Stantec

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September 27, 2019
File: 121416276

Attention: Terri Fraser, P.Eng.
Technical Manager
Northern Pulp Nova Scotia Corporation
PO Box 549, Station Main
New Glasgow, NS B2H 5E8

Dear Ms. Fraser,

Reference: Responses to Environment and Climate Change Canada and Nova Scotia Environment Comments on the Receiving Water Study in the Environmental Assessment Registration Document – Northern Pulp Effluent Treatment Facility Project

Stantec Consulting Ltd. (Stantec) is pleased to provide the following responses to the comments provided by Environment and Climate Change Canada (ECCC) and Nova Scotia Environment (NSE). The responses to comments provided below are in reference primarily to the Stantec report *Addendum Receiving Water Study for Northern Pulp Effluent Treatment Facility Replacement Project – Additional Outfall Location CH-B, Caribou Point, Nova Scotia*, which was submitted as Appendix E1 in the Environmental Assessment Registration Document (EARD) for the Northern Pulp Effluent Treatment Facility Replacement Project.

ECCC's comments of March 18, 2019 on Effluent Treatment and Discharges

ECCC_IR1-01 (page 3)

- **Without empirical baseline information on the Caribou Harbour area associated with the proposed outfall location, ECCC is not in a position to assess the predictions made in the report, nor to evaluate the potential environmental impacts related to that aspect of the project.**

Response IR1-01

> *Northern Pulp Nova Scotia Corporation (NPNS) conducted a field survey program to measure the oceanographic conditions (i.e., currents, waves, water levels) and marine water qualities in the Caribou Harbour area. The meteorological data were obtained from the Caribou Point (AUT) climate station of ECCC. These data sets were used to calibrate the hydrodynamic effluent dispersion model and to assess the predictions of potential environmental effects.*

ECCC_IR1-02 (page 3)

- **Mixing Zone as defined in the report glossary in the context of this project, refers to the marine area within a 100 m distance from the termination of the effluent pipeline (page**

xxviii). However, several of the effluent plume figures refer to a "regulatory mixing zone." There is no federal regulatory mixing zone, however effluent concentration at fixed distances from discharge are relevant to determining EEM requirements. Clarification on what is intended by the term "regulatory mixing zone", and what regulations might be referred to here is needed.

Response IR1-02

Figures with the "Regulatory Mixing Zone" are screen shots from CORMIX. In CORMIX the mixing zone is called "regulatory mixing zone". Regulatory Mixing Zone (RMZ) in CORMIX is the region in the receiving water where mixing zone regulations are applied. It is sometimes referred to as the legal mixing zone. The figures from CORMIX will be revised and "regulatory" will be removed.

ECCC_IR1-09 (page 4)

- **Section 8.11.2.4, p.343. It is stated: "Pictou Harbour is used as a proxy for Caribou Harbour with respect to water quality, in the absence of available water quality data for Caribou Harbour. Pictou Harbour is similar to Caribou Harbour in terms of depth and geography, but likely has greater freshwater influence." Without empirical baseline data from the actual discharge location, it is not possible to assess such statements or to evaluate the potential environmental impacts of the effluent discharge.**

Response IR1-09

NPNS implemented a field survey program to measure the oceanographic conditions (i.e., currents, waves, water levels) and marine water qualities in the Caribou Harbour area. These data sets will be used to calibrate the hydrodynamic effluent dispersion model and to assess the predictions of potential environmental effects.

ECCC_IR1-10 (page 4)

- **Section 8.11.3.1, p.346. This section summarizes the predicted residual effects on the physical environment of Caribou Harbour (sediment and water quality) despite the absence of baseline information on water and sediment quality in the assessment area.**

  No information has been provided with respect to the physical and chemical characteristics of the sediments to be excavated to install the pipeline. Conclusions on environmental quality resulting from the project are presented after extrapolating from data from Pictou Road.

  Empirical baseline information on the Caribou Harbour and Caribou Point area of Northumberland Strait is necessary to estimate with some confidence the direction and impact of residual effects on the physical environment within the marine assessment area.

The follow-up and monitoring program outlined in Appendix H should be considered preliminary only, subject to modification once predictions, conclusions and decisions based on site specific data are made regarding the project.

Response IR1-10

The predicted residual effects on the physical environment of Caribou Harbour (sediment and water quality) will be updated and based on the baseline information on water and sediment quality in the assessment area that was collected by NPNS for the Focus Report. The proposed follow-up and monitoring program to be implemented for the new outfall location will be updated and resubmitted in the Focus Report.

ECCC_IR1-11 (page 4)

- **Appendix E1, Section 2.0. It appears that the Far-Field model simulations were run before the Near-Field model. One could expect that the behavior of the plume further afield depends to a large extent on how it behaved at the diffuser, i.e. how quickly it mixed and spread and rose to the surface. It should be explained how the initial mixing and dispersal of the plume was taken into account when simulating Far-Field extent and concentrations of effluent in Section 3.**

Response IR1-11

In the 2D far-field model, the outfall discharge is specified as a source discharge. At the end of the outfall pipe, the magnitude of source (the discharge rate) is taken into account in the continuity equation, while the initial jet velocity vectors are not taken into account in the source contribution to the momentum equations. As a result, the 2D model underestimates the initial mixing of effluent plume due to the jet momentum - i.e., the 2D model is expected to predict higher concentrations than actual jet plume dispersion in near-field mixing. Therefore, the 2D far-field model is considered a conservative approach when simulating the far-field extent and concentrations of effluent dispersion. The 2D model is conservative because it does not take advantage of the geometry of the outfall diffuser and jet velocity effects that help mixing in the near field. Therefore, the 2D far-field model is considered a conservative approach when simulating the far-field extent and concentrations of effluent dispersion.

ECCC_IR1-12 (page 5)

- **References should be provided to support the arguments on page 3. An alternative would be to provide the equivalent plume simulation during winter conditions to compare to the summer modelling results.**

Response IR1-12

NPNS has conducted effluent dispersion modelling during winter conditions to compare to the summer modelling results. The SW Module was added to the MIKE21 model to model the effects of wind and waves for summer conditions and to simulate ice cover for the winter condition.

ECCC_IR1-13 (page 5)

- **Appendix E1, Table 2.1. The table identifies the simulation time step as 60 seconds. Is this correct? An explanation on the step interval used for the plume simulation should be provided.**

Response IR1-13

The simulation time step is one of the key parameters calibrated in the hydrodynamic model through a systematic calibration process. The details on how a time step of 60 seconds was determined can be found in Section 2.2.2.1 Spectral Wave Model and Section 2.2.2.2 Hydrodynamic Model of the updated Receiving Water Study. The time step used for the plume simulation in the Particle Tracking (PT) module needs to be the same as in the Hydrodynamic (HD) model.

ECCC_IR1-14 (page 5)

- **Appendix E1, p.6 and Figures 2.5 to 2.13. The explanatory details provided on far-field simulations are very brief and do not permit a full appreciation of the model's robustness or the credibility of its results.**

  Figure 2.13 shows the final state of the plume at the end of one month, more than 9 days after the tidal phase depicted by the preceding Figure 2.12. It is not specified whether any of these figures depict the maximum extent of the simulated plume, nor how isolated effluent patches form, nor why the final plume at the end of the month is further south-east than any of the preceding snapshots provided.

  Given that EA predictions for the aquatic environment are based on the premise that simulated conditions return to surrogate (Pictou area) background levels within 2- to 100 m from the diffuser depending on the parameter in question, it is important to establish a high degree of confidence in the model simulation and input parameters.

  It would be helpful in understanding the simulation to see how the isolated patches form and disintegrate, as well as an animation of the plume for the few days leading to the final state of the plume in Figure 2.13. The maximum extent of the modelled plume should have been provided, if it is not depicted in one of the figures.

Response IR1-14

We agree that Appendix E1 provides brief summaries of effluent dispersion characteristics. More detailed discussions and observations on the hydrodynamics and effluent plume behavior are presented in Appendix A at the end of this document and based on the updated receiving water study.

Figure A-1 in Appendix A presents the water level variations of a neap tide from July 10 to July 11 at the outfall location, where the slack low tide occurs at 23:00 on July 10. Figures A-2 to A-14 illustrate the spatial distribution of effluent concentration at various stages of the neap tide at 10-minute intervals during the two-hour simulation period of slack low tide from July 10 at 22:00 to July 11 at 00:00. Note that the outfall is located at 526737 m E and 5067239 m N, which is approximately at the center of the plot area (1.4 km x 1.4 km), and that the figure legend for the plume effluent concentration is provided in a lower concentration up to 2.5 mg/L compared to the full scale of 100 mg/L for the effluent discharge concentration at the outfall. The isolated effluent patches are formed by the dynamic changes of current magnitudes, directions and circulation patterns, just like the clouds in the sky driven by winds. We can provide the video clips of the hydrodynamic plume dispersion for better review and observation, if required.

