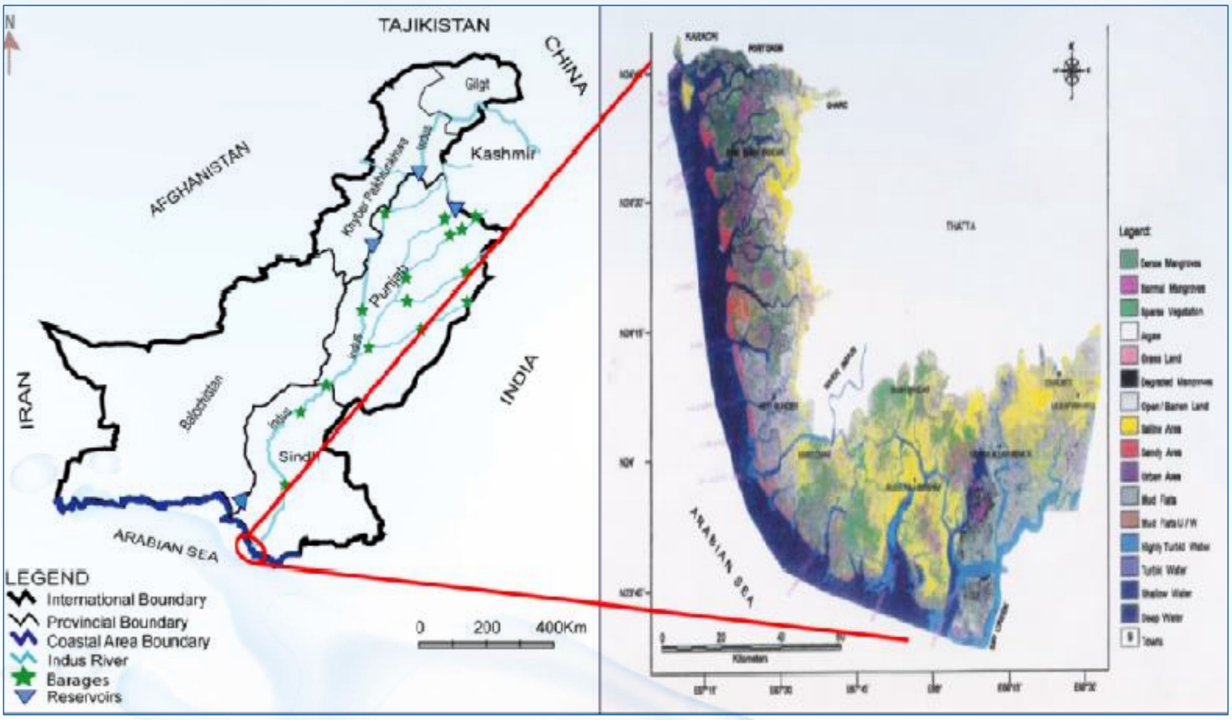
U.S.-Pakistan
Centers for Advanced Studies in Water

# Monitoring of Seawater Intrusion in Indus Delta for Climate Change Adaptation

## Final Report 2019





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**Disclaimer**

The contents of the report are the sole responsibility of the authors and do not necessarily reflect the views of the funding agency and the institutions they work for.

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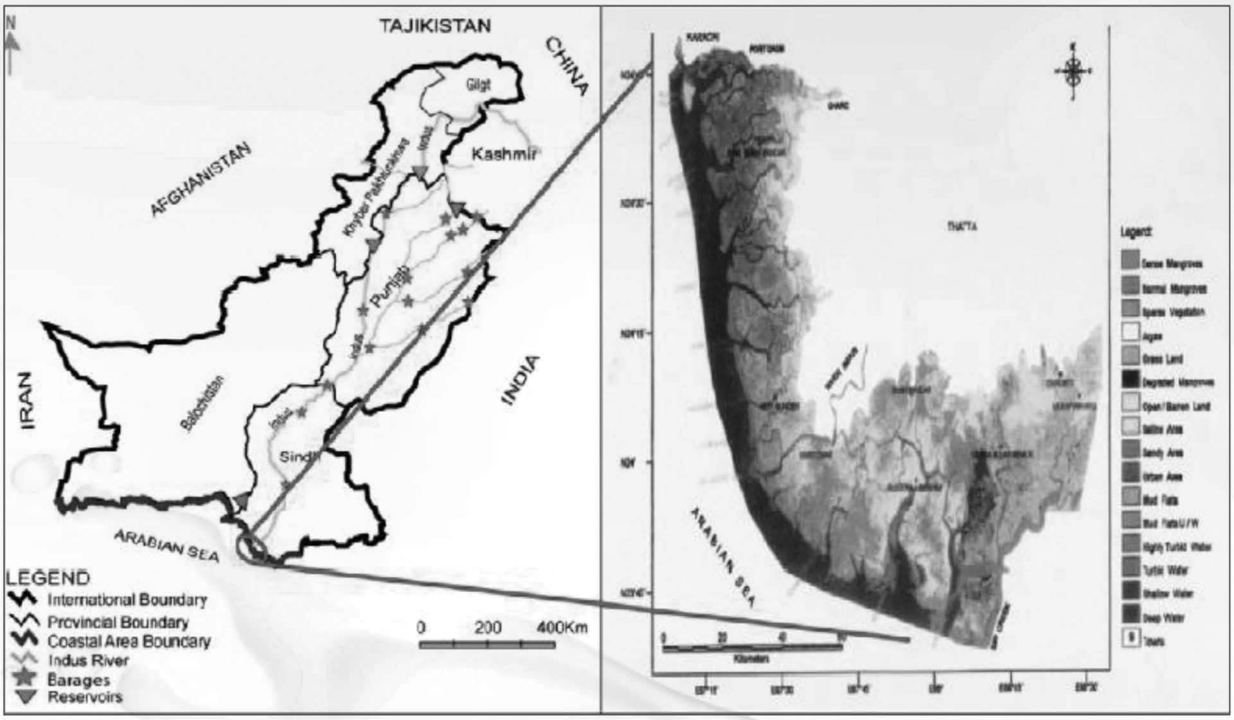


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# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# LIST OF ANNEXURES

# ACKNOWLEDGEMENTS

The authors are highly thankful to the United States Agency for International Development (USAID) for funding this project through the U.S.-Pakistan Centre for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering Sciences and Technology (MUET), Jamshoro, Sindh, Pakistan. The efforts of PCRWR colleagues from Regional Office, Tandojam and Karachi are also appreciated for the smooth execution and field activities. We are also thankful to Mr. Naveed Iqbal, Deputy Director PCRWR who has provided his support for GIS mapping pertaining to various physio-chemical parameters of groundwater monitoring and for his assistance in editing of this report. It is no doubt a fact that this study was not possible to be completed without the technical guidance and leadership role extended by Dr. Muhammad Ashraf, Chairman PCRWR.

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# LIST OF ABBREVIATION

| | |
|---|---|
| DTW | Depth to Water Table |
| EC | Electric Conductivity |
| FGD | Focused Group Discussion |
| GIS | Geographic Information System |
| IUCN | International Union for Conservation of Nature |
| MLOW | Multi-Level Observation Well |
| NEQS | National Environmental Quality Standards |
| NGO | Non-Governmental Organization |
| NGVS | No Guideline Values |
| PCRWR | Pakistan Council of Research in Water Resources |
| PRA | Participatory Rural Appraisal |
| PSDP | Public Sector Development Program |
| RO | Reverse Osmosis |
| SDG | Sustainable Development Goal |
| SWI | Sea Water Intrusion |
| TDS | Total Dissolved Solids |
| WWF | World Wildlife Fund |

# EXECUTIVE SUMMARY

The impacts of climate change implications are more pronounced in the deltaic region of Pakistan, dominantly influenced by sea level rise, seawater intrusion, increased salinity, erosion and variability in surface flows. The temporal changes in the spatial extent and salinity level are important factors in understanding the dynamics of seawater intrusion. In keeping with this background, PCRWR conducted this research study with the financial assistance of U.S. Pakistan Center for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering and Technology, Jamshoro. The main objective of the study was to assess the extent and vulnerability of the Indus Delta so that strategic adaptation measures could be suggested to protect productive agricultural lands and thereby socio-economic development of the area. The major activities included; i) collection of existing information related to seawater intrusion in the Indus delta besides other studies in the area; ii) installation of new network of multi-level observation wells (MLOWs); iii) collection of water quality samples and water level data from MLOWs on monthly basis; iv) development of PRAs design and conducting the field survey for socioeconomic assessment; and v) data analysis and synthesis with ground observations and other studies in the area and also in other parts of the world.

The main delta area with relatively flat topography is covered under silty loam to loam soils in upper 3.0 m depth whereas further up in Sujawal and Badin areas, the soils are silty clay loam to clay loam. The latter type of lithology has a dominant role in restricting the groundwater recharge in Sujawal and Badin areas. The study area falls mainly in hot desert climate with warm to hot summers and mild winter. The long term analysis of annual rainfall data showed about 40 mm decrease in annual rainfall during the years 1997-2017. The analysis of maximum and minimum temperature variations in the study area showed insignificant increase in summer extreme temperatures whereas the winter minimum temperatures are getting milder showing an average increase of 2$^{o}$C. This shows that night time temperatures are rising which have adverse effect on crop physiography and productivity. This evidence clearly conforms with the observations gathered from the community during the PRA surveys in relation to rainfall reduction and rising temperatures; having direct impact on crops and ultimately community livelihood.

The climate change is therefore seriously being observed by the deltaic community. About 63% of the respondents shared that their income got affected because of changing climatic conditions and that almost 23% respondents had suffered harshly due to loss of agricultural land. This is supported by the geo-spatial analysis under the study which is also endorsed by other similar studies in the area. The change in water

availability for crops in recent years was a hot debate as majority was experiencing significant decline in water availability (70%) which is required to be explored further in the context of recommended environmental flows. About 34% respondents said climate change has direct impact on cropping season and that they have started practicing early sowing and early harvesting to cope with the change.

The groundwater monitored in the study area was within 1.0 m depth from surface during monsoon period and it varied seasonally. The extremes of watertable depths were observed in pre-monsoon (June) and monsoon (Jul-Aug) seasons, on an average, from 3.0 m to 1.0 m, respectively, whereas in the main deltaic region the groundwater remained almost near the surface. The salinity (EC) increases with depth from the surface in terms of concentration and areal extent from 1,000 µS/cm to greater than 150,000 µS/cm with highest concentrations in Badin and the areas along the Thar desert. The trend also shows increase in salinity from post-monsoon towards low-flow period (November towards June). The higher concentration of salinity needs further study by isotopic sampling to help certify the source and aging of groundwater in the Indus delta because salinity in the aquifer could be predominantly due to fossil water salinity from geological origin.

Two well-known ionic ratios were studied viz. $Ca^{2+}$:$Mg^{2+}$ and $Cl^-$:$HCO_3^-$ whereby the values more than unity (1.0) are indicative of seawater intrusion. The $Ca^{2+}$:$Mg^{2+}$ ratio was generally near or more than unity in most part of the study area with higher values in Thatta district. The ratio significantly decreases with depth below ground surface and also with passage of time (November to June). The Cl:$HCO_3$ ratios are much higher than unity in most part of the study area with significant temporal and spatial variation. The ionic ratio increases with depth and time (from November to June). The increase in ionic ratio also extends from Badin towards Sujawal in a similar manner.

While linking these two ratios with presence of higher concentration of Cl and Mg, it is inferred that the presence of high concentration of these ions in the groundwater indicates availability of soluble salts in groundwater like magnesium chloride, which is generally extracted from seawater. The higher concentration of chloride is also linked with the presence of sodium (Na) in the groundwater analyzed under the study which is also of concern as higher concentration of sodium generally poses risk of cardiovascular diseases and also of developing hypertension as reported by the deltaic community of having same diseases in the study area. The presence of higher concentrations of chloride with time and depth might be linked with incidence of seawater intrusion in study area which is substantiated with similar observations in coastal areas in other parts of the world.

Summarizing the observations and analyses based on approximately one-year data, it is inferred that various ionic ratios, presence of higher concentration of magnesium, chloride and sodium ions and their variation in the study area with depth and time might be linked with incidence of seawater intrusion. The effect is certainly less in upper parts of the study area which are away from the main deltaic region. These observations were further substantiated to some extent from the field observations and direct response from the concerned community.

Poverty is evident in the area as job opportunities are quite limited and most of the people find their ways to urban centers for their earning. Although most of the children are going to schools and colleges but large proportion of the youth (80%) is still limited to fishing and agricultural activities. Regarding women participation, almost all of the women are participating in household work while a small fraction also participates in transplanting rice, feeding and milking livestock, harvesting of crops etc. The information gathered from the field revealed that over the last 10 years, no significant migration had taken place from the area. Of the survey respondents, 49% were pondering about migration, the major reasons were the loss of land because of salinity (30%), and lack of drinking water (25%) leading to poverty in the area.

About 70% of the surveyed population depends on groundwater as their source of drinking water, with other sources as ponds and canal water. Due to highly saline water, 97% had one or the other family member suffering from serious diseases like hepatitis, hypertension, vomiting, diarrhea, skin infections and liver diseases which may be related to higher concentration of sodium/ salinity found in the study area. Electricity is the major source of energy in the area (42%) though the majority finds the supply to be erratic and unreliable. This leads to deforestation in the area which could be one of the reasons of abandoning of mangroves in the Indus delta as wood is another energy source. Although large number of NGOs were reported to be present in the area but the contribution was limited and wherever they were working, they helped for education, health and agriculture.

In order to deal with such conditions in the deltaic region, certain strategic recommendations have been made ranging from continuation of the subject study to have more data and isotopic sampling to justify the extent of salinity besides structural and socio-economic measures for the sustainable livelihoods of the deltaic community.

# 1. INTRODUCTION

## 1.1 Background and Rationale of the Study

The issue of climate change is one of the most challenging problems of the current century. Similarly, greenhouse gas emissions also affect the atmosphere in the same way no matter in what part of the world they originate from. The estimates show that the climate change during current century would affect rainfall patterns, river flows and sea levels all over the world, whereby the least developed countries are expected to suffer more (IPCC, 2008). The recently adopted world agenda as Sustainable Development Goals under SDG-13 says *"Take urgent action to combat climate change and its impacts.* Similarly, SDG-6.6 on Water suggests *"By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes".*

Pakistan falls amongst top ten countries which have been affected the most in the last two decades as per Climate Risk Index (Eckstein *et al.*, 2019). The recurrent flooding and droughts with large variability in monsoon rains are affecting the overall water, food and energy nexus worldwide and Pakistan is no exception (Rasul *et al.*, 2012). Such effects are more pronounced in coastal areas, especially in the Indus delta where issues of sea level rise, erosion, seawater intrusion and increasing cyclonic activity are at rise (Rabbani *et al.*, 2008). The large variability in downstream freshwater flows and probable saltwater intrusion might have devastating effects on the ecology and human economy of the Indus delta.

In the Indus delta, large productive lands in the area have become unsuitable for agriculture, and drinking water sources have become very scarce or have already vanished (GoP, 2001; IRIN, 2001; Zaigham, 2002; Memon, 2005). According to the reports, the seawater has encroached about 64 km of land area, and loss of agricultural lands has been around 1.2 million acres (IUCN, 2005). Climate change and environmental degradation over time are thought to be root causes of the rise of sea level leading to loss of land making it unusable for cultivation, increasing salinity, depleting mangroves and decline in fish business Mimura, 2013). A study conducted by IUCN (2003) showed that reduced freshwater flows and consequent ecosystem degradation had impacted heavily on local livelihoods and economic production in the Indus delta area. Further fish catch had also declined steadily as salinity had increased.

Seawater intrusion is a complex process by which salty water gradually migrates into freshwater areas (Barlow and Reichard, 2010). It is a common process that occurs in nearly all coastal areas and can be brought about by geological mechanisms, river flows, groundwater development or even storms. Consequently, the loss in fertile soil leads to the decline in crop production and resulting ruthless downfall to livestock, lack of fodder, loss of grazing land, water bodies, and ultimately extensive migration of population and livestock (Salman, 2002). The residents of the deltaic region are forced into involuntary migration and so far 1.5 million people have been displaced (Junejo, 2011).

Some climate scientists do not see fresh flows from the Indus River into the sea as the only solution to reduce seawater intrusion (Rasul *et al.,* 2012). Khan (2008) provided diverse community perceptions and evidences regarding displacement because of sea erosion, and both environmentalists and communities relate sea erosion to scarcity of fresh water flows into the sea. On other hand, climate scientists see global climate change as the main precedent for rise in sea level. The rapid decline in fresh water also damaged the quality of water in the delta and it became increasingly saline. Gill *et al.* (2012) has clearly mentioned that because of imbalance between fresh and brackish water the area had been converted to saline pools. Seawater (saline water) intrusion, therefore, presents a significant threat to water quality in coastal aquifer systems in the right and left bank of Indus River near coastal areas of southern Sindh. The current study therefore was carried out to assess the presence and thereby extent of seawater intrusion in Indus delta and also its impacts on socio-economic situation of the area.

## 1.2 Objectives

The main objective of the study was to assess the extent of seawater intrusion and vulnerability of the Indus delta so that strategic adaptation measures could be suggested to protect productive agricultural lands and thereby socio-economic development of the area. The specific objectives are:

1. Physical monitoring of seawater intrusion in the Indus delta.
2. Impacts of seawater intrusion on land, water and related socio-economic conditions in the affected areas.
3. Predictive scenarios to suggest evidence-based climate change adaptation measures for marginalized communities and their livelihoods.

# 2. MATERIALS AND METHODS

Under this project, in order to accomplish the overall project objectives, a number of activities were carried out in the Indus delta region covering existing data/ information collection, field physical monitoring of groundwater, socio-economic surveys, and conceptual model setting.

## 2.1 Study Area Description

The Indus River delta is the area where the Indus River flows into the Arabian Sea, mostly in the southern Sindh province of Pakistan with a small portion in the Kutch Region of the western tip of India. The fan-shaped delta consists of creeks, estuaries, mud, sand, salt flats, mangrove habitat, marshes, sea bays, and straits and rocky shores. The climate in the area is mainly arid with rainfall varying from 250 to 500 mm in a normal year. The delta has been the home to the largest arid mangrove forests in the world as well as many birds, fish and the Indus dolphin. There are currently 17 major creeks such as Sir Creek, Kori Creek, Bhitiaro Creek, and numerous minor creeks (Fig. 2.1).

The length of coastline of the Indus delta with the Arabian sea has been reported by different sources as 210 km (WWF, 2012), 220 km (Memon, 2005), or 240 km (Saifullah, 1997). Historically, the Indus river has changed its location over time, so it has an “active” delta region, and total delta region - all area that was once a part of the delta- (Coleman *et al.*, 2008). The total area is reported to be 29,524 km$^2$ (Coleman *et al.,* 2008), 30,000 km$^2$ (Memon, 2005), or 41,440 km$^2$ (WWF, 2012); the active area is estimated as 4,762 km$^2$ (Coleman *et al.*, 2008) or 6,000 km$^2$ (IUCN, 2003; Memon,

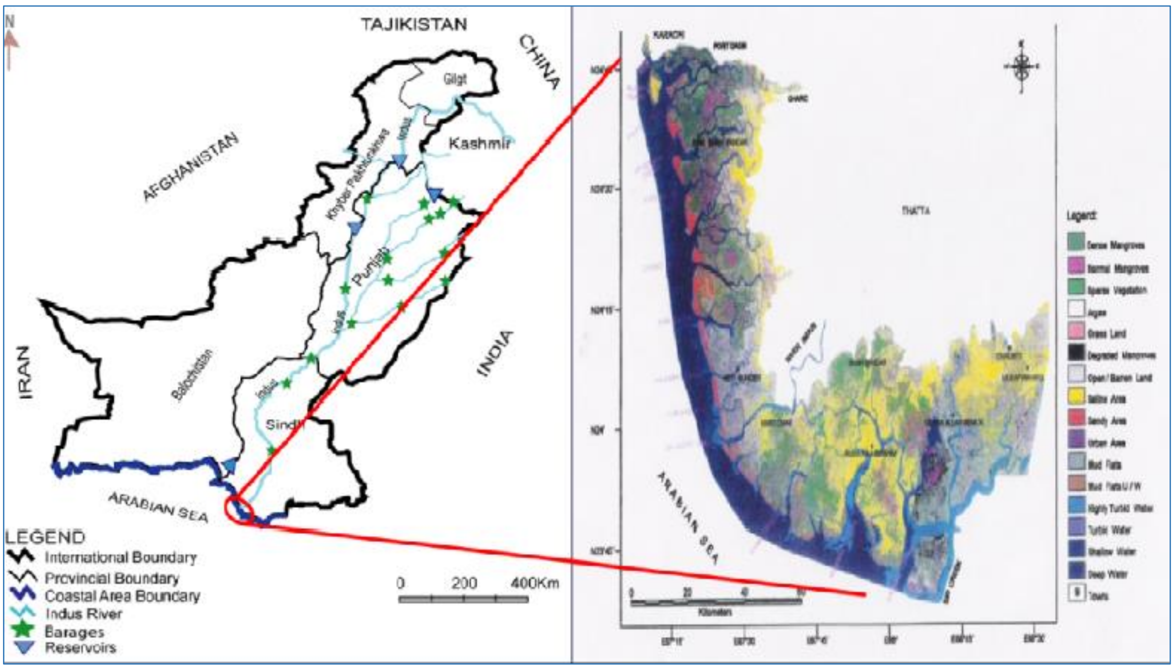


**Fig. 2.1: Location map of the Indus Delta, Pakistan (Source: Saied *et al.*, 2013)**

2005); whereas the current delta stretches from the Arabian sea to just south of Thatta at a distance of ~100 km (Memon, 2005).

The deltaic areas fall mainly in Thatta, Sujawal and Badin districts of Sindh province, involving Indus river where it discharges into the Arabian sea. The area on eastern side is bounded by the Thar desert, western side by Thatta district and southern side is the Arabian sea.

## 2.2 Scheme for Physical Monitoring of Seawater Intrusion in the Indus Delta

Under this objective, the activities were designed to monitor the groundwater fluctuations and quality from different depths by installing multi-level observation wells (MLOWs) on a regular grid network. Although the deltaic areas fall mainly in Thatta, Sujawal and Badin districts of Sindh province, the piezometeric network was extended up to downstream of Kotri Barrage so that the extent of seawater intrusion could be assessed in the Indus deltas as well as in the adjoining areas.

Total 42 MLOWs were installed at an approximate grid of 18 km x 18 km to strategically cover whole Indus delta and upstream areas. As such 05 districts (Thatta, Badin, Sujawal, Tando Muhammad Khan and Hyderabad/Latifabad) were included as a part of the study covering total area of 24,764 km$^2$ (Table 2.1) whereas the network of 42 piezometers was spread over an area of 14,608 km$^2$ excluding the marshy and creek areas while including most parts of Thatta, Badin, Sujawal and Tando Muhammad Khan districts and a minor part of Hyderabad district (part of Latifabad Tehsil) downstream of Kotri Barrage. The Fig. 2.2 shows the coverage of piezometric network (dotted magenta color line) as well as extent of study area (green color lines). The design of MLOWs is shown in Fig. 2.3 along with glimpses of installation, wherein 1.5 inch (37.5 mm) outer casing includes three small tubes of 5 mm, 5 mm and 12.5 mm size inserted up to 6 m, 13 m and 20 m depths, respectively, for water quality monitoring at these depths.

These MLOWs were meant to monitor water quality at three different water table depths viz. 6 m, 13 m, and 20 m. Furthermore, the changes in depth to water table (DTW) were also monitored at these MLOWs. For both water quality and DTW, samples were collected on monthly basis. This network of MLOWs was utilized on monthly basis for the monitoring of depth to water table (DTW) along with 09 other physico-chemical parameters (Hardness, EC, pH, TDS, Ca, Mg, Cl, $HCO_3$ and Na). GIS based mapping of DTW, EC and ionic ratios were used for the spatio-temporal analysis of seawater intrusion in the study area. Monitoring only EC is not reflective of seawater intrusion; therefore the factors responsible for the brackish groundwater quality with respect to the influence of seawater were assessed, using the standard ionic ratios, such as $Ca^{2+}$ : $Mg^{2+}$, TA : TH and $Cl^{-1}$ : $HCO_3^{-1}$ (Rao *et al.*, 2005; Barlow and Reichard, 2010). The physical field monitoring took place from November 2017 to June 2018 as the study period was only one year.

**Table 2.1: Area coverage of piezometric network under study**

| S. # | District | Tehsils | Total area ($km^2$) | Area under piezometric study ($km^2$) | % Area |
|---|---|---|---|---|---|
| 1 | Thatta | i. Thatta, ii. Mirpur Sakro, iii. Keti Bander, iv. Ghorabari | 8570 | 5000 | 58 |
| 2 | Sujawal | i. Sujawal, ii. Shah Bandar, iii. Mirpur Bathoro, iv. Jati, Kahro Chan, v. Jati | 7335 | 2988 | 41 |
| 3 | Badin | i.Badin, ii. Nindo Shaher, iii. Khoski, iv. Golarchi, v. Matli, vi. Shaheed Fazal Rahu, vii. Talhar, viii.Tando Bago | 6726 | 5250 | 78 |
| 4 | Tando Muhammad Khan | i. Bulri Shah Karim, ii. Tando Ghulam Hyder, iii. Tando Muhammad Khan | 1814 | 1051 | 58 |
| 5 | Hyderabad | i. Latifabad only | 319 | 319 | 100 |
| Total | 05 | 20 | 24,764 | 14,608 | 59 |

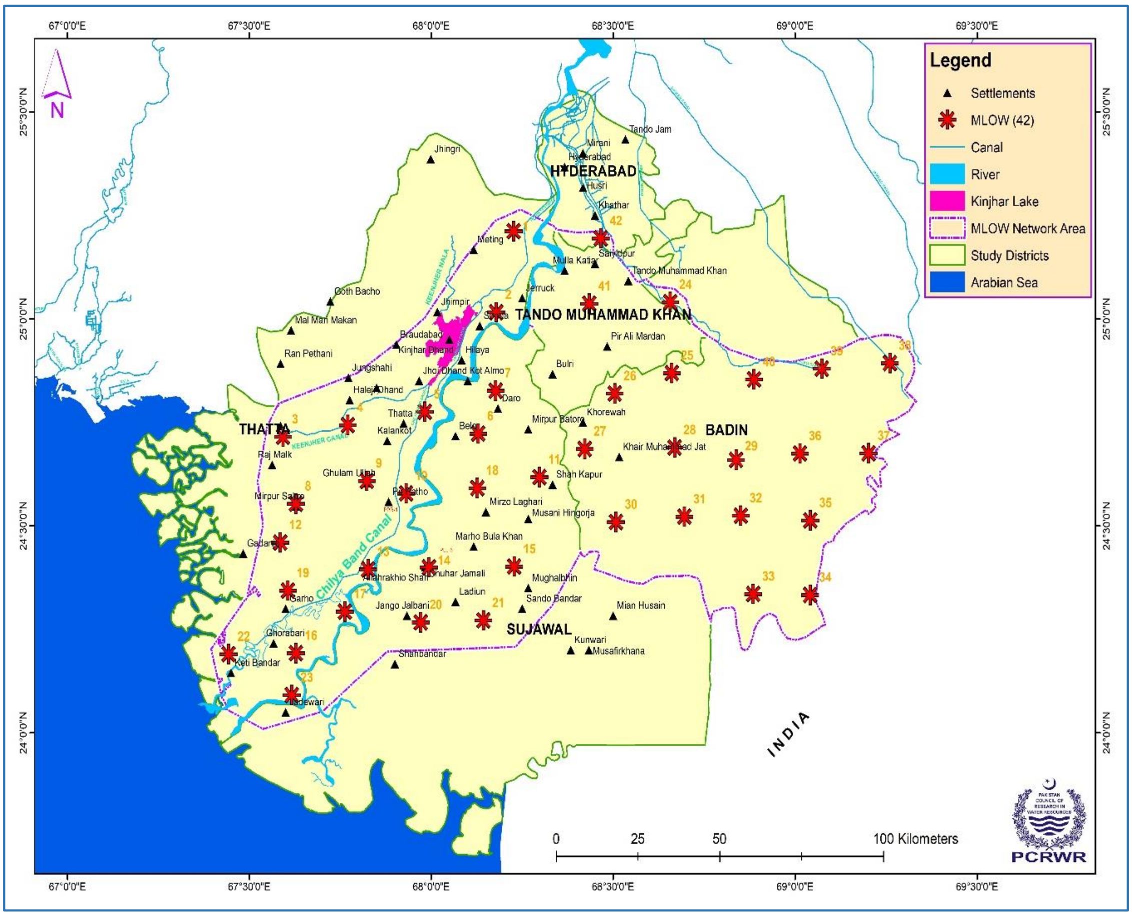


**Fig. 2.2:** **Piezometric network developed under study for groundwater quality and levels**

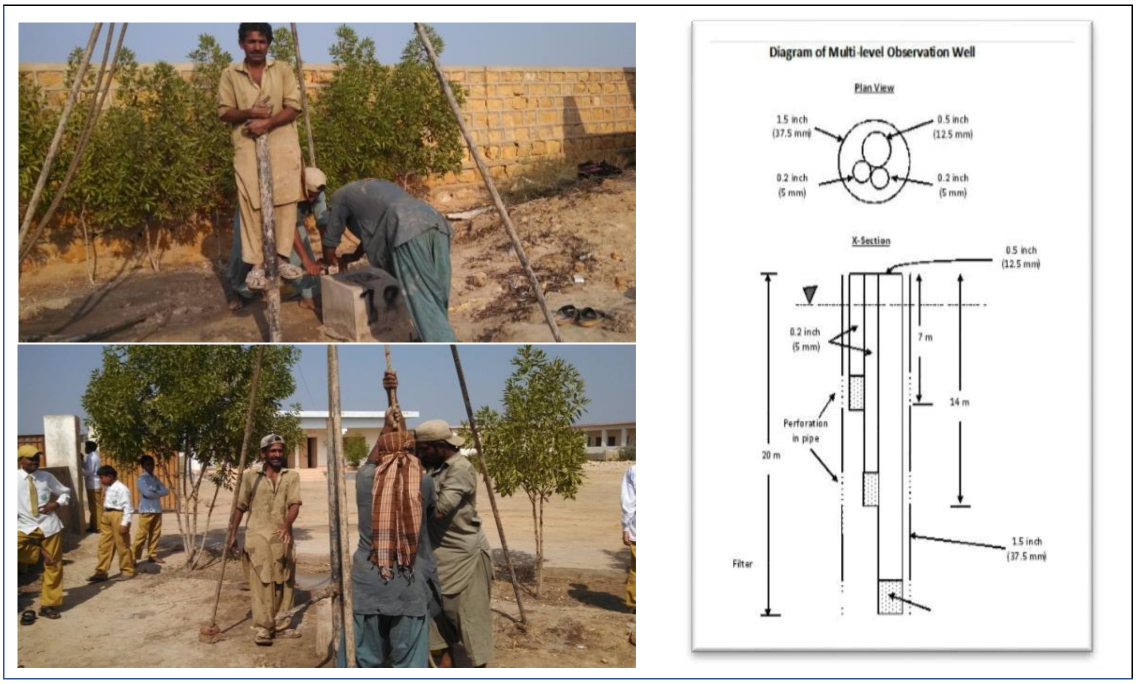


**Fig. 2.3:** **Design and installation of MLOWs**

## 2.3 PRAs to Underpin the Impacts of Seawater Intrusion on Land, Water and Socio-Economic Conditions in the Indus Delta

To underpin the impacts on land, water and socio-economic conditions, PRAs were conducted using Focused Group Discussion (FGD) approach in the study area. A well-structured questionnaire (Annex-1) was developed and used for the input of the community, with special consideration to gender and youth. After testing, the regular PRAs were conducted in the field by a team comprising of technical and social members. The PRAs were designed in such a way that at least one FGD was conducted in each grid covering 20 Tehsils falling in the five districts; Badin, Thatta, Sujawal, Tando Muhammad Khan and Hyderabad (Latifabad Tehsil only) and that total 42 FGDs were held. Based on population concentration and active part of Indus delta, more than one FGD were held in some tehsils such as Thatta, Sujawal, Badin, etc. (Table 2.2). This provided reasonable coverage of the Indus delta, extending to all 42 grids under the project. The PRAs were conducted taking into consideration true representation of the relevant deltaic community of specific area as the participants were local public representatives, common people, farmers, teachers, fishermen, community workers, women and youth. Total respondents were 771 with 99:1 male: female ratio and average participation of 18 persons per FGD.

**Table 2.2: Areas where PRAs were conducted in the Indus Delta**

| S.No. | District | Tehsils | FGDs |
|---|---|---|---|
| 1 | Thatta | i. Thatta, ii. Mirpur Sakro, iii. Keti Bander, iv. Ghorabari | 14 |
| 2 | Sujawal | i. Sujawal, ii. Shah Bandar, iii. Mirpur Bathoro, iv. Jati, Kahro Chan, v. Jati | 08 |
| 3 | Badin | i. Badin, ii. Nindo Shaher, iii. Khoski, iv. Golarchi, v. Matli, vi. Shaheed Fazal Rahu, vii. Talhar, viii.Tando Bago | 16 |
| 4 | Tando Muhammad Khan | i. Bulri Shah Karim, ii. Tando Ghulam Hyder, iii. Tando Muhammad Khan | 03 |
| 5 | Hyderabad | i Latifabad | 01 |
| Total | 05 | 20 | 42 |

## 2.4 Predictive Scenarios to Suggest Evidence-based Climate Change Adaptation Measures for Marginalized Communities and their Livelihoods

To achieve the third objective of this study, the predictive scenarios would be simulated through physical groundwater modeling. This prediction was proposed to be based on the input datasets consisting of physical data mainly climatic (rainfall, temperature, aridity etc.), surface flows, land use/land cover, groundwater lithology and water quality/ fluctuations data, land degradation, salinity and waterlogging, water use for various purposes. For this purpose, a comprehensive surface-cum-groundwater interaction model was required to be developed. The main purpose of this modeling would be to simulate the spatio-temporal changes (such as extent, lateral and vertical variability and severity) and impacts of seawater intrusion in deltaic region as well as generation of futuristic scenarios for sustainable ecosystem management in Indus Delta.

The data collected were analyzed to see the extent of the issue. The appropriate strategic adaptation measures are proposed to combat climate change impacts towards sustainable land and water use for productive agriculture and enhanced livelihoods. Those would be in the form of actions needed either as further research studies, development activities, policy guidelines or capacity building needs of the farmers, community or the institutions concerned in those areas. A national level workshop would also be organized to share and disseminate the outcomes of the study amongst researchers, policy makers and development agencies for wider understanding and appreciation of the problem.

# 3. RESULTS AND DISCUSSION

## 3.1 Physical Monitoring of Seawater Intrusion in the Indus Delta

In order to monitor seawater intrusion in the Indus Delta, a network of 42 multi-level observation wells (MLOWs) was established under this project. The main objective for installing MOWs was to monitor spatio-temporal variations related to groundwater levels and salinity status at different depths in the Indus delta and adjoining upstream areas. During the installation of these MOWs, soil profile data and water quality samples were collected at 0, 3, 6, 13, and 20 m. After installation, the water quality and water levels were monitored at the end of every month and the samples were analyzed at PCRWR Water Quality Labs for important parameters such as EC, TDS, pH, Hardness, $CO_3$, $HCO_3$, Cl, Ca, Mg, and Na. The monitoring for groundwater levels was started from July-August 2017 (during MLOWs installation period) whereas for water quality sampling was done from November 2017 and continued till June 2018 (end of project), providing 11 months' data for water levels and 8 months' data for the water quality monitoring from MLOWs as the study period was only one-year.

The **lithological variations** based on soil samples collected during the installation of piezometers are shown in Annex-2. The Fig. 3.1 shows the average sub-surface lithological variations up to 3 m depth, based on the bore-logs of 42 MLOWs.

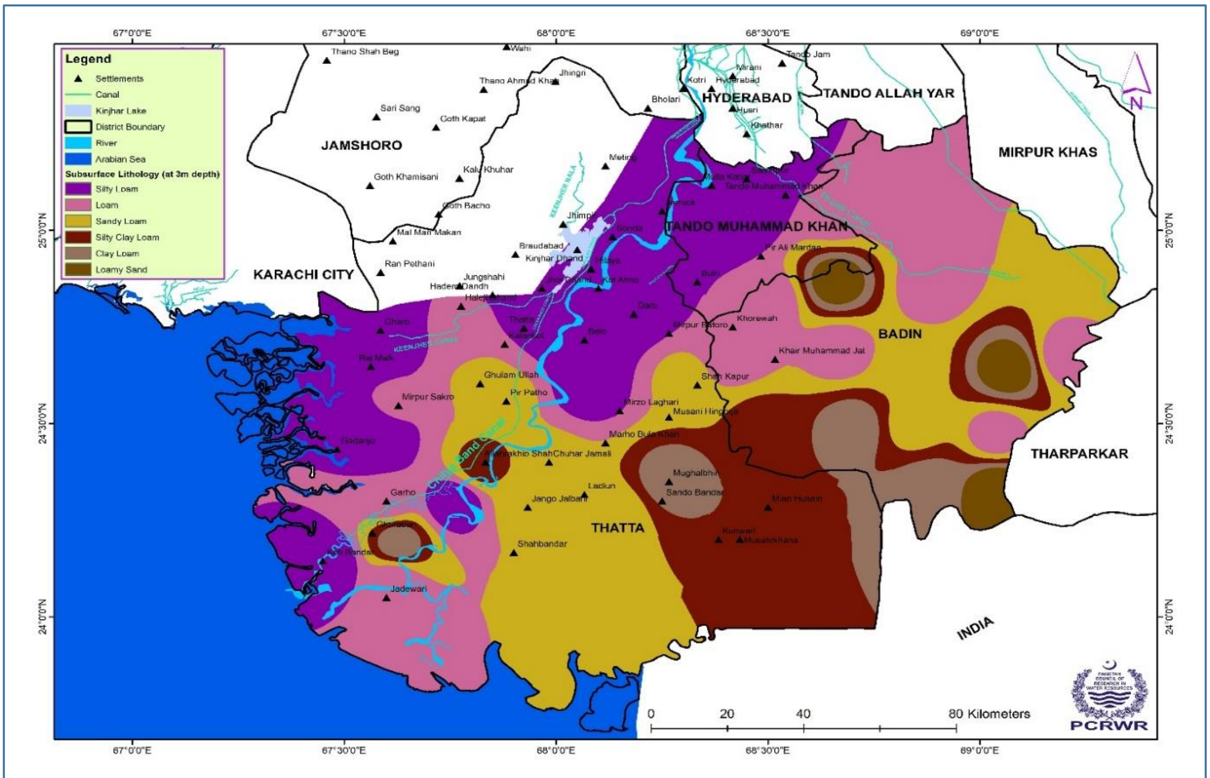


**Fig. 3.1: Average sub-surface lithological variations in the Indus Delta up to 3 m depth**

It is quite evident from the map that most of the area in main delta part has silty loam to loam soils in upper 3 m depth whereas further up in Sujawal and Badin areas, the soils are silty clay loam to clay loam. The latter type of lithology has a dominant role in restricting the groundwater recharge in deltaic areas of Sujawal and Badin. The topography of the study area shows elevation variation in main delta from 0-4 m whereas in the remaining study area the elevation varies up to 20 m and a small area in the upper part goes up to 200 m (Fig. 3.2).

