3.2. Water Quality

3.2.1. Intensive Survey

(1) Salinity

The survey results of salinity are shown with interpolated values in:

- Figure 3.2.1 for spring tide during rainy season,
- Figure 3.2.2 for neap tide during rainy season,
- Figure 3.2.3 for spring tide during dry season,
- Figure 3.2.4 for neap tide during dry season, and
- Figure 3.2.5 for neap tide during transient season.

1) Rainy Season

Spring Tide

Salinity ranged from 0.12 to 33.94 during the spring tide. The averages of three layers (upper, middle, and lower) were 11.13, 18.01, and 18.12, respectively, and the overall average was 15.63. It is likely that there existed a water mass with a wide range of salinity during the spring tide. One of the characteristics of the study area was that the stratification of salinity was small due to the frequent vertical mixing of river water and seawater.

The area where vertical mixing occurred most frequently was the nearly entire northern half of the estuary. Salinity was remarkably low there, less than 10 at most of the stations, and notably, it was lower than 1 in the upper bay area, exemplifying the enormity of the river water inflow into the Pearl River Estuary.

Another characteristics of the study area was the frontline of the low-salinity water mass moved parallel with the bay mouth, extending from the east to the west. Salinity was higher than 20 in the comparatively deep area near the bay mouth. Salinity stratification was commonly observed in such zones. The stratification was particularly sharp between the upper- and middle layers.

Neap Tide

Salinity ranged widely from 0.11 to 34.19 during the neap tide as was the case during the spring tide. The average values for each layer were 6.26, 15.18, and 19.41, respectively, and the overall average was 13.94. The low salinity at each layer implies that river water had an important effect on the Pearl River Estuary during the neap tide as well as it had during the spring tide.

However, since the tidal influence became weaker during the neap tide, the degree of vertical mixing was reduced. As a result, stratification of salinity expanded in nearly the entire estuary. The upper layer had a water mass with salinity of less than 10 spreading out of the Estuary to the outer sea. On the other hand, a water mass with high salinity entered into the bottom layer from the eastern part of the bay, and intruded into the upper bay area, gradually reducing its salinity level. No stratification was observed in the western shallow zone of the estuary. Salinity was below 1 in the western zone because of the large quantity of the river water inflow in addition to the shallowness. One of the characteristics of this area was that the frontline of the low-salinity water mass moved parallel with the eastern coast of the Estuary, extending from south to north.

2) Dry Season

Spring Tide

Salinity ranged from 0.25 to 32.36 during the spring tide. The average salinities for the three layers were 24.05, 25.64, and 25.15, respectively for the upper, middle, and bottom layers, and the depth-average was 24.92. Horizontally, the salinity values were distinctively higher toward the southeastern part from the northwestern part in the estuary. The western upper bay was dominated by the river-inflow and the eastern part of the bay mouth was under influence of seawater from the outer sea.

P04 had the lowest value in the western zone of the estuary. Generally, stratification was very weak with difference less than 1 between the upper and the bottom layers. In the western zone of the estuary where stratification was comparatively developed, the difference was only 2 to 3.

Neap Tide

Salinity ranged from 0.22 to 32.60 during the neap tide. The averages of each layer were 21.93, 25.21, and 25.99, respectively, and the depth-average was 24.33. The horizontal distribution during the neap tide was somewhat different from that during the spring tide. Horizontally, low values were seen in the zone from the western part of the upper bay to the western part of the estuary mouth, while higher values were observed from the eastern part of the estuary mouth to the eastern coast. The salinity contour lines extended from the north to the south in parallel.

In addition, water mass with comparatively low salinity spread from the western part of the estuary mouth to the outer sea. In this zone, stratification was stronger during the neap tide than during the spring tide. On the other hand, water mass with high salinity intruded toward the upper bay zone from the eastern part of the estuary mouth. P01 and P02 had comparatively high values during the neap tide. It likely that the outer seawater intruded extended into the upper bay through the eastern navigation channel.

(2) pH

1) Rainy Season

Spring Tide

pH ranged from 7.3 to 8.0 during the spring tide. The averages of each layer were uniform at 7.9 without stratification. Horizontally, P01 had a low pH level and the estuary mouth had higher pH levels. Overall pH level of the estuary was lower than that of the representative outer seawater (salinity: 34, pH: 8.2).

Neap Tide

pH ranged from 7.5 to 8.5 during the neap tide. The overall average was 7.9. Where salinity stratification was observed, pH levels were about 8.0. In some areas around the estuary mouth, P19 to P23 in particular, the upper layers had pH levels of over 8.2, somewhat higher than the average. The Chlorophyll-a measurement in the same area indicated that these high pH levels were related to the photosynthesis by microorganisms.

2) Dry Season

Spring and Neap Tide

pH ranged from 7.6 to 8.2 during the spring tide. The averages of each layer were uniform at 8.0 during the spring tide.

During the neap tide, it ranged from 7.7 to 8.1. The averages of each layer were 7.9, 8.0, 7.9, respectively, and the depth-average was 7.9. The values are within the common levels found in the coastal area. Higher pH values were associated with high salinity areas and low pH levels with low salinity areas.

(3) DO

The survey results of DO are shown by interpolation in:

- Figure 3.2.6 for spring tide during rainy season,
- Figure 3.2.7 for neap tide during rainy season,
- Figure 3.2.8 for spring tide during dry season,
- Figure 3.2.9 for neap tide during dry season, and
- Figure 3.2.10 for neap tide during transient season.

1) Rainy Season

DO ranged from 3.1 to 7.4 mg/L during the spring tide. The averages of the three layer were 5.7, 5.2, and 4.6 mg/L, respectively. DO in the upper layer was only slightly higher than in the bottom layer. Horizontally, all the layers at P01 and the bottom layer at P11 had low DO levels while the upper layer near the estuary mouth had high DO levels.

During the neap tide, DO ranged from 1.6 to 10.2 mg/L, a much wider than during the spring tide. The averages of the three layers were, respectively, 6.7, 4.9, and 4.2 mg/L. Vertically, the upper layers had high DO levels and bottom layers low DO levels, thus it was presumed that discontinuous layer of DO was developing widely.

High DO levels were observed in the upper layer near the mouth of the estuary, including some points with over-saturated condition. On the other hand, low DO levels were observed in the bottom layer at P01 and P18. DO stratification was discernible even at P10 located in the comparatively shallow area.

2) Dry Season

During the spring tide, DO ranged from 5.2 to 8.5 mg/L with an overall average of 7.1 mg/L.

During the neap tide, it ranged from 5.7 to 8.2 mg/L and the average was 7.0 mg/L. Over-saturated condition was commonly observed with nearly uniform horizontal and vertical distribution. Slightly lower DO values were observed at P01 and P10.

(4) COD

The survey results of COD are shown by interpolation in:

- Figure 3.2.11 for spring tide during the rainy season,
- Figure 3.2.12 for neap tide during the rainy season,
- Figure 3.2.13 for spring tide during the dry season,
- Figure 3.2.14 for neap tide during the dry season, and
- Figure 3.2.15 for neap tide during the transient season.

The survey results of COD_{JPN} are shown by interpolation in:

- Figure 3.2.16 for spring tide during the rainy season, and
- Figure 3.2.17 for neap tide during the rainy season.

1) Rainy Season

COD

COD ranged from 0.4 to 4.8 mg/L during the spring tide. The averages of the three layer were 1.8, 1.4, and 1.7 mg/L, respectively from the surface to the bottom, with an overall average of 1.6 mg/L. No significant COD stratification was recognized. Horizontally, P10 had the highest COD level and there were some other points with high COD levels spreading from the upper bay zone to the center of the estuary. On the other hand, the points around the estuary mouth had low COD levels especially in the bottom layer at P25.

No difference was observed in the range or the overall average between the neap tide and the spring tide. However, the upper layer had higher average and bottom layer lower average during the neap tide, i.e. the vertical stratification was more significant during the neap tide. As for the horizontal distribution, water mass with high COD level in the upper layer spread into the estuary mouth. At the same time, water mass with low COD level in the bottom layer spread from the estuary mouth to the center. P10 had high COD levels both during the spring tide and the neap tide. It appears that the organic pollution was proceeding most seriously around this area.

The result of correlation analysis between COD and salinity, shown in Figure 5.3.177, reveals a negative correlation between the two items. In addition, areas with low salinity level had a wide range of COD variation and areas with high salinity level had a narrower range of COD. It is likely that the majority of COD originates from the river inflow.

The fact that areas with low salinity had wider COD range implies unstable condition of COD level in the river water. Also, that the areas with high salinity had narrower COD range indicate that the COD distribution in the Pearl River Estuary is greatly governed by the mixing condition of the river water and the sea water. The correlation between COD and salinity at P10, however, was apparently different from the other points. The marine environment around P10 may have a special characteristic.

COD（Japanese Method）

The analysis on COD_{Jpn} (Japanese method) was carried out as well as COD_{Chn} (Chinese method), to compare the state of organic pollution in the Pearl River Estuary with conditions in Japan using Japanese pollution indices. The result of COD_{Jpn} showed similar tendency to that of COD_{Chn}, both vertically and horizontally.

2) Dry Season

During the spring tide, COD_{Jpn} ranged from 0.3 to 2.9 mg/L with an average of 1.0 mg/L Horizontally, P01 and P10 had higher COD_{Jpn} levels, and P18, P20, and P22 had lower COD_{Jpn} levels. Vertical variation was insignificant.

During the neap tide, COD_{Jpn} ranged from 0.2 to 1.6 mg/L with an average of 0.8 mg/L. Horizontal and vertical distribution patterns during the neap tide were similar to that of the spring tide. However, COD_{Jpn} values at P01 and P10 during the neap tide were lower than those during the spring tide. Therefore, the horizontal variation of COD_{Jpn} was smaller during the neap tide than that during the spring tide.

(5) TOC

The survey results of TOC are shown by interpolation in:

- Figure 3.2.18 for spring tide during the rainy season,
- Figure 3.2.19 for neap tide during the rainy season,
- Figure 3.2.20 for spring tide during the dry season,
- Figure 3.2.21 for neap tide during the dry season, and
- Figure 3.2.22 for neap tide during the transient season.

1) Rainy Season

TOC ranged from 2.6 to 8.3 mg/L with an overall average of 4.4 mg/L during the spring tide. During the neap tide, it ranged from 2.1 to 6.8 mg/L and the overall average was 4.2 mg/L. P25 had higher TOC levels during both the tides. Except for this point, no specific trend was discernible in the TOC distribution patterns.

2) Dry Season

During the spring tide, TOC ranged from 2.6 to 6.9 mg/L with the average of 3.5 mg/L. During the neap tide, it ranged from 2.0 to 8.7 mg/L with the average of 3.9 mg/L. Higher than average values were observed at P03 and P07 during the spring tide and at P03 during the neap tide.

(6) BOD_5

The survey results of BOD_5 are shown with interpolated values in,

- Figure 3.2.23 for spring tide during the rainy season,
- Figure 3.2.24 for neap tide during the rainy season,
- Figure 3.2.25 for spring tide during the dry season,
- Figure 3.2.26 for neap tide during the dry season, and
- Figure 3.2.27 for neap tide during the transient season.

1) Rainy Season

During the spring tide, BOD_5 ranged from 0.1 to 2.2 mg/L. The averages for the three layers were 0.9, 0.8, and 0.7mg/L, respectively for the upper, the middle, and the bottom layers. The overall average was 0.8 mg/L. BOD_5 levels were less than 1 mg/L at most points except for P10 where a somewhat higher BOD_5 level was observed.

During the neap tide, BOD_5 ranged from 0.1 to 3.5 mg/L. The averages for the three layers were 1.2, 0.8, and 0.7 mg/L, respectively. The overall average was 0.9 mg/L. BOD_5 levels were slightly higher in the upper layers than in the lower layers. Horizontally, the upper bay zone and P10 had higher levels.

BOD_5 is one of the indices for organic pollution similar to COD and TOC. BOD_5 distribution pattern was similar to that of COD. However, BOD_5 distribution pattern was not as distinctive as that of the COD pattern resulting from the low BOD_5 levels on the whole.

2) Dry Season

During the spring tide, BOD_5 ranged from 0.1 to 1.9 mg/L and the average was 0.6 mg/L. During the neap tide, it ranged from 0.1 to 1.3 mg/L and the average was 0.5 mg/L. Generally, BOD_5 levels were very low.

Horizontally, P01 and P10 had higher than average values. This trend was also observed in the COD distribution pattern. On the other hand, no particular trend in horizontal distribution was observed during the neap tide.

