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EX 6152

Gravesend Town Pier, Construction of a ferry pontoon

Provision of flow information arising from pontoon extension to Town Pier, Gravesend Reach, Thames Estuary

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Summary

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Provision of flow information arising from pontoon extension to Town Pier, Gravesend Reach, Thames Estuary

Report EX6152
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HR Wallingford was commissioned by Gravesham Borough Council to provide flow information in the vicinity of a proposed pontoon development at Gravesend Town Pier. The study provides flow data that will be used to inform other studies being carried out and / or the need and extent of further hydrodynamic studies to support the planning applications.

The proposed pontoon, which will be 80 m in length, will extend from the eastern side of the Town Pier jetty head and access to it will be by means of a link span that can adjust throughout the tide so that continuous access is possible to the floating pontoon.

Numerical modelling was required to simulate the flow magnitudes before and after construction of the structure and so demonstrate the effect of the strucure on tidal propagation and local flow conditions.

The conclusions of the assessment were as follows:

- The proposed pontoon is not particularly well aligned to the flow. A 4-5° anticlockwise rotation of the main pontoon would bring the structure more in line with the 2D flow.

- The change to the flow speed following the installation of the pontoon extension and the new piles will be small.

- Changes to the flow regime adjacent to the river wall are expected to be minimal. A small increase in current speed is predicted but it is small compared to the peak current experienced in the area. It is therefore considered that that the foreshore fronting the river wall will not be subject to any scouring. The integrity of the river wall will therefore be unaffected.

- Flow changes will be small and localised and will have little effect on riparian activities in the area.

- The new layout will not affect tidal propagation in the Estuary and as the structures float or are held above the waterline for parts of the tide, there will only be a nominal effect on the tidal volume.

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1. Introduction

HR Wallingford was commissioned by Gravesham Borough Council to provide flow information in the vicinity of a proposed pontoon development at Gravesend Town Pier. The study provides flow data that will be used to inform other studies being carried out and / or the need and extent of further hydrodynamic studies to support the planning applications.

The proposed pontoon, which will be 80 m in length, will extend from the eastern side of the Town Pier jetty head and access to it will be by means of a link-span that can adjust throughout the tide so that continuous access is possible to the floating pontoon. The link-span will be a two stage structure with an adjoining intermediate platform that floats with the tide during the top half of the tide. The intermediate platform when floating will have a draft of 1.3 m. During the lower half of the tide the intermediate platform will sit on steel piles. The main pontoon will float at all stages of the tide, its draft being 0.7 m. An arrangement of piles, some of which will be used as vertical support whereas others will be used to hold the floating pontoon in place, will be deployed.

This report contains three further Sections. Section 2 provides: background information; details the information provided by the client, their structural consultants and obtained from other sources and a description of the numerical model used for the study. In Section 3 the results are presented with a brief description of the principal findings. Finally, in Section 4 the need for and extent of further studies is discussed and recommendations made.

2. 2D Hydrodynamic Modelling

2.1 SITE INFORMATION

Town Pier lies on the south side of Gravesend Reach approximately 100 m to the east of West Street Pier and 350 m to the west of Royal Terrace Pier (Figure 1). The proposed pontoon development will be linked to and extend from the eastern side of the pier-head. Gravesend Reach experiences strong tidal flows on almost all tides. In the vicinity of the proposed works the flows can be particularly strong and dynamic on the ebb tide.

2.2 DATA ACQUIRED

Information for the modelling process was derived from four main sources:

- Details of the proposed structure were provided by Gifford by means of drawings 330601-GA-100-P1, 330601-GA-130 P1 and 13814-SK-001 Rev1 (Figure 2) which were received via email on 14/08/09 and 17/08/09,
- Details of the existing structures (West Street, Town and Royal Terrace Piers) especially the piling and pontoon arrangements, were obtained from the Port of London Authority (PLA)
- Photographs provided by the PLA and from the HR Wallingford archives.
- Bathymetric and coastline data was obtained from PLA Chart 336. The chart shows three pontoons that were moored at Royal Terrace Pier which were included

in the model. These pontoons have now been replaced with a single smaller pontoon.

2.3 MODELLING APPROACH

Knowledge of the existing through-tide flow environment was obtained, with permission from the Environment Agency (EA) and the Port of London Authority (PLA), from the 2D numerical flow model of the Thames Estuary set-up by HR Wallingford on behalf of the EA and PLA to assist them with their regulatory responsibilities. This model has been successfully calibrated to a wide variety of tide and fluvial flow conditions (HR Wallingford 2004) and its use negated the need to carry out a bespoke site flow measurement exercise for this project.

This estuary wide model does not have a sufficiently fine mesh in all areas to be able to carry out detailed studies at any location. To ensure that the proposed development and the local flow structure and the potential changes to it could be robustly assessed the numerical model cell mesh size was reduced in the vicinity of the proposed woks so that structures, including those that float could be adequately represented. The influence of the support piles on the flow was included in the simulations by adding an appropriate drag coefficient (based up on the size, shape and density of the piles) within each piled area.

The mesh size was refined to a 5m grid in the area of the development and can be seen in Figure 3.

3. *Model results and discussion*

Information presented in this report provides flow data for the existing present day condition and following the construction of the proposed works. The information presented comprises:-

- Flow speed vectors and contoured current speed at hourly intervals in the vicinity of the proposed pontoon to assess good alignment with the flow;
- Time series of current speeds and directions at selected sites;
- Contoured current speed difference at hourly intervals

3.1 FLOW SPEED AND DIRECTION AT HOURLY INTERVALS IN THE VICINITY OF THE PROPOSED PONTOON

Figures 4 to 11 show the through-tide depth-averaged flow for both the existing and proposed scenarios. Although aligned with Town Pier, the pontoon structure is not particularly well aligned to the flow. A 4-5° anticlockwise rotation of the main pontoon would bring the pontoon more in line with the simulated 2D flow. It is suggested that this issue be addressed by site inspection and possibly measurements.

Depth-averaged peak ebb speeds at the new pontoon are expected to vary slightly from the existing state, rising from 0.3 m/s to 0.4 m/s at peak flood and remaining at approximately 0.5 m/s at peak ebb.

The footprint of effect of the works on hydrodynamics in the area are shown by Figure 12 which shows the percentage change in speed magnitude, at both peak ebb and peak

flood, due to the proposed pontoon. General slowing of the water is seen to the east at peak ebb, extending approximately 440m from Town Pier (less than 10% change). At peak flood the change is seen up to 230m to the west. A 10% in reduction of speed at West Street Pier is noted, with existing speeds at 0.8 m/s. An increase is also noted on the intertidal area fronting St Andrew's Gardens. However, existing speeds are in the magnitude of 0.4 m/s, with an increase to 0.48 m/s (20%). The basic speed and the increase to it are considered to be insufficient to affect the integrity of the adjacent intertidal foreshore and river wall.

The replacement of the three pontoons at Royal Terrance Pier with one smaller pontoon is not considered to have any significant impact on the results given.

3.2 TIME SERIES OF CURRENT SPEEDS AND DIRECTIONS AT SELECTED SITES

Figures 14 to 15 show through-tide time histories of speed and direction for both existing (black) and proposed (red), with Figure 13 showing the locations. Speeds at West Street Pier are seen to decrease slightly, remain relatively the same at the PLA St Andrew's Barge and nominally decrease at Royal Terrace Pier and associated barges. Peak Speeds at all locations in the vicinity do not exceed 1.1 m/s and no major change in flow direction is noted. This suggests that the pontoon addition will have little effect on other riparian activities in the area.

3.3 CONTOURED CURRENT SPEED DIFFERENCE AT HOURLY INTERVALS;

Figures 16 to 19 show the depth-averaged, through-tide speed differences. A general pattern of slowing around the pontoon is noted. Some small speed localised increases may be present after construction in the immediate vicinity of the structure due to flow being displaced around the pontoon.

The addition of the floating structures and additional support piles have only extremely localised affects.

4. Conclusions

1. The proposed pontoon is not particularly well aligned to the flow. A 4-5° anticlockwise rotation of the main pontoon would bring the structure more in line with the 2D flow. It is suggested that this issue be addressed by site inspection and possibly measurements

2. The change to the flow speed in the surrounding vicinity following the installation of the pontoon extension and the new piles will be small.

3. Changes to the flow regime adjacent to the river wall are expected to be minimal. It is therefore considered that that the foreshore fronting the river wall will not be subject to any scouring. The integrity of the river wall will therefore be unaffected.

4. Flow changes in the vicinity of other riparian activities in the area will be small and localised and will therefore have little effect on their operation.

5. The new layout will not affect tidal propagation in the Estuary and as the structures float or are held above the waterline for parts of the tide, there will only be a nominal effect on the tidal volume.

