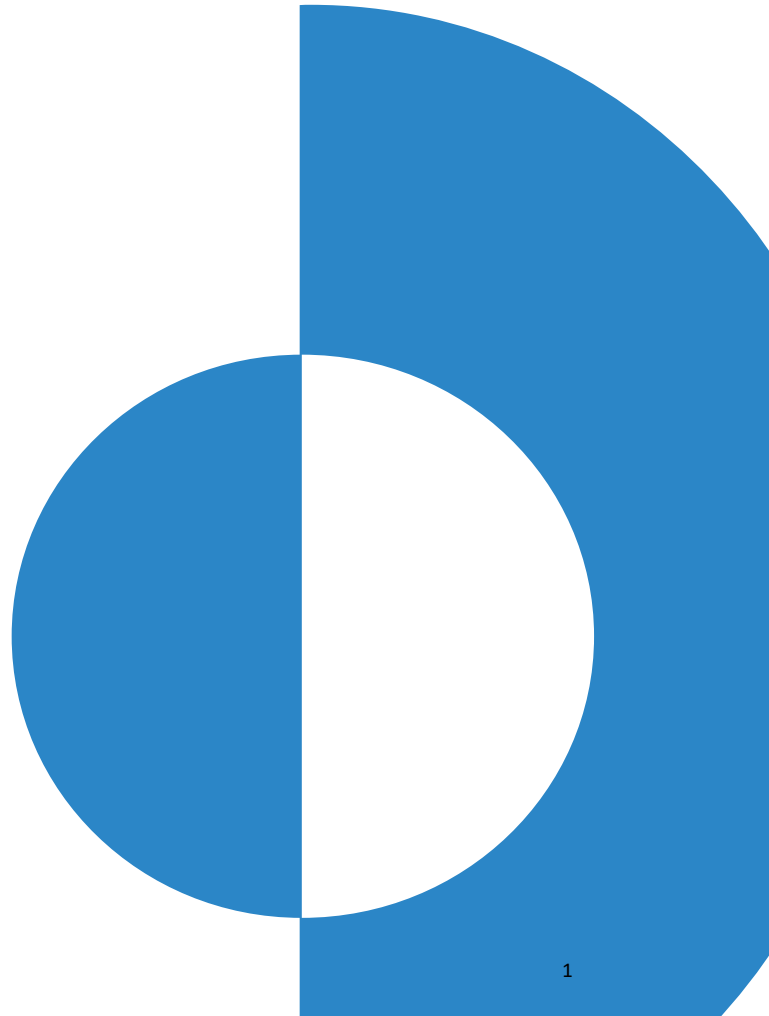




Technologies for Evaluating Risks to Existing Berth Infrastructure from Larger Vessels

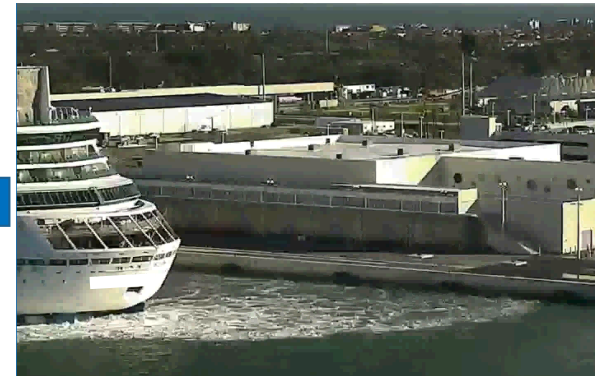
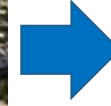


2019 Facilities Engineering Seminar



Risks Posed by Larger Vessels

1. Navigation
2. Passing other docks
3. Maneuvering at berth
4. Berthing
5. Mooring
6. (other)



Navigation

CMA CGM Ben Franklin
Port of Oakland, CA

Comprehensive vessel accommodation study, included maneuvering, surge effects, berthing and mooring.



Particular	CMA CGM Ben Franklin
Length Overall (ft)	1309
Breadth (ft)	177
Moulded Depth (ft)	99
Draft (ft)	52.5

Navigation

CMA CGM Ben Franklin
Port of Oakland, CA

*Maneuvering simulations
define suitable environmental
conditions, pilot procedures,
and data for surge analysis.*



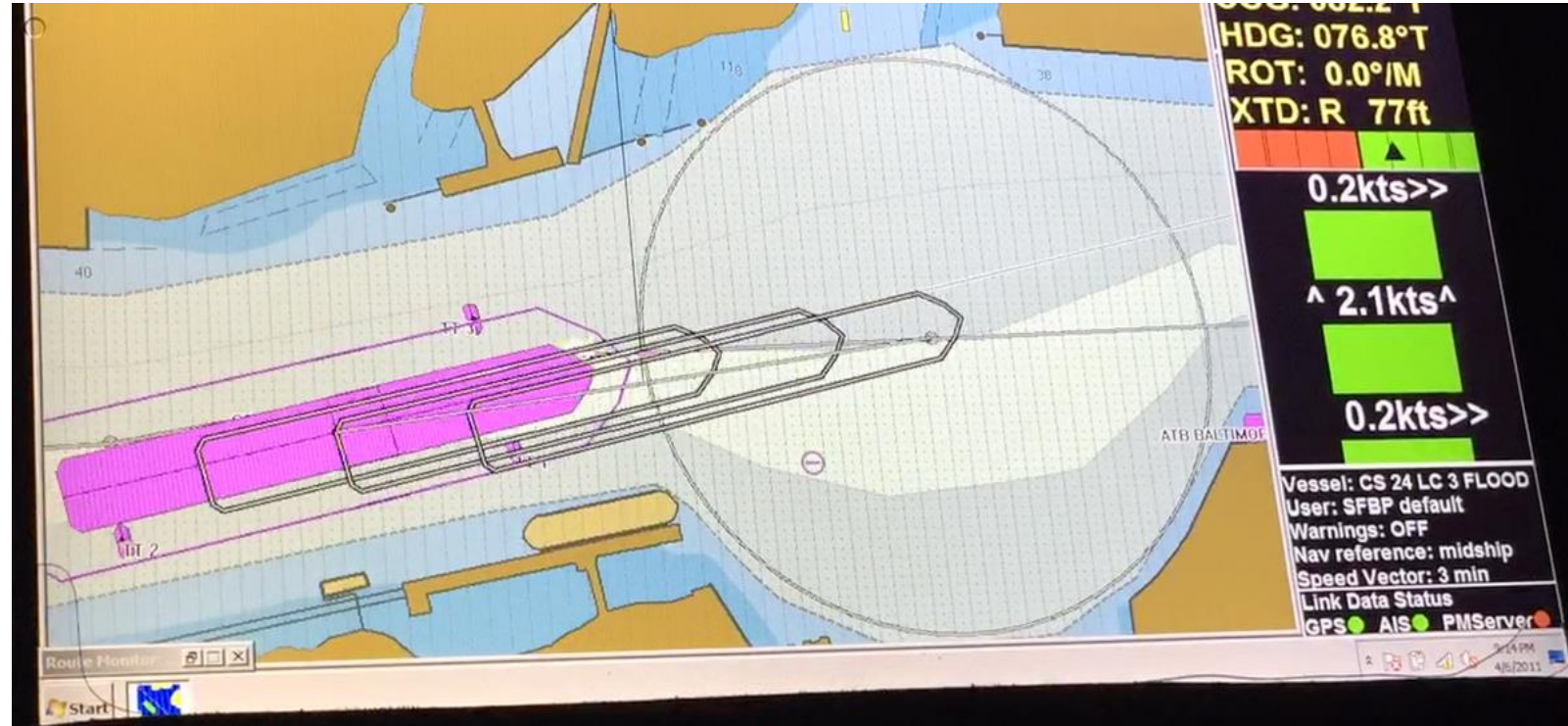
Simulations at CA Maritime Academy

Navigation

CMA CGM Ben Franklin
Port of Oakland, CA

High resolution PPU equipment provide better maneuvering guidance and accuracy than available on many vessels.

Pilots required the PPU with 2nd pilot for VLCVs over 1200' LOA.