(6) SS

The survey results of SS are shown by interpolation in:

- Figure 3.2.28 for spring tide during the rainy season,
- Figure 3.2.29 for neap tide during the rainy season,
- Figure 3.2.30 for spring tide during the dry season,
- Figure 3.2.31 for neap tide during the dry season, and
- Figure 3.2.32 for neap tide during the transient season.

1) Rainy Season

During the spring tide SS ranged widely from 2 to 259 mg/L. The averages in the three layers were 47, 52, and 83, respectively, and the overall average was 61 mg/L. The upper layer had consistently lower SS levels than the lower layers. Majority of the points and layers had SS levels less than 10 mg/L.

Areas of high SS levels in all the layers spread from the center to the upper bay zone of the estuary. In the middle and the bottom layers of P06, conspicuously high SS levels, over 200 mg/L, were recorded. High SS levels were also observed in the bottom layers of P17 and P19 located in the western part of the estuary. Low SS levels were observed in the eastern part and also in the outer zone of the estuary.

During the neap tide, SS ranged from 1 to 137 mg/L. The averages of the three layers were 22, 14, and 29 mg/L with an overall average of 22 mg/L. The range of SS during the neap tide was about 1/2 and the overall average was 1/3 of the values observed during the spring tide.

The high SS levels observed during the spring tide diminished to about 10 mg/L, a representative level of the outer sea, nearly homogeneously as the tide shifted to the neap phase.

2) Dry Season

During the spring tide, SS ranged widely from 2 mg/L to 335 mg/L. The averages of the three layers were 43, 46, and 60 mg/L, with an overall average of 50 mg/L. The level in the bottom layer was slightly higher than that in the upper layers. Horizontally, higher than average levels were observed at P01 and P19. Vertically, the SS stratification was not distinctive, except that the bottom layers at P01 and P11, had higher values than in the upper layer

During the neap tide, SS ranged from 5 to 144 mg/L. The averages of the three layers were 31, 27, and 38 mg/L. Horizontally, high values were found in the western part of the estuary mouth. Unusually high values were not found elsewhere.

The unique feature of the SS distribution pattern was that high values were detected in the bottom layer resulting from the re-suspension process induced by the strong tidal currents. This phenomenon was observed typically at P10 during the spring tide. At P19, as the water depth became very shallow during the ebb phase of the spring tide, the re-suspended the bottom sediment reached to the water surface exemplified by homogeneously high SS values throughout the depth.

(7) Heavy Metals (Hg, Cu, Pb, Zn, As, Cd)

The survey results of *Hg* are shown by interpolation in:

- Figure 3.2.33 for spring tide during the rainy season,
- Figure 3.2.34 for neap tide during the rainy season,
- Figure 3.2.35 for spring tide during the dry season,
- Figure 3.2.36 for neap tide during the dry season, and
- Figure 3.2.37 for neap tide during the transient season.

The survey results of *Cu* are shown by interpolation in:

- Figure 3.2.38 for spring tide during the rainy season,
- Figure 3.2.39 for neap tide during the rainy season,
- Figure 3.2.40 for spring tide during the dry season,
- Figure 3.2.41 for neap tide during the dry season, and
- Figure 3.2.42 for neap tide during the transient season.

The survey results of *Pb* are shown by interpolation in:

- Figure 3.2.43 for spring tide during the rainy season,
- Figure 3.2.44 for neap tide during the rainy season,
- Figure 3.2.45 for spring tide during the dry season,
- Figure 3.2.46 for neap tide during the dry season, and
- Figure 3.2.47 for neap tide during the transient season.

The survey results of *Zn* are shown by interpolation in:

- Figure 3.2.48 for spring tide during the rainy season,
- Figure 3.2.49 for neap tide during the rainy season,
- Figure 3.2.50 for spring tide during the dry season,
- Figure 3.2.51 for neap tide during the dry season, and
- Figure 3.2.52 for neap tide during the transient season.

The survey results of *As* are shown by interpolation in:

- Figure 3.2.53 for spring tide during the rainy season,
- Figure 3.2.54 for neap tide during the rainy season,
- Figure 3.2.55 for spring tide during the dry season,
- Figure 3.2.56 for neap tide during the dry season, and
- Figure 3.2.57 for neap tide during the transient season.

The survey results of *Cd* are shown by interpolation in:

- Figure 3.2.58 for spring tide during the rainy season,
- Figure 3.2.59 for neap tide during the rainy season,
- Figure 3.2.60 for spring tide during the dry season,
- Figure 3.2.61 for neap tide during the dry season, and
- Figure 3.2.62 for neap tide during the transient season.

1) Rainy Season

The five heavy metals monitored in the present study are universally present in all water bodies on the earth, albeit in minute quantity. The heavy metal concentration levels found in the present survey are within the normal levels encountered in the natural environment and do not raise concerns for human health directly. Han, et al conducted a survey on heavy metals in the Pearl River Estuary from 1976 to 1977. They pointed out the seasonal changes in heavy metal concentrations and also the irregularity of concentrations in the river water. The concentration levels found in the present study were nearly the same or slightly lower than those reported by Han, et al. Some heavy metals had characteristic distribution patterns; however, it was not clear whether these trends were due to a rainy season.

Hg ranged from 0.004 to 0.077 μg/L during the spring tide, and 0.007 to 0.044 μg/L during the neap tide. The overall averages were 0.026 μg/L and 0.020 μg/L. No significant differences in the range or the averages were recognized between the spring- and the neap tide. No specific trend in distribution pattern was observed; however, slightly high levels were found in the middle and the bottom layers of P02 during the spring tide.

Cu ranged from 0.3 to 3.6 μg/L during the spring tide, and during the neap tide 0.2 to 3.0 μg/L. The overall averages were respectively 1.8 μg/L and 1.4 μg/L. No significant differences in the range or the averages were recognized between the spring- and the neap tide. During the spring tide, *Cu* levels were often higher than the average in the northern half of the estuary, while they were lower in the southern half. No specific trend in distribution pattern was recognized during the neap tide.

Pb ranged from 0.03 to 4.90 μg/L during the spring tide, and during the neap tide from 0.17 to 4.21 μg/L. The overall averages were respectively 0.97 μg/L and 1.34 μg/L. During the spring tide, all the layers at P04 and the bottom layer at P10 had higher *Pb* levels than the neighboring points. No trend in distribution pattern was recognized during the neap tide.

Zn ranged from 2.9 to 59.3 μg/L during the spring tide, and during the neap tide from 3.5 to 38.3 μg/L. The overall averages were respectively 31.0 μg/L and 14.7 μg/L,. The ranges during the spring tide were wider than that during the neap tide, and also the overall average of the spring tide was about twice as high as that of the neap tide.

As ranged from 1.0 to 5.2 μg/L during the spring tide, and during the neap tide from 1.1 to 4.5 μg/L. The overall averages were respectively 2.2 μg/L and 2.4 μg/L. No difference in the range or the overall average was recognized between the spring- and the neap tide. No specific trend in distribution pattern was recognized during both the tides.

Cd ranged from 0.01 to 0.51 μ g/L during the spring tide, and during the neap tide from 0.06 to 0.46 μ g/L. The overall averages were respectively 0.21 μ g/L and 0.20 μ g/L. No difference in the range or the overall average was recognized between the spring- and the neap tide. No specific trend in distribution pattern was recognized during both the tides.

2) Dry Season

Hg ranged from 0.005 to 0.038 μ g/L during the spring tide, and during the neap tide 0.005 to 0.048 μ g/L. The averages were respectively 0.019 μ g/L and 0.025 μ g/L. *Hg* levels were low generally. No specific trend was observed in the distribution pattern.

Cu ranged from 0.2 to 2.7 μ g/L During the spring tide, and during the neap tide, 0.2 to 5.0 μ g/L. The averages were respectively 0.7 μ g/L and 2.2 μ g/L. The levels were higher during the neap tide than during the spring tide. P10, P04, P05, and P07 had comparatively high values.

Zn ranged from 16.1 to 54.0 μ g/L during the spring tide, and during the neap tide from 1.6 to 39.0 μ g/L. The averages were respectively 33.8 μ g/L and 21.8 μ g/L. The levels were generally higher during the spring tide than during the neap tide.

Pb ranged from 0.20 to 3.61 μ g/L during the spring tide, and during the neap tide from 0.25 to 4.30 μ g/L. The averages were respectively, 1.24 μ g/L and 1.81 μ g/L. At P06, P16, and P21, the levels were slightly higher during the neap tide than during the spring tide.

Cd ranged from 0.03 to 0.94 μ g/L during the spring tide, and during the neap tide from 0.06 to 0.76 μ g/L. The averages were 0.30 μ g/L and 0.31 μ g/L, respectively. Horizontally, slightly higher values were recorded at the points in the western side of the estuary mouth.

As ranged from 2.0 to 9.8 μ g/L with an average of 3.7mg/L during the spring tide. P01, P11, P12, P19, and P23 had over 5 μ g/L. No distinct distribution pattern was recognized. During the neap tide, on the other hand, *As* ranged from 1.7 to 6.8 μ g/L with the average of 3.2 μ g/L. P01, P04, P17, P21, P24, and P27, located in the western part of the estuary, had consistently over 5 μ g/L. Horizontally, higher values were seen in the western part of the estuary and lower values in the eastern part.

(8) Secci Disk Visibility

The survey results of Secci disk visibility are shown by interpolation in:

- Figure 3.2.63 (left) for the rainy season,
- Figure 3.2.64 (left) for the dry season, and

- Figure 3.2.65 (left) for the transient season.

(9) Oil Contents

The survey results of oil contents are shown by interpolation in:

- Figure 3.2.63 (right) for the rainy season,
- Figure 3.2.64 (right) for the dry season, and
- Figure 3.2.65 (right) for the transient season.

1) Rainy Season

Oil contents ranged from 0.01 to 0.08 mg/L during the spring tide and from 0.01 to 0.07mg/L during the neap tide. The overall average were 0.02 mg/L and 0.03 mg/L, respectively. No difference in range or overall average was recognized between the spring- and the neap tide. Higher levels of oil contents were obtained at P10 during the spring tide.

The measurement of oil contents does not focus on the petroleum contamination only. From its feature of analytical methodology, oil contents, thus measured, were rather considered as indices of organic matters. Therefore, it should be noted that the high level of oil content observed at P10 was not directly linked to the petroleum contamination.

2) Dry Season

Oil contents ranged from 0.02 to 0.08 mg/L during the spring tide and from 0.02 to 0.07mg/L during the neap tide. The averages were 0.03 mg/L and 0.04 mg/L, respectively. Concentrations observed were generally low. Horizontally, slightly higher values were observed around the upper bay and in Shenzhen bay, while lower values were recorded near the estuary mouth.

(10) T-N

The survey results of *T-N* are shown by interpolation in:

- Figure 3.2.66 for spring tide during the rainy season,
- Figure 3.2.67 for neap tide during the rainy season,
- Figure 3.2.68 for spring tide during the dry season,
- Figure 3.2.69 for neap tide during the dry season, and
- Figure 3.2.70 for neap tide during the transient season.

1) Rainy Season

During the spring tide, *T-N* ranged from 0.40 to 4.66 mg/L. The maximum *T-N* level was observed in the middle layer at P18 (significantly high for unknown reason), and the minimum level in the bottom layer at P25. Averages of each layers were respectively 1.52, 1.58, and 1.42 mg/L, and overall average was 1.50 mg/L. Horizontally, high *T-N* levels were observed in the upper bay area, gradually turning lower toward the estuary mouth. Vertically, no specific trend or concentration gradient was recognized, probably because of the enhanced vertical mixing. *T-N* consists of organic nitrogen and inorganic nitrogen, and inorganic nitrogen consists of ammonia nitrogen (NH_4-N), nitrite nitrogen (NO_2-N), and nitrate nitrogen (NO_3-N). During the spring tide, the ratio of inorganic nitrogen in *T-N* ranged widely from 9 to 97%; however, the average (70%) indicated that most of the *T-N* was inorganic.

During the neap tide, *T-N* ranged from 0.26 to 3.18 mg/L. The maximum *T-N* level was recorded in the upper layer at P03 and the minimum level in the bottom layer at P22. Averages of each layers were respectively 2.13, 1.67, and 1.47 mg/L and overall average was 1.76 mg/L. Horizontally, high *T-N* levels were observed in the upper bay area and also in the western shallow zone. Low *T-N* levels were observed in the bottom layers near the eastern part of the estuary mouth. Vertically, *T-N* concentration gradients were more discernible than during the spring tide.

