Okay.
Can you hear me?
>> Yep.
Sounds great.
Thank you.
We'll just wait a moment for Jen to start us here.
>> Okay.
>> Yeah, good afternoon, everyone.
Welcome back from lunch.
And our next presenter is Derrick Beach.
A water resources engineer working with environment Change Canada.
Take it away, Derrick.
>> Good afternoon.
I hope everybody enjoyed lunch.
So we're going to change gears a bit now.
And look at the low water datum and what we might be doing with that in conjunction with the IGLD.
So the Great Lakes low water datum is an important reference level used for safe water navigation and harbor infrastructure development.
Nautical charts Great Lakes are referred to low water datum.
The current low water datum hasn't been updated until 1933.

The ongoing update this is an appropriate time to look further into this question and if changes are needed undertake the changes in conjunction with the IGLD updates.
The results presented here with preliminary investigation of an I object toer agency -- coordinating committee on Great Lakes basic hydraulic and hydrographic data.
These results will be used in the ongoing investigation into the current data should be update one of the key purposes [reading] [indiscernible]
.
In this presentation I'll be going through the definition of low water datum and why an update to low water datum is being considered, a brief summary to analyze potential changes and preliminary results of magnitude of potential changes and following that we'll have a couple presentations on some potential operational changes from low water datum.
So what you're seeing now is a depiction of the Great Lakes system starting on the right the ocean levels so the afternoon ocean levels and moving up through the St. Lawrence river, Lake Ontario, Lake Erie and Michigan and superior with the connecting channels.
So the low water datum is established for each different lake.
And through the system.
Each lake has a different -- a different level.
It doesn't stop completely apparent in this graph but you can certainly see the difference in Lake Ontario to Lake Erie due to the escarpment of Niagara Falls and each of the upstreams have a slightly higher low water datum.
It's defined as a lake-wide surface.
So it's a flat surface across the entire lake.
And the there are different low water datums established through the connecting channels for --
between each of the lakes as well.
So low water datum was established in 1933.
And we did limited data at that time.
To actually establish it.
And it was a -- a compromise between two existing datums at the time.
That were in use.
And there was no real specific scientific method used to establish the actual datums.
It's simply defined as a level that rarely the level of lake goes below, that's the -- that's the key definition of that.
Each of the -- the levels were established on a number of points across the lakes, that was a lake-wide average.
So each lake has a number of different points to take into account the different lake level changes across the lake that we saw earlier this morning.
And then that particular datum the low water datum has simply been updated similar to what we saw this morning for the IGLD 2020, for the IGLD 1955 and 1985.
So during those times the physical location of the low water datum did not change in the lakes.
So one of the key things we're going to look at is potentially changing that physical datum location.

So why update the low water datum now, it's a good opportunity with the IGLD 2020 going on.
That if we're going to change the actual value of that elevation, this would be a good time to do it.
As mentioned previously, the level was established in the you know, pre 1930s data.
We now have over a hundred years worth of data to look at for lake-wide averages.
So we've got a lot of more information to work with.
As well as there's been a number of potential water diversions, channel modifications and erosion in channels.
We've got outflow regulation plans for Superior and for Lake Ontario as well as potential climate effects that may have changed where the low water datum or where the low water streams may be in each of the lakes.
So this shows -- this shows a hundred years of data up to --
from 1918 to 2018 for the upper lakes, Lake superiorSuperior, Michigan and Huron.
We're missing five years of data that had exceptionally high water level in the Great Lakes, record levels actually, but based on the 1918 to 2018 data we see that you know 42 of the hundred years we've been above low water datum and 185 months certain been at the low water datum through that.
And you can see and regulation actually started in Lake Superior in 1920.
So it's been regulated pretty much the whole data set here.
Below Lake Michigan Huron has no regulation on it and it too has a large number of values below what low water datum 28 of the hundred years, 186 months below that.
You can see that the swings in the data through time, and you can also see within those you can also see kind of the seasonal variation too with the highs in the spring and then lose in the fall winter period.
So know we had in the upper lakes we had 1998, to about 2014, we had an exceptionally low water period.
And then we've swung very rapidly into regard high period after that.
The lower lakes is a different story.
You can see Lake Erie on the top and Lake Ontario on the bottom.
And it has not been below low water datum prior to 19 prior to 1968 was basically when it was below water datum and since then neither of them have gone below low water datum since then.
Lake Erie is not regulated and Ontario is regulate.
Ontario started regulation in full about 1964 or so and you can actually see the swings in the Ontario fluctuations kind of tightening up there and crawling aband.
Lake Erie has no regulation but it also has been higher than the water datum quite a bit since 1918.
So that does bring questions into you know, do -- does the low water datum need to be raised for the upper lakes, sorry, lower for the upper lakes and what would we do with the lower lakes as well on that.
So we've looked at the hundred years worth of data 1918 to 2018, we took two approaches.
We looked at the historical lake-wide averages, been coordinate through the coordinating committee task groups and are statistics on that.

We also looked at another method using the coordinated Great Lakes regulation and modelling model which is used to predict the water levels using water supplies to the different lakes.
So the two different ways we're looking at it.
We've actually got quite a bit of data up to 2020 now.
So that's been updated a bit since this slide was made.
The idea between the two is to look historical data.
It's certainly at the tried and true method of doing statistics on various levels.
The model was investigated or has been investigated to basically look at the potential changes over time to channels, to the different things about water takings, channel changes, regulations, that sort of thing.
So basically it uses the current model with all those things built into it and then back calculates the water levels placed on historical water --
water supplies to each of the lakes which would give us an idea if we had current conditions and had historic water supplies what would be our lake levels?
So then those numbers generated through the model and the historical database were then it was a generalized extreme value analysis was completed on those numbers.
It's basically a method that's been used for ocean levels to predict what the probability of an extreme event that would --
that could occur. The lake levels in order -- and the seasonal cycle the lake levels were broken into blocks, year blocks to perform this analysis.
But the year blocks were taken from July to June in order to avoid the low typically low seasonal lows that we see in the wintertime in the Great Lakes.
And that way we avoid double counting lows in the analysis.
So preliminary results are showing on this table.
We looked at a -- we're looking at a number of different exceed dance levels for calculations across the board on that.
These are unlike we talked about this morning where there was changes in values and not changes in physical location on the earth these would actually be a physical change on the earth surface to low water datum.
So for instance, Superior we could look at if we're looking at 90% exceedance it could be lowered by 24 to 20 centimeters based on our calculations and a 90% exceedance level.
Michigan and Huron would have the highest potential change, 30 centimeters 12 inches, 8 inches lowering.
Lake St. Clair would have a 20-centimeter to a 4-centimeter lower.
Erie we could look at the somewhere between a one centimeter or zero inches lowering to an 8ths -- 8th centimeter 3 inches rise in the actual low water datum.
And Ontario we could look at a lowering as well.
So that would be the key things to look at for these to see what those might impact on present operations in the Great Lakes and stakeholders for the -- for the surrounding Great Lakes areas.
And that is -- that's what I have to introduce you to that.
So I'm looking at the questions here.
Thanks for that overview Derrick.
This is Jacob Heck.

I'll be moderating the questions box.
So the first question comes from Paul Boyce, what is the difference in low water definition between Great Lakes and coastal tidal areas.
Yesterday an epoch was defined about 19 years, was the epoch different in the Great Lakes?
>> I'll differ that to maybe Laura.
>> Yeah, this is Laura.
So Paul, yesterday we were talking about the coastline that the outer coast, if you will, around the U.S.
And for those purposes the datum is defined as 19 years because it's a tidally driven effect.
In the Great Lakes there's not really a tide and so over time that definition of low water does not as along the shoreline of the outer like continuous U.S.
So the low water definition has been -- I will say unclear looking at past historic records and documentation.
It was defined in 1933 as a compromise between two separate datums and really, I think we mentioned that they beginning so we now have an opportunity to define it better and document the way that we're going to do that as well.
So yeah, so it is different than the NTD definition.
>> So just I mean, add a bit on that is the basically the levels were -- the levels were actually leveled engineering leveled up from the the [indiscernible]
IGLD 1985 reference.
So it was leveling taken up through the lakes.
And so the change-over would be then as we discussed this morning, establishing those new levels.
>> And we've got another question from Paul Boyce: When defining low water datum sea way for navigational purposes generally seasonal operation must be considered such as late March to the end of December, mid-January, lower water trends are typical in winter months when commercial marine traffic slows and stops.
>> I can start with that.
OOne is the marine traffic actually is going year -- pretty much year-round I believe, that's what we're certainly hearing from the [inaudible]
seaway.
The only reason it stops is the seaway actually needs to do repair on the seaway otherwise it goes year-round.
That's one of the reasons why we looked at the full year.
The other reason we did that is -- it's -- because we get the lower levels in the winter.
So if we are looking at that for different uses around the lake we thought that we should include that in our analysis as well.
>> Okay.
We've got a follow-up of those last couple questions from Mike Michalski: In the Great Lakes we're looking at variability of water levels based on [inaudible] while water is based on the effects of relative sea level change.
So I think that goes back up to the first question about the NTE epoch and Paul also put in a follow-up marine traffic is not year-round where locks restrict traffic.