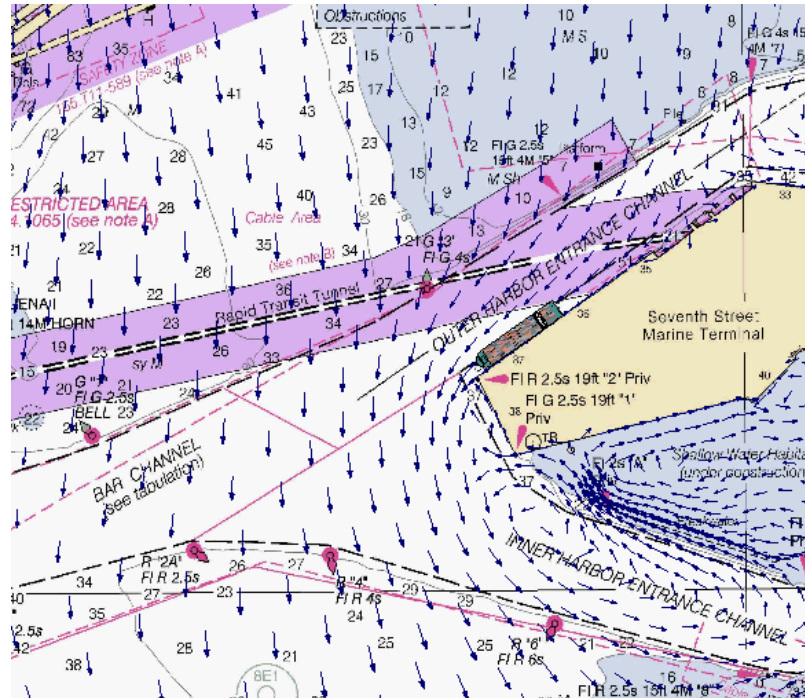
Navigation

CMA CGM Ben Franklin
Port of Oakland, CA

Navigation practice re-enacted after simulations.

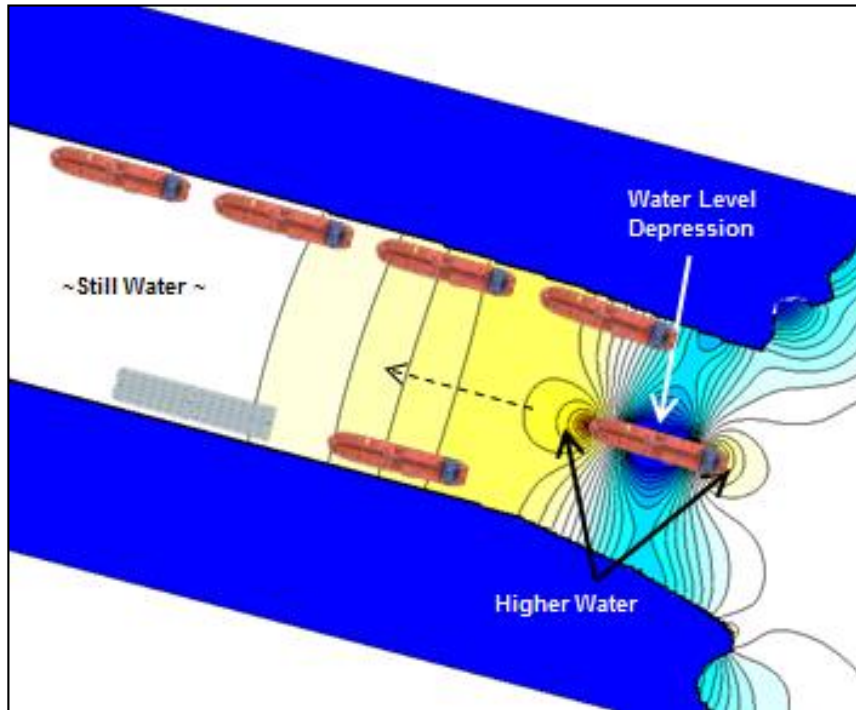
Surge effects were single greatest concern for pilots.

Simulations provide accurate data for simulation of surge effects.



Passing Other Docks (Surge Effects)

Surge effects are nothing new...



http://www.maritimequest.com/liners/titanic_page_6.htm



<https://www.belfasttelegraph.co.uk/news/northern-ireland/titanic-near-miss-that-could-have-changed-course-of-history-30636858.html>

Passing Other Docks (Surge Effects)

Surge effects are nothing new...

...but good understanding of surge effects is recent.

Many facilities do not have adequate consideration of surge effects.



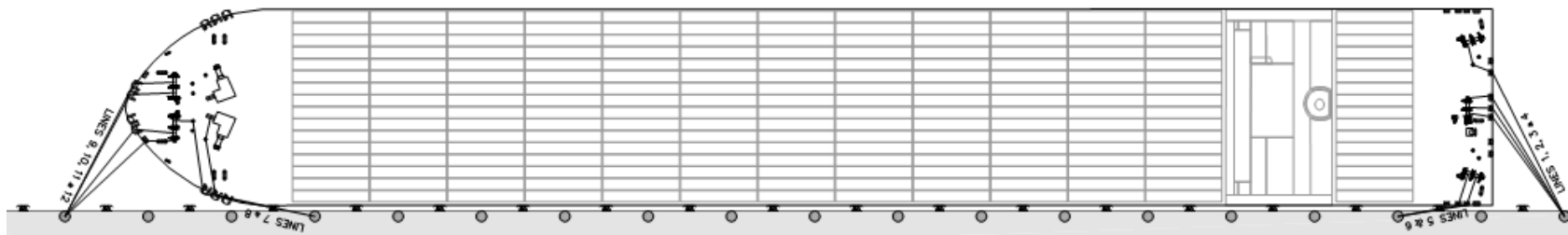
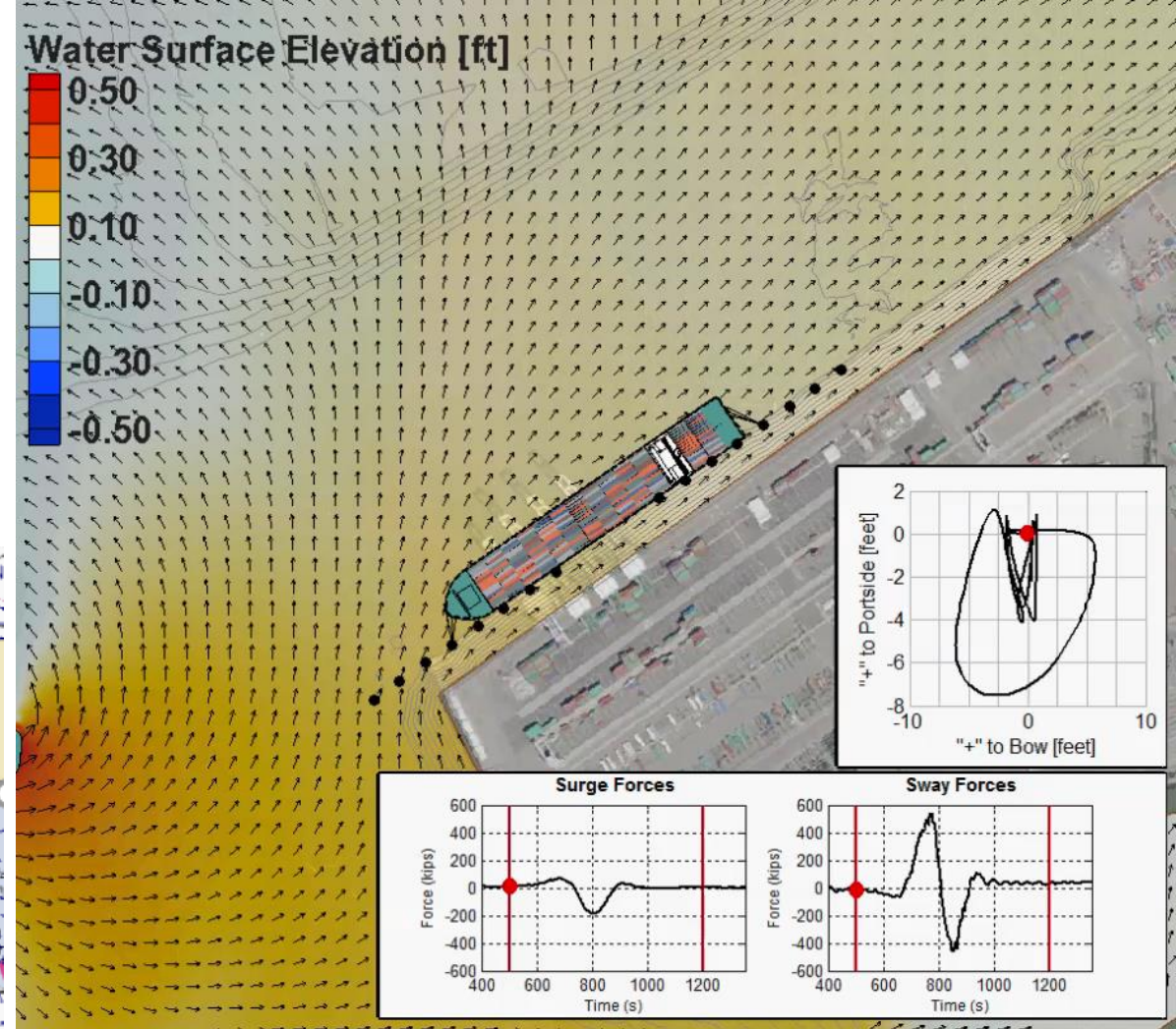
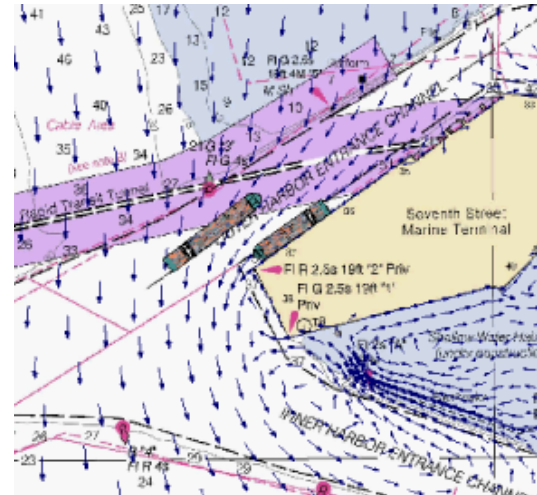
Passing Other Docks (Surge Effects)

CMA CGM Ben Franklin
Port of Oakland, CA

Surge modeling performed using maneuvering patterns taken from full bridge.