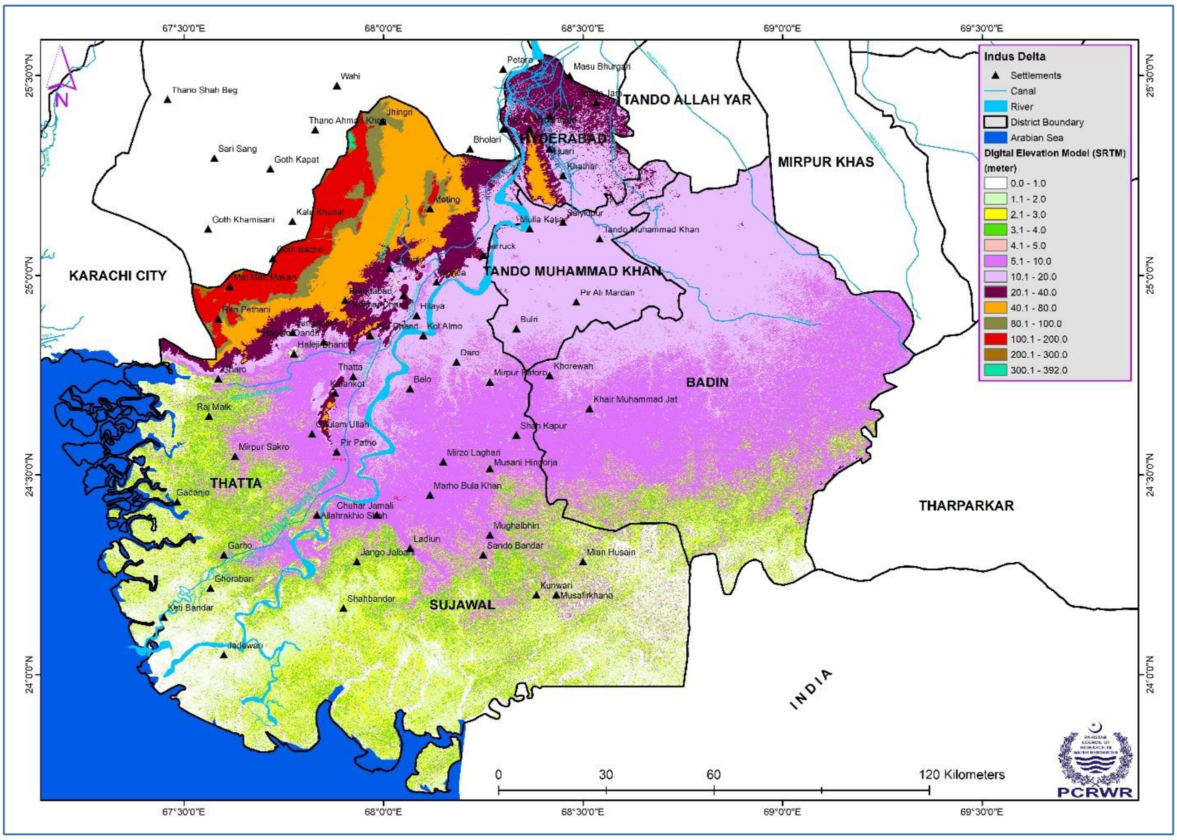


**Fig. 3.2: Elevation variation in the study area**

The **water table condition** in the Indus delta (Fig. 3.3) monitored during end July 2017 (MLOWs installation period) showed that it varied upto 1.0 m (0 - 3 ft) depth from the surface in most of the study area. However, it varied seasonally as indicated by the variations in water table during June 2018 when it declined up to 3.0 to 5.0 m depth (Fig. 3.4). This is not the case in the main delta part where it remained within 1.0 m from the surface. Furthermore, the extremes of water table depths were observed in pre-monsoon (June) and monsoon (Jul-Aug) seasons, on an average, from 3.0 m to 1.0 m water levels, respectively, whereas in the main deltaic region the groundwater remained almost near the surface (Annex-3). As such, there is no significant groundwater pumping in this area due to high salinity and waterlogging conditions except for limited hand pumps for drinking purpose only, but the water level changes with respect to high aridity (evaporation) and variations in climatic conditions.

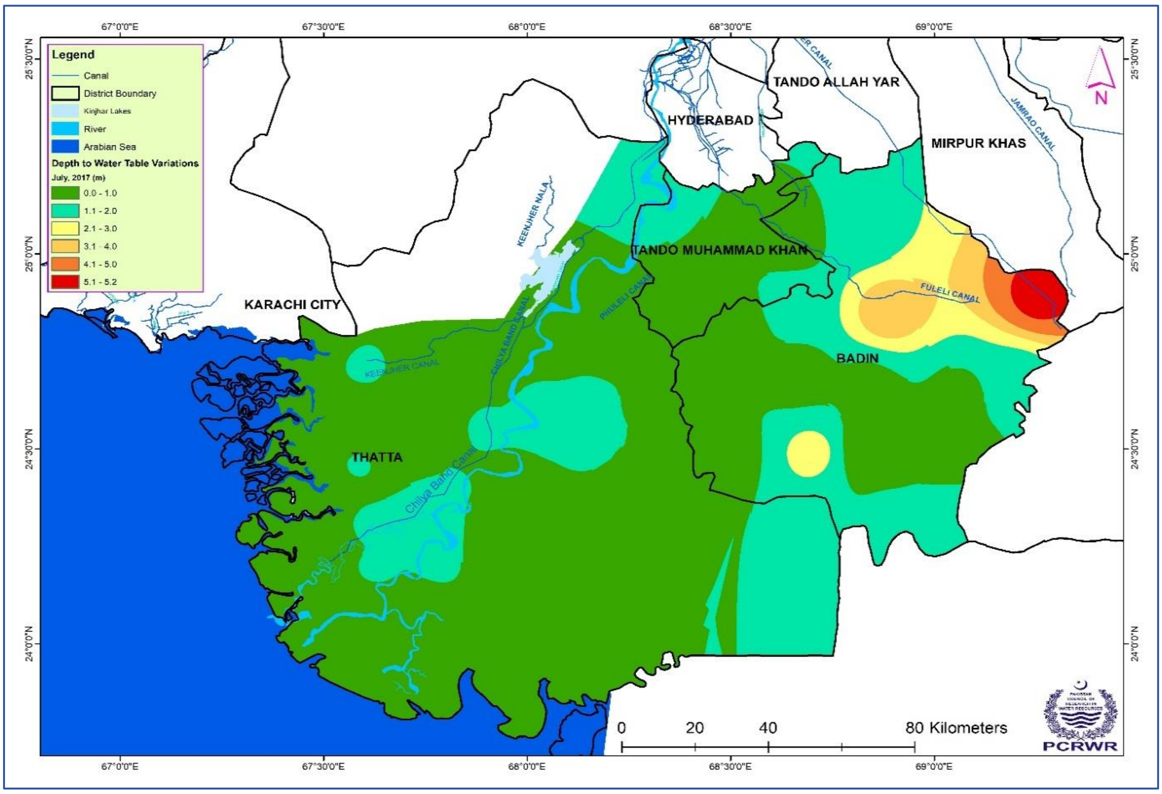


**Fig. 3.3:** **Depth to water table during July-August 2017 in the Indus delta**

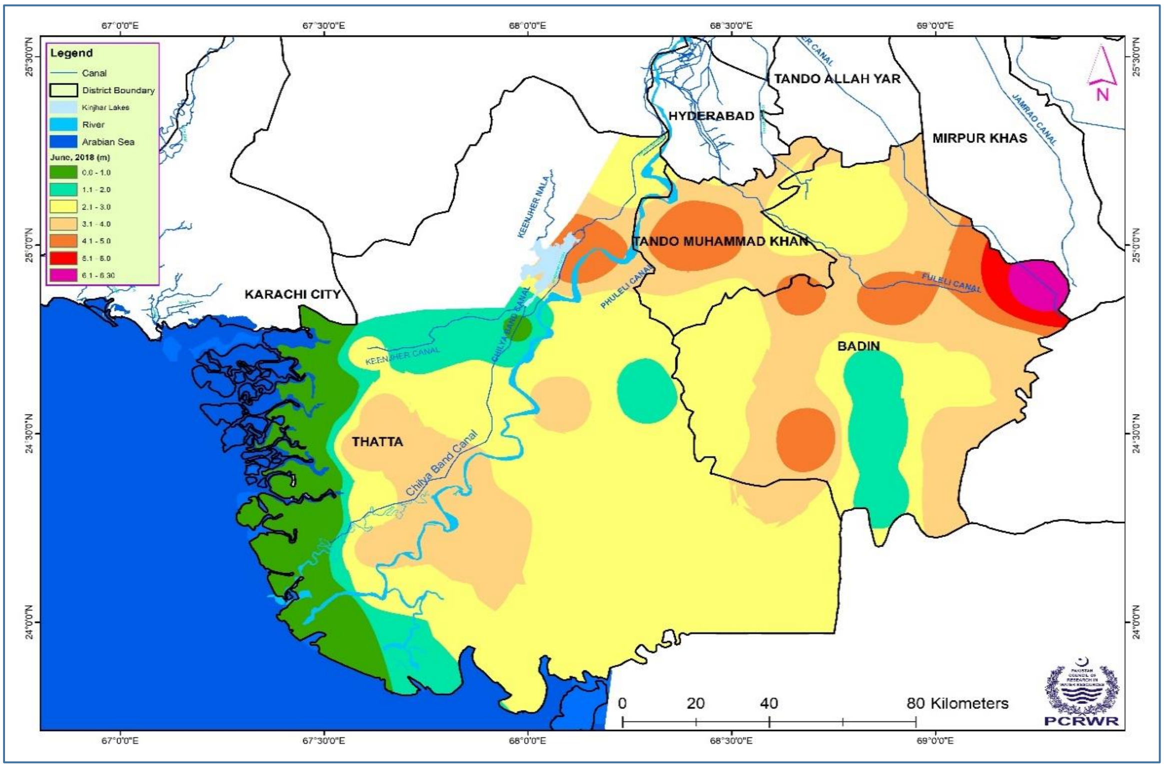


**Fig. 3.4:** **Depth to water table during June 2018 in the Indus delta**

Spatial and temporal variation of groundwater salinity was monitored in terms of electrical conductivity (EC) and the data are presented in Fig. 3.5 for November 2017 to June 2018. The EC increases with depth from the surface in terms of concentration and areal extent. The trend shows increase in salinity from post-monsoon towards low-flow period (November towards June) as well as with depth. The EC varies from 1,000 μS/cm to more than 150,000 μS/cm with highest concentrations in Badin and the areas along the Thar desert as further shown in Annex-4 for the study period. The higher EC levels need further study by isotopic sampling to certify the source and aging of groundwater in the Indus delta because groundwater salinity could be predominantly due to fossil water salinity from geological origin.

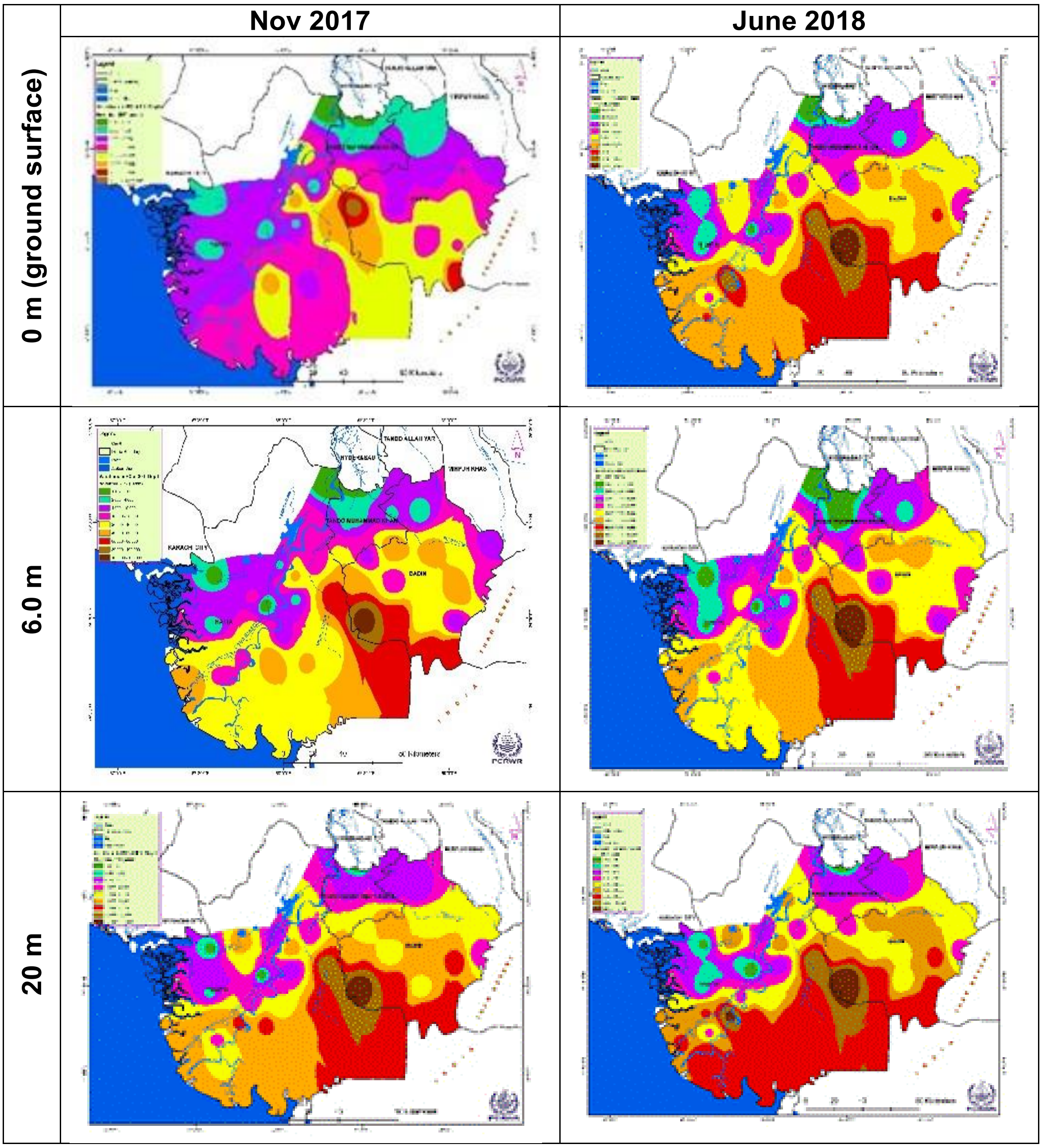


**Fig. 3.5: Spatial and temporal variation of salinity (EC) in the Indus Delta**

The analytical data regarding different quality parameters of the water samples collected from different monitoring sites are presented in Annex-5. The results of the parameters such as TDS, Cl and hardness are on higher side (generally in several thousands) in almost all the cases and well beyond the permissible limits as per country's National Environmental Quality Standards (NEQS) for drinking water

(Annex-5). The trend remained same as for salinity (EC) since the concentrations generally increase with depth and also from post-monsoon towards low-flow period (November towards June).

The salinity (EC) parameter alone is not reflective of seawater intrusion. The factors responsible for the brackish groundwater quality with respect to the influence of seawater are generally assessed, using the standard ionic ratios, such as $Ca^{2+}$:$Mg^{2+}$, TA:TH and $Cl^{-}$:$HCO_3^{-1}$ (Rao *et al.*, 2005; Barlow and Reichard, 2010). If the value of the ratio of these ions is less than unity, the effect of seawater intrusion is not there but if the ratio increases more than unity, the effect of seawater intrusion is present.

The spatial and temporal variation of $Ca^{2+}$:$Mg^{2+}$ ratio based on monitoring and analysis of the water samples collected from MLOWs is presented in Fig. 3.6 – 3.11 from November 2017 to June 2018 for different depths. The $Ca^{2+}$:$Mg^{2+}$ ratio is generally near or more than unity (1.0) in most part of the study area with high concentration in Thatta area. The ratio significantly decreases with depth below ground surface and also with passage of time (November to June) as also shown in Annex-6 for entire period of the study.

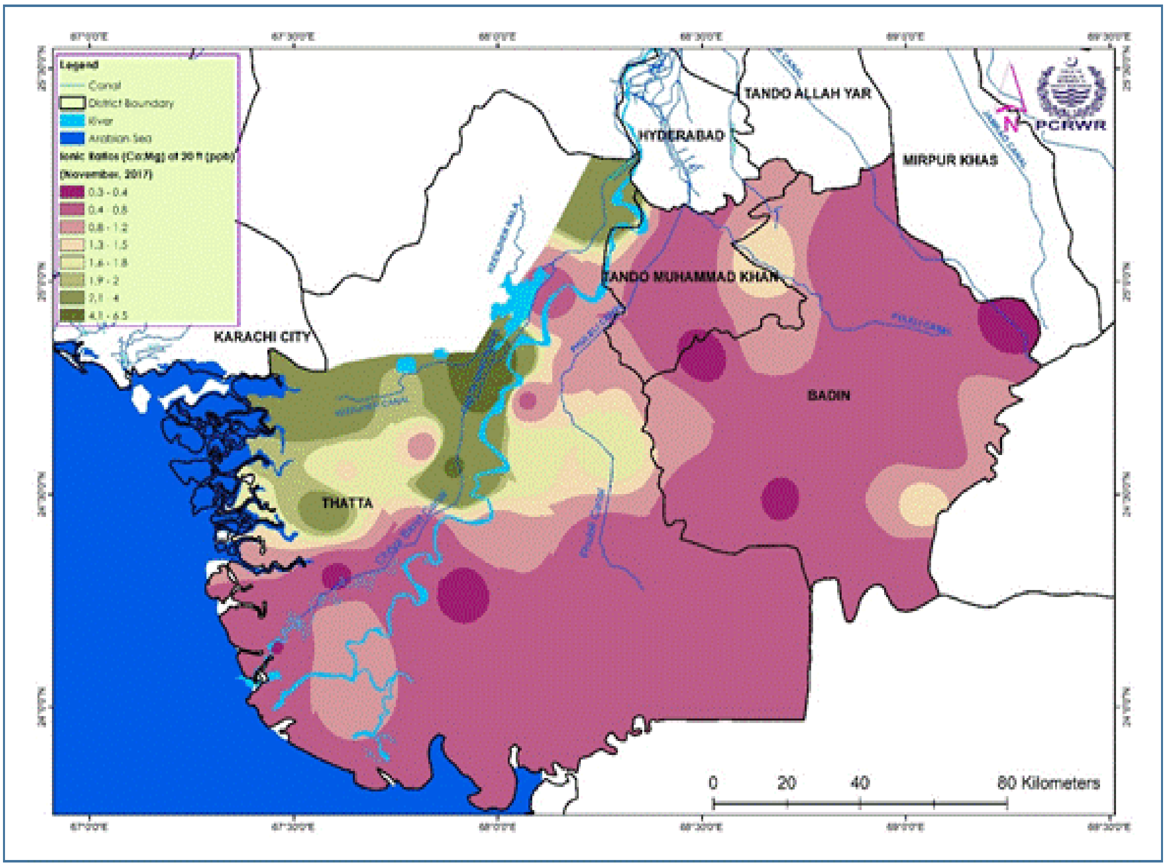


**Fig. 3.6: Variations in $Ca^{2+}$:$Mg^{2+}$ ratio during November 2017 at 6 m depth in the Indus Delta**

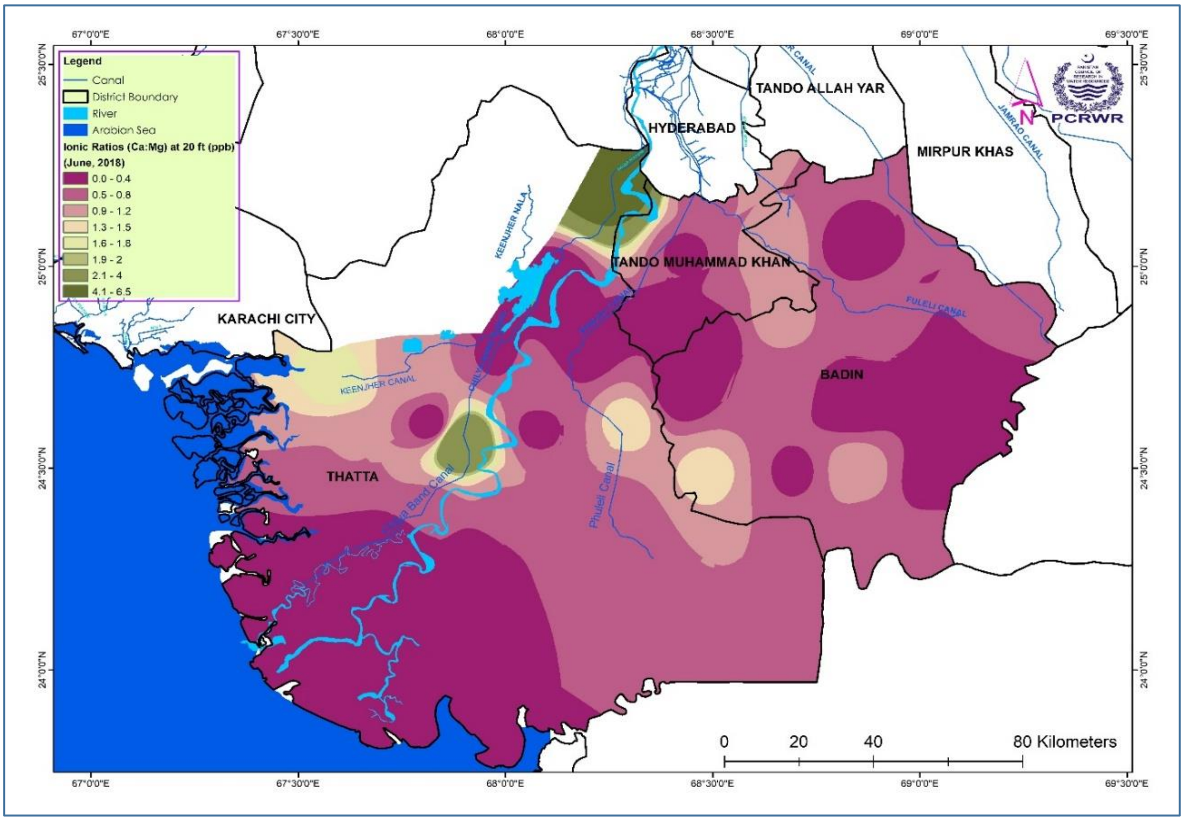


**Fig. 3.7:** **Variations in $Ca^{2+}$:$Mg^{2+}$ ratio during June 2018 at 6 m depth in the Indus Delta**

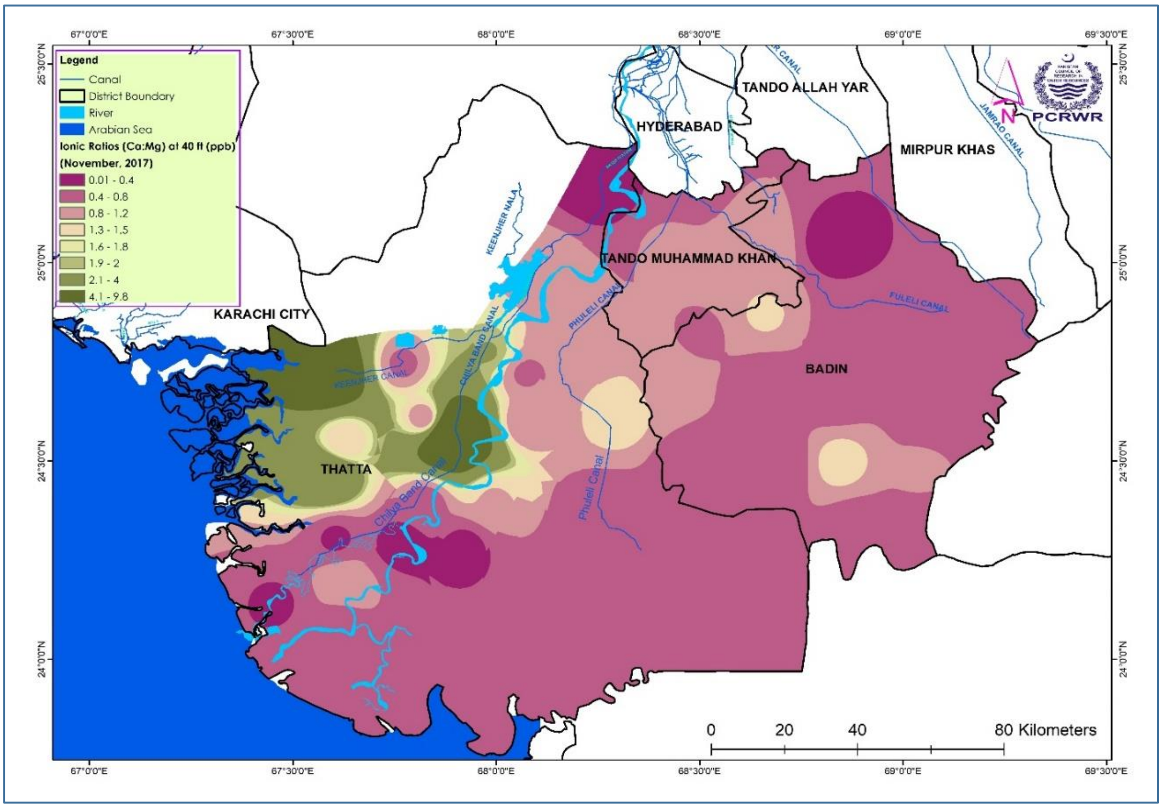


**Fig. 3.8:** **Variations in $Ca^{2+}$:$Mg^{2+}$ ratio during November 2017 at 13 m depth in the Indus Delta**

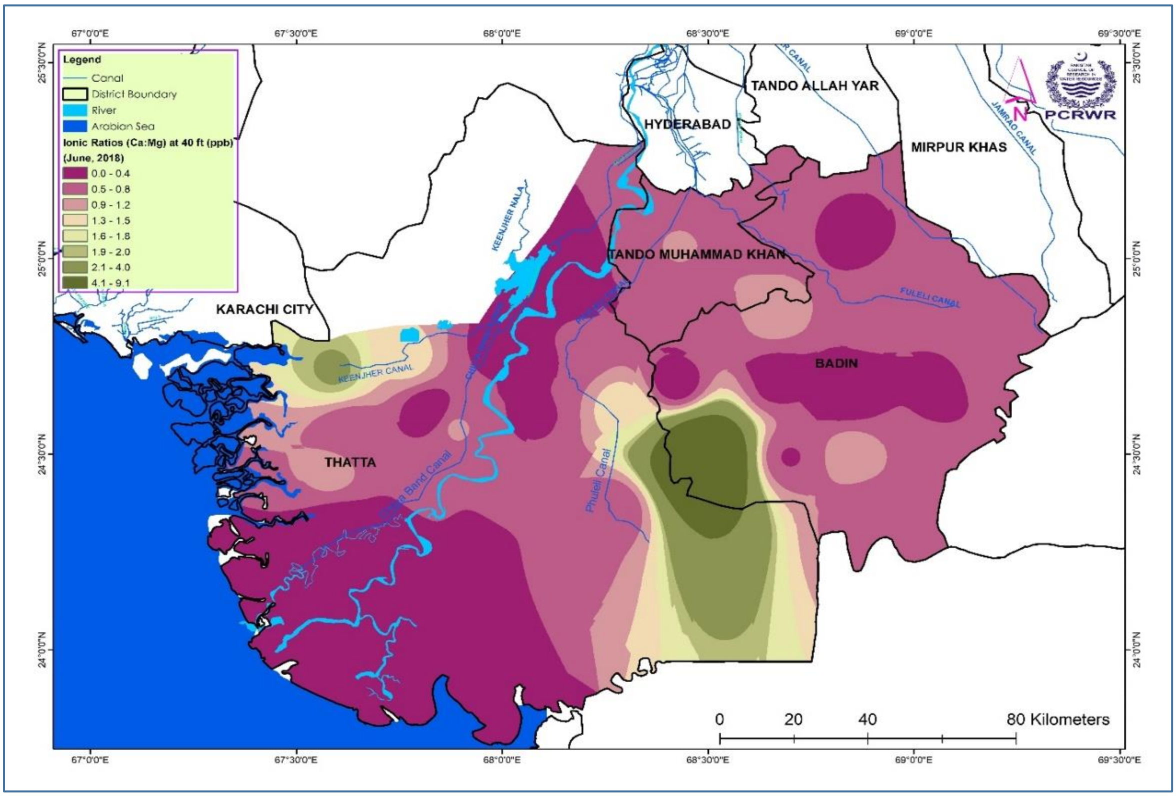


**Fig. 3.9: Variations in $Ca^{2+}$:$Mg^{2+}$ ratio during June 2018 at 13 m depth in the Indus Delta**

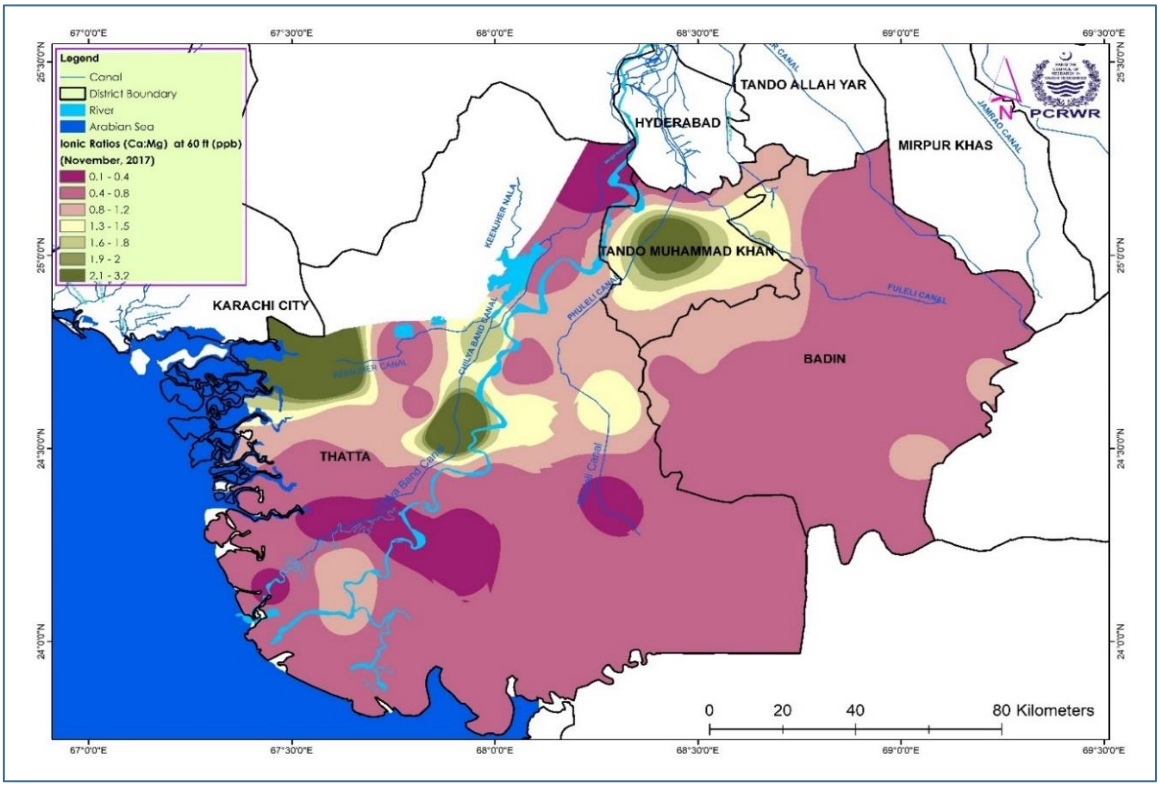


**Fig. 3.10: Variations in $Ca^{2+}$:$Mg^{2+}$ ratio during November 2017 at 20 m depth in the Indus Delta**

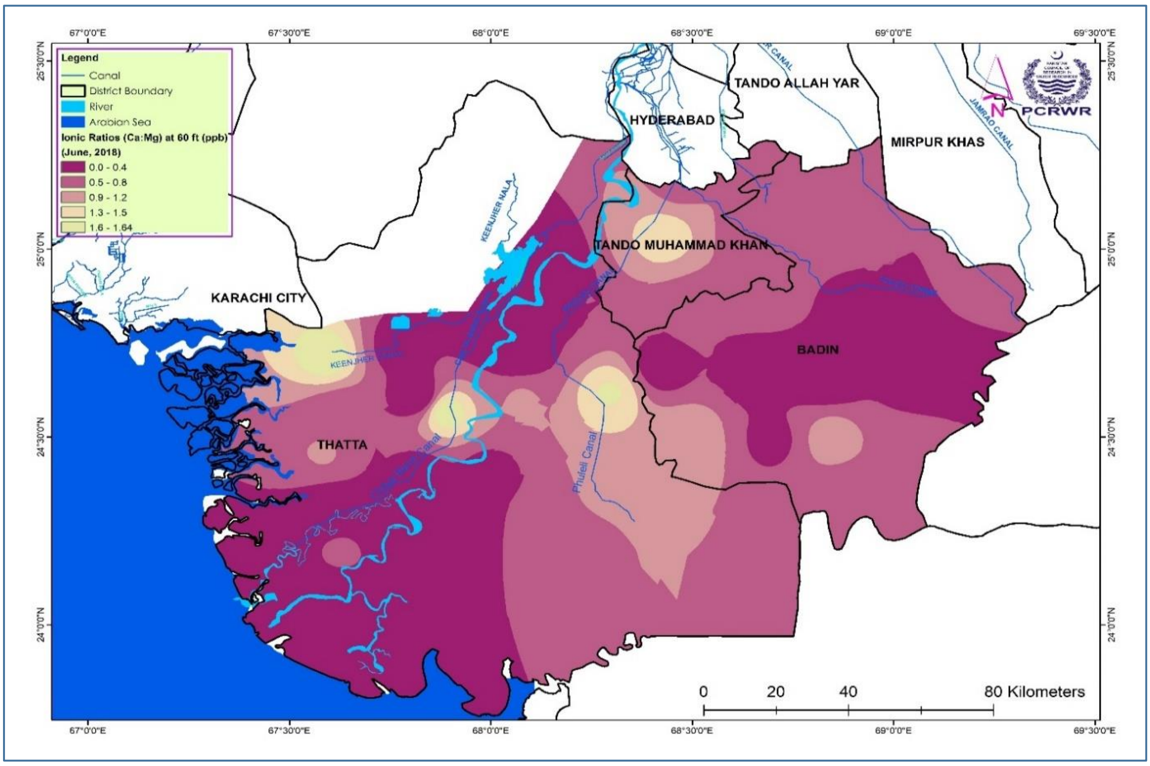


**Fig. 3.11: Variations in $Ca^{2+}$:$Mg^{2+}$ ratio during June 2018 at 20 m depth in the Indus Delta**

Another measure of seawater intrusion was also analyzed using Cl:$HCO_3$ ratio based on monitoring and analysis of the water samples collected from MLOWs as presented in Fig. 3.12 - 3.17 from November 2017 to June 2018. This presents completely different outcomes as compared to Fig. 3.6 - 3.11 for $Ca^{2+}$:$Mg^{2+}$ ratio. The Cl:$HCO_3$ ratios (Fig. 3.12 to 3.17) are much higher than unity in most part of the study area with significant temporal and spatial variation. The ionic ratio increases with depth and time (from November as post-monsoon to June as pre-monsoon seasons). This increase in ionic ratio also extends from Badin towards Sujawal in a similar manner.

From this limited data available, the higher concentrations of chloride and magnesium are observed in the groundwater samples of the study area including deltaic region. The presence of high concentration of such ionic species in the groundwater indicates availability of soluble salts in water like magnesium chloride generally extracted from seawater (Kettani and Hussein, 1973; Zohdy *et al.*, 2013). The characterization of saltwater intrusion, however, requires clear understanding of the sources and movement of the different water components (Barlow and Reichard, 2010). The higher concentration of chloride is also linked with the presence of sodium (Na) in the groundwater which is also of concern as higher concentration of sodium generally poses risk of cardiovascular diseases and also of developing hypertension as observed in coastal areas of Bangladesh (Alam and Khan, 2014) where sodium concentration decreases as moving away from coastal areas.

