ESRI UC 2014, CONFERENCE PRESENTATION

USING MASSIVE AMOUNTS OF MARINE AIS DATA TO EVALUATE MARINE TRAFFIC

AARON LICKER – BC GIS LEAD - aaron_licker@golder.com
BC REGION - GOLDER ASSOCIATES LTD.

THE CHALLENGE

- Our team is involved with a number of environmental assessments which propose to add marine commercial traffic to existing routes

- Per environmental assessment regulations, we must create a baseline and understand project effects
- The defining question is: **<u>What is the spatial representation of a marine traffic baseline?</u>**

EXISTING DATA IS INSUFFICIENT FOR GIS

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

- Traditional source is call-in points for large vessels
- Two dimensional window on a complex phenomena.
- Vessels passes between transects

EXISTING DATA IS INSUFFICIENT FOR GIS

- What we need to know for our entire study area is:
  - how many vessels;
  - where they were going;
  - how big they are; and
  - what they are doing

MARINE AIS DATA

- **AIS** = **A**utomatic **I**dentification **S**ystem.
- ISO standard that allows vessels to communicate their location, vessel information, heading and speed at regular intervals

AIS DATA

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

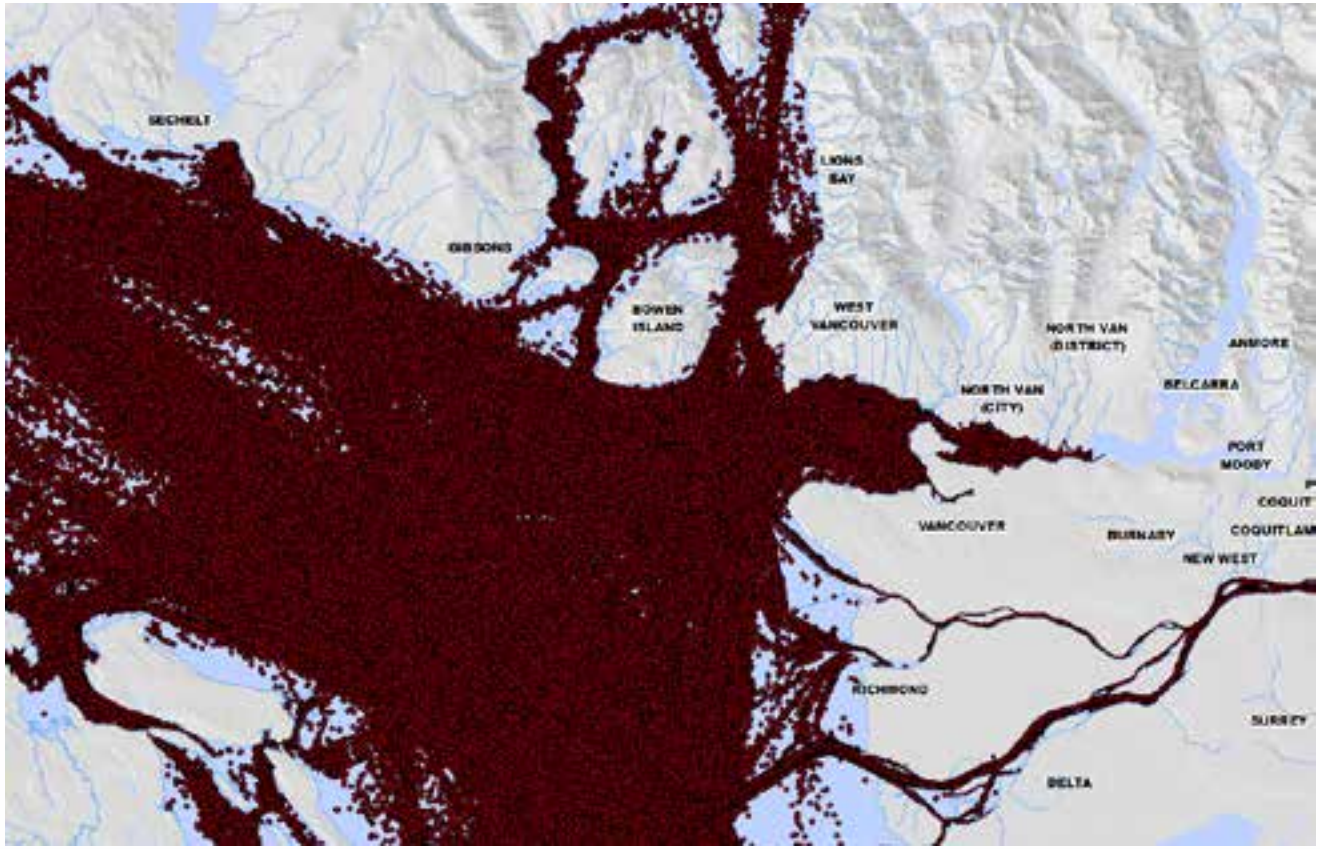
ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

- Fundamentally an xy coordinate with a boat id (MMSI) and a timestamp



AIS DATA

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

- Additionally contains a numerous useful attributes

- OBJECTID
- MMSI
- Message_ID
- Repeat_indicator
- Time
- Millisecond
- Region
- Country
- Base_station
- Online_data
- Group_code
- Sequence_ID
- Channel
- Data_length
- Vessel_Name
- Call_sign
- IMO
- Ship_Type
- Dimension_to_Bow
- Dimension_to_stern
- Dimension_to_port
- Dimension_to_starboard
- Draught
- Destination
- AIS_version
- Navigational_status
- ROT
- SOG
- Accuracy
- Longitude
- Latitude
- Heading
- Communication_flag
- Communication_state
- Sequence
- Destination_ID
- Retransmit_flag
- Country_code
- Functional_ID
- Data

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AIS DATA: PROS

- Temporal resolution
- Spatial resolution
- Standardization
- Availability
- Automatic

AIS DATA: CONS

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

- Spatial-Temporal resolution
- Positional Error
- Big data
- Not complete
- Cost

