ERDC EL
Moderator: Courtney Chambers
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Courtney Chambers: Okay, at this time I'm going to give you today's speaker. Mr. Joe Gailani is a research hydraulic engineer at the ERDC Coastal and Hydraulics Laboratory. He has been with ERDC for over 21 years as the manager for the sediment and dredging processes focus area, and also serves on the International Conference on Cohesive Sediment. He has additional work experience with the EPA Office of Research and Development.

Today, Joe will be speaking about how dredged material can be a source of sediment to supplement and balance our sediment deficits. Strategic placement is when material is placed at one location, with the expectation that waves and currents will transport the sediment towards resources of interest.

More about Joe can be found in his bio posted with the presentation and the recording of today's meeting on the DOTS Web page for your reference. All right, Joe. We're very happy to have you sharing with us today. At this time I'm going to give you the presenter rights. We'll enter listen-only mode, and you can begin.

Joe Gailani: Hi, good morning or good afternoon, everyone, depending on what part of the country you're in. Thank you for the introduction, Courtney. I'm going to talk about the strategic placement of dredged material, and how this policy is evolving within the Corps.

As an outline for my talk, I'm going to give a definition of strategic placement and some of the benefits of it. And then strategic placement is something that USACE utilizes at many locations. And so these selected case studies I'm going to show you are only a sub-sample meant to represent practice in different environments where the Corps dredges.

The international examples that I'm going to show next are somewhat different than those methods applied in the US. And some may not be applicable under US law, but they were meant to show the potential for strategic placement.

And then I'm going to show an example study that was performed by ERDC for the Savannah District for near-shore placement of predominantly sandy dredged material that was not beach quality. And the goal was to identify a placement site that would most benefit a shoreline stabilization effort.

So for the definition, for the first piece in that outline, we know that direct placement of dredged sediment is used to construct beaches and wetlands and berms by directly placing the material into the location where you want it.

While it's effective at nourishing the resources, it can have some downsides. The cost, for example, can be high if you need to put flexible pipeline or something into a wetland or onto a beach. The available dredged sediment may not be compatible with the requirements for the resource -- for example, beach placement requiring 90% sand in the dredged material.

And there can be significant impact on environmental resources at the placement site, because a direct placement just overwhelms them as a dose of sediment.

So as Courtney mentioned in the intro, strategic placement is a practice of placing at one location, in a water body, with the expectation that some fraction of sediment -- whether you want the clay, the silt or the sand fraction

-- to transport to nearby resources. Obviously for near-shore beach placement, for example, you'd want the sand material only to approach the resource.

It's often lower cost than direct placement. That's really site-specific. It may not be lower cost, but it often is. It permits a natural sorting of sediments, with the desired sediments transported towards the resource of interest. And those that are not beneficial to that resource are hopefully moved away from the resource of interest.

The slower rates of accumulation at the resource permit habitat recovery. And this really is in keeping with the regional sediment management policy that the Corps is trying to enact, where regional sediment management is a holistic approach to evaluate sediment as a resource; improve our sediment management regionally from the watershed to the sea, looking at sediment not just as a navigation issue, but as a navigation and shore protection issue at the same time.

And RSM philosophy includes beneficial use of dredged material, and this should be utilized where possible so that this sediment resource isn't disposed of in a CDF or open-water disposal site, for example.

Now we're going to talk about strategic placement examples within the Corps. I'm going to first talk about shoreline/open water/coastal applications; then a riverine application at Horseshoe Bend on the Atchafalaya River; and then an in-bay placement in Mobile Bay.

At Fort Myers Beach, Florida, the dredged sediment from a nearby pass is not beach quality. So the goal was to build a near-shore berm and permit winnowing of finer sediments prior to deposition on the beach. And this was done in 2009, and a four-year monitoring program was enacted by the Jacksonville District, and led by the University of South Florida.

Dr. Ping Wang -- and one of his students, Dr. Katie Brutsche, who is now here at ERDC -- was one of the leads on this project, as well as other students. Monitoring included morphology, shoreline evolution, and grain size distribution throughout the monitoring area.