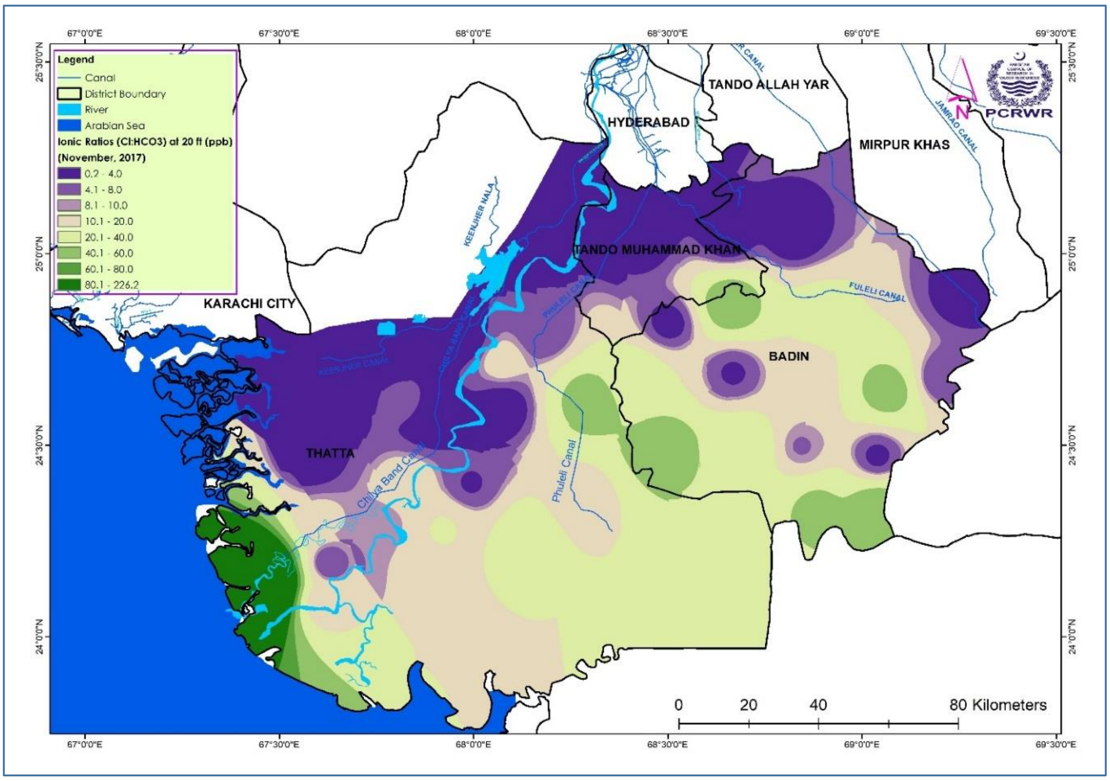


**Fig. 3.12: Variations in $Cl^-:HCO_3^-$ ratio during November 2017 at 6 m depth in the Indus Delta**

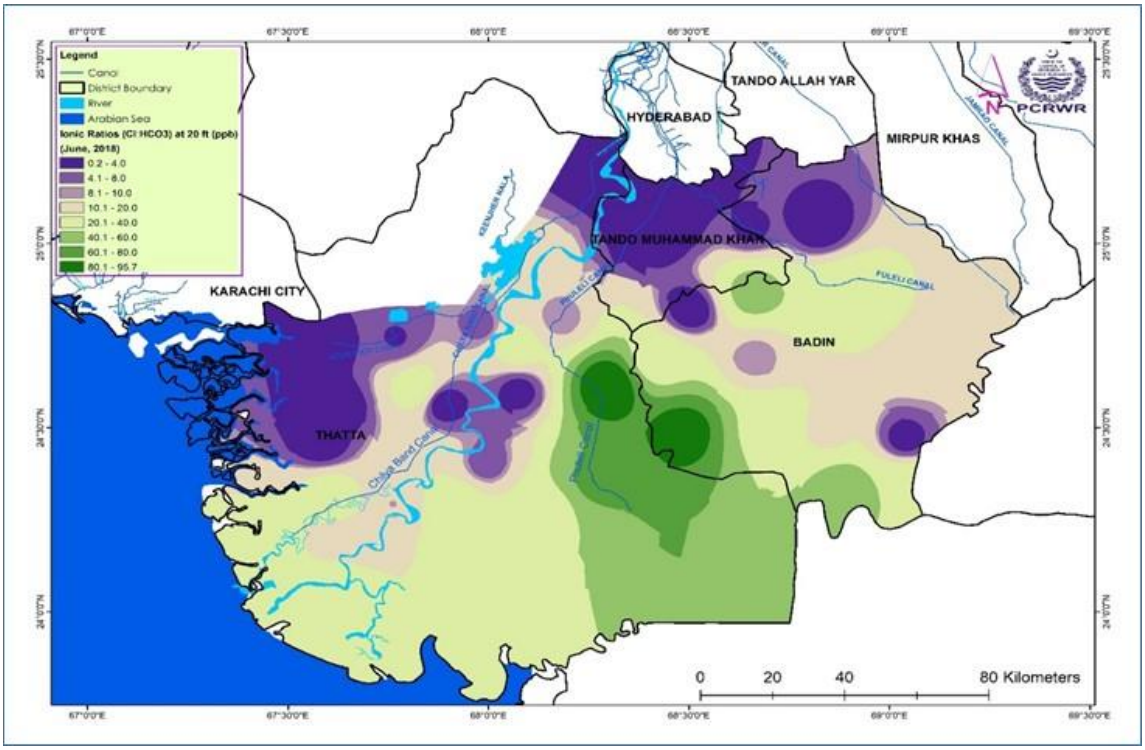


**Fig. 3.13: Variations in $Cl^-:HCO_3^-$ ratio during June 2018 at 6 m depth in the Indus Delta**

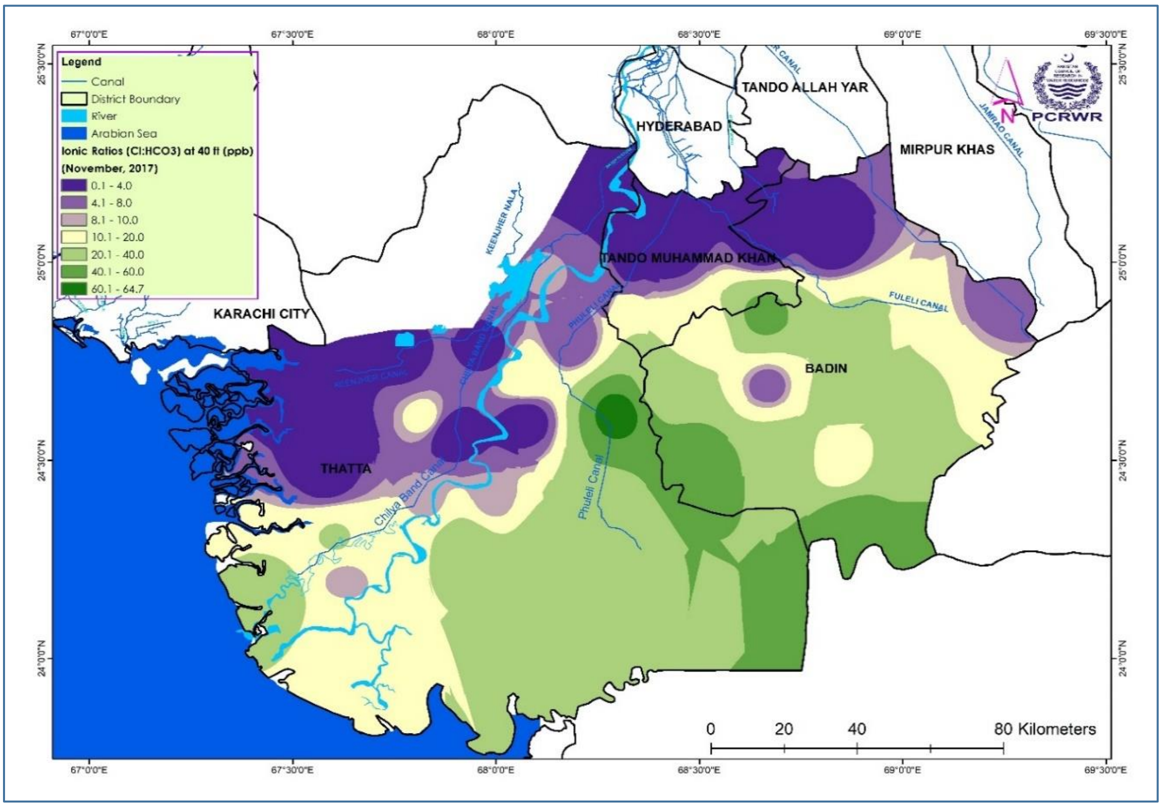


**Fig. 3.14: Variations in $Cl^-:HCO_3^-$ ratio during November 2017 at 13 m depth in the Indus Delta**

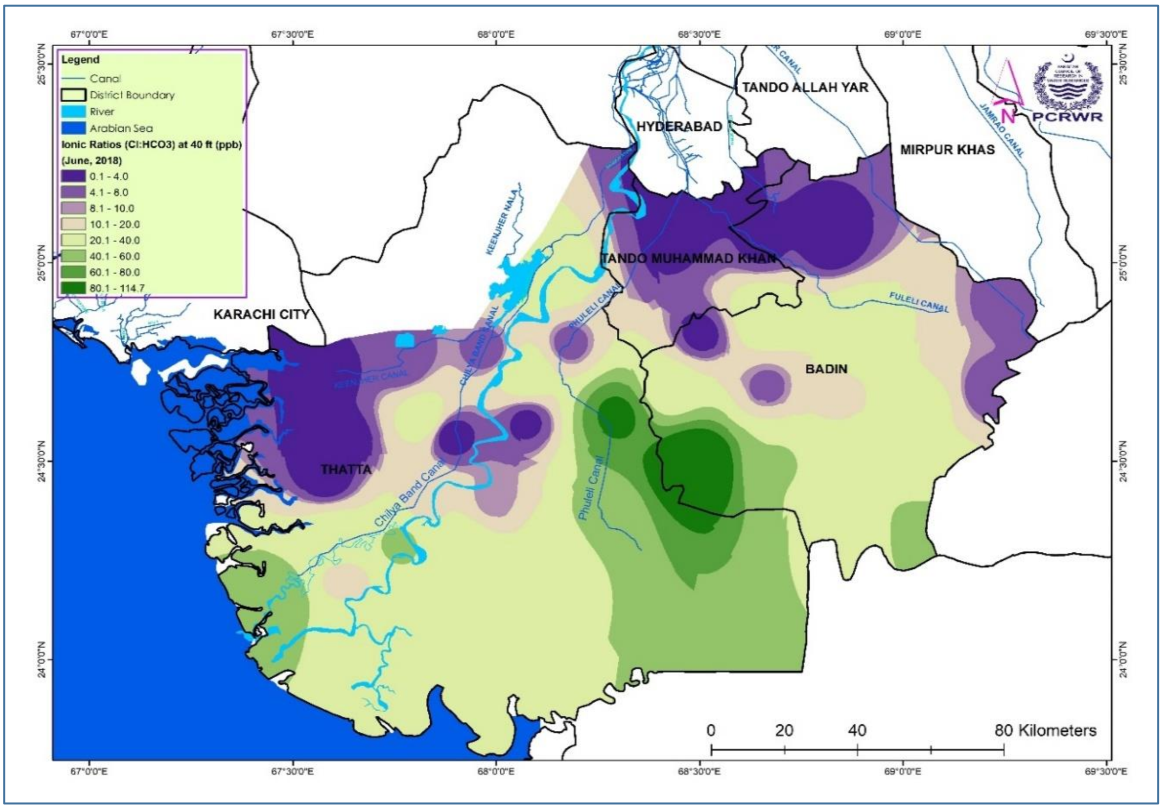


**Fig. 3.15: Variations in $Cl^-:HCO_3^-$ ratio during June 2018 at 13 m depth in the Indus Delta**

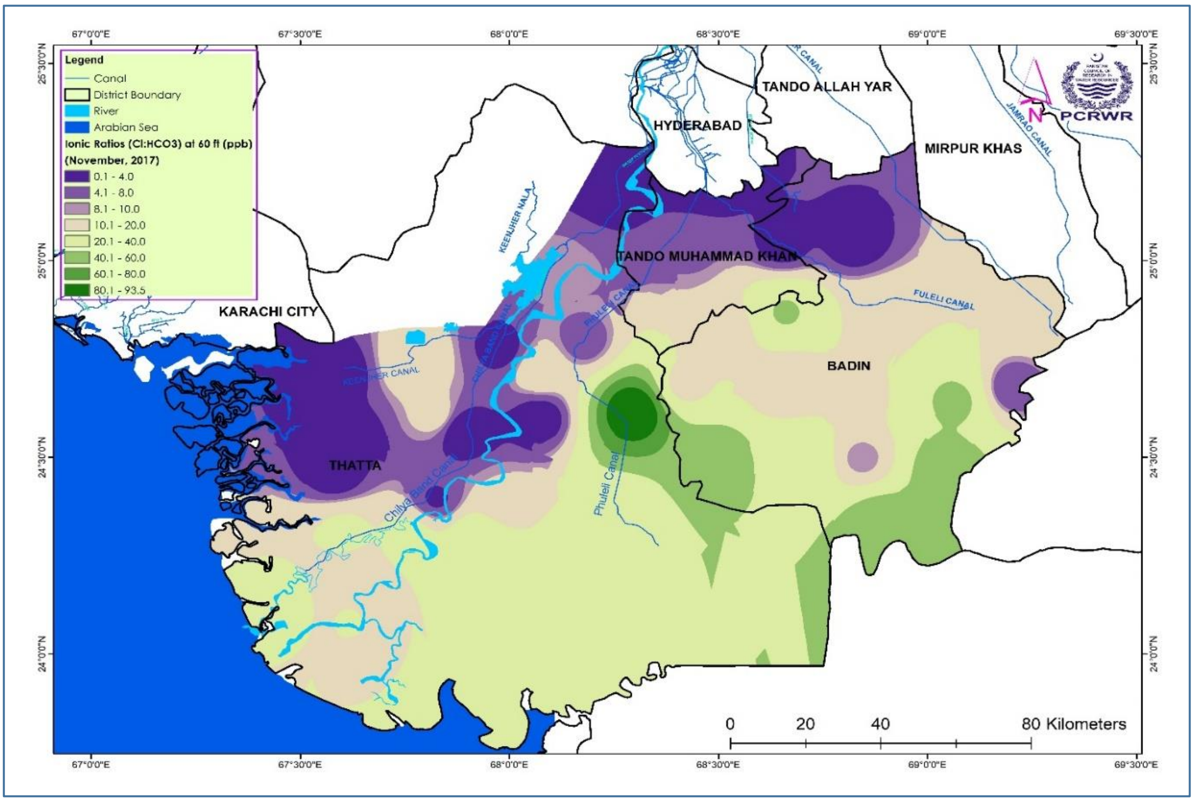


**Fig. 3.16: Variations in $Cl^-:HCO_3^-$ ratio during November 2017 at 20 m depth in the Indus Delta**

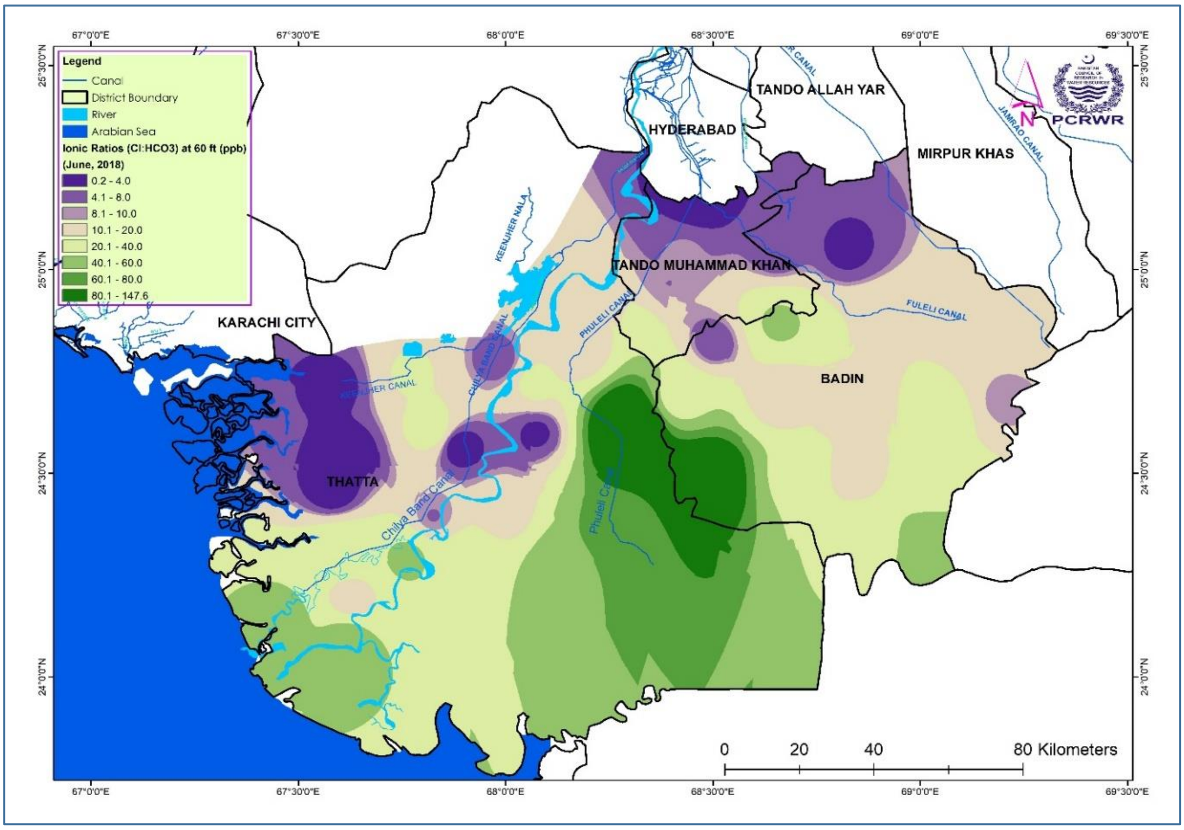


**Fig. 3.17: Variations in $Cl^-:HCO_3^-$ ratio during June 2018 at 20 m depth in the Indus Delta**

Under the current study, $Mg^+$, $Cl^-$ and $Na^+$ ionic concentrations were determined over a period of 8 months from November to June and at four depths i.e. 0, 6, 13, and 20 m from surface. The analysis for $Mg^+$ (Fig. 3.18) shows variation with time and depth in terms of maximum, minimum and average values observed during the study. In general, much higher concentrations are observed in the lower part of the study area with minimum values in the upper most parts below Kotri Barrage.

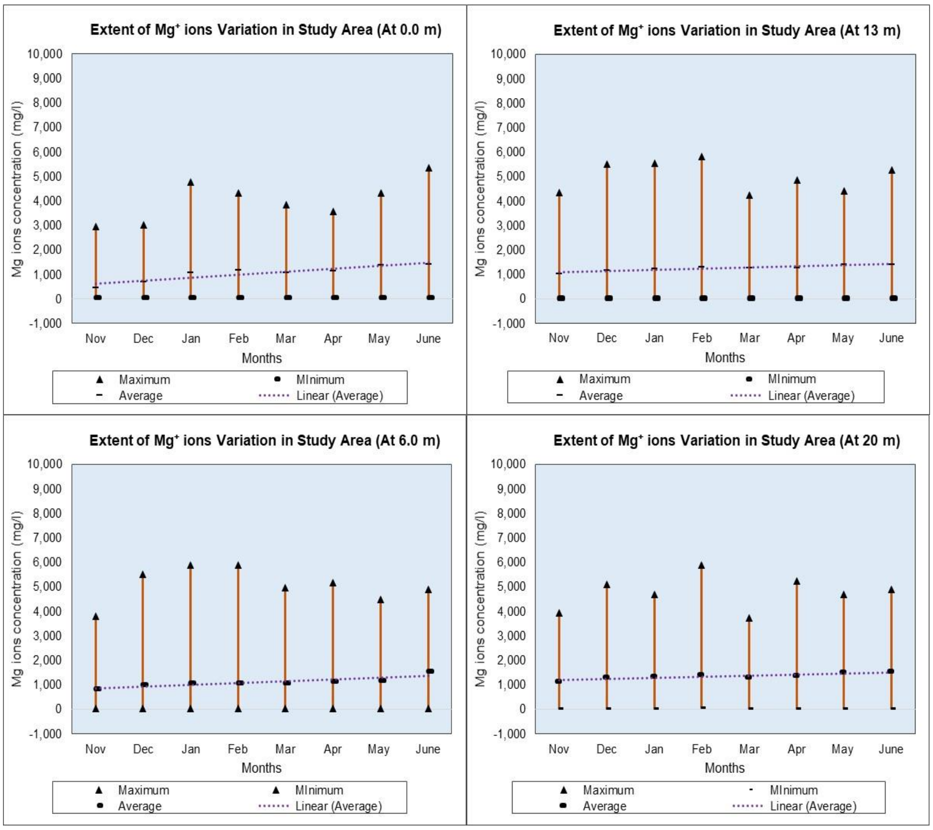


**Fig. 3.18: Variation of $Mg^+$ concentration with time and depth in the study area**

Similarly, Cl concentration (Fig. 3.19) showed significant increase with depth and slight fluctuations with time. The presence of higher concentrations of chloride with time and depth might be linked with incidence of seawater intrusion in study area which is substantiated by long-term observation of seawater intrusion (chloride) in Coastal Region of North America (Fig. 3.20).

This was further studied by determining Na concentration in the study area as having direct link with Cl. The data are presented in Fig. 3.21 with reference to maximum, minimum and average values of $Na^+$ concentration with depth and time. The presence of increasing concentrations of Na with time and depth is of serious concern as higher concentration of sodium generally poses risk of cardiovascular diseases and also of developing hypertension as observed in coastal areas of Bangladesh (Alam and Khan, 2014).

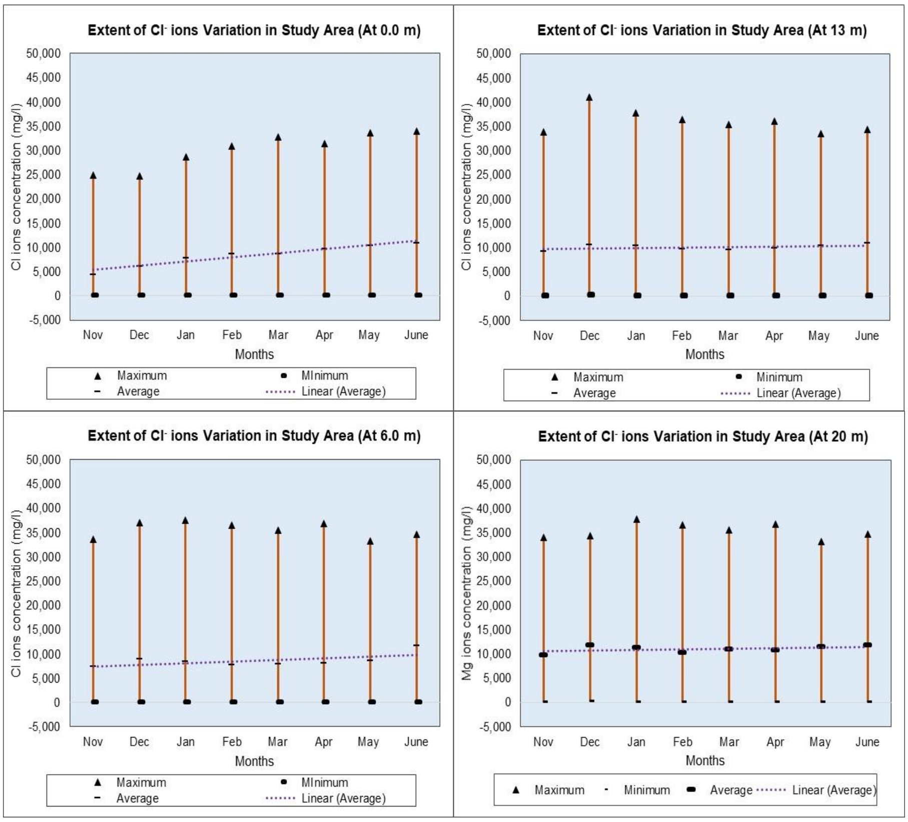


**Fig. 3.19: Variation of $Cl^-$ concentration with time and depth in the study area**

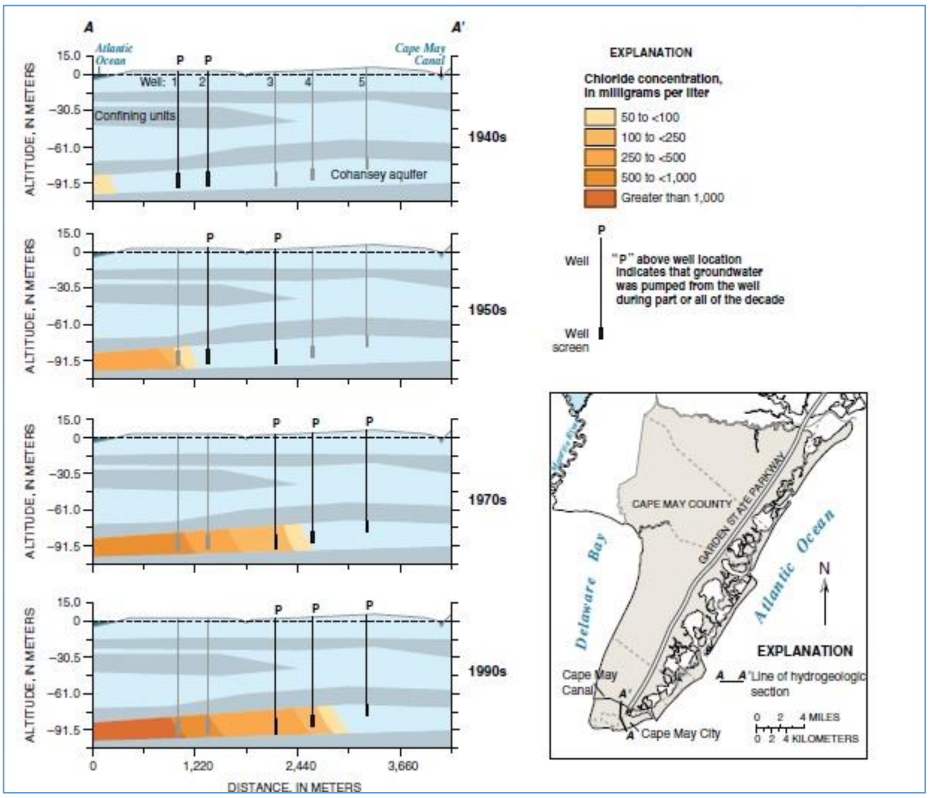


**Fig. 3.20: Hydrogeologic sections showing lateral concentration of saltwater (chloride) and contamination of supply wells in the Cape May City (New Jersey) well field , Coastal region, North America from 1940 to 1990 (Source: Barlow and Reichard, 2010)**

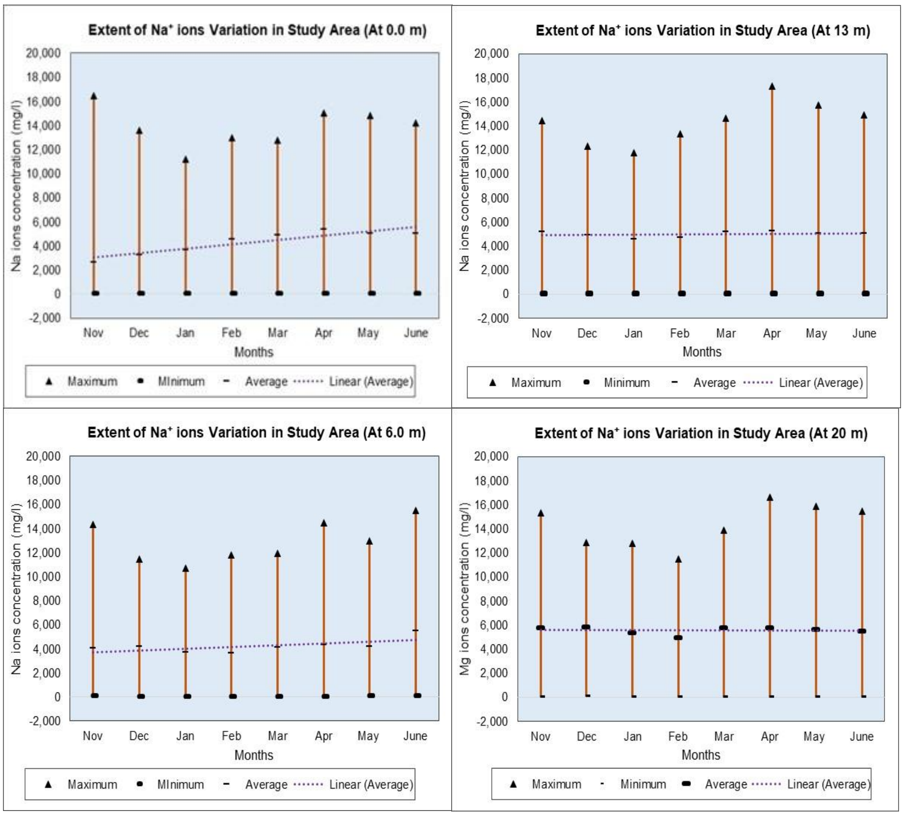


**Fig. 3.21: Variation of Na+ concentration with time and depth in the study area**

Summarizing the observations and analyses based on approximately one-year data, it can be inferred that based on various ionic ratios and presence of higher concentration of Mg, Cl and Na ions and their variation in the study area with depth and time, might be linked with incidence of seawater intrusion. The effect is certainly less in upper parts of the study area which are away from the main deltaic region. These observations could be further substantiated from the field observations and direct response from the concerned community as presented in the forthcoming sections.

Nevertheless, it is proposed to conduct further studies in connection with seawater intrusion in the deltaic and adjoining areas as future study to be more confident for arriving at this conclusion. For this further monitoring is required by PCRWR as the study was supported until June 2018 under this project. In addition, collection of isotopic sampling is important in this regard to help certify the source and aging of groundwater in the Indus delta in order to justify the seawater intrusion with area and its extent because salinity in the aquifer is predominantly due to fossil water salinity from geological origin (Gonazalez *et al.*, 2005).

## 3.2 Impacts of Seawater Intrusion on Land, Water and related Socio-economic Conditions in the Affected Areas

Under this objective, impact of seawater intrusion in the Indus Delta was assessed on land, water and related socio-economic conditions by direct interaction with the community and on-ground. The PRA was designed in such a way that at least one focused-group discussion (FGD) was held in each grid covering 20 Tehsils falling in five districts; Badin, Thatta, Sujawal, Tando Muhammad Khan and Hyderabad (Latifabad Tehsil only) and that total 42 FGDs were held. This provided reasonable coverage of the Indus delta and adjoining areas, extending to all 42 grids under the project. The FGDs were conducted taking into consideration true representation of the relevant deltaic community of specific area as the participants were local public representatives, common people, farmers, teachers, fishermen, community workers, women and youth (Fig. 3.22). Total respondents were 771 with 99%:1% ratio (male:female) with average size of 18 per FGD.

**Fig. 3.22: Glimpses of PRAs (FGDs) conducted under the project**

The information gathered through PRAs focused on land, water and socioeconomic aspects of the communities living in the Indus delta as affected by seawater intrusion (if any). In particular, the FDGs included status of agriculture, livestock, fisheries, land use, livelihood, living standard, income, education and health conditions, community knowledge on climate change related impacts and their adaptation, and suggestions for the betterment of the situation. The data collection also included review of past studies carried out by other organizations including WWF, IUCN etc. to have better understanding of the past socio-economic and environmental impacts and how such information has changed over the period of time.

## 3.3 General Social Conditions

The survey included total 771 respondents, 99% of those were male, with majority (54%) in 25-44 years age group, followed by 32% in 45-66 years age group (Fig. 3.23). An overwhelming majority of respondents spoke Sindhi language, followed by Urdu, Saraiki and others. Almost 60% respondents were illiterate although the youth participants were having primary level education.

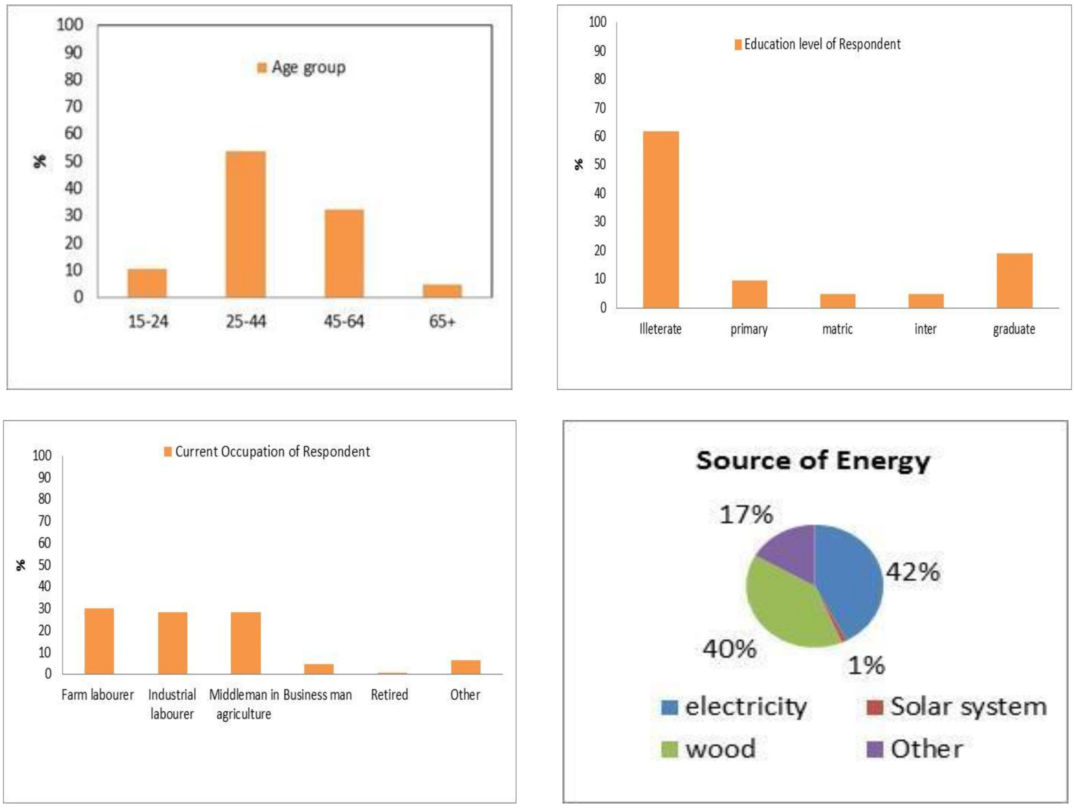


**Fig. 3.23: General conditions in the the Indus Delta**

Major occupation and source of livelihood of the participating communities is farm labor (30%), industrial labor (29%) or middleman in agriculture/ fisheries (29%). Electricity is the major source of energy in the area (42%) although the majority finds the supply to be erratic and unreliable. This leads to deforestation in the area which is one of the reasons of abandoning of mangroves in the Indus delta as wood is another energy source (40%).

Poverty is evident in the area having limited job opportunities and most of the residents find their ways to urban centers for their earning. Very few industrial units are available in the area. A look into their livelihoods showed that about Rs. 10,000 is the average monthly income and almost similar are the average monthly expenditures (Fig. 3.24). The people having higher income are in government/ NGOs job or middlemen. Water availability and health issues are serious in the area.


**Fig. 3.24: Livelihood conditions in the study area**

## 3.4 Drinking Water and Health Status

About 70% of the surveyed population depends on groundwater as their source of drinking water which is available for 30% of households at a depth of 15-20 ft. Other drinking water sources are ponds and canal water (Fig. 3.25).

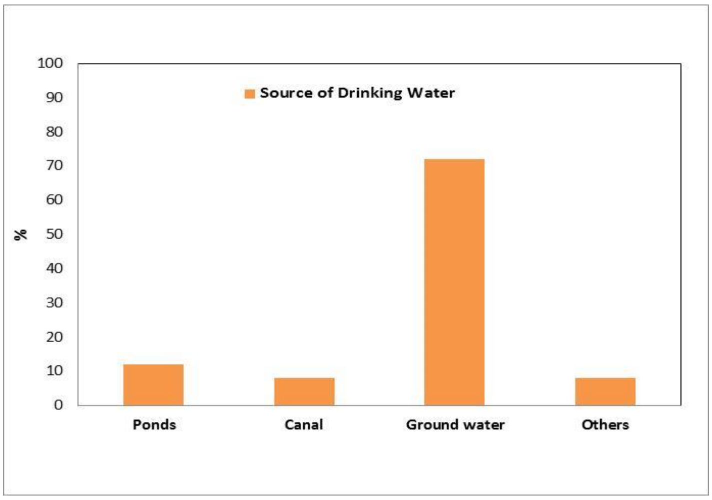


**Fig. 3.25: Sources of drinking water in study area**

An alarmingly high number of population do not treat water before consumption while only up to 20% households use chlorine tablets (Fig. 3.26). Majority finds their water as salty and the most common issue to the local community regarding water supply is of health-related. About 97% had a family member suffering from serious disease; major ones reported were hepatitis, hypertension, vomiting, diarrhea, skin infections and liver diseases which may be related to higher concentration of sodium found in the study area and also observed in coastal areas of Bangladesh by Alam and Khan (2014), the values were much higher than WHO limit of 25 mg/l. Despite the diseases prevalence, majority were satisfied with the available facilities though majority is deprived of health provisions by Government/NGOs.

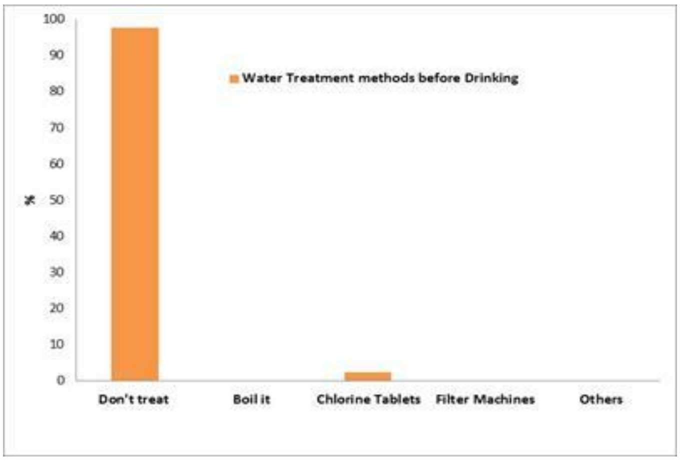


**Fig. 3.26: Water treatments practices in study area**

## 3.5 Climate Change and Impact on Agriculture and Livestock

The climate change is seriously being observed by the deltaic community. Regarding changes in delta, temperature received a unanimous affirmative with 95% agreeing that rainfall pattern had changed over time along with temperature rise.

Agriculture and fisheries are highly dependent on the climate. The community have experienced decline in fish catch which is up to 15%, thus their income is also getting reduced due to this issue. Similarly, almost 55% responded that the agriculture situation had not been affected by the changing temperatures. While 45% of the respondents who experienced a decline in the agriculture sector in the area also complained about lower income gain because of the issue. About 63% responded that their income is affected by climate change (Fig. 3.27) while 23% respondents had suffered from loss of agricultural land with majority claiming 50% loss and 2% saying that there is no change in agricultural land.

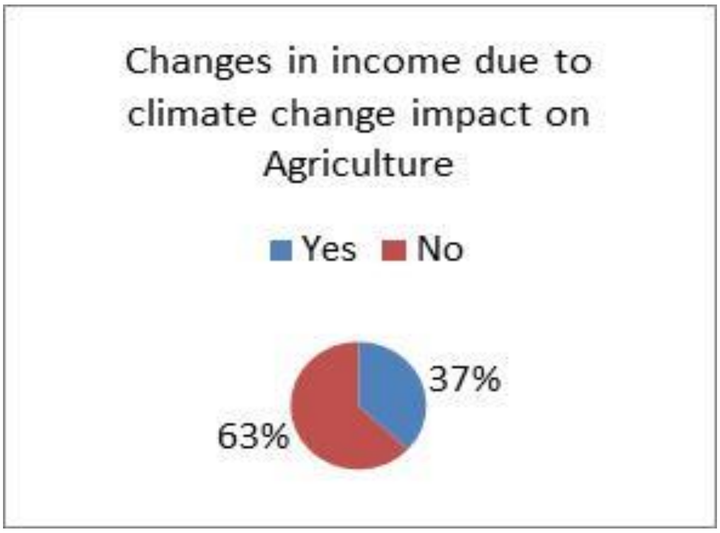


**Fig. 3.27: Climate change impact on agriculture income**

The change in water availability for crops in recent years (Fig. 3.28) was a hot debate as majority is experiencing significant decline in water availability (70%) in the study area. The survey also revealed that climate change had no effect on cropping season (63%), however 34% didn't agree to it and said, climate change has direct impact on crop season and they have started practicing early sowing and early harvesting to cope with the change.

Majority of the respondents own livestock (mostly up to 5 heads per family) and claim that seawater intrusion had an effect on it but this did not have any effect on their annual earnings from the livestock.

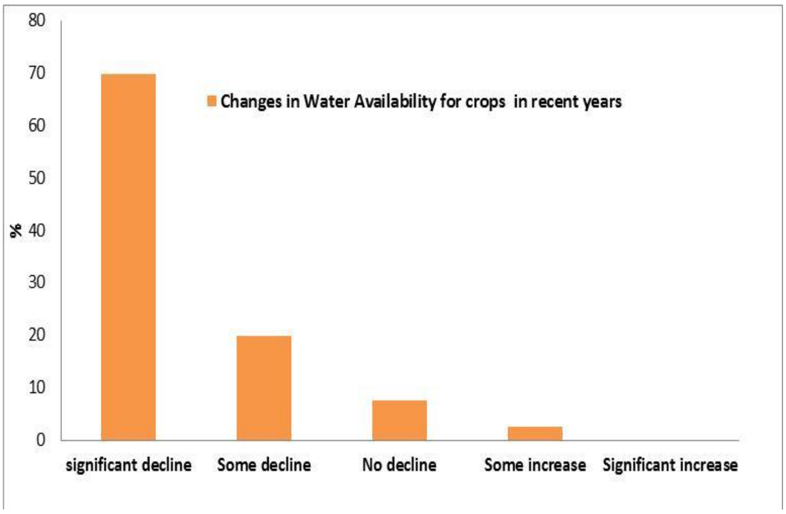


**Fig. 3.28: Changes in irrigation water availability**

## 3.6 Migration from the Delta Region and the Major Reasons

The information revealed that over the last 10 years, no significant migration had taken place from the area(Fig. 3.29). About 51% respondents were still not thinking of migration while 49% were pondering about migration, the major reasons included the loss of land because of salinity (30%) and lack of drinking water (25%) leading to poverty in the area. Despite all difficulties, leaving the area is not a simple option for most of them.

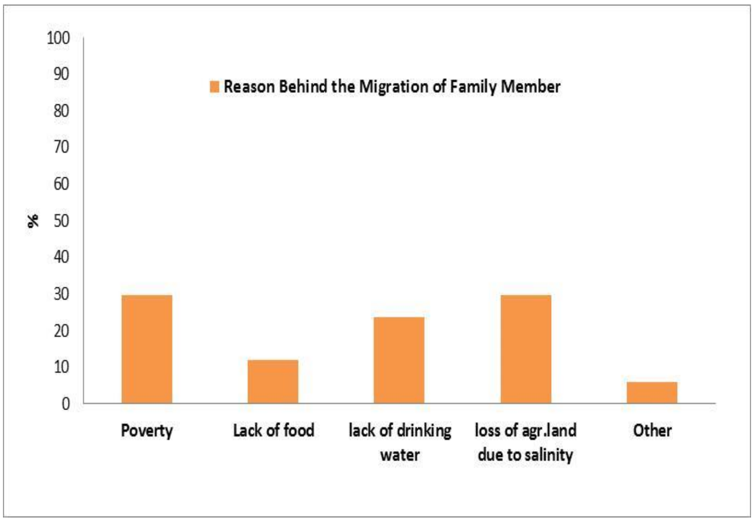


**Fig. 3.29: Reasons for migration from the Delta Areas**

## 3.7 Role of NGOs/ Community Organizations

Most respondents informed that no NGOs/ community organizations had been working in their area, while the areas in which they were present; they helped for education, health and agriculture. The role of NGOs as learnt from the community is projected in (Fig. 3.30). The major NGOs/ INGOs working in the area as told by the community are:

- Sindh Agriculture and Forestry Workers Cooperative Organization (SAFWCO)
- Sindh Education Foundation (SEF)
- National Rural Support Program (NRSP)
- Health and Nutrition Development Society (HANDS)
- Human Development Foundation (HDF)
- The Citizens Foundation (TCF)
- AWARE
- Basic Integrated Rural Development Society (BIRDS)
- Livelihood Employment and Enterprise Development
- Association for Humanitarian Development (AHD)
- Expanded Program on Immunization (EPI)
- Commission on the Status of Women (CSW)

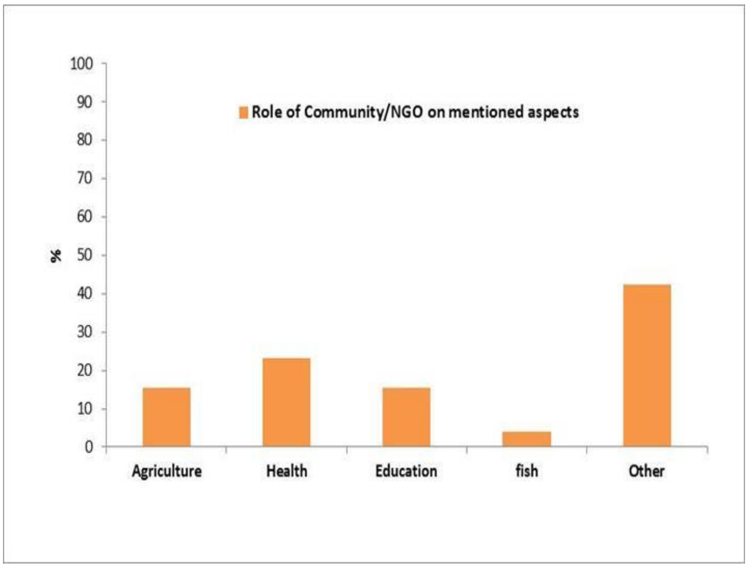


**Fig. 3.30: Role of community/ NOGs in the Delta areas**

## 3.8 Role of Youth and Women Participation

Education level of youth varies a lot with 14% illiterate, 36% primary, 17% matric, 7% intermediate and 26% graduate (Fig. 3.31). However, the engagement of youth is mainly (80%) limited to fishing and agricultural activities.

Regarding women participation, almost 100% of the women are participating in household work while a small fraction also takes part in transplanting rice, feeding and milking livestock, harvesting of crops etc.

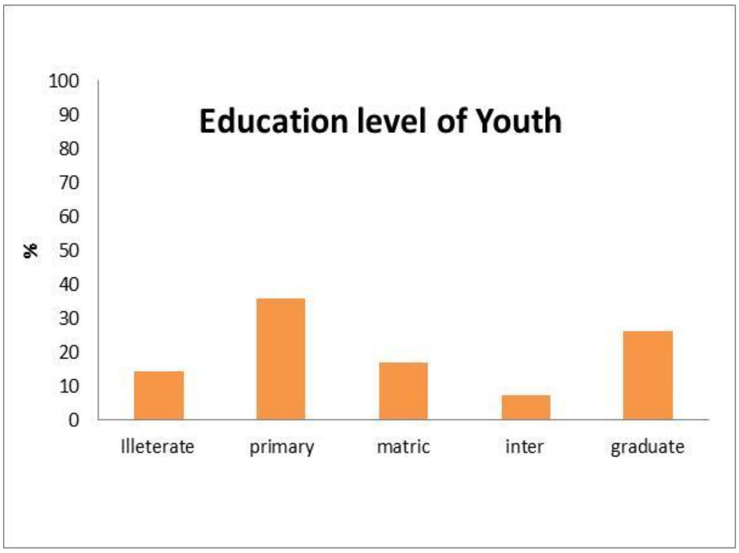


**Fig. 3.31: Education level of youth in the study area**

## 3.9 Community Suggestions to Improve Situation in the Indus Delta

The respondents shared their opinions regarding improvement in the current situation, and what actions and support they seek from government in order to cope with the existing situation, as presented below:

- ☐ Flow of water in downstream and construction of embankments from Bhambhore to KT-Bandar are the opportunities to decrease the tidal floodplain areas, thereby the seawater intrusion will be controlled.
- ☐ Disposal of industrial and municipal wastes should be banned in the natural steams and canals, to have safe water for drinking. Also the flow of contaminated water of fish ponds in distributaries should be stopped.
- ☐ The existing water supply schemes should be managed, repaired and made functional which are not functioning from last 10 years.
- ☐ The government should provide plant species with high salt tolerance and yield along with the effective insecticides and pesticides. The government should fix the economic rate for selling the sugarcane.