ECCC_IR1-15 (page 5)

- **Appendix E1, p. 16. The report indicates that higher background level of contaminants from the Pictou area of the Strait were used as input parameters for background water quality, (due to a lack of data from the Caribou area), and as such can be considered more conservative. This may not be accurate: the Caribou Harbour area is expected to be less contaminated than Pictou Harbour, such that the effluent being discharged near Caribou would in reality be more concentrated relative to receiving water than what is suggested by the simulation based on Pictou baseline data. In other words, it would require greater dilution than estimated based on Pictou data to achieve a return to the levels theoretically prevailing in the Caribou area. To use an example from page 24, where TN is taken to be 0.24 mg/L (as in Pictou Road), a 1:25 dilution of effluent is needed to return TN levels to "background". But if TN in Caribou area were, say, 0.1 mg/L, then a 1:60 dilution would be required to return TN concentrations to ambient levels. The dilution ratios and distances required to achieve background levels for most other water-quality parameters may also be underestimated on page 24-25.**

Response IR1-15

Assimilative capacity of a receiving environment (i.e., ocean, river, or lake) refers to its capacity to accept and dissipate pollutant discharges without exceeding water quality (WQ) standards. If the receiving environment has a background concentration of the pollutant equal to the WQ standard, then the receiving environment has no assimilative capacity for that particular pollutant. Ignoring flows and volumes, the assimilative capacity can broadly be defined as a difference between the background receiving environment concentration and the WQ standard. Therefore, the lower the background concentration in the receiving environment is, the higher the assimilative capacity will *be (i.e., the higher the contaminant concentration can be assimilated before the WQ standard is reached).*

As per the example noted by the reviewer, TN in the effluent is 6 mg/L; TN in the receiving environment is 0.24 mg/L and the excess concentration is 5.76 mg/L. As per CORMIX results (Table 3.4), a 32.5 dilution ratio is observed in the immediate vicinity of the outfall and a 144.1 dilution ratio is observed within 100 m. Therefore, the excess concentration of TN will be 0.177 mg/L at 2 m and 0.004 mg/L at 100 m. Predicted TN concentration at the end of the mixing zone will be 0.244 mg/L which is basically the background concentration.

As per the reviewer assumption that Caribou Harbour has a lower background concentration of TN (e.g., assume 0.1 mg/L), then the excess concentration will be 5.9 mg/L at the outfall and the excess concentration of TN will be 0.181 mg/L at 2 m and 0.042 mg/L at 100 m. Predicted TN concentration at the end of the mixing zone will be 0.14 mg/L which is much less than when the receiving environment background concentration was 0.24 mg/L. Therefore, predictions made using the Pictou Harbour data are conservative over an assumed lower background concentration at Caribou.

No background water quality data were available for Caribou Harbour at time of the modeling investigation; therefore, the Pictou Road data were used. Dilution ratios will be recalculated from background water quality from Caribou Harbour and discussed in the updated receiving water study.

ECCC_IR1-16 (page 5)

- **Appendix E1, Table 3.1. The table presents some water-quality parameters used as background conditions for Caribou Harbour. The title of the table should have identified the source of the samples as being from Pictou rather than Caribou area. As well, the depth in the water column at which samples were collected to obtain these averages was not provided.**

Response IR1-16

Water quality from Caribou Harbour area, including depth averages, were collected and are reflected in the updated receiving water study.

ECCC_IR1-17 (page 6)

- **Appendix E1, Figure 3.2. The figure shows the frequency and force of prevailing currents derived from the MIKE 21 model. A more intuitive representation of current directions and speeds would be a current "rose" as is commonly done with winds. The figure's title should have specified that these are depth-averaged speeds and directions. Their pertinence to effluent mixing and entrainment at the discharge point near the bottom is not obvious.**

Current directions should have been provided to aid in the visualization of prevailing currents. A rationale for the use of depth-averaged currents instead of near-bottom currents when simulating effluent mixing and entrainment at the diffuser should also be presented.

Response IR1-17

The figure title will be revised to indicate that depth-averaged velocities and directions are provided. Predictions were made with a 2D model. Therefore, the velocities and directions are depth-averaged throughout the water column.

NPNS completed a field survey program to measure the currents in the water column in the area of the diffuser. Data analysis indicates that the water column is weakly stratified at the CH-B location confirming that the use of 2D modelling is appropriate using depth-averaged data.

ECCC_IR1-18 (page 6)

- **Appendix E1, p.25. The dilution ratio required (1:7) to return salinity to ambient levels appears to be underestimated, as ambient salinity is being reduced, not increased, by mixing with freshwater effluent. The correct dilution and distance estimates for the return to ambient salinity should be provided. A discussion on how the adjustments affect all conclusions based on dilution throughout the EA registration document should also be provided.**

Response IR1-18

In the EARD effluent salinity was 4 g/L and the background salinity was 28 g/L. In the immediate vicinity of the outfall (<2 m), the ambient salinity concentration will be 27.3 g/L which is practically the background concentration. This ambient salinity concentration was based on the dilution ratio of the effluent at 32.4 times within 2 m of the diffuser (Table 3.4) and calculated as: ((32.4 L x 28 g/L) + 4 g)/ (32.4 L + 1 L) = 27.3 g/L

A dilution ratio of 7 was meant to indicate the excess salinity concentration ratio required to reach ambient levels. Text in the updated receiving water study report will be revised.

ECCC_IR1-19 (page 6)

- **Appendix G, p.2.2. The proponent proposes to confirm the spatial extent of the effluent plume empirically with the use of a tracer dye once the project is operational.**

  Empirical verification of the plume will be important not only for validating the simulations but also for confirming the location of the exposure area(s) for EEM studies.

Response IR1-19

It is agreed that empirical verification of the plume should be conducted to validate the simulation and provide valuable information to be used in EEM studies.

NSE Focus Report Terms of Reference, April 23, 2019: Addendum Questions Section 3.0

Addendum_Q-01

- **Explain how the initial mixing and dispersal of the plume was taken into account when simulating far-field extent and concentrations of effluent in Section 3 of Appendix E1 of EARD. It appears that the far-field model simulations were run before the near-field model. One could expect that the behaviour of the plume further afield depends a large extent on how it behaved at the diffuser, i.e. how quickly it mixed and spread and rose to the surface;**

Response Q-01

*Refer to **Response IR1-11***

Addendum_Q-02

- **Confirm dilution ratios and distances required to achieve background level for water quality parameters in Appendix E1 of the EARD, as the dilution ratios and distances may be overestimated;**

Response Q-02

*Dilution ratios and distances will be recalculated using the Caribou Harbour background data and presented in the updated receiving water study. Refer also to **Response IR1-15**.*

Addendum_Q-03

- **Explain if the salinity and temperature differential between the effluent and the receiving waters has been accounted for in the model. When the buoyancy differential between the effluent and receiving waters are greater in winter, it results in a faster rising plume. This can potentially affect the visibility of the effluent in the receiving environment. Has this been accounted for in the model? Also provide results for winter conditions;**

Response Q-03

Both the effluent density (which varies with the total dissolved solids (TDS) and temperature of the effluent water) and the ambient water density (which varies with the salinity and temperature of marine water) have been taken into account in the 2D far-field modelling and in the CORMIX *model. NPNS conducted additional 2D far-field modelling for winter conditions and provide the corresponding results to further evaluate the potential effects.*

Addendum_Q-04

- **Explain if re-entrainment of effluent and sediment at the diffuser location was accounted for in the one-hour period surrounding slack tide. Support this explanation with model results using a smaller time step (30 minutes) if necessary.**

Response Q-04

*Please refer to **Responses IR1-14** and **Appendix A** for the presentation of the effluent plume in 10-minute intervals during the two-hour simulation period of a neap tide at slack low tide from July 10 at 22:00 to July 11 at 00:00, which is considered a worse time period over the entire 31 days of simulation time in July and modelled in the updated receiving water study. As it can be observed, no effluent re-entrainment or effluent plume buildup at the outfall location is anticipated.*

*The CORMIX 3D model will also be revised based on the results of the 2D far-field model as indicated in the **Response IR1-17**. NPNS completed a field survey program to measure the currents in the water column in the area of the diffuser. Data analysis indicates that the water column is weakly stratified at the CH-B location confirming that the use of 2D modelling is appropriate using depth-averaged data.*

CLOSING

The information contained in this letter has been prepared for the sole benefit of Northern Pulp Nova Scotia Corporation. This letter may not be used by any other person or entity without the express written consent of Stantec Consulting Ltd. and Northern Pulp Nova Scotia Corporation.

Any use that a third party makes of this letter, or any reliance on decisions made based on it, are the responsibility of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made, or actions taken, based on this letter.

The information and conclusions contained in this letter are based upon work undertaken by trained professional and technical staff in accordance with generally accepted engineering and scientific practices current at the time the work was performed. Conclusions and recommendations presented in this letter should not be construed as legal advice.