And that -- do you have anything to follow-up on that, Derrick or maybe --
>> [Multiple speakers].
>> Yeah, yeah.
And that the correct.
But the reason we are hearing is it's actually the seaway locks that are saying we need to shut down for maintenance at that point during those periods.
Whereas marine traffic is saying hey we can keep going if you keep the locks opened.
So if we don't put that in our analysis we could potentially be losing some important information for the future on the particular aspect of things if for some reason down the road the shipping season starts to expand right through the full year.
>> Okay.
Terese, I see you typed a comment about that, would you like to chime in here?
I think you're only panel?
>> Yeah, I am but I was muted.
Sorry I had to find that unmute button.
Yeah, so there is year-round traffic, ship traffic.
And ice breaking of course in the winter months on Lake Erie and Lakes Michigan and Huron and on the interconnecting channels between the two, so all the way from Huron all the through Lake Erie there's traffic as well.
>> Yeah, so you may not be able to go from one end of the lake system all the way out to the out let during that time but there are cases where you can go from one place to another and so still -- you're still at relevance there.
Okay and then another comment to clarify marine traffic is not year-round where lock closure stop traffic there are [inaudible] [reading]
[indiscernible]
and Ontario.
So yeah, I think we've addressed a lot of that at this point.
So I'm going to go ahead with another question that came in from Dave Wolf.
Interesting to note that lakes Huron and Michigan may not technically be regulated but that their levels are subject to downstream of Lake superior regulation in addition to the outflow changes of the St. Clair river due to bathymetric changes.
Wouldn't subtle adjustments to those conditions have a moderating effect on stabilizing extreme water levels.
>> That is true to a certain extent.
Now, we certainly seen recently for high water levels that it's basically meet logically driven.
If we get enough rain it basically overpowers any regulation we can do certainly in Lake Erie Ontario and I think we might be seeing that in Lake Superior now too as we've got extremely high levels there.
We haven't been through a dry period that would specifically indicate that.
Although we were very low in Lake Superior during the mid-'90s to the 2013s.
We came close to record lows.
And certainly Michigan Huron we did hit lows which isn't regulated.
So we -- that was part of our --

why we looked at the modelling numbers to basically build that regulation into our numbers.
And the range we did -- I did show actually showed kind of a range modelling historical.
And we weren't finding a big difference between the two values basically whether we molded -- molded them or whether we used historical data.
I think hopefully that answers your question on regulation.
We basically accounted for it we think.
And what is basically -- it's the meteorological conditions that are going to drive the levels in the future.
>> Okay.
And I do see a follow-up to that aside from meteorological influences Huron and Michigan have been impacted by ice jams and so on.
These could be addressed with ice booms.
So just real quick, any follow-up on that?
We do get lows in the rivers in the interconnecting channel flows however the actual lake levels it's a minimal impact, the ice jams minimal impact on lake levels, I believe is with a we're seeing for that.
So --
>> Okay.
We've got five minutes still.
So I'll go jump onto another question here.
When defining rural water in Great Lakes for navigational purposes are extreme low water events due to -- removed.
These events are short-term and marine traffic can wait to transit rather than trying to maintain channel depths to accommodate deep draft vessels 24/7.
>> Yes, we didn't -- we weren't including those specific events.
We were looking monthly, monthly values basically.
Lake wide average monthly values.
>> Okay.
Okay.
Yeah just going through the comment real quick.
I guess back on that seasonal question, why would you want it seasonal?
Well, I think you've kind of gone through and explained the time line that you used.
Yeah.
Unless there's any follow-up you want to include on that.
>> Yeah, the seasonal part of it we just thought for future --
for future considerations and the fact that even though the actual seaways are closed there's movement on the lakes.
We thought that we should include the entire year for low water datum.
>> Okay.
All right.
I think that covers questions that have come in so far.
It's probably a good time to move on with the next presentation.
So Alexis would you wants to lead us into that?
>> Yep.

All right.
Thanks Derrick for your presentation on the low water datum.
Next up we have with us two presenters, Travis Newman with the NOAA office of coast survey.
Travis has been with the marine chart division for over 29 years and Mina Foroutan, Great Lakes and southern waters division for the Canadian hydrographic service.
Please take it away Travis and Mina.
>> Okay, thank you.
Good afternoon.
To start I thought I would kind of go over the products we have in the Great Lakes at NOAA.
Here I have a screen capture of our website that shows our boundaries of our ENC coverage.
We currently have almost 300 ENCs.
I didn't include the paper chart coverage because maybe some of you are aware that we are cancelling our traditional paper charts throughout all of our coverage and supposed to be cancelled by the end of 2024.
For this talk I'm just talking about electronic navigational charts along with maintaining and producng updates and new additions we're also going through an effort calling rerescheming.
So you can see in this graphic Lake Superior has a nice gridded format.
We've finished that area as far as the band 4 coverage which is like the 80,000s and 40,000s, we're currently working our way through the lakes there in Michigan right now.
And our current coverage in Michigan is based on the paper chart boundaries.
All of our ENCs were collected from using the paper charts.
So some of the -- some of the advantages of the rescheming is the gridded boundaries.
We're going to make all the scales uniform.
Right now they're again, based on the paper charts.
There's a vast number of different scales out there that butt up against each other and makes edge matching difficult sometimes.
And also the rescheming will help with the -- the S-101 is an ENC -- the new ENC product specification that's on the horizon.
Right now the specification is S-57 we've been doing that since we first started producing ENCs but a new product specification coming out in 2026.
So this rescheming will help with that transition.
And it will also help us with our NOAA custom chart tool that's on our website that creates paper charts in the pdf format that's created from ENC data.
My team is tasked with not only maintaining the Great Lakes but we also maintain all of the West Coast and southeast Pacific such as Hawaii and the island and Guam.
And we currently have 11 cartographers on my team.
So it's quite a bit of coverage for the team.
We also have contracting work that helps us with compilation of all the data that we receive.
So I'll pass it offer to Mina.

Ed and I also wanted to mention another note that unfortunately the CHS does not have all of our data load need the databases meaning that they're not yet digital so a considerable amount of work and effort that we'll need to bring these data sets and then the products onto IGLD 2020 even with automated tools.
Similar to the U.S. our current transformation and preparation for 1-101 in 2026 we brought those initiatives underway created boundaries and moving to uniform scales.
Back to you, Travis.
The last time this happened was in 1985, the datum update.
So there wasn't too many people who current work in the office that were you know, involved in this decision.
But what happened back in --
well it was done in 1993, exceptionally the only thing that changed was a note on the chart.
We didn't have ENCs obviously.
We just had paper charts and so in 1985, they had the plain of reference note where they revised the low water datum levels based you know on the information we got from co-ops and was about roughly a foot difference in each lake it looks like.
And then revised the zero reference point location to [indiscernible] Quebec.
So there was no other changes.
All the depths and the clearances, the heights were just you know, they were just kept as charted.
All right.
Mina, you're up.
>> Yeah, thank you.
CHS took a similar approach to what NOAA did as Travis explained.
What we did for many. Our products and by the way I was around when we made that change not to age myself but many of our products had no depths, no changes to depths and he will facials.
And so what we did was via a note caution to mariner's note and other products we compiled per normal life cycle maintenance.
Back to you, Travis.
>> Okay.
So what are your options for revising the you know, the low water -- the new IGLD? One is essentially following what we did in 1985 is leave the products as is and just revise a note.
Maybe if depending on the I guess depending on the corrections maybe give the correction for the mariner to calculate the values themselves.
Now, at NOAA we have all of our information in a database and I know Mina said don't have that yet but essentially can run a mathematical you know, calculation on all the values that needed to be changed.
And then finding which object need to be changed on heights and so forth could be a challenge.
The next thing is recompile all the effective charts in a perfect world with unlimited resource that would be great but one is the -- there's not --
there's some lack of contemporary data in the Great Lakes as far as -- goes.