Fort Myers can be seen on the picture on the right-hand side. It's on the Gulf side of the Florida peninsula. The lower picture, the red outline is the berm location.

And the survey lines on the left are for a control area, just so they can compare what's happening in the control area, from what was happening within the monitoring area. And you can see the survey lines within the monitoring area to the right, passing through the berm itself, and on either side of the berm.

Near-shore berms are not uncommon. Similar experiments in the last couple of years that included detailed long-term monitoring included Perdido Key and Egmont Key in Florida. But those berms were closer to the shore. They were in the swash zone.

At Fort Myers, because it's on the Gulf side, the swash zone's relatively near shore except during storms. And there was a relatively small, dynamic natural barrow only 150 feet offshore. The dredged sediment berm was placed 600 feet offshore, and was three feet high and 6000 feet long. It included a volume of 230,000 cubic yards.

There was a four-year monitoring effort by the University of South Florida, and the berm migrated onshore during this entire period. There was a beach accretion of 23 feet at the berm site after the four-year period, without any negative impacts to adjacent beaches.

The onshore movement was dominated by high energy winter months. And the berm project area experienced less erosion than control areas during storms.

The picture here, that I'm showing you here, shows the original berm as this black dashed line. And you can see that each one of these colored profiles - the blue colored profile that I'm pointing to now was the original shoreline survey.

And the colored ones are at some time after post-placement. As I mentioned, this was placed in 2009. The green line is early 2010. The purple line, late 2010. The light blue line, June of 2011. And the orange line, September 2011. And you can see the progression towards the shore, the onshore movement.

Another issue that was an issue was the fine content in this berm placement, because it was not beach quality. It was determined that in April, soon after placement, the finest material was offshore and in the trough. By June of 2011, the tough sediment had coarsened and the offshore became finer, indicating transport of fine-grain sediment away from the beach.

It should be noted that the control are included fine-grain sediment naturally in this region. And the grain size distribution of the dried beach didn't change during the entire four-year monitoring effort.

So I've already discussed RSM principles, and I'm going to discuss engineering with nature principles a little later in this presentation. And this intense monitoring effort was intended to inform future design of berms.

But some of the RSM and engineering with nature strategic placement practices that were enacted as part of this demonstration project were the winnowing of fine-grain sediments from the berm to reduce the percent fine content that makes it to the beach, so that the sediments that migrated onshore were compliant, and the fine-grain sediments dispersed.

And the natural berm also provides shore protection from large waves breaking on the berm during storms, which again led to that beach accretion, as well as this nourishment of the sand. There was also a wave reduction. And this is a sustainable dredged sediment management solution, because the berm migrated. And at the end of four years, that placement site was available again.

My next example is a riverine example. The lower Atchafalaya River in Louisiana is a navigable waterway linking the Gulf of Mexico to inland communities and additional waterways. Hydrodynamic conditions include river flow and tidal conditions of nearby Atchafalaya Bay, creating a typical river-like estuary bay system, and the hydrodynamic response.

By the 1990s, the typical placement was wetland development adjacent to existing wetlands. But by the 1990s, these sites were fully developed - by 1999. So we looked at alternative placements, alternatives which included converting wetland to upland; the long-distance pipeline to the bay; and the mounding of material mid-river.

If you look at my arrow pointing, that would be mounding material in this general location with the intent that that material would migrate to a naturally forming island just down river, with the hopes of creating additional wetland.

So this mid-river placement was selected to investigate the downriver shoaling, and was initiated in 2002. And then intense monitoring effort was initiated by the New Orleans District in cooperation - or with support from ERDC, to look at acreage, habitat, soils, and so on.

This is an Army Corps of Engineers Engineering with Nature project. And it's certified by PIANC as a Working with Nature project. I'll tell you a little bit about what that is.

Engineering with Nature is a USACE initiative that involves the intentional alignment of natural engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes -- in this case, linking engineering processes and environmental benefits.

So in this case, collaborative processes include a cost-effective dredged material management and habitat development. PIANC, which is the worldwide organization - or the World Association of Waterborne Transport Infrastructure, that was founded in 1885, has approved this as one of their Working with Nature projects.