The conclusions presented in this letter represent the best technical judgment of Stantec Consulting Ltd. based on the data obtained from the work. If any conditions become apparent that differ from our understanding of conditions as presented in this letter, we request that we be notified immediately to reassess the conclusions provided herein.

This letter was prepared by Shelton Liu (Ph.D., P.Eng.), Igor Iskra (Ph.D., P.Eng.), reviewed by Sam Salley (M.Sc.) and independently reviewed by Don Carey (M.Sc., P.Eng.).

Regards,

Stantec Consulting Ltd.

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Attachment: Appendix A

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APPENDIX A

Figures

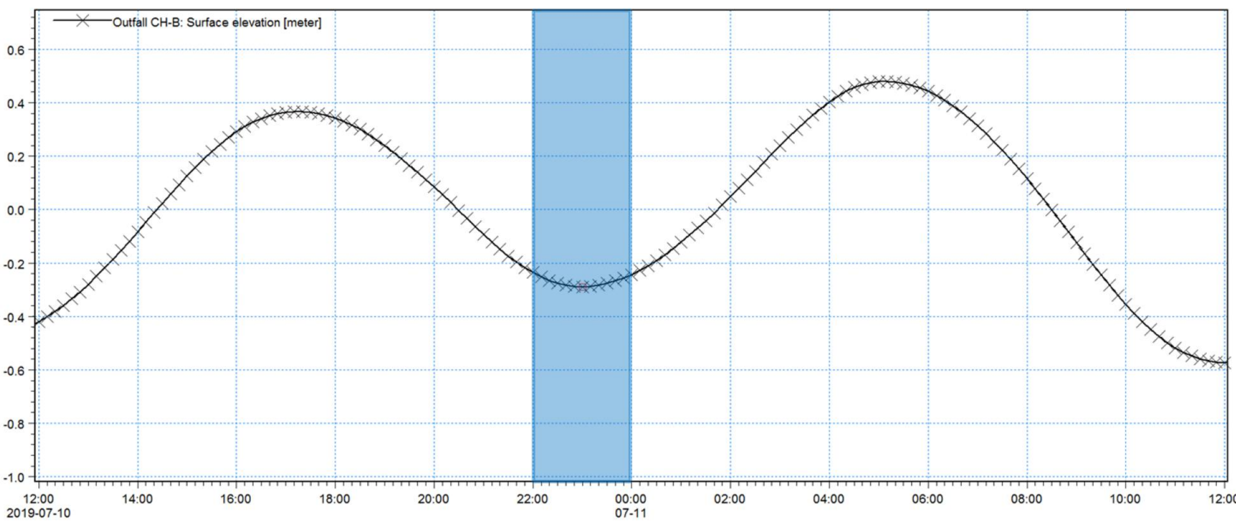

Figure A-1 Simulated Water Levels at the Outfall Location during a Neap Tide on July 10 – 11, 2019

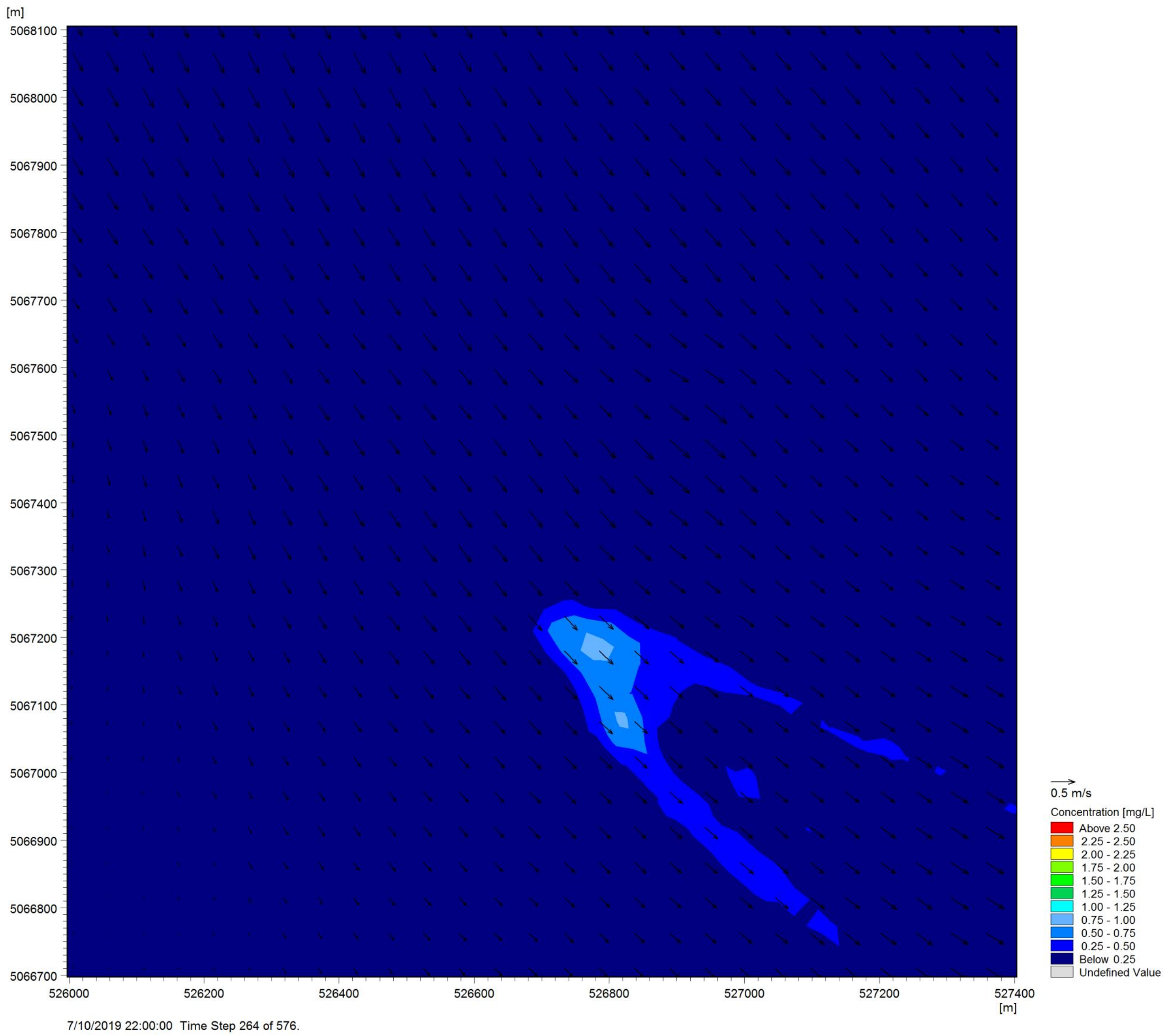

Figure A-2 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 22:00 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