Loads imposed by passing ships can rival wind loads during storm events.

Surge modeling results used to evaluate mooring risk, develop navigation guidance.

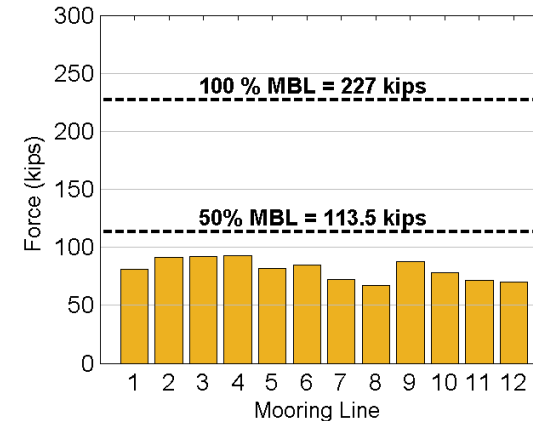
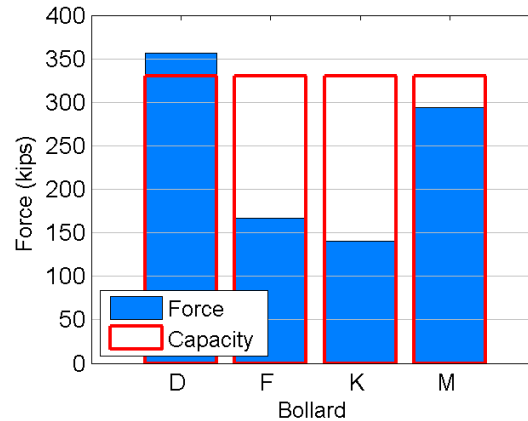
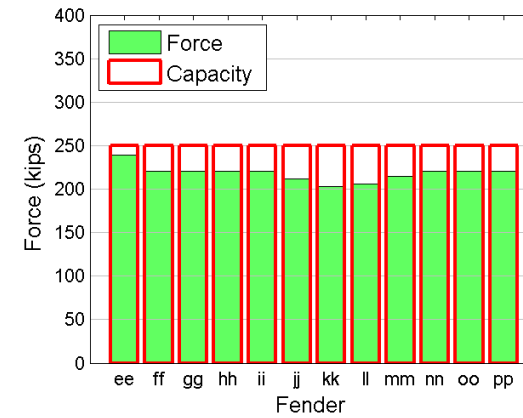
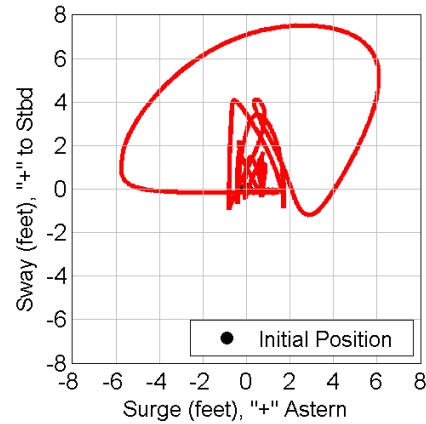
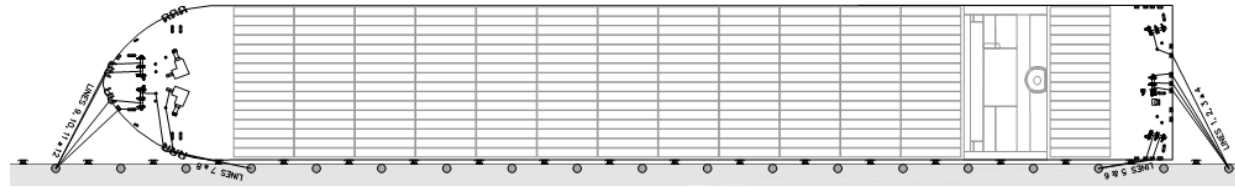


Passing Other Docks (Surge Effects)

CMA CGM Ben Franklin
Port of Oakland, CA

Mooring simulations help define risk to berth infrastructure from bypassing.

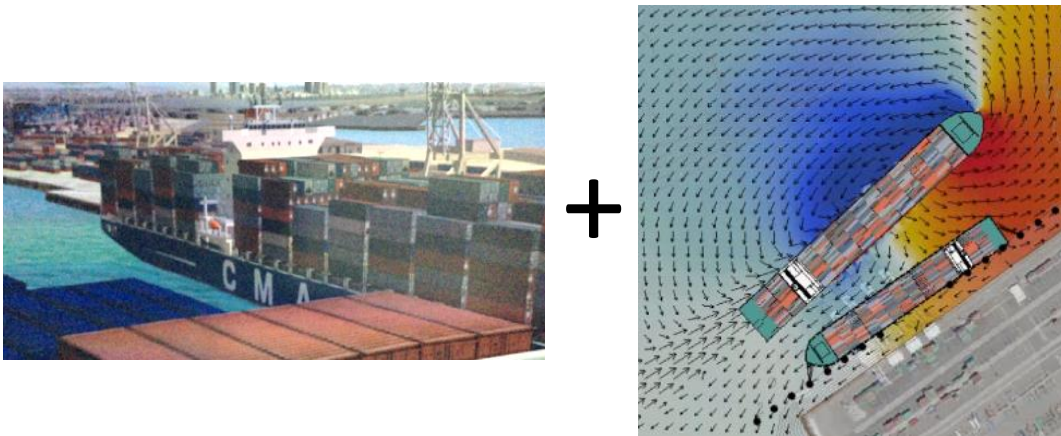
Evaluates motions, downtime, fenders, bollards, mooring lines.



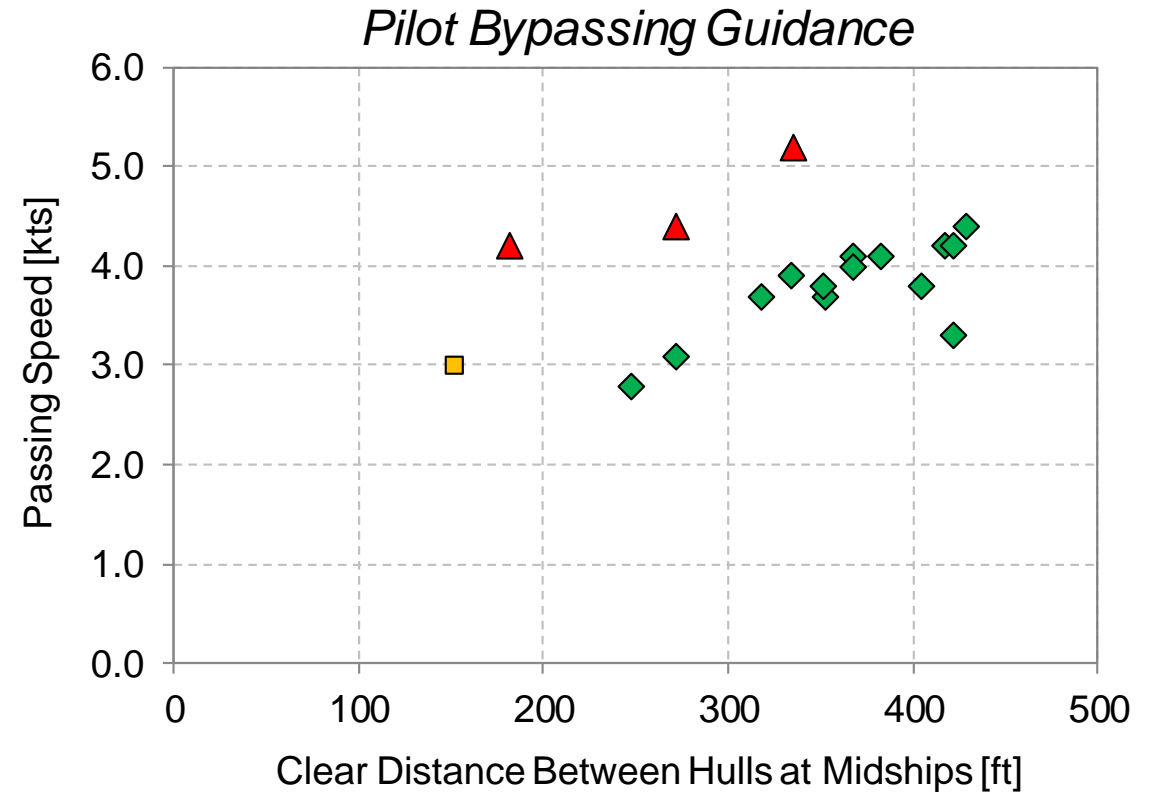
Passing Other Docks (Surge Effects)

CMA CGM Ben Franklin
Port of Oakland, CA

Bypassing guidance can be developed for better understanding of risks.