- In areas of high water-table, on-farm open drains and drainage outfalls should be constructed to lower the water-table for providing favourable environment for the crop cultivation.
- RO plants (Reverse Osmosis) and water reservoirs should be constructed.
- The excess water in Kotri downstream should be allowed.
- Electricity, gas and water supply schemes should be provided in those areas to solve drinking water and energy issues.

## 3.10 Predictive Scenarios to Suggest Evidence-based Climate Change Adaptation Measures for Marginalized Communities and Their Livelihoods

Under this objective, it was intended to assess the Indus delta condition through model applications and GIS techniques based on physical data mainly climatic (rainfall, temperature, aridity etc.), surface flows, land use/ land cover, groundwater lithology and water quality/ fluctuations data, land degradation, salinity and water logging, water use for various purposes, socio-economic data (PRAs based and other sources). For this purpose, a comprehensive surface-cum-groundwater interaction model was proposed to be developed. The main purpose of this modeling was to simulate the spatio-temporal changes (such as extent, lateral and vertical variability and severity) and impacts of seawater intrusion in deltaic region as well as generation of futuristic scenarios for sustainable ecosystem management in the Indus Delta.

In this regard, further analyses were made in continuation of physical groundwater quality and fluctuations monitoring and PRAs presented in previous section to establish link between seawater intrusion and consequential socio-economic impacts in relation to climate change.

## 3.11 Climate Change Pattern

The study area falls in hot desert climate with warm to hot summers and mild winter. The average annual rainfall varies from 245 mm to 210 mm as we move from Mithi (Thar desert) to Badin and then to Thatta (Fig. 3.32). The average temperature varies from 34°C at Mithi to 32°C at Thatta during summers whereas in winters it varies from 17°C to 18 °C, respectively, based on long term record (1982 – 2012).

For the long term analysis of the climate change variations, rainfall and temperature data were explored for the weather stations in the study area. The long term data available from Badin station (source: Pakistan Meteorological Department) ranged

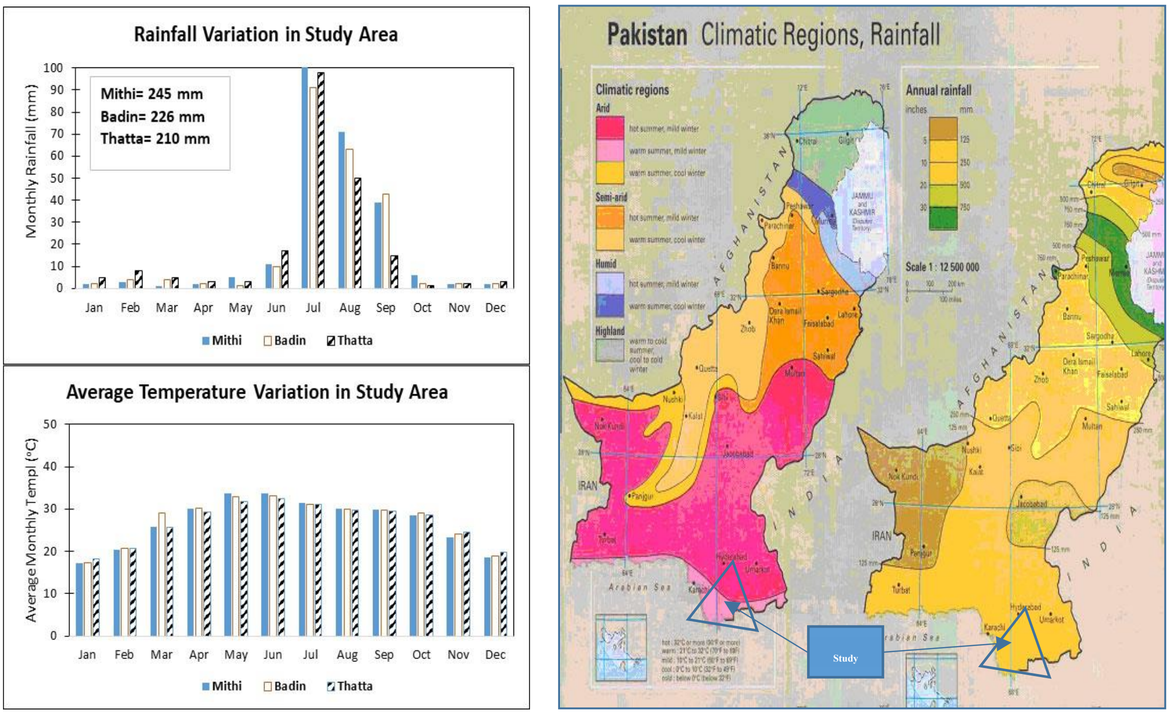


**Fig. 3.32: Climatic variation in the study area**

from 1982 – 2017 which also defines the average climate conditions for the study area. Analysis of the annual rainfall data showed about 40 mm decrease in rainfall during the period 1997-2017 over that for the period 1982-1997 (Fig. 3.33). With limited data available at Thatta (2010-2017), a less intense decreasing trend is observed (Fig. 3.34) whereby the average rainfall decreased from 210 mm in 1982-2012) to 200 mm in 1982-2017.

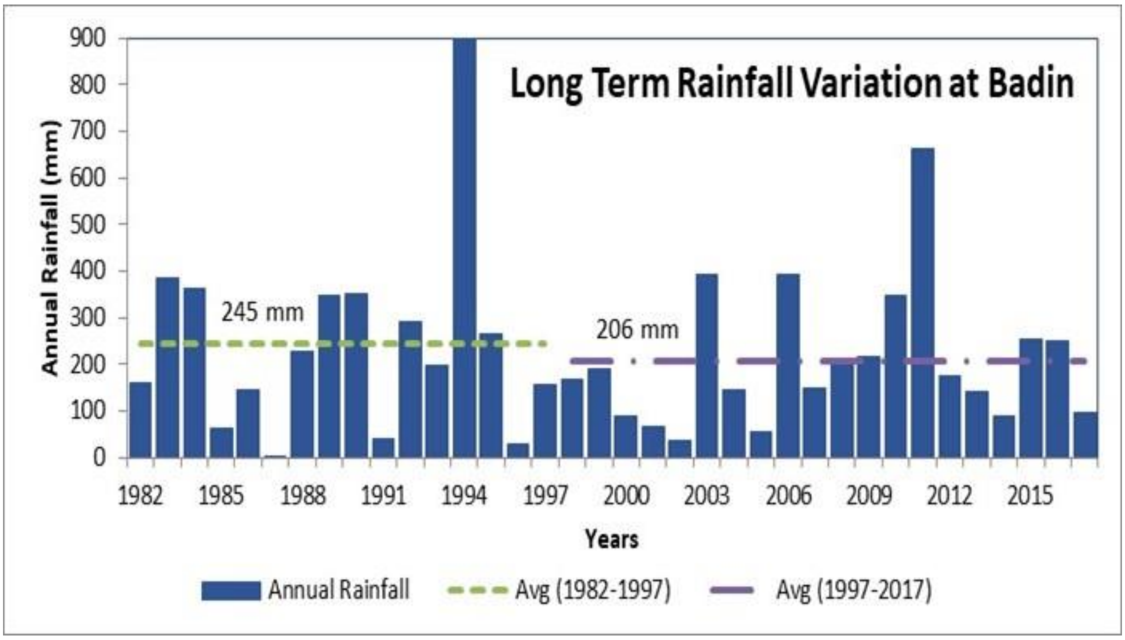


**Fig. 3.33: Long term annual rainfall pattern in study area**

Analysis of the maximum and minimum temperature variations in the study area showed insignificant increase in summer temperatures (Fig. 3.35) whereas the winter

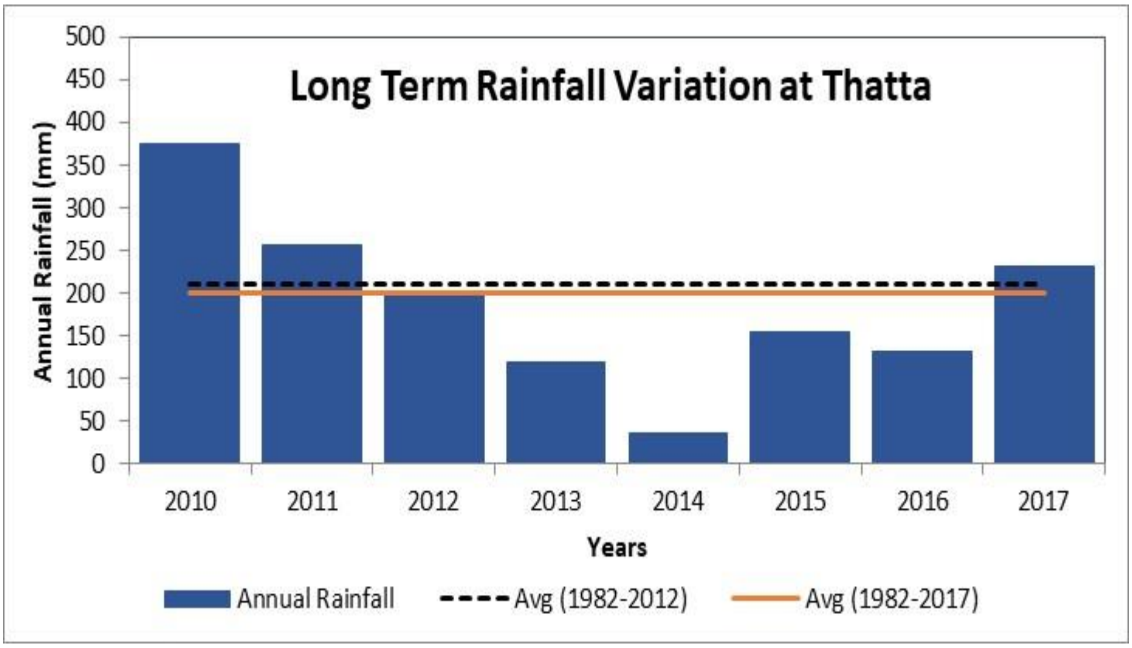


**Fig. 3.34: Long term annual rainfall pattern in Thatta area**

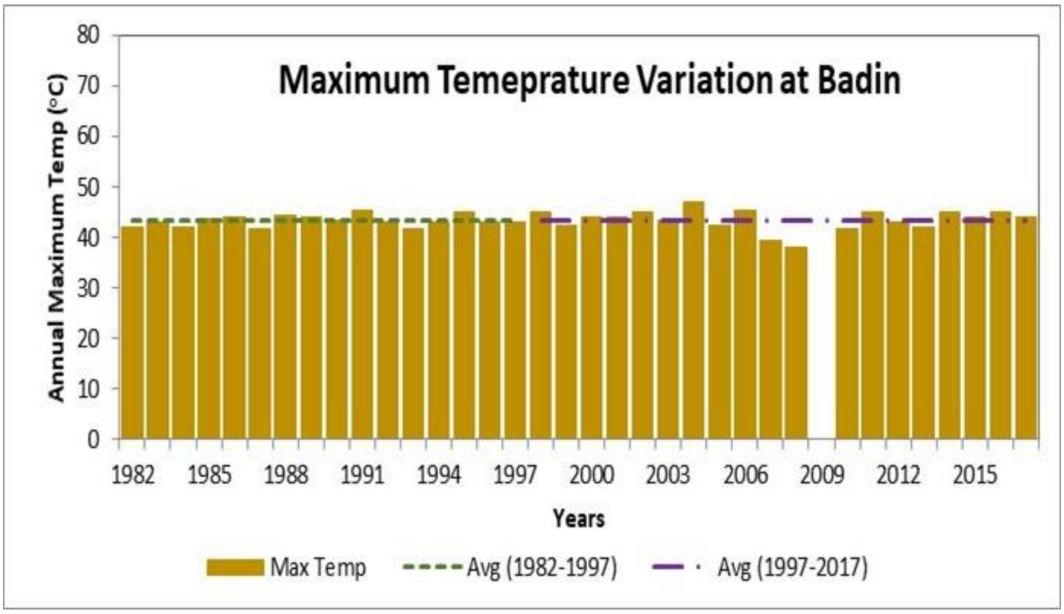


**Fig. 3.35: Long term annual maximum temperature pattern in study area**

temperatures are getting milder showing an average increase of 2oC (Fig. 3.36). This shows that night time temperatures are rising which can have adverse effect on crop physiography and productivity (Mohammed and Tarpley, 2011).

This evidence clearly conforms with the observations from the community gathered during the PRA surveys in relation to rainfall reduction and rising temperatures (Fig 3.27 and 3.28) having direct impact on community livelihood. This fact is further supported by another study by WWF (2012) showing decreasing trend of rainfall and increase in temperature in delta area (Fig. 3.37).

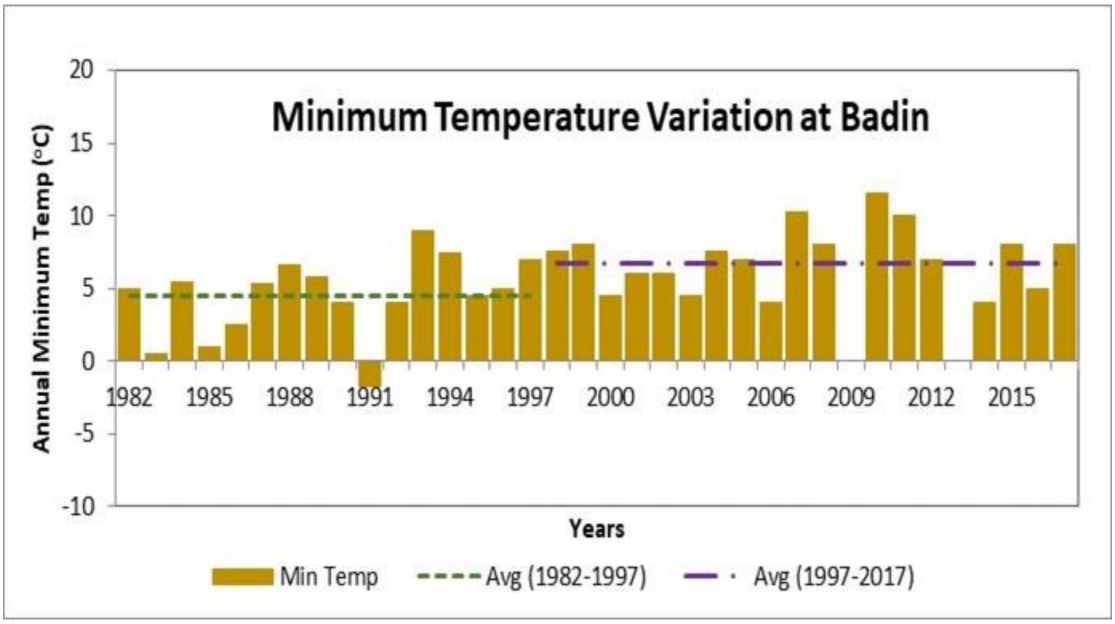


**Fig. 3.36: Long term annual minimum temperature pattern in the study area**

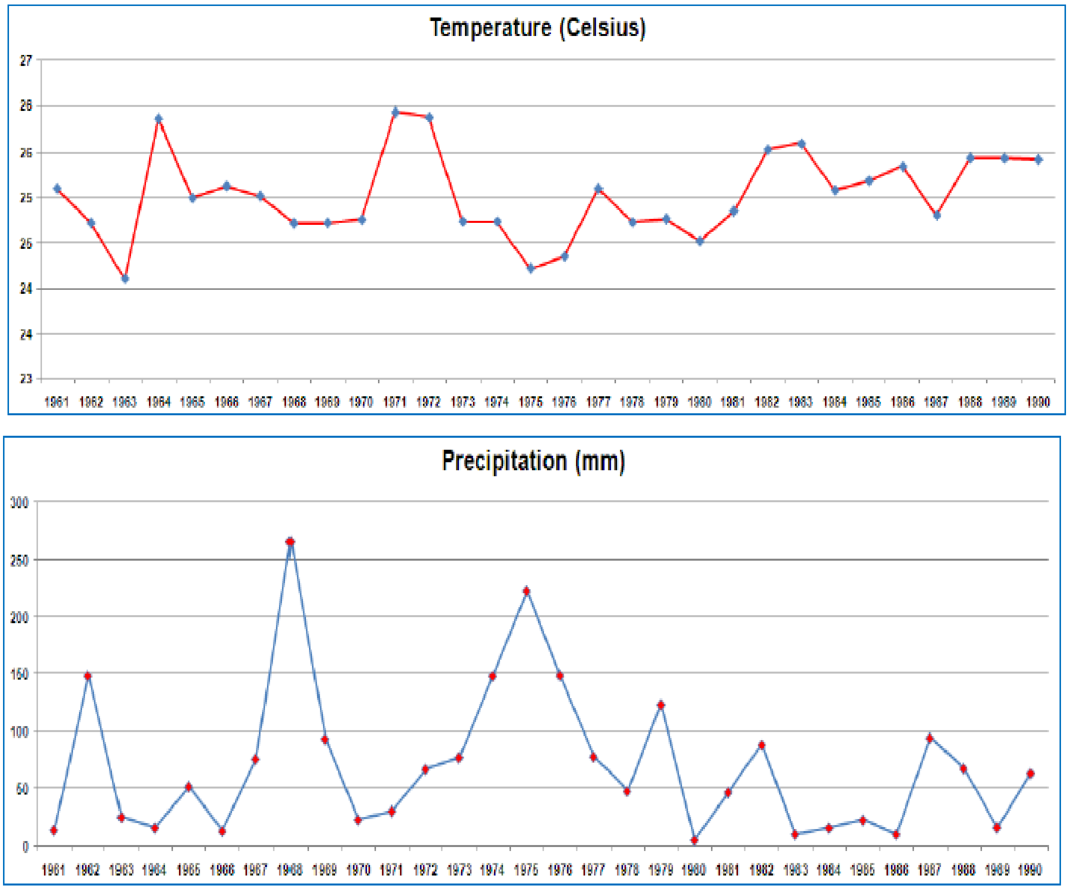


**Fig. 3.37: Rainfall and temperature data 1961-1990 in the Indus Delta (Source: WWF, 2012)**

In the wake of decreasing rainfalls and rising temperatures, the availability of inflows from upstream areas through Indus river has a definite connection. For this, long term outflows downstream Kotri Barrage were studied.

For Sindh it would be advantageous to have environmental flows downstream Kotri Barrage for maintaining ecosystems services to benefit the entire nation and not just Sindh (Anwar and Bhatti, 2018). The long term annual volume measured at Kotri Barrage and assumed to have been released downstream to the Arabian Sea was compared with the environmental flow of 4.444 Gm$^3$/year or 5,000 cusecs throughout the year as recommended by Gonzalez *et al.* (2005). Until 1999–2000, the flow downstream Kotri Barrage consistently exceeded the recommended environmental flow (Fig. 3.38). After that the volumes released into the sea have occasionally fallen below this threshold value. The 5-year moving sum has, however, consistently remained greater than the 30.861 Gm$^3$ recommended by Gonzalez *et al.* (2005). Although Sindh has not formally accepted or refuted the recommendation of Gonzalez *et al.* (2005), the operation of the Indus Basin is by and large in compliance with these recommendations (Anwar and Bhatti, 2018). On the other hand, if Sindh holds its position on 12.335 Gm$^3$/year for environmental flows, the basin operation is not in compliance with this threshold for environmental flows which conforms the observations gathered from the community during the PRAs for reduction in water availability for agriculture (Fig. 3.28).

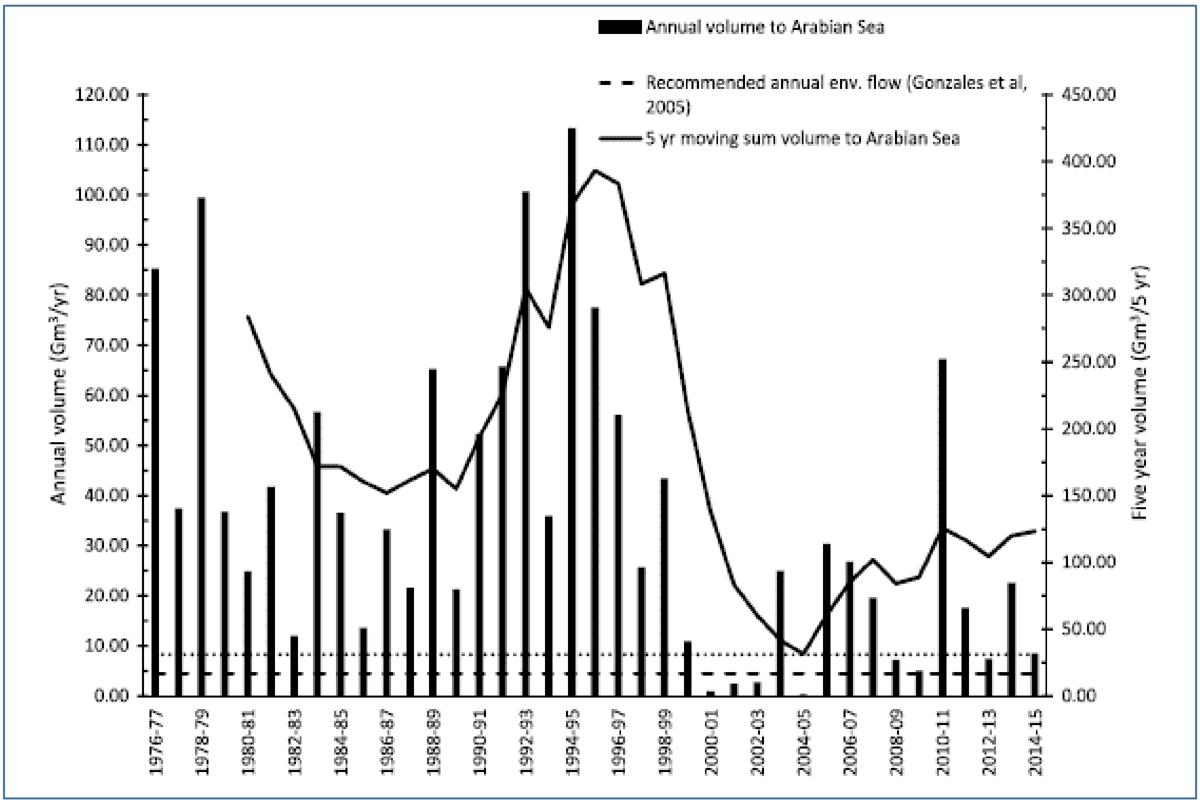


**Fig. 3.38: Flow to the Arabian Sea from the Indus River (Source: Anwar and Bhatti, 2018)**

## 3.12 Geo-spatial Analysis

The geo-spatial analysis was also carried out using historical geographic maps. The analysis was performed to study the historical variations in terms of changes in the intrusion extent or the areas that became unavailable. The historical maps (1848 to 2018) were obtained from various sources (Annex-8) and digitized along with visual interpretation of Landsat satellite imagery in Arc-GIS software to demarcate the extent of land degradation in relation to seawater intrusion (Fig. 3.39). It indicated that there was noticeable degradation/ reduction in the land mass of deltaic region

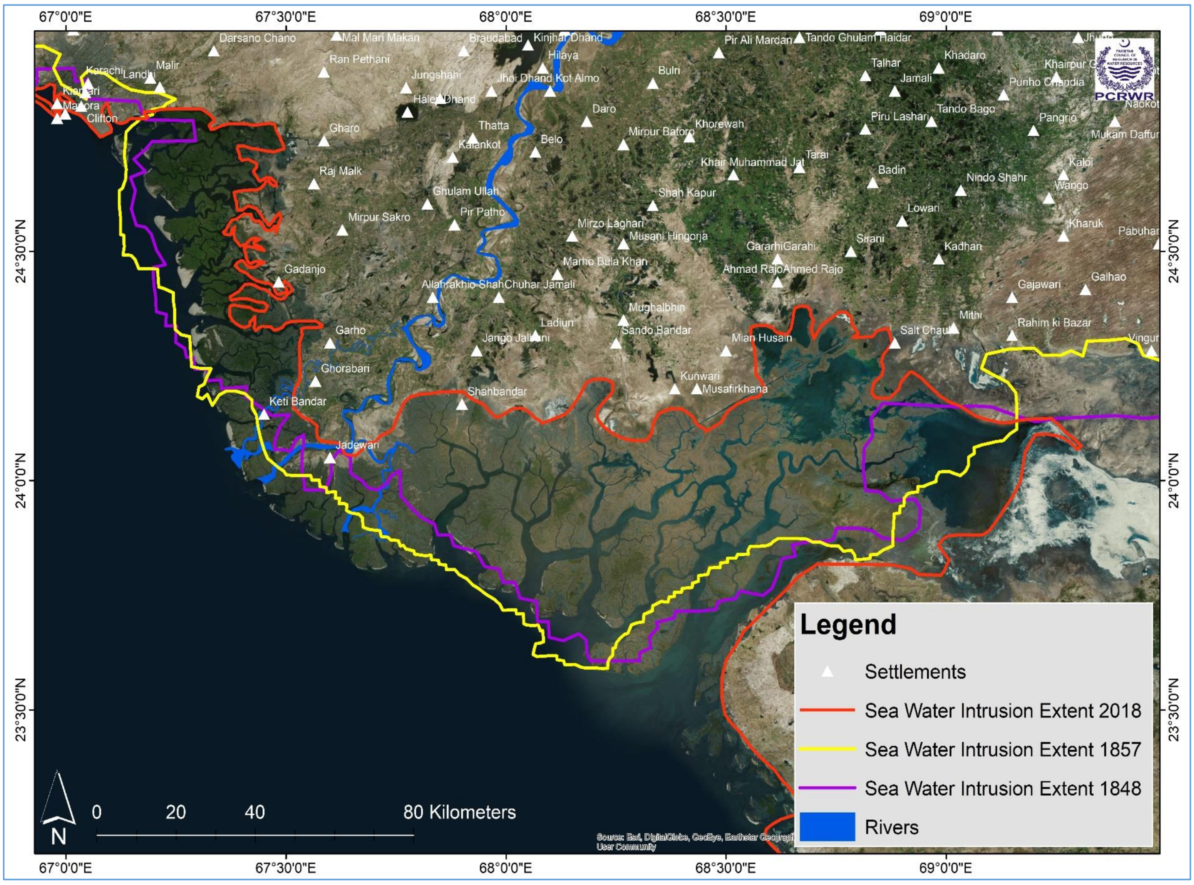


**Fig. 3.39: Geo-spatial analysis of land degradation in relation to seawater intrusion in the Indus Delta**

as assessed using Arc-GIS. This increase in extent is more dominantly visible in lower parts of Thatta district. This could be associated with land erosion and/or sea-level rise. A similar study by WWF (2012) from 1972 to 2009 also presented similar evidence for land degradation/ loss due to seawater intrusion (Fig. 3.40). This fact is further supported by the observed sea-level rise at Karachi (adjoining area) through National Institute of Oceanography by Rabbani *et al.* (2008) as shown in Fig. 3.41.

## 3.13 Conceptual Model

In the previous sections a series of field monitoring activities, data collection and analyses were presented in connection with seawater intrusion versus climate change and consequential effects on socio-economic conditions of the communities living in the Indus delta and adjoining regions. Further, it was envisaged to work on an integrated concept model making use of long term data on various accounts

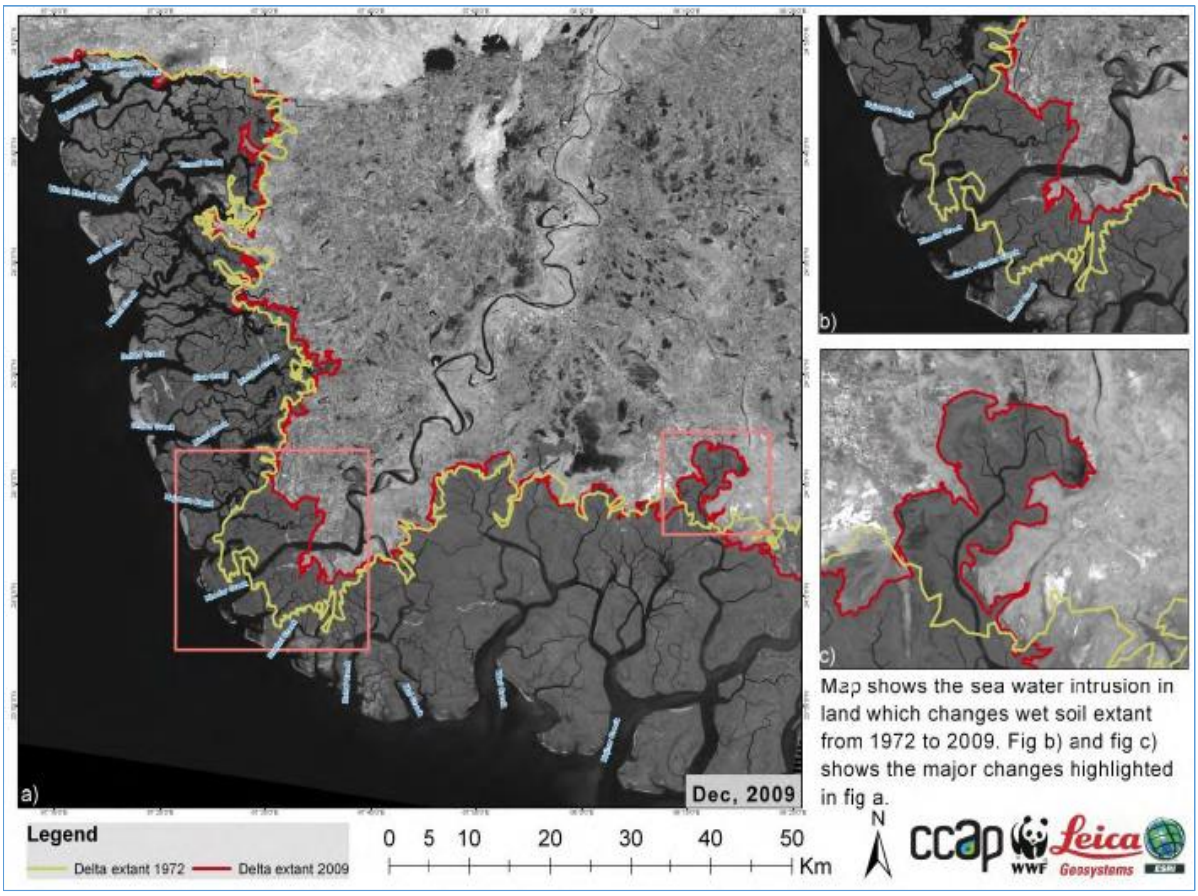


Fig. 3.40: Inland extent of the Indus Delta (Source WWF, 2012)

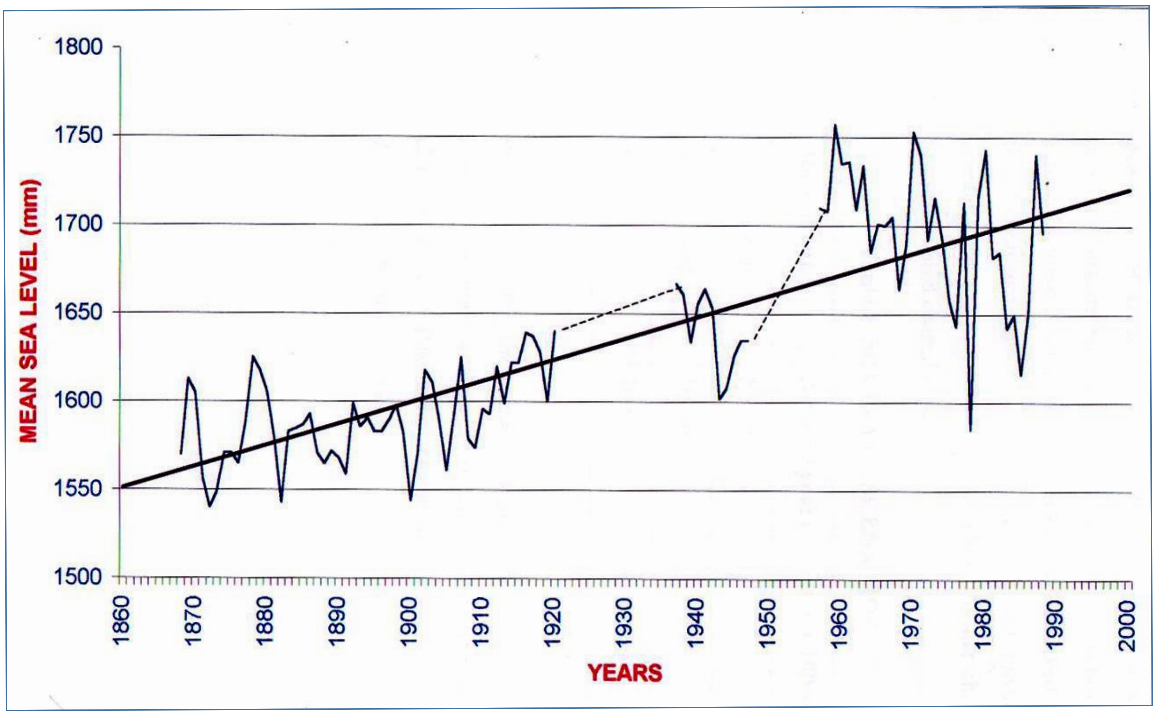


Fig. 3.41: Trend of the sea level rise at Karachi, Pakistan (Source: Rabbani *et al.*, 2008)

such as surface flows, groundwater levels and water quality data, rainfall and other climatic records, water use for various purposes, sea-levels, land use etc.

The Indus delta is a fan-shaped area but the study area selected was rectangle shaped area of about 24,764 $km^2$ (approximately 176 km x 140 km). A conceptual model is basically the representation of the physical system which helps to understand the interaction among various system components in time and space. Under this study, the finite difference "SEAWAT" model was proposed to be setup at a grid size of 5 km x 5 km with 986 total cells. The seawater intrusion model of Indus Delta was conceptualized as a four-layer case as shown in Fig. 3.42. The thickness of first two layers was considered as 5 m each below the surface whereas; the thickness of third layer as 10 m (10 - 20 m depth). The fourth layer was extended up to bedrock. The depth to bedrock was considered as 20 m. The thickness of vertical layers was defined based on the analysis of subsurface lithological variations in the deltaic region by using the well logs of 42 piezometric locations which were drilled at approx. grid interval of 18 km x 18 km. For horizontal boundaries, the seaside boundary was considered as variable head and salinity, however the northern boundary up to Hyderabad was considered as general head boundary. The eastern and western boundaries were treated as no flow boundaries.

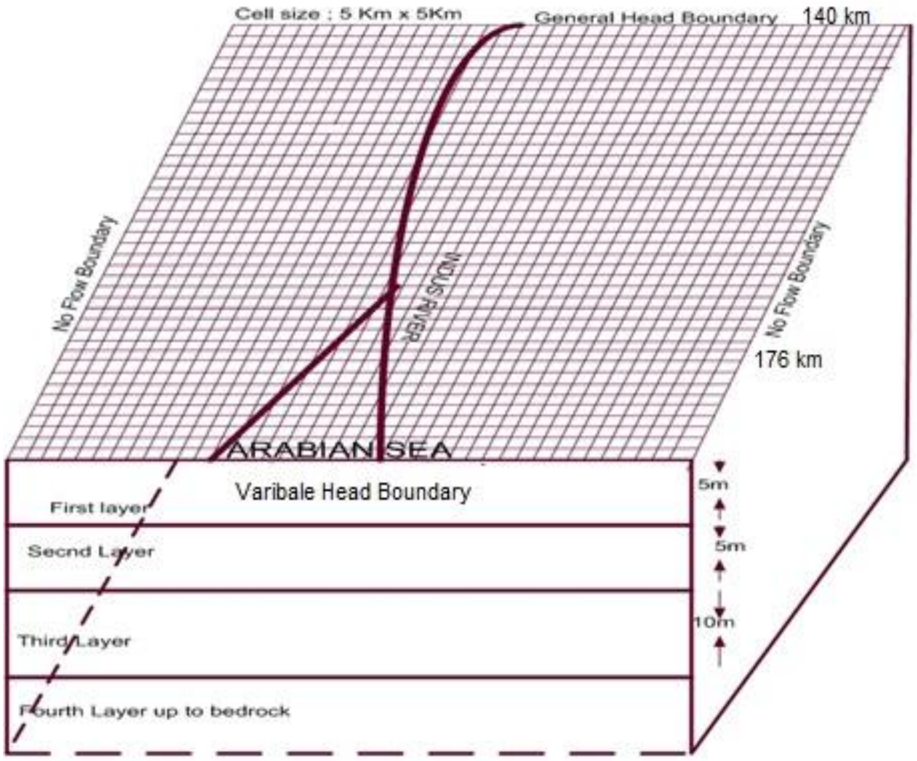


**Fig. 3.42: Surface-cum groundwater interaction model**

In order to proceed for the calibration and simulation mode, the water level and quality data from the study covered less than a year as the study continued from July 2017 to June 2018. This dataset was even insufficient for any realistic calibration. The subject component of the study was proposed while relying on continued monitoring on monthly basis from the MLOWs network established under the study as a good model requires at least 3–5 years data (monthly basis in this case) for any realistic calibration and scenario simulation. Therefore, it was not possible right now with limited dataset (8 to 10 months) to calibrate and produce any predictive scenario for the simulation of extent of seawater intrusion influenced by climatic implications. However, PCRWR may continue further monitoring and data collection under this study, if the PSDP funded project titled “Monitoring Seawater Intrusion, Sea level rise, coastal erosion and land subsidence along Sindh and Balochistan Coast” is approved. This would provide funding to continue further and accomplish model development and till sufficient datasets are available for yielding useful scenarios to better understand the behavior of seawater intrusion in deltaic region.

# 4. MAJOR FINDINGS AND STRATEGIC RECOMMENDATIONS

## 4.1 Major Findings

On the basis of physical monitoring of water quality and groundwater levels in the Indus delta and adjoining areas, information obtained through FGDs from the community on socio-economic conditions, and linkage of this study with the other similar studies in the subject area and other coastal regions, it is inferred from the limited data available as given below:

1. The main delta area is covered either under silty loam to loam soils in upper 3 m depth whereas further up in Sujawal and Badin areas, the soils are silty clay loam to clay loam. The later type of lithology has a dominant role in restricting the groundwater recharge in Sujawal and Badin areas. The topography of the main delta area is relatively flat varying from 0 - 4.0 m whereas in the remaining study area the elevation varies up to 20 m and small area in the upper part goes up to 200 m.

2. The study area falls in hot desert climate with warm to hot summers and mild winter. The long term analysis of annual rainfall data showed about 40 mm decrease in rainfall during the period 1997-2017 over that for the period 1982-1997. The analysis of maximum and minimum temperature variations in the study area showed insignificant increase in summer extreme temperatures whereas the winter minimum temperatures are getting milder showing an average increase of 2$^{o}$C. This shows night time temperatures are rising which can have adverse effect on crop physiography and productivity. This evidence clearly conforms with the observations gathered from the community during the PRA surveys in relation to rainfall reduction and rising temperatures; having direct impact on crops and ultimately community livelihood.

3. The climate change is therefore a serious concern of the deltaic community. About 63% responded that their income is affected by climate change while 23% respondents had suffered from loss of agricultural land. This is supported by the geo-spatial analysis under the study which is also endorsed by other studies in the area.

4. The change in water availability for crops in recent years was a hot debate as majority is experiencing significant decline in water availability (70%) which is to be explored further in the context of recommended environmental

flows. About 34% said climate change has direct impact on cropping season and that they have started practicing early sowing and early harvesting to cope with the change.

5. The groundwater level monitored in the study area was within 1.0 m from surface during monsoon period and it varied seasonally. The extremes of water table depths were observed in pre-monsoon (June) and monsoon (Jul-Aug) seasons, on an average from 3.0 m to 1.0 m, respectively whereas in the main deltaic region the groundwater remained almost near the surface. The salinity (EC) increases with depth from the surface in terms of concentration and areal extent from 1,000 μS/cm to greater than 150,000 μS/cm with highest concentrations in Badin and the areas along the Thar desert. The trend also shows increase in salinity from post-monsoon towards low-flow period (November towards June).

6. Two well-known ionic ratios were studied viz. $Ca^{2+}$:$Mg^{2+}$ and $Cl^-$:$HCO_3^-$ whereby the values more than unity (1.0) are indicative of seawater intrusion. The $Ca^{2+}$:$Mg^{2+}$ ratio was generally near or more than unity in most part of the study area with high values in Thatta district. The ratio significantly decreases with depth below ground surface and also with passage of time (November to June). The Cl: $HCO_3$ ratios are much higher than unity in most part of the study area with significant temporal and spatial variation. The ionic ratio increases with depth and time (from November as post-monsoon to June as pre-monsoon seasons). This increase in ionic ratio also extends from Badin towards Sujawal in a similar manner.