2) Dry Season

During the spring tide, *T-N* ranged from 0.18 to 2.53 mg/L and the average was 0.85 mg/L. Horizontally, high *T-N* levels were observed at P09 and P10 in and near Shenzhen bay. The *T-N* levels gradually lowered toward the estuary mouth. P20 and P22 had particularly low values. Vertically, no particular trend was recognized.

During the neap tide, *T-N* ranged from 0.24 to 1.61 mg/L and the average was 0.89 mg/L. Horizontally, zone of high *T-N* levels spread widely from the upper bay to the western part of the estuary. Low *T-N* levels were observed at P18, P20, and P22 near the eastern part of the estuary mouth. The values during the neap tide were lower than those during the spring tide in and near the Shenzhen bay. Vertically, no particular trend was recognized.

(11) NH_3-N

The survey results of NH_3-N are shown by interpolation in:

- Figure 3.2.71 for spring tide during the rainy season,
- Figure 3.2.72 for neap tide during the rainy season,
- Figure 3.2.73 for spring tide during the dry season,
- Figure 3.2.74 for neap tide during the dry season, and
- Figure 3.2.75 for neap tide during the transient season.

1) Rainy Season

During the spring tide, NH_3-N ranged from 0.01 to 0.09 mg/L. Averages of each layers were 0.03, 0.02, and 0.03 mg/L, respectively, and overall average was 0.03 mg/L. No significant difference was recognized among the three layers except in the bottom layers of P09, P10, and P12 where low NH_3-N levels were recorded.

During the neap tide, NH_3-N ranged from 0.00 to 0.25 mg/L. Averages of each layers were uniform at 0.04 mg/L. Horizontally, P01, P09, and P10 had higher than average NH_3-N levels, especially in the bottom layer at P10.

While NH_3-N is one of the indices of organic pollution, it plays an important role in the health of marine biota. Organic pollution appears to be serious at and around P10.

2) Dry Season

During the spring tide, NH_3-N ranged from 0.01 to 0.19 mg/L and the average was 0.06 mg/L. Horizontally, higher than average values were observed in the northern part of the estuary, and lower values in the southern part. The water mass with high salinity, near the estuary mouth, had particularly low NH_3-N concentration. Vertically, concentrations were nearly uniform.

During the neap tide, NH_3-N ranged from 0.01 to 0.16 mg/L and the average was 0.07 mg/L. Horizontally, higher than average values were recorded in and around the Shenzhen bay (P09, P10, and P12) as well as off the western coast of the central part of the estuary (P04, P07, and P14). The high salinity water mass near the estuary mouth as was the case during the spring tide, had low NH_3-N concentrations. No vertical difference was recognized.

The NH_3-N to T-N ratio was not very high. The ratio ranged from 5 to 15 % during the spring tide and 5 to 25 % during the neap tide. Most of the monitoring points had ratios less than 10%. Where NH_3-N level was high, the NH_3-N to T-N ratio was also high.

(12) NO_2-N

The survey results of NO_2-N are shown by interpolation in:

- Figure 3.2.76 for spring tide during the rainy season,
- Figure 3.2.77 for neap tide during the rainy season,
- Figure 3.2.78 for spring tide during the dry season,
- Figure 3.2.79 for neap tide during the dry season, and
- Figure 3.2.80 for neap tide during the transient season.

1) Rainy Season

During the spring tide, NO_2-N ranged from 0.01 to 0.15 mg/L with the overall average of 0.06 mg/L. During the neap tide, it ranged from 0.02 to 0.33 mg/L with the overall average of 0.07 mg/L. The pattern of NO_2-N distribution was similar to that of NH_3-N, i.e., NO_2-N levels were high in the upper bay, and in and around Shenzhen Bay.

2) Dry Season

During the spring tide, NO_2-N ranged from 0.02 to 0.17 mg/L with the average of 0.06 mg/L. Horizontally, higher than average values were observed at P01 and P02 near the estuary mouth, and at P09 and P10 in Shenzhen bay. Lower values were observed near the estuary mouth. Little vertical difference was recognized.

During the neap tide, NO_2-N ranged from 0.00 to 0.20 mg/L with the average of 0.08 mg/L. Horizontally, the distribution pattern during the neap tide was similar to that during the spring tide. Vertically, NO_2-N levels gradually increased from the bottom to the upper layer in the upper bay area.

The NO_2-N to T-N ratio was not very high. The ratio ranged from 2 to 14 % during the spring tide, and from 2 to 29 % during the neap tide. Most of the monitoring points had less than 10 %. Both the NO_2-N to T-N and the NH_3-N to T-N ratios were high where NO_2-N levels were high.

(13) NO_3-N

The survey results of NO_3-N are shown by interpolation in:

- Figure 3.2.81 for spring tide during the rainy season,
- Figure 3.2.82 for neap tide during the rainy season,
- Figure 3.2.83 for spring tide during the dry season,
- Figure 3.2.84 for neap tide during the dry season, and
- Figure 3.2.85 for neap tide during the transient season.

1) Rainy Season

During the spring tide, NO_3-N ranged from 0.30 to 1.63 mg/L. The averages for the three layers were 1.04, 0.87, and 0.84 mg/L respectively from the upper to the bottom layer with the overall average of 0.92 mg/L. The NO_3-N to T-N ratio ranged from 8 to 98%, with the average of 63%. Horizontally, higher than average NO_3-N levels were observed in the upper bay area and lower levels around the estuary mouth. This was especially conspicuous in the upper layer. The middle and the bottom layers, on the whole, had lower NO_3-N levels than the upper layer, with the lowest levels occurring in the eastern zone of the estuary mouth.

During the neap tide, NO_3-N ranged from 0.07 to 1.67 mg/L. The averages of each layers were 1.22, 0.88, and 0.77 mg/L, and the overall average was 0.98 mg/L. The NO_3-N to T-N ratio ranged from 19 to 83%, with the average of 53%. Compared to the case during the spring tide, higher NO_3-N levels were found near the estuary mouth and lower levels occurred in the upper bay zone. However, the upper layer as a whole was nearly uniform. The middle layer had similar trend, only slightly lower than the levels found in the upper layer. The lower layer had lower levels near the eastern part of the estuary mouth as with the case during the spring tide. It was also noteworthy that P10 had lower NO_3-N levels than at the surrounding points in all the layers, with particularly low levels found in the upper layer (nearly the same level found in the eastern part of the estuary mouth). As in the case of COD, P10 appears to be representing a quite different environment from any other areas in the estuary.

2) Dry Season

During the spring tide, NO_3-N ranged from 0.08 to 0.78 mg/L and the average was 0.37 mg/L. Horizontally, the levels were high in the upper bay to the western coastal area, and low in the eastern part of the estuary mouth. The differences among the layers were small.

During the neap tide, NO_3-N ranged from 0.08 to 0.87 mg/L and the average was 0.33 mg/L. Horizontally, the distribution pattern during the neap tide was similar to that during the spring tide. The water mass with low NO_3-N levels spread from the eastern part of the estuary mouth to the upper bay. The differences among the layer were also small.

(14) T-P

The survey results of T-P are shown by interpolation in:

- Figure 3.2.86 for spring tide during the rainy season,
- Figure 3.2.87 for neap tide during the rainy season,
- Figure 3.2.88 for spring tide during the dry season,
- Figure 3.2.89 for neap tide during the dry season, and
- Figure 3.2.90 for neap tide during the transient season.

1) Rainy Season

During the spring tide, T-P ranged from 0.019 to 0.185 mg/L. Averages of the three layers were 0.073, 0.067, and 0.071 mg/L, respectively, with an overall average of 0.071 mg/L. Higher than average T-P levels were observed in the upper layers of P09 and P10, with P09 registering the maximum level during the spring tide. The middle and bottom layers in the eastern part of the estuary mouth had lower than average T-P levels.

During the neap tide, T-P ranged from 0.009 to 0.476 mg/L, much wider than during the spring tide, resulting from the exceptionally high level registered in the upper layer of P10 with. Averages of the three layers were 0.063, 0.045, and 0.064 mg/L with an overall average of 0.059 mg/L. In comparison to the data obtained during the spring tide, all the layers had lower T-P levels. No discernible distribution pattern was recognized in the upper layer except at P10. As for the middle- and bottom layers, those at P10 were the highest T-P level as in the case of the upper layer. P03, P04, P07, and points in the eastern part of the estuary mouth had low T-P levels in the middle- and bottom layers.

2) Dry Season

During the spring tide, T-P ranged widely from 0.007 to 0.614 mg/L with an average of 0.076 mg/L. The exceptionally high value was observed at P10 in

Shenzhen bay. In general, values were higher in the upper bay zone and lower in the estuary mouth and the outer sea area. The vertical differences were insignificant.

During the neap tide, T-P also ranged widely from 0.023 to 0.567 mg/L with an average of 0.091 mg/L. Again, the level at P10 in Shenzhen bay was exceptionally high. Higher than average levels were found in the zone from the upper bay to the western part of the estuary mouth, and lower levels were observed in the eastern side of the estuary mouth

The unusually high T-P values found in Shenzhen bay far exceed the normal marine water levels and were anomalies within the Pearl River Estuary. It was likely that these levels did not resulted from natural condition, but were influenced by industrial and domestic discharges.

(15) PO_4-P

The survey results of PO_4-P are shown by interpolation in:

- Figure 3.2.91 for spring tide during the rainy season,
- Figure 3.2.92 for neap tide during the rainy season,
- Figure 3.2.93 for spring tide during the dry season,
- Figure 3.2.94 for neap tide during the dry season, and
- Figure 3.2.95 for neap tide during the transient season.

1) Rainy Season

During the spring tide, PO_4-P ranged from 0.002 to 0.087 mg/L. The averages of the three layers were 0.034, 0.030, and 0.032 mg/L, respectively downward, with an overall average of 0.032 mg/L. The PO_4-P to T-P ratio was 45%. Horizontally, P03, P04 and P10 had higher than average PO_4-P levels, and lower levels were found in the eastern part of the estuary mouth. No significant vertical distribution pattern was recognized.

During the neap tide, PO_4-P ranged from 0.002 to 0.045 mg/L. The averages of the three layers were 0.045, 0.032, and 0.044 mg/L, respectively downward, with an overall average of 0.042 mg/L. The PO_4-P to T-P ratio was 71%, a significant 30% greater than the ratio found during the spring tide. In addition, while the T-P level decreased in all the layers, the PO_4-P level increased instead. This resulted from the exceptionally high PO_4-P levels observed in the upper- and the bottom layers of P10. The upper layer of P10 had a maximum level of 0.451 mg/L. Taking the background levels of the estuary into consideration, it was likely that the area was under the influence of some wastewater discharge during the observation period. P10 and its surrounding area along the eastern coastline generally had higher levels. Except for the eastern part, the remaining area had PO_4-P levels below the average. P03, P04, and points near the estuary mouth had particularly low levels.

Redfield Ratio is used as an index to indicate the normal state of material composition in seawater given by, C : N : P = 106 : 16 : 1.

This ratios signify that the composition of C, N, and P in seawater is nearly constant, whatever forms they may take. Using the data obtained N:P ratios for both the spring- and the neap tide were calculated. In the Pearl River Estuary, the N:P ratios were 21:1 during the spring tide, and 30:1 during the neap tide, exemplifying the unusual imbalance of N:P ratio in the Pearl River Estuary .

2) Dry Season

During the spring tide, PO_4-P ranged from 0.004 to 0.430 mg/L and the average was 0.044 mg/L, while during the neap tide it ranged from 0.018 to 0.416 mg/L with the average of 0.057 mg/L. Because PO_4-P was the prime contributor to T-P, the horizontal distribution of PO_4-P was similar to that of T-P.

(16) SiO_3-Si

1) Rainy Season

During the spring tide, SiO_3-Si ranged from 0.29 to 3.91 mg/L. The averages of the three layers were 2.30, 2.01, and 1.79 mg/L, respectively downward, and the overall average was 2.04 mg/L. Horizontally, higher than average SiO_3-Si levels were observed in the upper bay area, and lower levels towards and around the estuary mouth. Vertically, SiO_3-Si levels decreased gradually from the upper- to the bottom layer.

During the neap tide, SiO_3-Si ranged from 0.45 to 5.09 mg/L. The averages of the three layers were 3.41, 2.72, and 2.17 mg/L, and the overall average was 2.84 mg/L. Compared to the data during the spring tide, the vertical concentration gradient during the neap tide was more prominent.

2) Dry Season

During the spring tide, SiO_3-Si ranged from 0.85 to 3.91 mg/L and the average was 2.04 mg/L. The levels registered at P01, P02, and P03 in the upper bay and at P10 in Shenzhen bay were higher than average and lower at P16, P18, and P20 in the eastern part of the estuary mouth.