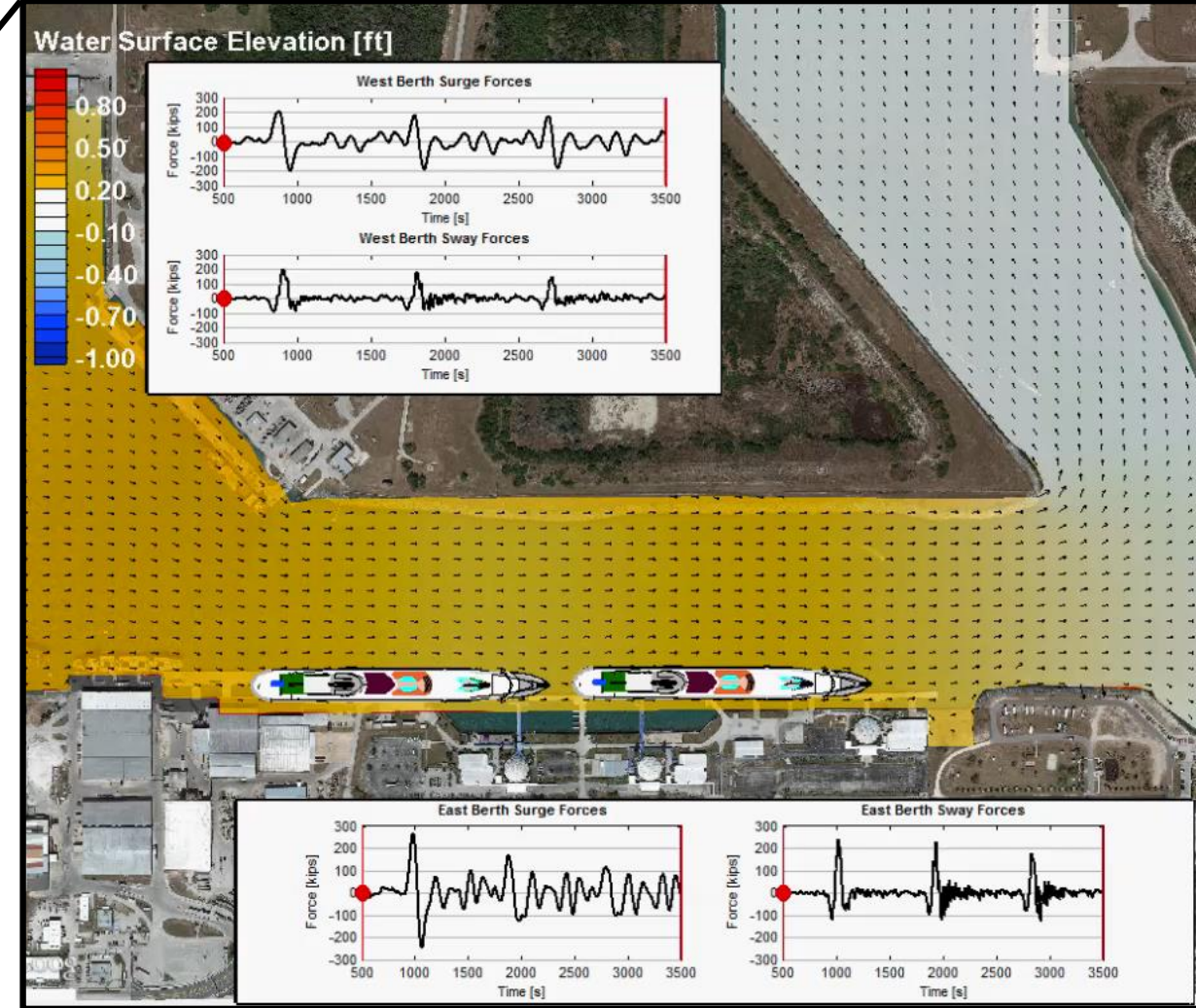
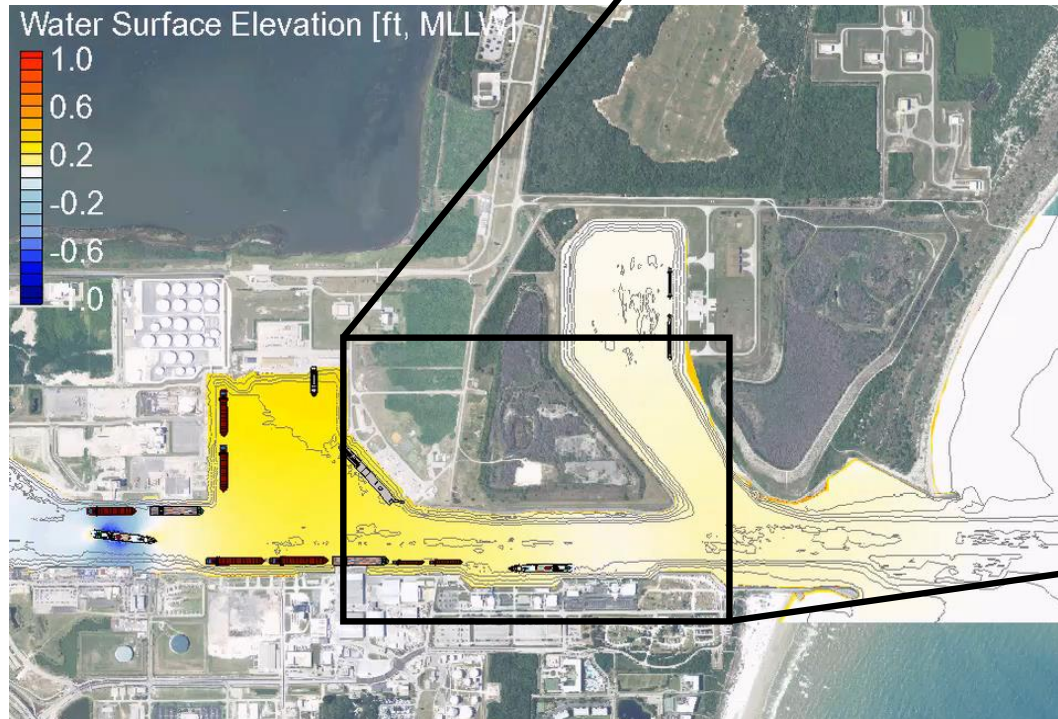
- ◆ Safe Mooring
- Use Caution
- ▲ Potentially Unsafe



Passing Other Docks (Surge Effects)

Cruise Terminal 3
Port Canaveral

Surge effects simulated Port-wide for mooring design, and bunkering safety analysis.