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MARINE TRAFFIC SOLUTION

THE CHALLENGE

THE DATA

PROS

CONS

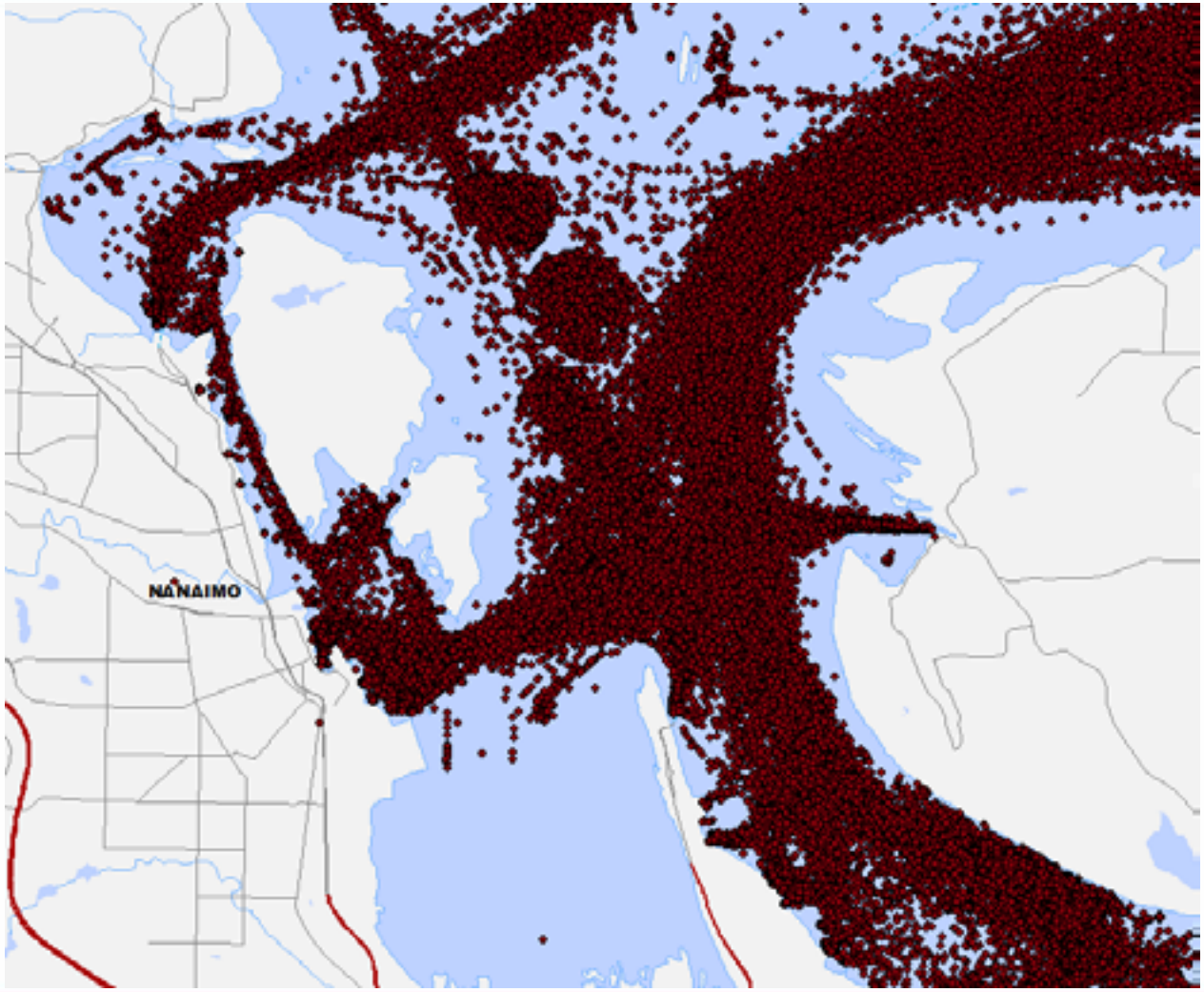
THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION



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MARINE TRAFFIC SOLUTION

THE CHALLENGE

THE DATA

PROS

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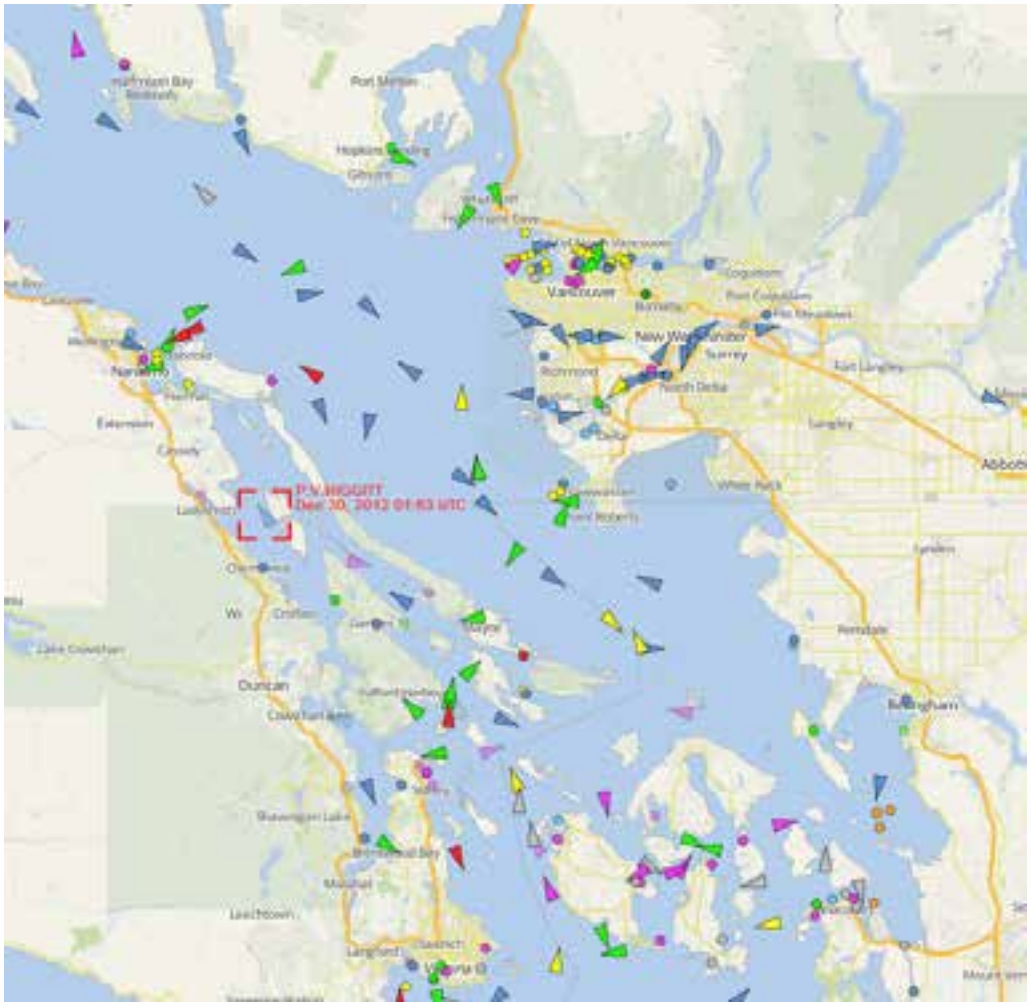
THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION



ATTEMPT #1 CONNECT THE DOTS

- Locate discrete trips and connect the end points
- Not effective
- Connecting the dots requires bounding conditions