During the neap tide, SiO_3-Si ranged from 0.88 to 3.92 mg/L and the average was 2.19 mg/L. The horizontal distribution pattern was similar to that during the spring tide. Compared to the distribution pattern during the spring tide, slightly higher values were observed in the western coastal zone.

(17) Comparison with the Water Quality Standard for Sea Water (GB3097-1997)

1) Rainy Season

The results of the intensive survey in the rainy season were compared with the water quality standard for seawater. The ratios of categorization for each water quality index are shown in Table 3.2.1 and 3.2.2.

The pH results were categorized into Class I or II. Most the water quality indices during the spring tide belonged to Class II and during the neap tide mostly to Class I. The *DO* results ranged almost evenly from Class I to IV. Some of the results in the bottom layer during the neap tide exceeded the standard of Class IV. More than 90 % of the COD and BOD_5 results correspond to Class I or II.

All the Hg, Cu, and Cd results belong to Class I. Most of the Zn and Pb results correspond to Class I or II. The Zn levels during the spring tide mostly correspond to Class II. In contrast, the Pb levels during the spring tide were mainly classified into Class I.

Most of the SS levels belonged to Class I or II with the majority matching Class I. Some of the SS levels during the spring tide exceeded Class IV. More than 80 % of the I-N levels exceeded Class IV. The PO_4-P levels spread widely from I to VI with more than 10 % exceeding Class IV. Most of the Oils levels were categorized into Class I.

2) Dry Season

The results of the intensive survey in the dry season were compared with the water quality standard for seawater. The ratios of categorization of each index are shown in Table 3.2.3 and 3.2.4.

The difference in water quality classification between the spring tide and the neap tide was small for all the indices. Parameters directly affecting the aquatic biota, such as pH, DO, COD, were categorized into the upper levels of classification. Heavy metals, with some minor exceptions, were also categorized into the upper classifications. On the other hand, SS and nutrients (IN and PO_4-P) were classified low. Especially, most of the nutrients levels exceeded Class Ⅳ.

(18) Relation among Major Water Quality Indices

The relationships among the major water quality indices are shown by scatter charts in:

- Figure 3.2.96 for salinity - COD in the rainy season,
- Figure 3.2.97 for salinity - COD in the dry season,
- Figure 3.2.98 for salinity - T-N in the rainy season,
- Figure 3.2.99 for salinity - T-N in the dry season,
- Figure 3.2.100 for salinity - NO_3-N in the rainy season,
- Figure 3.2.101 for salinity - NO_3-N in the dry season,
- Figure 3.2.102 for salinity - SiO_3-Si in the rainy season,
- Figure 3.2.103 for salinity - SiO_3-Si in the dry season,
- Figure 3.2.104 for COD - TOC in the rainy season, and
- Figure 3.2.105 for COD - COD_{JPN} in the rainy season.

1) Salinity – COD

The rainy season result revealed an inverse correlation between the two indices. In addition, areas with low salinity level had a wide range of COD and areas with high salinity level a narrow range of COD. It was likely that the majority of COD originated from the river inflows. The fact that areas with low salinity had wider COD range implies that COD level in the river water was unstable. The other fact that that areas with high salinity had narrow COD ranges suggested that COD distribution in the Pearl River Estuary was greatly governed by the mixing condition of the river water and the seawater. The relationship between COD and salinity at P10, however, was distinctively different from the other points. The marine environment around P10 is anomaly within the Pearl River Estuary.

The dry season result also revealed an inverse correlation between the two indices. However, more scattering was recognized compared to the rainy season result. It is likely that COD originated not only from the water mass with low salinity typically at P04, but also from the water with comparatively high salinity in Shenzhen Bay or Humen.

2) Salinity - T-N

The rainy season result showed an inverse correlation between the two indices. Both of the results from the spring- and the neap tide were almost on the same primary recurrence line. Points with low salinity had somewhat higher T-N levels. This implies that most of the T-N originates from the incoming river water and that the T-N distribution pattern or concentration gradient was strongly affected by the mixing condition of river- and seawater. The T-N concentration in the incoming river water was not steady and might vary widely according to the season.

The result of the dry season showed small T-N dependence on salinity between 0 and 20. For salinity over 20, however, the points such as P05, P09 or P10 with higher than average T-N levels, were separated from the correlation groups. It is likely that the T-N originated not only from the river water but also from Shenzhen. While elsewhere in the estuary T-N was composed of mainly I-N, T-N at P09 and P10 during the spring tide was composed of mostly organic nitrogen, pointing to the seriousness of organic pollution of anthropogenic origin in and around Shenzhen bay.

3) Salinity - NO_3-N

The result of the rainy season also showed an inverse correlation between the two indices. Both of the results from the spring- and the neap tide were almost on the same primary recurrence line. Similar to the cases of COD and TN, most of the NO_3-N was attributable to the incoming river water. Its distribution pattern seemed to be strongly influenced by the mixing condition of river- and seawater.

The result of the dry season showed the same trend that higher NO_3-N levels were found at low salinity locations and lower levels at high salinity points. It is likely that the low NO_3-N water mass, typically at P03 and

P04, was mixed with the high salinity water mass of the estuary mouth. However, the trend that NO_3-N level decreases with salinity increase was not a linear relationship, and NO_3-N levels higher than what the correlation formula indicates were observed frequently during the spring-tide period. On the other hand, during the neap-tide period, NO_3-N values were scattered across the recurrence line. This tendency was recognized in a wide range of salinity.

4) Salinity - SiO_3-Si

The result of the rainy season showed a smooth inverse correlation between two the two indices well represented by the primary recurrence lines. Similar to COD and T-N, most of the SiO_3-Si seemed to originate from the incoming river water. Its distribution pattern was strongly affected by the mixing condition of river- and sea water. However, since the data during the spring tide and those during the neap tide were represented by two different recurrence lines, it is evident that SiO_3-Si concentration in river water was less stable than T-N or COD concentration. While SiO_3-Si is one of the key nutrients for diatoms (Bacillariophtceae), its amount in the Pearl River Estuary is more than sufficient to support the growth of phytoplankton.

The results of the dry season showed that the highest SiO_3-Si occurred where salinity was around 15. SiO_3-Si gradually increased with some scattering as salinity increased where salinity was below 15. On the other hand, where salinity was over 15, SiO_3-Si decreased with salinity increase. This observation indicates that the SiO_3-Si distribution pattern cannot be attributed to the mixing of the river water and the seawater alone. It is likely that SiO_3-Si concentration fluctuated in the river water and that several concentrated sources of SiO_3-Si might have existed.

5) COD – TOC

COD-TOC correlation was analyzed for the rainy season only. Despite the fact that the both are used as organic indices, no similarities in distribution patterns were recognized horizontally and vertically, and no correlation was found between the two indices. It should be noted that even though COD (Chinese method) levels were low, TOC levels were high at most of the monitoring points. The reason for this discrepancy is evidently because COD (Chinese method) represents only the readily decomposable components of organic matters while TOC measures all organic matters. It appears that an abundance of organic matters was present around the estuary, that could not be accounted for by the COD (Chinese method) analytical methodology. This is most likely attributable to the large expanse of the Pearl River drainage basin. Organic matter reaching the Pearl River Estuary is thought to be residual matters transported through a long stretch traversing the large drainage basin, during which readily degradable components of the organic matter would have been fully decomposed, and the remaining decomposition-resistant organic matter enters the estuary.

6) COD - COD_{JPN}

Correlation analysis for the two indices was performed in the rainy season only. The correlation of two indices was nearly right on the primary recurrence line. COD (Japanese method) levels were 1.5 to 2 times higher than COD (Chinese method) levels, likely attributable to the difference in oxidizing reagent used by the two methods, i.e., H_2SO_4 versus $KMnO_4$.

3.2.2. Continuous Survey

The average values of water quality indices during the continuous survey are shown in:

- Table 3.2.5 for spring tide in the rainy season,
- Table 3.2.6 for neap tide in the rainy season,
- Table 3.2.7 for spring tide in the dry season, and
- Table 3.2.8 for neap tide in the dry season.

The time series of each index are shown in:

- Figure 3.2.106 to 3.2.117 for the rainy season, and
- Figure 3.2.133 to 3.2.144 for the dry season.

The relationship among major water quality indices, are shown by scatter charts in:

- Figure 3.2.119 to 3.2.132 for the rainy season, and
- Figure 3.2.145 to 3.2.150 for the dry season.

The results were summarized as follows:

The six locations at which the continuous survey took place were categorized into four groups from A to D by the salinity characteristics. Group A is where salinity was low under influence of the river water and, therefore, the indices of river originating pollutants such as T-N, NO_3-N, and SiO_3-Si registered high levels. P04 belongs to this category.

Group B represents the area where the influence of river water was limited to the spring tide period only. In this category, vertical mixing process dominates during the spring tide. The levels of T-N, SiO_3-Si, and particularly COD were high in all the layers during the spring tide. During the neap tide, salinity stratification formed and T-N and SiO_3-Si registered low levels in the bottom layer, influenced by the sea water intrusion. P01 belonged to this category.

Group C represents the zone characterized by active mixing of the river water and the seawater. P11, P12, and P19 belonged to this category. At these locations, the bottom sediments were re-suspended by the strong currents and high SS levels were recorded even in the upper layer. At the same time, COD, N, and P, etc., included in SS, influenced the water quality in a complex manner.

Group D represents the zone highly influenced by the sea water. P20 belonged to this category. The levels of water quality indices were generally low in this zone. The characteristics of the representative indices are described below:

Table 3.2.1 Corresponding Percentage of Water Quality Results to Chinese Environmental Standard for Sea Water (Spring Tide)

(%)

<table>
<tr><th rowspan="2">Items</th><th colspan="5">Classification</th></tr>
<tr><th>1st</th><th>2nd</th><th>3rd</th><th>4th</th><th>Others</th></tr>
<tr><td>p H</td><td colspan="2">35</td><td colspan="2">65</td><td>0</td></tr>
<tr><td>DO</td><td>19</td><td>43</td><td>20</td><td>18</td><td>0</td></tr>
<tr><td>COD</td><td>76</td><td>15</td><td>8</td><td>1</td><td>0</td></tr>
<tr><td>BOD_5</td><td>84</td><td>16</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Hg</td><td>100</td><td colspan="2">0</td><td>0</td><td>0</td></tr>
<tr><td>Cu</td><td>100</td><td>0</td><td>0</td><td colspan="2">0</td></tr>
<tr><td>Zn</td><td>19</td><td>78</td><td>3</td><td>0</td><td>0</td></tr>
<tr><td>Pb</td><td>69</td><td>31</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Cd</td><td>100</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td>As</td><td>100</td><td>0</td><td>0</td><td colspan="2">0</td></tr>
<tr><td>SS</td><td>73</td><td colspan="2">15</td><td>0</td><td>12</td></tr>
<tr><td>IN</td><td>0</td><td>3</td><td>7</td><td>9</td><td>81</td></tr>
<tr><td>PO_4-P</td><td>14</td><td colspan="2">30</td><td>43</td><td>14</td></tr>
<tr><td>Oils</td><td colspan="2">96</td><td>4</td><td>0</td><td>0</td></tr>
</table>

Table 3.2.2 Corresponding Percentage of Water Quality Results Neap Tide to Chinese Environmental Standard for Sea Water (Neap Tide)

(%)

<table>
<tr><th rowspan="2">Items</th><th colspan="5">Classification</th></tr>
<tr><th>1st</th><th>2nd</th><th>3rd</th><th>4th</th><th>Others</th></tr>
<tr><td>p H</td><td colspan="2">74</td><td colspan="2">26</td><td>0</td></tr>
<tr><td>DO</td><td>29</td><td>28</td><td>24</td><td>15</td><td>4</td></tr>
<tr><td>COD</td><td>84</td><td>11</td><td>4</td><td>1</td><td>0</td></tr>
<tr><td>BOD_5</td><td>65</td><td>34</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Hg</td><td>100</td><td colspan="2">0</td><td>0</td><td>0</td></tr>
<tr><td>Cu</td><td>100</td><td>0</td><td>0</td><td colspan="2">0</td></tr>
<tr><td>Zn</td><td>76</td><td>24</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Pb</td><td>34</td><td>66</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Cd</td><td>100</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td>As</td><td>100</td><td>0</td><td>0</td><td colspan="2">0</td></tr>
<tr><td>SS</td><td>97</td><td colspan="2">3</td><td>0</td><td>0</td></tr>
<tr><td>IN</td><td>4</td><td>4</td><td>6</td><td>1</td><td>85</td></tr>
<tr><td>PO_4-P</td><td>12</td><td colspan="2">33</td><td>39</td><td>16</td></tr>
<tr><td>Oils</td><td colspan="2">96</td><td>4</td><td>0</td><td>0</td></tr>
</table>