7. While linking these two ratios with presence of higher concentration of chloride and magnesium, it is inferred that the presence of high concentration of these ions in the groundwater indicates availability of soluble salts in water like magnesium chloride which is generally extracted from seawater.

8. The higher concentration of chloride is linked with the presence of sodium (Na) in the groundwater analyzed under the study which is also of concern as higher concentration of sodium generally poses risk of cardiovascular diseases and also of developing hypertension as reported by the deltaic community of having hypertension and cardiac diseases in the study area. The presence of higher concentrations of chloride with time and depth might be linked with incidence of seawater intrusion in study area which is substantiated with similar observations in coastal areas in other parts of the world.

9. Summarizing the observations and analyses based on approximately one-year data, it is inferred that various ionic ratios, presence of higher concentration of Mg, Cl and Na ions and their variation in the study area with depth and time might be linked with incidence of seawater intrusion. The effect is certainly less in upper parts of the study area which are away from the main deltaic region. These observations were further substantiated from the field observations and direct response from the concerned community.

10. Poverty is evident in the area having limited job opportunities and most of the residents find their ways to urban centers for their earning. Although most of the children are going to schools and colleges but large proportion of the youth (80%) is mainly limited to fishing and agricultural activities. Regarding women participation, almost all of the women are participating in household work while a small fraction also takes part in transplanting rice, feeding and milking livestock, harvesting of crops etc.

11. The information gathered from the field revealed that over the last 10 years no significant migration had taken place from the area. Of the respondents, 49% were pondering about migration, the major reasons included the loss of land because of salinity (30%) and lack of drinking water (25%) leading to poverty in the area.

12. About 70% of the surveyed population depends on groundwater as their source of drinking water. Other drinking water sources are ponds and canal water. Due to highly saline water, about 97% had a family member suffering from serious disease; major ones reported were hepatitis, hypertension, vomiting, diarrhea, skin infections and liver diseases which may be related to higher concentration of sodium/ salinity found in the study area.

13. Electricity is the major source of energy in the area (42%) though the majority finds the supply to be erratic and unreliable. This leads to deforestation in the area which could be one of the reasons of abandoning of mangroves in Indus delta as wood is another energy source.

14. Although large number of NGOs were reported to be present in the area but their contribution was limited and wherever they were working, they helped for education, health and agriculture.

## 4.2 Strategic Recommendations

In the light of major findings and data limitations under the study, it is recommended that;

1. The study is needed to be continued as a regular feature making use of MLOWs network established under this study in connection with seawater intrusion in the deltaic and adjoining areas and as future study to be more confident for arriving this conclusion.

2. In addition, isotopic sampling is important in this regard to help certify the source and aging of groundwater in the Indus delta, thus to justify the seawater intrusion with area and its extent because salinity in the aquifer is predominantly due to fossil water salinity from geological origin.

3. Integrated model accomplishment with sufficient data availability would be advantageous for better management of deltaic region as practiced in the coastal areas of developed countries.

4. The change in water availability for cropping in the main deltaic region and lower part of Sindh needs to be explored further in the context of recommended environmental flows

5. The excess water in Kotri downstream should be allowed for which another control structure downstream would be of great importance to regulate the environmental flows.

6. The government should provide plant species with high salt tolerance and yield along with the effective insecticides and pesticides through promotion of bio-saline agriculture in the deltaic region.

7. In areas of high water-table, on-farm open drains and drainage outfalls should be constructed to lower the water-table for providing favourable environment for crops cultivation.

8. Sustainable RO plants (Reverse Osmosis) and water reservoirs should be constructed.

9. Proper management of industrial and municipal waste disposal being dumped in the natural steams and canals to avoid further contamination.

10. Electricity, gas and water supply schemes should be provided in those areas to solve drinking water and energy issues.

11. Better health facilities and job opportunities along with value addition of agricultural products should be explored for improving livelihood and socio-economic conditions of the area.

12. Community level awareness programs should be launched for the

adoption of appropriate mitigation measures of seawater intrusion and resilience building of communities living in the Indus Delta.

13. Promotion of indigenous solutions and their implementation with the involvement of local community.

14. Mangrove plantation in the coastal belt as one of the mitigation measure.

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## Annex-1: Questionnaire for Participatory Rural Appraisal (PRAs)

**SOCIO-ECONOMIC SURVEY (Indus Delta) Through Focused Group Discussion Approach**

**Name of the Study: Monitoring Sea-water intrusion in Indus delta for Climate Change Adaptation**

**<u>Section A: Identification</u>**

| | |
|---|---|
| **Q 01**. Date : | |
| **Q 02**. Grid No: | |
| **Q 03**. Village/town: | |
| **Q 04.** Taluka:<br>**Q 0**5. Names of Team Members: | |

**Section B: General Information about Respondent**

| | |
|---|---|
| **Q 06.** Number of respondents | |
| **Q 07.** Gender | ☐ No of male:<br>☐ No of female: |
| **Q 08.** Age group | ☐ 15-24<br>☐ 25-44<br>☐ 3. 45-64<br>☐ 4. 65+ |
| **Q 09.** Major Language | ☐ Sindhi ☐ Urdu ☐ Siraiki ☐ Other |
| **Q 10.** Education level | ☐ Illiterate<br>☐ Primary<br>☐ Matric<br>☐ Inter<br>☐ Graduate |
| **Q 11.** Education level of Children | ☐ Illiterate<br>☐ Primary<br>☐ Matric<br>☐ Inter<br>☐ Graduate |

| | |
|---|---|
| **Q 12.** Current occupations | ☐ Farm laborer<br>☐ Industrial laborer<br>☐ Middleman in agriculture<br>☐ Business man<br>☐ Retired<br>☐ Other |
| **Q 13.** Source of income | ☐ Farming<br>☐ Husbandry<br>☐ Trading<br>☐ Fishery<br>☐ Wood and wood products<br>☐ Other |
| **Q 14.** Average monthly income in area | Rs. |
| **Q 15.** Monthly Expenditures | Rs. |
| **Q 16.** Any adverse impact of SWI (seawater intrusion) | ☐ Yes ☐ No<br>Past:<br>Present: |
| **Q 17.** Impacts of SWI | ☐ Loss of agricultural land<br>☐ Loss of livestock<br>☐ Loss of crops<br>☐ Loss of business premises<br>☐ Other |
| **Q 18.** What is the quality of drinking water? | ☐ Sweet<br>☐ Salty<br>☐ Not known |
| **Q 19.** What is the source of drinking water? | ☐ Pond<br>☐ Canal<br>☐ Ground water<br>☐ Other |

**Q 20.** If the source is groundwater then what is the depth of ground water?

ft. ……………………………………………………………………………………………

**Q 21.** How do you treat water before drinking?

☐ Don't treat

☐ Boil it

☐ Chlorine tablets

☐ Filter machines

☐ Others

**Q 22.** What kind of problem do you face with water supply?

…………………………………………………………………………………………

## Section C: Health

**Q 23.** Does anyone in your house have a permanent health problem?

☐ Yes ☐No

**Q 24.** Any specific disease experienced due to SWI issue? If yes then its name?

…………………………………………………………………………………………..

**Q 25**. Is GOV or NGOs providing any health facilities?

☐ Yes ☐No

**Q 26**. How satisfied you are with that facility?

1. Satisfied 2. Highly satisfied 3. Not satisfied 4. Neither satisfied nor unsatisfied

## Section D: Energy, Livestock, Agricultural land and fish catch

**Q 27.** What is the source of energy?

1. Electricity 2. Solar system 3. Wood 4. Other

**Q 28**. What kind of problem do you face regarding the source of energy?

…………………………………………………………………………………………..

**Q 29**. What is the number of livestock you own?

Number: ……………………………

**Q 30** .Any adverse effects of SWI on livestock?

…………………………………………………………………………………………..

**Q 31**. Any changes in annual earnings from livestock in last five years?

……………………………………………………………………………....…………

**Q 32**. How much agricultural land do you own?

…………………………………………………………………………..……….....

**Q 33**. Have you lost any land due to salinity or sea intrusion?

☐Yes ☐No

**Q 34.** If yes then how much land is lost? …………………………….

**Q 35.** What changes you have seen in the availability of water for your crops in recent years?

- ☐ Significant decline
- ☐ Some
- ☐ No decline'
- ☐ Some increase
- ☐ Significant increase
- ☐ Not sure

**Q 36**. Any change in income due to climate change impacts on agriculture?

……………………………………………………………………………………….....

**Q 37.** What kind of overall change you have observed in the fish catch?

1. Increased 2. Decreased 3. No change

**Q 38.** Any change in income due to decline in fish catch?

………………………………………………………………………………………..

<u>**Section E: Temperature variations and Rainfall patterns**</u>

**Q 39.** Do you feel any change in the temperature of Delta?

☐Yes ☐No

**Q 40.** Is there any change in the rainfall pattern?

☐Yes ☐No

**Q 41.** What is the situation of floods and drought in the area?

…………………………………………………………………………………………..…

**Q 42.** What is the current situation of agriculture/ vegetation due to changes in temperature and rainfall pattern?

Increased /decreased /same

**Q 43.** Did you find any changes in crop yield, sowing and harvesting patterns due to the changing climate?

☐Yes ☐No

…………………………………………………………………………………………..…

**Q 44.** Is there any significant change in cropping pattern in last 20 years?

☐Yes ☐No

**Q 45.** If yes then what is the change?

…………………………………………………………………………………………..…

**Q 46.** What do you think is the reason behind changing crop pattern?

…………………………………………………………………………………………..…

**Q 47.** What is the effect of climate change on crop season?

1. Early growth   2. Late growth   3. Growing as per season

**Q.48.** What measures they have taken to cope with such changes

1.______________ 2.______________ 3. No measures taken

## Section F: Role of Government and NGOs

**Q 49.** Are you aware of any non-government or community organization working to support the communities in your area and on what aspect?

☐ Yes ☐ No

1. Agriculture   2. Health   3. Education   4. Fish catch   5. Other

**Q 50.** If yes then what is the name?

………………………………………………………………………………………….....

## Section G: Migration

**Q 51.** Do you have any member that migrated to some other place?

☐ Yes ☐ No

**Q 52.** If yes then what was the reason?

- ☐ Poverty
- ☐ Lack of food
- ☐ Lack of drinking water
- ☐ Loss of agriculture land to the sea/salinity
- ☐ Other …………………………………………………

**Q 53.** What changes have you seen in the population of your village or locality over the past 10 years?

- ☐ Increased Substantially
- ☐ Increased Somewhat
- ☐ Stayed the Same
- ☐ Reduced Somewhat
- ☐ Reduced Substantially

**Q 54.** Do you think of yourself migrating to some other place?

Yes /No/Not Sure

**Q 55.** If yes, what are the main reasons? (Check multiple options if necessary)

1. Because of Poverty
2. Lack of employment
3. Poor crops.
4. Fear of drought
5. Being in debt.
6. Lack of Education Facilities
7. Do not know
8. Lack of adequate food
9. Lack of fish catch
10. Loss of agricultural land to the sea or salinity

11. .Fear of floods
12. Lack of Drinking Water
13. 13.Lack of Health Facilities
14. Other_________________(Specify)

**Section H: Youth and Women (Responsibilities and Views)**

**Q 56.** What is the education level of youth?

Illiterate: Primary: Matric: Inter: Graduate:

**Q 57**. Is your youth engaged in fishing and agriculture at the moment?

1. Fishing 2. Agriculture 3. Both 4. None

**Q 58.** What is the opinion of youth about SWI? And what opportunities they think about?

…………………………………………………………………………………….....

**Q 59.** What is the nature and extent of participation of women in various agricultural and non- agricultural activities?

…………………………………………………………………………………….....

**ection I: Perception and Expectation**

**Q 60.** In your opinion what are the ways to improve the current situation?

…………………………………………………………………………………….....

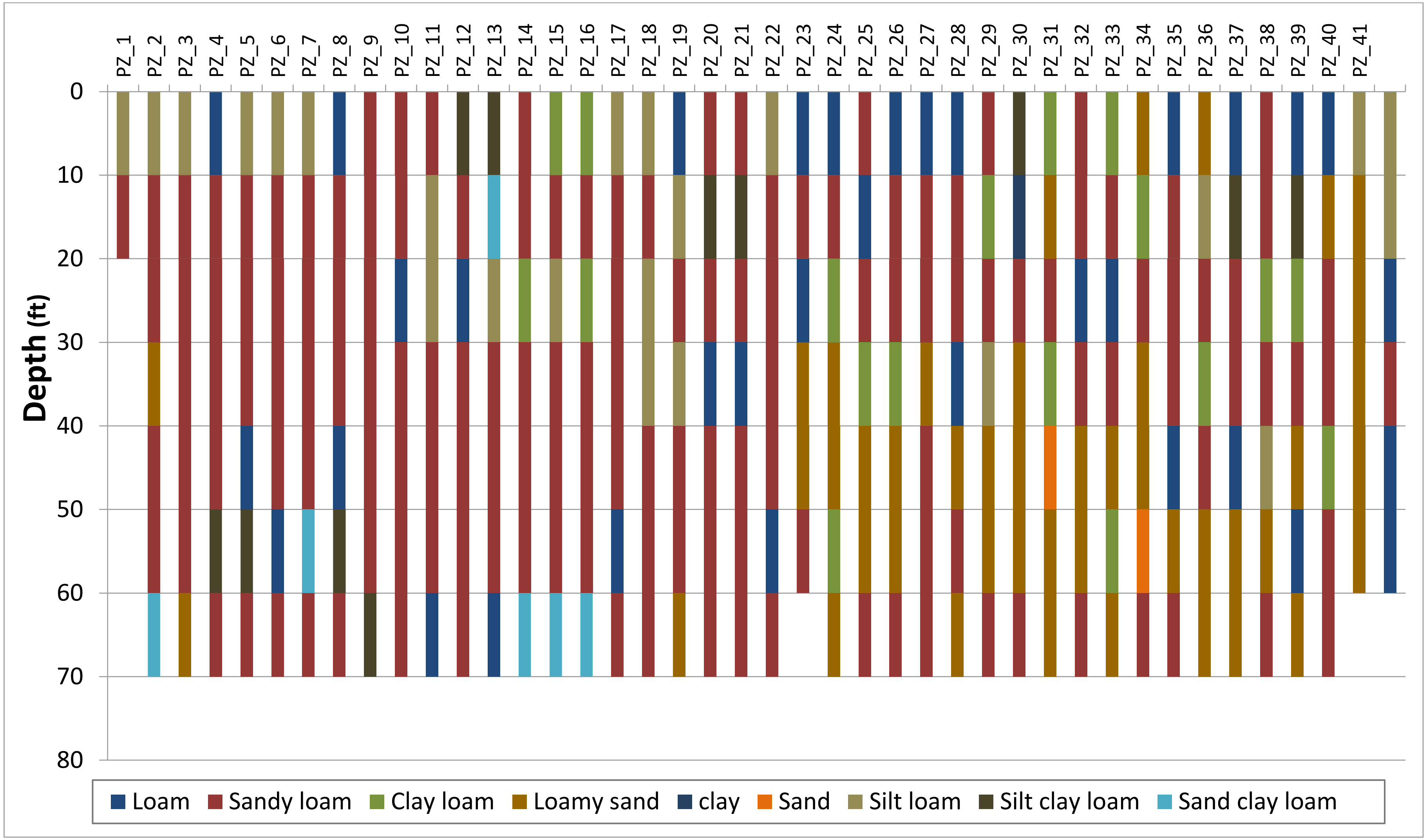
**Q 61.** What actions/ support do you expect in future to take measures or to adapt to sea water intrusion?

…………………………………………………………………………………….....

**Q 62.** Any further comments or suggestions

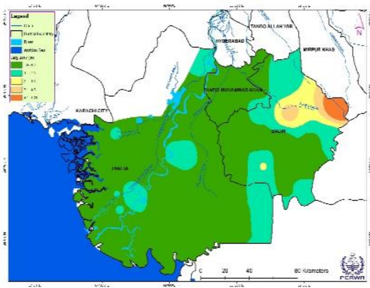
…………………………………………………………………………………….....

## Annex-2: Detailed Sub-surface lithological variations at 42 MLOW in Indus Delta

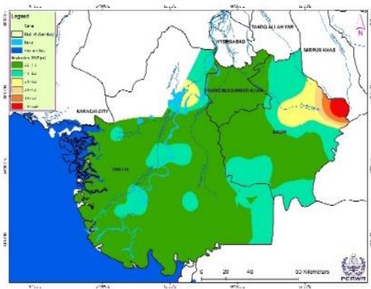


## Annex-3: Spatial and temporal variation of Groundwater fluctuations in Indus Delta

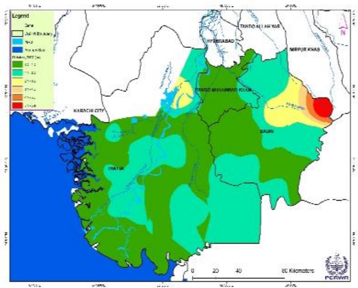
July-Aug 2017



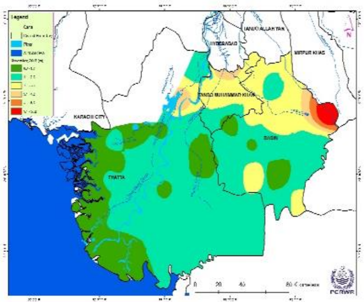
September 2017



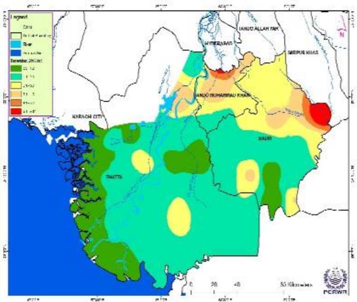
October 2018



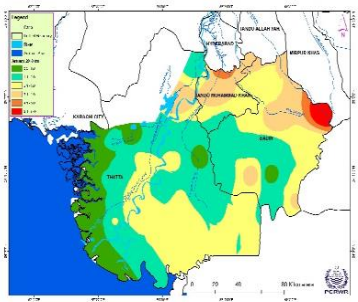
November 2017



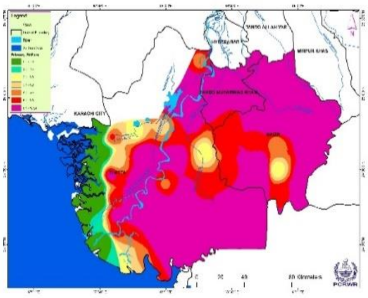
December 2017



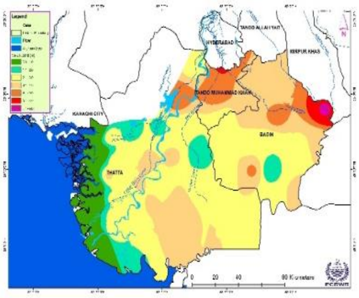
Janaury 2018



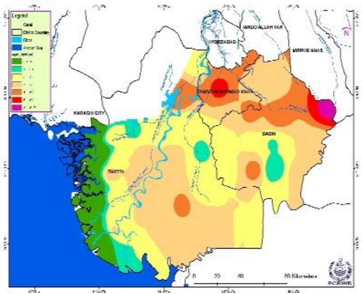
February 2018



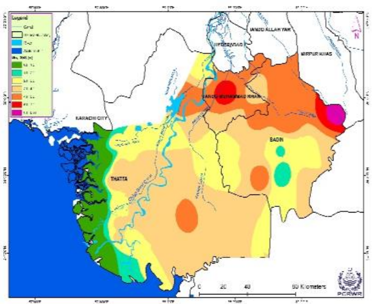
March 2018



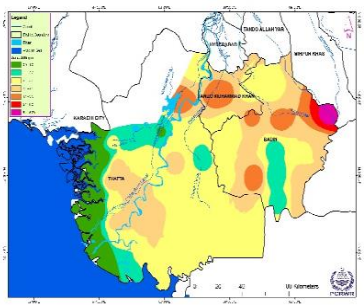
April 2018



May 2018



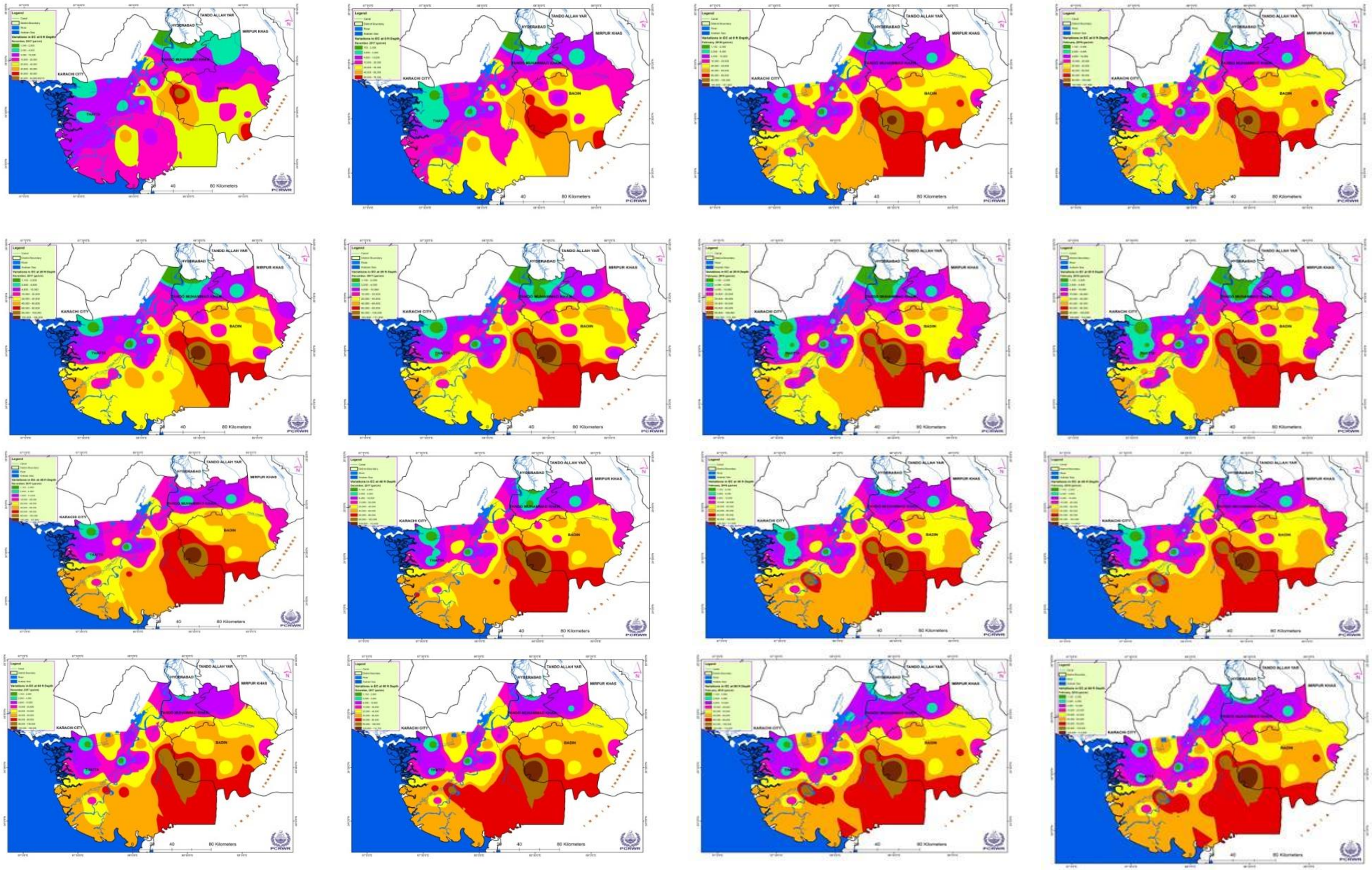
June 2018



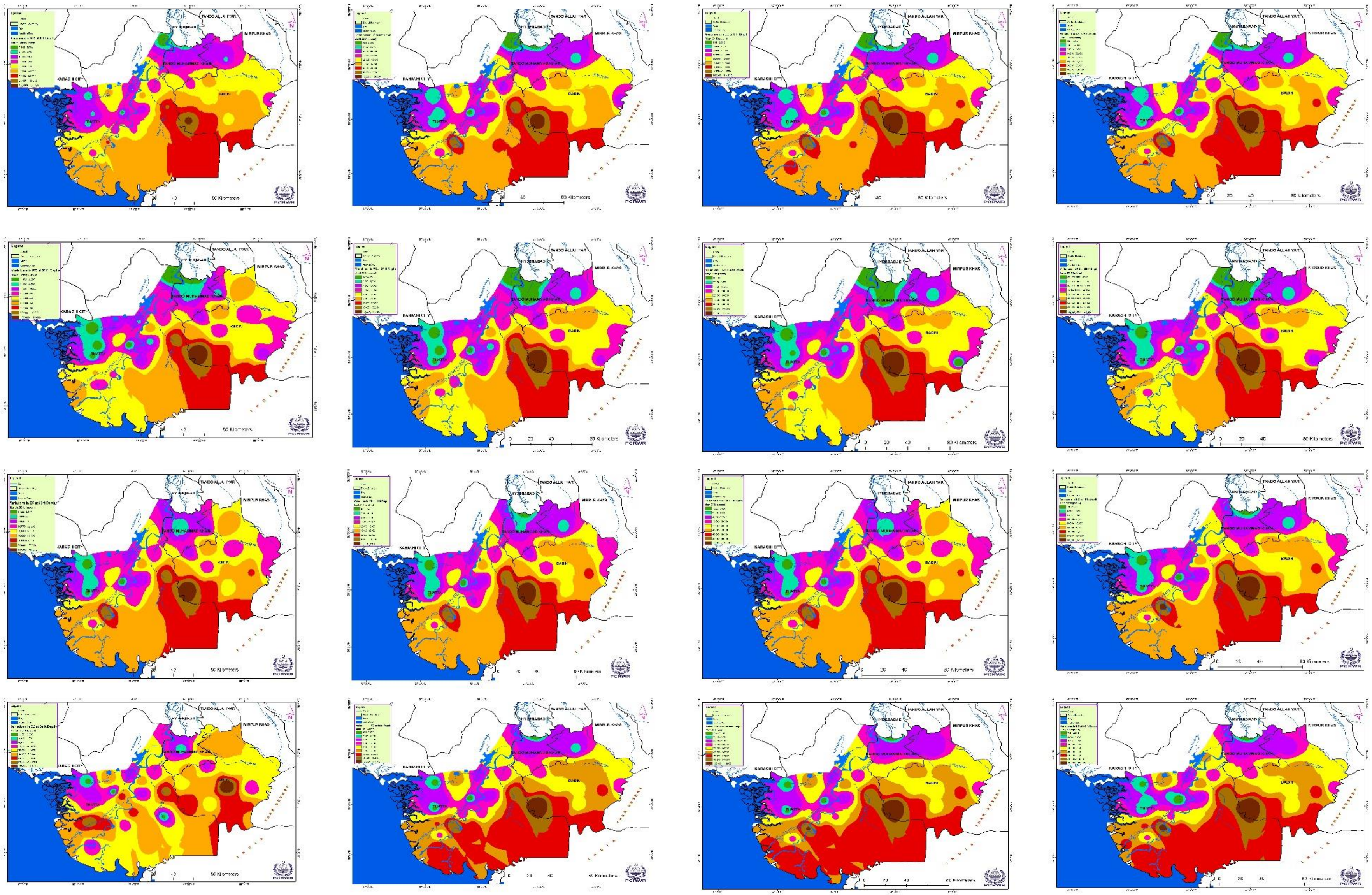
## Annex-4: Spatial and temporal variation of Salinity (EC) in Indus Delta

November 2017 | December 2017 | January 2018 | February 2018

At water level (0 m) | 6 m | 13 m | 20 m



| | March 2018 | April 2018 | May 2018 | June 2018 |
|---|---|---|---|---|
| At water level (0 m) | | | | |
| 6 m | | | | |
| 13 m | | | | |
| 20 m | | | | |



# Annex-5: Results of Groundwater Samples Collected during the study

## 5.1 Water Quality Analysis from 42 MLOWs during November 2017 (at 0 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 0 | 1241 | 794 | 8.3 | 10 | 150 | 174 | 40 | 36.45 | 169 | 250 |
| 2 | MLOW-02 | 68.12 | 24.97 | 0 | 21400 | 13696 | 7.6 | Nil | 650 | 4002 | 440 | 449 | 3535 | 2950 |
| 3 | MLOW-03 | 68.18 | 24.79 | 0 | 2430 | 1555 | 7.7 | Nil | 350 | 522 | 180 | 48.6 | 255 | 650 |
| 4 | MLOW-04 | 67.98 | 24.78 | 0 | 3950 | 2528 | 7.7 | Nil | 550 | 666 | 140 | 109 | 505 | 800 |
| 5 | MLOW-05 | 68.07 | 24.72 | 0 | 46100 | 29504 | 8 | Nil | 650 | 10585 | 540 | 1543 | 7000 | 7700 |
| 6 | MLOW-06 | 67.59 | 24.71 | 0 | 2660 | 1702 | 8.4 | Nil | 450 | 493 | 100 | 157 | 976 | 900 |
| 7 | MLOW-07 | 67.77 | 24.74 | 0 | 7200 | 4608 | 7.9 | Nil | 800 | 1160 | 80 | 109 | 1330 | 650 |
| 8 | MLOW-08 | 68.08 | 24.60 | 0 | 3550 | 2272 | 7.7 | Nil | 250 | 580 | 80 | 60.75 | 603 | 450 |
| 9 | MLOW-09 | 68.30 | 24.62 | 0 | 54600 | 34944 | 7.2 | Nil | 450 | 14500 | 2400 | 1385 | 7115 | 11700 |
| 10 | MLOW-10 | 67.63 | 24.55 | 0 | 6500 | 4160 | 8.1 | Nil | 650 | 1247 | 200 | 230 | 810 | 1450 |
| 11 | MLOW-11 | 67.82 | 24.61 | 0 | 7320 | 4684 | 7.6 | Nil | 250 | 1508 | 240 | 170 | 1065 | 1300 |
| 12 | MLOW-12 | 67.89 | 24.57 | 0 | 2080 | 1331 | 8.3 | 20 | 550 | 377 | 80 | 109 | 170 | 650 |
| 13 | MLOW-13 | 68.27 | 24.36 | 0 | 11370 | 7276 | 7.3 | Nil | 400 | 2320 | 160 | 279 | 1870 | 1550 |
| 14 | MLOW-14 | 67.58 | 24.46 | 0 | 2880 | 1843 | 7.8 | Nil | 450 | 522 | 180 | 24.3 | 403 | 550 |
| 15 | MLOW-15 | 67.83 | 24.40 | 0 | 11260 | 7206 | 7.8 | Nil | 600 | 2755 | 140 | 328 | 1780 | 1700 |
| 16 | MLOW-16 | 67.99 | 24.40 | 0 | 13130 | 8403 | 7.6 | Nil | 500 | 3422 | 200 | 218 | 2360 | 1400 |
| 17 | MLOW-17 | 68.14 | 24.27 | 0 | 8080 | 5171 | 7.7 | Nil | 400 | 2030 | 160 | 158 | 1356 | 1050 |
| 18 | MLOW-18 | 67.61 | 24.31 | 0 | 6730 | 4307 | 8 | Nil | 650 | 1218 | 80 | 182 | 1090 | 950 |
| 19 | MLOW-19 | 67.76 | 24.29 | 0 | 6050 | 3872 | 7.4 | Nil | 350 | 1160 | 120 | 182 | 888 | 1050 |
| 20 | MLOW-20 | 67.92 | 24.28 | 0 | 46600 | 29824 | 8.1 | Nil | 750 | 13485 | 400 | 1178 | 7969 | 5850 |
| 21 | MLOW-21 | 67.63 | 24.19 | 0 | 5110 | 3270 | 8 | Nil | 700 | 1015 | 220 | 182 | 555 | 1300 |
| 22 | MLOW-22 | 67.46 | 24.14 | 0 | 7300 | 4672 | 7.3 | Nil | 300 | 1479 | 240 | 133 | 1133 | 1150 |
| 23 | MLOW-23 | 67.62 | 24.09 | 0 | 19470 | 12460 | 7.6 | Nil | 250 | 3538 | 460 | 315 | 3333 | 2450 |
| 24 | MLOW-24 | 68.66 | 25.04 | 0 | 4360 | 2790 | 8.3 | 10 | 400 | 783 | 160 | 72.9 | 679 | 700 |
| 25 | MLOW-25 | 68.66 | 24.87 | 0 | 4810 | 3078 | 7.8 | Nil | 100 | 1008 | 180 | 206 | 492 | 1300 |
| 26 | MLOW-26 | 68.50 | 24.82 | 0 | 14560 | 9318 | 7.7 | Nil | 400 | 3220 | 200 | 413 | 2309 | 2200 |
| 27 | MLOW-27 | 68.42 | 24.69 | 0 | 84900 | 54336 | 7.4 | Nil | 550 | 22910 | 1020 | 947 | 16498 | 6450 |
| 28 | MLOW-28 | 68.67 | 24.69 | 0 | 5740 | 3673 | 7.8 | Nil | 300 | 870 | 120 | 218 | 744 | 1200 |
| 29 | MLOW-29 | 68.84 | 24.66 | 0 | 23200 | 14848 | 7.7 | Nil | 550 | 4582 | 320 | 510 | 3971 | 2900 |
| 30 | MLOW-30 | 68.49 | 24.49 | 0 | 50200 | 32128 | 7.8 | Nil | 650 | 16520 | 640 | 1640 | 7646 | 8350 |
| 31 | MLOW-31 | 68.70 | 24.49 | 0 | 34800 | 22272 | 7.4 | Nil | 500 | 10920 | 540 | 972 | 5502 | 5350 |
| 32 | MLOW-32 | 68.84 | 24.50 | 0 | 12700 | 8128 | 8 | Nil | 650 | 3500 | 240 | 328 | 2001 | 1950 |
| 33 | MLOW-33 | 68.88 | 24.34 | 0 | 21900 | 14016 | 7.6 | Nil | 300 | 9000 | 320 | 413 | 3859 | 2500 |
| 34 | MLOW-34 | 69.04 | 24.33 | 0 | 76900 | 49216 | 7.1 | Nil | 400 | 24920 | 1340 | 2952 | 10468 | 15500 |
| 35 | MLOW-35 | 69.04 | 24.47 | 0 | 19240 | 12313 | 8 | Nil | 750 | 5040 | 400 | 571 | 2849 | 3350 |
| 36 | MLOW-36 | 69.07 | 24.64 | 0 | 30400 | 19456 | 7.3 | Nil | 550 | 6496 | 600 | 1057 | 4249 | 5850 |
| 37 | MLOW-37 | 69.20 | 24.68 | 0 | 12170 | 7788 | 7.9 | Nil | 500 | 3472 | 240 | 376 | 1788 | 2150 |
| 38 | MLOW-38 | 69.26 | 24.89 | 0 | 7450 | 4768 | 8 | Nil | 700 | 1680 | 180 | 279 | 951 | 1600 |
| 39 | MLOW-39 | 68.89 | 24.85 | 0 | 7110 | 4550 | 7.8 | Nil | 450 | 1680 | 140 | 218 | 1035 | 1250 |
| 40 | MLOW-40 | 68.82 | 25.05 | 0 | 2010 | 1286 | 7.9 | Nil | 160 | 352 | 80 | 145 | 91 | 800 |
| 41 | MLOW-41 | 68.43 | 25.04 | 0 | 3010 | 1926 | 8.3 | 10 | 220 | 627 | 112 | 145 | 181 | 880 |
| 42 | MLOW-42 | 68.47 | 25.20 | 0 | 1043 | 667 | 8.4 | 10 | 330 | 156 | 44 | 65.61 | 61 | 380 |

## 5.2 Water Quality Analysis from 42 MLOWs during December 2017 (at 0 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 0 | 753 | 481 | 8.3 | 20 | 200 | 134 | 36 | 36.45 | 60 | 240 |
| 2 | MLOW-02 | 68.12 | 24.97 | 0 | 21600 | 13824 | 7.4 | Nil | 650 | 4992 | 400 | 534.6 | 3482 | 3200 |
| 3 | MLOW-03 | 68.18 | 24.79 | 0 | 3700 | 2368 | 7.7 | Nil | 400 | 1200 | 160 | 194.4 | 294 | 1200 |
| 4 | MLOW-04 | 67.98 | 24.78 | 0 | 3820 | 2444 | 7.7 | Nil | 500 | 1120 | 160 | 157.95 | 391 | 1050 |
| 5 | MLOW-05 | 68.07 | 24.72 | 0 | 44700 | 28608 | 7.6 | Nil | 800 | 14790 | 580 | 1372.95 | 6981 | 7100 |
| 6 | MLOW-06 | 67.59 | 24.71 | 0 | 1772 | 1134 | 7.7 | Nil | 350 | 323 | 100 | 72.9 | 150 | 550 |
| 7 | MLOW-07 | 67.77 | 24.74 | 0 | 14610 | 9350 | 7.7 | Nil | 800 | 4256 | 220 | 303.75 | 2520 | 1800 |
| 8 | MLOW-08 | 68.08 | 24.60 | 0 | 3610 | 2310 | 7.9 | Nil | 500 | 896 | 80 | 145.8 | 456 | 800 |
| 9 | MLOW-09 | 68.30 | 24.62 | 0 | 58300 | 37312 | 7.1 | Nil | 450 | 16320 | 2520 | 2077.65 | 13575 | 14850 |
| 10 | MLOW-10 | 67.63 | 24.55 | 0 | 2560 | 1638 | 8.2 | Nil | 300 | 608 | 80 | 121.5 | 262 | 700 |
| 11 | MLOW-11 | 67.82 | 24.61 | 0 | 7750 | 4960 | 7.7 | Nil | 400 | 2144 | 260 | 157.95 | 1869 | 1300 |
| 12 | MLOW-12 | 67.89 | 24.57 | 0 | 1772 | 1134 | 8.4 | 20 | 350 | 384 | 100 | 72.9 | 151 | 550 |
| 13 | MLOW-13 | 68.27 | 24.36 | 0 | 19200 | 12288 | 7.5 | Nil | 400 | 5792 | 280 | 486 | 3149 | 2700 |
| 14 | MLOW-14 | 67.58 | 24.46 | 0 | 2650 | 1696 | 7.9 | Nil | 450 | 576 | 80 | 72.9 | 377.89 | 500 |
| 15 | MLOW-15 | 67.83 | 24.40 | 0 | 15890 | 10169 | 7.6 | Nil | 950 | 4672 | 220 | 461.7 | 2505 | 2450 |
| 16 | MLOW-16 | 67.99 | 24.40 | 0 | 15350 | 9824 | 7.7 | Nil | 600 | 4448 | 240 | 315.9 | 2635 | 1900 |
| 17 | MLOW-17 | 68.14 | 24.27 | 0 | 16260 | 10406 | 7.8 | Nil | 500 | 4768 | 220 | 437.4 | 2635 | 2350 |
| 18 | MLOW-18 | 67.61 | 24.31 | 0 | 11380 | 7283 | 7.6 | Nil | 500 | 2944 | 160 | 291.6 | 1872 | 1600 |
| 19 | MLOW-19 | 67.76 | 24.29 | 0 | 8070 | 5164 | 7.7 | Nil | 400 | 2336 | 140 | 194.4 | 1315 | 1150 |
| 20 | MLOW-20 | 67.92 | 24.28 | 0 | 47600 | 30464 | 8 | Nil | 850 | 15680 | 320 | 1202.85 | 8260 | 5750 |
| 21 | MLOW-21 | 67.63 | 24.19 | 0 | 6790 | 4345 | 7.8 | Nil | 600 | 1728 | 160 | 291.6 | 816 | 1600 |
| 22 | MLOW-22 | 67.46 | 24.14 | 0 | 12940 | 8281 | 7.6 | Nil | 550 | 3584 | 200 | 352.35 | 2062 | 1950 |
| 23 | MLOW-23 | 67.62 | 24.09 | 0 | 28600 | 18304 | 7.7 | Nil | 450 | 7424 | 540 | 789.75 | 4430 | 4600 |
| 24 | MLOW-24 | 68.66 | 25.04 | 0 | 3480 | 2227 | 8.3 | 10 | 400 | 800 | 120 | 121.5 | 427 | 800 |
| 25 | MLOW-25 | 68.66 | 24.87 | 0 | 50500 | 32320 | 7.3 | Nil | 350 | 15648 | 3300 | 2806 | 2437 | 19800 |
| 26 | MLOW-26 | 68.50 | 24.82 | 0 | 9540 | 6105 | 8.1 | Nil | 450 | 2368 | 140 | 461.7 | 1145 | 2250 |
| 27 | MLOW-27 | 68.42 | 24.69 | 0 | 61400 | 39296 | 7.3 | Nil | 750 | 17472 | 520 | 741.15 | 12980 | 4350 |
| 28 | MLOW-28 | 68.67 | 24.69 | 0 | 6290 | 4025 | 8.3 | Nil | 600 | 1472 | 80 | 315.9 | 742 | 1500 |
| 29 | MLOW-29 | 68.84 | 24.66 | 0 | 36000 | 23040 | 7.6 | Nil | 650 | 10080 | 480 | 1081.35 | 5641 | 5650 |
| 30 | MLOW-30 | 68.49 | 24.49 | 0 | 78300 | 50112 | 7.4 | Nil | 550 | 24704 | 1420 | 3025 | 7849 | 16000 |
| 31 | MLOW-31 | 68.70 | 24.49 | 0 | 64900 | 41536 | 7.4 | Nil | 750 | 17604 | 420 | 2114 | 10355 | 9750 |
| 32 | MLOW-32 | 68.84 | 24.50 | 0 | 16450 | 10528 | 7.8 | Nil | 400 | 4185 | 220 | 413.1 | 2718 | 2250 |
| 33 | MLOW-33 | 68.88 | 24.34 | 0 | 44500 | 28480 | 7.5 | Nil | 400 | 13230 | 320 | 1688 | 6605 | 7750 |
| 34 | MLOW-34 | 69.04 | 24.33 | 0 | 73200 | 46848 | 7.1 | Nil | 500 | 24030 | 1080 | 2223 | 11305 | 11850 |
| 35 | MLOW-35 | 69.04 | 24.47 | 0 | 33200 | 21248 | 7.6 | Nil | 550 | 8775 | 420 | 1275 | 3715 | 6300 |
| 36 | MLOW-36 | 69.07 | 24.64 | 0 | 32900 | 21056 | 7.5 | Nil | 700 | 6750 | 300 | 1117 | 5059 | 5350 |
| 37 | MLOW-37 | 69.20 | 24.68 | 0 | 12010 | 7686 | 7.9 | Nil | 550 | 3024 | 280 | 558.9 | 1929 | 3000 |
| 38 | MLOW-38 | 69.26 | 24.89 | 0 | 10320 | 6604 | 7.8 | Nil | 550 | 2160 | 140 | 437.4 | 1361 | 2150 |
| 39 | MLOW-39 | 68.89 | 24.85 | 0 | 11610 | 7430 | 7.9 | Nil | 550 | 2509 | 100 | 291.6 | 1984 | 1450 |
| 40 | MLOW-40 | 68.82 | 25.05 | 0 | 2630 | 1683 | 8.4 | 10 | 550 | 510 | 40 | 72.9 | 415 | 400 |
| 41 | MLOW-41 | 68.43 | 25.04 | 0 | 3730 | 2387 | 8.3 | 10 | 400 | 900 | 100 | 97.2 | 550 | 650 |
| 42 | MLOW-42 | 68.47 | 25.20 | 0 | 1040 | 665 | 8.3 | 10 | 250 | 180 | 60 | 36.45 | 99 | 250 |