Working with Nature is a PIANC initiative which calls for a shift in thinking in the approach to navigation projects that places these projects within the context of the entire ecosystem, and emphasizes solutions that include best navigation practice, and ecosystem or social benefit development.

So Jeff Corbino and others from the New Orleans District worked with ERDC research, as I mentioned, particularly Jacob Berkowitz and Burton Suedel as well as others, to develop the long-term monitoring program that would evaluate evolution of the island and its habitat.

And some of the things they looked at were the hydrology of the river through numerical modeling; the evolution of the island; sediment transport from the placement site to the island through numerical modeling -- they didn't actually monitor in the field the transport; the soil and biogeochemical activity; habitat diversity; and they used aerial photography. And they have a future study planned for economic value of the strategic placement.

And if you go to the Terra et Aqua Journal Web site and look for the article Suedel, et al in 2015, in September 2015, that gives a good overview of this project, and it references some articles by Jacob Berkowitz that are more technical in nature, but equally interesting.

This is the evolution of the island from 2008 to 2014, with each frame showing a given year. The island has altered the local hydrodynamics. It's actually reduced shoaling in the navigation channels to the east that I'm pointing to here on the 2008 picture.

It reduced shoaling in that navigation channel and they've actually - in 2014, USACE and the Coast Guard moved the navigation channel from the west side of the island, which I'm pointing to now, to the east side. And this is reducing their navigation dredging costs, which is just an added benefit.

At present, as of 2012, the island is 35 hectares. The island hasn't grown every year. It recedes some years in specific locations, and but the trend is that the island is growing. And the habitat has been documented, and has a diverse habitat, and includes a diverse avian community.

Now the modeling was done by Dr. Sung-Chan Kim here in the Coastal and Hydraulics Laboratory at ERDC. He used a three-dimensional CH3D curvilinear grid hydrodynamic model. The boundary conditions for the model were driven by the river flow in the north, and the tidal elevation in the south.

This is just a snippet, part, of the entire hydrodynamic modeling domain. It doesn't include the entire domain. And it shows the - on the right-hand side here, the bed load transport. And you can see the bed load transport is more intense on that east side of the island, this being the island that I'm pointing to now, where they moved the navigation channel.

And ERDC really maintains a suite of sediment transport tools, from screening level to fully 3D sediment transport. In this case, Sung-Chan used a 3D hydrodynamic model.

But he used a sediment pathway model, which is more of a screening level model, which I'm going to talk about a little later on in more detail, to look at the potential for transport and the direction of transport. And that's how he developed these analyses that are shown in these two images for suspended solid transport and bed load transport.

The third example I wanted to present was an in-bay placement for Mobile Bay. And the Mobile-Tensaw river system is one of the largest in the country. And the Mobile-Tensaw river delta is actually at the head of Mobile Bay, up here in the north where I'm pointing to now, is the largest inland delta complex in the US, and includes diverse freshwater and estuarine habitat.

The Corps maintains, the Mobile District maintains, a 40 or more-mile-long navigation channel. And it's a major project within the Mobile District portfolio, because this very large river system introduces such a large volume of sediment to the delta and the bay, and only about 30% of which actually makes it out through the pass here that I'm pointing to now, into the Gulf of Mexico.

The majority of the dredged sediment was placed in bay until the Water Resources Development Act of 1986. Post-WRDA, all sediment was placed in the Gulf, supposedly to improve bay environmental quality. That meant 4 million cubic yards was annually transported up to 40 miles to an ODMDS in the Gulf of Mexico.

It's been recognized through wetland recession and such that the bay is losing sediment. Mark Byrnes of Applied Coastal Research and Engineering developed a detailed sediment budget for the bay, which he published in 2013. And that is online. And that indicated that the sediment deficit in the bay was about 1.6 million cubic yards per year, which is smaller than the 4 million cubic yards per year annually moved through navigation dredging.

Now the modification to WRDA in 1996 included considerations for in-bay placement, and 2012 recertification included permission for emergency open bay think layer placement options, which I'll talk about in the next slide.