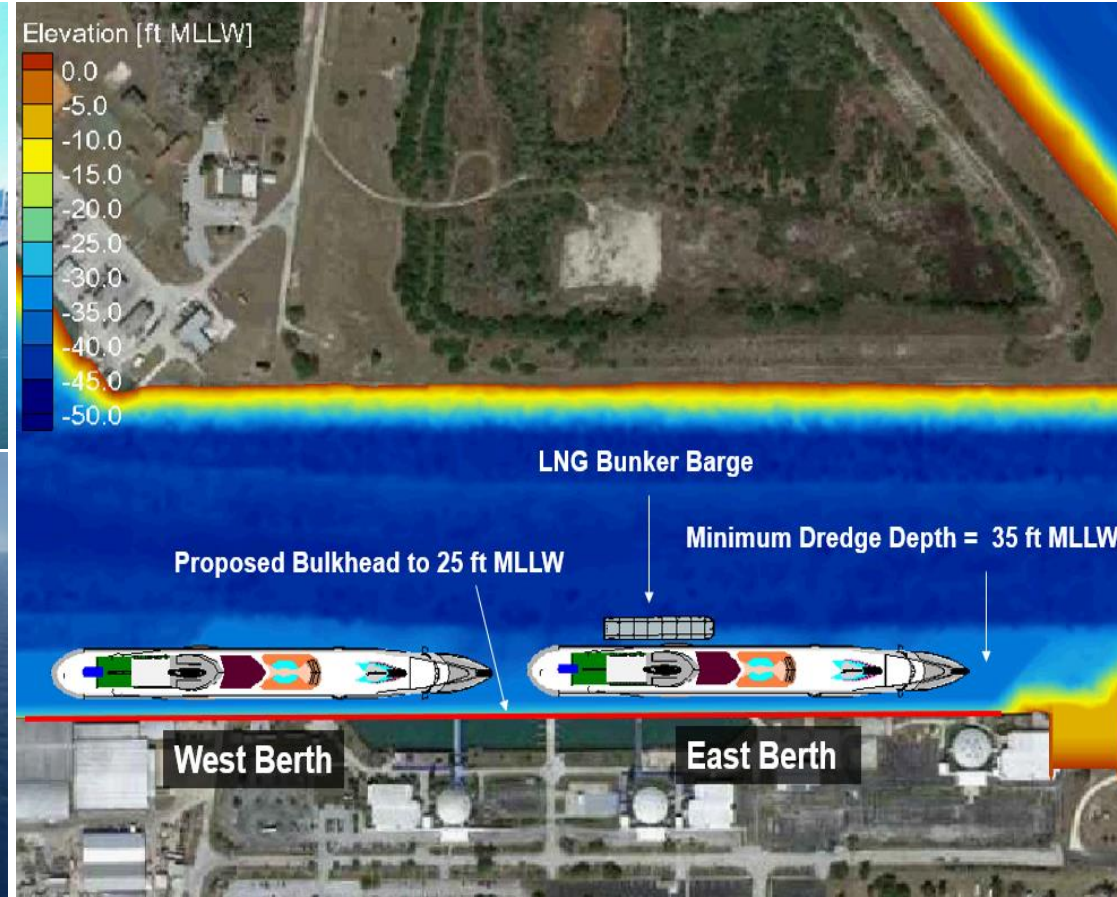


Passing Other Docks: Bunkering

Cruise Terminal 3
Port Canaveral

LNG bunker barges are relatively small → passing ship surge forces should be manageable.

Surge-related challenges are mostly spatial conflicts, and development of suitable mooring arrangements.

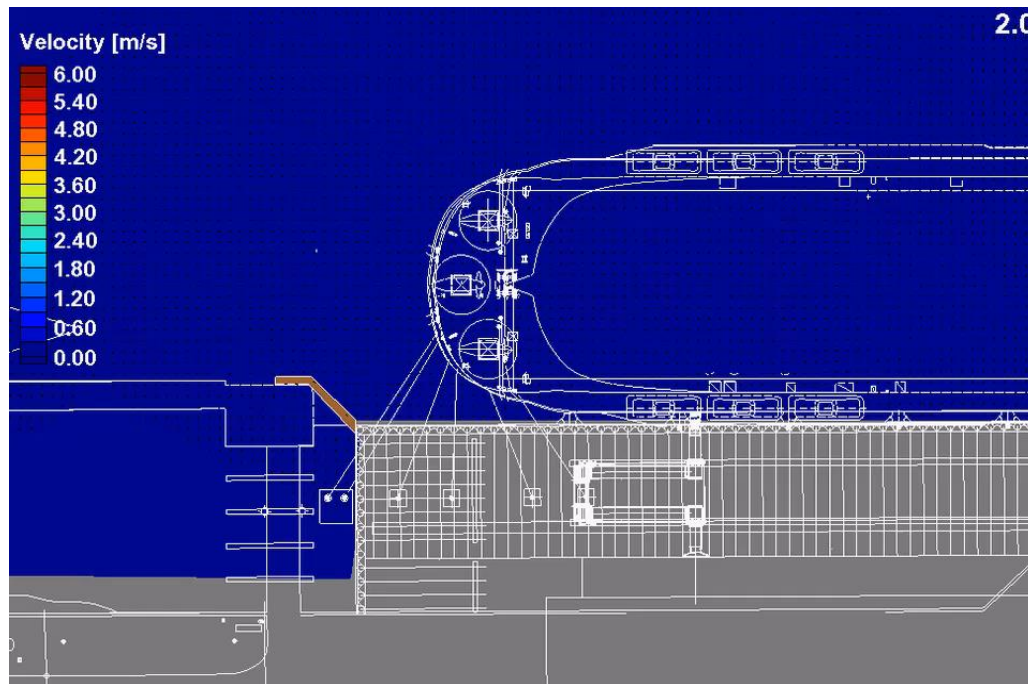
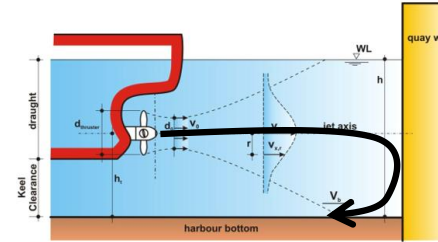


<https://www.portcanaveral.com/getattachment/About/LNG-at-Port-Canaveral/LNG-Bunkering-Info.pdf.aspx?lang=en-US>

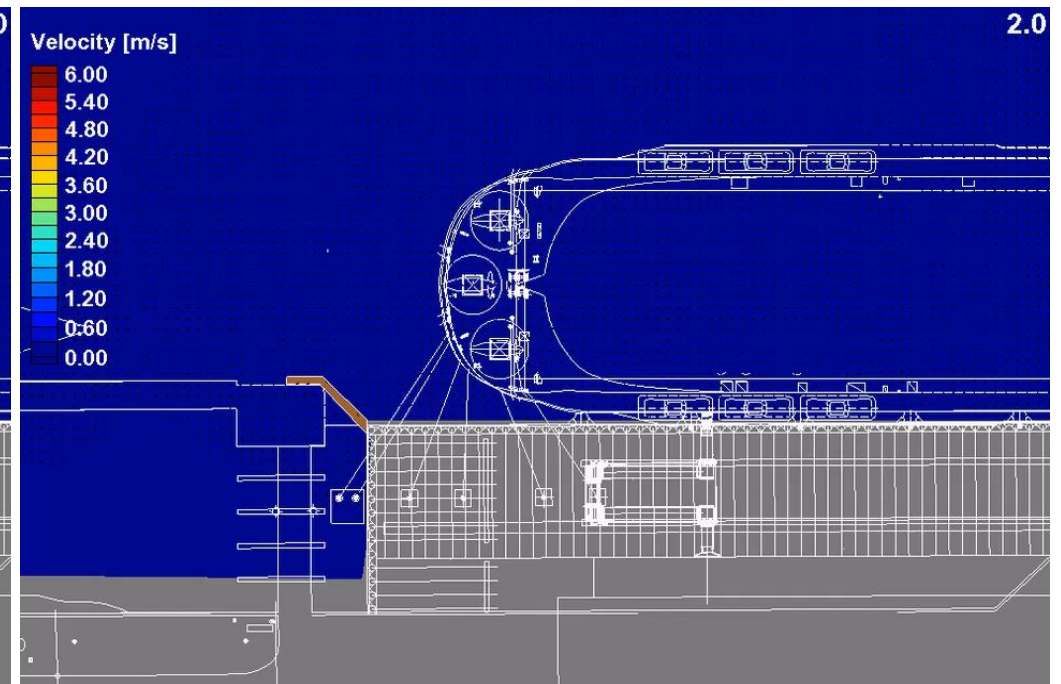
Maneuvering at Berth

Propulsion systems on new/larger vessels can affect berth stability

CFD simulations are now routine and efficient.