5. References

HR Wallingford 2004. Thames Estuary 2D Base Model. HR Wallingford Report EX 4912, April 2004

Figures

Figure 1 Study Area

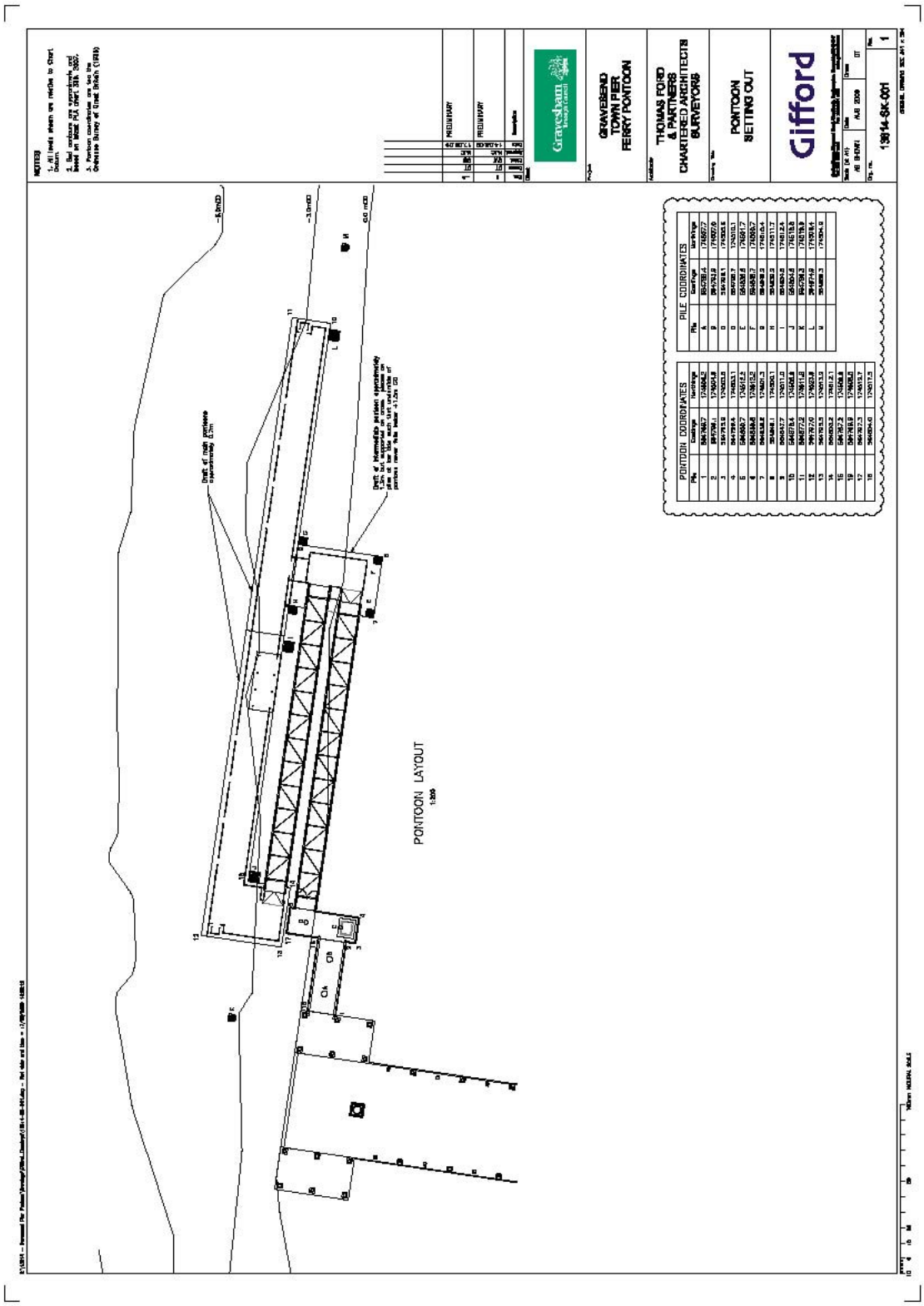

Figure 2 Proposed Configuration: Drawing 13814-SK-001 (provided by Gifford)

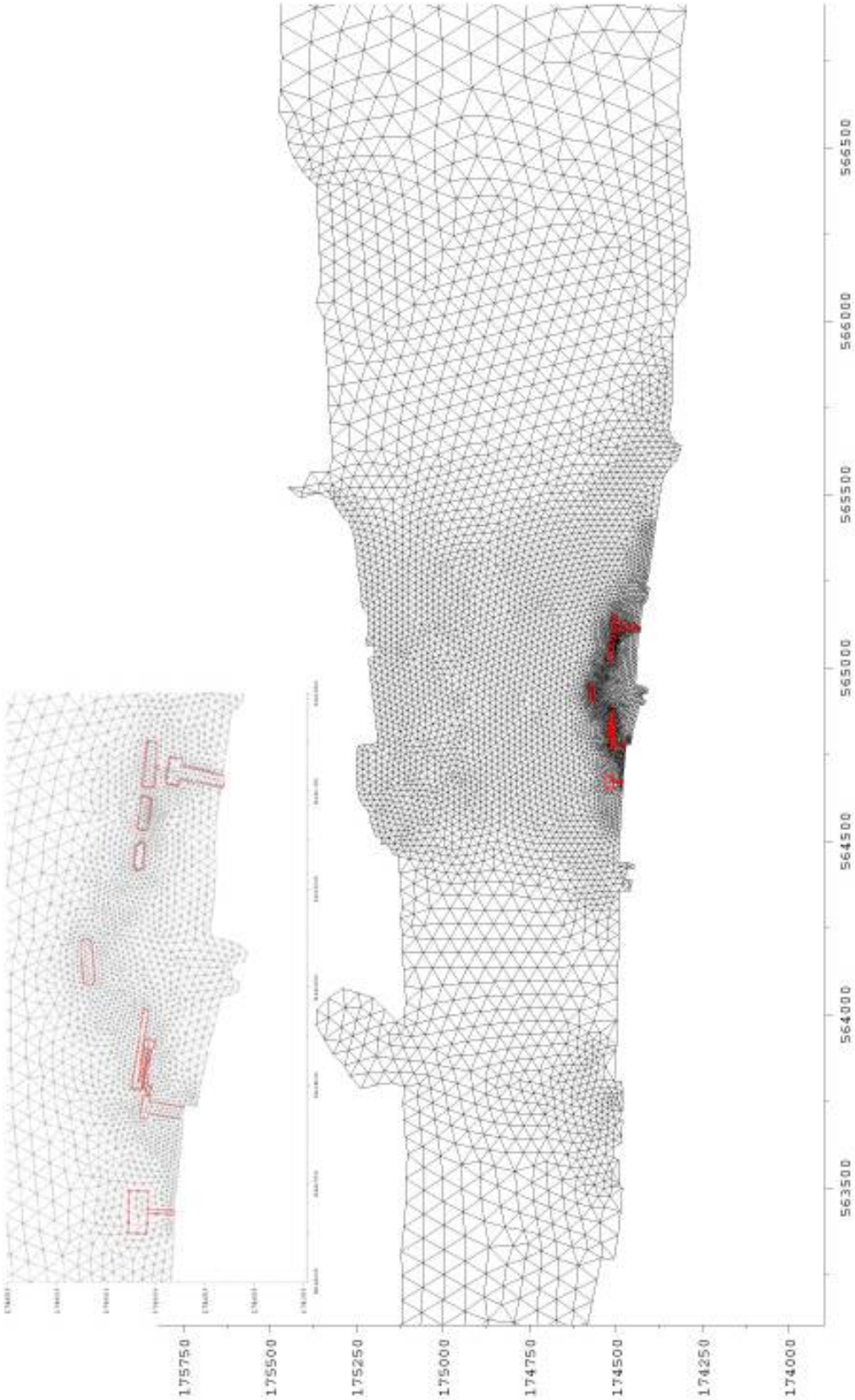

Figure 3 Model Mesh

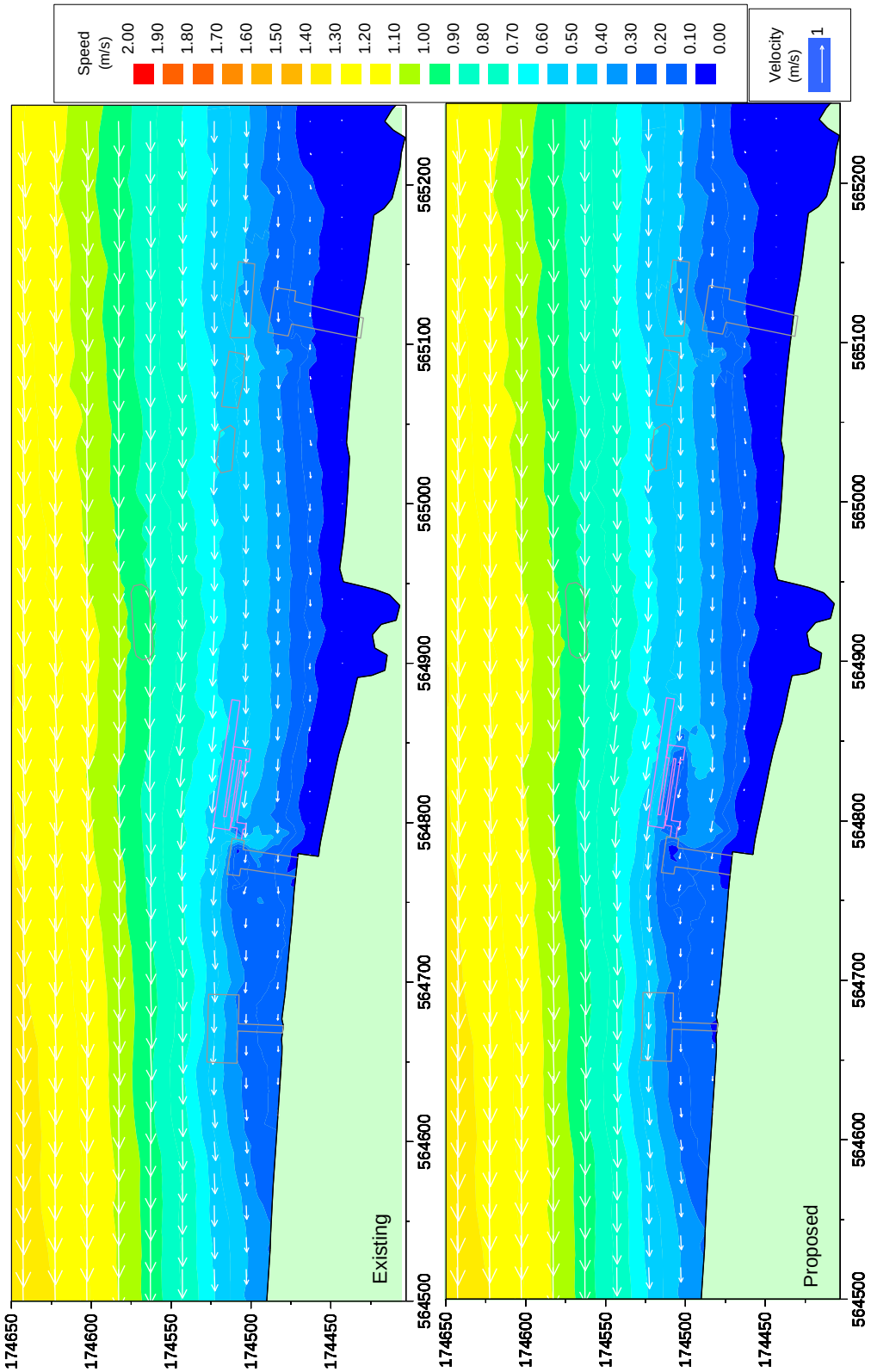

Figure 4 Existing (top) and Proposed (bottom) speed magnitude and direction at High Water -3 Hours