ATTEMPT #1 CONNECT THE DOTS

THE CHALLENGE

THE DATA

PROS

CONS

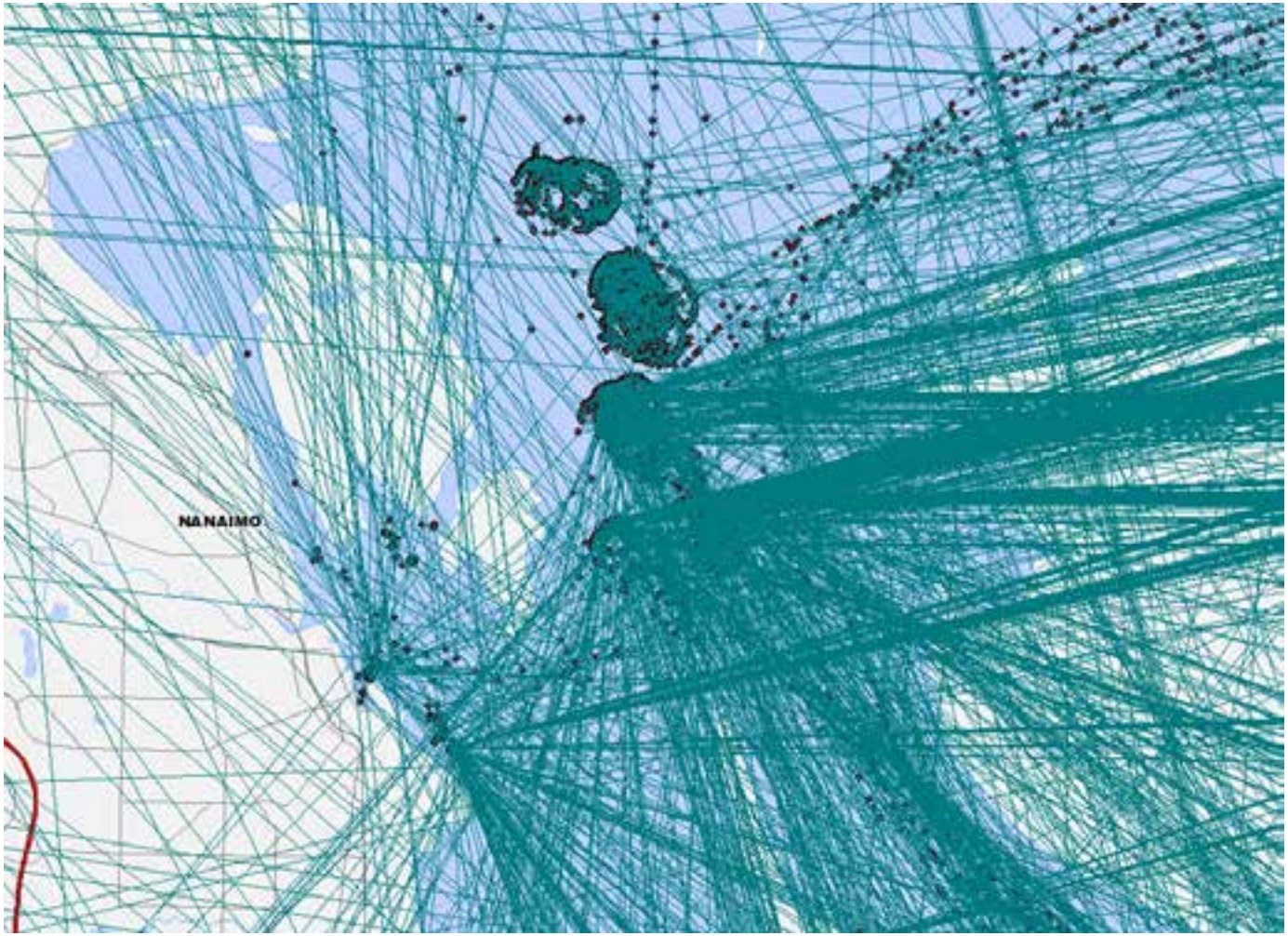
THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION



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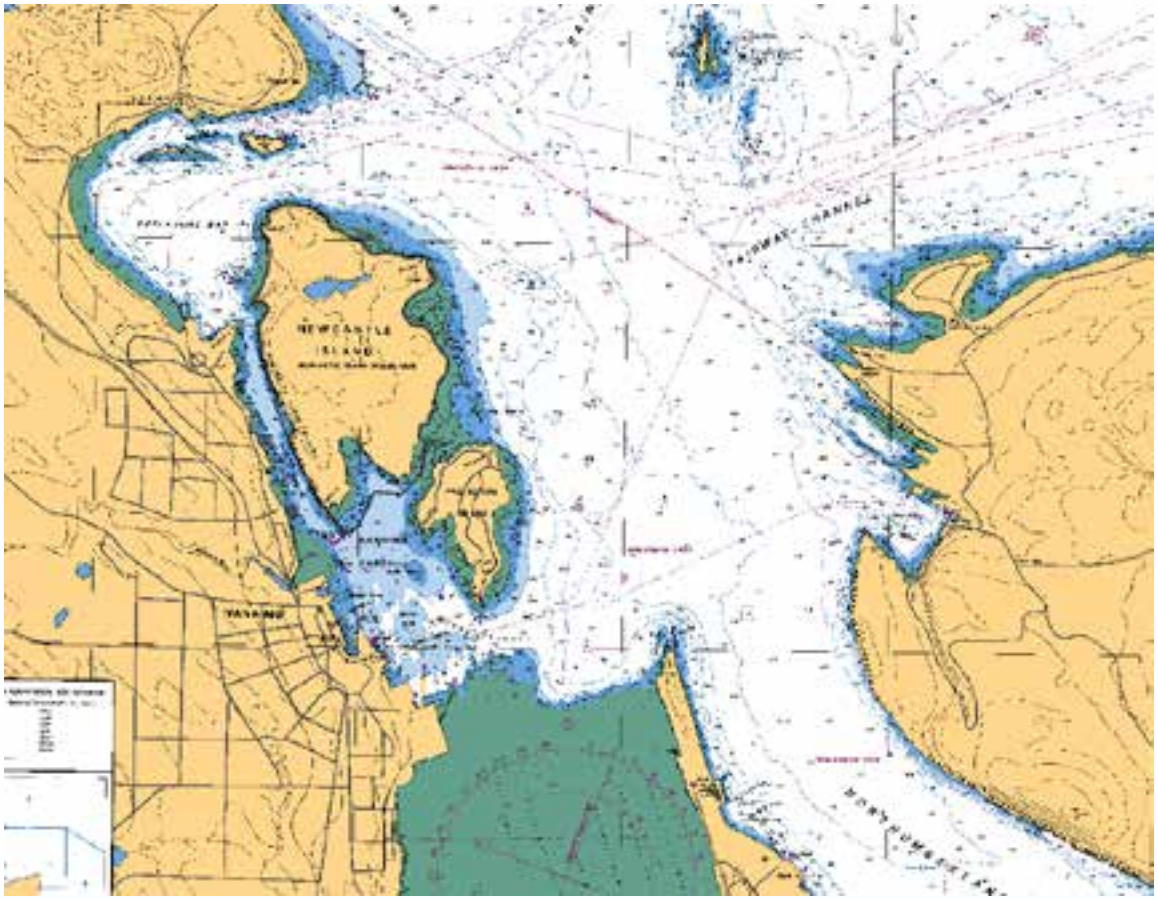
ATTEMPT #2 NETWORK ANALYSIS