In 2012, infilling conditions were severe enough that Mobile District exercised an emergency in-bay placement option to clear the navigation channel within budget, because the cost efficiency of using a cutter head dredge - so they used a cutter head dredge only in the north part of the channel, north of this split in the channel that I'm pointing to right now, and used this in-bay placement.

They used this 2012 in-bay placement monitoring and modeling of this, in cooperation with ERDC, between the Mobile District and ERDC, modeling and monitoring after it was performed, to demonstrate that this in-bay placement was a feasible option that was environmentally acceptable and would actually benefit the bay.

In 2014, the Mobile District got permission for long-term in-bay placement strategies, in part using this demonstration project which I'm going to talk about next.

So as I mentioned, in 2012 the District used thin-layer placement, emergency thin-layer placement, operations to clear the channel. So the requirement was that placement was less than 1 foot thickness for re-establishment of benthic organisms.

And according to that Byrnes report, who did the sediment budget, thin-layer placement would be the best method to mimic what would naturally happen in the bay if the navigation channel were not there, and you were trying to recreate natural deposition processes.

Emergency placement in 2012 was permitted only in the pre-1986 channel-adjacent placement sites that were used prior to offshore placement. And I'm pointing to those placement sites right now. They're labeled 1, 2, 3, 4, 5, 6, 7 and 8 and 10. Those were the placement sites that were used in 2012, where we did the monitoring.

The Mobile District was concerned that this near-channel placement would result in increased shoaling in the channel. And this is addressed as part of the modeling study discussed in the next slide.

And to demonstrate that, in this lower image here on the left-hand side, 219 sediment profile images were performed by Dr. Bob Diaz of the Virginia Institute of Marine Sciences, in cooperation with the Corps of Engineers, to look at the thickness of the generated thin layer mounds.

And you can see this. Each tick mark on the side here is 1 centimeter. And this grayish area on the bottom is the buried native sediment. And it shows the thickness of the placed sediment.

So as - after the study in 2014, the Mobile District is developing plans for placement near emergent tidal marshes in the north of the bay here, that would re-introduce less sediment to the navigation channel, and provide more sediment to the receding wetlands.

So now I'm going to talk a little bit more about the modeling and the placement process and transport studies that were done by ERDC for the Mobile District.

So this was a combination of sand, silt and clay, so it was considered a fine-grain sediment. So the sediment was considered cohesive. To model cohesive sediment transport, we need site-specific data on erosion potential, and critical shear stress.

So we collected those data using what we call SEDflume. That was done by ERDC. And then those data were used to parametize a three-dimensional cohesive sediment transport hydrodynamic and wave modeling effort that was done by Drs. Earl Hayter and Ray Chapman here at ERDC.

This was a multi-grain size three-dimensional model of the entire base system, to evaluate the fate of each sediment class -- sand, silt and clay -- within the bay. And it included separate analysis of the fate of the thin-layer placement. So they were treated separately from all the sediments moving around the bay.

And the model actually indicated, as shown on this table, that there was a significant amount of reintroduction of sediment from the thin-layer placement sites back to the navigation travel. And there remains about 35%, and the remainder was disbursed throughout the bay. And for alternative placement sites further away from the channel, the modeling indicates there would be obviously less channel in-filling.

Now looking at strategic placement examples outside of the US, I wanted to talk about the Delfland Sand Motor in the Netherlands, which is an experimental design for a very large strategic placement feature, and that is a sand feature; and then Harwich Haven, which is a restoration project that emphasizes the importance of fine-grain sediments in the resource. I may need to hurry up here a little, because we're running out of time.

But the Dutch coast is naturally receding, and the Dutch government has committed to sustaining the present coastline. Back in 1990, a national policy was adopted on coastal defense that emphasized protection of low-lying areas, as well as sustaining preservation of coastal dunes that protect those low-lying areas behind the dunes.

The main protection in Delfland was direct placement - direct beach nourishment, which was done at various locations on a three- to five-year cycle using offshore barrow sites.