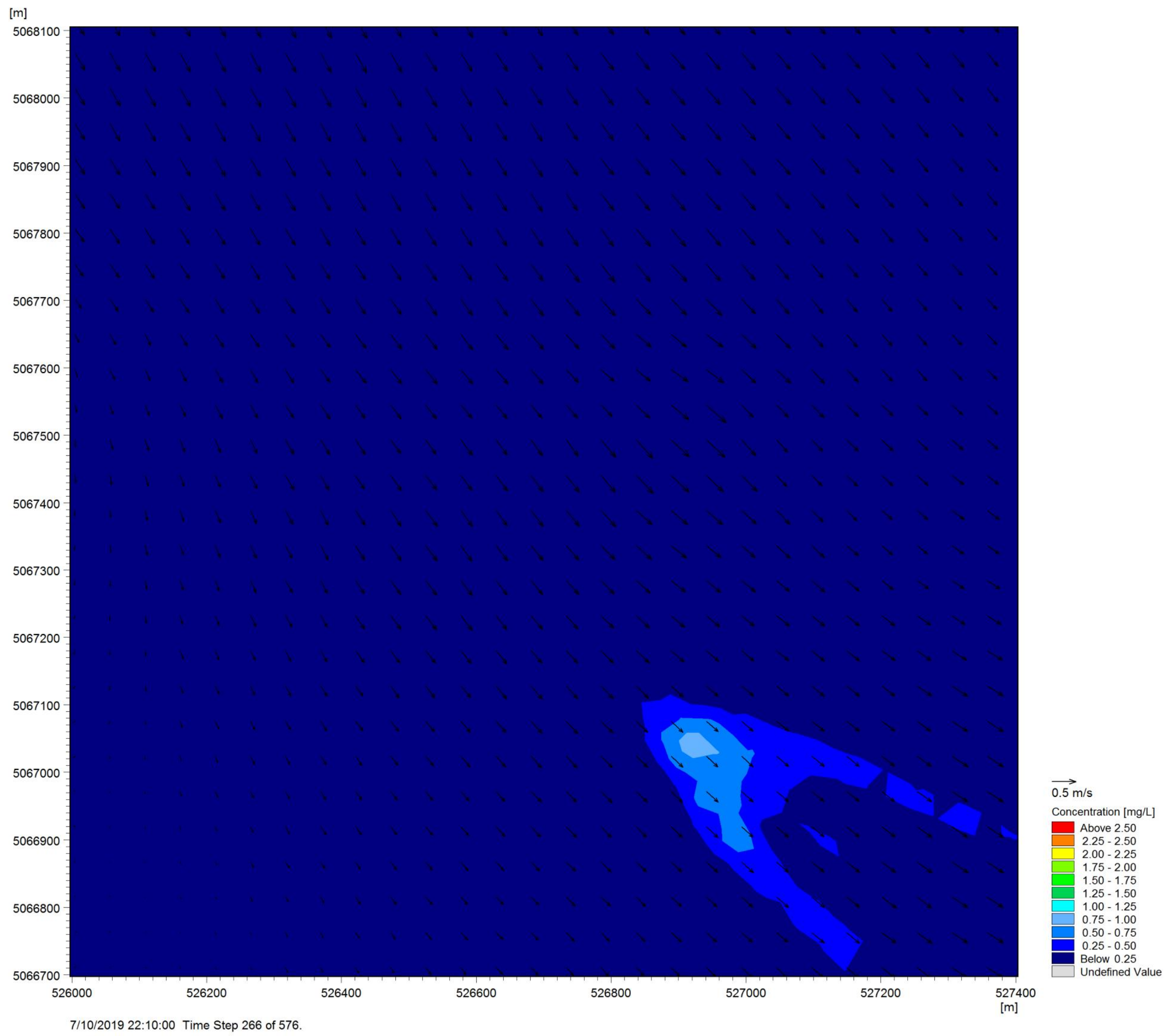

Figure A-3 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 22:10 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

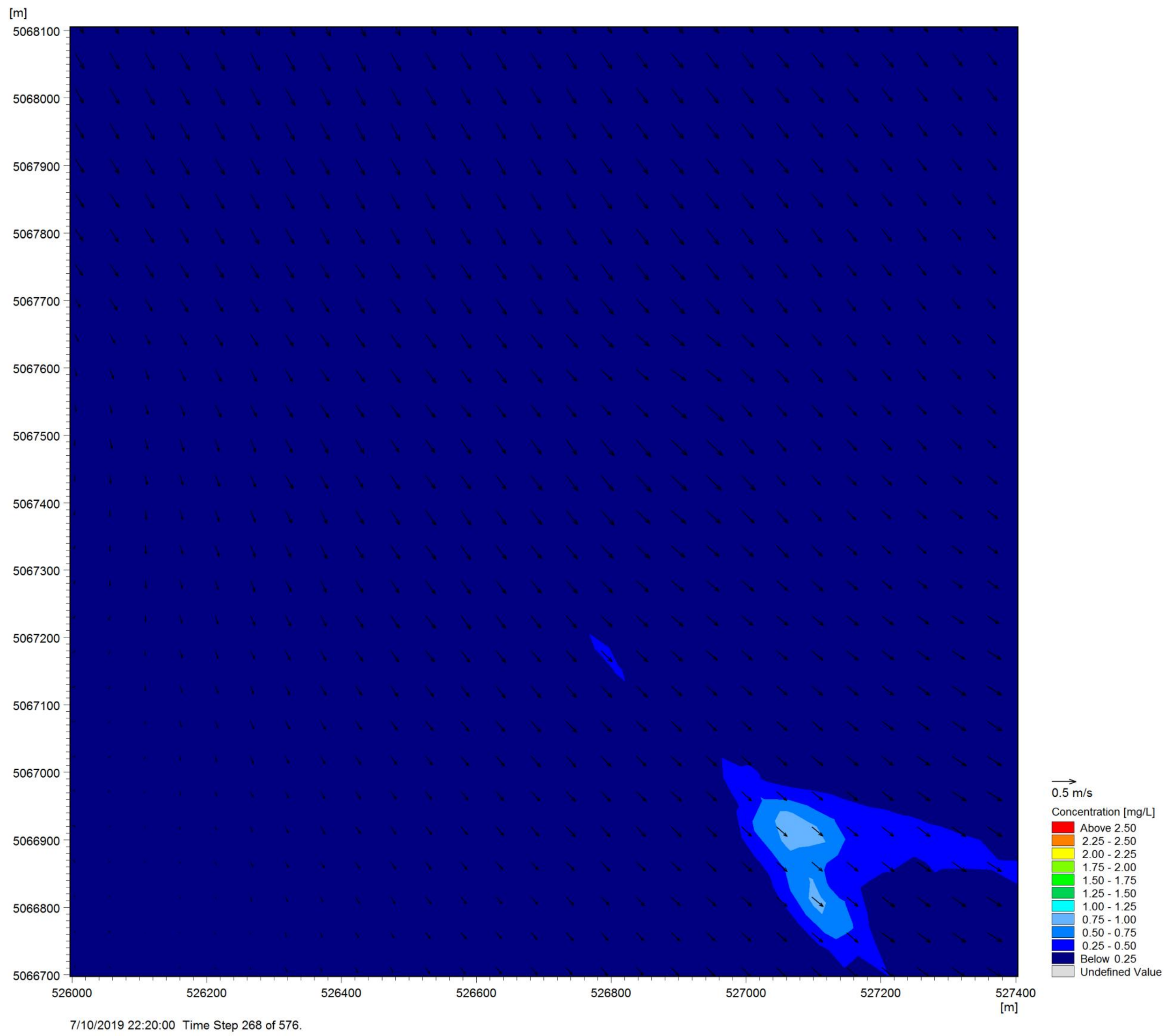

Figure A-4 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 22:20 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

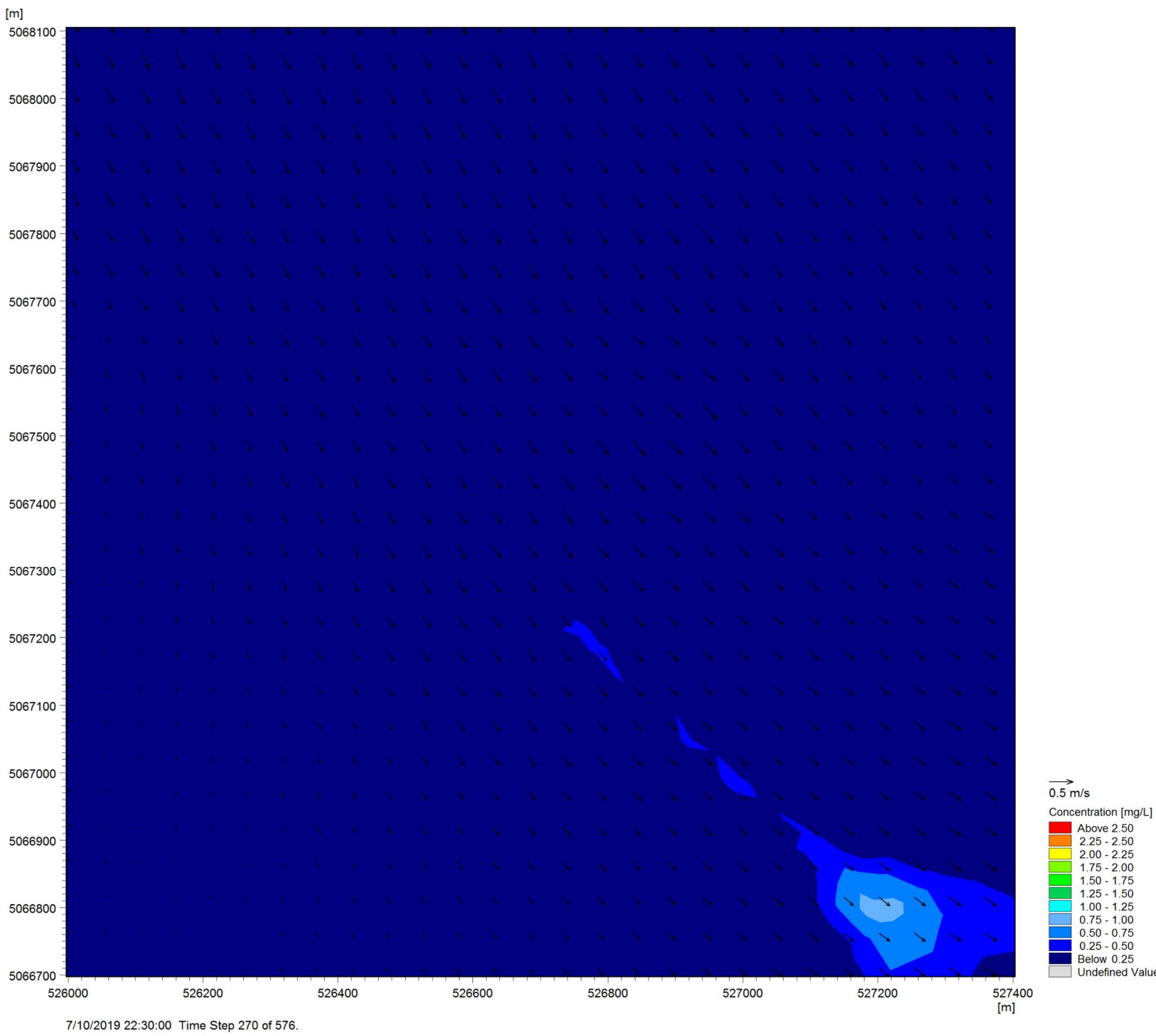

Figure A-5 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 22:30 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