- Boats must adhere to a network



ATTEMPT #2 NETWORK ANALYSIS

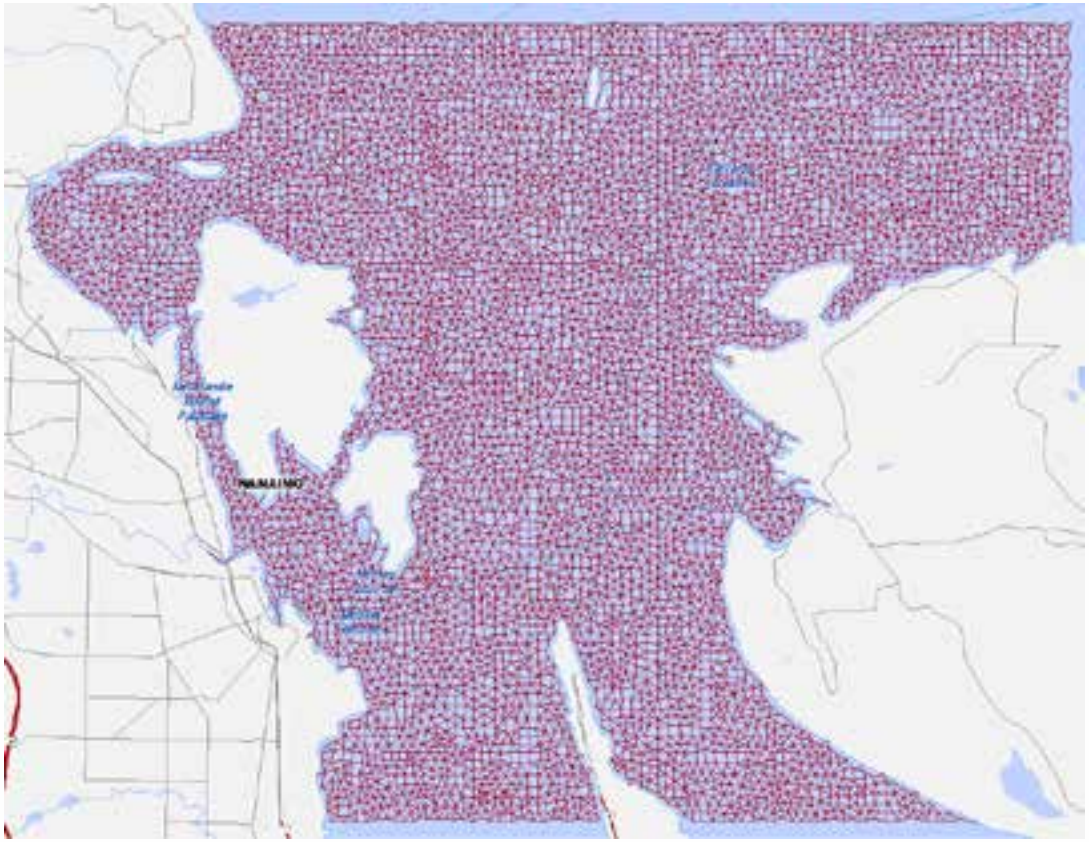
- Three step process to make a marine network
- Step 1 Transform ocean into a raster

ATTEMPT #2 NETWORK ANALYSIS

- Transform the raster into polylines

ATTEMPT #2 NETWORK ANALYSIS

- Integrate the polylines to create natural travel lines



ATTEMPT #2 NETWORK ANALYSIS

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

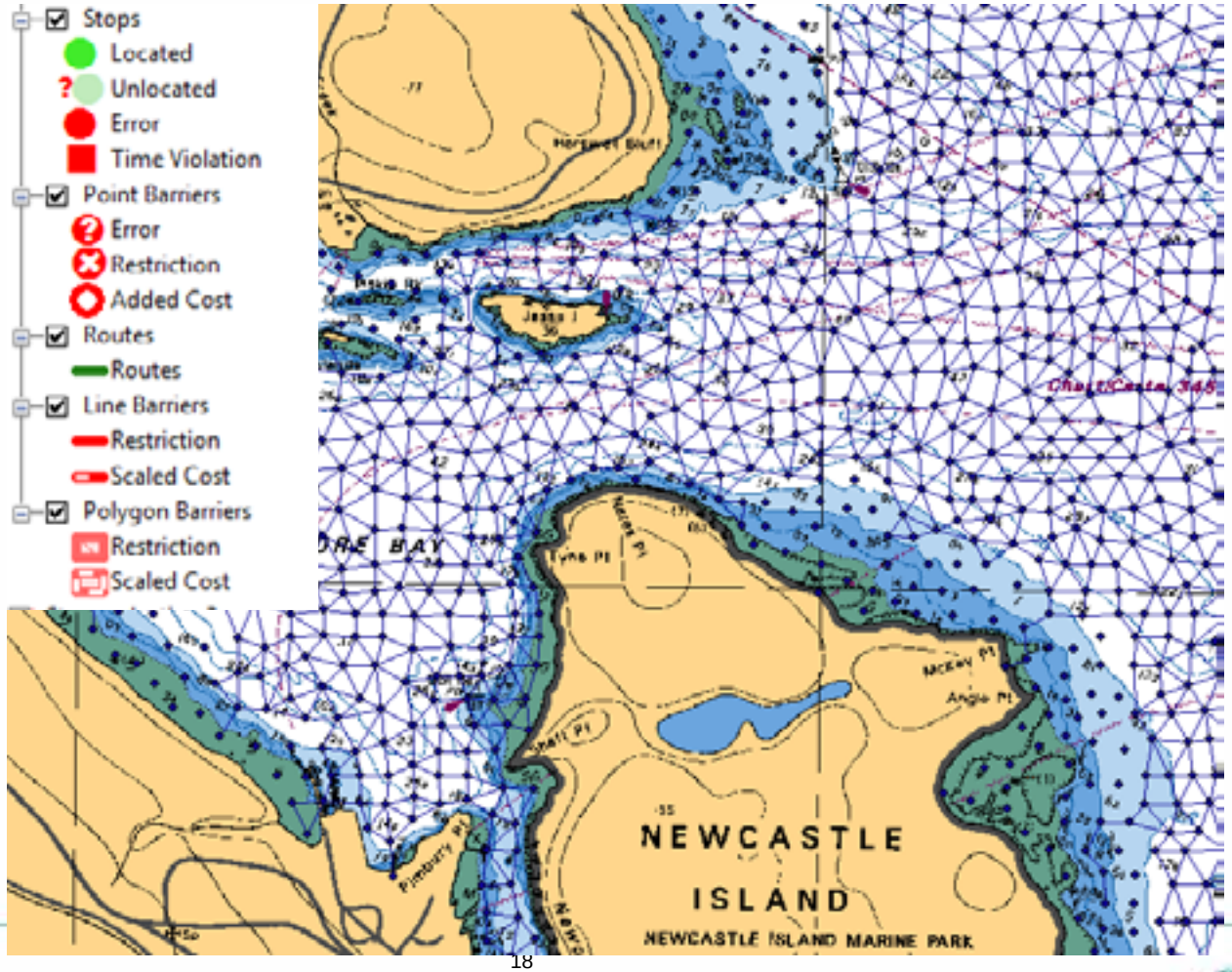
ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