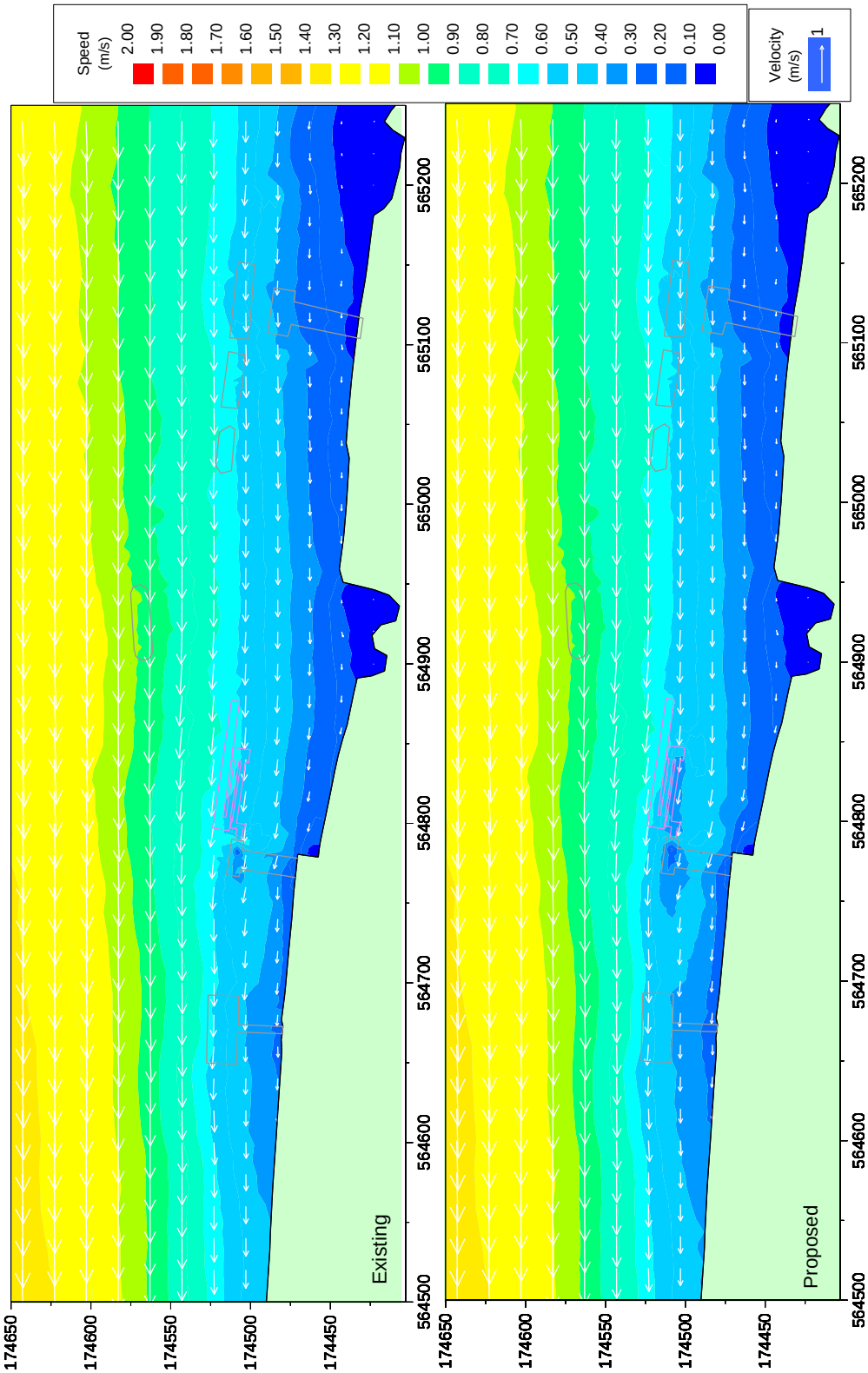

Figure 5 Existing (top) and Proposed (bottom) speed magnitude and direction at High Water -2 Hours

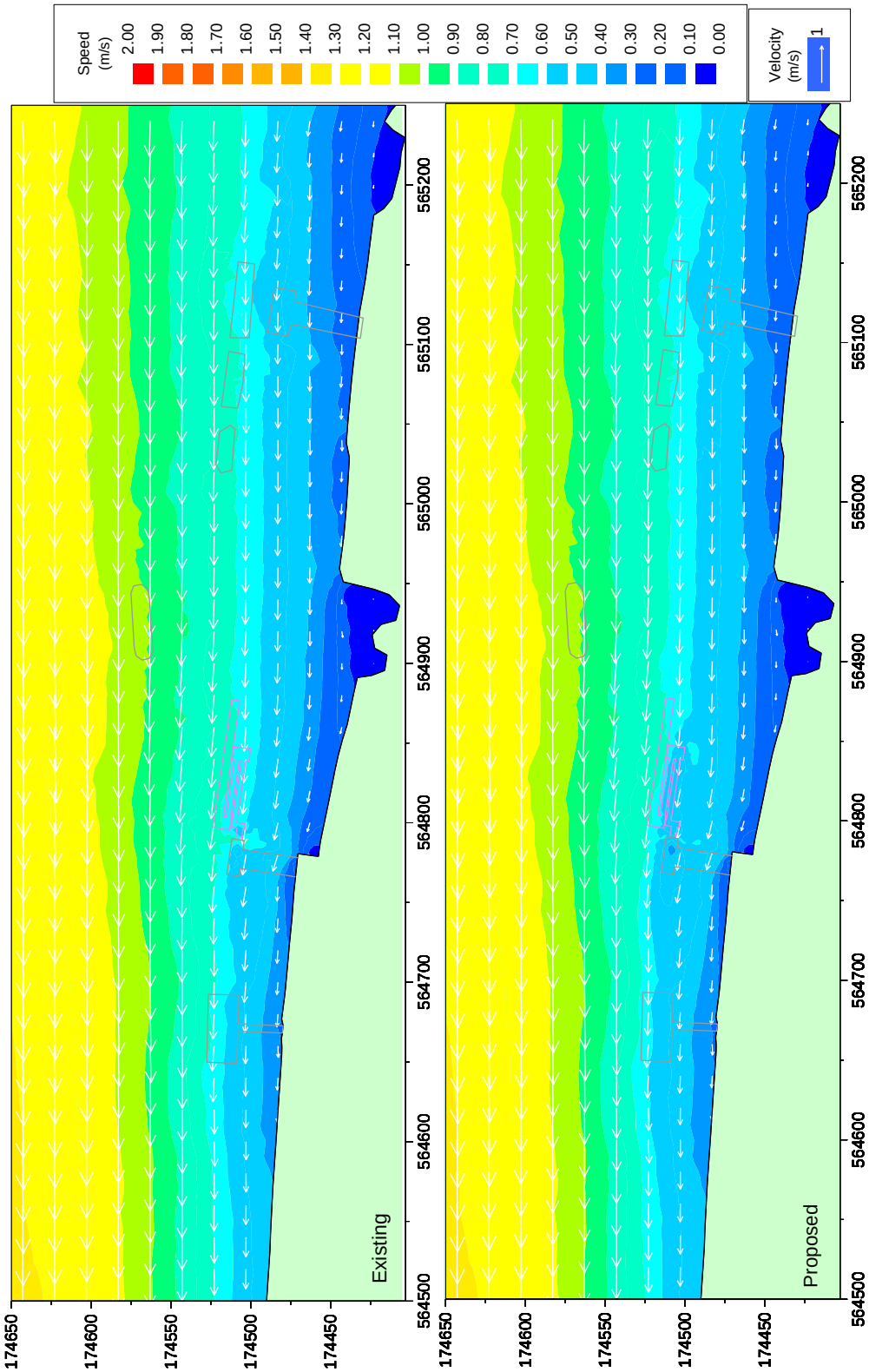

Figure 6 Existing (top) and Proposed (bottom) speed magnitude and direction at High Water -1 Hour