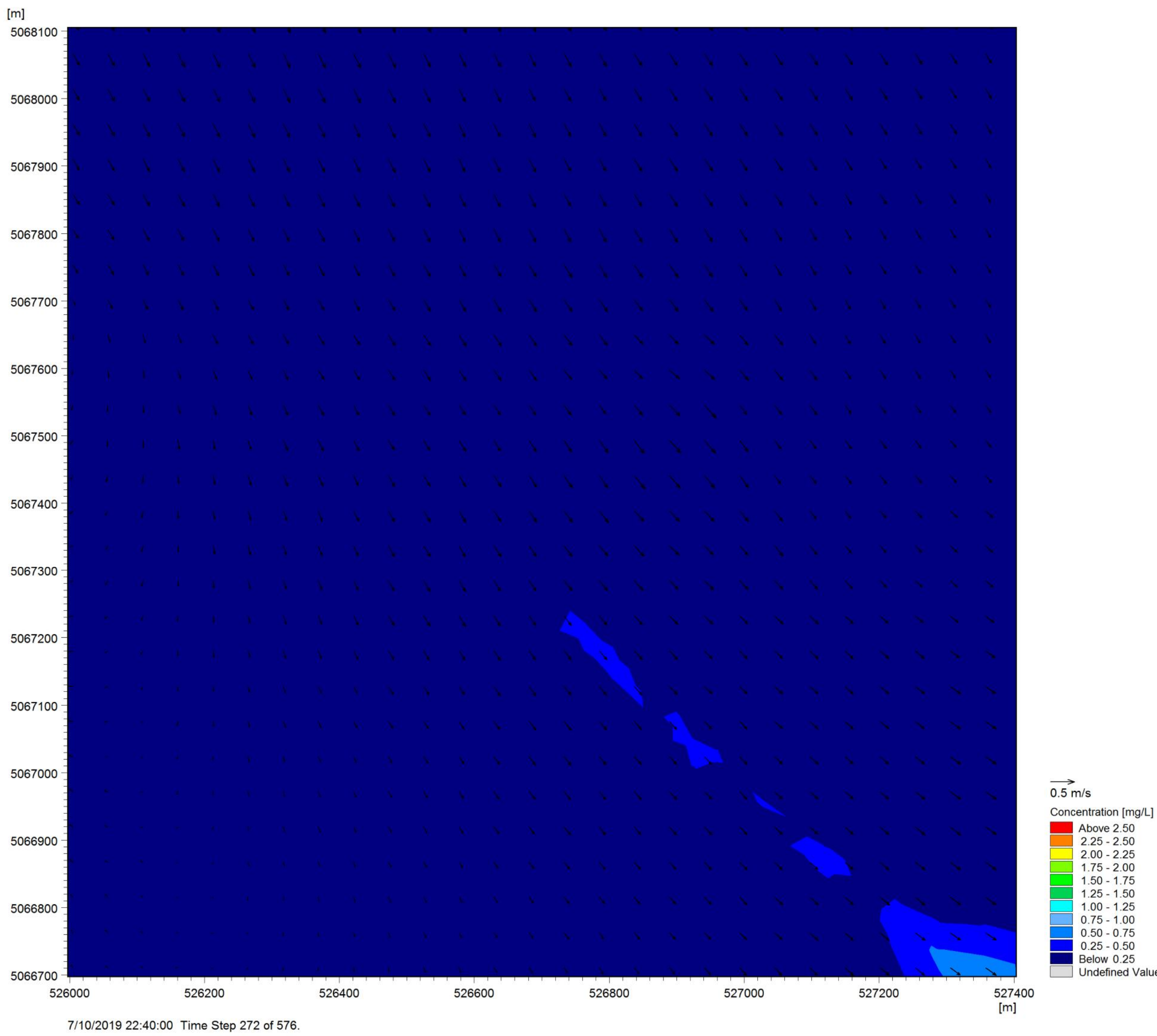

Figure A-6 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 22:40 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

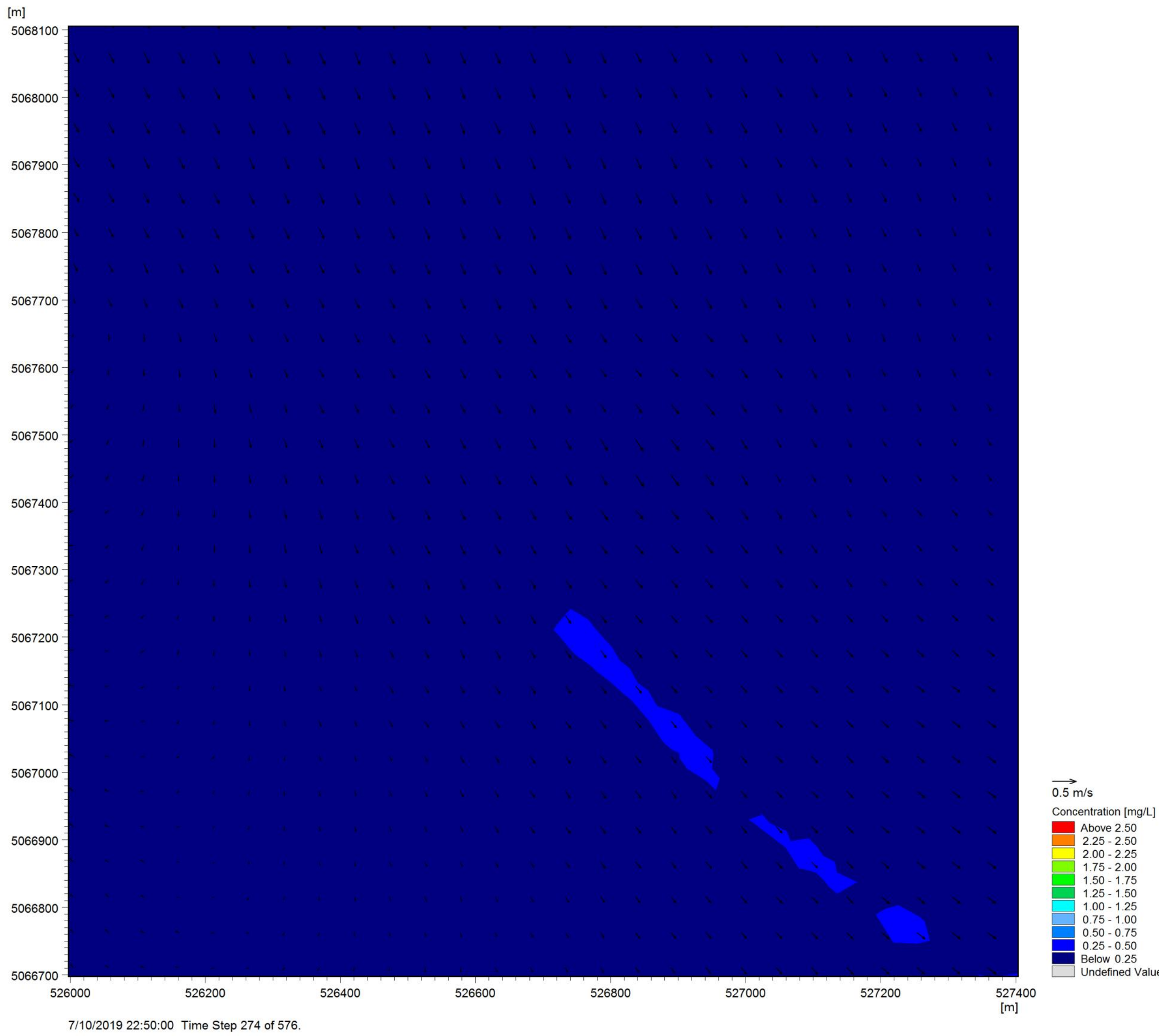

Figure A-7 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 22:50 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