So I don't know if we could --
if you could use the current chart to do that or if you need to actually go back to the original hydrographic surveys.
It would take many years to do regardless because it's -- it's very time-consuming.
We could just start maybe prioritize areas that have the greatest change and work from there.
Also or maybe the most critical areas the most important ports that have the changes work from there.
Another option is kind of a hybrid option where we leave it as is but as the data comes in that's then surveyed on IGLD 2020 we would update the chart and we would encode that area as you know, this survey was done at IGLD 2020.
And I'm going to show an example of that in the next slide.
And then you know maybe some new tools might be developed or provided in the near future before we have to tackle this.
And this is a example of a real live example of Columbia river where the Colombia river, the ENC is on the river datum, there's a hybrid survey provided to us where it was based on mean lower level water.
So you can actually have an ENC with -- at one sounding datum but area inside that ENC that's highlighted as a separate datum sounding datum.
Okay.
Mina.
>> Thank you.
I've included a snapshot of a product in our database just to illustrate you know what we're looking at when we're talking about the changes that need to be made.
So I know it's very small.
It is on my screen anyways.
So sorry about that we've got some wet values, dry values some intertidal areas we've got contours in metric 2, 5 and 10 and so forth.
And while we do have an automated way with our production software to either add or subtract a constant value from each product and we have that in our bathymetric database as well for all the wet values, the contours now will represent depending on the shift and the direction say three did he say meters, plus will be 2.3 for example or minus will be 1.7.
The software doesn't automatically move those contours to those correct locations it's not intuitive that way.
And in addition the values that are sometimes wet or dry or even the small rocks shown there they will have to be manually changed if they become wet -- or vice versa.
So these two examples mean that the only way to reflect correct values on the product is to recompile it.
And as Travis mentioned earlier that's not really a viable option at this time.
And he's given a bit of a snapshot of his team.
I can do the same.
I only have three people working on products I am a new division that's focussing on the Great Lakes and the St. Lawrence so I'm building a team.

But even at the maximum point of my team I won't have probably more than five or six people working on products at any given time and also have other tasks that they're responsible for.
And I will say we are CHS is working with our software developers to come up with solutions to fix this problem for the symbology issue at the very least.
So -- sorry.
This slide here is more of what Travis and I need to know for us to be able to make the right decision on how we're going to make this change for our products.
And so it's more if we can answer these questions great, but I think with more information and with time we'll have more answers to these you know what is the type of effect will there be on chart datum, what's the order of magnitude, is it something we don't have to do anything.
Is it very important for us to have to recompile all our products or can we add a note just like we did when we went to 85, is the note sufficient?
What are the implications of having multiple datums on a product or an area or even a risk of having a product line with three different datums or three different usages having three different datums what's the risk of having that?
Is it critical we make the changes in one area or body of water at a time.
Similar to the example that Travis just gave before here.
And the other question we really have is what are mariner's expectations and what do they see in terms of the update and what do they expect out of our products.
What I think is important here is for us to continue our conversations moving forward better equip Travis and I so we can make the decision how we're going to update our representative portfolios.
Thank you.
>> Thank you, Travis and Mina we've had a couple questions come in and I'm sure we'll have more come in as we go through this discussion.
First one is: What adjustments are Canadian authorities considering to allow navigational drafts for St.
Lawrence seaway with the upcoming vertical and low water datum updates?
>> That's a very good question but that is not my area.
I don't know if we have somebody here who could speak to -- who could speak to that, answer that question.
>> Yeah, I can -- I can --
let's give an indication of how we're going to proceed on that.
We were going to look at the values of change to the low water datum on the lakes itself.
And then through that we looked at a step like process through the connecting channels to connect the new low water datums between the channels.
So we haven't specifically landed on a methodology for that.
That's still something we're going to look into.
But if we do do decide to change the low water datums we would look at a method for establishing a connection between the lakes and the connecting channels.
>> Okay.
Yeah.

Thanks for that.
Next question is for both U.S.
and Canada beyond conversion to ENCs is updated sounding data being pursued?
>> So if I can just speak to the Canadian side as I mentioned before, we are currently working -- we're in talks with [indiscernible] and they're the suppliers of our software or that's the software that we use to make our products and for our bathymetric database.
So we're looking at -- as I mentioned the issue is with symbology change for things that will be now wet or now dry depending on which direction of the shift of the magnitude.
So we're working on that with them.
But my thought is that it is for our sounding database.
It isn't that difficult to shift using the caveat that it still takes people to do things.
So you know, we'll have to assign people to that to make sure that shift is there but I don't personally want to make any changes until we can determine how to deal with those locks or the things that will become wet or dry depending on the direction of the shift.
For me, that's a critical piece that needs to be solved before we can make those changes to our bathymetric database sounding data.
Go ahead, Travis
>> Yeah, well, if I understand the correct question, maybe if he's asking if there is any like new information coming in, as far as surveying goes, I think there's quite a bit of work being done on the Great Lakes.
Yeah, I know I have some quite a few recent surveys that have come in on the Great Lakes if that's what that means updated sounding data being pursued.
>> Yeah --
>> Yeah, there's always survey work being done.
As far as on the U.S. side that I know of.
>> Okay.
I have a follow-up to that, who is doing that updated survey data collection?
>> Well, we have -- we have our hydrographic surveys division which is under the office of coastal survey they do that work along with they -- they have contracts out too.
It all comes through our hydrographic surveys division.
And then there's also always the Corps of Engineers which I think they're talking next for the channel, the channel surveys.
But you know, out in open water it's usually the hydrographic surveys division.
>> Okay.
And Mina, is there an equivalent to that over on the Canadian side?
>> So I can't speak to our survey team but I know that --
like because -- yeah, I can't speak for them but generally once -- once those shift values are there, then, yes that new data that will be collected will be in that new datum.
We have a tides team that is responsible for doing analysis.
And so they work with our operations team, the one that does the data collection.
Sorry I'm just answering from a charting perspective.
Sorry, go ahead, Terese.
>> I can answer that a little bit.

So my unit is responsible for providing the adjustments for the bathymetry to go through, Mina and Morris teams take that data and put them on products.
So when we're surveying right now, obviously we're surveying for IGLD 85.
And when we move to 2020, the surveys will operate on IGLD 2020, I believe.
I'm not -- that has been the case in the past.
We've always gone to the newer datum.
And then the data would be adjusted to go on the product --
to whatever datum, not product is still on until such time as we get to the point for rerecompilation.
>> Thanks, Terese.
So there was a follow-up comment or question.
So Mina, previous comments thoughts on how much crustal [inaudible] datum change?
>> Another question I'm sorry that I can't answer for you.
I'm really looking to this team to actually give us that answer.
So that we can determine how we're going to make those changes on the products.
I don't know if Terese, you can help me out with that one too.
Thank you.
>> On mute here.
Could you please repeat the question?
>> So the question was building on a previous comment of Mina's thoughts how much Crustal -- as a consequence of datum change?
And I guess I'll kind of float out there something I had mentioned in my talk earlier today how -- you know from one side of the basin to the other there's that 7-millimeter tilt due to GIA, I don't know if that helps you with your answer, Terese, but --
>> I'm not sure I know the exact answer to this, but, Jeff Oiler if he's on may be able to help me but the IGLD 1985 datum is a flat reference plain.
And it's basically static in time.
So anything that is surveyed on IGLD 85 is reduced using the water level data which is operating the gauges are all operating on IGLD 85 as well.
So when we moved to IGLD 2020, that past 35 years of GIA will be removed.
And everything zeroed back so that the GIA has been accounted for for that past since 85.
I don't know if that makes sense.
>> I think that helps.
There might be some of these follow-up questions might help take it into it a little more.
I'll jump out to this next one what hard point navigation such as [inaudible] will drive rational operational vessel drafts in this rational low water datum are those [inaudible] seaway system in areas where earth's crust is rebounding or rising?
So again kind of on that topic of GIA -- yeah, go ahead.
>> I can start on this and others can jump in.
I think that's one of the key things we wants to look at.
And why we through the numbers out of how much it could change based on analysis of water levels.