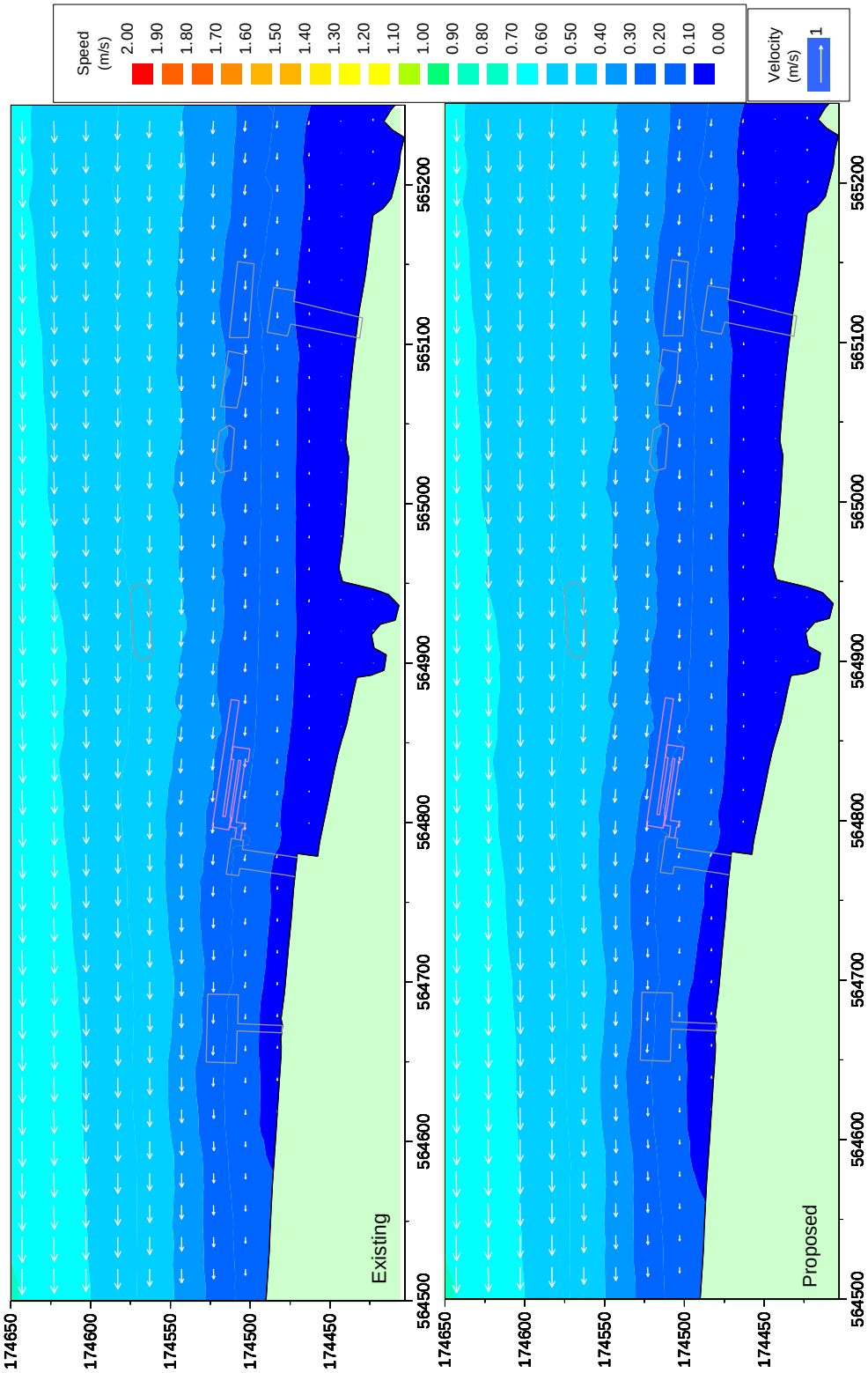

Figure 7 Existing (top) and Proposed (bottom) speed magnitude and direction at High Water

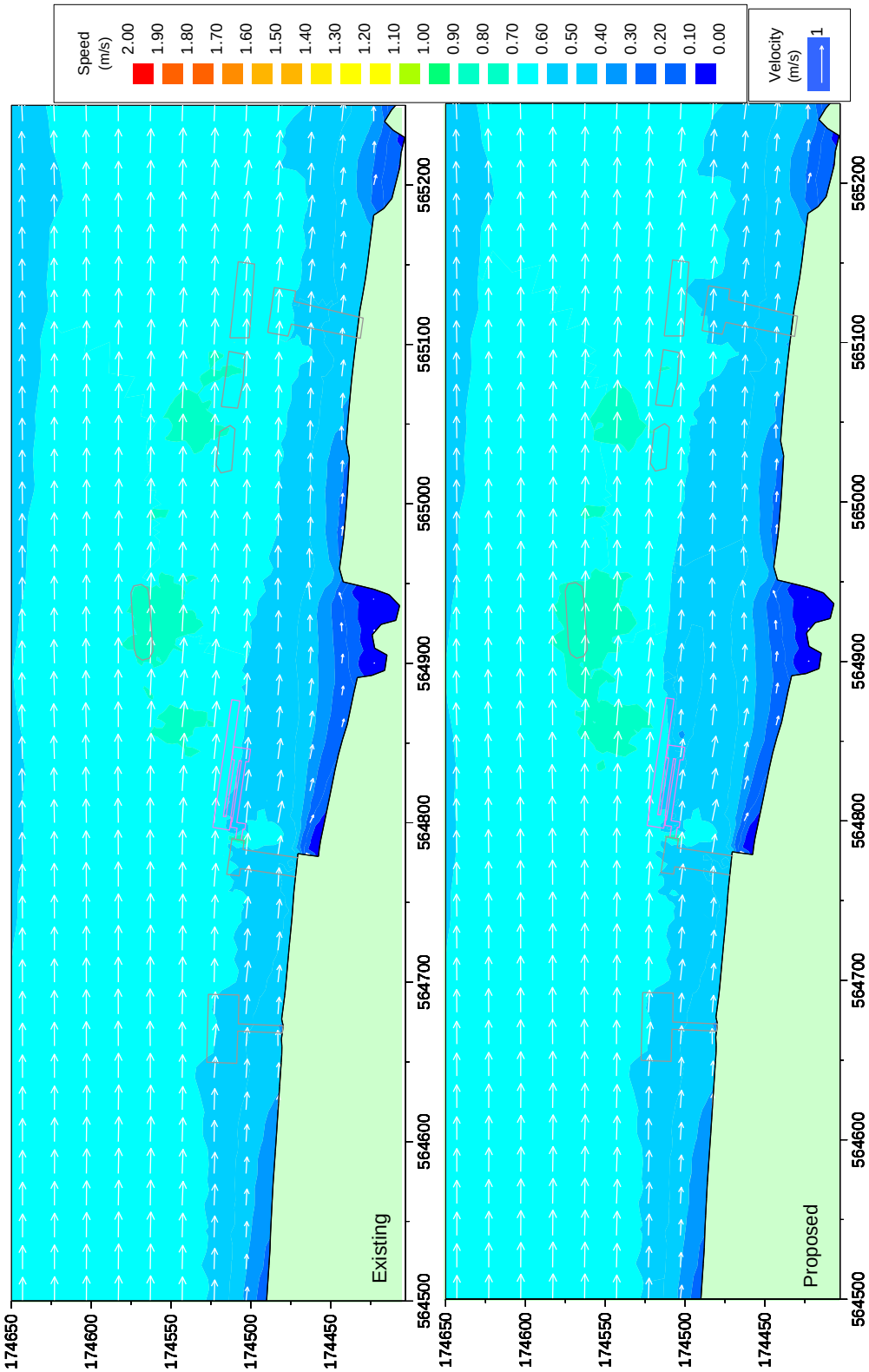

Figure 8 Existing (top) and Proposed (bottom) speed magnitude and direction at High Water +1 Hour

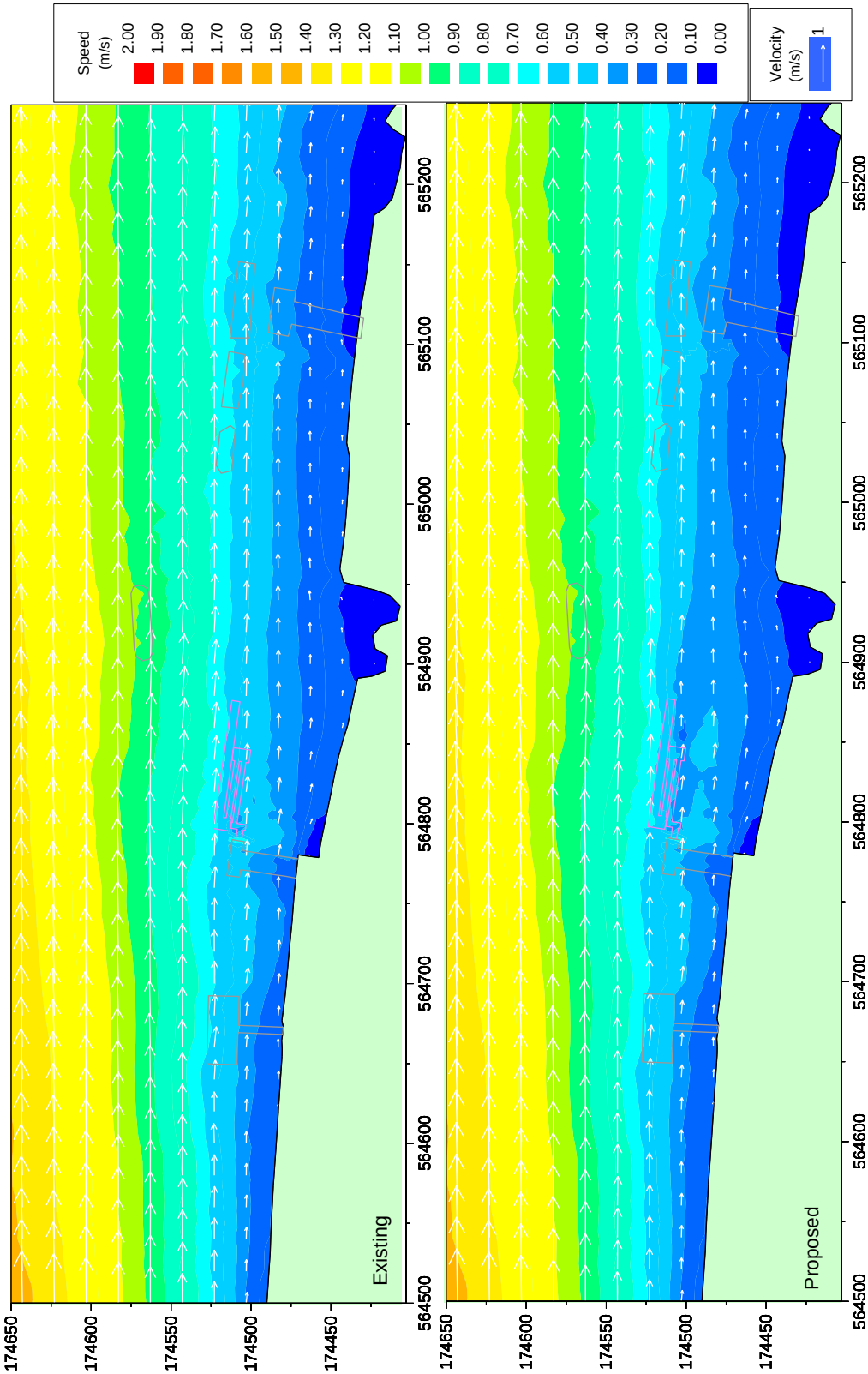

Figure 9 Existing (top) and Proposed (bottom) speed magnitude and direction at High Water +2 Hours