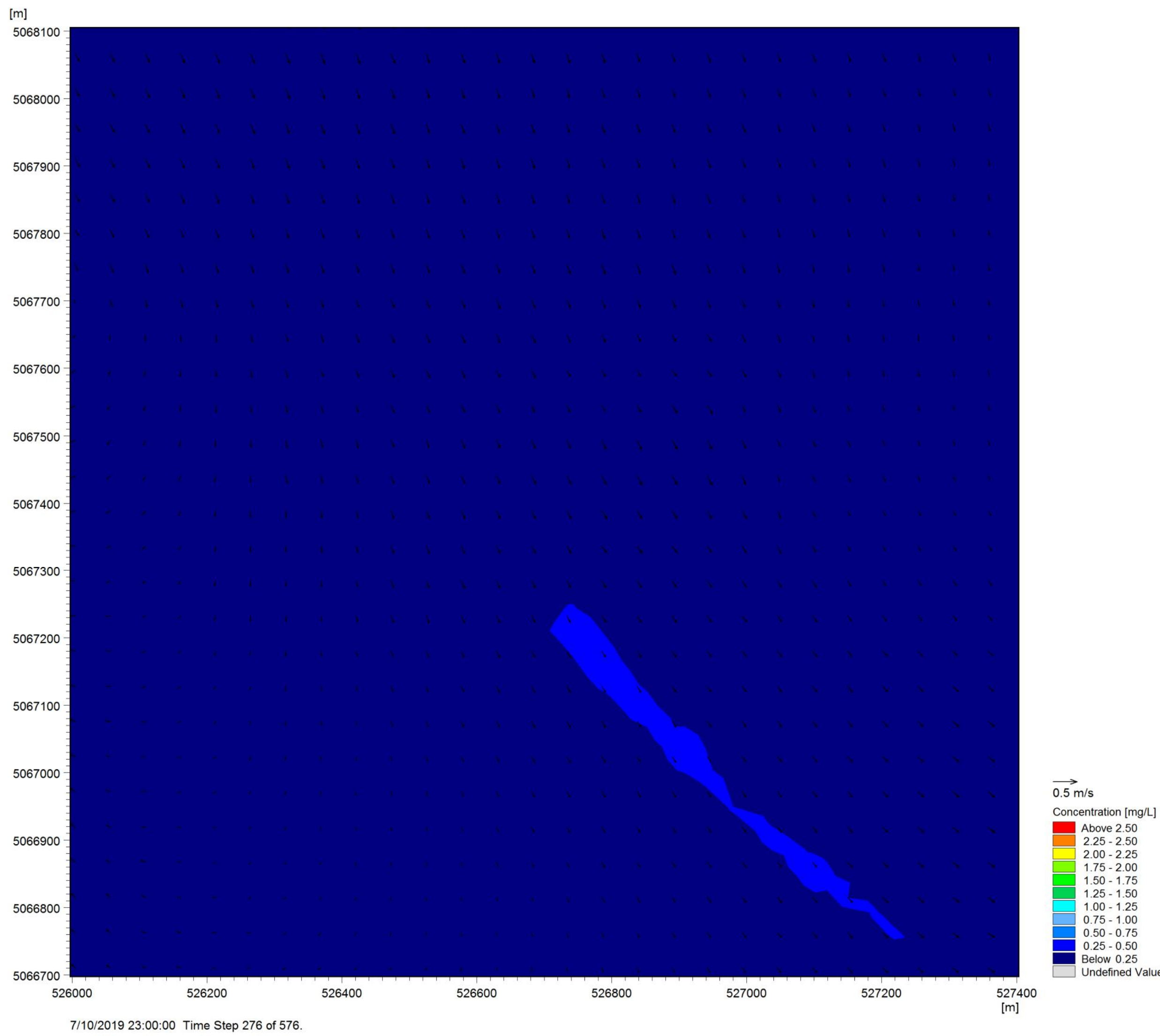

Figure A-8 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 23:00 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

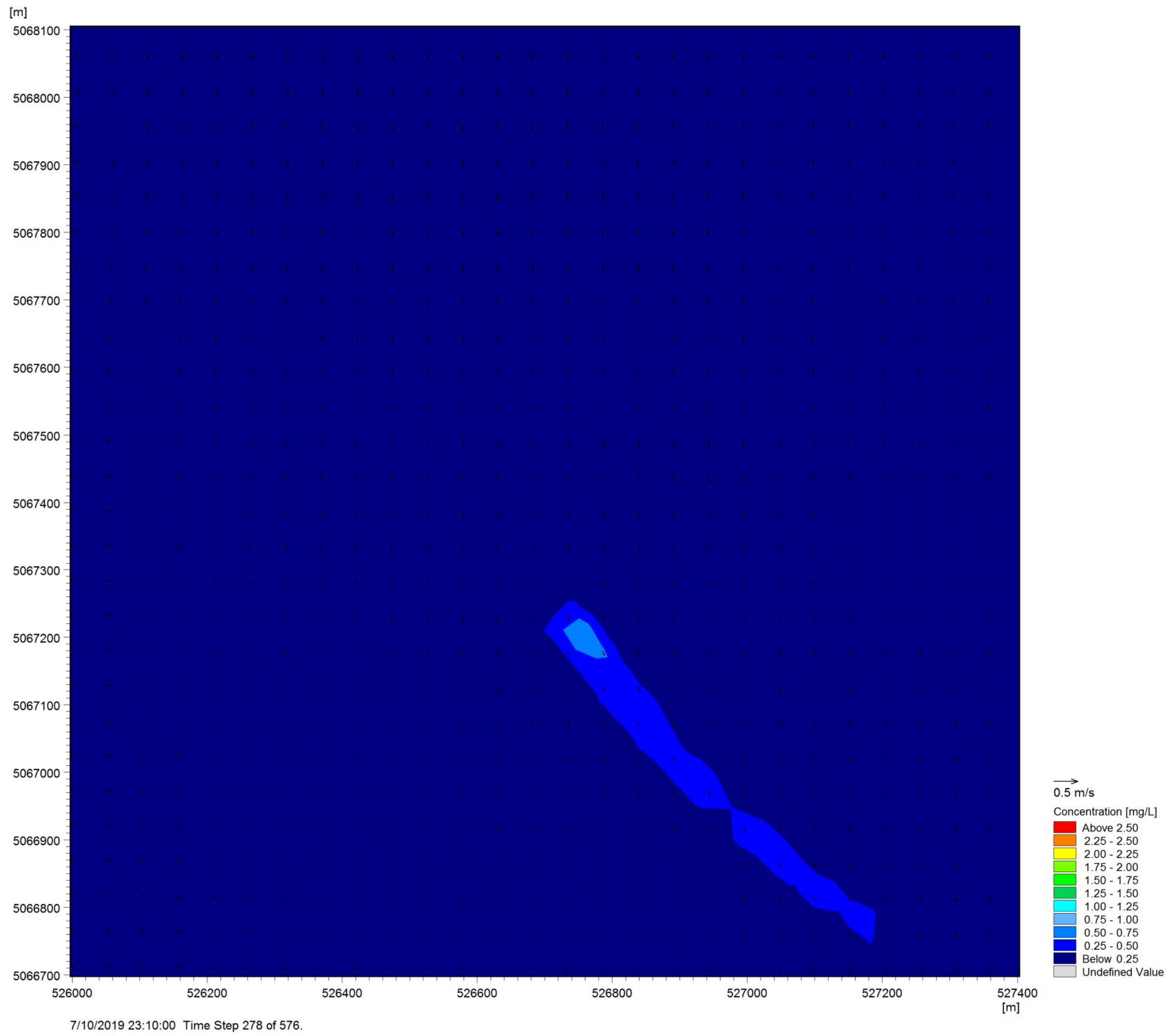

Figure A-9 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 23:10 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