In 2011, they decided to implement a new strategic placement method called the Sand Motor, which is a 21-million cubic meter parabolic peninsula that was 2 kilometers wide, and protrudes 1 kilometer out into the ocean, with the goal of reducing the frequency of interruption to the beach caused by the three- to five-year cycle of nourishment that had to happen at each place along this coast.

And the Sand Motor is a demonstration of the European initiative called Building with Nature, which is similar to Engineering with Nature. And Building with Nature is an alternative approach to hydraulic engineering that emphasizes more than just protective structures.

It's a design philosophy that incorporates the forces and processes of nature in shoreline infrastructure design, to simultaneously strengthen natural systems, economic function, and societal benefits.

This is an aerial photograph of that 2-kilometer/1-kilometer peninsula, designed to feed adjacent beaches and eliminate the need for direct beach nourishment along 12.4 miles of coast. Wind action, wave action, littoral currents -- modeling indicated that they would move these sand sediments; the wind offering natural dune growth.

This was an experimental project, so they wanted to get knowledge development out of this, so they can apply this method, if successful, at other sites on the Dutch coast.

As you can see from this picture, there is an inland lake and a lagoon that I'm pointing to now, with an opening out into the ocean. They wanted to create a diverse habitat, and they wanted to improve the function of the Dutch coast for leisure activities.

Unfortunately, the lagoon entrance silted in by wind and littoral current-driven transport, and that caused some water quality problems in this lagoon. But that's part of the learning curve.

So the Dutch government, the (Reif Mutterstadt), monitored the hydrodynamics, the waves, the morphology, the ecology of both the beach and foreshore, and the dunes, dune development and habitat development. They monitored the groundwater. They monitored the number of leisure visitors.

As I mentioned, this was built in 2011, and 2013 monitoring indicated that 95% of the sand remained within the monitoring area. And 80% of that sand was within the original design footprint. And the preconstruction models really compared favorably to the 2013 and 2015 monitoring data, which indicated a 20-year life span.

Like at Fort Myers, the data indicated that storms are the major driver of transport. And they're looking at habitat recovery compared to the typical beach fill. Because this is still a relatively new feature, those data are still being compiled.

The final example that I'm going to give before going into my demonstration project is called Harwich Haven. It's a major commercial shipping channel on the east coast of England, so it enters the English Channel. It had a tidal range of up to 3.5 meters. Channel in-filling is dominated by fine-grain sediments. About 2 to 3 million cubic yards of dredging per year. The majority is placed offshore at a disposal site.

The wetlands are adjacent to the entrance channel, and they're very near to the entrance channel, so the large ship passage causes additional wave attack and recession of these wetlands. And modeling was used to support sustainable wetland maintenance efforts.

In 1998, the channel was deepened, and the modeling predicted that this would increase wetland recession. And a combination of direct placement and innovative strategic placement practice methods were proposed to mitigate for that wetland loss.

The direct placement included construction of 16.5 hectares of wetland, as well as thin-layer placement spraying on some salt marsh that was receding. The monitoring of thin-layer placement indicated no adverse effects to vegetation, as long as it kept it below 1 centimeter. They call this thin-layer placement artificial accretion, and it's an ongoing use of dredge material, not a one-time deal.

And the thin-layer placement is done two times a day during the highest tide levels, using an innovative flexible pipe method which minimizes damage to the existing salt marsh, and permits them increased accessibility.

Now strategic placement or bypassing of dredging material includes some tidal placements; low-feature berms; a fine-grain sediment near the wetlands, near the entrance to the wetlands, near the entrance channel to the wetlands. You can see where those berms were placed as these red areas on the map that I'm pointing to now.

It also includes something called water column recharge during flood tide. This is the spraying of dredge material into the water column, with the idea that it will remain suspended during these flood tides, and increase the suspended solids concentration of the water going into - flooding the wetland.

They also increased overflow dredging in the navigation channel here, with the idea of just increasing the suspended solids concentrations regionally, to what they would be if there was no navigation channel, with the intent that some of this material would get to the wetlands.

And some of the methods that Harwich Haven - is the understanding that really the beneficial use of fine-grain sediments perform less often than that for predominantly sandy sediments.