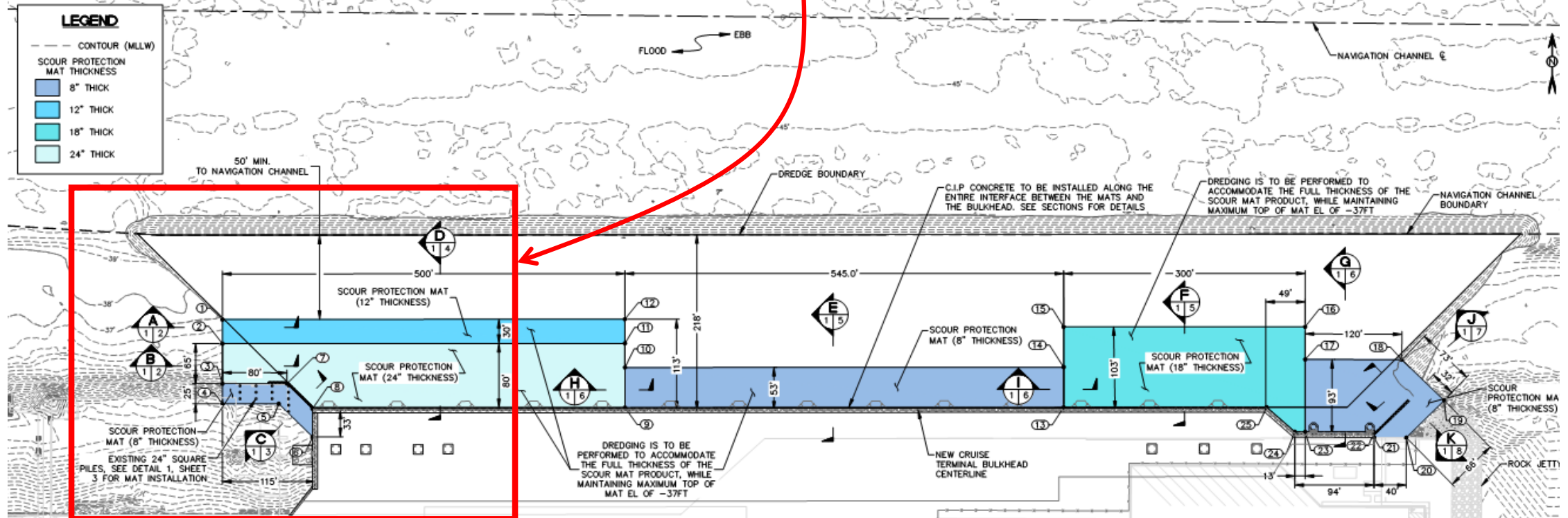
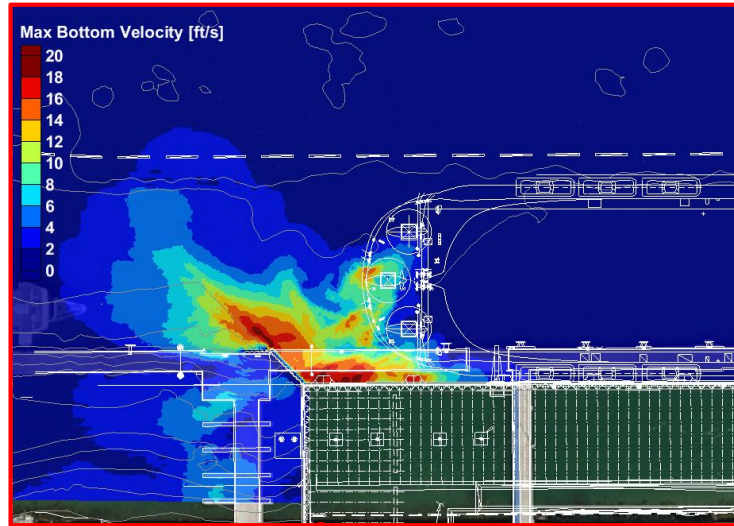
Azipods at 50% applied power, directed 45 deg aft



Azipods at 50% applied power, directed starboard

Propulsion Effects and Scour Protection

CFD analysis demonstrates shortcomings in existing systems, or new efficient designs.



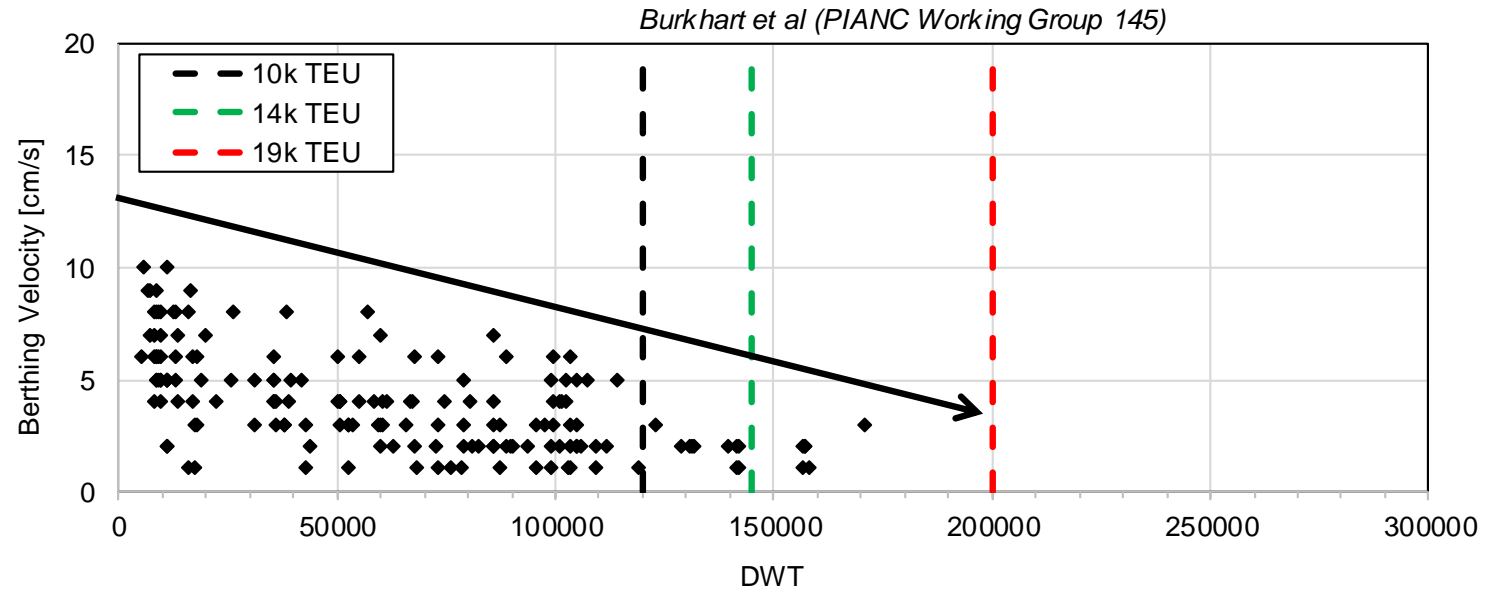
Fender Suitability for Larger Vessels

Port of Oakland
Berth Infrastructure Risk Assessment

Fender capacity guidelines (e.g. PIANC) are intended for new installations.

Some recommendations should not necessarily be applied to evaluate risks to existing systems.

Data show lower impact velocities for larger vessels.

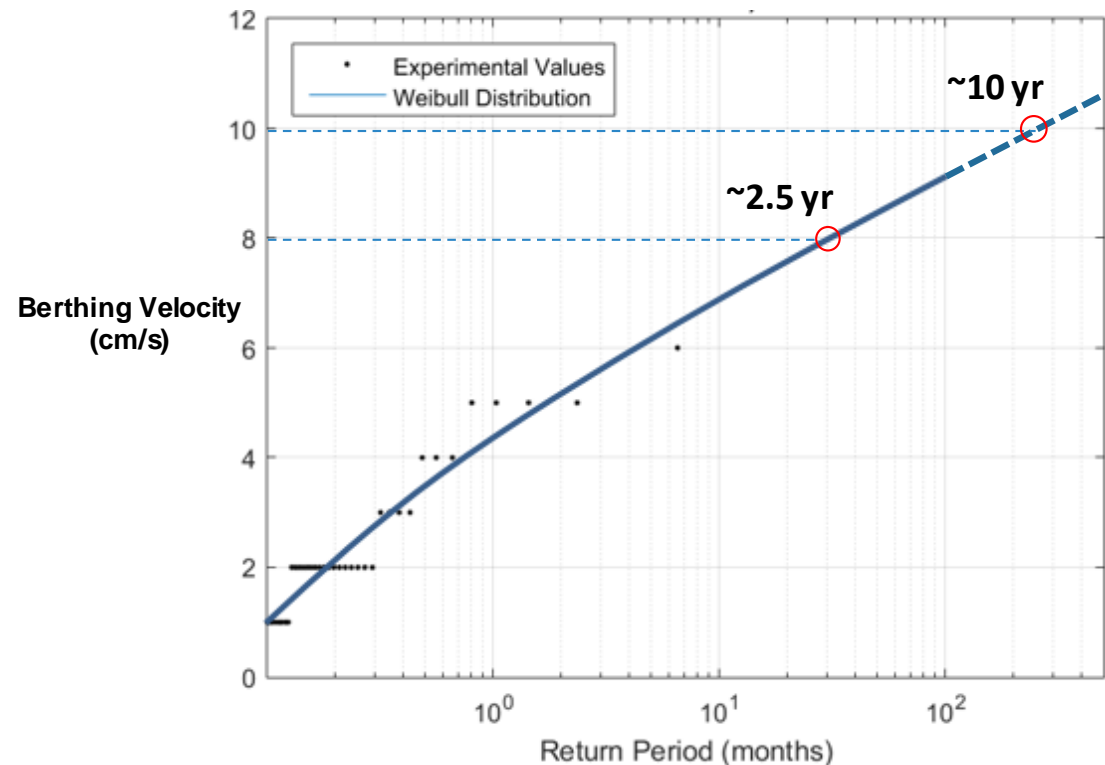
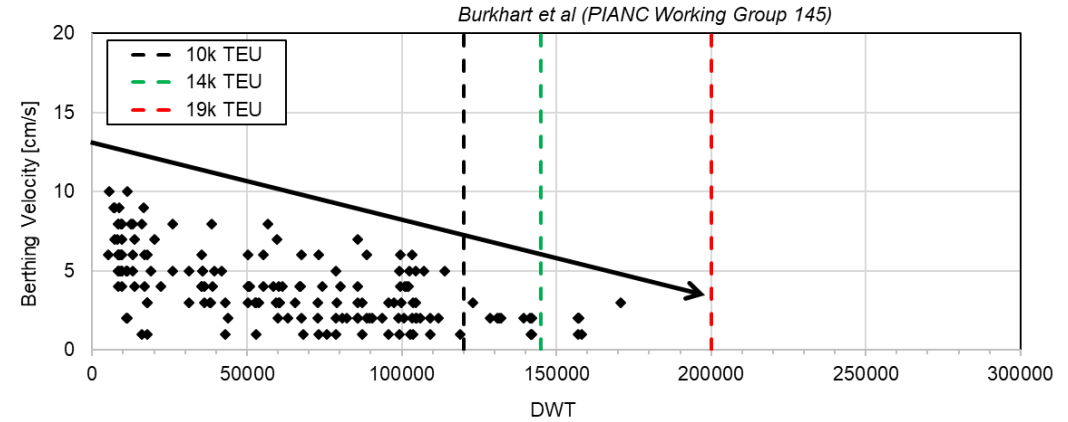