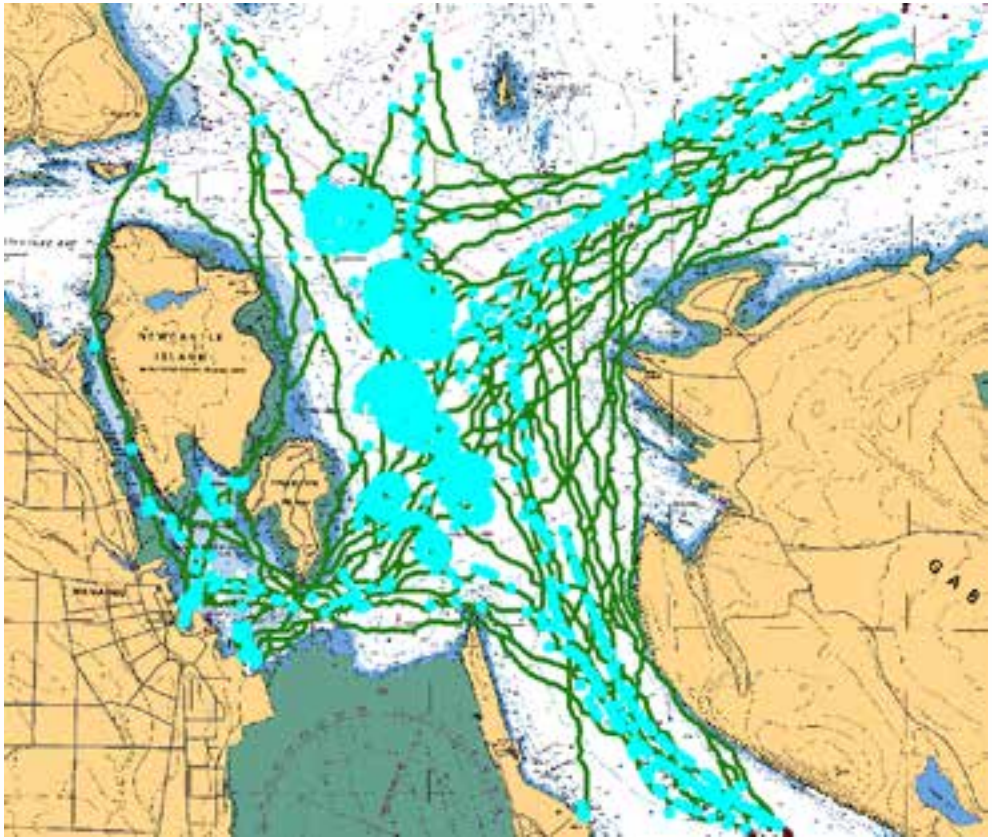
CALIBRATION

- Create a network and run route analysis



ATTEMPT #2 NETWORK ANALYSIS

- Results



ATTEMPT #2 NETWORK ANALYSIS

- Validation

ATTEMPT #2 NETWORK ANALYSIS - ISSUES

THE CHALLENGE

THE DATA

PROS

CONS

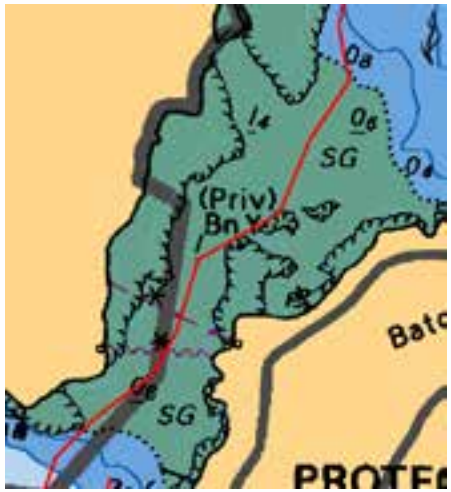
THE SOLUTION

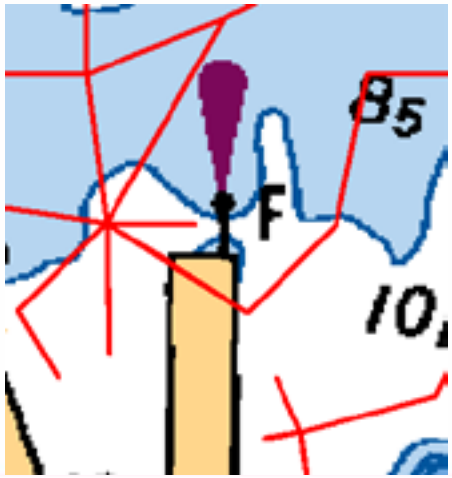
ATTEMPT #1

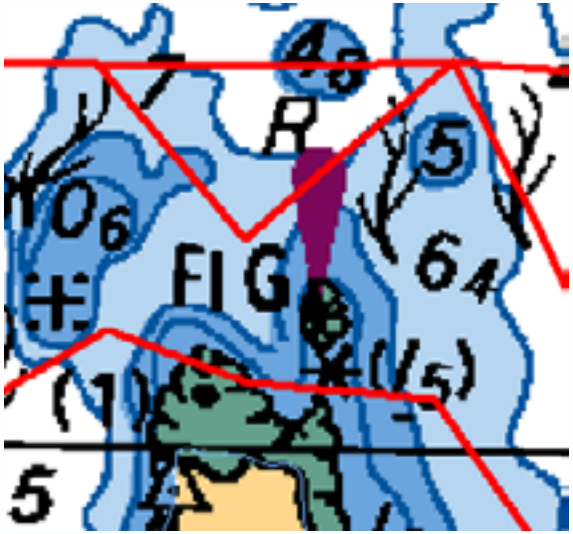
ATTEMPT #2

ATTEMPT #3

CALIBRATION







ATTEMPT #3 BETTER NETWORK ANALYSIS