Because that is one thing where we're going to have to consider as well is what are the operation of locations of changing the low water datum which could be some those hard points in the seaways.
So I think that's, I guess that's one of the things we want some feedback on.
>> Let me jump down to a couple comments here.
There is a big thing to concern one thing to realize the absolute depths will not change we're just changing the reference zero to understand the -- to better represent the [reading[reading] [indiscernible]] let's see.
So let me jump up with this, there's a question here from Roger with restore our waters international, are there any plans to revisit the IGLD step elevations for the interconnecting waterways particularly for the St. Clair river and the international section of the St. Lawrence river.
NOAA has recently collected new bathymetry for the entire Detroit river and U.S. Army Corps has been collecting for the St. Clair river, will NOAA review the U.S. Army Corps data and use it to update its charts.
Changes in conveyance are a constant problem [reading]
[indiscernible] so --
>> I can't speak to what NOAA will do, but the recalculation of the step plans on the interconnecting channels is on the -- on the agenda to relook at that, that it will have to be rerecomputed wins we get IGLD 2020 sorted out on the lakes.
>> Okay.
Yeah, thanks, Terese.
Travis, if you have to add to that and --
>> I'm just kind of catching up on the questions a long way.
NOAA's recently collected new --
so if it's recent it hasn't hit our shop yet.
So you know, I assume we would, you know, we will apply it to the charts.
And the core data in that area I think if I'm trying to remember historically in some of those waterways like St. Mary's, St.
Clair and Detroit a lot of those areas we've put in project depths because we get so much data in there we can't keep up with it.
Ideally we'd love to be able to update it in real time and you know, apply it.
I can't say right now whether we'll be able to do that.
But hopefully in the near future we could give full controlling depths for all those waterways.
That's kind of a separate issue.
That has nothing to do with the biomodals.
It's more of a marine chart division-wide policy right now with core data.
So, yeah.
That's all I got for that, I think.
>> [Multiple speakers]
>> Go ahead, Jeff.
>> I got my mic on now and there's a lot of in the discussion here and a lot to be looked at as -- especially with the lock scenarios.

And they were designed and built most of them, you know, on older engineering designs.
And with the thought of an elevation above the sill, upper and lower sills and those new heights I truly need to be determined on those sills.
I know the sill was built 32 feet above the upper and lower sill and that determined the low water datum reference because I work with the Corps on that and our charting office to determine those as we had something different earlier.
So that's going to have to be looked at down through the St.
Lawrence and I think that's going to be -- then we'll be able to make decisions on what those -- if we can change the low water datums or not because you just can't change a thousand feet of concrete.
That the well-known.
And so that's going to be a huge reference to what the low water datums can actually be reference to.
Under 85 datum we actually held the low water datum references on a lake, lake to lake and did a regression analysis down through the river system for station to station to determine the low water datum at every station down through the sloping surfaces so that it could be better managed.
Hopefully we're going to be able to look at that again and be able to do that environmentally so, that's the way to handle the steps and maintain those gauges that are in those sloping surfaces for the future.
>> Okay.
Thanks, Jeff.
Now, we're coming up to the end of our time on this presentation but I did want to point out a few things shared here in the chat box.
Survey plans from last year, and from this upcoming year.
And also a link to the datum web page.
So you can go ahead and access those.
And I will turn it back over to Jen to help us move into the next set of presentations.
Again, thank you, Travis and Mina and Terese, Jeff, everybody who child in -- chimed in.
>> All right.
Sounds great.
Thank you, Travis and Mina for that presentation.
And our last presentation before our LWD session is with -- Cindy is the chief of operation and maintenance for the U.S. Army Corps of Engineers in Detroit district and Jennifer start with the federal government in 2017 and is a recent employee of the Canadian Coast Guard.
Jennifer brings with her experience in hydrography.
Jeff's career started in 2017, in 2019 I transition today a management position and received a youth achievement award.
Since 2019, has been working with the waterways program.
Take it away, all.
>> Thank you, Jen.
Good afternoon, everyone.
My name is Cindy Jarema as just describeddescribed.

I will take some time to what we see in impacts in Great Lakes navigation and what that means in terms of channel navigation.
So the Great Lakes system is comprised of 140 U.S. federal harbors, 60 of which are identified as commercial and 80 as recreational.
These are maintained as a system by the Corps's Great Lakes navigation team and that's comprised of our Buffalo, Chicago and Detroit districts.
Of course we also have the three connecting changes within the system, a little hard to see on the screen there but they're circled, St. Mary, St. Clair and Detroit River.
And it's important to note that each harbor and channel has a congressionally step we do that through drudging.
That depth is measured from low water datum.
So as we've been discussing today, low water datum is the navigational chart datum to which channel depths are referenced.
In addition to having the responsibility of drudging, the Corps also conducted hydrographic surveys of the channels to convey our current channel conditions to users and to determine the need and extent of future drudging.
So the graphic on the right-hand side is an example of a survey taken in Holland harbor on Lake Michigan.
The gray picture like part of the drawing is the north and south breakwater structures and the channel extent is what is shown in color.
With the left-hand side being the lake.
So anything you see here in blue is considered to be at the maintained depth of the harbor.
In this challenge the project depth is 23 feet in the outer harbor and 21 feet in inner harbor.
So anything shallower than those depths is shown in red.
In the Corps is responsible for maintaining the channel to the authorized extent and depth.
So essentially what we want to get at we want that red to become blue.
Corps.
So Derrick explained this earlier.
Any future change in low water datum can be best determined using that 90% exceedance level.
I think I have a little bit different number for St. Clair than what Derrick had showed but these are the numbers on the --
in the right here that we've used for determining potential impacts trying to calculate what those impacts are.
And apologies for not including metric.
So we use 9 inches on Superior and 12 on Michigan, Huron.
One and a half St. Clair, three inch increase on Erie and a drop of 2 inches on Ontario.
So our impact analysis uses these unanimous so that we can begin planning for these change and continuing communicating what that might look like.
So I want to give an idea of what current conditions look like here and compare that to what a new low water datum would mean for navigation.

This is an example of water depths on Lakes Michigan and Huron with the current water elevation up at the top.
Channel depth again is measured from low water datum, and in this particular example the project channel depth is 27 feet.
And I did want to note that in times of higher water levels the actual depth of water is greater than the channel maintained depth.
So what a new low water datum on Michigan Huron could look like for harbor here in red in this example.
Let's use a valley of 12 inches of lowering of the low water datum on Lake Michigan and Huron.
So this leaves us a 26-foot depth when the authorized depth should be 27.
This means that we need to extend that red arrow down into the channel bed and dredge and additional foot of material in order to meet my depth.
Again congressionally authorized we must maintain that depth.
So keep in mind that that 12-inch lowering of low water datum tomorrow does no the mean that water levels and the available navigation depth has physically diminished.
It is not the water levels that are changing, but the reference point.
So for navigation users a low lower low water datum might not have much impact during periods of higher water but this would have more serious impacts to valuable depth during low water periods.
Just a quick refresher, where we're at with our changes in low water datum.
I wanted to hop right on over to this slide here that shows just a couple examples of what this looks like for in this particular situation.
St. Mary's river.
So Saint Mary's River on the U.S. side as a current backlog of material of over 750,000 cubic yards.
It the same concept here where the survey colors indicate you know, red is where the channel depth is -- the channel is not at project depth.
So any additional material must be removed.
With the new low water datum this will be approximately 760,000 cubic yards of additional material on top of that to remove -- meet the required depth.
So looking at total of one and a half million cubic yards.
And to put that into perspective we typically handle no more than 200,000 cubic yards of material for the St. Mary's and a dredge cycle.
We don't dredge St. Mary's very often but that's really on the high end.
So the challenge of this channel is the channel bed material is mostly rock making the required material removal very costly and mention E lengthy.
And another challenge we're facing and perhaps even more critical, is the lack of material placement options to hold that material volume.
I have another example here for Indiana harbor on Lake Michigan.
So we're looking at a 12-inch change in low water datum.
Here we have 58,000 cubic yards of material that will needed to be removed to meet that required depth.
The challenge here is the presence of contaminated material, it's in a very industrialized area.

The amount of material is not as pronounced as let's stay the St.
Mary's River but it does give an idea of how much material we're going to be needing to remove across the Great Lakes system.
So I wanted to break this down to what the -- what the impacts are for the Great Lakes navigation users.
We've put together this rough estimate of what it would take to bring the navigation channels to project depth under the a new low water datum.
Over the years we work with stakeholders on developing what we call a functional channel dimension for our commercial harbors which is a smaller extent than the authorized channel limits.
We do this to really focus in on the areas that we need to be focussing on.
We have limited resources.
So you know, we can shift those resources to the critical areas.
We've developed two -- with the more conservative being fully authorized product dimensions.
So that's depth and width.
But we're trying to bring this down into some form of reasonableness and we're just focussing on the functional dimensions.
So that third column over the total cost I'll submit for all 110 impacted harbors and channels is upwards of around $400 million for material removal and placement, and it's just for the functional dimensions.
Over 80% of the quantity of material and costs are contributable to the deep draft commercial harbors.
Sediment composition challenges are expected at about 40 or so of our projects.
We are expecting some risk based on the history of some of the project sites and historical sediment data easterly in the material type or in contamination.
For 53 project we expect to have challenges with dredgement material placement availability and capacity.
Right now many of our confined disposal facilities which we typically reserve for our more contaminated material, we're already at our limit for capacity.
Many of these facilities are at the design -- another design-like capacity.
So you know the Corps is currently communicating what these impacts of a new low water datum means for navigation to stakeholders.
And we continue to refine the calculated new dredge material quantities and those associated costs.
We will need to heavily engage our system users to which harbors should be focused on first as maintenance on all those harbors can't happen overnight.
It's going to take many years to -- to approach that due to limited resources and placement location availability without you know, we're going to have to be working with our state partners as well.
We currently have a three million cubic yard dredging backlog that's not even including these low water datum change impact from that.
I did want to mention that we operate under a two year out budget cycle.
So next year in 2025, we will be strategically requesting funds for 2027.