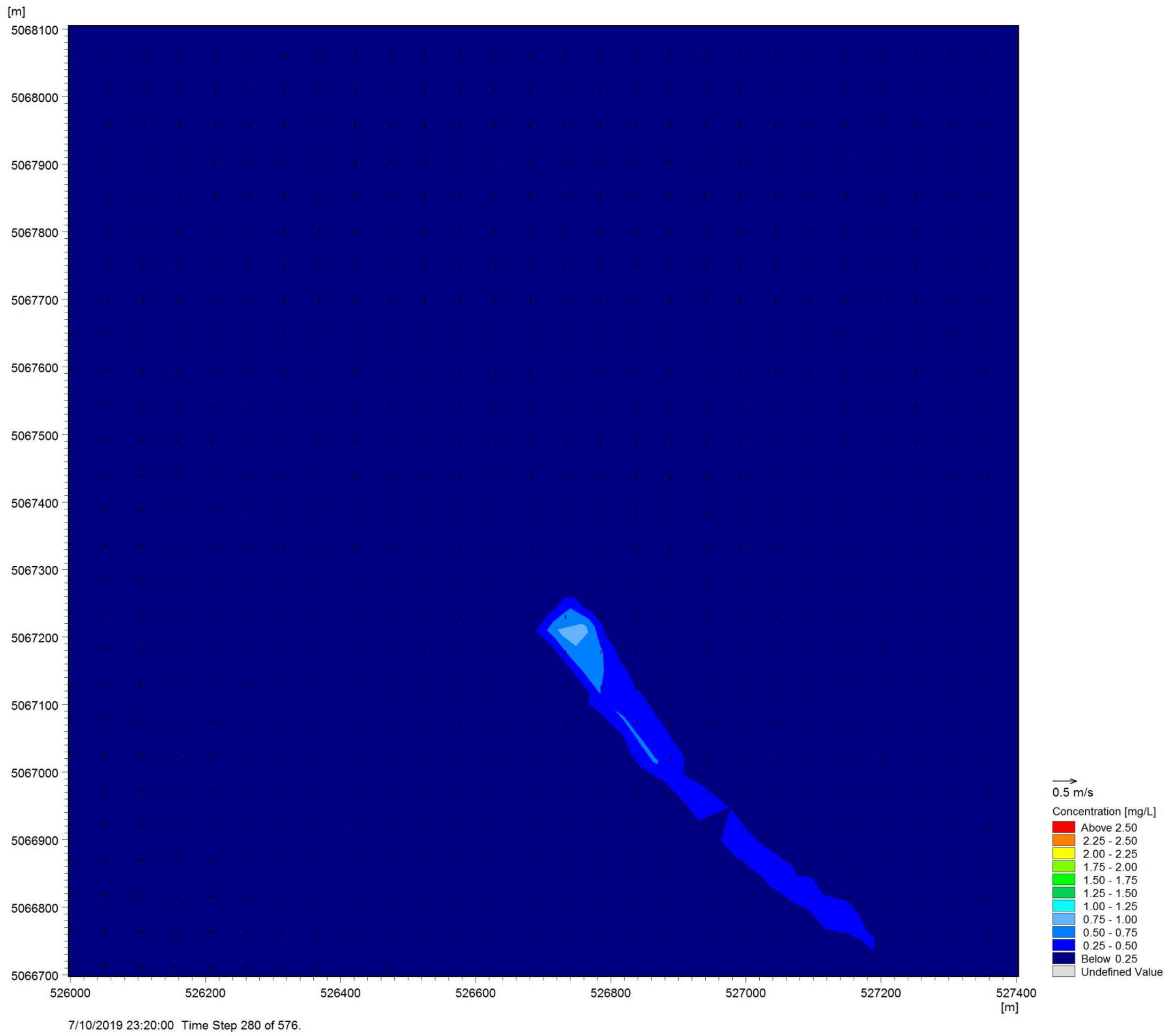

Figure A-10 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 23:20 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

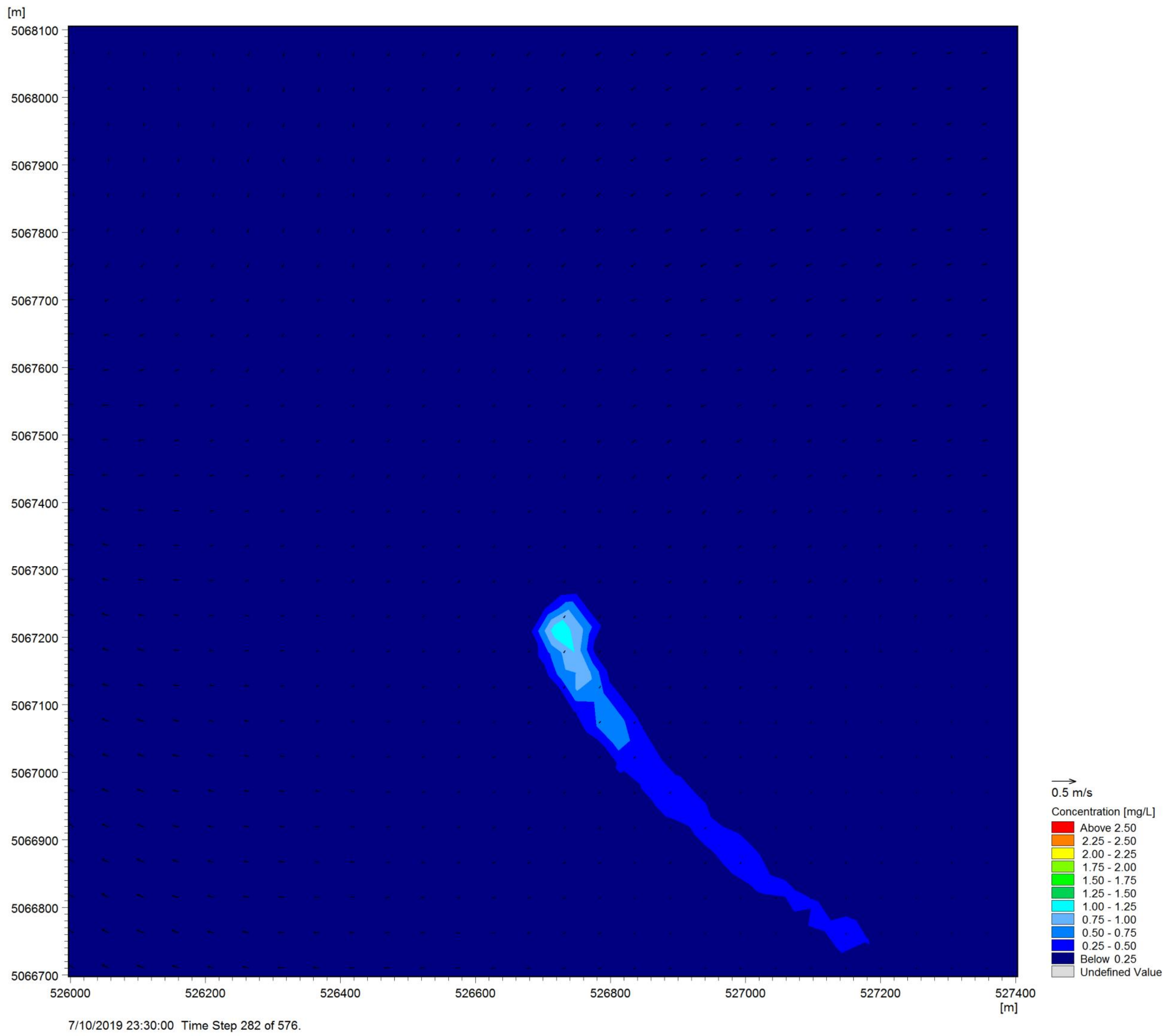

Figure A-11 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 23:30 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

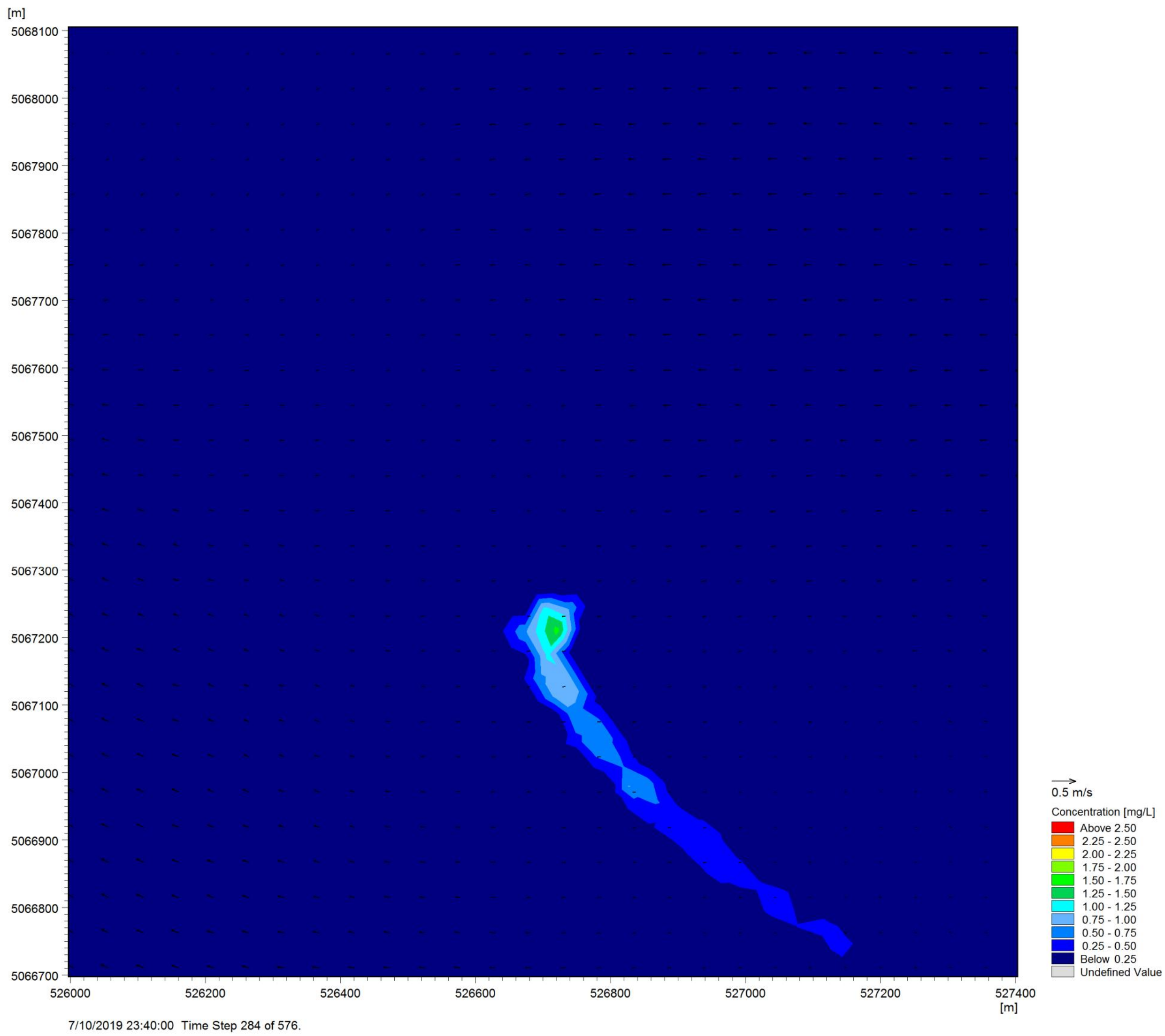

Figure A-12 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 23:40 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