Table 3.2.3 Corresponding Percentage of Water Quality Results to Chinese Environmental Standard for Sea Water (Spring Tide)

(%)

<table>
<tr><th rowspan="2">Items</th><th colspan="5">Classificstion</th></tr>
<tr><th>Class 1</th><th>Class 2</th><th>Class 3</th><th>Class 4</th><th>Others</th></tr>
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<tr><td>DO</td><td>97</td><td>3</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>COD</td><td>94</td><td>6</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>BOD_5</td><td>92</td><td>8</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Hg</td><td>100</td><td colspan="2">0</td><td>0</td><td>0</td></tr>
<tr><td>Cu</td><td>100</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td>Zn</td><td>8</td><td>92</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Pb</td><td>54</td><td>46</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Cd</td><td>100</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td>As</td><td>100</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td>SS</td><td>17</td><td colspan="2">67</td><td>10</td><td>6</td></tr>
<tr><td>IN</td><td>21</td><td>7</td><td>7</td><td>17</td><td>49</td></tr>
<tr><td>PO_4-P</td><td>18</td><td colspan="2">29</td><td>29</td><td>24</td></tr>
<tr><td>Oils</td><td>96</td><td>4</td><td>0</td><td>0</td><td>0</td></tr>
</table>

Table 3.2.4 Corresponding Percentage of Water Quality Results to Chinese Environmental Standard for Sea Water (Neap Tide)

(%)

<table>
<tr><th rowspan="2">Items</th><th colspan="5">Classificstion</th></tr>
<tr><th>Class 1</th><th>Class 2</th><th>Class 3</th><th>Class 4</th><th>Others</th></tr>
<tr><td>p H</td><td colspan="2">90</td><td colspan="2">10</td><td>0</td></tr>
<tr><td>DO</td><td>96</td><td>4</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>COD</td><td>100</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>BOD_5</td><td>99</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Hg</td><td>100</td><td colspan="2">0</td><td>0</td><td>0</td></tr>
<tr><td>Cu</td><td>100</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td>Zn</td><td>40</td><td>60</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Pb</td><td>32</td><td>68</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Cd</td><td>100</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td>As</td><td>100</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td>SS</td><td>28</td><td colspan="2">62</td><td>10</td><td>0</td></tr>
<tr><td>IN</td><td>17</td><td>11</td><td>17</td><td>17</td><td>38</td></tr>
<tr><td>PO_4-P</td><td>0</td><td colspan="2">28</td><td>18</td><td>54</td></tr>
<tr><td>Oils</td><td>88</td><td>12</td><td>0</td><td>0</td><td>0</td></tr>
</table>

Table 3.2.5(1) Result of the Continuous Survey on Water Quality (Average: Spring Tide, Rainy Season)

Point, Average		Sampl-ing depth (m)	Water temp. (° C)	Sal.	pH	DO (mg/L)	COD (CHN) (mg/L)	COD (JPN) (mg/L)	BOD5 (mg/L)	Hg (μ g/L)	Cu (μ g/L)	Zn (μ g/L)	Pb (μ g/L)	Cd (μ g/L)	As (μ g/L)	Remark
					Detection limit											
					1.5	0.18	0.01	0.01	0.0005	0.006	0.012	0.002	0.001	0.014	0.01	
P01	Average of Upper Layer	1.0	30.05	0.15	7.4	3.1	1.9	5.4	0.7	0.014	3.1	20.3	1.11	0.10	2.1	*:Half valu of ditecti-on limit
	Average of Middle Layer	13.1	29.99	0.17	7.3	3.4	2.1	5.5	0.8	0.004	2.3	22.8	0.34	0.06	3.5	
	Average of Bottom Layer	25.2	29.90	0.20	7.3	3.5	2.6	6.0	0.9	0.007	2.0	27.8	1.22	0.09	3.2	
P04	Average of Upper Layer	1.0	29.19	0.13	7.8	6.0	1.6	4.8	0.9	0.018	2.4	34.8	0.76	0.15	2.4	
	Average of Middle Layer	3.2	29.18	0.13	7.8	5.9	1.6	4.8	0.6	0.020	2.3	35.7	0.59	0.14	3.0	
	Average of Bottom Layer	5.4	29.15	0.13	7.8	5.8	1.6	4.4	0.6	0.014	2.6	31.5	0.90	0.42	2.9	
P11	Average of Upper Layer	1.0	29.68	8.42	7.8	5.8	1.5	4.7	0.7	0.020	1.8	26.2	0.92	0.19	2.8	
	Average of Middle Layer	4.0	29.24	13.28	7.7	5.1	1.6	5.3	0.6	0.026	2.2	30.2	1.65	0.21	3.5	
	Average of Bottom Layer	7.1	27.91	22.90	7.7	3.6	1.9	5.3	0.6	0.023	2.6	32.1	0.54	0.21	2.9	
P12	Average of Upper Layer	1.0	28.27	10.43	7.6	5.6	2.5	4.2	1.7	0.032	2.0	32.0	1.45	0.30	2.3	
	Average of Middle Layer	6.2	29.09	16.08	7.6	4.9	1.9	3.0	1.0	0.052	2.0	33.4	0.68	0.15	2.0	
	Average of Bottom Layer	11.4	27.83	22.62	7.6	3.7	1.8	3.9	0.9	0.042	2.4	33.0	1.04	0.19	2.1	
P19	Average of Upper Layer	1.0	28.60	17.30	7.6	5.1	1.5	2.3	1.0	0.027	1.3	33.8	0.19	0.34	1.8	
	Average of Middle Layer	3.1	28.23	21.73	7.7	4.7	1.3	3.3	0.6	0.033	1.3	36.5	0.21	0.23	2.4	
	Average of Bottom Layer	5.2	27.92	24.71	7.7	3.7	1.2	2.8	0.9	0.056	1.5	40.2	0.71	0.24	3.4	
P20	Average of Upper Layer	1.0	28.29	18.66	7.8	5.6	1.0	2.4	0.5	0.013	1.4	54.6	0.28	0.38	1.5	
	Average of Middle Layer	9.6	26.56	30.07	7.8	4.2	0.6	3.2	0.4	0.015	0.6	29.2	0.36	0.17	1.2	
	Average of Bottom Layer	18.3	25.94	32.07	7.8	3.8	0.7	3.6	0.5	0.021	0.6	37.3	0.25	0.12	1.2	

Table 3.2.5(2) Result of the Continuous Survey on Water Quality (Average: Spring Tide, Rainy Season)

Point	Average	Sampl-ing depth (m)	Water temp. (° C)	Sal.	SS (mg/L)	TOC (mg/L)	TN (mg/L)	NH_3-N (mg/L)	NO_2-N (mg/L)	NO_3-N (mg/L)	IN (mg/L)	TP (mg/L)	PO_4-P (mg/L)	SiO_3-Si (mg/L)	Oil (UV) (mg/L)	Remark
	Detection limit				1.5	0.18	0.01	0.01	0.0005	0.006	0.012	0.002	0.001	0.014	0.01	
P01	Average of Upper Layer	1.0	30.05	0.15	53	4.3	2.46	0.02	0.02	1.56	1.60	0.058	0.031	2.92	0.02	*:Half valu of ditecti—on limit
	Average of Middle Layer	13.1	29.99	0.17	73	3.7	2.41	0.02	0.02	1.48	1.53	0.074	0.031	2.74		
	Average of Bottom Layer	25.2	29.90	0.20	131	3.8	2.30	0.02	0.02	1.43	1.47	0.084	0.031	2.76		
P04	Average of Upper Layer	1.0	29.19	0.13	39	4.0	2.43	0.03	0.02	1.49	1.54	0.050	0.022	2.10	0.02	
	Average of Middle Layer	3.2	29.18	0.13	46	3.2	2.33	0.03	0.02	1.45	1.49	0.055	0.023	2.22		
	Average of Bottom Layer	5.4	29.15	0.13	52	3.5	3.19	0.03	0.02	1.46	1.50	0.059	0.022	2.07		
P11	Average of Upper Layer	1.0	29.68	8.42	42	4.8	1.62	0.02	0.07	1.08	1.17	0.087	0.039	2.92	0.02	
	Average of Middle Layer	4.0	29.24	13.28	78	4.3	1.64	0.02	0.08	1.05	1.14	0.095	0.045	3.07		
	Average of Bottom Layer	7.1	27.91	22.90	143	5.5	1.50	0.01	0.05	0.75	0.81	0.105	0.045	2.09		
P12	Average of Upper Layer	1.0	28.27	10.43	49	5.1	1.67	0.04	0.12	1.02	1.18	0.096	0.054	2.02	0.04	
	Average of Middle Layer	6.2	29.09	16.08	55	4.8	1.51	0.05	0.13	0.87	1.05	0.080	0.045	1.43		
	Average of Bottom Layer	11.4	27.83	22.62	79	6.0	1.18	0.07	0.11	0.70	0.87	0.094	0.043	1.22		
P19	Average of Upper Layer	1.0	28.60	17.30	13	4.8	1.66	0.03	0.08	0.89	1.00	0.051	0.030	1.72	0.02	
	Average of Middle Layer	3.1	28.23	21.73	50	3.5	1.31	0.02	0.08	0.74	0.83	0.067	0.033	1.64		
	Average of Bottom Layer	5.2	27.92	24.71	111	3.7	1.09	0.02	0.06	0.56	0.64	0.072	0.028	1.42		
P20	Average of Upper Layer	1.0	28.29	18.66	12	5.6	1.30	0.02	0.09	0.67	0.79	0.047	0.035	1.94	0.02	
	Average of Middle Layer	9.6	26.56	30.07	22	4.3	0.97	0.03	0.06	0.42	0.51	0.039	0.022	1.14		
	Average of Bottom Layer	18.3	25.94	32.07	35	3.8	0.56	0.02	0.04	0.28	0.35	0.040	0.016	0.88		

Table 3.2.6(1) Result of the Continuous Survey on Water Quality (Average: Neap Tide, Rainy Season)

Point, Average		Sampl-ing depth (m)	Water temp. (° C)	Sal.	pH	DO (mg/L)	COD (CHN) (mg/L)	COD (JPN) (mg/L)	BOD5 (mg/L)	Hg (μ g/L)	Cu (μ g/L)	Zn (μ g/L)	Pb (μ g/L)	Cd (μ g/L)	As (μ g/L)	Remark
					Detection limit											
					1.5	0.18	0.01	0.01	0.0005	0.006	0.012	0.002	0.001	0.014	0.01	
P01	Average of Upper Layer	1.0	30.03	0.53	7.6	4.2	2.1	4.9	1.5	0.012	1.5	15.4	0.53	0.17	3.1	*:Half valu of ditecti —on limit
	Average of Middle Layer	12.9	28.83	6.96	7.3	2.4	2.2	3.5	0.8	0.024	1.1	16.4	0.76	0.26	3.2	
	Average of Bottom Layer	24.8	27.88	15.12	7.5	2.5	1.9	4.7	0.6	0.022	0.8	24.1	0.79	0.31	2.5	
P04	Average of Upper Layer	1.0	30.02	0.11	8.0	5.8	1.3	3.0	0.7	0.025	1.4	10.4	1.01	0.12	3.9	
	Average of Middle Layer	4.2	30.01	0.11	8.0	5.8	1.4	3.0	0.7	0.024	1.5	6.3	1.39	0.14	4.5	
	Average of Bottom Layer	7.3	30.00	0.11	8.0	5.7	1.6	3.4	0.7	0.024	1.0	7.8	1.20	0.09	4.1	
P11	Average of Upper Layer	1.0	29.39	2.94	7.9	6.2	1.6	2.6	0.6	0.019	1.1	8.9	2.11	0.16	4.0	
	Average of Middle Layer	3.8	28.28	12.28	7.8	5.6	1.7	2.7	0.7	0.018	0.8	6.3	0.77	0.16	3.9	
	Average of Bottom Layer	6.5	26.18	25.79	7.8	3.6	1.0	2.3	0.9	0.031	0.7	12.9	1.71	0.28	3.9	
P12	Average of Upper Layer	1.0	29.21	6.88	7.8	5.6	1.7	2.4	0.5	0.011	1.2	6.0	0.70	0.12	3.1	
	Average of Middle Layer	7.3	26.55	24.70	7.8	4.1	1.1	2.2	0.3	0.016	0.4	3.5	1.65	0.14	3.0	
	Average of Bottom Layer	13.6	25.78	27.68	7.8	3.6	0.9	2.0	0.5	0.012	0.6	21.1	0.67	0.22	2.5	
P19	Average of Upper Layer	1.0	29.68	6.35	8.2	7.9	1.8	2.9	1.3	0.022	1.7	9.4	0.84	0.19	2.8	
	Average of Middle Layer	3.5	27.98	15.98	8.2	7.2	1.8	3.0	1.2	0.017	2.7	10.5	1.50	0.18	2.8	
	Average of Bottom Layer	6.0	26.44	25.72	7.9	3.2	0.9	2.5	0.7	0.030	2.2	10.6	1.60	0.20	3.2	
P20	Average of Upper Layer	1.0	30.15	6.56	8.3	8.6	2.0	2.7	1.4	0.012	2.1	33.2	1.36	0.33	2.5	
	Average of Middle Layer	9.3	25.37	32.16	8.0	4.0	0.5	1.9	0.4	0.007	2.2	27.2	2.08	0.17	1.8	
	Average of Bottom Layer	17.5	24.79	33.51	8.0	3.8	0.6	2.0	0.2	0.012	1.6	16.8	2.05	0.20	1.6	