And this is a really good example of using a diverse portfolio of methods to use fine-grain sediment beneficially, and how we can reintroduce some portion of this dredged material into sediment-starved systems, and introduce it in a manner where the dosing won't overwhelm the surrounding resources.

The picture here is actually that sediment recharge that I was telling you about, where they were spraying dredged material into the near-shore, near the entrance channel to wetlands.

Now I've really got to speed this up, but at Harwich Haven they - really the sediment physical processes, they accepted the fate of fine-grain sediments as difficult to monitor, and they used an estuary-wide monitoring program that included bathometric surveys, looking at the habitat and the suspended solids concentration, and inter-tidal deposition. That was led by Dr. Ian Simpson of the University of Stirling in England.

And the modeling exercises were applied to assess various remediation options and how successful they might be. And now they're comparing results of their monitoring to see if the modeling was correct.

And they have an adaptive management plan that they have enacted, and they have modified some of their practices. And they have an advisory group for that adaptive management program that includes everyone from fish ecologists down through the engineers.

Our example of field laboratory modeling to support strategic placement site optimization is going to be at the Savannah River entrance channel, and the Tybee Island shoreline. And recession of adjacent shorelines is common at entrance channels, with deep navigation channels and jetties which direct the sediment further out, and move the edge shoal further away from the shoreline.

The attachment bar, you can see, Tybee Island is right here. This lower left-hand picture is a present structure. You can see the navigation channel; the jetties, which I'm pointing to now; and Tybee Island here, that I'm pointing to now.

On the right-hand side you can see that the north side of Tybee in 1866 protruded much further than it does now. It's receding. The attachment bar has moved south from where I'm pointing now, nearer to the Savannah River, further south to about here by 1982.

So there are a number of issues with strategic placement. Right now if we look at the picture, the green is the navigation channel, and some areas here where they do advanced maintenance dredging to avoid rapid channel shoaling. And the yellow is the present offshore placement site.

There's a barrow site to nourish Tybee Island just south of this placement site. So it's almost like two ships passing in the night -- one taking sediment towards Tybee Island, while the other's removing sediment from the entrance channel that's predominantly sandy, and dropping it offshore.

So it's logical from an RSM, a Regional Sediment Management, standpoint, given that dry sediment's predominantly sand, that near-shore placement can possibly be a cost-effective method of keeping sediment within the regional system.

The problem is that the cost of near-shore placement is generally more expensive than the cost of offshore placement. But if you look at it from a multi-project, if you include not just the navigation project but the shoreline protection project, it might be more cost-effective to do the beneficial use study.

In this picture you can see, just to note that, Tybee Island here, at their extensive wetland complexes both to the north and the south of the Savannah River entrance channel.

So what we wanted to look at was the benefits of strategic placement to the Tybee Island littoral system; any negative impacts that this might have on the shoreline; any reintroduction of sediment to the entrance channel; and issues associated with near-shore turbidity, because this wasn't beach quality material. And we wanted to identify the optimal placement locations and orientation.

As a first step, the Savannah District, when they came to ERDC, identified 12 potential placement locations. These included channel-adjacent sites similar to kind of a sister inlet, Brunswick Harbor, which is further to - 60 miles to the south, that has a similar system.

I should note that - so you can see the sites labeled here, 1, 2, 3, 4, 5, 6, 7. And then 8, 9 and 12 are not strategic placement sites, but designed to fill scour holes that have developed.

And the Savannah District wanted ERDC to evaluate the benefits of the near-shore placement at each of these sites, and determine a best practice for the placement options. Since these features - this area between the navigation channel and the Tybee shoreline is a very kind of featureless, flat shelf. And so these would create stark features -- these near-shore berms that the district was proposing.

We could have, as was done at Mobile Bay, applied a 3D sediment transport hydrodynamic wave model system, integrated system. But here we had to assess multiple placement options, so we needed a strategy for rapid evaluation alternatives, and that's really not feasible using the available mixed-grain sediment transport model.