## 5.3 Water Quality Analysis from 42 MLOWs during January 2018 (at 0 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 0 | 780 | 499 | 8.6 | 20 | 350 | 66 | 60 | 24.3 | 63 | 250 |
| 2 | MLOW-02 | 68.12 | 24.97 | 0 | 20400 | 13056 | 7.5 | Nil | 750 | 4676 | 340 | 619.65 | 3111 | 3400 |
| 3 | MLOW-03 | 68.18 | 24.79 | 0 | 4840 | 3097 | 7.9 | Nil | 550 | 812 | 200 | 267.3 | 369 | 1600 |
| 4 | MLOW-04 | 67.98 | 24.78 | 0 | 4010 | 2566 | 8 | Nil | 600 | 812 | 180 | 218.7 | 294 | 1350 |
| 5 | MLOW-05 | 68.07 | 24.72 | 0 | 46200 | 29568 | 7.8 | Nil | 850 | 12152 | 360 | 1701 | 6944 | 7900 |
| 6 | MLOW-06 | 67.59 | 24.71 | 0 | 2040 | 1305 | 8.9 | 20 | 250 | 420 | 100 | 85.05 | 190 | 600 |
| 7 | MLOW-07 | 67.77 | 24.74 | 0 | 32300 | 20672 | 8 | Nil | 700 | 9660 | 360 | 838.35 | 5396 | 4350 |
| 8 | MLOW-08 | 68.08 | 24.60 | 0 | 4140 | 2649 | 8 | Nil | 500 | 896 | 100 | 194.4 | 461 | 1050 |
| 9 | MLOW-09 | 68.30 | 24.62 | 0 | 61000 | 39040 | 7.5 | Nil | 200 | 19012 | 3160 | 2612 | 5359 | 18650 |
| 10 | MLOW-10 | 67.63 | 24.55 | 0 | 4280 | 2739 | 8.3 | 30 | 500 | 952 | 200 | 85.05 | 576 | 850 |
| 11 | MLOW-11 | 67.82 | 24.61 | 0 | 10480 | 6707 | 7.4 | Nil | 550 | 3108 | 100 | 413.1 | 1491 | 1950 |
| 12 | MLOW-12 | 67.89 | 24.57 | 0 | 1396 | 893 | 8.5 | 20 | 400 | 198 | 60 | 72.9 | 110 | 450 |
| 13 | MLOW-13 | 68.27 | 24.36 | 0 | 34600 | 22144 | 7.4 | Nil | 350 | 14532 | 240 | 1032 | 5688 | 4850 |
| 14 | MLOW-14 | 67.58 | 24.46 | 0 | 2500 | 1600 | 8.8 | 30 | 550 | 616 | 60 | 60.75 | 385 | 400 |
| 15 | MLOW-15 | 67.83 | 24.40 | 0 | 15600 | 9984 | 8.1 | Nil | 750 | 4480 | 200 | 498.15 | 2389 | 2550 |
| 16 | MLOW-16 | 67.99 | 24.40 | 0 | 16020 | 10252 | 7.6 | Nil | 600 | 4564 | 180 | 498.15 | 2500 | 2500 |
| 17 | MLOW-17 | 68.14 | 24.27 | 0 | 28200 | 18048 | 7.4 | Nil | 400 | 8568 | 320 | 899.1 | 4369 | 4500 |
| 18 | MLOW-18 | 67.61 | 24.31 | 0 | 32300 | 20672 | 7.5 | Nil | 800 | 10612 | 260 | 911.25 | 5355 | 4400 |
| 19 | MLOW-19 | 67.76 | 24.29 | 0 | 12880 | 8243 | 7.6 | Nil | 500 | 3332 | 120 | 425.25 | 1999 | 2050 |
| 20 | MLOW-20 | 67.92 | 24.28 | 0 | 55500 | 35520 | 7.7 | Nil | 650 | 15960 | 260 | 1992.6 | 8633 | 8850 |
| 21 | MLOW-21 | 67.63 | 24.19 | 0 | 8660 | 5542 | 7.7 | Nil | 700 | 2072 | 80 | 291.6 | 1335 | 1400 |
| 22 | MLOW-22 | 67.46 | 24.14 | 0 | 22600 | 14464 | 7.6 | Nil | 700 | 6216 | 220 | 656.1 | 3666 | 3250 |
| 23 | MLOW-23 | 67.62 | 24.09 | 0 | 36900 | 23616 | 7.7 | Nil | 500 | 10388 | 640 | 1081.35 | 5660 | 6050 |
| 24 | MLOW-24 | 68.66 | 25.04 | 0 | 3540 | 2265 | 8.3 | 20 | 450 | 700 | 200 | 206.55 | 186 | 1350 |
| 25 | MLOW-25 | 68.66 | 24.87 | 0 | 41500 | 26560 | 7.6 | Nil | 350 | 13433 | 2300 | 2490 | 2119 | 16000 |
| 26 | MLOW-26 | 68.50 | 24.82 | 0 | 12350 | 7904 | 7.9 | Nil | 750 | 3511 | 180 | 461.7 | 1735 | 2350 |
| 27 | MLOW-27 | 68.42 | 24.69 | 0 | 50900 | 32576 | 7.9 | Nil | 750 | 15960 | 300 | 984.15 | 9464 | 4800 |
| 28 | MLOW-28 | 68.67 | 24.69 | 0 | 9000 | 5760 | 8.1 | Nil | 750 | 2527 | 100 | 218.7 | 1527 | 1150 |
| 29 | MLOW-29 | 68.84 | 24.66 | 0 | 43800 | 28032 | 8 | Nil | 700 | 13300 | 440 | 1603.8 | 6481 | 7700 |
| 30 | MLOW-30 | 68.49 | 24.49 | 0 | 94400 | 60416 | 7.5 | Nil | 700 | 28728 | 1580 | 4750 | 10755 | 23500 |
| 31 | MLOW-31 | 68.70 | 24.49 | 0 | 73500 | 47040 | 8 | Nil | 950 | 23940 | 240 | 2830 | 11185 | 12250 |
| 32 | MLOW-32 | 68.84 | 24.50 | 0 | 21400 | 13696 | 8.6 | 60 | 400 | 6272 | 260 | 4730.85 | 3702 | 2600 |
| 33 | MLOW-33 | 68.88 | 24.34 | 0 | 57900 | 37056 | 7.3 | Nil | 300 | 20412 | 1000 | 2417 | 7515 | 12450 |
| 34 | MLOW-34 | 69.04 | 24.33 | 0 | 74200 | 47488 | 8 | Nil | 350 | 24300 | 1020 | 2928 | 10269 | 14600 |
| 35 | MLOW-35 | 69.04 | 24.47 | 0 | 44100 | 28224 | 7.9 | Nil | 350 | 13048 | 1160 | 1543 | 5840 | 9250 |
| 36 | MLOW-36 | 69.07 | 24.64 | 0 | 58900 | 37696 | 7.9 | Nil | 950 | 19320 | 580 | 1810 | 9398 | 8900 |
| 37 | MLOW-37 | 69.20 | 24.68 | 0 | 10190 | 6521 | 8.6 | 30 | 450 | 3164 | 120 | 413.1 | 1404 | 2000 |
| 38 | MLOW-38 | 69.26 | 24.89 | 0 | 14180 | 9075 | 8.3 | 20 | 500 | 2296 | 200 | 595.35 | 1880 | 2950 |
| 39 | MLOW-39 | 68.89 | 24.85 | 0 | 14850 | 9504 | 8.1 | Nil | 550 | 3248 | 220 | 267.3 | 2637 | 1650 |
| 40 | MLOW-40 | 68.82 | 25.05 | 0 | 2770 | 1772 | 8.5 | 70 | 660 | 448 | 40 | 82.62 | 429 | 440 |
| 41 | MLOW-41 | 68.43 | 25.04 | 0 | 4460 | 2854 | 8.3 | 20 | 340 | 879 | 88 | 165.24 | 603 | 900 |
| 42 | MLOW-42 | 68.47 | 25.20 | 0 | 1211 | 775 | 8.5 | 20 | 440 | 151 | 96 | 38.88 | 91 | 400 |

## 5.4 Water Quality Analysis from 42 MLOWs during February 2018 (at 0 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | 25 (WHO) | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 0 | 697 | 446 | 8.3 | 15 | 140 | 75 | 40 | 34.02 | 49.17 | 240 |
| 2 | MLOW-02 | 68.12 | 24.97 | 0 | 26200 | 16768 | 7.7 | Nil | 700 | 7632 | 264 | 1006 | 3794 | 4800 |
| 3 | MLOW-03 | 68.18 | 24.79 | 0 | 7960 | 5094 | 7.9 | Nil | 480 | 2082 | 64 | 383.94 | 1018 | 1740 |
| 4 | MLOW-04 | 67.98 | 24.78 | 0 | 3710 | 2374 | 7.4 | Nil | 440 | 870 | 40 | 238.17 | 346 | 1080 |
| 5 | MLOW-05 | 68.07 | 24.72 | 0 | 45800 | 29312 | 7.5 | Nil | 640 | 13224 | 368 | 1987 | 6290 | 9100 |
| 6 | MLOW-06 | 67.59 | 24.71 | 0 | 1874 | 1199 | 9 | 20 | 200 | 348 | 40 | 106.92 | 176 | 540 |
| 7 | MLOW-07 | 67.77 | 24.74 | 0 | 43500 | 27840 | 7.7 | Nil | 650 | 11455 | 200 | 1506.6 | 6880 | 6700 |
| 8 | MLOW-08 | 68.08 | 24.60 | 0 | 4660 | 2982 | 7.7 | Nil | 700 | 841 | 48 | 189.54 | 648 | 900 |
| 9 | MLOW-09 | 68.30 | 24.62 | 0 | 76200 | 48768 | 6.8 | Nil | 300 | 23635 | 4840 | 2527.2 | 6641 | 22500 |
| 10 | MLOW-10 | 67.63 | 24.55 | 0 | 3630 | 2323 | 8.5 | 20 | 550 | 667 | 48 | 128.79 | 527 | 650 |
| 11 | MLOW-11 | 67.82 | 24.61 | 0 | 20200 | 12928 | 7.2 | Nil | 550 | 3016 | 152 | 843.21 | 2844 | 3850 |
| 12 | MLOW-12 | 67.89 | 24.57 | 0 | 1278 | 817 | 8.4 | 20 | 350 | 203 | 56 | 75.33 | 84.27 | 450 |
| 13 | MLOW-13 | 68.27 | 24.36 | 0 | 52500 | 33600 | 7.3 | Nil | 300 | 16385 | 800 | 2053.4 | 7205 | 10450 |
| 14 | MLOW-14 | 67.58 | 24.46 | 0 | 2530 | 1619 | 8.8 | 30 | 450 | 382 | 120 | 121.5 | 207 | 800 |
| 15 | MLOW-15 | 67.83 | 24.40 | 0 | 15570 | 9964 | 7.6 | Nil | 550 | 4640 | 80 | 826.2 | 1896 | 3600 |
| 16 | MLOW-16 | 67.99 | 24.40 | 0 | 17250 | 11040 | 8 | Nil | 500 | 5220 | 160 | 643.95 | 2539 | 3050 |
| 17 | MLOW-17 | 68.14 | 24.27 | 0 | 49100 | 31424 | 7.3 | Nil | 400 | 15950 | 540 | 2077.7 | 6666 | 9900 |
| 18 | MLOW-18 | 67.61 | 24.31 | 0 | 39400 | 25216 | 7.8 | Nil | 750 | 11629 | 300 | 1688.9 | 5459 | 7700 |
| 19 | MLOW-19 | 67.76 | 24.29 | 0 | 50800 | 32512 | 7.6 | Nil | 750 | 12586 | 320 | 2138.4 | 7199 | 9600 |
| 20 | MLOW-20 | 67.92 | 24.28 | 0 | 56500 | 36160 | 7.6 | Nil | 500 | 12035 | 260 | 1810.4 | 9211 | 8100 |
| 21 | MLOW-21 | 67.63 | 24.19 | 0 | 14250 | 9120 | 7.8 | Nil | 500 | 3074 | 60 | 400.95 | 2424 | 1800 |
| 22 | MLOW-22 | 67.46 | 24.14 | 0 | 47100 | 30144 | 7.9 | Nil | 500 | 8700 | 300 | 1215 | 8145 | 5750 |
| 23 | MLOW-23 | 67.62 | 24.09 | 0 | 38800 | 24832 | 7.8 | Nil | 450 | 9570 | 500 | 1093.5 | 6805 | 5750 |
| 24 | MLOW-24 | 68.66 | 25.04 | 0 | 4040 | 2585 | 8.5 | 30 | 450 | 580 | 80 | 218.7 | 411 | 1100 |
| 25 | MLOW-25 | 68.66 | 24.87 | 0 | 53000 | 33920 | 7 | Nil | 300 | 17545 | 3100 | 3145 | 2559 | 20750 |
| 26 | MLOW-26 | 68.50 | 24.82 | 0 | 10740 | 6873 | 7.8 | Nil | 950 | 2291 | 40 | 170.1 | 2077 | 800 |
| 27 | MLOW-27 | 68.42 | 24.69 | 0 | 46100 | 29504 | 7.1 | Nil | 650 | 14268 | 220 | 643.95 | 9100 | 3200 |
| 28 | MLOW-28 | 68.67 | 24.69 | 0 | 24300 | 15552 | 7.8 | Nil | 700 | 6641 | 100 | 619.65 | 4269 | 2800 |
| 29 | MLOW-29 | 68.84 | 24.66 | 0 | 40800 | 26112 | 7.2 | Nil | 500 | 11513 | 240 | 1397.3 | 6417 | 6350 |
| 30 | MLOW-30 | 68.49 | 24.49 | 0 | 101400 | 64896 | 7 | Nil | 500 | 30914 | 1700 | 4301.1 | 13000 | 21950 |
| 31 | MLOW-31 | 68.70 | 24.49 | 0 | 70400 | 45056 | 6.8 | Nil | 750 | 22910 | 200 | 2600.1 | 10966 | 11200 |
| 32 | MLOW-32 | 68.84 | 24.50 | 0 | 29100 | 18624 | 8.7 | 30 | 300 | 8555 | 140 | 729 | 5121 | 3350 |
| 33 | MLOW-33 | 68.88 | 24.34 | 0 | 63600 | 40704 | 7.3 | Nil | 500 | 17690 | 1040 | 2211.3 | 9177 | 11700 |
| 34 | MLOW-34 | 69.04 | 24.33 | 0 | 73900 | 47296 | 7 | Nil | 400 | 22620 | 980 | 2745.9 | 10588 | 13750 |
| 35 | MLOW-35 | 69.04 | 24.47 | 0 | 54200 | 34688 | 7.4 | Nil | 400 | 13253 | 1340 | 2102 | 6884 | 12000 |
| 36 | MLOW-36 | 69.07 | 24.64 | 0 | 60800 | 38912 | 7.3 | Nil | 1250 | 14413 | 220 | 1980.5 | 9911 | 8700 |
| 37 | MLOW-37 | 69.20 | 24.68 | 0 | 9620 | 6156 | 7.9 | Nil | 500 | 2233 | 140 | 352.35 | 1366 | 1800 |
| 38 | MLOW-38 | 69.26 | 24.89 | 0 | 28700 | 18368 | 7.5 | Nil | 400 | 5075 | 340 | 1178.6 | 3939 | 5700 |
| 39 | MLOW-39 | 68.89 | 24.85 | 0 | 39400 | 25216 | 7.3 | Nil | 600 | 6960 | 100 | 972 | 7068 | 4250 |
| 40 | MLOW-40 | 68.82 | 25.05 | 0 | 3210 | 2054 | 9.2 | 60 | 700 | 262 | 40 | 60.75 | 566 | 350 |
| 41 | MLOW-41 | 68.43 | 25.04 | 0 | 8070 | 5164 | 8.3 | 30 | 200 | 1595 | 80 | 243 | 1286 | 1200 |
| 42 | MLOW-42 | 68.47 | 25.20 | 0 | 1020 | 652 | 9.2 | 20 | 400 | 97 | 40 | 48.6 | 93 | 300 |

## 5.5 Water Quality Analysis from 42 MLOWs during November 2017 (At 6 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 20 | 640 | 409 | 8.3 | 10 | 150 | 116 | 40 | 12.15 | 77 | 150 |
| 2 | MLOW-02 | 68.12 | 24.97 | 20 | 17650 | 11296 | 7.9 | Nil | 750 | 2455 | 260 | 400 | 2959 | 2300 |
| 3 | MLOW-03 | 68.18 | 24.79 | 20 | 10990 | 7033 | 7.3 | Nil | 450 | 2030 | 520 | 473 | 1002 | 3250 |
| 4 | MLOW-04 | 67.98 | 24.78 | 20 | 3610 | 2310 | 7.6 | Nil | 450 | 650 | 160 | 24.3 | 570 | 500 |
| 5 | MLOW-05 | 68.07 | 24.72 | 20 | 41800 | 26752 | 7.3 | Nil | 800 | 9831 | 1200 | 1603 | 5135 | 9600 |
| 6 | MLOW-06 | 67.59 | 24.71 | 20 | 1689 | 1080 | 7.6 | Nil | 300 | 261 | 60 | 24.3 | 260 | 250 |
| 7 | MLOW-07 | 67.77 | 24.74 | 20 | 7070 | 4524 | 7.5 | Nil | 600 | 1131 | 140 | 72.9 | 1305 | 650 |
| 8 | MLOW-08 | 68.08 | 24.60 | 20 | 3430 | 2195 | 7.6 | Nil | 600 | 522 | 80 | 48.6 | 600 | 400 |
| 9 | MLOW-09 | 68.30 | 24.62 | 20 | 67000 | 42880 | 7.1 | Nil | 300 | 19430 | 2960 | 2077 | 8000 | 15950 |
| 10 | MLOW-10 | 67.63 | 24.55 | 20 | 7810 | 4998 | 7.8 | Nil | 400 | 1150 | 180 | 121 | 1330 | 950 |
| 11 | MLOW-11 | 67.82 | 24.61 | 20 | 10640 | 6809 | 7.4 | Nil | 450 | 2291 | 260 | 255 | 4350 | 1700 |
| 12 | MLOW-12 | 67.89 | 24.57 | 20 | 1076 | 688 | 8.3 | 20 | 400 | 116 | 100 | 24.3 | 84 | 350 |
| 13 | MLOW-13 | 68.27 | 24.36 | 20 | 30100 | 19264 | 7.6 | Nil | 550 | 6380 | 340 | 619 | 5320 | 3400 |
| 14 | MLOW-14 | 67.58 | 24.46 | 20 | 2140 | 1369 | 7.7 | Nil | 450 | 406 | 80 | 36.45 | 315 | 350 |
| 15 | MLOW-15 | 67.83 | 24.40 | 20 | 34400 | 22016 | 7.1 | Nil | 650 | 9164 | 620 | 1093 | 5390 | 6050 |
| 16 | MLOW-16 | 67.99 | 24.40 | 20 | 6490 | 4153 | 7.7 | Nil | 400 | 1508 | 100 | 97 | 1180 | 650 |
| 17 | MLOW-17 | 68.14 | 24.27 | 20 | 40900 | 26176 | 7.2 | Nil | 500 | 13862 | 760 | 959 | 6666 | 5850 |
| 18 | MLOW-18 | 67.61 | 24.31 | 20 | 37000 | 23680 | 7.4 | Nil | 650 | 7540 | 340 | 959 | 6265 | 4800 |
| 19 | MLOW-19 | 67.76 | 24.29 | 20 | 17360 | 11110 | 7.1 | Nil | 450 | 3625 | 200 | 461 | 2863 | 2400 |
| 20 | MLOW-20 | 67.92 | 24.28 | 20 | 52200 | 33408 | 7.6 | Nil | 800 | 16385 | 400 | 1287 | 9040 | 6300 |
| 21 | MLOW-21 | 67.63 | 24.19 | 20 | 11380 | 7283 | 7.7 | Nil | 550 | 2726 | 200 | 182 | 2015 | 1250 |
| 22 | MLOW-22 | 67.46 | 24.14 | 20 | 50900 | 32576 | 7.1 | Nil | 500 | 11310 | 460 | 1154 | 8945 | 5900 |
| 23 | MLOW-23 | 67.62 | 24.09 | 20 | 28900 | 18496 | 7.5 | Nil | 500 | 5597 | 540 | 595 | 4863 | 3800 |
| 24 | MLOW-24 | 68.66 | 25.04 | 20 | 3510 | 2246 | 8.4 | 20 | 650 | 493 | 160 | 109 | 413 | 850 |
| 25 | MLOW-25 | 68.66 | 24.87 | 20 | 52100 | 33344 | 6.8 | Nil | 300 | 15512 | 3240 | 3304 | 1908 | 21700 |
| 26 | MLOW-26 | 68.50 | 24.82 | 20 | 8270 | 5292 | 7.6 | Nil | 600 | 1540 | 120 | 255 | 1275 | 1350 |
| 27 | MLOW-27 | 68.42 | 24.69 | 20 | 57700 | 36928 | 7.2 | Nil | 700 | 16965 | 600 | 619 | 11370 | 4050 |
| 28 | MLOW-28 | 68.67 | 24.69 | 20 | 12850 | 8224 | 7.5 | Nil | 600 | 2146 | 240 | 340 | 2009 | 2000 |
| 29 | MLOW-29 | 68.84 | 24.66 | 20 | 31800 | 20352 | 7.4 | Nil | 550 | 6235 | 340 | 692 | 5595 | 3700 |
| 30 | MLOW-30 | 68.49 | 24.49 | 20 | 106000 | 67840 | 7.1 | Nil | 700 | 33600 | 2420 | 3790 | 14309 | 21650 |
| 31 | MLOW-31 | 68.70 | 24.49 | 20 | 76200 | 48768 | 7.1 | Nil | 750 | 24640 | 960 | 2563 | 11508 | 12950 |
| 32 | MLOW-32 | 68.84 | 24.50 | 20 | 21900 | 14016 | 7.5 | Nil | 500 | 5824 | 340 | 425 | 3816 | 2600 |
| 33 | MLOW-33 | 68.88 | 24.34 | 20 | 71100 | 45504 | 7.0. | Nil | 500 | 21280 | 1380 | 2313 | 10311 | 12970 |
| 34 | MLOW-34 | 69.04 | 24.33 | 20 | 79100 | 50624 | 7.1 | Nil | 500 | 25760 | 1480 | 2988 | 10811 | 16000 |
| 35 | MLOW-35 | 69.04 | 24.47 | 20 | 4600 | 2944 | 8 | Nil | 300 | 952 | 80 | 60.75 | 844 | 450 |
| 36 | MLOW-36 | 69.07 | 24.64 | 20 | 56100 | 35904 | 7.8 | Nil | 350 | 16240 | 840 | 1895 | 8290 | 9900 |
| 37 | MLOW-37 | 69.20 | 24.68 | 20 | 11300 | 7232 | 7.8 | Nil | 550 | 2548 | 260 | 243 | 1809 | 1650 |
| 38 | MLOW-38 | 69.26 | 24.89 | 20 | 7050 | 4512 | 8 | Nil | 800 | 1540 | 100 | 279 | 945 | 1400 |
| 39 | MLOW-39 | 68.89 | 24.85 | 20 | 43600 | 27904 | 7.2 | Nil | 600 | 13720 | 720 | 1069 | 7125 | 6200 |
| 40 | MLOW-40 | 68.82 | 25.05 | 20 | 2200 | 1408 | 8.4 | 10 | 500 | 235 | 88 | 140 | 133 | 800 |
| 41 | MLOW-41 | 68.43 | 25.04 | 20 | 2500 | 1600 | 8.3 | 10 | 380 | 504 | 80 | 170 | 155 | 900 |
| 42 | MLOW-42 | 68.47 | 25.20 | 20 | 1469 | 940 | 8.3 | 20 | 470 | 179 | 48 | 97.2 | 94 | 520 |

## 5.6 Water Quality Analysis from 42 MLOWs during December 2017 (At 6 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 0 | 753 | 481 | 8.3 | 20 | 200 | 134 | 36 | 36.45 | 60 | 240 |
| 2 | MLOW-02 | 68.12 | 24.97 | 0 | 21600 | 13824 | 7.4 | Nil | 650 | 4992 | 400 | 534.6 | 3482 | 3200 |
| 3 | MLOW-03 | 68.18 | 24.79 | 0 | 3700 | 2368 | 7.7 | Nil | 400 | 1200 | 160 | 194.4 | 294 | 1200 |
| 4 | MLOW-04 | 67.98 | 24.78 | 0 | 3820 | 2444 | 7.7 | Nil | 500 | 1120 | 160 | 157.95 | 391 | 1050 |
| 5 | MLOW-05 | 68.07 | 24.72 | 0 | 44700 | 28608 | 7.6 | Nil | 800 | 14790 | 580 | 1372.95 | 6981 | 7100 |
| 6 | MLOW-06 | 67.59 | 24.71 | 0 | 1772 | 1134 | 7.7 | Nil | 350 | 323 | 100 | 72.9 | 150 | 550 |
| 7 | MLOW-07 | 67.77 | 24.74 | 0 | 14610 | 9350 | 7.7 | Nil | 800 | 4256 | 220 | 303.75 | 2520 | 1800 |
| 8 | MLOW-08 | 68.08 | 24.60 | 0 | 3610 | 2310 | 7.9 | Nil | 500 | 896 | 80 | 145.8 | 456 | 800 |
| 9 | MLOW-09 | 68.30 | 24.62 | 0 | 58300 | 37312 | 7.1 | Nil | 450 | 16320 | 2520 | 2077.65 | 13575 | 14850 |
| 10 | MLOW-10 | 67.63 | 24.55 | 0 | 2560 | 1638 | 8.2 | Nil | 300 | 608 | 80 | 121.5 | 262 | 700 |
| 11 | MLOW-11 | 67.82 | 24.61 | 0 | 7750 | 4960 | 7.7 | Nil | 400 | 2144 | 260 | 157.95 | 1869 | 1300 |
| 12 | MLOW-12 | 67.89 | 24.57 | 0 | 1772 | 1134 | 8.4 | 20 | 350 | 384 | 100 | 72.9 | 151 | 550 |
| 13 | MLOW-13 | 68.27 | 24.36 | 0 | 19200 | 12288 | 7.5 | Nil | 400 | 5792 | 280 | 486 | 3149 | 2700 |
| 14 | MLOW-14 | 67.58 | 24.46 | 0 | 2650 | 1696 | 7.9 | Nil | 450 | 576 | 80 | 72.9 | 377.89 | 500 |
| 15 | MLOW-15 | 67.83 | 24.40 | 0 | 15890 | 10169 | 7.6 | Nil | 950 | 4672 | 220 | 461.7 | 2505 | 2450 |
| 16 | MLOW-16 | 67.99 | 24.40 | 0 | 15350 | 9824 | 7.7 | Nil | 600 | 4448 | 240 | 315.9 | 2635 | 1900 |
| 17 | MLOW-17 | 68.14 | 24.27 | 0 | 16260 | 10406 | 7.8 | Nil | 500 | 4768 | 220 | 437.4 | 2635 | 2350 |
| 18 | MLOW-18 | 67.61 | 24.31 | 0 | 11380 | 7283 | 7.6 | Nil | 500 | 2944 | 160 | 291.6 | 1872 | 1600 |
| 19 | MLOW-19 | 67.76 | 24.29 | 0 | 8070 | 5164 | 7.7 | Nil | 400 | 2336 | 140 | 194.4 | 1315 | 1150 |
| 20 | MLOW-20 | 67.92 | 24.28 | 0 | 47600 | 30464 | 8 | Nil | 850 | 15680 | 320 | 1202.85 | 8260 | 5750 |
| 21 | MLOW-21 | 67.63 | 24.19 | 0 | 6790 | 4345 | 7.8 | Nil | 600 | 1728 | 160 | 291.6 | 816 | 1600 |
| 22 | MLOW-22 | 67.46 | 24.14 | 0 | 12940 | 8281 | 7.6 | Nil | 550 | 3584 | 200 | 352.35 | 2062 | 1950 |
| 23 | MLOW-23 | 67.62 | 24.09 | 0 | 28600 | 18304 | 7.7 | Nil | 450 | 7424 | 540 | 789.75 | 4430 | 4600 |
| 24 | MLOW-24 | 68.66 | 25.04 | 0 | 3480 | 2227 | 8.3 | 10 | 400 | 800 | 120 | 121.5 | 427 | 800 |
| 25 | MLOW-25 | 68.66 | 24.87 | 0 | 50500 | 32320 | 7.3 | Nil | 350 | 15648 | 3300 | 2806 | 2437 | 19800 |
| 26 | MLOW-26 | 68.50 | 24.82 | 0 | 9540 | 6105 | 8.1 | Nil | 450 | 2368 | 140 | 461.7 | 1145 | 2250 |
| 27 | MLOW-27 | 68.42 | 24.69 | 0 | 61400 | 39296 | 7.3 | Nil | 750 | 17472 | 520 | 741.15 | 12980 | 4350 |
| 28 | MLOW-28 | 68.67 | 24.69 | 0 | 6290 | 4025 | 8.3 | Nil | 600 | 1472 | 80 | 315.9 | 742 | 1500 |
| 29 | MLOW-29 | 68.84 | 24.66 | 0 | 36000 | 23040 | 7.6 | Nil | 650 | 10080 | 480 | 1081.35 | 5641 | 5650 |
| 30 | MLOW-30 | 68.49 | 24.49 | 0 | 78300 | 50112 | 7.4 | Nil | 550 | 24704 | 1420 | 3025 | 7849 | 16000 |
| 31 | MLOW-31 | 68.70 | 24.49 | 0 | 64900 | 41536 | 7.4 | Nil | 750 | 17604 | 420 | 2114 | 10355 | 9750 |
| 32 | MLOW-32 | 68.84 | 24.50 | 0 | 16450 | 10528 | 7.8 | Nil | 400 | 4185 | 220 | 413.1 | 2718 | 2250 |
| 33 | MLOW-33 | 68.88 | 24.34 | 0 | 44500 | 28480 | 7.5 | Nil | 400 | 13230 | 320 | 1688 | 6605 | 7750 |
| 34 | MLOW-34 | 69.04 | 24.33 | 0 | 73200 | 46848 | 7.1 | Nil | 500 | 24030 | 1080 | 2223 | 11305 | 11850 |
| 35 | MLOW-35 | 69.04 | 24.47 | 0 | 33200 | 21248 | 7.6 | Nil | 550 | 8775 | 420 | 1275 | 3715 | 6300 |
| 36 | MLOW-36 | 69.07 | 24.64 | 0 | 32900 | 21056 | 7.5 | Nil | 700 | 6750 | 300 | 1117 | 5059 | 5350 |
| 37 | MLOW-37 | 69.20 | 24.68 | 0 | 12010 | 7686 | 7.9 | Nil | 550 | 3024 | 280 | 558.9 | 1929 | 3000 |
| 38 | MLOW-38 | 69.26 | 24.89 | 0 | 10320 | 6604 | 7.8 | Nil | 550 | 2160 | 140 | 437.4 | 1361 | 2150 |
| 39 | MLOW-39 | 68.89 | 24.85 | 0 | 11610 | 7430 | 7.9 | Nil | 550 | 2509 | 100 | 291.6 | 1984 | 1450 |
| 40 | MLOW-40 | 68.82 | 25.05 | 0 | 2630 | 1683 | 8.4 | 10 | 550 | 510 | 40 | 72.9 | 415 | 400 |
| 41 | MLOW-41 | 68.43 | 25.04 | 0 | 3730 | 2387 | 8.3 | 10 | 400 | 900 | 100 | 97.2 | 550 | 650 |
| 42 | MLOW-42 | 68.47 | 25.20 | 0 | 1040 | 665 | 8.3 | 10 | 250 | 180 | 60 | 36.45 | 99 | 250 |

## 5.7 Water Quality Analysis from 42 MLOWs during Janaury 2018 (At 6 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 20 | 651 | 416 | 8.6 | 20 | 250 | 77 | 40 | 36.45 | 33 | 250 |
| 2 | MLOW-02 | 68.12 | 24.97 | 20 | 19310 | 12358 | 8.1 | Nil | 650 | 3332 | 280 | 607.5 | 2952 | 3200 |
| 3 | MLOW-03 | 68.18 | 24.79 | 20 | 13690 | 8761 | 7.8 | Nil | 450 | 3276 | 540 | 911.25 | 775 | 5100 |
| 4 | MLOW-04 | 67.98 | 24.78 | 20 | 3180 | 2035 | 8 | Nil | 350 | 560 | 180 | 121.5 | 288 | 950 |
| 5 | MLOW-05 | 68.07 | 24.72 | 20 | 46200 | 29568 | 7.7 | Nil | 600 | 12180 | 800 | 2284 | 5315 | 11400 |
| 6 | MLOW-06 | 67.59 | 24.71 | 20 | 1553 | 993 | 9.1 | 10 | 250 | 364 | 80 | 48.6 | 169 | 400 |
| 7 | MLOW-07 | 67.77 | 24.74 | 20 | 6610 | 4230 | 8 | Nil | 800 | 1260 | 120 | 145.8 | 1098 | 900 |
| 8 | MLOW-08 | 68.08 | 24.60 | 20 | 3290 | 2105 | 8.1 | Nil | 500 | 700 | 100 | 243 | 174 | 1250 |
| 9 | MLOW-09 | 68.30 | 24.62 | 20 | 85600 | 54784 | 7.5 | Nil | 250 | 27020 | 5460 | 3499 | 6666 | 28050 |
| 10 | MLOW-10 | 67.63 | 24.55 | 20 | 2780 | 1779 | 9 | 30 | 500 | 644 | 60 | 85.05 | 405 | 500 |
| 11 | MLOW-11 | 67.82 | 24.61 | 20 | 23700 | 15168 | 7.9 | Nil | 450 | 6748 | 600 | 656.1 | 3488 | 4200 |
| 12 | MLOW-12 | 67.89 | 24.57 | 20 | 930 | 595 | 8.7 | 20 | 250 | 132 | 80 | 36.45 | 51 | 350 |
| 13 | MLOW-13 | 68.27 | 24.36 | 20 | 57000 | 36480 | 7.7 | Nil | 350 | 16520 | 1060 | 1652 | 8690 | 9450 |
| 14 | MLOW-14 | 67.58 | 24.46 | 20 | 1863 | 1192 | 8.7 | 30 | 400 | 448 | 40 | 60.75 | 263 | 350 |
| 15 | MLOW-15 | 67.83 | 24.40 | 20 | 36700 | 23488 | 7.9 | Nil | 550 | 11620 | 900 | 1506.6 | 4456 | 8450 |
| 16 | MLOW-16 | 67.99 | 24.40 | 20 | 6340 | 4057 | 8.5 | 20 | 350 | 1652 | 100 | 97.2 | 1141 | 650 |
| 17 | MLOW-17 | 68.14 | 24.27 | 20 | 47000 | 30080 | 7.8 | Nil | 550 | 14112 | 580 | 1008.45 | 8525 | 5600 |
| 18 | MLOW-18 | 67.61 | 24.31 | 20 | 42100 | 26944 | 7.6 | Nil | 650 | 13300 | 280 | 1628 | 6216 | 7400 |
| 19 | MLOW-19 | 67.76 | 24.29 | 20 | 13920 | 8908 | 8.2 | Nil | 850 | 3164 | 100 | 388.8 | 2323 | 1850 |
| 20 | MLOW-20 | 67.92 | 24.28 | 20 | 57100 | 36544 | 8 | Nil | 550 | 16100 | 280 | 1761 | 9422 | 7950 |
| 21 | MLOW-21 | 67.63 | 24.19 | 20 | 14230 | 9107 | 8 | Nil | 550 | 4004 | 100 | 388.8 | 1399 | 1850 |
| 22 | MLOW-22 | 67.46 | 24.14 | 20 | 50800 | 32512 | 8.5 | 30 | 550 | 17080 | 620 | 1555.2 | 7979 | 7950 |
| 23 | MLOW-23 | 67.62 | 24.09 | 20 | 40100 | 25664 | 7.9 | Nil | 600 | 11480 | 700 | 862.65 | 6755 | 5300 |
| 24 | MLOW-24 | 68.66 | 25.04 | 20 | 2990 | 1913 | 8.3 | 30 | 550 | 560 | 120 | 109.35 | 338 | 750 |
| 25 | MLOW-25 | 68.66 | 24.87 | 20 | 54200 | 34688 | 7.6 | Nil | 350 | 17423 | 4400 | 2891 | 1855 | 22900 |
| 26 | MLOW-26 | 68.50 | 24.82 | 20 | 6920 | 4428 | 9 | 90 | 1150 | 1649 | 100 | 97.2 | 1289 | 650 |
| 27 | MLOW-27 | 68.42 | 24.69 | 20 | 47100 | 30144 | 7.9 | Nil | 850 | 15561 | 320 | 801.9 | 8914 | 4100 |
| 28 | MLOW-28 | 68.67 | 24.69 | 20 | 13250 | 8480 | 8.2 | Nil | 750 | 3857 | 160 | 473.85 | 1947 | 2350 |
| 29 | MLOW-29 | 68.84 | 24.66 | 20 | 29900 | 19136 | 7.7 | Nil | 700 | 9443 | 360 | 1032.75 | 4470 | 5150 |
| 30 | MLOW-30 | 68.49 | 24.49 | 20 | 113320 | 72524 | 7.4 | Nil | 350 | 37506 | 4740 | 5868 | 9365 | 36000 |
| 31 | MLOW-31 | 68.70 | 24.49 | 20 | 73300 | 46912 | 7.3 | Nil | 900 | 23940 | 320 | 3025 | 10669 | 13250 |
| 32 | MLOW-32 | 68.84 | 24.50 | 20 | 27200 | 17408 | 8.3 | 10 | 250 | 6832 | 460 | 498.15 | 4759 | 3200 |
| 33 | MLOW-33 | 68.88 | 24.34 | 20 | 69700 | 44608 | 7.6 | Nil | 300 | 20860 | 1100 | 3183 | 8653 | 15850 |
| 34 | MLOW-34 | 69.04 | 24.33 | 20 | 75600 | 48384 | 8 | Nil | 300 | 24381 | 1240 | 3156 | 9900 | 16090 |
| 35 | MLOW-35 | 69.04 | 24.47 | 20 | 5890 | 3769 | 8.9 | 30 | 500 | 1456 | 60 | 97.2 | 1098 | 550 |
| 36 | MLOW-36 | 69.07 | 24.64 | 20 | 28500 | 18240 | 8.1 | Nil | 800 | 8400 | 300 | 972 | 4333 | 4750 |
| 37 | MLOW-37 | 69.20 | 24.68 | 20 | 8790 | 5625 | 8.3 | 30 | 900 | 2240 | 160 | 291.6 | 1268 | 1600 |
| 38 | MLOW-38 | 69.26 | 24.89 | 20 | 10870 | 6956 | 8.3 | 20 | 500 | 2492 | 180 | 571.05 | 1189 | 2800 |
| 39 | MLOW-39 | 68.89 | 24.85 | 20 | 43800 | 28032 | 7.6 | Nil | 900 | 12457 | 640 | 896.18 | 7605 | 4850 |
| 40 | MLOW-40 | 68.82 | 25.05 | 20 | 2990 | 1913 | 9 | 50 | 760 | 207 | 40 | 82.62 | 479 | 440 |
| 41 | MLOW-41 | 68.43 | 25.04 | 20 | 1216 | 778 | 8.9 | 10 | 340 | 179 | 48 | 29.16 | 166 | 240 |
| 42 | MLOW-42 | 68.47 | 25.20 | 20 | 1067 | 682 | 9 | 20 | 400 | 106 | 48 | 43.74 | 103 | 300 |