And we'll continue to put those budget requests in a phased approach in subsequent years.
So there is a lot of planning and work to be done and I hope that providing these types of information briefs help others understand the large undertaking and impacts.
And you know, looking forward to continuing that discussion and what else we might be able to come up with as solutions moving forward.
So that brings me to the end of the Corps presentation and impacts.
I will turn it back over to Jen.
>> Yeah.
And next up is Jennifer.
Jennifer March.
>> Hi, everyone.
So thanks Cindy.
I guess we have a lot of the same challenges for our portion of taking care of the interconnecting channels on the Canadian side.
Sorry about overlap that we will probably are V.
So I'm a project officer with the waterways team.
We're responsible for keeping the channels on the Canadian side of the waterway dredged to the maintained depth as prescribed on the navigation charts.
And today I'm going to be presenting with my colleague Joffrey, Dufour, Joffrey do you want to say a few things.
>> Hello Jennifer and everyone.
I will be presenting on the technical aspect of modifying chart datum from a waterways management perspective.
The purpose is to share with stakeholders quantity to be dredged, challenges and needs.
However, I want to say that we don't have the complete technical visibility assessment at this time.
Our objective today is to share facts status 6 to industry that we are working to harmonize the approach with our U.S. partners such as NOAA and U.S. Army Corps of engineer.
>> Okay.
So we are responsible for dredging the Canadian portion of the interconnected changes you see here outlined by the blue dotted circles.
For analysis we use the numbers in blue and in red those are the preliminary numbers for the did it shift from the coordinating committee.
You can see not uniform across the land because as we learned earlier the land is rebounding from glacial iso static adjustment differently across the country.
The changes proposed are larger in the north than the south with a preliminary a adjustment of 30 centimeters -- it's looking like this could be the situation for the St. Mary's and for the St. Clair River secondly maybe a change -- this maybe a situation of the Detroit river [indiscernible] dredging in this area for some final.
And then lastly no change which would mean business as usual but we're looking for input from you guys today to drive some changes going forward.
And next Joffrey will dive into those impacts further.

>> Impact to our operations will be seen in the chart is lowered.
Same maintained depth in the channels.
Please note that if the new chart data is put in place on our nautical charts and as Mina explained earlier you will see the surrounding -- ENCs being reduced but maintained depth in the channel will remain the same.
That's the explanation on the figures on your right.
By dredging to accommodate any chart datum changes we are going to be adding to our existing challenges.
We're Carbolith of -- current have issue with management and [indiscernible] in addition our -- window is very short which can increase time to complete dredging project.
So mitigate some of these issues we have invested and researched to adopt a more long-term strategy planning approach, however we are having difficulties with that since our disposal needs will increase depending on the changes to chart datum.
Other studies will also need to be completed to assess the full and environmental impact of dredging to accommodate any chart datum changes as well as fully understanding our restrictions.
When it comes to the [indiscernible] protection.
So ultimately complete assessment will be need to be completed extensive sampling to understand the amount of contaminated material we are dealing with and the type of material that will need to be dredged.
Going more in details I want to present firstly the St. Mary's River.
The image on the top shows a small portion of the St. Mary's River.
The area shown in red area are our -- and in the picture below the areas in red are the -- created with the proposed datum changes.
Right now we have little bit more than 30,000 cubic meters and -- dredge material and in the entire river.
And after the proposed change we are expecting to have at least double the amount of material to remove.
We didn't include slide slope and overdredged air so we can further expect volume to increase. This is one of the areas in which we may need to do blasting in order to deepen the channel as well as U.S. Army Corps engineer may face as well.
This will be extremely difficult undertaking in just a six-week in water window in this area.
Due to fisheres protection.
Secondly, in the St. Clair River we are zero in the portion called [indiscernible] channel.
Here our largest challenge is that the -- mostly salty and contaminated.
We are looking at more of a range right now regardless of the exact number we will be looking at taking care of the backlog of dredge material in addition to any increased chart datum will -- which may increase the volume to dredge up to more than one one thousand cubic meter.
>> And lastly there may be areas where the dredge datum will rise or remain the same.
And if this is the case we'll continue to work on our existing challenges Joffrey and sin deep pointed out and we'll also prepare to plan for eventual changes in our areas as time goes on.

We'll also continue it work on modernizing our document guidelines for the safe design and use for shipping changes and target vessels.
And of course also continue to monitor the ongoing science performed by the experts we've heard from today.
Because as we know nothing is final just yet.
>> Going forward we understand it will take time to address our challenges.
This is why we would like to prioritize dredging areas based on industry need because although our bathymetric can point out -- areas we'll be looking to confirm with users particular areas we are identifying our problem for them.
We are working on disposal options for now.
And for the future.
We'll be finalizing volumes and so that we can discuss our program needs and quantify the impact for any future changes.
We'll also need to put concentrated effort on researching the visibility of dredging to the maintained depth.
>> All right.
That concludes our presentation.
Thanks for listening and I encourage to reach out to anyone on this list.
We would really like to hear from you.
Thanks.
>> Okay.
Yeah, thanks, Cindy, Jennifer, and Joffrey.
So we have had some questions come in.
And I'll go ahead and lead off with those and what we we get to during the next couple minutes we'll get to and what we don't, we can cover during the discussion session after the break.
So go ahead with the first one here.
When considering channel depths what clearance below keel to channel bottom is assumed masters required and there was a response to that and that was yes fair Rick clew that's up to the prudent mariner being in quotes but maybe specific jurisdictions have set rules for vessels at times can either of you speak to that or elaborate on that?
>> Any type of --
>> I can go, Joffrey speaking.
>> Yeah, go ahead, Joffrey.
>> As my colleague Jennifer mentioned we are performing update of our guidelines, but mainly it will depend on the speed of the ship and the type of the ship.
So as you may know as the ship is going fast, there's more --
so it will depend on the would say transit planning, you know.
So it's not a clear answer for that.
It will let them -- if it's on fresh water or salt water.
So a lot of parameters have to be considered -- site but it remains -- responsibility.
>> Okay.
Cindy, is there a [inaudible]
side equivalent to that or any other considerations that need to be -- that need to happen on the U.S. side?

>> We don't really get into the requirements for what is you know, is needed for each vessel.
We state that the depths through our channel condition surveys and our authorized or functional depths are clearly posted.
>> Okay.
We have another question here from Paul Boyce again.
What is the U.S. Army Corps of Engineers's definition of future LWD in context of presentation?
My is the helping of epoch suggests considering water depths during primary operational seasons nine to ten months and restrict draft during winter.
Are --
>> I'll have to differ to the committee comparing values.
I believe Derrick put into the chat down below too in response to that question.
You know, we're using our the best values that we have hat this point just to start really you know, calculating what the impacts can mean in terms of operations and cost.
So the Corps will be using whatever low water datum is provided.
I don't have much involvement as to the epoch or how the operating season is factored into determine low water datum.
I'll have to pass it over.
>> Okay.
Now, I'll go ahead and read Derrick's response to that.
So this is from Derek Cusimano.
The future LWD referenced [reading] [indiscernible]] so following up on Cindy's response there.
Okay.
So there's another question in that same line as vertical and low water datums are updated will project definitions be reviewed.
Some projects have channel and definitions that are outdated and haven't been used in decades.
For example the upper channel basin at the navigational limit on the -- river extend to unused water front.
Those are the big grain elevators there on the river in Toledo.
Any thoughts on that?
And again this probably be a U.S. answer here.
>> Yeah, so I think this goes back to the discussion on authorized project depth and functional.
Right.
So thought the Great Lakes on our Corps nav Team we have determined on attorney harbors where we have agreed to move those channel stents narrower, so that if they are unused areas that we're not, you know, maintaining dredging areas that just aren't needed any more, different stakeholders you know, they'll move in and out of harbors.
So we kind of adjust to that.
So that's why our analysis really focused on the functional limits that we've developed.
Hopefully that answered your question.
>> Yeah, I think so.