So we applied the ADCIRC 2-dimensional circulation model; a wave transformation model, the (STWAVE) model, to look at wave shoaling over each of these berm features; a sediment transport pathways model, GTRAN, that looks at the sand pathways, as opposed to actually evaluating morphology change and sediment transport; and then a shoreline evolution model called GENESIS.

The issue is - one of the issues that we had to address was that these mounds create features. If you look in this picture at the bottom, these features which emerge from this flat, bottomless foreshore can cause wave focusing, which can change shoreline wave distribution and wave breaking. And it can create areas of shoreline accretion and shoreline recession, which we didn't want.

So I'm about out of time, so I'm going to go through this fast. We used a regional ADCIRC model where we refined the grid at Tybee Island and Savannah River, which I'm pointing to now. This is a 2D model for currents and model levels.

We compared the (unintelligible) data where possible to current and elevation data. We modeled both storm conditions, hurricane conditions, and active months and typical months for both waves and currents. This is an example of the circulation pattern during peak tide.

The colors indicate the intensity of the currents, with orange being lower currents, and going through yellow and green being the most intense currents. And you can see that there are intense currents near shore, particularly near the north end of Tybee Island. Here you can see these long arrows indicating the Tybee Island recession.

The wave modeling was done using the (STWAVE) model, and there's a wave transformation model. The picture on the left shows the wave elevations and directions, with blue being low wave, green and yellow being higher waves. And you can see that the waves over that, by Tybee Island, which is where I'm pointing to now, break significantly over that flat, shallow foreshore.

The actual wave conditions were developed through the wave information study (unintelligible), and it was used to drive the (STWAVE) model. And the (STWAVE) model was run for each mound scenario.

GTRAN is a numerical tool to estimate sand transport under combined waves and current. It's not a morphologic model. It's applied over a distribution of points in a region, and it indicates sediment pathways and trends. And the input includes the hydrodynamic solution from the ADCIRC model, and the waves from the (STWAVE) model, and grain size data.

It's computationally efficient, so we could look at long-term sediment pathways for multiple scenarios. So it was applied to both a base case no-mound scenario, and for each mound scenario.

And this is - on the left-hand side is a rose plot that shows the - with each wedge showing the direction and magnitude of transport at that point. So you can see flood-dominant transport transports towards the river, the entrance channel, along the north side of Tybee Island.

And ebb-dominated transport - not transport near the island, near the navigation channel. And decreasing ebb-dominated transport, which indicates shoaling, as you move further down the channel away from the jetties. And the picture on the right indicates the net transport direction at this subset of points on the GTRAN grid.

One thing to note, that the channel-adjacent mounds will have no net transport toward the shore to benefit Tybee Island.

So, as I said, we looked at this. This is that picture that I showed you before, but we've added Mounds 13 and 14 there, which is what ERDC proposed as the best alternatives for feeding sand to the north Tybee littoral system, while minimizing rehandling of the sand, reintroduction of sand to the navigation channel.

Mounds 13 and 14 are just north of the attachment bar. So we proposed these locations to the district.

And I've got to move on, so I'm just going to move to the next slide. For Mound 13 in this previous slide, we looked at the shoreline evolution using a GENESIS model. We were concerned that we would induce wave focusing, which may result in changes in the longshore transport.

And GENESIS is a long-term shoreline evolution model that predicts the recession and accretion of a beach under wave and wave-induced current conditions. It's a one-line numerical model. It has its limitations, but we were comparing alternatives here.

And what is shown here is Tybee Island kind of rotated. And this is Mound 13, and we can see that Mound 13 will increase accretion -- accretion being the positive numbers on this Y-axis -- in the north side of the island, while inducing a little recession on the south side of the island, where I'm pointing to now, compared to the base case. This is a 20-year simulation.

But that recession on the south side of the island is somewhat acceptable, since the south side of the island is naturally accreting anyhow.

So basically this is a scenario - this is just an overall picture of how we picture Berm 13 and 14 interacting with the Tybee shoreline system. Move materials as in this black arrow, from the navigation channel to one of these berms, and it will induce north-directed longshore transport that will nourish the shoreline. And some of that will re-enter the channel.