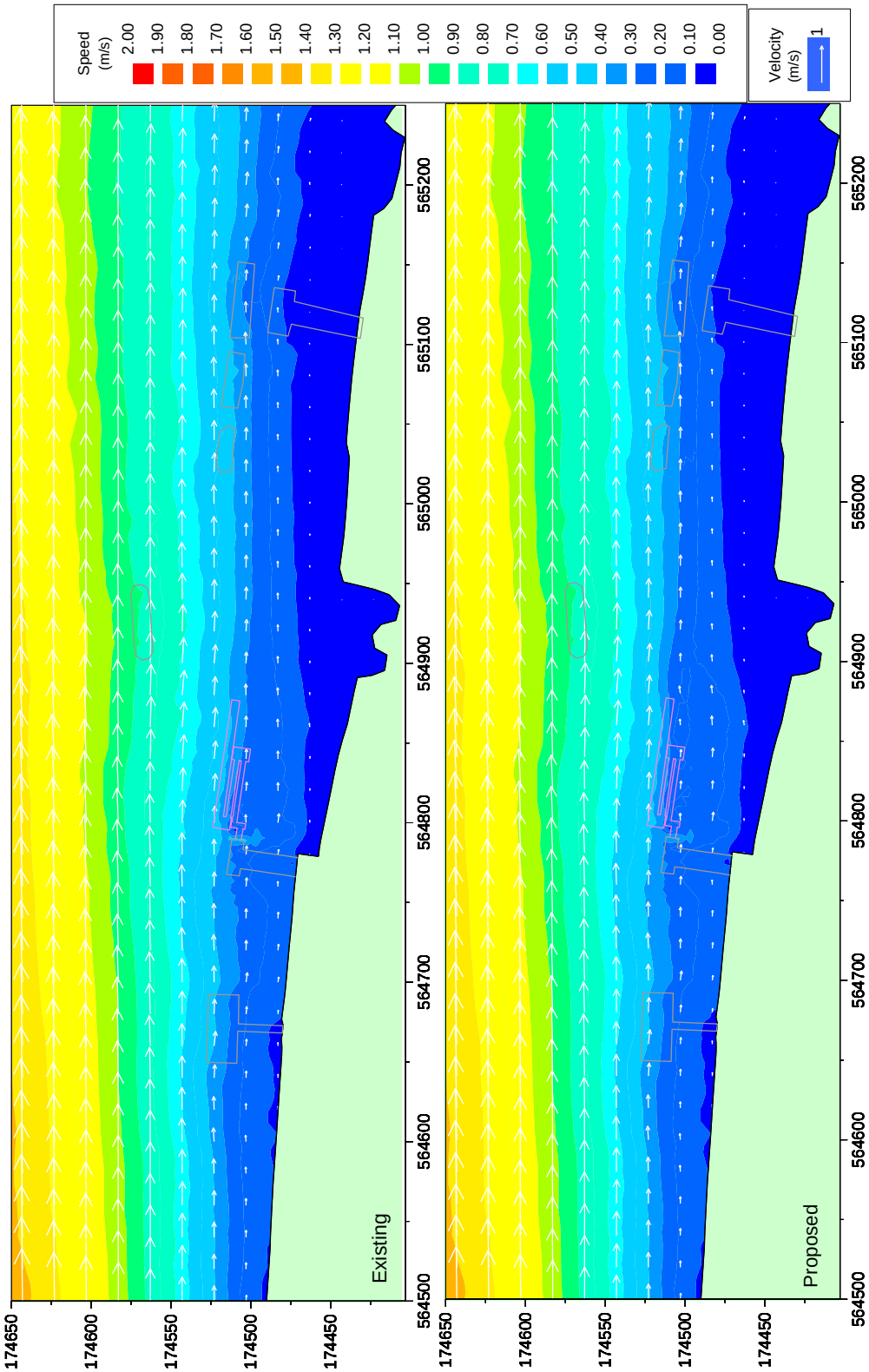

Figure 10 Existing (top) and Proposed (bottom) speed magnitude and direction at High Water +3 Hours

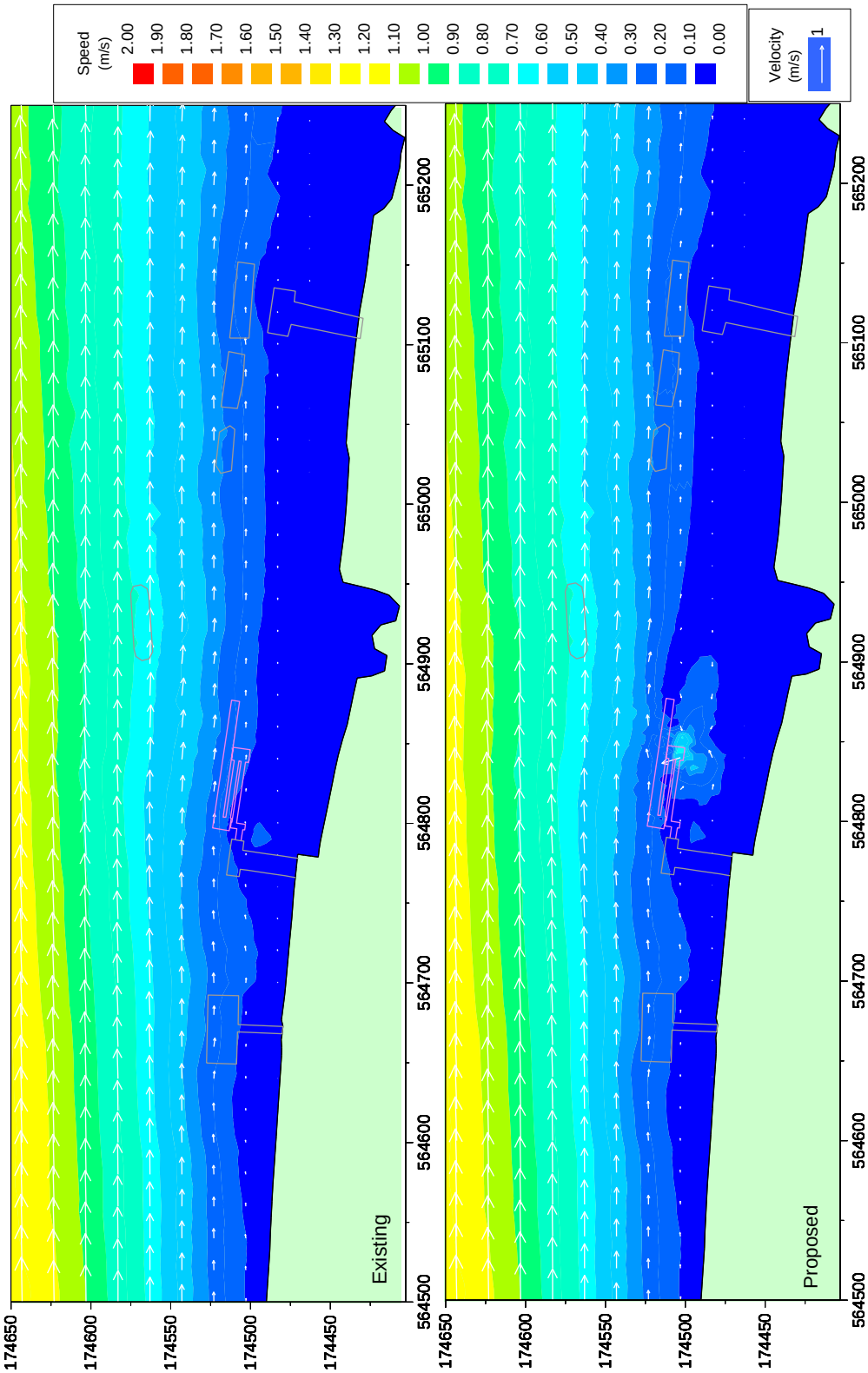

Figure 11 Existing (top) and Proposed (bottom) speed magnitude and direction at High Water +4 Hours