Fender Suitability for Larger Vessels

Port of Oakland
Berth Infrastructure Risk Assessment

Probability of different berthing velocities can be quantified.

Combined with consequences, can inform risks of utilizing existing fenders.



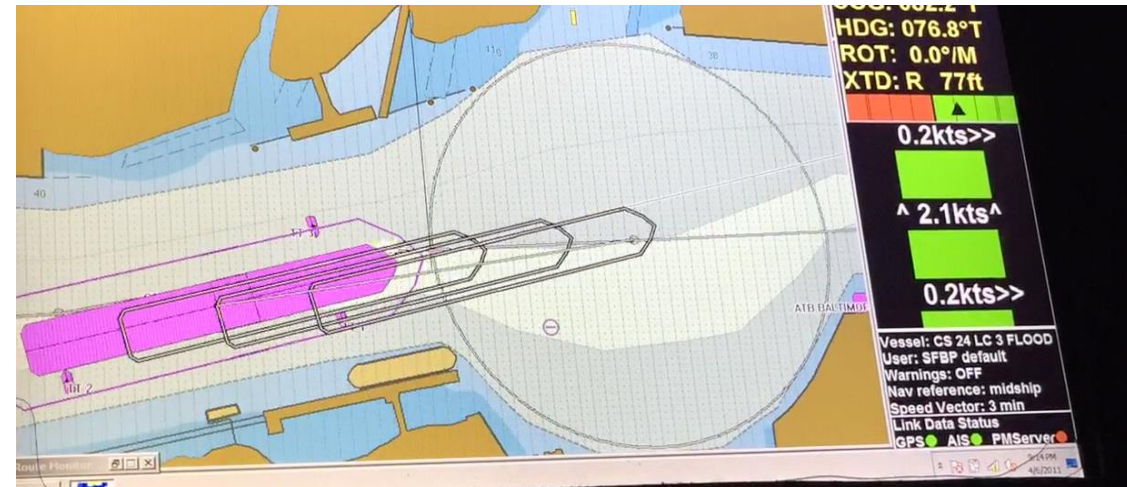
Fender Suitability for Larger Vessels

Port of Oakland
Berth Infrastructure Risk Assessment

Real-world experience shows that this makes sense.

Pilot procedures for VLCVs

- 2 pilots
- 4 tugs
- Daylight
- Wind/current/tide/draft restrictions
- PPU equipment



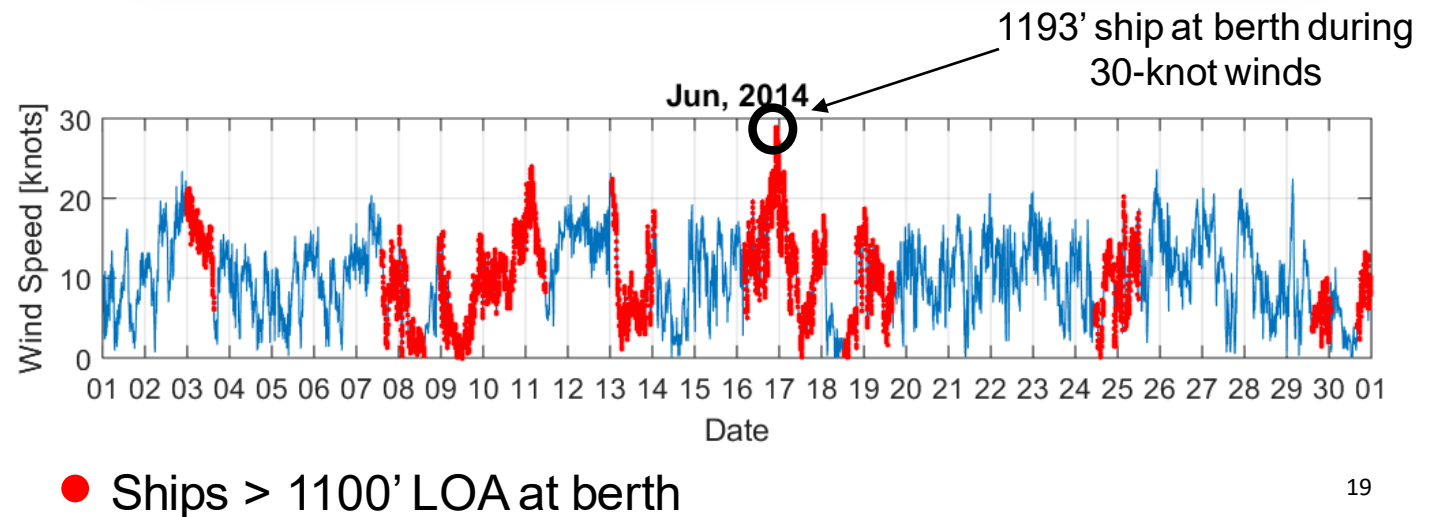
Low berthing velocities + low berthing angles = **High Loads in Existing Fenders are NOT Likely**

Bollard Suitability for Larger Vessels

Port of Oakland
Berth Infrastructure Risk Assessment

AIS data show that vessels don't necessarily leave the dock during wind events.

High bollard loads are possible, and probability should be evaluated with site-specific wind data.