And these are just the conclusions, which I pretty much said before, that berm location will affect shoreline evolution. You've got to be aware of that. That sediment will move at rather rapid rates, so this will be a sustainable solution. And that strategic placement supports the broader use of Regional Sediment Management and Engineering with Nature goals.

And that is the end of my presentation. I apologize for running over.

Courtney Chambers: That's okay, Joe. We're still doing all right. We're still under the hour, and have some time for questions. I'm going to open the lineup.

Recording: All participants are now in interactive talk mode.

Courtney Chambers: So at this time you can unmute your phone and ask Joe a question, or you can use the chat feature.

(Rod): Hey, Joe. This is (Rod) from Portland. Nice presentation. You covered a lot of ground on that. The GTRAN's example on the last project - yeah, that image right there, the one you just had up. It showed the nourishment kind of going toward shore, and then passing along shore into the inlet. Is that kind of a one - that's kind of like a one-directional aspect, I guess, based on the net transport.

But through many tide cycles, isn't there kind of a back and forth thing going on? There's flood and ebb, even though it might be flood-dominated. Is there a back-feeding from…

Joe Gailani: Yes. If we go up to the slide where we showed the sediment transport rose plots, if we look at the one I have my arrow on now, you'll see that there is south-directed transport. But the net transport direction in the right-hand image is northward.

Courtney Chambers: Did that answer your question?

(Rod): Yeah. One follow-up, and I'll be quiet. So GTRAN works on the residual transport type concept?

Joe Gailani: It works on a - GTRAN performs - evaluates sediment transport in all directions. And from it you develop these transport roses. And from that we develop net transport directions, as shown in the right-hand image. But we use these roses to determine that sediment is also going south.

(Rod): Thanks. That was helpful.

Joe Gailani: And you can see from these roses that transport is much greater channel-adjacent, than it is in the near-shore or over that broad, flat feature between the channel and the island.

Courtney Chambers: All right. Thank you, Joe. Are there any other questions? We still have a few minutes. Just a reminder to unmute your phone first.

Steve Wolf: Yeah, this is Steve Wolf up in New England. I was curious. What's the level of effort associated with that sediment transport, sort of a screening level assessment?

Joe Gailani: GTRAN - well it really depends on how many alternatives you have. GTRAN's set up so it works on a grid of points that you have to provide it. We usually provide the hydrodynamic grid cell solution, and interpolate the waves onto that, that distribution of points.

And then it moves fairly rapidly, because all the - it's only going through the high-end cast of hydrodynamic conditions and at these points, taking the hydrodynamic solution for waves and currents, and calculating the rose.

Are you talking level of effort as in cost?

Steve Wolf: Yeah. So if you had a hydrodynamic application already, you know, what are we talking about in sort of someone's time to set this up and run with?

Joe Gailani: If you had a hydrodynamic solution already, you're talking a matter of a two-month effort possibly. It's about an order of magnitude lower than a fully three-dimensional, coupled hydrodynamic and sediment transport model.

Steve Wolf: Okay, well that's helpful. Thanks.

Courtney Chambers: All right. Other questions? Okay, I'll give you another minute to think while I remind you that if you would like a PDH, that you need to send me a chat message, or you could send me an email if you would prefer, with your full name and office, requesting the PDH. And I'll email that to you following the meeting, in the next day or so.

All right, last call for questions. Okay, Joe, well thank you for sharing your work with us today. And do you have any final comments before we close?

Joe Gailani: No, I just wanted to show some examples of how the Corps and others are using strategic placement, and emphasize the importance of good design in optimizing your strategic placement options.

Courtney Chambers: Very good. Well thank you for sharing those examples. And I'm sure you'd welcome any follow-up questions.

Joe Gailani: Yeah. My email address is right there. I'm the only Gailani in Outlook, so…that's easy.

Courtney Chambers: Yeah, great. Okay, well thank you again, Joe. And thank you, participants, for joining us to make a successful Webinar. Please be watching for any notices on additional DOTS Webinars. And we'll look forward to learning with you again soon. Have a good afternoon.

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