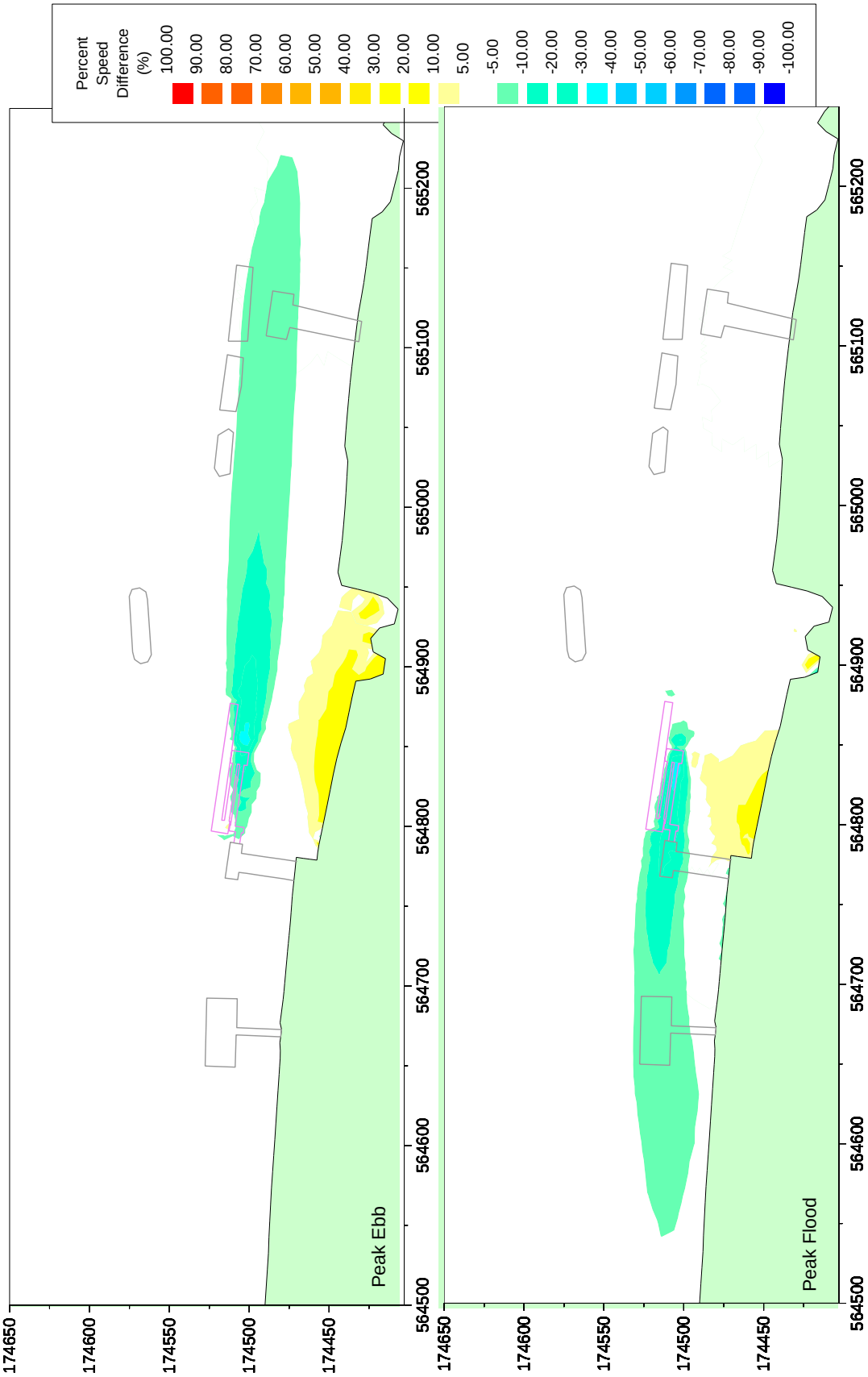

Figure 12 Percent Speed Difference

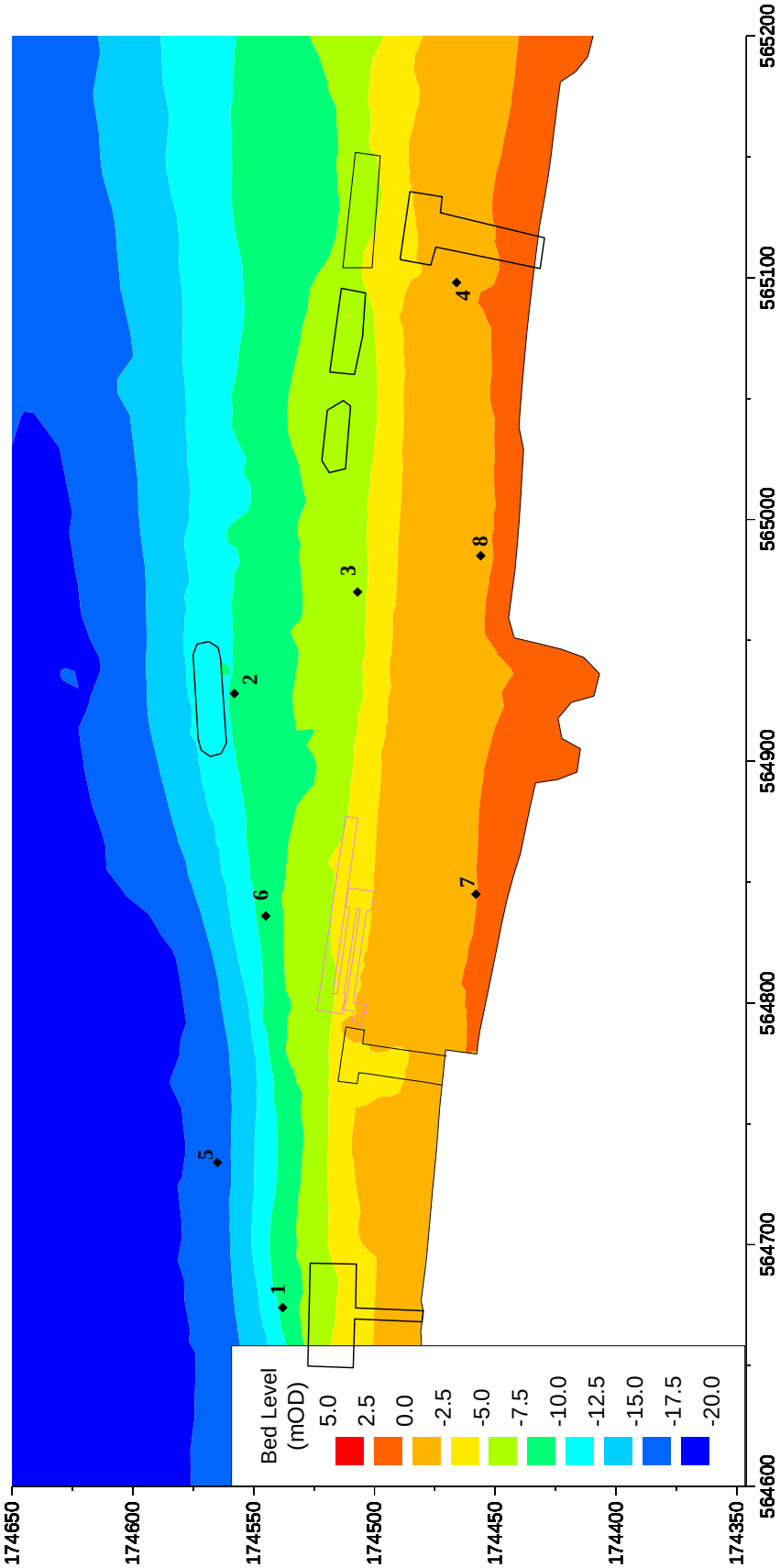

Figure 13 Time History Locations

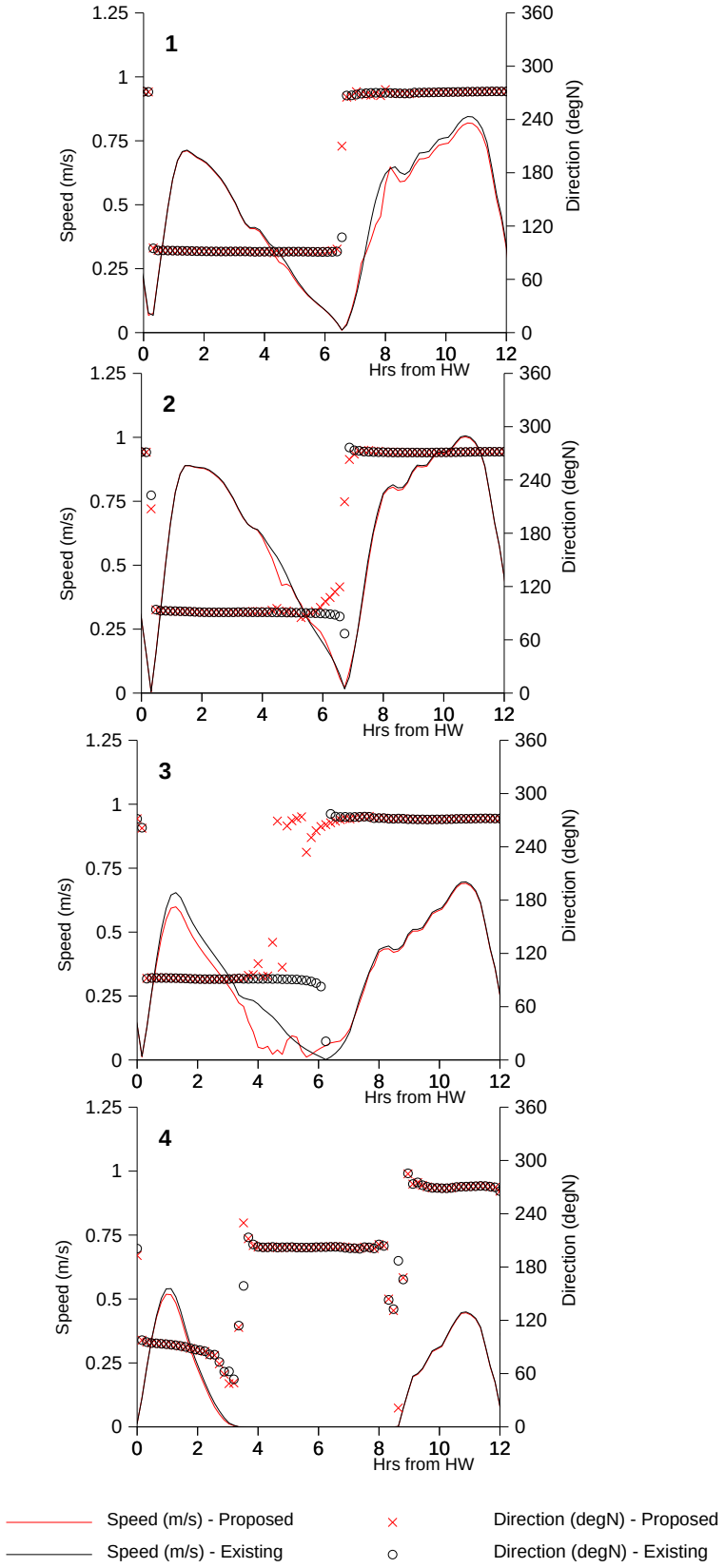

Figure 14 Time History of speed and direction, points 1-4