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

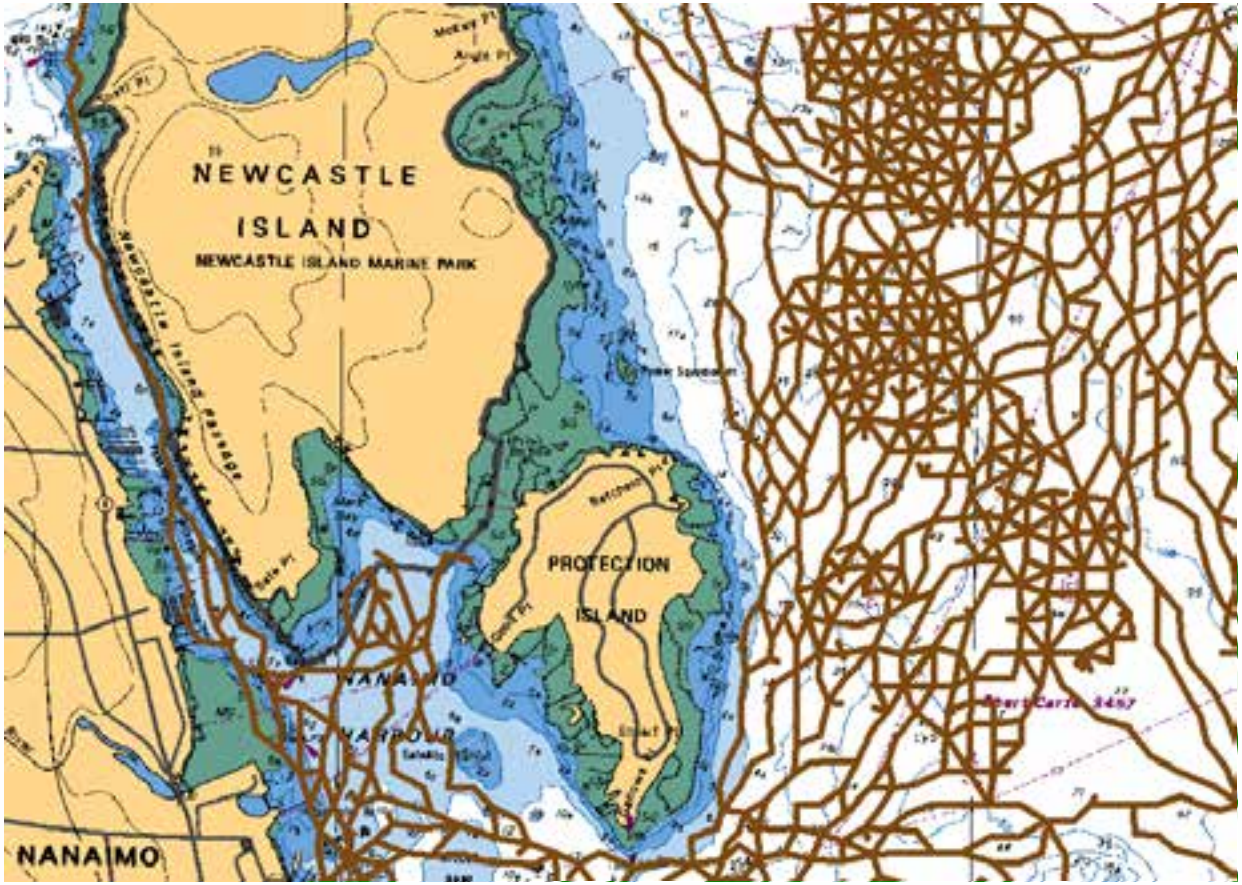
ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

- Refine the network



ROUTE FINALIZATION

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

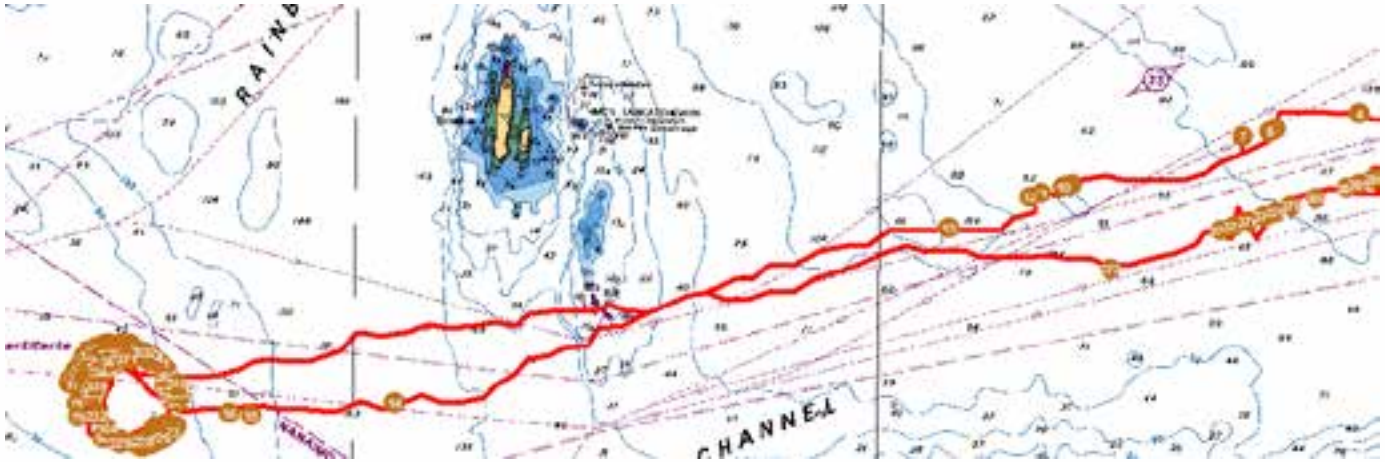
ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

- Each route must be attributed after it has been assigned



ROUTE FINALIZATION

- Coral Amethyst (MMSI: 373948000)
- It was in the study area from Dec 31st, 2012 – Jan 05th 2013