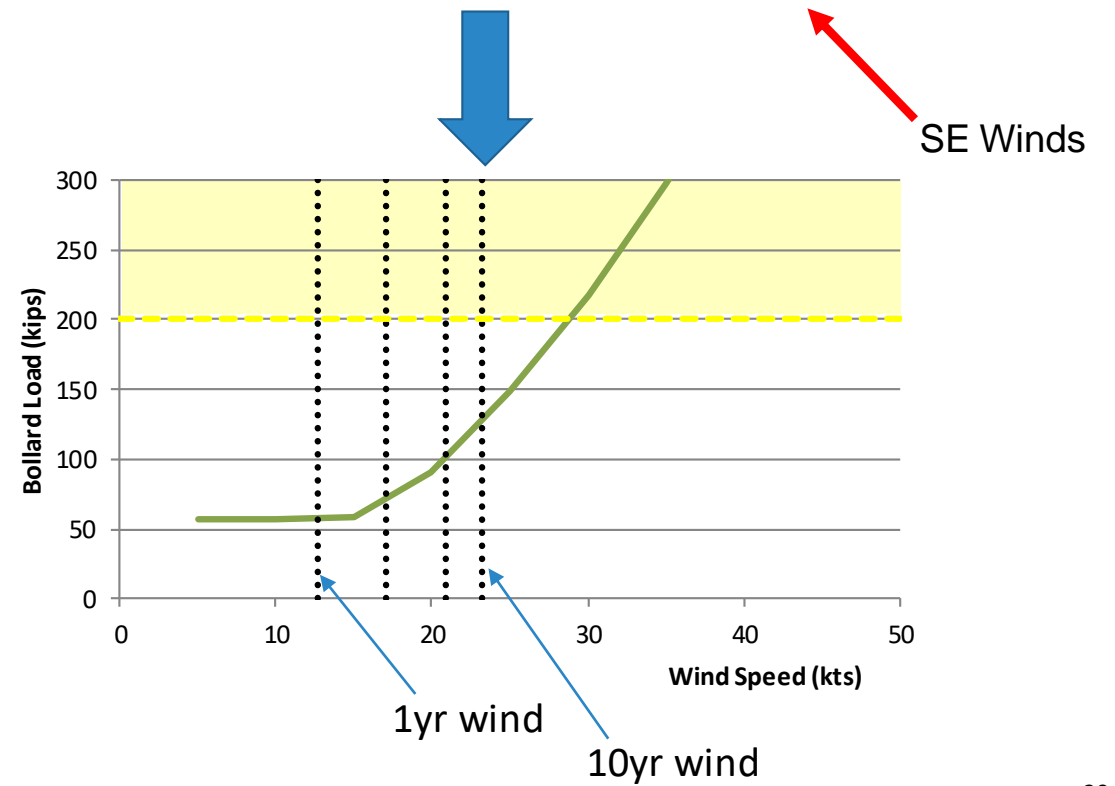
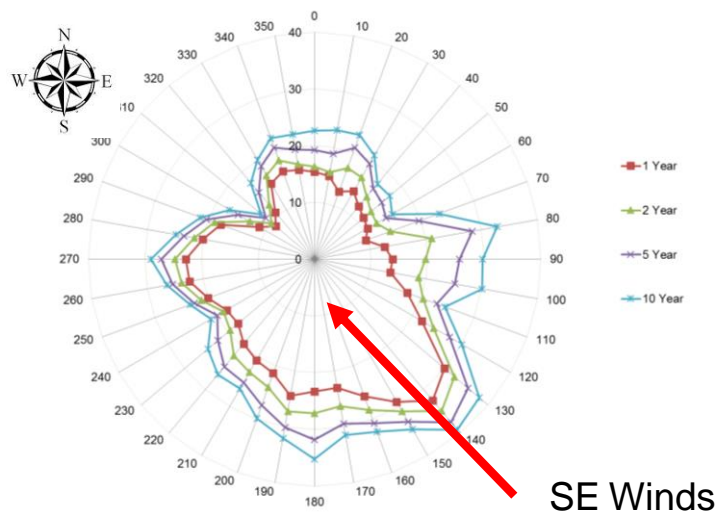
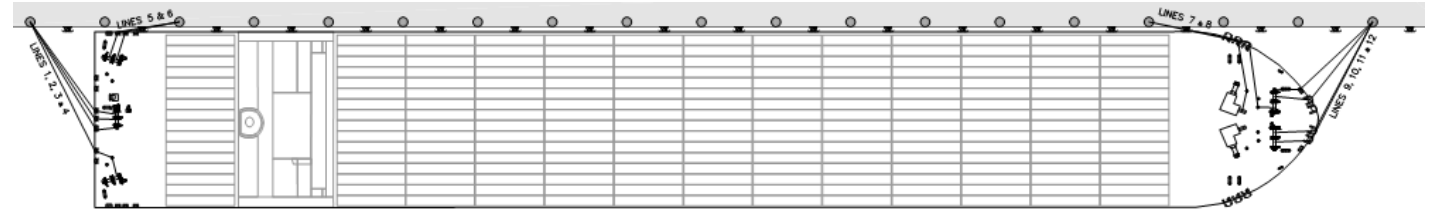
Bollard Suitability for Larger Vessels

Port of Oakland
Berth Infrastructure Risk Assessment

Risks to bollards are berth-specific.

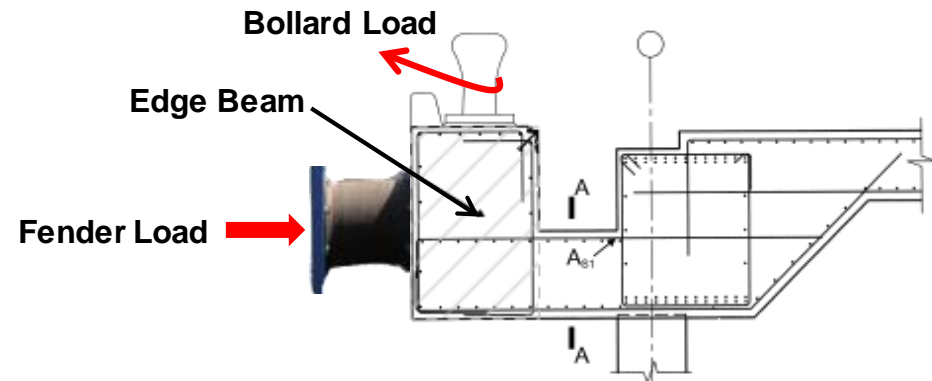
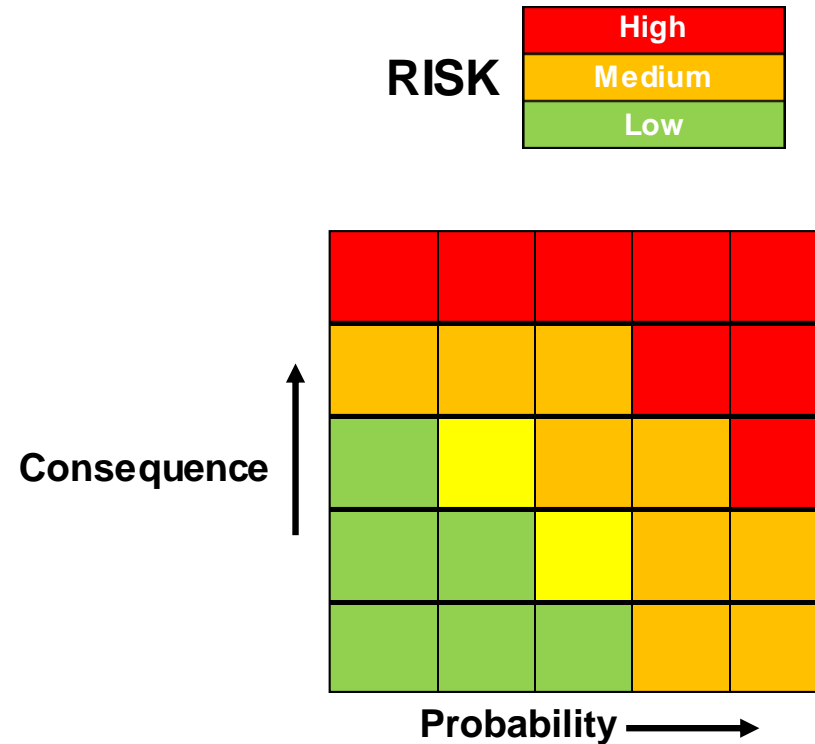
Not all berths need the same bollards to achieve safe mooring.

Some berths with lower bollard capacities may still have lower risk.



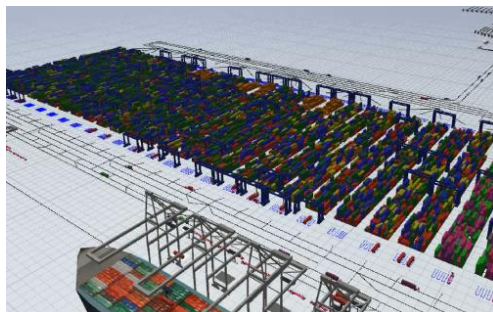
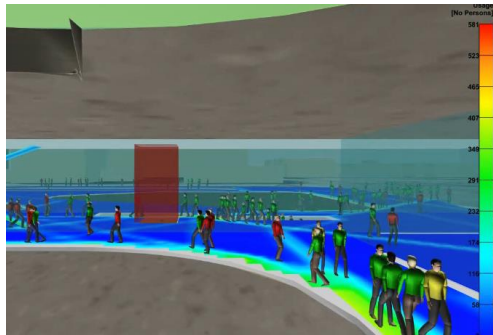
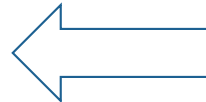
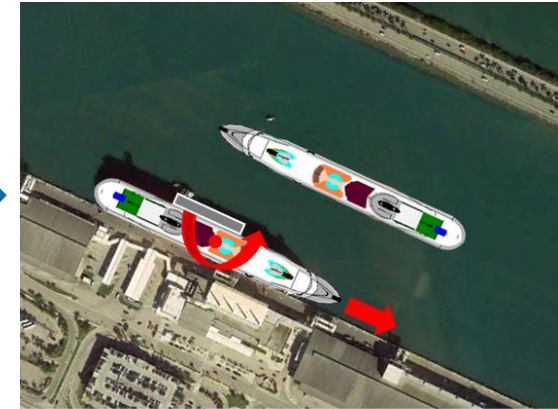
Fender and Bollard Suitability for Larger Vessels - Conclusions

- Risk is not only about probability, but also consequence.
- Risk can be quantified.
 1. Define probabilities using suitable analysis.
 2. Define consequences using damage evaluation.
 3. Combination of these informs risk.
- Accommodating larger vessels may carry acceptable level of risk for existing fenders/bollards.



Summary

- New, larger vessels bring new potential risks.
- Analysis tools can help understand/minimize risks.
- A prepared analysis toolkit can be deployed very quickly upon notice of imminent larger vessels.



Technologies for Evaluating Risks to Existing Berth Infrastructure from Larger Vessels

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Questions?