Table 3.2.6(2) Result of the Continuous Survey on Water Quality (Average: Neap Tide, Rainy Season)

Point	Average	Sampl-ing depth (m)	Water temp. (° C)	Sal.	SS (mg/L)	TOC (mg/L)	TN (mg/L)	NH_3-N (mg/L)	NO_2-N (mg/L)	NO_3-N (mg/L)	IN (mg/L)	TP (mg/L)	PO_4-P (mg/L)	SiO_3-Si (mg/L)	Oil (UV) (mg/L)	Remark
	Detection limit				1.5	0.18	0.01	0.01	0.0005	0.006	0.012	0.002	0.001	0.014	0.01	
P01	Average of Upper Layer	1.0	30.03	0.53	18	3.8	2.39	0.10	0.16	1.23	1.49	0.046	0.025	4.46	0.05	*:Half valu of ditecti-on limit
	Average of Middle Layer	12.9	28.83	6.96	13	3.6	2.29	0.10	0.19	1.14	1.44	0.048	0.037	4.08		
	Average of Bottom Layer	24.8	27.88	15.12	38	3.3	1.95	0.06	0.16	0.99	1.20	0.076	0.042	3.26		
P04	Average of Upper Layer	1.0	30.02	0.11	27	4.5	2.22	0.03	0.02	1.45	1.49	0.036	0.022	4.25	0.02	
	Average of Middle Layer	4.2	30.01	0.11	38	3.8	2.24	0.03	0.02	1.43	1.48	0.040	0.022	4.17		
	Average of Bottom Layer	7.3	30.00	0.11	37	4.2	2.08	0.03	0.02	1.43	1.47	0.047	0.022	4.06		
P11	Average of Upper Layer	1.0	29.39	2.94	13	4.2	2.15	0.02	0.05	1.39	1.46	0.044	0.031	4.23	0.04	
	Average of Middle Layer	3.8	28.28	12.28	12	4.3	1.87	0.02	0.06	1.27	1.35	0.051	0.031	4.34		
	Average of Bottom Layer	6.5	26.18	25.79	35	4.1	0.90	0.02	0.06	0.47	0.55	0.061	0.035	1.92		
P12	Average of Upper Layer	1.0	29.21	6.88	13	3.5	2.36	0.08	0.10	1.23	1.41	0.062	0.051	4.05	0.03	
	Average of Middle Layer	7.3	26.55	24.70	7	3.1	1.50	0.03	0.17	0.67	0.87	0.064	0.053	2.26		
	Average of Bottom Layer	13.6	25.78	27.68	13	3.2	1.26	0.02	0.15	0.55	0.72	0.058	0.046	1.79		
P19	Average of Upper Layer	1.0	29.68	6.35	5	5.3	1.86	0.02	0.05	1.15	1.22	0.039	0.010	3.08	0.03	
	Average of Middle Layer	3.5	27.98	15.98	5	5.0	2.03	0.01	0.06	1.14	1.21	0.042	0.011	3.00		
	Average of Bottom Layer	6.0	26.44	25.72	11	5.3	1.20	0.02	0.09	0.50	0.60	0.045	0.033	1.45		
P20	Average of Upper Layer	1.0	30.15	6.56	7	4.5	1.96	0.02	0.07	1.17	1.27	0.035	0.012	3.90	0.03	
	Average of Middle Layer	9.3	25.37	32.16	7	3.1	0.78	0.02	0.04	0.21	0.26	0.022	0.019	1.13		
	Average of Bottom Layer	17.5	24.79	33.51	10	3.6	0.54	0.02	0.04	0.14	0.20	0.025	0.018	0.96		

Table 3.2.7(1) Result of the Continuous Survey on Water Quality (Average: Spring Tide, Dry Season)

Point	Average	Sampl-ing depth (m)	Water temp. (° C)	Sal.	pH	DO (mg/L)	COD (CHN) (mg/L)	BOD5 (mg/L)	Hg (μg/L)	Cu (μg/L)	Zn (μg/L)	Pb (μg/L)	Cd (μg/L)	As (μg/L)	Remark
Detection limit					1.5	0.18	0.01	0.2	0.008	0.2	3.1	0.03	0.01	0.4	
P01	Average of Upper Layer	1.0	19.71	10.73	7.7	6.3	1.9	0.9	0.007	0.8	35.0	1.94	0.28	2.9	*:Half valu of ditecti—on limit
	Average of Middle Layer	11.7	20.05	13.06	7.6	6.2	2.2	1.3							
	Average of Bottom Layer	22.3	20.07	14.42	7.6	6.3	2.9	1.7	0.012	0.6	37.2	2.21	0.44	5.6	
P11	Average of Upper Layer	1.0	19.47	27.64	7.9	7.2	1.1	0.7	0.029	0.8	29.4	0.80	0.55	9.5	
	Average of Middle Layer	3.5	19.52	27.81	8.0	7.2	1.1	0.6							
	Average of Bottom Layer	6.1	19.63	28.56	8.0	7.2	1.3	0.7	0.038	0.9	27.4	0.67	0.43	6.6	
P12	Average of Upper Layer	1.0	20.95	30.00	7.9	6.8	0.7	0.6	0.031	0.9	29.3	0.96	0.38	4.1	
	Average of Middle Layer	5.9	21.05	30.25	7.9	6.7	0.7	0.6							
	Average of Bottom Layer	10.8	21.24	30.64	7.9	6.7	0.8	0.7	0.031	0.5	31.8	0.69	0.54	3.4	
P19	Average of Upper Layer	1.0	20.41	29.09	8.0	7.1	1.6	0.7	0.036	0.9	46.9	0.38	0.67	5.1	
	Average of Middle Layer	3.5	20.45	29.36	8.0	7.0	1.5	0.7							
	Average of Bottom Layer	5.9	20.47	29.41	8.0	7.0	1.4	0.9	0.038	1.1	45.5	0.71	0.51	5.8	
P20	Average of Upper Layer	1.0	21.21	31.02	8.0	7.3	0.6	0.5	0.029	0.5	46.9	0.31	0.47	2.3	
	Average of Middle Layer	8.4	21.16	31.90	8.0	7.2	0.6	0.4							
	Average of Bottom Layer	15.9	21.15	31.97	8.0	7.2	0.6	0.4	0.023	0.3	54.0	0.43	0.60	3.5	
P22	Average of Upper Layer	1.0	21.13	32.03	8.1	7.4	0.4	0.5	0.018	0.2	24.7	0.97	0.33	3.0	
	Average of Middle Layer	6.5	21.14	32.12	8.1	7.4	0.4	0.4							
	Average of Bottom Layer	12.0	21.13	32.15	8.1	7.4	0.4	0.4	0.019	0.3	23.8	0.77	0.32	3.9	

Table 3.2.7(2) Result of the Continuous Survey on Water Quality (Average: Spring Tide, Dry Season)

Point, Average		Sampl-ing depth (m)	Water temp. (° C)	Sal.	SS (mg/L)	TOC (mg/L)	TN (mg/L)	NH_3-N (mg/L)	NO_2-N (mg/L)	NO_3-N (mg/L)	IN (mg/L)	TP (mg/L)	PO_4-P (mg/L)	SiO_3-Si (mg/L)	Oil (UV) (mg/L)	Remark
					Detection limit											
					1.5	0.18	0.01	0.01	0.0005	0.006	0.012	0.002	0.001	0.014	0.01	
P01	Average of Upper Layer	1.0	19.71	10.73	27	3.0	1.13	0.11	0.16	0.55	0.81	0.075	0.058	3.57	0.05	*:Half valu of ditecti-on limit.
	Average of Middle Layer	11.7	20.05	13.06	65	3.3	1.16	0.11	0.16	0.51	0.78	0.083	0.057	3.43		
	Average of Bottom Layer	22.3	20.07	14.42	187	3.3	1.10	0.10	0.15	0.47	0.72	0.087	0.049	3.91		
P11	Average of Upper Layer	1.0	19.47	27.64	124	3.7	0.71	0.06	0.06	0.55	0.66	0.086	0.041	2.00	0.03	
	Average of Middle Layer	3.5	19.52	27.81	140	3.3	0.76	0.06	0.06	0.51	0.62	0.079	0.042	1.87		
	Average of Bottom Layer	6.1	19.63	28.56	194	3.5	0.74	0.05	0.05	0.48	0.58	0.095	0.042	1.83		
P12	Average of Upper Layer	1.0	20.95	30.00	44	3.2	0.63	0.04	0.05	0.42	0.51	0.051	0.033	1.24	0.04	
	Average of Middle Layer	5.9	21.05	30.25	51	3.3	0.68	0.04	0.05	0.43	0.52	0.050	0.039	1.30		
	Average of Bottom Layer	10.8	21.24	30.64	103	3.1	0.73	0.04	0.05	0.53	0.62	0.065	0.039	1.25		
P19	Average of Upper Layer	1.0	20.41	29.09	335	5.0	0.62	0.03	0.04	0.36	0.43	0.091	0.030	1.45	0.04	
	Average of Middle Layer	3.5	20.45	29.36	323	4.3	0.68	0.03	0.05	0.38	0.45	0.093	0.036	1.88		
	Average of Bottom Layer	5.9	20.47	29.41	320	4.2	0.69	0.03	0.04	0.41	0.48	0.095	0.035	1.61		
P20	Average of Upper Layer	1.0	21.21	31.02	29	2.9	0.38	0.04	0.03	0.25	0.32	0.038	0.028	1.18	0.02	
	Average of Middle Layer	8.4	21.16	31.90	17	2.8	0.34	0.03	0.03	0.22	0.28	0.035	0.025	1.05		
	Average of Bottom Layer	15.9	21.15	31.97	32	3.0	0.33	0.03	0.02	0.21	0.26	0.043	0.026	1.15		
P22	Average of Upper Layer	1.0	21.13	32.03	13	3.7	0.23	0.02	0.02	0.12	0.16	0.030	0.016	1.14	0.02	
	Average of Middle Layer	6.5	21.14	32.12	11	3.0	0.24	0.02	0.02	0.13	0.17	0.028	0.018	1.15		
	Average of Bottom Layer	12.0	21.13	32.15	16	3.1	0.25	0.01	0.02	0.13	0.17	0.034	0.018	1.10		

Table 3.2.8(1) Result of the Continuous Survey on Water Quality (Average: Neap Tide, Dry Season)