ROUTE FINALIZATION

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

- MV HIGGIT (MMSI 316009480)
- In study area from Dec 29th, 2012 – Dec 30th 2012

RESULTS – TUG, BARGES AND TANKERS

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

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RESULTS – PLEASURE CRAFT

THE CHALLENGE

THE DATA

PROS

CONS

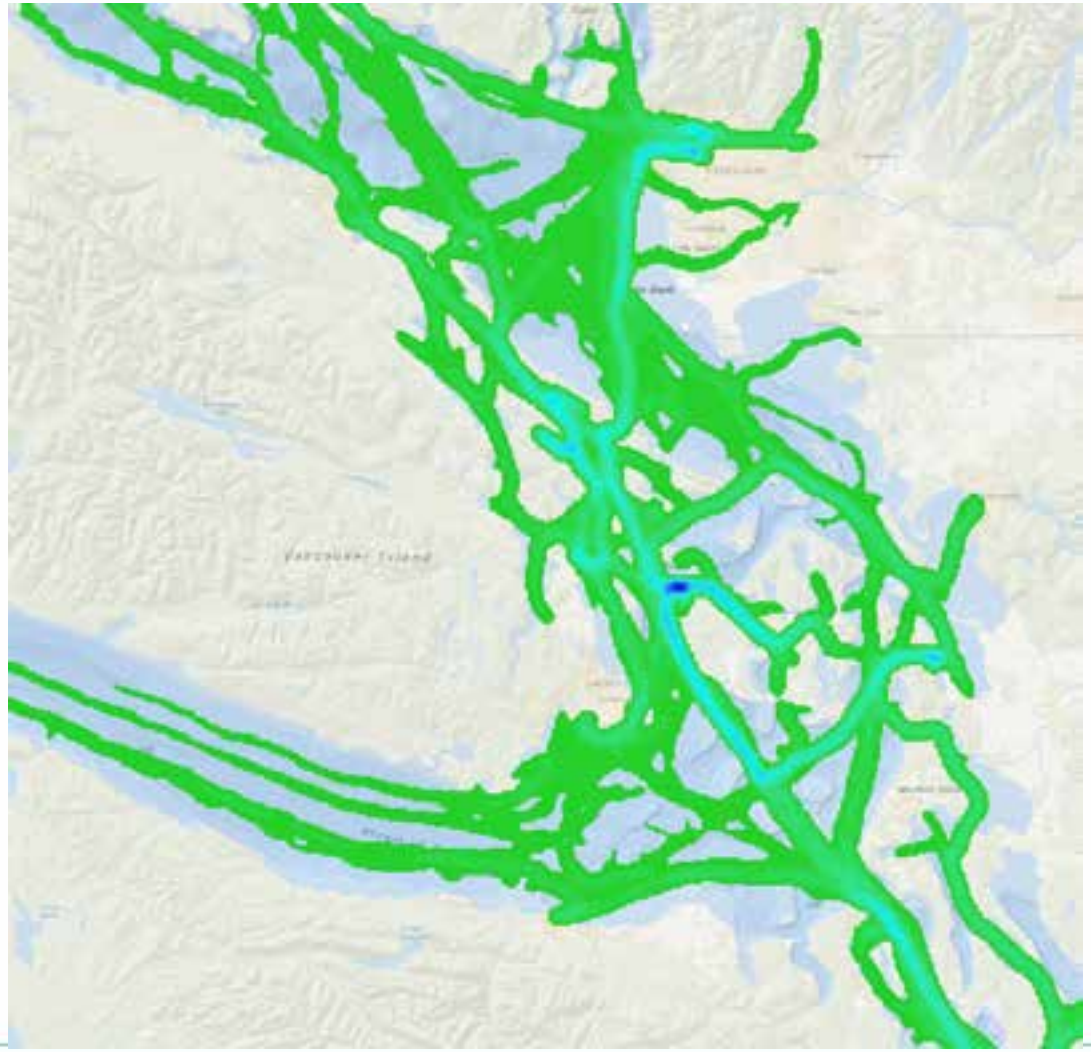
THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION



RESULTS – FERRIES

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

CALIBRATION

THE CHALLENGE

THE DATA

PROS

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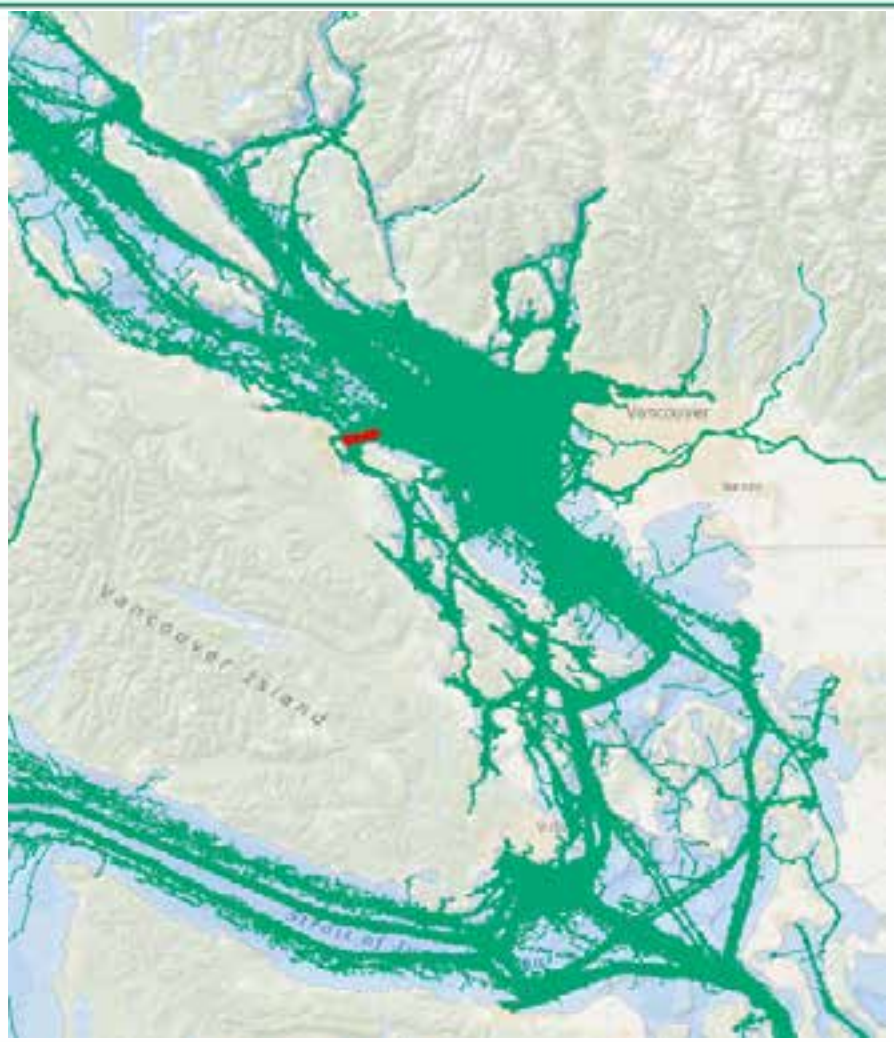
ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION



USE THE CALL IN POINTS AGAIN

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

- Some routes can not be captured with marine AIS methods

CALIBRATION YIELDS RESULTS

- Data was calibrated to four classes of marine transport vehicle: Tanker, Tug, Passenger Ferry and Merchant Ferry.
- Outcome is density of vessels per day
- Data will be used to calculate impact of additional vessels or to calculate how vessel traffic is changing over time