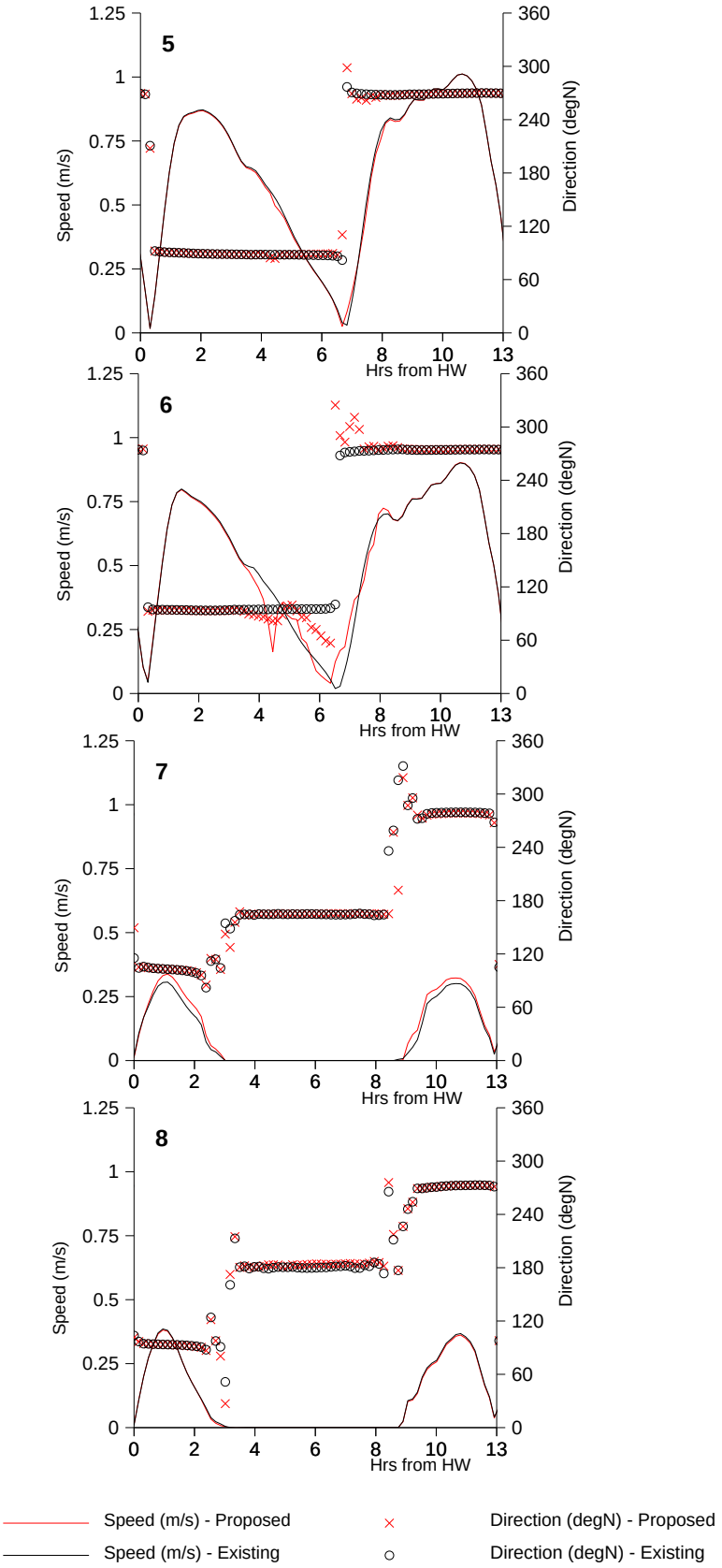

Figure 15 Time History of speed and direction, points 5-8

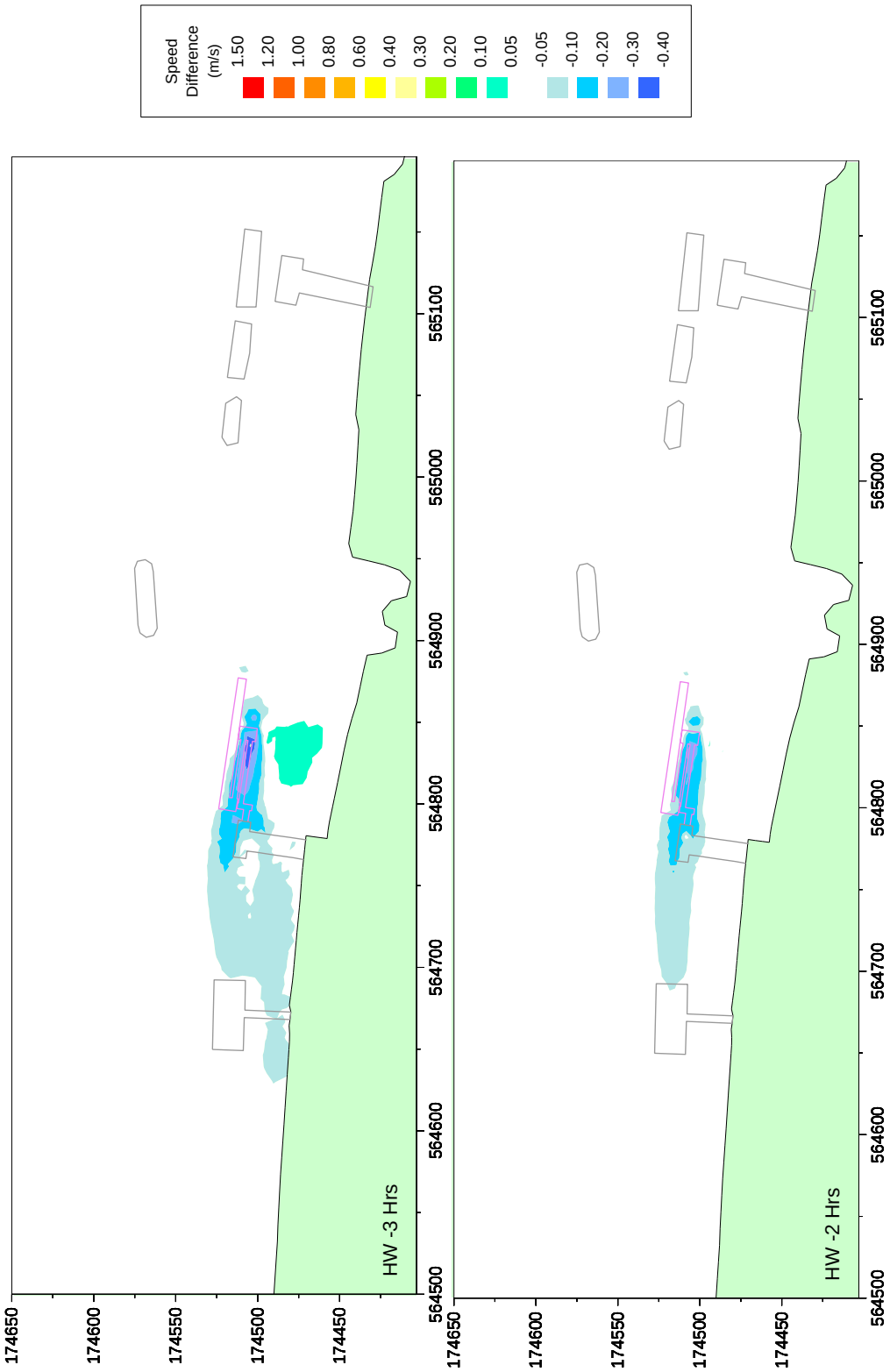

Figure 16 Speed Difference at High Water -3 Hours and -2 Hours

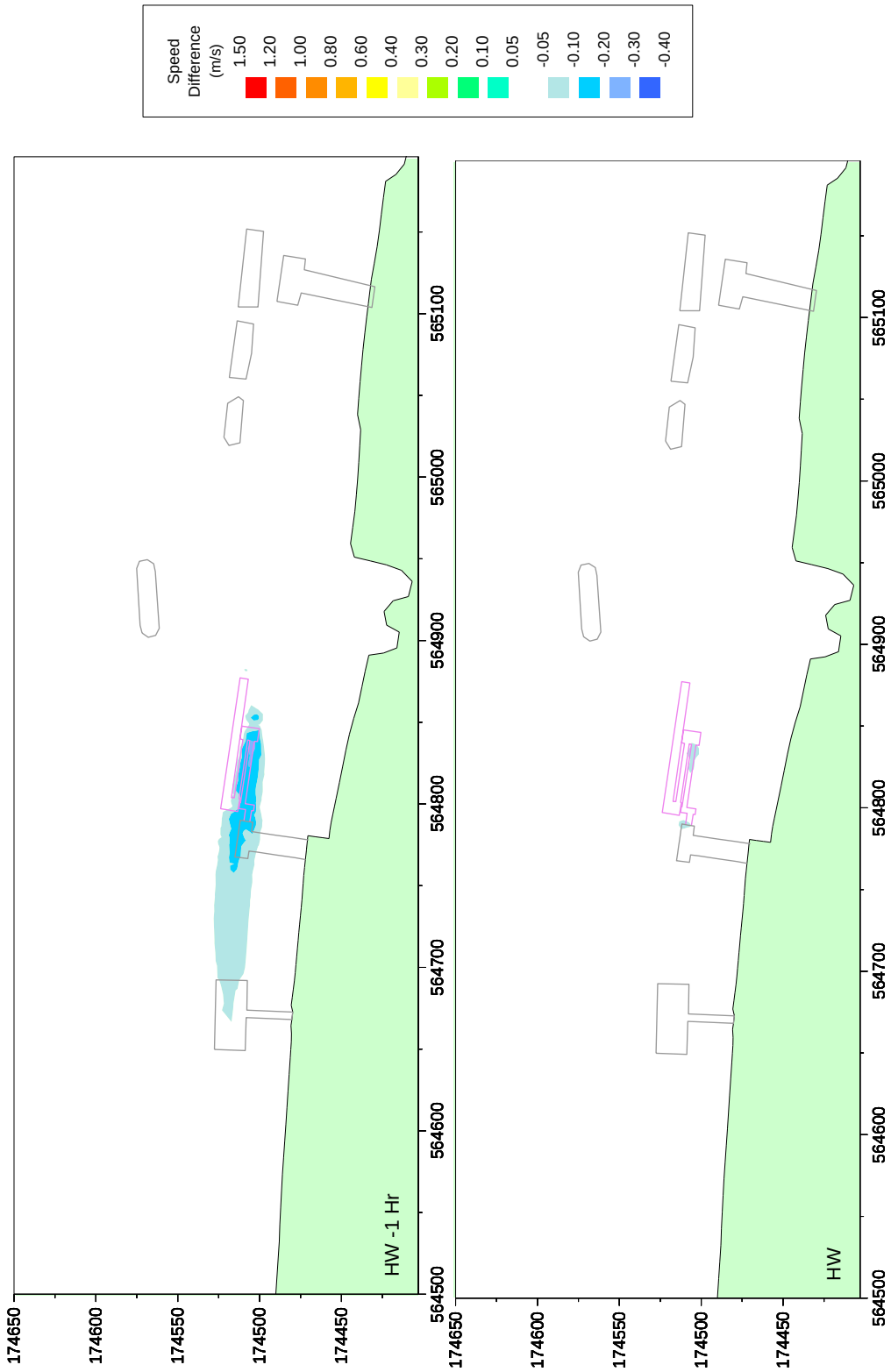