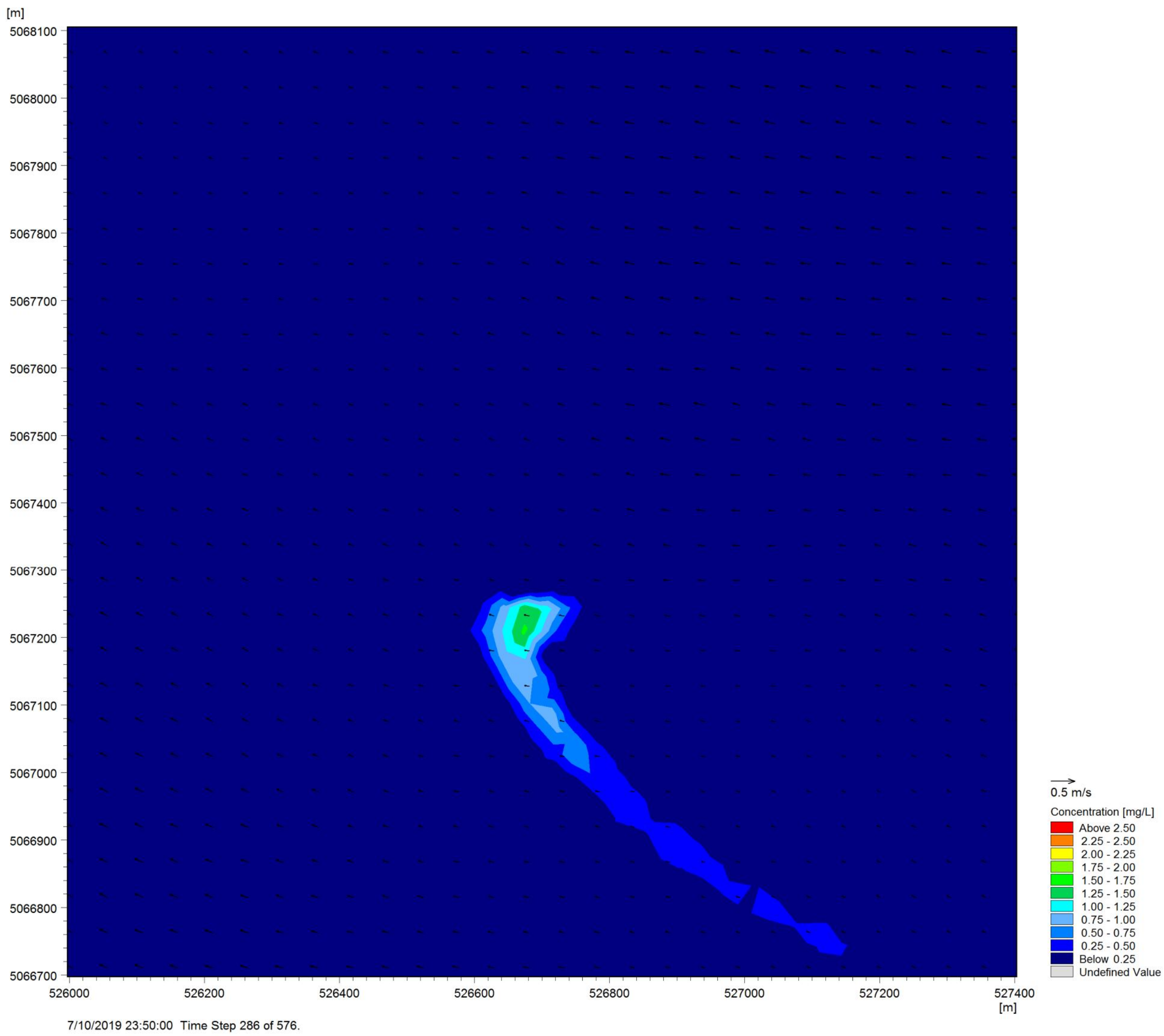

Figure A-13 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 23:50 hr, July 10

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend

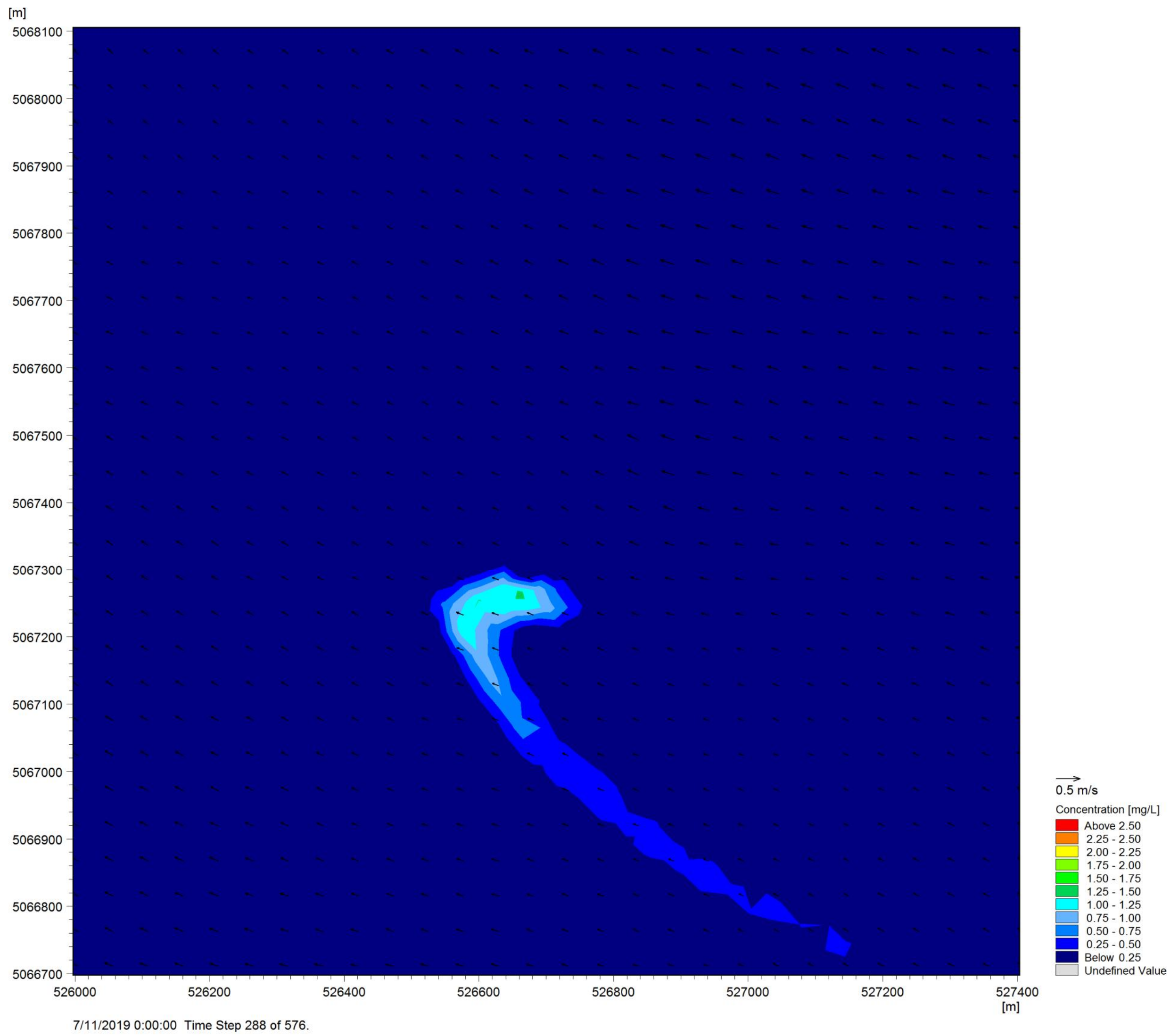

Figure A-14 Simulated Effluent Concentrations for Typical Neap Tide during Slack Low Tide at 00:00 hr, July 11

Note:

- Effluent concentration at outfall discharge 100 mg/L
- Using lower concentration of 2.5 mg/L for the upper bound in the figure legend