CALIBRATION YIELDS RESULTS

THE CHALLENGE

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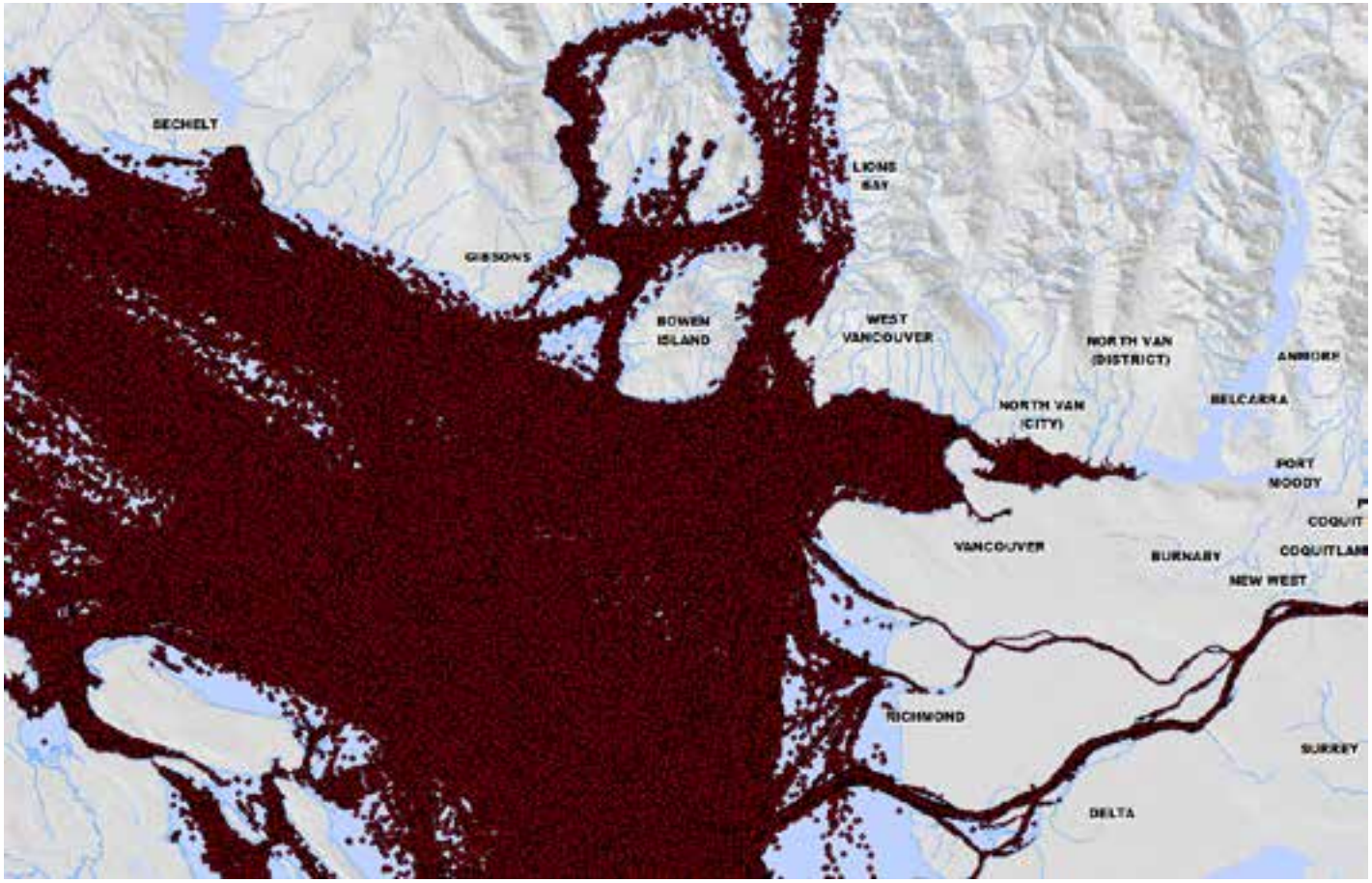
ATTEMPT #3

CALIBRATION



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CALIBRATION YIELDS RESULTS

THE CHALLENGE

THE DATA

PROS

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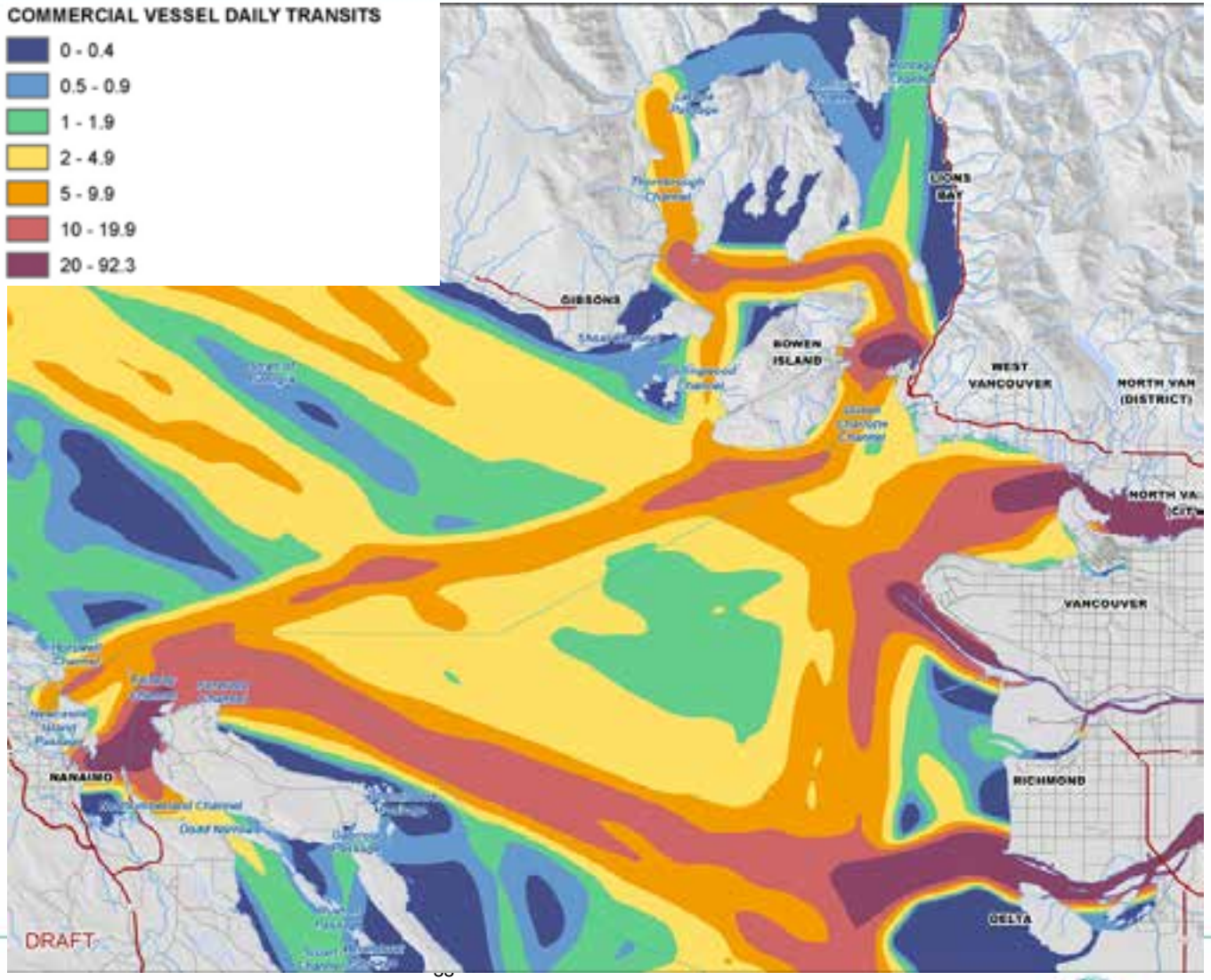
CALIBRATION



NEXT STEPS & THANK YOU

THE CHALLENGE

THE DATA

PROS

CONS

THE SOLUTION

ATTEMPT #1

ATTEMPT #2

ATTEMPT #3

CALIBRATION

- Still some errors
- Always have the possibility of new solutions
- Network can be refined

More info:

AARON LICKER

BC GIS LEAD

BC OFFICE - GOLDER ASSOCIATES LTD.

Aaron_licker@golder.com