I see a response here just came in from Chris Zervas I think follows along the same lines there is no epoch for the Great Lakes it is not considered that the lake levels are on an upward or downward trend.
Any high or low water in the past are considered likely to occur.
You might consider the epoch as the period from 1918 to the present.
And I think that -- that's much different from the -- from the what we've discussed this morning with the IGLD update having the epoch in 2020.0, so this is more as I'm interpreting it the long-term averaging over a certain amount of time looking at the water levels.
I see Sierra is typing an answer here.
So I'll let her, unless Sierra, you might be able to just jump on your microphone to respond to that.
>> Thanks, Jacob, yeah, I just wanted to thank you for making that clarification that the period of record being used to develop these low water datum values is different than the 7-year epoch that we're talking about for updating IGLD 2020.
And just to make that distinction.
>> Yeah and I appreciate you chiming in.
We're talking about two different datums something to do with water level yet being drastically different in some regards here.
So let me see going back through what we have here still.
Here's a -- I think this is a comment from Jack Riley.
Under the assumption that the bathymetry has not changed during the new [reading] [indiscernible]
[indiscernible]] and I'll open that up for any response there and then I think we can go to break right after that and save the other questions for later.
Okay well and we can address that again after the break too we want.
We do have an hour coming up for discussion and more question and answer.
So how about for right now I'll hand it over to Jen Drury to move us along.
And you're muted if you're trying to speak.
Okay well --
>> Yeah, I'll cover for Jen.
Yeah, we'll take a 15-minute break at this time.
Please meet us back here at 2:45 eastern and we will jump into our low water datum discussion where we can have a more in-depth discussion on these topics.
Thank you.
>> All right thank you for everyone coming back to us.
We're coming up on our low water datum breakout session.
Thank you Jeff for the questions that come up.
So thank ou.
>> Thanks, Jen.
So welcome back everybody.
At this time we're going to move over to the low water datum discussion session.
Purpose of this session is to solicit your feedback on the LWD and any concerns or comments you may have about it.
So similar to the IGLD session earlier today we'll prompt all of you with some questions.

Please respond to these questions in the chat box labeled LWD discussion.
And we will have someone capture those responses.
So but before I jump into that, I do want to wrap up a couple of the questions from earlier that we had before the break.
So the first one is more of a follow-up from Jack Riley the key point is chart depths will adjust in concert with the low water datum change under the assumption that the bathymetry has not changed a one to one [reading[reading] corrected water level to bathymetry change [reading] a lot of that discussion earlier with the cost and impacts of having to dredge channels due to the change in LWD.
And there's another question that came in that was answered but I'll open it up for the discussion for the others to answer if they have further incompetent sights, would managing water levels where possible be more cost effective than dredging to a new LWD, and the question here or that the response from Frank -- is it would not be possible to MAEVENG the lake outflows to avoid water level.
When they are low water supplies regulation temporarily adjusts which part of the lakes have more or less water.
Currently outflow is only regulated for Lake Superior and Ontario.
So before I move on from that, were there any other -- anybody else want to chime in on that?
>> I guess just it goes back to the lake levels are driven by meteorological conditions whether we have wet or dry, dry conditions.
So I think that's -- I think that's implicit on what Frank's answer was but I just wanted to highlight that again.
>> Yeah, thanks, Derrick and that the how I interpreted it too.
Now, I'm going to jump back to that earlier comment from before this last question.
Sorry for junk around --
jumping around so much.
I'm reading through the question document and I in I have had a part of it.
So in regards to Jack Riley's last comment about the water datum change and crustal connections I probably missed the point that looked at the bias introduced from the old to the new LWD any new change required and authorized channel depth back in order with respect to the data change.
So if ships are going aground something's wrong.
Le in LWD will not cause that to happen suddenly.
Is there any follow-up comments on that from the panel here?
>> Hi, it's Jennifer here.
No, I think that was a good response.
I mean the available water depth won't change overnight.
And so the water will still be there for the ships.
So I think that's pretty good answer.
>> Yeah.
A number is a number.
>> Yeah.
>> Okay.

Now, I'm going to get back to the questions that we wanted to ask you, the audience and get your input on that.
So I'll give you a couple minutes here to go through those.
So the first one: What would the impact be on your industry or occupation?
So again think about the costs, time lines environmental impacts, updates to existing information, and so on when answering this question.
So go ahead and give you a chance to type out some answers here.
So and during the session much like with the IGLD discussion earlier today we've got four questions laid out for you.
And some of them are similar, but it will be good to have a little bit of discussion to hear some of your ideas and opinions and give the panel an opportunity to chime in with their ideas.
So killing time here wearing for answers to show up, if anyone on the panel if you want to go ahead and maybe speak to it from the -- from our side about it kinds of things that maybe we already heard or concerns that have been coming in.
Okay.
Starting to get some answers coming in here.
See lots of people typing here which is good.
So Lauren Frye who I was just talking to on the break because she sits down the hall from me saying that these are pretty big costs to the two governments potentially with the -- with an update to LWD here.
And Paul Boyce says that datum changes are best if documents and charts are electronic and easily corrected.
And I think this time around we are seeing a lot more of that where we don't have to go through and reprint documents, reprint charts, maps that we can just update the data set and call it up as we want.
Another thing to think about that Lauren's pointed out what's the cost of not updating.
We saw in Cindy's presentation the costs of potentially updating and what that might mean but what's on the other side of it?
If we don't update what is that going to cost?
Who's going to be impacted there?
So do we have anybody from the panel want to step up and start discussion on that?
I mean think not just about dredging but the people who are impacted by that dredging and how deep the channel is and anything with shipping?
I don't know Laura, do you have any thoughts on that?
>> My first reaction to that question is you know, we strive to be as accurate as possible when we provide data to the public.
And datums to the public.
And so if we're not giving them the most up to date information and we're providing continuing to provide something that's a hundred years old, you know, what does that -- what does that do for our stakeholders?
And so in my mind it's priceless.
>> [Multiple speakers].
>> I'm happy to hear other people's perspective.
>> Terese here.

I would agree with Laura.
The cost of not updating is that we're providing outdated products the water levels will continually diverge from the datum.
So it will be mismatched and we're not providing our clients with up to date and accurate products for marine navigation if we don't do an update.
Now, doing an update doesn't mean that we have to change the low water datum, but we have to do an IGLD 2020 update for sure at a bear minimum.
>> Okay.
Yeah.
And I was thinking more in line with what does the update to LWD mean for the -- for the industryindustry.
Yeah, I think with IGLD update, I think that's pretty clear about the how and why, but with IGLD because it has not been updated in so long, I think that's where we might be seeing some bigger exacts.
We haven't gone through this process in a long time unlike with IGLD we have in the past you know with 85 coming out.
>> And just to add to that, Jacob, this is Laura again, you know, there's plenty of papers out there not plenty a few, a handful that say -- that have looked at low water datum in the past.
And have said, you know, you'll probably need to update this in the future.
And have just left it at that, right.
And so we have this opportunity while we're making one change with IGLD, to really look and learn and evaluate any changes that should be made to low water datum.
So we know, you know and the science is telling us what the science is telling us.
So I think that's the -- that's the biggest perspective I have.
>> Yeah, thanks, Laura.
And thanks, Terese for that.
I'm going to go through some more of the comments coming in here.
So point out more work for dredge contractors which I think that's -- we saw that at the presentations earlier.
Accurate and complete data and data analysis of LWD and other parameters of the Great Lakes water system will increasingly be important as the real stresses on the system are down the road.
Climate change increased evaporation for example.
And demand for water for consumption by people on farms.
So that was Paul -- who sent that in.
JS Allen geospacial data will be useful for modelling.
And that might be more in line with the IGLD question there.
So here's another response here Paul Boyce updates to IGLD are what they are, updates to low water datum should be rational look at hard points consider primary operational season nine to ten months [inaudible]
[reading] marine traffic pause.
So a lot of good points there.
I know we've addressed some of them right now.

Actually let me read through these next two here if jack Riley one thing for sure it forces all to become more savvy in geomatics which is a good thing given the connection with technological changes and capabilities, in other words precise accurate GNSS available to users.
And I think that go in general with a lot of these different datum updates.
Modernized NSRS, IGLD, another comment here from Paul: Survey costs dredging costs will be passed on most total taxpayers.
User may carry some burden.
Dredging should be based on rational IGLD [reading]
[technical interruption].
>> That's kind of the reason why we asked for participation from the users.
Because it's almost impossible to be able to dredge the entire channel down to its perfect authorized depth a hundred percent of the time in every area.
But what we would like to do is getting -- get feedback for areas that people are finding difficult to navigate whereas like we go do surveys and can say [inaudible] and dredge it but is that really an area that mariners find difficult to navigate.
That's why we would like to have input from users because we know we can't do it a hundred percent perfect in every area.
I'm not sure if that answers the question or like --
>> [Multiple speakers].
>> But --
>> [Multiple speakers].
>> No.
>> I like that answer.
Yeah, that's part of the reason why we're hosting this workshop and opening it up for that discussion.
Because yeah, on the federal side I don't think anybody has all the answers but we do want to get an understanding of the how things are used and why they're used and what would be beneficial to the people out there who are impacted by it.
So I appreciate that response.
Anybody else want to say something?
I want to move onto the next question here soon?
Okay.
So the next question I think somebody else will bring that slide up here.
Based on the impact what are your concerns on moving towards a new LWD?
Think about the cost the environmental impacts updates to existing information and so on.
So we'll give a couple minutes here for the answers to start trickling in.
So and while those answers are coming in, so with the panel, what kind of feedback have you heard already at this point about concerns moving towards a new LWD?
And I think we did already hear some in that last question and the answers that came in.
Anybody want to take a lead on that?
>> Hi, this is Mina.