Figure 17 Speed Difference at High Water -1 Hours and High Water

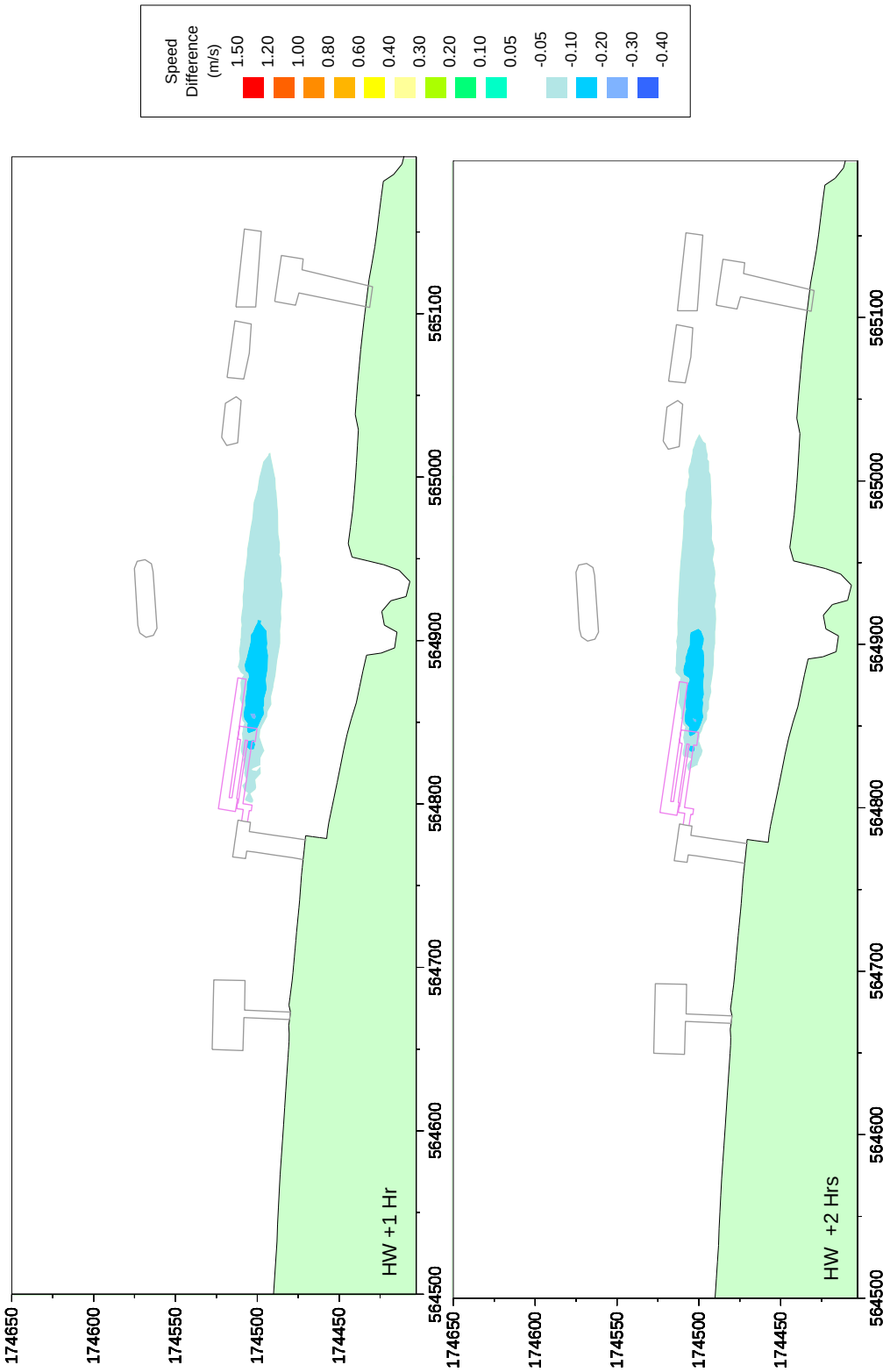

Figure 18 Speed Difference at High Water +1 Hour and +2 Hours

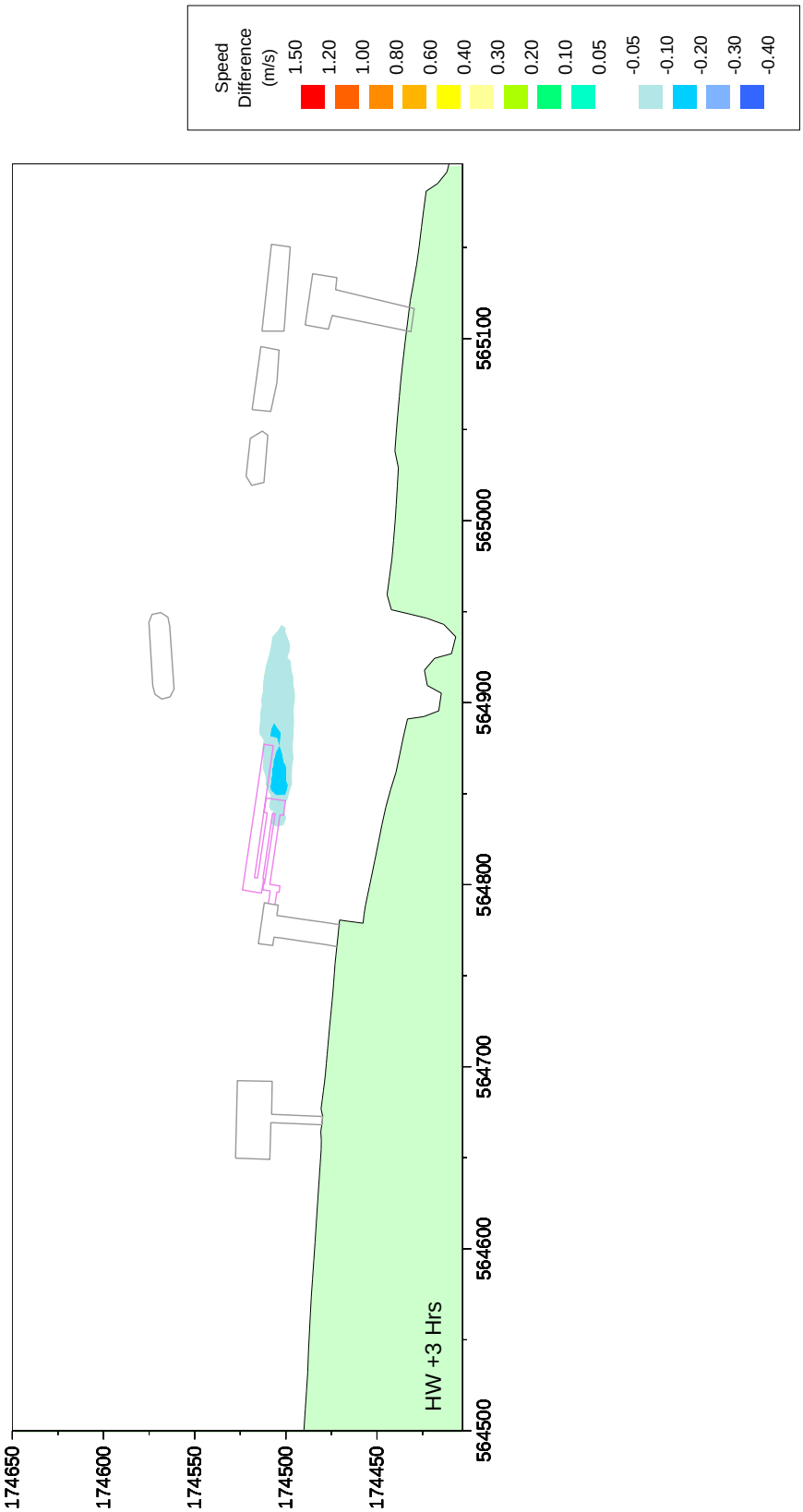

Figure 19 Speed Difference at High Water +3 Hours