## 5.8 Water Quality Analysis from 42 MLOWs during February 2018 (At 6 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 20 | 562 | 359 | 8.7 | 20 | 180 | 58 | 24 | 24.3 | 55 | 160 |
| 2 | MLOW-02 | 68.12 | 24.97 | 20 | 18790 | 12025 | 8 | Nil | 520 | 4031 | 160 | 831.06 | 2540 | 3020 |
| 3 | MLOW-03 | 68.18 | 24.79 | 20 | 13630 | 8723 | 7.9 | Nil | 440 | 3543 | 452 | 1100.79 | 502 | 5660 |
| 4 | MLOW-04 | 67.98 | 24.78 | 20 | 3510 | 2246 | 7.6 | Nil | 360 | 800 | 80 | 272.16 | 190 | 1320 |
| 5 | MLOW-05 | 68.07 | 24.72 | 20 | 46200 | 29568 | 6.9 | Nil | 560 | 13601 | 1064 | 2415 | 4808 | 12600 |
| 6 | MLOW-06 | 67.59 | 24.71 | 20 | 1599 | 1023 | 8.6 | 10 | 240 | 232 | 48 | 68.04 | 179 | 400 |
| 7 | MLOW-07 | 67.77 | 24.74 | 20 | 6710 | 4294 | 7.8 | Nil | 750 | 1015 | 40 | 133.65 | 1237 | 650 |
| 8 | MLOW-08 | 68.08 | 24.60 | 20 | 3310 | 2118 | 7.6 | Nil | 650 | 522 | 56 | 221.13 | 269 | 1050 |
| 9 | MLOW-09 | 68.30 | 24.62 | 20 | 85800 | 54912 | 6.7 | Nil | 350 | 26390 | 5240 | 3169 | 7579 | 26200 |
| 10 | MLOW-10 | 67.63 | 24.55 | 20 | 1957 | 1252 | 9 | 30 | 400 | 261 | 40 | 48.6 | 308 | 300 |
| 11 | MLOW-11 | 67.82 | 24.61 | 20 | 25700 | 16448 | 7.5 | Nil | 450 | 7192 | 472 | 1001.16 | 3649 | 5300 |
| 12 | MLOW-12 | 67.89 | 24.57 | 20 | 1029 | 658 | 8.3 | 20 | 350 | 145 | 64 | 70.47 | 27.55 | 450 |
| 13 | MLOW-13 | 68.27 | 24.36 | 20 | 59100 | 37824 | 7.6 | Nil | 300 | 17400 | 1420 | 2612.25 | 6941 | 14300 |
| 14 | MLOW-14 | 67.58 | 24.46 | 20 | 1839 | 1176 | 8.8 | 30 | 450 | 348 | 80 | 24.3 | 281 | 300 |
| 15 | MLOW-15 | 67.83 | 24.40 | 20 | 36300 | 23232 | 7.1 | Nil | 550 | 10962 | 460 | 1931.85 | 4111 | 9100 |
| 16 | MLOW-16 | 67.99 | 24.40 | 20 | 6380 | 4083 | 8.6 | 20 | 400 | 1740 | 100 | 109.35 | 1135 | 700 |
| 17 | MLOW-17 | 68.14 | 24.27 | 20 | 49400 | 31616 | 7.3 | Nil | 500 | 15950 | 320 | 1530.9 | 8040 | 7100 |
| 18 | MLOW-18 | 67.61 | 24.31 | 20 | 41200 | 26368 | 7.2 | Nil | 700 | 12383 | 260 | 2041.2 | 5252 | 9050 |
| 19 | MLOW-19 | 67.76 | 24.29 | 20 | 13690 | 8761 | 8.2 | Nil | 900 | 3016 | 100 | 473.85 | 1679 | 2200 |
| 20 | MLOW-20 | 67.92 | 24.28 | 20 | 57400 | 36736 | 7.3 | Nil | 550 | 13050 | 280 | 1688.85 | 9629 | 7650 |
| 21 | MLOW-21 | 67.63 | 24.19 | 20 | 7010 | 4486 | 7.9 | Nil | 400 | 1044 | 40 | 230.85 | 1111 | 1050 |
| 22 | MLOW-22 | 67.46 | 24.14 | 20 | 51800 | 33152 | 8.4 | 30 | 700 | 13920 | 320 | 1567.35 | 815 | 7250 |
| 23 | MLOW-23 | 67.62 | 24.09 | 20 | 40100 | 25664 | 7.7 | Nil | 700 | 9773 | 420 | 1251.45 | 6320 | 6200 |
| 24 | MLOW-24 | 68.66 | 25.04 | 20 | 3340 | 2137 | 8.6 | 30 | 350 | 522 | 80 | 145.8 | 390 | 800 |
| 25 | MLOW-25 | 68.66 | 24.87 | 20 | 55100 | 35264 | 6.9 | Nil | 350 | 17661 | 3820 | 1749.6 | 4914 | 16750 |
| 26 | MLOW-26 | 68.50 | 24.82 | 20 | 6030 | 3859 | 8.8 | 60 | 1000 | 1015 | 20 | 97.2 | 1166 | 450 |
| 27 | MLOW-27 | 68.42 | 24.69 | 20 | 46900 | 30016 | 7.2 | Nil | 550 | 14355 | 180 | 899.1 | 8840 | 4150 |
| 28 | MLOW-28 | 68.67 | 24.69 | 20 | 13590 | 8697 | 8.2 | Nil | 500 | 2871 | 120 | 473.85 | 2066 | 2250 |
| 29 | MLOW-29 | 68.84 | 24.66 | 20 | 30100 | 19264 | 7.3 | Nil | 500 | 7569 | 220 | 826.2 | 5077 | 3950 |
| 30 | MLOW-30 | 68.49 | 24.49 | 20 | 113300 | 72512 | 7.3 | Nil | 350 | 36540 | 4380 | 5892.75 | 9705 | 35200 |
| 31 | MLOW-31 | 68.70 | 24.49 | 20 | 73100 | 46784 | 7 | Nil | 750 | 22910 | 240 | 2660.85 | 11777 | 11550 |
| 32 | MLOW-32 | 68.84 | 24.50 | 20 | 29500 | 18880 | 8.4 | 20 | 350 | 7888 | 220 | 656.1 | 5266 | 3250 |
| 33 | MLOW-33 | 68.88 | 24.34 | 20 | 69800 | 44672 | 7.1 | Nil | 450 | 17690 | 1080 | 2660.85 | 9699 | 13650 |
| 34 | MLOW-34 | 69.04 | 24.33 | 20 | 75800 | 48512 | 6.9 | Nil | 300 | 19720 | 960 | 2527.2 | 11471 | 12800 |
| 35 | MLOW-35 | 69.04 | 24.47 | 20 | 5530 | 3539 | 8.1 | Nil | 450 | 725 | 80 | 85.05 | 1007 | 550 |
| 36 | MLOW-36 | 69.07 | 24.64 | 20 | 20100 | 12864 | 8 | Nil | 500 | 3335 | 240 | 607.5 | 3177 | 3100 |
| 37 | MLOW-37 | 69.20 | 24.68 | 20 | 8830 | 5651 | 7.5 | Nil | 450 | 1744 | 200 | 315.9 | 1181 | 1800 |
| 38 | MLOW-38 | 69.26 | 24.89 | 20 | 12760 | 8166 | 7.6 | Nil | 500 | 2987 | 220 | 631.8 | 1228 | 3150 |
| 39 | MLOW-39 | 68.89 | 24.85 | 20 | 43900 | 28096 | 7.7 | Nil | 500 | 8700 | 280 | 1105.65 | 7639 | 5250 |
| 40 | MLOW-40 | 68.82 | 25.05 | 20 | 2990 | 9113 | 9.2 | 50 | 700 | 203 | 40 | 72.9 | 491 | 400 |
| 41 | MLOW-41 | 68.43 | 25.04 | 20 | 1031 | 659 | 9.2 | 40 | 400 | 174 | 20 | 36.45 | 141 | 200 |
| 42 | MLOW-42 | 68.47 | 25.20 | 20 | 986 | 631 | 9.2 | 20 | 450 | 95 | 20 | 48.6 | 105 | 250 |

## 5.9 Water Quality Analysis from 42 MLOWs during November 2017 (At 13 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 2 | MLOW-02 | 68.12 | 24.97 | 40 | 21300 | 13632 | 7.5 | Nil | 450 | 3685 | 400 | 388 | 3655 | 2600 |
| 3 | MLOW-03 | 68.18 | 24.79 | 40 | 10470 | 6700 | 7.4 | Nil | 450 | 1945 | 300 | 364 | 1210 | 2250 |
| 4 | MLOW-04 | 67.98 | 24.78 | 40 | 4060 | 2598 | 8 | Nil | 300 | 701 | 220 | 109 | 455 | 1000 |
| 5 | MLOW-05 | 68.07 | 24.72 | 40 | 49500 | 31680 | 7.2 | Nil | 650 | 11252 | 1360 | 1834 | 6260 | 10950 |
| 6 | MLOW-06 | 67.59 | 24.71 | 40 | 1680 | 1075 | 7.7 | Nil | 250 | 261 | 80 | 121.5 | 261 | 250 |
| 7 | MLOW-07 | 67.77 | 24.74 | 40 | 15000 | 9600 | 7.8 | Nil | 900 | 2871 | 180 | 255 | 2715 | 1500 |
| 8 | MLOW-08 | 68.08 | 24.60 | 40 | 4550 | 2912 | 8 | Nil | 500 | 841 | 140 | 170 | 555 | 1050 |
| 9 | MLOW-09 | 68.30 | 24.62 | 40 | 78300 | 50112 | 6.9 | Nil | 300 | 23490 | 3540 | 2587 | 8955 | 19500 |
| 10 | MLOW-10 | 67.63 | 24.55 | 40 | 7460 | 4774 | 8 | Nil | 550 | 1247 | 160 | 133 | 1260 | 950 |
| 11 | MLOW-11 | 67.82 | 24.61 | 40 | 22500 | 14400 | 7.2 | Nil | 450 | 5220 | 500 | 571 | 3480 | 3600 |
| 12 | MLOW-12 | 67.89 | 24.57 | 40 | 1090 | 697 | 8.3 | 20 | 450 | 116 | 120 | 121.5 | 84 | 350 |
| 13 | MLOW-13 | 68.27 | 24.36 | 40 | 66200 | 42368 | 7.1 | Nil | 650 | 16414 | 960 | 2255 | 9770 | 11200 |
| 14 | MLOW-14 | 67.58 | 24.46 | 40 | 2370 | 1516 | 8 | Nil | 400 | 464 | 80 | 24.3 | 401 | 300 |
| 15 | MLOW-15 | 67.83 | 24.40 | 40 | 21500 | 13760 | 7.4 | Nil | 550 | 4930 | 360 | 595 | 3375 | 3350 |
| 16 | MLOW-16 | 67.99 | 24.40 | 40 | 9940 | 6361 | 7.8 | Nil | 300 | 2523 | 140 | 121 | 1876 | 850 |
| 17 | MLOW-17 | 68.14 | 24.27 | 40 | 57900 | 37056 | 7.1 | Nil | 450 | 16675 | 1140 | 1433 | 9239 | 8750 |
| 18 | MLOW-18 | 67.61 | 24.31 | 40 | 55100 | 35264 | 7.3 | Nil | 600 | 12470 | 520 | 1506 | 9166 | 7500 |
| 19 | MLOW-19 | 67.76 | 24.29 | 40 | 28200 | 18048 | 7.2 | Nil | 450 | 6235 | 200 | 704 | 4885 | 3400 |
| 20 | MLOW-20 | 67.92 | 24.28 | 40 | 60900 | 38976 | 7.4 | Nil | 550 | 17255 | 460 | 1701 | 10195 | 8150 |
| 21 | MLOW-21 | 67.63 | 24.19 | 40 | 15730 | 10067 | 7.8 | Nil | 550 | 4408 | 260 | 230 | 2863 | 1600 |
| 22 | MLOW-22 | 67.46 | 24.14 | 40 | 59800 | 38272 | 7.2 | Nil | 500 | 12731 | 540 | 1506 | 10215 | 7550 |
| 23 | MLOW-23 | 67.62 | 24.09 | 40 | 43600 | 27904 | 7.3 | Nil | 600 | 9570 | 700 | 1057 | 7177 | 6100 |
| 24 | MLOW-24 | 68.66 | 25.04 | 40 | 4580 | 2931 | 8.3 | 10 | 550 | 725 | 200 | 170 | 497 | 1200 |
| 25 | MLOW-25 | 68.66 | 24.87 | 40 | 54400 | 34816 | 6.7 | Nil | 350 | 15515 | 3400 | 2745 | 3319 | 19800 |
| 26 | MLOW-26 | 68.50 | 24.82 | 40 | 22300 | 14270 | 7.4 | Nil | 500 | 6020 | 460 | 400 | 3815 | 2800 |
| 27 | MLOW-27 | 68.42 | 24.69 | 40 | 66900 | 42816 | 7.2 | Nil | 750 | 21518 | 780 | 692 | 13133 | 4800 |
| 28 | MLOW-28 | 68.67 | 24.69 | 40 | 27200 | 17408 | 7.8 | Nil | 700 | 4640 | 240 | 473 | 5050 | 2550 |
| 29 | MLOW-29 | 68.84 | 24.66 | 40 | 49900 | 31936 | 7.3 | Nil | 450 | 10208 | 720 | 1227 | 8266 | 6850 |
| 30 | MLOW-30 | 68.49 | 24.49 | 40 | 107800 | 68992 | 7.1 | Nil | 650 | 33880 | 1780 | 4349 | 14399 | 22350 |
| 31 | MLOW-31 | 68.70 | 24.49 | 40 | 78600 | 50304 | 7.1 | Nil | 850 | 25256 | 900 | 1992 | 13198 | 10450 |
| 32 | MLOW-32 | 68.84 | 24.50 | 40 | 32400 | 20736 | 8 | Nil | 450 | 9240 | 620 | 449 | 5858 | 3400 |
| 33 | MLOW-33 | 68.88 | 24.34 | 40 | 71400 | 45696 | 7.3 | Nil | 400 | 21840 | 1420 | 2405 | 10166 | 13450 |
| 34 | MLOW-34 | 69.04 | 24.33 | 40 | 78900 | 50496 | 7.1 | Nil | 550 | 25284 | 1420 | 3086 | 10587 | 16250 |
| 35 | MLOW-35 | 69.04 | 24.47 | 40 | 45200 | 28928 | 7.3 | Nil | 450 | 13580 | 1280 | 1470 | 6255 | 9250 |
| 36 | MLOW-36 | 69.07 | 24.64 | 40 | 59200 | 37888 | 7.2 | Nil | 750 | 17472 | 840 | 2029 | 8733 | 10450 |
| 37 | MLOW-37 | 69.20 | 24.68 | 40 | 13510 | 8646 | 7.9 | Nil | 350 | 3556 | 240 | 303 | 2222 | 1850 |
| 38 | MLOW-38 | 69.26 | 24.89 | 40 | 10320 | 6604 | 7.1 | Nil | 500 | 2940 | 280 | 461 | 1140 | 2600 |
| 39 | MLOW-39 | 68.89 | 24.85 | 40 | 41300 | 26432 | 7.3 | Nil | 600 | 12600 | 460 | 984 | 7062 | 5200 |
| 40 | MLOW-40 | 68.82 | 25.05 | 40 | 3110 | 1990 | 8.3 | 20 | 640 | 257 | 40 | 194 | 292 | 900 |
| 41 | MLOW-41 | 68.43 | 25.04 | 40 | 2700 | 1728 | 8.7 | 10 | 410 | 520 | 104 | 121 | 265 | 760 |
| 42 | MLOW-42 | 68.47 | 25.20 | 40 | 12337 | 791 | 8.3 | 10 | 370 | 145 | 48 | 77.76 | 77 | 440 |

## 5.10 Water Quality Analysis from 42 MLOWs during December 2017 (At 13 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 2 | MLOW-02 | 68.12 | 24.97 | 40 | 22200 | 14208 | 7.7 | Nil | 600 | 5696 | 440 | 486 | 3666 | 3100 |
| 3 | MLOW-03 | 68.18 | 24.79 | 40 | 13770 | 8812 | 7.6 | Nil | 500 | 4000 | 660 | 583.2 | 1290 | 4050 |
| 4 | MLOW-04 | 67.98 | 24.78 | 40 | 4050 | 2592 | 7.6 | Nil | 250 | 1140 | 260 | 97.2 | 446 | 1050 |
| 5 | MLOW-05 | 68.07 | 24.72 | 40 | 48600 | 31104 | 7.1 | Nil | 750 | 15270 | 1260 | 1956.2 | 5979 | 11200 |
| 6 | MLOW-06 | 67.59 | 24.71 | 40 | 1614 | 1032 | 8 | Nil | 250 | 288 | 60 | 48.6 | 206 | 350 |
| 7 | MLOW-07 | 67.77 | 24.74 | 40 | 12910 | 8262 | 7.7 | Nil | 1000 | 3680 | 180 | 243 | 2290 | 1450 |
| 8 | MLOW-08 | 68.08 | 24.60 | 40 | 4130 | 2643 | 7.6 | Nil | 700 | 768 | 180 | 170.1 | 412 | 1150 |
| 9 | MLOW-09 | 68.30 | 24.62 | 40 | 89600 | 57344 | 6.9 | Nil | 400 | 28320 | 5760 | 3256.2 | 7730 | 27800 |
| 10 | MLOW-10 | 67.63 | 24.55 | 40 | 3830 | 2451 | 8.1 | Nil | 500 | 800 | 100 | 145.8 | 484 | 850 |
| 11 | MLOW-11 | 67.82 | 24.61 | 40 | 28100 | 17984 | 7.3 | Nil | 350 | 7968 | 320 | 1154.3 | 3870 | 5550 |
| 12 | MLOW-12 | 67.89 | 24.57 | 40 | 1078 | 689 | 8.3 | 20 | 350 | 224 | 100 | 36.45 | 62 | 400 |
| 13 | MLOW-13 | 68.27 | 24.36 | 40 | 59500 | 38080 | 7.3 | Nil | 550 | 18880 | 1060 | 1725 | 9141 | 9750 |
| 14 | MLOW-14 | 67.58 | 24.46 | 40 | 2100 | 1344 | 8 | Nil | 450 | 512 | 60 | 72.9 | 274 | 450 |
| 15 | MLOW-15 | 67.83 | 24.40 | 40 | 26900 | 17216 | 7.3 | Nil | 700 | 7360 | 440 | 801.9 | 4131 | 4400 |
| 16 | MLOW-16 | 67.99 | 24.40 | 40 | 11570 | 7404 | 7.8 | Nil | 500 | 3040 | 140 | 194.4 | 2121 | 1150 |
| 17 | MLOW-17 | 68.14 | 24.27 | 40 | 60200 | 38528 | 7.1 | Nil | 350 | 20256 | 900 | 1701 | 9550 | 9250 |
| 18 | MLOW-18 | 67.61 | 24.31 | 40 | 58200 | 37248 | 7.3 | Nil | 500 | 17944 | 680 | 1883.3 | 8988 | 9450 |
| 19 | MLOW-19 | 67.76 | 24.29 | 40 | 47600 | 30464 | 7.2 | Nil | 500 | 15360 | 380 | 1458 | 7705 | 6950 |
| 20 | MLOW-20 | 67.92 | 24.28 | 40 | 58100 | 37184 | 7.3 | Nil | 650 | 18752 | 420 | 1385.1 | 10211 | 6750 |
| 21 | MLOW-21 | 67.63 | 24.19 | 40 | 16030 | 10259 | 7.7 | Nil | 500 | 4448 | 200 | 303.75 | 2860 | 1750 |
| 22 | MLOW-22 | 67.46 | 24.14 | 40 | 60200 | 38528 | 7.3 | Nil | 400 | 18528 | 520 | 1725.3 | 9925 | 8400 |
| 23 | MLOW-23 | 67.62 | 24.09 | 40 | 41300 | 26432 | 7.3 | Nil | 500 | 12672 | 460 | 1275.8 | 6008 | 6400 |
| 24 | MLOW-24 | 68.66 | 25.04 | 40 | 4570 | 2924 | 8.4 | 10 | 400 | 1120 | 240 | 182.25 | 423 | 1350 |
| 25 | MLOW-25 | 68.66 | 24.87 | 40 | 49900 | 31936 | 7.1 | Nil | 550 | 15616 | 2640 | 2952 | 2778 | 18750 |
| 26 | MLOW-26 | 68.50 | 24.82 | 40 | 19350 | 12384 | 7.6 | Nil | 800 | 4864 | 220 | 352.35 | 3518 | 2000 |
| 27 | MLOW-27 | 68.42 | 24.69 | 40 | 50800 | 32512 | 7.2 | Nil | 850 | 14720 | 180 | 850.5 | 9810 | 3950 |
| 28 | MLOW-28 | 68.67 | 24.69 | 40 | 18590 | 11897 | 8.2 | Nil | 850 | 4608 | 140 | 522.45 | 3103 | 2500 |
| 29 | MLOW-29 | 68.84 | 24.66 | 40 | 44500 | 28480 | 7.2 | Nil | 550 | 12800 | 740 | 1178.6 | 7101 | 6700 |
| 30 | MLOW-30 | 68.49 | 24.49 | 40 | 113400 | 72576 | 6.9 | Nil | 200 | 41120 | 4020 | 5491 | 10900 | 31650 |
| 31 | MLOW-31 | 68.70 | 24.49 | 40 | 77600 | 49664 | 7.1 | Nil | 1100 | 24462 | 280 | 2697 | 12311 | 11800 |
| 32 | MLOW-32 | 68.84 | 24.50 | 40 | 31900 | 20416 | 7.7 | Nil | 450 | 7911 | 280 | 619.65 | 5800 | 3250 |
| 33 | MLOW-33 | 68.88 | 24.34 | 40 | 70600 | 45184 | 7.2 | Nil | 300 | 21897 | 760 | 2563 | 10419 | 12450 |
| 34 | MLOW-34 | 69.04 | 24.33 | 40 | 77300 | 49472 | 6.9 | Nil | 500 | 24408 | 1040 | 2660 | 11465 | 13550 |
| 35 | MLOW-35 | 69.04 | 24.47 | 40 | 49200 | 31488 | 7.2 | Nil | 400 | 16200 | 1060 | 1749 | 6743 | 9850 |
| 36 | MLOW-36 | 69.07 | 24.64 | 40 | 59400 | 38016 | 7.3 | Nil | 1000 | 15660 | 180 | 2417 | 8800 | 10400 |
| 37 | MLOW-37 | 69.20 | 24.68 | 40 | 10010 | 6406 | 8.2 | Nil | 450 | 2322 | 140 | 279.45 | 1596 | 1500 |
| 38 | MLOW-38 | 69.26 | 24.89 | 40 | 14780 | 9459 | 7.8 | Nil | 450 | 4023 | 100 | 716.85 | 1891 | 3200 |
| 39 | MLOW-39 | 68.89 | 24.85 | 40 | 41000 | 26240 | 7.4 | Nil | 550 | 11760 | 200 | 1008.5 | 7250 | 4650 |
| 40 | MLOW-40 | 68.82 | 25.05 | 40 | 2920 | 1868 | 8.9 | 20 | 750 | 360 | 40 | 24.3 | 568 | 200 |
| 41 | MLOW-41 | 68.43 | 25.04 | 40 | 1865 | 1193 | 8.3 | 10 | 250 | 420 | 60 | 24.3 | 310 | 200 |
| 42 | MLOW-42 | 68.47 | 25.20 | 40 | 1493 | 955 | 8.3 | 20 | 300 | 240 | 60 | 48.6 | 178 | 350 |

## 5.11 Water Quality Analysis from 42 MLOWs during January 2018 (At 13 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 20 | 651 | 416 | 8.6 | 20 | 250 | 77 | 40 | 36.45 | 33 | 250 |
| 2 | MLOW-02 | 68.12 | 24.97 | 20 | 19310 | 12358 | 8.1 | Nil | 650 | 3332 | 280 | 607.5 | 2952 | 3200 |
| 3 | MLOW-03 | 68.18 | 24.79 | 20 | 13690 | 8761 | 7.8 | Nil | 450 | 3276 | 540 | 911.25 | 775 | 5100 |
| 4 | MLOW-04 | 67.98 | 24.78 | 20 | 3180 | 2035 | 8 | Nil | 350 | 560 | 180 | 121.5 | 288 | 950 |
| 5 | MLOW-05 | 68.07 | 24.72 | 20 | 46200 | 29568 | 7.7 | Nil | 600 | 12180 | 800 | 2284 | 5315 | 11400 |
| 6 | MLOW-06 | 67.59 | 24.71 | 20 | 1553 | 993 | 9.1 | 10 | 250 | 364 | 80 | 48.6 | 169 | 400 |
| 7 | MLOW-07 | 67.77 | 24.74 | 20 | 6610 | 4230 | 8 | Nil | 800 | 1260 | 120 | 145.8 | 1098 | 900 |
| 8 | MLOW-08 | 68.08 | 24.60 | 20 | 3290 | 2105 | 8.1 | Nil | 500 | 700 | 100 | 243 | 174 | 1250 |
| 9 | MLOW-09 | 68.30 | 24.62 | 20 | 85600 | 54784 | 7.5 | Nil | 250 | 27020 | 5460 | 3499 | 6666 | 28050 |
| 10 | MLOW-10 | 67.63 | 24.55 | 20 | 2780 | 1779 | 9 | 30 | 500 | 644 | 60 | 85.05 | 405 | 500 |
| 11 | MLOW-11 | 67.82 | 24.61 | 20 | 23700 | 15168 | 7.9 | Nil | 450 | 6748 | 600 | 656.1 | 3488 | 4200 |
| 12 | MLOW-12 | 67.89 | 24.57 | 20 | 930 | 595 | 8.7 | 20 | 250 | 132 | 80 | 36.45 | 51 | 350 |
| 13 | MLOW-13 | 68.27 | 24.36 | 20 | 57000 | 36480 | 7.7 | Nil | 350 | 16520 | 1060 | 1652 | 8690 | 9450 |
| 14 | MLOW-14 | 67.58 | 24.46 | 20 | 1863 | 1192 | 8.7 | 30 | 400 | 448 | 40 | 60.75 | 263 | 350 |
| 15 | MLOW-15 | 67.83 | 24.40 | 20 | 36700 | 23488 | 7.9 | Nil | 550 | 11620 | 900 | 1506.6 | 4456 | 8450 |
| 16 | MLOW-16 | 67.99 | 24.40 | 20 | 6340 | 4057 | 8.5 | 20 | 350 | 1652 | 100 | 97.2 | 1141 | 650 |
| 17 | MLOW-17 | 68.14 | 24.27 | 20 | 47000 | 30080 | 7.8 | Nil | 550 | 14112 | 580 | 1008.45 | 8525 | 5600 |
| 18 | MLOW-18 | 67.61 | 24.31 | 20 | 42100 | 26944 | 7.6 | Nil | 650 | 13300 | 280 | 1628 | 6216 | 7400 |
| 19 | MLOW-19 | 67.76 | 24.29 | 20 | 13920 | 8908 | 8.2 | Nil | 850 | 3164 | 100 | 388.8 | 2323 | 1850 |
| 20 | MLOW-20 | 67.92 | 24.28 | 20 | 57100 | 36544 | 8 | Nil | 550 | 16100 | 280 | 1761 | 9422 | 7950 |
| 21 | MLOW-21 | 67.63 | 24.19 | 20 | 14230 | 9107 | 8 | Nil | 550 | 4004 | 100 | 388.8 | 1399 | 1850 |
| 22 | MLOW-22 | 67.46 | 24.14 | 20 | 50800 | 32512 | 8.5 | 30 | 550 | 17080 | 620 | 1555.2 | 7979 | 7950 |
| 23 | MLOW-23 | 67.62 | 24.09 | 20 | 40100 | 25664 | 7.9 | Nil | 600 | 11480 | 700 | 862.65 | 6755 | 5300 |
| 24 | MLOW-24 | 68.66 | 25.04 | 20 | 2990 | 1913 | 8.3 | 30 | 550 | 560 | 120 | 109.35 | 338 | 750 |
| 25 | MLOW-25 | 68.66 | 24.87 | 20 | 54200 | 34688 | 7.6 | Nil | 350 | 17423 | 4400 | 2891 | 1855 | 22900 |
| 26 | MLOW-26 | 68.50 | 24.82 | 20 | 6920 | 4428 | 9 | 90 | 1150 | 1649 | 100 | 97.2 | 1289 | 650 |
| 27 | MLOW-27 | 68.42 | 24.69 | 20 | 47100 | 30144 | 7.9 | Nil | 850 | 15561 | 320 | 801.9 | 8914 | 4100 |
| 28 | MLOW-28 | 68.67 | 24.69 | 20 | 13250 | 8480 | 8.2 | Nil | 750 | 3857 | 160 | 473.85 | 1947 | 2350 |
| 29 | MLOW-29 | 68.84 | 24.66 | 20 | 29900 | 19136 | 7.7 | Nil | 700 | 9443 | 360 | 1032.75 | 4470 | 5150 |
| 30 | MLOW-30 | 68.49 | 24.49 | 20 | 113320 | 72524 | 7.4 | Nil | 350 | 37506 | 4740 | 5868 | 9365 | 36000 |
| 31 | MLOW-31 | 68.70 | 24.49 | 20 | 73300 | 46912 | 7.3 | Nil | 900 | 23940 | 320 | 3025 | 10669 | 13250 |
| 32 | MLOW-32 | 68.84 | 24.50 | 20 | 27200 | 17408 | 8.3 | 10 | 250 | 6832 | 460 | 498.15 | 4759 | 3200 |
| 33 | MLOW-33 | 68.88 | 24.34 | 20 | 69700 | 44608 | 7.6 | Nil | 300 | 20860 | 1100 | 3183 | 8653 | 15850 |
| 34 | MLOW-34 | 69.04 | 24.33 | 20 | 75600 | 48384 | 8 | Nil | 300 | 24381 | 1240 | 3156 | 9900 | 16090 |
| 35 | MLOW-35 | 69.04 | 24.47 | 20 | 5890 | 3769 | 8.9 | 30 | 500 | 1456 | 60 | 97.2 | 1098 | 550 |
| 36 | MLOW-36 | 69.07 | 24.64 | 20 | 28500 | 18240 | 8.1 | Nil | 800 | 8400 | 300 | 972 | 4333 | 4750 |
| 37 | MLOW-37 | 69.20 | 24.68 | 20 | 8790 | 5625 | 8.3 | 30 | 900 | 2240 | 160 | 291.6 | 1268 | 1600 |
| 38 | MLOW-38 | 69.26 | 24.89 | 20 | 10870 | 6956 | 8.3 | 20 | 500 | 2492 | 180 | 571.05 | 1189 | 2800 |
| 39 | MLOW-39 | 68.89 | 24.85 | 20 | 43800 | 28032 | 7.6 | Nil | 900 | 12457 | 640 | 896.18 | 7605 | 4850 |
| 40 | MLOW-40 | 68.82 | 25.05 | 20 | 2990 | 1913 | 9 | 50 | 760 | 207 | 40 | 82.62 | 479 | 440 |
| 41 | MLOW-41 | 68.43 | 25.04 | 20 | 1216 | 778 | 8.9 | 10 | 340 | 179 | 48 | 29.16 | 166 | 240 |
| 42 | MLOW-42 | 68.47 | 25.20 | 20 | 1067 | 682 | 9 | 20 | 400 | 106 | 48 | 43.74 | 103 | 300 |

## 5.12 Water Quality Analysis from 42 MLOWs during February 2018 (At 13 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^{3}$ (mg/l) | $HCO^{3}$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 2 | MLOW-02 | 68.12 | 24.97 | 40 | 23800 | 15232 | 7.5 | Nil | 480 | 6380 | 256 | 884.52 | 3879 | 4280 |
| 3 | MLOW-03 | 68.18 | 24.79 | 40 | 13500 | 8640 | 7.6 | Nil | 480 | 3741 | 456 | 1059 | 545 | 5500 |
| 4 | MLOW-04 | 67.98 | 24.78 | 40 | 3880 | 2483 | 7.5 | Nil | 380 | 875 | 88 | 228.42 | 348 | 1160 |
| 5 | MLOW-05 | 68.07 | 24.72 | 40 | 46400 | 29696 | 7.6 | Nil | 400 | 13601 | 1072 | 2507 | 4615 | 13000 |
| 6 | MLOW-06 | 67.59 | 24.71 | 40 | 1632 | 1044 | 8.7 | 10 | 160 | 255 | 56 | 63.18 | 187 | 400 |
| 7 | MLOW-07 | 67.77 | 24.74 | 40 | 10990 | 7033 | 7.5 | Nil | 800 | 2436 | 64 | 240.57 | 1988 | 1150 |
| 8 | MLOW-08 | 68.08 | 24.60 | 40 | 4860 | 3110 | 7.6 | Nil | 550 | 783 | 40 | 218.7 | 652 | 1000 |
| 9 | MLOW-09 | 68.30 | 24.62 | 40 | 85300 | 54592 | 6.5 | Nil | 350 | 26535 | 6760 | 1919.7 | 8144 | 24800 |
| 10 | MLOW-10 | 67.63 | 24.55 | 40 | 2800 | 1792 | 8.4 | 20 | 450 | 493 | 64 | 155.52 | 270 | 800 |
| 11 | MLOW-11 | 67.82 | 24.61 | 40 | 26600 | 17024 | 7.2 | Nil | 400 | 6554 | 456 | 852.93 | 3955 | 4650 |
| 12 | MLOW-12 | 67.89 | 24.57 | 40 | 1246 | 797 | 8.3 | 20 | 350 | 174 | 64 | 70.47 | 77 | 450 |
| 13 | MLOW-13 | 68.27 | 24.36 | 40 | 59600 | 38144 | 7.3 | Nil | 400 | 17545 | 1420 | 2551.5 | 7171 | 14050 |
| 14 | MLOW-14 | 67.58 | 24.46 | 40 | 1960 | 1254 | 8.5 | 20 | 550 | 348 | 40 | 48.6 | 305 | 300 |
| 15 | MLOW-15 | 67.83 | 24.40 | 40 | 20800 | 13312 | 7.3 | Nil | 600 | 6380 | 200 | 959.85 | 2703 | 4450 |
| 16 | MLOW-16 | 67.99 | 24.40 | 40 | 12380 | 7923 | 8.3 | 10 | 350 | 2958 | 140 | 315.9 | 2072 | 1650 |
| 17 | MLOW-17 | 68.14 | 24.27 | 40 | 58200 | 37248 | 7.1 | Nil | 350 | 18270 | 640 | 2235.6 | 8350 | 10800 |
| 18 | MLOW-18 | 67.61 | 24.31 | 40 | 55700 | 35648 | 7.3 | Nil | 500 | 17980 | 300 | 2818.8 | 7050 | 12350 |
| 19 | MLOW-19 | 67.76 | 24.29 | 40 | 93800 | 60032 | 7 | Nil | 700 | 29145 | 480 | 4009.5 | 13337.2 | 17700 |
| 20 | MLOW-20 | 67.92 | 24.28 | 40 | 56700 | 36288 | 7.2 | Nil | 550 | 13195 | 240 | 1676.7 | 9539 | 7500 |
| 21 | MLOW-21 | 67.63 | 24.19 | 40 | 13210 | 8454 | 7.5 | Nil | 450 | 2929 | 60 | 413.1 | 2161 | 1850 |
| 22 | MLOW-22 | 67.46 | 24.14 | 40 | 58200 | 37248 | 8.3 | 20 | 400 | 15225 | 400 | 1701 | 9640 | 8000 |
| 23 | MLOW-23 | 67.62 | 24.09 | 40 | 53500 | 34240 | 7.2 | Nil | 450 | 14935 | 580 | 1798.2 | 8169 | 8850 |
| 24 | MLOW-24 | 68.66 | 25.04 | 40 | 4430 | 2835 | 8.4 | 20 | 250 | 696 | 120 | 170.1 | 530 | 1000 |
| 25 | MLOW-25 | 68.66 | 24.87 | 40 | 54900 | 35136 | 7 | Nil | 400 | 17545 | 3020 | 3389.9 | 2640 | 21500 |
| 26 | MLOW-26 | 68.50 | 24.82 | 40 | 6850 | 4384 | 8.3 | 30 | 1000 | 1798 | 20 | 97.2 | 1355 | 450 |
| 27 | MLOW-27 | 68.42 | 24.69 | 40 | 46500 | 29760 | 7.2 | Nil | 750 | 14210 | 200 | 801.9 | 8911 | 3800 |
| 28 | MLOW-28 | 68.67 | 24.69 | 40 | 14850 | 9504 | 7.5 | Nil | 600 | 3010 | 100 | 534.6 | 2265 | 2450 |
| 29 | MLOW-29 | 68.84 | 24.66 | 40 | 37500 | 24000 | 7.2 | Nil | 500 | 9831 | 360 | 1105.7 | 6080 | 5450 |
| 30 | MLOW-30 | 68.49 | 24.49 | 40 | 111800 | 71552 | 7 | Nil | 350 | 36395 | 3580 | 5819.9 | 10412 | 32900 |
| 31 | MLOW-31 | 68.70 | 24.49 | 40 | 74700 | 47808 | 7.5 | Nil | 650 | 24360 | 220 | 2988.9 | 11189 | 12850 |
| 32 | MLOW-32 | 68.84 | 24.50 | 40 | 31400 | 20096 | 8.4 | 20 | 450 | 8207 | 360 | 631.8 | 5588 | 3500 |
| 33 | MLOW-33 | 68.88 | 24.34 | 40 | 69800 | 44672 | 7.2 | Nil | 350 | 20445 | 1100 | 2527.2 | 9922 | 13150 |
| 34 | MLOW-34 | 69.04 | 24.33 | 40 | 75800 | 48512 | 6.9 | Nil | 400 | 21025 | 1080 | 2563.7 | 11761 | 13250 |
| 35 | MLOW-35 | 69.04 | 24.47 | 40 | 49700 | 31808 | 7.3 | Nil | 500 | 10875 | 1220 | 1834.7 | 6500 | 10600 |
| 36 | MLOW-36 | 69.07 | 24.64 | 40 | 60000 | 38400 | 7.3 | Nil | 1000 | 15080 | 340 | 1895.4 | 9779 | 8650 |
| 37 | MLOW-37 | 69.20 | 24.68 | 40 | 9250 | 5920 | 7.7 | Nil | 350 | 1744 | 180 | 352.35 | 1233 | 1900 |
| 38 | MLOW-38 | 69.26 | 24.89 | 40 | 12320 | 7884 | 7.6 | Nil | 400 | 3074 | 200 | 607.5 | 1433 | 3000 |
| 39 | MLOW-39 | 68.89 | 24.85 | 40 | 39000 | 24960 | 7.3 | Nil | 700 | 6525 | 120 | 1008.5 | 6888 | 4450 |
| 40 | MLOW-40 | 68.82 | 25.05 | 40 | 2830 | 1811 | 9.5 | 50 | 650 | 203 | 20 | 48.6 | 522 | 250 |
| 41 | MLOW-41 | 68.43 | 25.04 | 40 | 5240 | 3353 | 8.4 | 30 | 500 | 986 | 60 | 121.5 | 893 | 650 |
| 42 | MLOW-42 | 68.47 | 25.20 | 40 | 1007 | 644 | 9.2 | 20 | 400 | 96 | 40 | 36.45 | 109 | 250 |