Point	Average	Sampl-ing depth (m)	Water temp. (° C)	Sal.	pH	DO (mg/L)	COD (CHN) (mg/L)	BOD5 (mg/L)	Hg (μ g/L)	Cu (μ g/L)	Zn (μ g/L)	Pb (μ g/L)	Cd (μ g/L)	As (μ g/L)	Remark
	Detection limit				1.5	0.18	0.01	0.2	0.008	0.2	3.1	0.03	0.01	0.4	
P01	Average of Upper Layer	1.0	21.09	14.20	7.7	5.7	1.6	0.6	0.029	0.6	27.6	1.42	0.11	2.8	*:Half valu of ditecti —on limit
	Average of Middle Layer	13.5	21.15	20.20	7.7	5.7	1.3	0.6							
	Average of Bottom Layer	26.0	21.15	23.09	7.8	5.9	1.5	0.7	0.029	0.8	31.8	1.81	0.19	3.9	
P11	Average of Upper Layer	1.0	21.27	22.28	8.0	7.2	0.8	0.5	0.009	0.9	17.5	3.42	0.29	2.5	
	Average of Middle Layer	4.0	21.14	30.05	8.0	7.0	0.6	0.4							
	Average of Bottom Layer	7.0	21.15	30.75	8.1	6.9	0.6	0.4	0.018	1.1	22.8	1.90	0.25	3.1	
P12	Average of Upper Layer	1.0	21.31	29.77	8.0	6.6	0.5	0.5	0.023	2.3	17.7	0.61	0.37	2.3	
	Average of Middle Layer	5.9	21.45	31.44	8.0	6.5	0.5	0.4							
	Average of Bottom Layer	10.8	21.51	31.72	8.0	6.3	0.6	0.4	0.033	1.4	15.6	0.32	0.20	2.0	
P19	Average of Upper Layer	1.0	20.75	23.17	8.0	7.6	0.5	0.5	0.036	1.1	19.4	1.58	0.36	2.3	
	Average of Middle Layer	3.4	20.76	30.56	8.1	7.3	0.5	0.4							
	Average of Bottom Layer	5.6	20.76	31.40	8.1	7.0	0.4	0.3	0.029	1.0	21.1	1.69	0.06	2.7	
P20	Average of Upper Layer	1.0	21.17	32.40	8.1	7.3	0.4	0.5	0.018	1.0	28.9	2.32	0.14	1.8	
	Average of Middle Layer	8.0	21.17	32.47	8.1	7.2	0.5	0.4							
	Average of Bottom Layer	15.0	21.16	32.48	8.1	7.2	0.4	0.5	0.023	1.8	25.8	1.21	0.18	2.0	
P22	Average of Upper Layer	1.0	21.15	32.47	8.1	7.3	0.3	0.4	0.021	0.8	17.7	2.54	0.22	2.3	
	Average of Middle Layer	5.9	21.14	32.49	8.1	7.2	0.2	0.4							
	Average of Bottom Layer	10.8	21.14	32.49	8.1	7.2	0.3	0.5	0.022	0.7	15.6	2.40	0.21	2.1	

Table 3.2.8(2) Result of the Continuous Survey on Water Quality (Average: Neap Tide, Dry Season)

Point	Average	Sampl-ing depth (m)	Water temp. (° C)	Sal.	SS (mg/L)	TOC (mg/L)	TN (mg/L)	NH_3-N (mg/L)	NO_2-N (mg/L)	NO_3-N (mg/L)	IN (mg/L)	TP (mg/L)	PO_4-P (mg/L)	SiO_3-Si (mg/L)	Oil (UV) (mg/L)	Remark
					Detection limit											
					1.5	0.18	0.01	0.01	0.0005	0.006	0.012	0.002	0.001	0.014	0.01	
P01	Average of Upper Layer	1.0	19.71	10.73	11	3.3	1.22	0.07	0.14	0.68	0.89	0.090	0.052	3.71	0.05	*:Half valu of ditecti-on limit
	Average of Middle Layer	11.7	20.05	13.06	23	3.3	0.98	0.06	0.14	0.63	0.83	0.086	0.053	3.13		
	Average of Bottom Layer	22.3	20.07	14.42	96	3.3	0.88	0.07	0.12	0.56	0.75	0.108	0.060	2.68		
P11	Average of Upper Layer	1.0	21.27	22.28	6	3.1	0.88	0.07	0.10	0.49	0.66	0.061	0.031	2.55	0.03	
	Average of Middle Layer	4.0	21.14	30.05	12	3.0	0.69	0.06	0.07	0.32	0.45	0.060	0.028	1.92		
	Average of Bottom Layer	7.0	21.15	30.75	16	3.6	0.53	0.05	0.06	0.22	0.32	0.066	0.029	1.69		
P12	Average of Upper Layer	1.0	21.31	29.77	8	3.1	0.71	0.14	0.07	0.28	0.49	0.079	0.061	1.69	0.03	
	Average of Middle Layer	5.9	21.45	31.44	8	3.2	0.58	0.14	0.07	0.25	0.46	0.077	0.054	1.53		
	Average of Bottom Layer	10.8	21.51	31.72	23	3.0	0.52	0.11	0.05	0.20	0.36	0.079	0.045	1.44		
P19	Average of Upper Layer	1.0	20.75	23.17	5	3.5	0.82	0.08	0.11	0.51	0.70	0.057	0.037	2.56	0.03	
	Average of Middle Layer	3.4	20.76	30.56	6	3.6	0.62	0.04	0.06	0.27	0.37	0.045	0.026	1.79		
	Average of Bottom Layer	5.6	20.76	31.40	6	3.3	0.50	0.04	0.04	0.22	0.30	0.044	0.020	1.48		
P20	Average of Upper Layer	1.0	21.17	32.40	7	3.2	0.30	0.02	0.02	0.10	0.13	0.034	0.022	1.17	0.02	
	Average of Middle Layer	8.0	21.17	32.47	9	3.1	0.33	0.01	0.02	0.09	0.12	0.041	0.021	1.04		
	Average of Bottom Layer	15.0	21.16	32.48	10	3.2	0.37	0.02	0.02	0.09	0.13	0.040	0.018	1.04		
P22	Average of Upper Layer	1.0	21.15	32.47	6	3.1	0.34	0.01	0.02	0.11	0.14	0.044	0.021	1.31	0.02	
	Average of Middle Layer	5.9	21.14	32.49	7	2.9	0.30	0.01	0.02	0.11	0.13	0.046	0.020	1.31		
	Average of Bottom Layer	10.8	21.14	32.49	7	3.4	0.30	0.01	0.02	0.11	0.14	0.040	0.021	1.29		

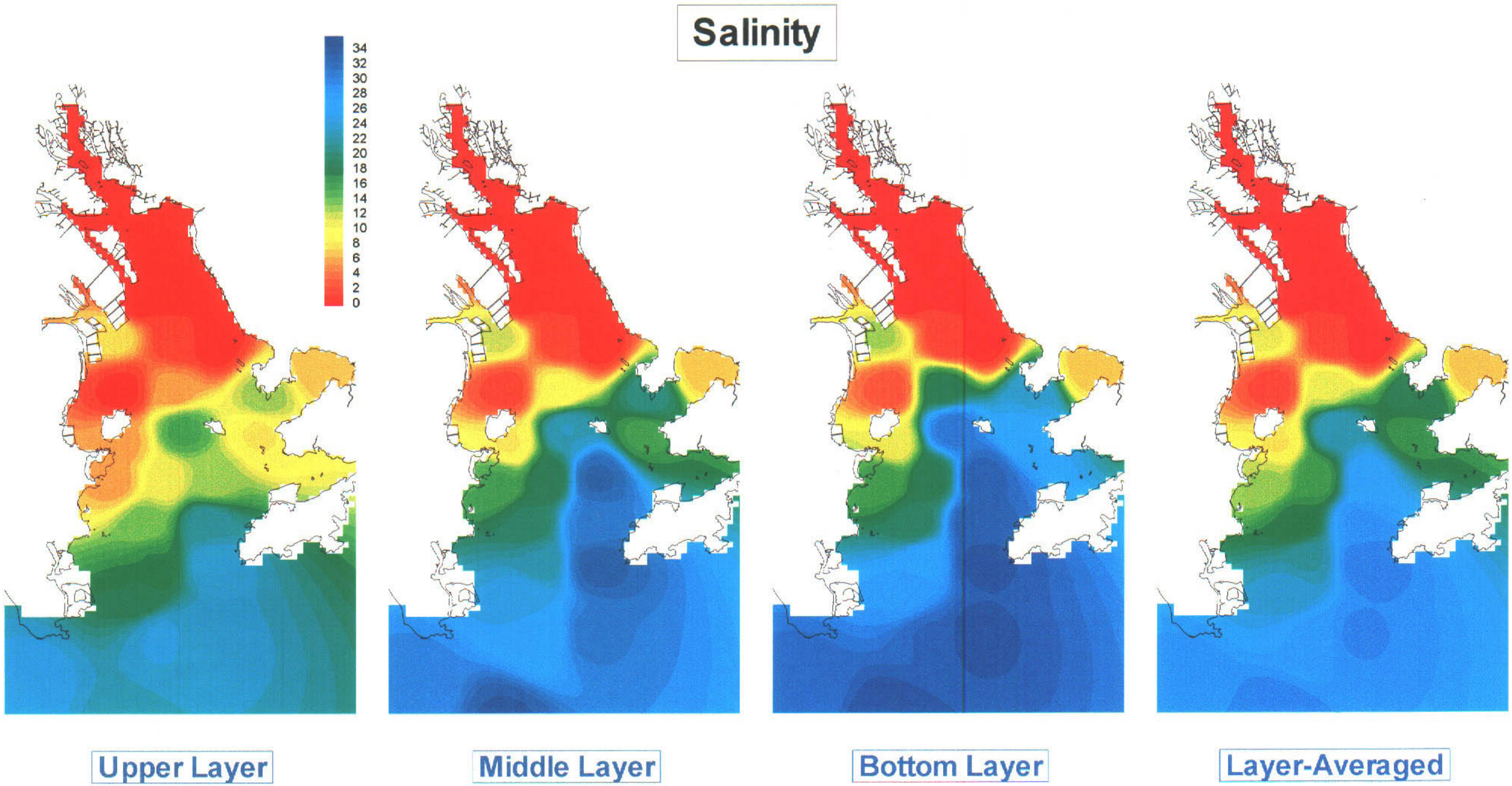

Figure 3.2.1 Result of the Survey on Salinity (Spring Tide, Rainy Season)

Spring Tide : July 31 - August 3, 2000

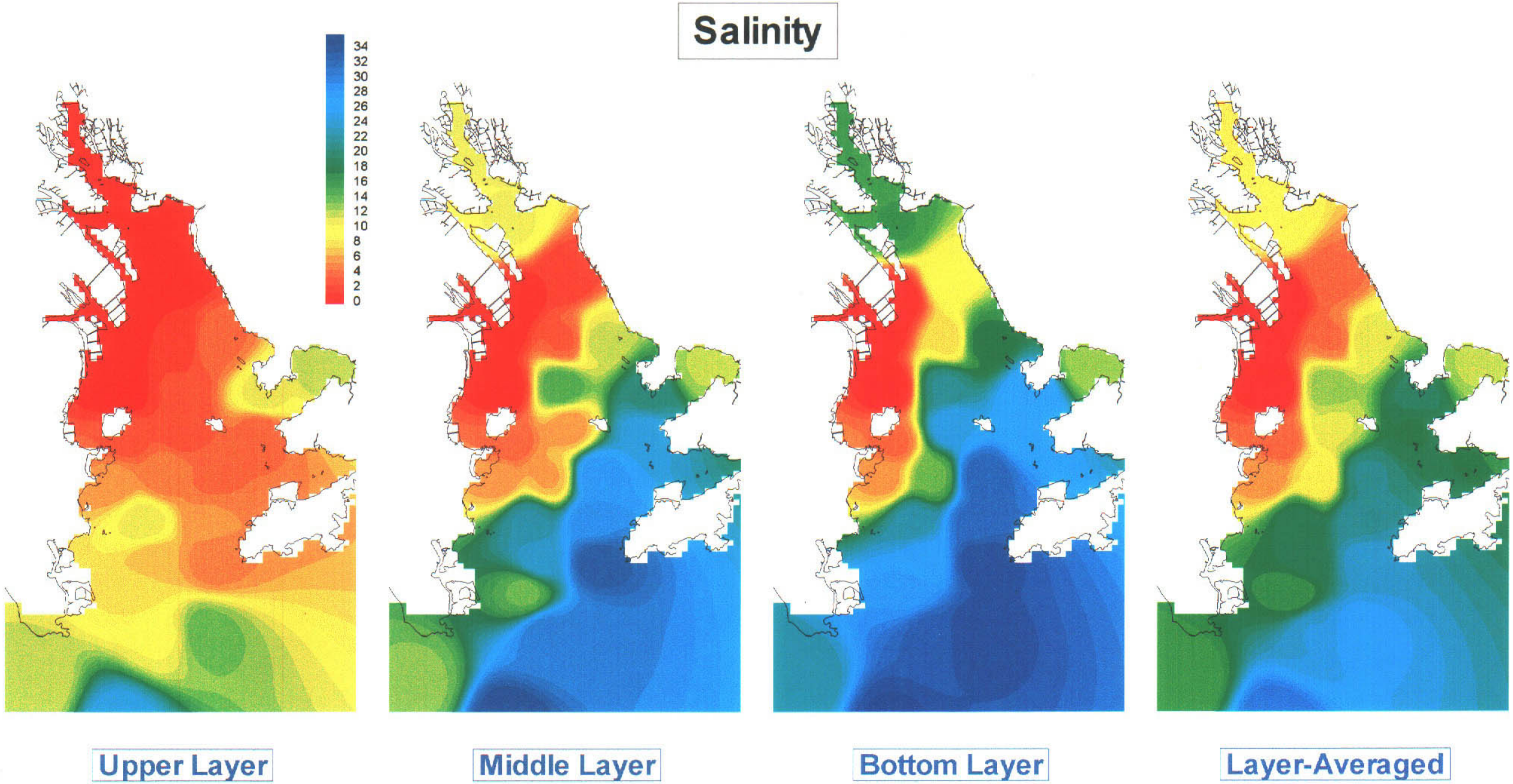

Figure 3.2.2 Result of the Survey on Salinity (Neap Tide, Rainy Season)