I'm not taking a lead on to question, but I have a sub question perhaps with this because I think Travis and I already talked about the impact on products and just you know in terms of workload.
So there's a lot of considerations to be thought of in advance before we change the datum of the product and how we're going to proceed with that and the different options that we have.
But my question is at the risk of sounding like I don't know what I'm doing in this industry, I didn't realize that we could just change the IGLD datum and optical water datum.
My misunderstanding is are they two separate things because I thought they were the same?
Love if someone could answer that and clear that up for me.
>> They are two separate things.
And in the last update.
So IGLD was updated with IGLD 55 and then again with IGLD 85.
At that 85 update low water datum was not updated.
So and more entries might be able to provide a little bit more context here.
But low water datum is reference to a fundamental datum like IGLD, so it's a height above some kind of reference zero.
So some kind of sea level determination.
And as that changes, then the LWD values will change with it, but a complete redoing of LWD takes a lot more into account than that.
So I'll let Terese run with this now.
>> Yeah.
Thanks, Jacob.
And so what you described is exactly right.
So in 1955, there was -- there was when IGLD was created because they realized they needed a uniform datum across the U.S. and Canada, low water datum already existed as a low water value on the Great Lakes.
And that value again was set in 1933 and it was a combination of two different datums it was a navigation dattum and a project datum on each lake that was looked at you know, based on data in the 1800s.
And so there's that low water datum reference.
And that in 1955 was given a 1955 IGLD height.
That value of low water datum.
In 195, that value was put on IGLD 195 reference frame values so the actual low water datum itself didn't change in reference to the -- because of the change to 85.
So this time around again what we're looking at doing is we know there's been changes as Derrick was talking about earlier we know there's been changes in the basin and we looked at that hundred year record to look at where low water datum was realizing that there might be a necessary change to be made with low water datum as we move to a new 2020.
So what we could do is we could not change it and we could just put that same value onto 2020 when we determined what 2020 is.

Or we could change the value using science that we know about and then reference it to IGLD 2020.
>> Thank you.
>> Thanks, Laura.
We're starting to get answers coming in.
As I think about this a little bit more.
We've been giving a lot of -- a lot of these responses had a lot to do with channel maintenance, dredging, ships going through and so on.
But I'm wondering too if there's anybody out there on like the coastal management side or the ecology side who might have any concerns there.
And I haven't looked at the guest list if there's anybody from like NOAA's office of coastal management or somebody like that.
I'd be interested to hear that perspective on it too.
So as I go through you've got from Derrick -- here share concern with Paul on hard points and navigation channels less clearance or lack sills require dredging and material in some location less buffer for channel [reading] [indiscernible]
et cetera.
So there are a lot of challenges there.
And when I think about a utility or road right-of-way it's not just the road it's the drainage, utility lines, cables and electricity and I think we might be running into similar things here based off of Derrick's comment there.
And Derrick does have a follow-up on top of that the cost to maintain channels to new LWD there is limited funding and limited dredging contractors in the Great Lakes.
So, yeah, that's another issue if there's work to be done but nobody to do it, work can't get done.
So Paul Boyce was asking or mentioning what lessons can be learned from other limited areas using LWDs for -- and primarily for river and harbor engineering such as Boston harbor or the Colombia river.
And that's another good point.
Because I'm -- that has me thinking about the parallels between IGLD and like a local tidal datum.
Or NTDE, those don't quite match up well because of the -- the tidal cycles and everything where you don't have to deal with that with that IGLD but I'm wondering too as a non-water level person if there are parallels between low water datum here in the Great Lakes and charting datums in the -- in the ocean coastal ports, anybody speak to that real quick?
>> So if I understand correctly, you're asking what we could learn from other areas that use low water datum, is that what I'm -- is that what I'm kind of understanding, or I think a low water reference frame.
>> That's how I --
>> Plain.
>> How I'm interpreting.
>> Yeah.
>> Go ahead.
>> You know, Colombia river has its own datum.

The Colombia River 2 datum.
So it's a little bit different than looking at the water in the Great Lakes.
I'm not sure the reference to Boston Harbor because I think Boston is on mean lower level water.
So I don't quite understand that question.
Necessarily.
Maybe Paul maybe can expand on your -- thought in the chat box.
>> The reference for Boston harbor is dated.
So and Chris Zervas is saying Anchorage may be analogues.
Chris do you want to come off and talk about that a little bit?
>> I was just thinking about where the sea floor is -- well the sea floor is rising so the faster than the water level.
So the -- I'm not sure what they're authorized depth is, but it must be hard to maintain it.
Juno, anything on the southern coast of Alaska because the water is getting shallower there because of land rising.
>> Yeah, so in order to maintain that depth to channel yeah, I wondered about that or dredging it is required or how that works.
And I guess in this case it's a little bit more of because we're sit Sething the datum level that you now, it may not be as much of a natural process in this case.
So all right here's a comment from Mike Michalski: The Great Lakes is its own system, very different driving factors affecting water levels.
So thanks for chiming in with that, Mike.
And yeah, that's a really good point.
It's not that close.
Yeah the Great Lakes are such a unique thing being a close system like that, lake system with rivers connecting, so yeah, on the ocean sea level changes that doesn't really impact what's going on in the lake system.
>> I think -- yeah.
This is --
>> [Multiple speakers].
>> Add that --
>> [Multiple speakers].
>> It's a binational data.
So it's two countries working together to --
>> [Multiple speakers].
[Inaudible].
>> [Multiple speakers].
[Inaudible] [indiscernible].
>> What's it called --
>> Yeah, thanks for pointing that out, Terese.
>> Sorry.
>> Coming back to the other responses here, I'll go through these before jumping onto the next question.

So JS Allen updates to channel cross-section and flow rates are certainly welcome and analogs to be at sea level are hard to agree upon.
Yeah, I think that's just follows the our line of discussion that we're just coming off of.
And I did want to -- there was a response to my -- my question going out there about the coastal management perspective.
So Roger -- that's how you say your name, sorry if I got that wrong -- LWD updates are likely unimportant however IGLD will affect high water mark designation the major factor in both federal and state oversight.
Okay, that makes a lot of sense.
And now, that you bring that up there was a lot of reference to that during the IGLD session this morning.
So any other last comments before I move onto the next question?
All right the next one is how do you currently use the LWD?
What are you using it for?
So go ahead and type your answers to that in the chat.
And while those are being typed anybody on the panel want to chime in here?
What kind of you know, what kinds of questions do you get about that?
How have you helped people who are using LWD?
And so on.
I suppose -- because Travis and Mina touched on this during their presentations, anything that you want to say while we're waiting for the answers to come in?
>> Well, we do have a couple answers that have come in here.
So Paul is saying operational elevation that were in terminals [inaudible] nautical charts so I use LWD, well, that's, yeah, really big use of them.
Top Lopper also said setting charts, Jack Riley GNSS collects data using the -- and corrects data using VDatum, IGLD 85, LWD mapping.
Another answer here navigation draft overhead clearances and creating docks and Great Lakes would use it for back fills for ship dockings.
So a lot of shipping, a lot of charting, a lot of showing what is underneath the water surface.
Got some more typing going on.
So all of you involved with with maintaining and updating the water datum what brought you into that?
Why -- what other kinds of background and experience do you have related to water level datum development?
Wondering too anybody that's out at NOAA headquarters out in silver Spring, what held you to want to work on a Great Lakes datum?
Laura, Chris, Travis?
>> Lobbing ones at us, huh, Jacob?
>> Yeah.
Talking I'm not the expert on this.
>> [Laughter].
>> Look at Tom's answer job description.

Yeah, no, I think in my previous role at co-ops is the mapping and charting program manager the international Great Lakes datum update fell under that management and through that we started talking about low water datum as well.
And so that's where we are.
Working through the IGLD update as well as the low water datum update and our office owns the datums on the U.S. cores coast the national datum -- nationally we've been involved with the coordinaing committee since its inception in one way or another.
I see some old names here on the list of attendees including Dave -- let me give a shout out to him but you know just starting to really work through the issue in the Great Lakes and understanding what the datum is, and how we need to get it updated.
That's where where I've come in.
>> Yeah, as far as the charting side goes I mean datums are very important but it's not something we really deal with day-to-day.
We're used to get data on the correct datums you know we just essentially apply whatever we get to the charts and the odd --
and if we get something that's in the -- a different datum, then we have to, you know, address it there.
But normally this is not something we deal with day-to-day.
It's -- this is very rare I would say when new datums.
>> Okay.
Yeah and Travis you said that you do charting not just for the Great Lakes but also for other parts of the country as well?
>> Yeah.
We -- I mean, my team we deal with the West Coast and south Pacific, but you know, we have other production branches that deal with the -- with all of the United States waters, um-hum.
>> Okay.
Okay.
All right.
Well, we've had a couple more responses come in here.
So Derek at Army Corps in Detroit navigation channel, mapping surveying, dredging, Army Corps navigation structures, locks, projects designed et cetera [reading] [indiscernible].
That covers a pretty big spectrum of the uses there.
We see the importance of it.
It does have a pretty broad use and yeah, and I just think about this too.
I mean this is fresh water.
This is really important.
And to have good had maintenance, yeah, there's --
there's a lot to it.
And I think anybody who lives up here in the region would agree.
Sierra had a good question, wondering if LWD is used for any FEMA flood insurance rate maps, I'm not sure if there's anyone here who can answer that and I see Jeff Jacobkowski is typing.
Just go ahead and take yourself off of mute.

You're probably the best person that could answer that call.
Looked like you were trying to say something there.
I see the little speech thing coming up but don't hear you.
>> Can you hear me now?
>> Now I do.
You're good.
>> My head set microphone quit working for some reason.
Just over top the other mic.
I've never personally seen a firm from FEMA that referenced low water datum but in some of their technical guidance I can't quote which manuals, they do clarify -- they basically have seen -- I think I've seen regurgitated essentially some of the LWD information from that --
Detroit page that we looked at earlier, that website.
And so yeah, they don't use it in mapping, right, but they clarifying in technical guidance what LWD is in the Great Lakes, right.
So for each lake and how it's referenced meaning in IGLD 85 heights.
Hopefully that gives a little bit of clarification there.
Best I can do anyways without working for FEMA.
[Laughter].
>> Yeah, thanks, Jeff.
And yeah, I can't think of anything to add to that.
You know, I haven't done a whole lot with FEMA flood rate maps but I have digged into them a little bit.
Go ahead.
Terese here.
I was going to say CHS is low water datum or IGLD 1985 low water datum for bathymetric surveys on the Great Lakes.
So we do surveys on the interconnecting channels on the Canadian side pretty much yearly and in the past couple years some additional surveying on Lake Superior and other areas and the Great Lakes.
And we're using -- obviously we don't have the datum on the Canadian side but we do have locally built models that we use for using GNSS survey techniques.
>> If I could, Jacob, this is Jeff.
>> Yeah.
>> Yeah, I've dealt with a lot of your different sanitary districts and everything and their reference to outflows, innflows for water intake all reference low water datum for where their intakes are and difference where datum will have to be you know, determined.
For their referencing coming up.
So yeah some huge impacts, but I would like to quickly say if I could, the sea level rise the North American sea level rise and the new datum is pretty much what is given us this reality check on the low water datum and with a we're going to do, but technology also.
I mean everything is now satellite, GNSS and trying to coordinate the national datum whereas before it was based on the mouth of the St. Lawrence and within the datums were within the -- within the Great Lakes basin determined, 55, we didn't -- they didn't

want to change-over to NGBD 29 or the Canadian datum of 28 because that was mixed datums there.
And so 55 was determined within itself and carried just within the basins.
Personally I would like to see the difference between what the 19-year epoch is at -- versus what the North American accepted sea level for the new datum just look at those differences that should be looked at.
Before we ever decide -- because the cost, you know, analogy here is just un-Godly I mean as far as what it's going to cost in taxpayers [inaudible] if we decide you know to go forward.
Looking at the low water datums absolutely what we need to do.
I mean it hasn't been really reviewed.
The changing of the datums from 55 to 85 was the difference in the PBML at your master station was then applied to the previous low water datum.
Then that's how they determined the new low water datum reference for the new datums.
Now, we're looking at possibly doing lake-wide averaging and I'm not going to go back to the 1918, but '62 forward with the building of the seaway and all the work that was done with the seaway which changed a lot of things, my personal belief is the time period to look at '62 forward.
So got everything looked at.
And then our percentiles of what we -- we look at 90% and 94.
You've got to use different percentiles.
If we look at a lower percentile then we get closer to reducing the effects cost wise.
And what has to be you know, dredged.
I think that needs to be looked at.
So just my perspective.
Thank you.
>> Thanks for providing a little more perspective on that, Jeff.
Getting the whole story misunderstanding where that comes from.
So before we wrap this up, audience any questions for us?
Go ahead and put those in the chat box there.
Now, you know, you brought up the sanitary outflows and that's another consideration for high water flows that we have to pay attention to.
I'm wondering if we had discussed anything about our generation today or if there's anything that we maybe need to address on that.
And Jeff, you might be able to speak to that.
Okay.
Yeah.
And again, if you got more to mention there, Jeff, just go ahead.
I do see a comment here commercial marine operators can upgrade their too [reading] [indiscernible].
Yeah some really good points there about the changes in technology and embracing those much like we are with the datum updates here and how the datums will be accessed.
So you know, good point.

>> Jacob can you hear me?
>> I hear ya now.
>> Yeah, I'm sorry my mic must have been -- yeah that's the whole reason the dynamic heights were with the realization in 55 datum and the building of the courted naturing committee --
coordinating committee in different countries and determining because of all the hydro plants that were being built and constructed all the way from the new power system powerplant down to the Niagara river down through the St.
Lawrence and dynamic heights are what remains flow determination which is required for obviously for hydro power, for navigation, for determining flow ratios from lake to lake.
So that's just another key from the understanding of why we need to use dynamic heights.
>> And just so the update to the low water datum, would that impact that, or is it only the IGLD update that would?
>> The IGLD update based on the new datum will be able to keep the dynamic heights but in reference all the gauges will be based on the new dynamic heights under the new datum.
So you're going to have a height like one Superior that is 68 centimeters two feet difference in height and obviously it's not going to equate to the existing low water datum unless you put an offset figure there and that can be really confusing for the navigation community as well as so many others.
So all that's going to have to be really closely huge impacts and how we're going to you know, all finally relate to how we can do this.
And you know, talking to the industry here, those that are on here from the industry, it's good that we're absolutely talking with them and understanding those impacts.
>> Okay.
Thanks for that.
Yeah, kind of giving it another minute here in case there are any more questions for us coming in.
But I think we're about getting to the point where we can wrap up here unless there's anything else that the panel has to say.
Watching who's typing here.
So Jack Riley says where the Great Lakes water level plots relative to LWD 1928-2018 corrected for crustal motion, that is were any mitigating impacts of that included in the dredging change assessment?
So who might -- Chris, do you have any answer for that?
>> It's Derek, I can answer that.
Yeah.
We used coordinate data from basically the Great Lakes coordinating committee.
So I won't say it's the data we used is perfect, but we've put a lot of effort into trying to make sure that we encounter for all the crustal motion and picking the actual gages we calculate the lake -- so yeah we think we've done a good job an that.
>> Okay.
Thanks, Derek.

I see Jack's typing again.
So I'll let that populate here.
Thank you.
So appreciate all that.
And yeah, I think we can hand it over to Jen to wrap us up.
>> Yeah.
Thank you for that turnover.
And yep, we'll be just having reviewing a few things from today.
So to recap, today we heard how vital it is to have access to correct water level datums, and understand the changes expected with the IGLD and low water datum.
On behalf of the coordinating committee and our presenters here today we thank each of you for attending.
Thank you to the audience for coming today with your energized conversation and questions.
Why you are feedback has helped us to better understand how you use datums and how we can better serve you as you roll out the new datum updates.
Thank you to our presenters for this great presentations.
We learned more about and discussed updates to the international Great Lakes datum.
As well as the low water datum.
And their impacts on coastal navigation and shipping communities and industries.
The three datums involved with the IGLD update, the NAPGD 2022, Geoid datum the international Great Lakes datum and the low water datum were all discussed in detail.
And we hope you walk away with more understanding about these important datums.
We will take all questions and comments into consideration going forward.
And we plan to generate a document of the questions posed here today with responses from our presenters and experts.
We will send those to all of you once it is complete.
Share this with other stakeholders.
We plan to conduct ongoing outreach and may host another workshop soon to continue these conversation.
Thank you again and reach out to us if you have any further questions, comments or concerns or input.
Thank you.