Neap Tide : August 6 - 9, 2000

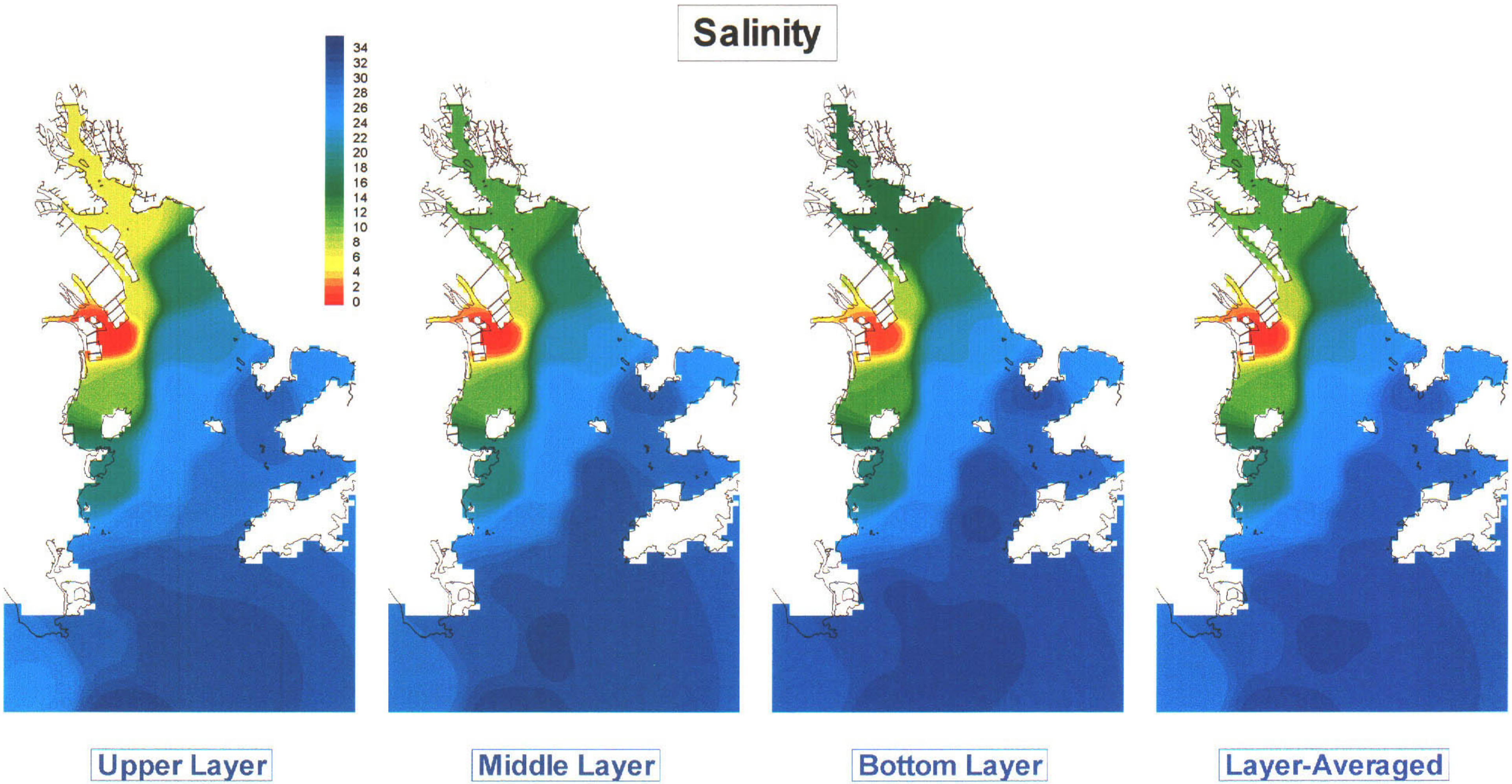

Figure 3.2.3 Result of the Survey on Salinity (Spring Tide, Dry Season)

Spring Tide : December 9 - 14, 2000

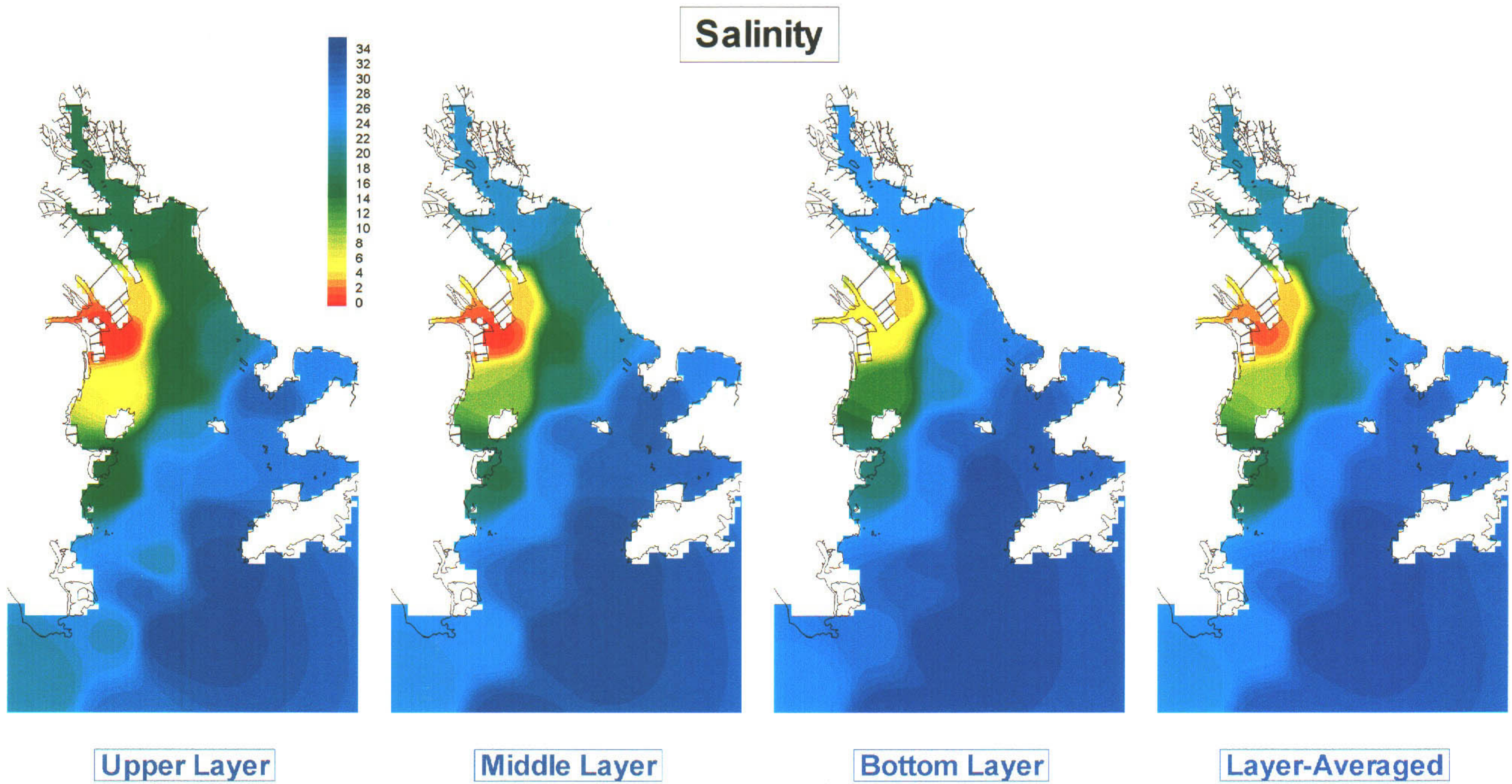

Figure 3.2.4 Result of the Survey on Salinity (Neap Tide, Dry Season)

Neap Tide : December 4 - 8, 2000

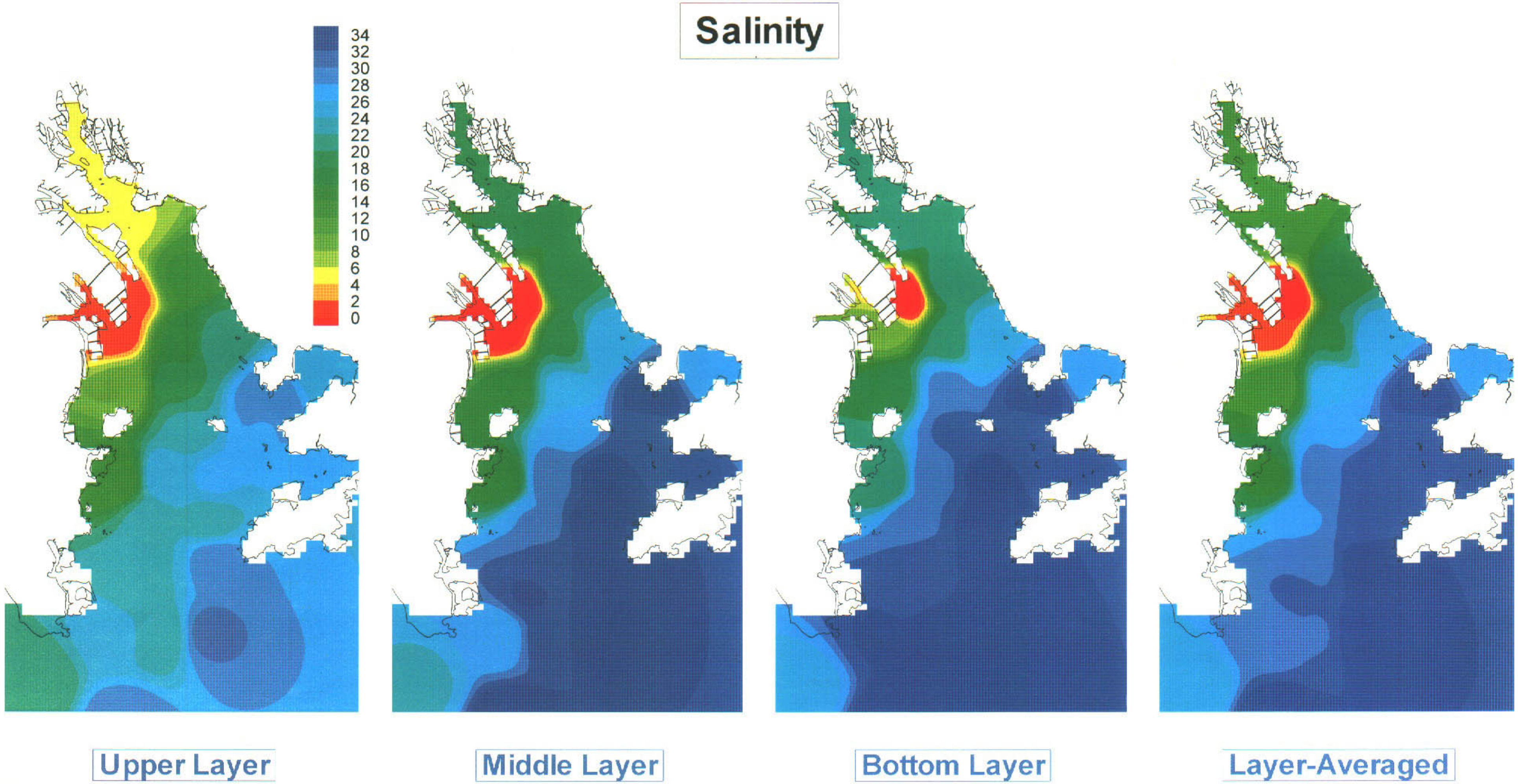

Figure 3.2.5 Result of the Survey on Salinity (Neap Tide, Intermediate Season)

Neap Tide : March 4 - 6, 2001