## 5.13 Water Quality Analysis from 42 MLOWs during November 2017 (At 20 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^{3}$ (mg/l) | $HCO^{3}$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 2 | MLOW-02 | 68.12 | 24.97 | 60 | 23100 | 14784 | 7.4 | Nil | 500 | 4440 | 360 | 522 | 3860 | 3050 |
| 3 | MLOW-03 | 68.18 | 24.79 | 60 | 13380 | 8563 | 7.8 | Nil | 400 | 2400 | 600 | 510 | 1395 | 3600 |
| 4 | MLOW-04 | 67.98 | 24.78 | 60 | 4050 | 2592 | 7.7 | Nil | 300 | 701 | 200 | 121 | 450 | 1000 |
| 5 | MLOW-05 | 68.07 | 24.72 | 60 | 49200 | 31488 | 7.7 | Nil | 800 | 11542 | 560 | 1385 | 7980 | 7100 |
| 6 | MLOW-06 | 67.59 | 24.71 | 60 | 1740 | 1113 | 7.7 | Nil | 250 | 290 | 80 | 24.3 | 260 | 300 |
| 7 | MLOW-07 | 67.77 | 24.74 | 60 | 48400 | 30976 | 7.3 | Nil | 700 | 10962 | 480 | 1069 | 8495 | 5600 |
| 8 | MLOW-08 | 68.08 | 24.60 | 60 | 5630 | 3603 | 7.7 | Nil | 550 | 812 | 140 | 109 | 902 | 800 |
| 9 | MLOW-09 | 68.30 | 24.62 | 60 | 88500 | 56640 | 6.9 | Nil | 250 | 26680 | 4600 | 3280 | 8795 | 25000 |
| 10 | MLOW-10 | 67.63 | 24.55 | 60 | 8850 | 5664 | 7.7 | Nil | 750 | 1682 | 180 | 194 | 1430 | 1250 |
| 11 | MLOW-11 | 67.82 | 24.61 | 55 | 23100 | 14784 | 7.4 | Nil | 450 | 5394 | 420 | 680 | 3505 | 3850 |
| 12 | MLOW-12 | 67.89 | 24.57 | 60 | 1238 | 792 | 8.4 | 20 | 400 | 145 | 120 | 36.45 | 75 | 450 |
| 13 | MLOW-13 | 68.27 | 24.36 | 60 | 76700 | 49088 | 7.2 | Nil | 700 | 20474 | 640 | 1992 | 13050 | 9800 |
| 14 | MLOW-14 | 67.58 | 24.46 | 60 | 3340 | 2137 | 7.9 | Nil | 450 | 551 | 60 | 97.2 | 507 | 550 |
| 15 | MLOW-15 | 67.83 | 24.40 | 60 | 12210 | 7814 | 7.8 | Nil | 750 | 2668 | 160 | 267 | 2080 | 1500 |
| 16 | MLOW-16 | 67.99 | 24.40 | 60 | 20000 | 12800 | 7.5 | Nil | 550 | 5742 | 260 | 413 | 3493 | 2350 |
| 17 | MLOW-17 | 68.14 | 24.27 | 60 | 54100 | 34624 | 7.2 | Nil | 500 | 13282 | 900 | 1360 | 8781 | 7850 |
| 18 | MLOW-18 | 67.61 | 24.31 | 60 | 54200 | 34688 | 7.2 | Nil | 550 | 12441 | 360 | 1603 | 8969 | 7500 |
| 19 | MLOW-19 | 67.76 | 24.29 | 60 | 62400 | 39936 | 7.2 | Nil | 650 | 15660 | 360 | 1846 | 10355 | 8500 |
| 20 | MLOW-20 | 67.92 | 24.28 | 60 | 63200 | 40448 | 7.3 | Nil | 500 | 17603 | 460 | 2016 | 10126 | 9450 |
| 21 | MLOW-21 | 67.63 | 24.19 | 60 | 16310 | 10438 | 7.6 | Nil | 450 | 4756 | 280 | 267 | 2898 | 1800 |
| 22 | MLOW-22 | 67.46 | 24.14 | 60 | 59100 | 37824 | 7.2 | Nil | 600 | 13282 | 520 | 1360 | 10369 | 6900 |
| 23 | MLOW-23 | 67.62 | 24.09 | 60 | 39300 | 25152 | 7.4 | Nil | 400 | 8091 | 700 | 850 | 6588 | 5250 |
| 24 | MLOW-24 | 68.66 | 25.04 | 60 | 4760 | 3046 | 8.6 | 20 | 350 | 725 | 200 | 133 | 608 | 1050 |
| 25 | MLOW-25 | 68.66 | 24.87 | 60 | 59100 | 37824 | 6.8 | Nil | 450 | 18340 | 3580 | 3110 | 3500 | 21750 |
| 26 | MLOW-26 | 68.50 | 24.82 | 60 | 32100 | 20544 | 7.8 | Nil | 700 | 7424 | 620 | 619 | 5465 | 4100 |
| 27 | MLOW-27 | 68.42 | 24.69 | 60 | 55000 | 35200 | 7.2 | Nil | 700 | 11890 | 480 | 631 | 10855 | 3800 |
| 28 | MLOW-28 | 68.67 | 24.69 | 60 | 31600 | 20224 | 7.6 | Nil | 650 | 6670 | 280 | 595 | 5788 | 3150 |
| 29 | MLOW-29 | 68.84 | 24.66 | 60 | 54100 | 34624 | 7.3 | Nil | 600 | 11020 | 740 | 1506 | 8689 | 8050 |
| 30 | MLOW-30 | 68.49 | 24.49 | 60 | 109000 | 69760 | 7.3 | Nil | 700 | 34020 | 1900 | 3924 | 15333 | 20900 |
| 31 | MLOW-31 | 68.70 | 24.49 | 60 | 78000 | 49920 | 7.1 | Nil | 950 | 25200 | 1060 | 2515 | 11888 | 13000 |
| 32 | MLOW-32 | 68.84 | 24.50 | 60 | 30900 | 19776 | 8 | Nil | 400 | 8120 | 480 | 692 | 5202 | 4050 |
| 33 | MLOW-33 | 68.88 | 24.34 | 60 | 71600 | 45824 | 7.4 | Nil | 450 | 21868 | 1300 | 2600 | 9970 | 13950 |
| 34 | MLOW-34 | 69.04 | 24.33 | 60 | 78500 | 50240 | 7.1 | Nil | 500 | 25256 | 1420 | 2916 | 10805 | 15550 |
| 35 | MLOW-35 | 69.04 | 24.47 | 60 | 60600 | 38784 | 7 | Nil | 400 | 18252 | 1880 | 2114 | 9170 | 13400 |
| 36 | MLOW-36 | 69.07 | 24.64 | 60 | 65200 | 41728 | 7.3 | Nil | 450 | 18900 | 1020 | 2187 | 9600 | 11550 |
| 37 | MLOW-37 | 69.20 | 24.68 | 60 | 11350 | 7264 | 7.6 | Nil | 550 | 2576 | 260 | 315 | 1688 | 1950 |
| 38 | MLOW-38 | 69.26 | 24.89 | 60 | 25400 | 16256 | 7.7 | Nil | 400 | 7420 | 600 | 984 | 3331 | 5550 |
| 39 | MLOW-39 | 68.89 | 24.85 | 60 | 34800 | 22272 | 7.6 | Nil | 600 | 10500 | 340 | 801 | 6055 | 4150 |
| 40 | MLOW-40 | 68.82 | 25.05 | 60 | 5180 | 3315 | 8.5 | 30 | 540 | 711 | 120 | 223 | 619 | 1120 |
| 41 | MLOW-41 | 68.43 | 25.04 | 60 | 9020 | 5772 | 7.8 | Nil | 320 | 2312 | 384 | 165 | 2996 | 1640 |
| 42 | MLOW-42 | 68.47 | 25.20 | 60 | 1584 | 1013 | 8.3 | 20 | 420 | 196 | 56 | 111 | 82 | 600 |

## 5.14 Water Quality Analysis from 42 MLOWs during December 2017 (At 20 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 2 | MLOW-02 | 68.12 | 24.97 | 60 | 31100 | 19904 | 7.6 | Nil | 650 | 8608 | 600 | 765.45 | 4994 | 4650 |
| 3 | MLOW-03 | 68.18 | 24.79 | 60 | 9800 | 6272 | 8 | Nil | 450 | 2688 | 200 | 291.6 | 1464 | 1700 |
| 4 | MLOW-04 | 67.98 | 24.78 | 60 | 4030 | 2579 | 7.6 | Nil | 490 | 1140 | 280 | 109.35 | 395 | 1150 |
| 5 | MLOW-05 | 68.07 | 24.72 | 60 | 48900 | 31296 | 7.4 | Nil | 650 | 15300 | 660 | 1373 | 7855 | 7300 |
| 6 | MLOW-06 | 67.59 | 24.71 | 60 | 1665 | 1065 | 7.9 | Nil | 300 | 291 | 60 | 60.75 | 196 | 400 |
| 7 | MLOW-07 | 67.77 | 24.74 | 60 | 49800 | 31872 | 7.2 | Nil | 750 | 19520 | 480 | 1300 | 8401 | 6550 |
| 8 | MLOW-08 | 68.08 | 24.60 | 60 | 5650 | 3616 | 7.6 | Nil | 650 | 1088 | 120 | 170.1 | 831 | 1000 |
| 9 | MLOW-09 | 68.30 | 24.62 | 60 | 88300 | 56512 | 7 | Nil | 300 | 28192 | 4640 | 3669.3 | 7927 | 26700 |
| 10 | MLOW-10 | 67.63 | 24.55 | 60 | 6290 | 4025 | 7.9 | Nil | 600 | 1664 | 200 | 109.35 | 1001 | 950 |
| 11 | MLOW-11 | 67.82 | 24.61 | 60 | 27100 | 17344 | 7.4 | Nil | 500 | 7104 | 360 | 1020.6 | 3857 | 5100 |
| 12 | MLOW-12 | 67.89 | 24.57 | 60 | 1213 | 776 | 8.4 | 20 | 400 | 256 | 120 | 24.3 | 93 | 400 |
| 13 | MLOW-13 | 68.27 | 24.36 | 60 | 72400 | 46336 | 7.2 | Nil | 750 | 24256 | 1040 | 2041.2 | 11535 | 11000 |
| 14 | MLOW-14 | 67.58 | 24.46 | 60 | 3060 | 1958 | 7.9 | Nil | 350 | 640 | 80 | 36.45 | 539 | 350 |
| 15 | MLOW-15 | 67.83 | 24.40 | 60 | 16330 | 10451 | 7.6 | Nil | 700 | 4800 | 240 | 583.2 | 2355 | 3000 |
| 16 | MLOW-16 | 67.99 | 24.40 | 60 | 20700 | 13248 | 7.5 | Nil | 550 | 6432 | 200 | 473.85 | 3611 | 2450 |
| 17 | MLOW-17 | 68.14 | 24.27 | 60 | 65800 | 42112 | 7.2 | Nil | 400 | 21536 | 1000 | 1761.8 | 10589 | 9750 |
| 18 | MLOW-18 | 67.61 | 24.31 | 60 | 61200 | 39168 | 7.3 | Nil | 750 | 20320 | 440 | 1482.3 | 10718 | 7200 |
| 19 | MLOW-19 | 67.76 | 24.29 | 60 | 83400 | 53376 | 7.6 | Nil | 700 | 27360 | 640 | 3074 | 12535 | 14250 |
| 20 | MLOW-20 | 67.92 | 24.28 | 60 | 78500 | 50240 | 7.3 | Nil | 650 | 24960 | 580 | 2539.4 | 12841 | 11900 |
| 21 | MLOW-21 | 67.63 | 24.19 | 60 | 16330 | 10451 | 7.7 | Nil | 550 | 4480 | 260 | 255.15 | 2958 | 1700 |
| 22 | MLOW-22 | 67.46 | 24.14 | 60 | 59400 | 38016 | 7.4 | Nil | 500 | 18304 | 440 | 1676.7 | 9929 | 8000 |
| 23 | MLOW-23 | 67.62 | 24.09 | 60 | 51000 | 32640 | 7.8 | Nil | 440 | 15008 | 560 | 1555.2 | 8095 | 7800 |
| 24 | MLOW-24 | 68.66 | 25.04 | 60 | 4870 | 3116 | 8.3 | 10 | 400 | 1216 | 260 | 194.4 | 446 | 1450 |
| 25 | MLOW-25 | 68.66 | 24.87 | 60 | 54300 | 34752 | 7.1 | Nil | 350 | 16032 | 3100 | 2976 | 3205 | 20000 |
| 26 | MLOW-26 | 68.50 | 24.82 | 60 | 37800 | 24192 | 7.4 | Nil | 800 | 11744 | 320 | 886.95 | 6602 | 4450 |
| 27 | MLOW-27 | 68.42 | 24.69 | 60 | 49300 | 31552 | 7.2 | Nil | 850 | 15232 | 140 | 899.1 | 9434 | 4050 |
| 28 | MLOW-28 | 68.67 | 24.69 | 60 | 33900 | 21696 | 7.7 | Nil | 750 | 10240 | 180 | 789.75 | 6058 | 3700 |
| 29 | MLOW-29 | 68.84 | 24.66 | 60 | 50100 | 32064 | 7.2 | Nil | 650 | 16768 | 900 | 1409.4 | 7761 | 8050 |
| 30 | MLOW-30 | 68.49 | 24.49 | 60 | 112700 | 72128 | 7 | Nil | 350 | 34290 | 3480 | 5103 | 12095 | 29700 |
| 31 | MLOW-31 | 68.70 | 24.49 | 60 | 76400 | 48896 | 7.1 | Nil | 850 | 22950 | 380 | 2490 | 12329 | 11200 |
| 32 | MLOW-32 | 68.84 | 24.50 | 60 | 31900 | 20416 | 7.8 | Nil | 350 | 7911 | 280 | 692.55 | 5670 | 3550 |
| 33 | MLOW-33 | 68.88 | 24.34 | 60 | 70700 | 45248 | 7.4 | Nil | 500 | 22275 | 760 | 2636 | 10303 | 12750 |
| 34 | MLOW-34 | 69.04 | 24.33 | 60 | 77300 | 49472 | 7 | Nil | 500 | 24192 | 940 | 2745 | 11421 | 13650 |
| 35 | MLOW-35 | 69.04 | 24.47 | 60 | 59700 | 38208 | 7 | Nil | 400 | 17820 | 1600 | 2199 | 7660 | 13050 |
| 36 | MLOW-36 | 69.07 | 24.64 | 60 | 61500 | 39360 | 7.3 | Nil | 1250 | 17820 | 160 | 2114 | 9898 | 9100 |
| 37 | MLOW-37 | 69.20 | 24.68 | 60 | 11020 | 7052 | 7.8 | Nil | 500 | 2403 | 100 | 364.5 | 1704 | 1750 |
| 38 | MLOW-38 | 69.26 | 24.89 | 60 | 29700 | 19008 | 7.6 | Nil | 500 | 8694 | 220 | 1287 | 4090 | 5850 |
| 39 | MLOW-39 | 68.89 | 24.85 | 60 | 40000 | 25600 | 7.4 | Nil | 600 | 11190 | 160 | 2053 | 5300 | 8850 |
| 40 | MLOW-40 | 68.82 | 25.05 | 60 | 3810 | 2438 | 8.4 | 10 | 350 | 420 | 60 | 60.75 | 684 | 400 |
| 41 | MLOW-41 | 68.43 | 25.04 | 60 | 8670 | 5548 | 7.7 | Nil | 350 | 2310 | 180 | 206.55 | 1380 | 1300 |
| 42 | MLOW-42 | 68.47 | 25.20 | 60 | 1483 | 949 | 8.3 | 10 | 300 | 240 | 60 | 48.6 | 171 | 300 |

## 5.15 Water Quality Analysis from 42 MLOWs during January 2018 (At 20 m

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NEQS Permissible Limit for Drinking | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 2 | MLOW-02 | 68.12 | 24.97 | 60 | 34900 | 22336 | 7.9 | Nil | 700 | 8148 | 660 | 1385.1 | 4601 | 7350 |
| 3 | MLOW-03 | 68.18 | 24.79 | 60 | 10470 | 6700 | 8.1 | Nil | 550 | 3136 | 280 | 437.4 | 1241 | 2500 |
| 4 | MLOW-04 | 67.98 | 24.78 | 60 | 3810 | 2438 | 8.2 | Nil | 400 | 728 | 240 | 145.8 | 318 | 1200 |
| 5 | MLOW-05 | 68.07 | 24.72 | 60 | 46800 | 29952 | 7.8 | Nil | 550 | 12227 | 180 | 2065 | 6580 | 8950 |
| 6 | MLOW-06 | 67.59 | 24.71 | 60 | 1691 | 1082 | 8.7 | 10 | 150 | 294 | 60 | 85.05 | 155 | 500 |
| 7 | MLOW-07 | 67.77 | 24.74 | 60 | 47900 | 30656 | 7.8 | Nil | 550 | 15559 | 480 | 1494.5 | 7588 | 7350 |
| 8 | MLOW-08 | 68.08 | 24.60 | 60 | 5650 | 3616 | 8 | Nil | 600 | 1120 | 100 | 206.55 | 782 | 1100 |
| 9 | MLOW-09 | 68.30 | 24.62 | 60 | 85000 | 54400 | 7.5 | Nil | 300 | 26880 | 4760 | 4191 | 6022 | 29150 |
| 10 | MLOW-10 | 67.63 | 24.55 | 60 | 5780 | 3699 | 8.3 | 30 | 500 | 1400 | 80 | 194.4 | 851 | 1000 |
| 11 | MLOW-11 | 67.82 | 24.61 | 60 | 26900 | 17216 | 7.4 | Nil | 400 | 7924 | 640 | 935.55 | 3641 | 5450 |
| 12 | MLOW-12 | 67.89 | 24.57 | 60 | 1128 | 721 | 8.4 | 10 | 300 | 176 | 100 | 36.45 | 73 | 400 |
| 13 | MLOW-13 | 68.27 | 24.36 | 60 | 65000 | 41600 | 7.8 | Nil | 500 | 18480 | 1440 | 1713 | 9288 | 10650 |
| 14 | MLOW-14 | 67.58 | 24.46 | 60 | 2470 | 1580 | 8.6 | 20 | 400 | 588 | 40 | 85.05 | 340 | 450 |
| 15 | MLOW-15 | 67.83 | 24.40 | 60 | 17850 | 11424 | 8 | Nil | 850 | 5236 | 300 | 619.65 | 2565 | 3300 |
| 16 | MLOW-16 | 67.99 | 24.40 | 60 | 19900 | 12736 | 8.3 | 10 | 450 | 5572 | 240 | 522.45 | 3277 | 2750 |
| 17 | MLOW-17 | 68.14 | 24.27 | 60 | 62800 | 40192 | 7.7 | Nil | 350 | 18284 | 1120 | 2114 | 9076 | 11500 |
| 18 | MLOW-18 | 67.61 | 24.31 | 60 | 60500 | 38720 | 7.2 | Nil | 550 | 15148 | 220 | 2235 | 9347 | 9750 |
| 19 | MLOW-19 | 67.76 | 24.29 | 60 | 89700 | 57408 | 7.9 | Nil | 650 | 29120 | 420 | 3839.4 | 12777 | 16850 |
| 20 | MLOW-20 | 67.92 | 24.28 | 60 | 63700 | 40768 | 8.2 | Nil | 700 | 18760 | 180 | 2332.8 | 9965 | 10050 |
| 21 | MLOW-21 | 67.63 | 24.19 | 60 | 15840 | 10137 | 8.2 | Nil | 500 | 4452 | 240 | 425.25 | 2540 | 2350 |
| 22 | MLOW-22 | 67.46 | 24.14 | 60 | 57500 | 36800 | 8.3 | 20 | 550 | 17973 | 820 | 1846.8 | 8730 | 9650 |
| 23 | MLOW-23 | 67.62 | 24.09 | 60 | 42700 | 27328 | 7.4 | Nil | 550 | 15764 | 600 | 1360.8 | 6513 | 7100 |
| 24 | MLOW-24 | 68.66 | 25.04 | 60 | 4730 | 3027 | 8.3 | 30 | 350 | 1176 | 220 | 170.1 | 506 | 1250 |
| 25 | MLOW-25 | 68.66 | 24.87 | 60 | 46400 | 29696 | 7.2 | Nil | 500 | 14497 | 2680 | 2721 | 2366 | 17900 |
| 26 | MLOW-26 | 68.50 | 24.82 | 60 | 38700 | 24768 | 7.9 | Nil | 700 | 12236 | 380 | 911.25 | 6698 | 4700 |
| 27 | MLOW-27 | 68.42 | 24.69 | 60 | 46600 | 29824 | 7.7 | Nil | 600 | 15135 | 280 | 692.55 | 9055 | 3550 |
| 28 | MLOW-28 | 68.67 | 24.69 | 60 | 29700 | 19008 | 7.5 | Nil | 1000 | 9310 | 100 | 777.6 | 5218 | 3450 |
| 29 | MLOW-29 | 68.84 | 24.66 | 60 | 48000 | 30720 | 7.7 | Nil | 700 | 14071 | 260 | 1336.5 | 8166 | 9150 |
| 30 | MLOW-30 | 68.49 | 24.49 | 60 | 113700 | 72768 | 7.6 | Nil | 300 | 37745 | 5700 | 4677 | 10619 | 33500 |
| 31 | MLOW-31 | 68.70 | 24.49 | 60 | 75500 | 48320 | 7.8 | Nil | 1150 | 24259 | 120 | 2903 | 11641 | 12250 |
| 32 | MLOW-32 | 68.84 | 24.50 | 60 | 31500 | 20160 | 8.3 | 10 | 300 | 8288 | 520 | 558.9 | 5563 | 3600 |
| 33 | MLOW-33 | 68.88 | 24.34 | 60 | 69500 | 44480 | 7.5 | Nil | 350 | 20804 | 1180 | 2928 | 9000 | 15000 |
| 34 | MLOW-34 | 69.04 | 24.33 | 60 | 75500 | 48320 | 8 | Nil | 350 | 24354 | 1300 | 2612 | 10849 | 14000 |
| 35 | MLOW-35 | 69.04 | 24.47 | 60 | 58000 | 37120 | 8 | Nil | 350 | 19040 | 1960 | 1567 | 8066 | 11350 |
| 36 | MLOW-36 | 69.07 | 24.64 | 60 | 61400 | 39296 | 7.9 | Nil | 850 | 18200 | 120 | 1846 | 10431 | 7900 |
| 37 | MLOW-37 | 69.20 | 24.68 | 60 | 9480 | 6067 | 8.3 | 10 | 500 | 2464 | 220 | 315.9 | 1313 | 1850 |
| 38 | MLOW-38 | 69.26 | 24.89 | 60 | 28800 | 18432 | 8.3 | 10 | 250 | 7364 | 280 | 1263 | 3866 | 5900 |
| 39 | MLOW-39 | 68.89 | 24.85 | 60 | 40100 | 25664 | 7.7 | Nil | 700 | 11816 | 440 | 716.85 | 7335 | 4050 |
| 40 | MLOW-40 | 68.82 | 25.05 | 60 | 3270 | 2092 | 8.6 | 40 | 760 | 252 | 48 | 82.62 | 535 | 460 |
| 41 | MLOW-41 | 68.43 | 25.04 | 60 | 8350 | 5344 | 8.3 | 20 | 260 | 2324 | 184 | 267.3 | 1189 | 1560 |
| 42 | MLOW-42 | 68.47 | 25.20 | 60 | 1203 | 769 | 8.5 | 30 | 500 | 106 | 48 | 63.18 | 98 | 380 |

## 5.16 Water Quality Analysis from 42 MLOWs during February 2018 (At 20 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 2 | MLOW-02 | 68.12 | 24.97 | 60 | 3660 | 23424 | 7.4 | Nil | 600 | 11687 | 456 | 1574.64 | 4868 | 7620 |
| 3 | MLOW-03 | 68.18 | 24.79 | 60 | 10440 | 6681 | 7.6 | Nil | 520 | 2784 | 104 | 641.52 | 1044 | 2900 |
| 4 | MLOW-04 | 67.98 | 24.78 | 60 | 3980 | 2547 | 7.5 | Nil | 300 | 933 | 96 | 272.16 | 280 | 1360 |
| 5 | MLOW-05 | 68.07 | 24.72 | 60 | 47700 | 30528 | 7.4 | Nil | 800 | 13630 | 408 | 2084 | 6490 | 9600 |
| 6 | MLOW-06 | 67.59 | 24.71 | 60 | 1741 | 1114 | 8.7 | 10 | 180 | 261 | 48 | 102.06 | 147 | 540 |
| 7 | MLOW-07 | 67.77 | 24.74 | 60 | 48200 | 3084 | 7.2 | Nil | 700 | 14790 | 232 | 1523.61 | 7889 | 6850 |
| 8 | MLOW-08 | 68.08 | 24.60 | 60 | 5860 | 3750 | 7.7 | Nil | 650 | 957 | 112 | 150.66 | 918 | 900 |
| 9 | MLOW-09 | 68.30 | 24.62 | 60 | 85400 | 54656 | 6.5 | Nil | 300 | 26593 | 5720 | 2393.55 | 8459 | 24150 |
| 10 | MLOW-10 | 67.63 | 24.55 | 60 | 5690 | 3641 | 8.3 | 20 | 550 | 1131 | 32 | 187.11 | 909 | 850 |
| 11 | MLOW-11 | 67.82 | 24.61 | 60 | 26700 | 17088 | 7.2 | Nil | 350 | 6670 | 440 | 862.65 | 3984 | 4650 |
| 12 | MLOW-12 | 67.89 | 24.57 | 60 | 1151 | 736 | 8.4 | 20 | 400 | 148 | 72 | 65.61 | 55.55 | 450 |
| 13 | MLOW-13 | 68.27 | 24.36 | 60 | 62900 | 40256 | 7.2 | Nil | 350 | 20155 | 1140 | 2648.7 | 8066 | 13750 |
| 14 | MLOW-14 | 67.58 | 24.46 | 60 | 2470 | 1580 | 8.5 | 20 | 400 | 348 | 40 | 170.1 | 192 | 800 |
| 15 | MLOW-15 | 67.83 | 24.40 | 60 | 12590 | 8057 | 7.6 | Nil | 650 | 3016 | 100 | 534.6 | 1747 | 2450 |
| 16 | MLOW-16 | 67.99 | 24.40 | 60 | 19800 | 12672 | 8.3 | 10 | 450 | 5510 | 160 | 716.85 | 2980 | 3350 |
| 17 | MLOW-17 | 68.14 | 24.27 | 60 | 63100 | 40384 | 6.8 | Nil | 350 | 19140 | 780 | 2928.15 | 7990 | 14000 |
| 18 | MLOW-18 | 67.61 | 24.31 | 60 | 57500 | 36800 | 7.2 | Nil | 600 | 18850 | 360 | 2174.85 | 8630 | 9850 |
| 19 | MLOW-19 | 67.76 | 24.29 | 60 | 92300 | 59072 | 6.9 | Nil | 550 | 28855 | 1200 | 3523.5 | 130 | 17500 |
| 20 | MLOW-20 | 67.92 | 24.28 | 60 | 66400 | 42496 | 7.2 | Nil | 550 | 15515 | 240 | 2296.35 | 10569 | 10050 |
| 21 | MLOW-21 | 67.63 | 24.19 | 60 | 14250 | 9120 | 7.8 | Nil | 500 | 3074 | 60 | 400.95 | 2424 | 1800 |
| 22 | MLOW-22 | 67.46 | 24.14 | 60 | 58000 | 37120 | 8.4 | 20 | 350 | 15370 | 380 | 1858.95 | 9317 | 8600 |
| 23 | MLOW-23 | 67.62 | 24.09 | 60 | 47300 | 30272 | 7.6 | Nil | 500 | 10353 | 420 | 1713.15 | 7100 | 8100 |
| 24 | MLOW-24 | 68.66 | 25.04 | 60 | 4740 | 3033 | 8.4 | 20 | 250 | 812 | 120 | 243 | 479 | 1300 |
| 25 | MLOW-25 | 68.66 | 24.87 | 60 | 53000 | 33920 | 7 | Nil | 300 | 17545 | 3100 | 3145 | 2559 | 20750 |
| 26 | MLOW-26 | 68.50 | 24.82 | 60 | 10740 | 6873 | 7.8 | Nil | 950 | 2291 | 40 | 170.1 | 2077 | 800 |
| 27 | MLOW-27 | 68.42 | 24.69 | 60 | 46100 | 29504 | 7.1 | Nil | 650 | 14268 | 220 | 643.95 | 9100 | 3200 |
| 28 | MLOW-28 | 68.67 | 24.69 | 60 | 33100 | 21184 | 7.8 | Nil | 800 | 9048 | 180 | 704.7 | 6040 | 3350 |
| 29 | MLOW-29 | 68.84 | 24.66 | 60 | 40800 | 26112 | 7.2 | Nil | 500 | 11513 | 240 | 1397.25 | 6417 | 6350 |
| 30 | MLOW-30 | 68.49 | 24.49 | 60 | 113000 | 72320 | 6.8 | Nil | 400 | 36540 | 3040 | 5892.75 | 11201 | 31850 |
| 31 | MLOW-31 | 68.70 | 24.49 | 60 | 75000 | 48000 | 7.1 | Nil | 750 | 23055 | 220 | 2879.55 | 11466 | 12400 |
| 32 | MLOW-32 | 68.84 | 24.50 | 60 | 31400 | 20096 | 8.3 | 20 | 450 | 9019 | 380 | 595.35 | 5635 | 3400 |
| 33 | MLOW-33 | 68.88 | 24.34 | 60 | 69600 | 44544 | 7 | Nil | 300 | 20300 | 860 | 2575.8 | 10065 | 12750 |
| 34 | MLOW-34 | 69.04 | 24.33 | 60 | 75400 | 48256 | 6.9 | Nil | 400 | 21634 | 1100 | 2697.3 | 10890 | 13850 |
| 35 | MLOW-35 | 69.04 | 24.47 | 60 | 58000 | 37120 | 6.9 | Nil | 300 | 14355 | 1560 | 2138.4 | 7433 | 12700 |
| 36 | MLOW-36 | 69.07 | 24.64 | 60 | 60800 | 38912 | 7.3 | Nil | 1250 | 14413 | 220 | 1980.45 | 9911 | 8700 |
| 37 | MLOW-37 | 69.20 | 24.68 | 60 | 9620 | 6156 | 7.9 | Nil | 500 | 2233 | 140 | 352.35 | 1366 | 1800 |
| 38 | MLOW-38 | 69.26 | 24.89 | 60 | 28700 | 18368 | 7.5 | Nil | 400 | 5075 | 340 | 1178.55 | 3939 | 5700 |
| 39 | MLOW-39 | 68.89 | 24.85 | 60 | 39400 | 25216 | 7.3 | Nil | 600 | 6960 | 100 | 972 | 7068 | 4250 |
| 40 | MLOW-40 | 68.82 | 25.05 | 60 | 3210 | 2054 | 9.2 | 60 | 700 | 262 | 40 | 60.75 | 566 | 350 |
| 41 | MLOW-41 | 68.43 | 25.04 | 60 | 8070 | 5164 | 8.3 | 30 | 200 | 1595 | 80 | 243 | 1286 | 1200 |
| 42 | MLOW-42 | 68.47 | 25.20 | 60 | 1020 | 652 | 9.2 | 20 | 400 | 97 | 40 | 48.6 | 93 | 300 |

## 5.17 Water Quality Analysis from 42 MLOWs during March 2018 (At 0 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^{3}$ (mg/l) | $HCO^{3}$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 0 | 637 | 407 | 8.4 | 20 | 230 | 60 | 40 | 24.3 | 52 | 200 |
| 2 | MLOW-02 | 68.12 | 24.97 | 0 | 27500 | 17600 | 8.2 | Nil | 350 | 6920 | 300 | 631.8 | 4766 | 3350 |
| 3 | MLOW-03 | 68.18 | 24.79 | 0 | 9850 | 6304 | 8 | Nil | 350 | 2279 | 200 | 315.9 | 1419 | 1800 |
| 4 | MLOW-04 | 67.98 | 24.78 | 0 | 3670 | 2348 | 8 | Nil | 300 | 859 | 100 | 218.7 | 300 | 1150 |
| 5 | MLOW-05 | 68.07 | 24.72 | 0 | 46000 | 29440 | 8.1 | Nil | 500 | 12900 | 180 | 1688.9 | 7102 | 7400 |
| 6 | MLOW-06 | 67.59 | 24.71 | 0 | 1910 | 1222 | 8.9 | 20 | 250 | 299 | 100 | 72.9 | 181 | 550 |
| 7 | MLOW-07 | 67.77 | 24.74 | 0 | 45300 | 28992 | 7.9 | Nil | 550 | 14933 | 180 | 1385.1 | 7533 | 6150 |
| 8 | MLOW-08 | 68.08 | 24.60 | 0 | 5140 | 3289 | 8.2 | Nil | 500 | 1064 | 80 | 133.65 | 818 | 750 |
| 9 | MLOW-09 | 68.30 | 24.62 | 0 | 81700 | 52288 | 7.2 | Nil | 250 | 26095 | 3960 | 39.6 | 6630 | 26200 |
| 10 | MLOW-10 | 67.63 | 24.55 | 0 | 3500 | 2240 | 8.6 | 20 | 450 | 671 | 200 | 206.55 | 176 | 1350 |
| 11 | MLOW-11 | 67.82 | 24.61 | 0 | 25600 | 1638 | 7.8 | Nil | 400 | 6631 | 220 | 947.7 | 3795 | 4450 |
| 12 | MLOW-12 | 67.89 | 24.57 | 0 | 1328 | 849 | 8.5 | 20 | 350 | 152 | 80 | 85.05 | 48 | 550 |
| 13 | MLOW-13 | 68.27 | 24.36 | 0 | 57700 | 36928 | 7.6 | Nil | 350 | 18200 | 220 | 2227.1 | 8636 | 9900 |
| 14 | MLOW-14 | 67.58 | 24.46 | 0 | 2170 | 1388 | 8.9 | 20 | 500 | 335 | 80 | 157.95 | 101 | 850 |
| 15 | MLOW-15 | 67.83 | 24.40 | 0 | 14940 | 9561 | 7.9 | Nil | 650 | 3360 | 60 | 546.75 | 2299 | 2400 |
| 16 | MLOW-16 | 67.99 | 24.40 | 0 | 18010 | 11526 | 7.9 | Nil | 550 | 4508 | 100 | 510.3 | 3033 | 2350 |
| 17 | MLOW-17 | 68.14 | 24.27 | 0 | 59000 | 37760 | 7.8 | Nil | 200 | 1526 | 1080 | 1676.7 | 9090 | 9600 |
| 18 | MLOW-18 | 67.61 | 24.31 | 0 | 32800 | 20992 | 7.7 | Nil | 500 | 11111 | 300 | 777.6 | 5691 | 3950 |
| 19 | MLOW-19 | 67.76 | 24.29 | 0 | 61700 | 39488 | 7.4 | Nil | 650 | 17635 | 220 | 2162.7 | 9777 | 9450 |
| 20 | MLOW-20 | 67.92 | 24.28 | 0 | 54900 | 35136 | 7.9 | Nil | 600 | 12093 | 160 | 1664.6 | 9033 | 7250 |
| 21 | MLOW-21 | 67.63 | 24.19 | 0 | 13220 | 8460 | 8.2 | Nil | 400 | 2647 | 100 | 425.25 | 2090 | 2000 |
| 22 | MLOW-22 | 67.46 | 24.14 | 0 | 54600 | 34944 | 7.8 | Nil | 650 | 12886 | 180 | 1494.5 | 9470 | 6600 |
| 23 | MLOW-23 | 67.62 | 24.09 | 0 | 48000 | 30720 | 8 | Nil | 250 | 15762 | 180 | 2187 | 6619 | 9450 |
| 24 | MLOW-24 | 68.66 | 25.04 | 0 | 4450 | 2848 | 8.4 | 20 | 200 | 603 | 80 | 279.45 | 382 | 1350 |
| 25 | MLOW-25 | 68.66 | 24.87 | 0 | 52000 | 33280 | 7.6 | Nil | 150 | 15670 | 3020 | 2442.2 | 3780 | 17600 |
| 26 | MLOW-26 | 68.50 | 24.82 | 0 | 14400 | 9216 | 8 | Nil | 600 | 3112 | 240 | 133.65 | 2767 | 1150 |
| 27 | MLOW-27 | 68.42 | 24.69 | 0 | 46500 | 29184 | 7.8 | Nil | 300 | 14742 | 200 | 741.15 | 9015 | 3550 |
| 28 | MLOW-28 | 68.67 | 24.69 | 0 | 32300 | 20672 | 8.2 | Nil | 450 | 8790 | 140 | 826.2 | 5656 | 3750 |
| 29 | MLOW-29 | 68.84 | 24.66 | 0 | 43300 | 27712 | 7.8 | Nil | 500 | 11739 | 340 | 1433.7 | 6799 | 6750 |
| 30 | MLOW-30 | 68.49 | 24.49 | 0 | 104500 | 66880 | 7.4 | Nil | 400 | 32760 | 3360 | 3827.3 | 12799 | 24150 |
| 31 | MLOW-31 | 68.70 | 24.49 | 0 | 70900 | 45376 | 7.6 | Nil | 500 | 22120 | 260 | 2490.8 | 11200 | 10900 |
| 32 | MLOW-32 | 68.84 | 24.50 | 0 | 30400 | 19456 | 8.5 | 20 | 400 | 7700 | 140 | 777.6 | 3516 | 3550 |
| 33 | MLOW-33 | 68.88 | 24.34 | 0 | 66000 | 42240 | 7.5 | Nil | 450 | 7500 | 240 | 2928.2 | 9277 | 12650 |
| 34 | MLOW-34 | 69.04 | 24.33 | 0 | 73200 | 46848 | 7.6 | Nil | 400 | 21840 | 460 | 2502.9 | 11488 | 11450 |
| 35 | MLOW-35 | 69.04 | 24.47 | 0 | 55900 | 35776 | 7.6 | Nil | 450 | 15922 | 980 | 2077.7 | 7733 | 11000 |
| 36 | MLOW-36 | 69.07 | 24.64 | 0 | 57100 | 36544 | 7.9 | Nil | 1200 | 12460 | 180 | 1827.3 | 9399 | 7950 |
| 37 | MLOW-37 | 69.20 | 24.68 | 0 | 9090 | 5817 | 7.8 | Nil | 350 | 2380 | 140 | 400.95 | 1137 | 2000 |
| 38 | MLOW-38 | 69.26 | 24.89 | 0 | 25100 | 16064 | 7.9 | Nil | 400 | 5880 | 300 | 1190.7 | 3122 | 5650 |
| 39 | MLOW-39 | 68.89 | 24.85 | 0 | 34600 | 22144 | 7.7 | Nil | 700 | 7788 | 180 | 984.15 | 5839 | 4500 |
| 40 | MLOW-40 | 68.82 | 25.05 | 0 | 3230 | 2067 | 8.7 | 40 | 650 | 252 | 80 | 109.35 | 424 | 650 |
| 41 | MLOW-41 | 68.43 | 25.04 | 0 | 7930 | 5075 | 8.3 | 30 | 350 | 1512 | 180 | 182.25 | 1239 | 1200 |
| 42 | MLOW-42 | 68.47 | 25.20 | 0 | 1071 | 685 | 9 | 40 | 150 | 224 | 80 | 24.3 | 101 | 300 |

## 5.18 Water Quality Analysis from 42 MLOWs during March 2018 (At 6 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NEQS Permissible Limit for Drinking | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 20 | 528 | 337 | 8.5 | 20 | 180 | 60 | 20 | 24.3 | 27 | 150 |
| 2 | MLOW-02 | 68.12 | 24.97 | 20 | 18650 | 11936 | 7.9 | Nil | 500 | 3917 | 220 | 449.55 | 3155 | 2400 |
| 3 | MLOW-03 | 68.18 | 24.79 | 20 | 13800 | 8832 | 8.1 | Nil | 250 | 3248 | 500 | 729 | 1185 | 4250 |
| 4 | MLOW-04 | 67.98 | 24.78 | 20 | 3790 | 2425 | 8 | Nil | 250 | 777 | 140 | 157.95 | 399 | 1000 |
| 5 | MLOW-05 | 68.07 | 24.72 | 20 | 46400 | 29696 | 7.2 | Nil | 550 | 12918 | 600 | 2053.4 | 6027 | 9950 |
| 6 | MLOW-06 | 67.59 | 24.71 | 20 | 1648 | 1054 | 8.7 | 20 | 350 | 231 | 60 | 60.75 | 190 | 400 |
| 7 | MLOW-07 | 67.77 | 24.74 | 20 | 6830 | 24512 | 7.9 | Nil | 700 | 1132 | 60 | 230.85 | 1039 | 1100 |
| 8 | MLOW-08 | 68.08 | 24.60 | 20 | 3280 | 2099 | 7.8 | Nil | 550 | 572 | 60 | 182.25 | 325 | 900 |
| 9 | MLOW-09 | 68.30 | 24.62 | 20 | 84400 | 54016 | 7.2 | Nil | 300 | 26347 | 2620 | 4969.4 | 6845 | 27000 |
| 10 | MLOW-10 | 67.63 | 24.55 | 20 | 1614 | 1032 | 8.4 | 20 | 450 | 223 | 80 | 194.4 | 88 | 1000 |
| 11 | MLOW-11 | 67.82 | 24.61 | 20 | 28200 | 18048 | 7.7 | Nil | 450 | 6943 | 160 | 959.85 | 4439 | 4350 |
| 12 | MLOW-12 | 67.89 | 24.57 | 20 | 1028 | 657 | 8.4 | 20 | 350 | 138 | 40 | 85.05 | 25 | 450 |
| 13 | MLOW-13 | 68.27 | 24.36 | 20 | 59800 | 38272 | 7.9 | Nil | 300 | 18200 | 480 | 2202.9 | 8995 | 11500 |
| 14 | MLOW-14 | 67.58 | 24.46 | 20 | 1794 | 1148 | 8.9 | 20 | 450 | 274 | 60 | 48.6 | 244 | 350 |
| 15 | MLOW-15 | 67.83 | 24.40 | 20 | 37500 | 24000 | 7.5 | Nil | 650 | 11144 | 120 | 1713.2 | 5178 | 7350 |
| 16 | MLOW-16 | 67.99 | 24.40 | 20 | 6370 | 4076 | 8.3 | 10 | 250 | 1365 | 80 | 133.65 | 1101 | 750 |
| 17 | MLOW-17 | 68.14 | 24.27 | 20 | 50900 | 32576 | 7.4 | Nil | 300 | 14769 | 460 | 801.9 | 9611 | 4450 |
| 18 | MLOW-18 | 67.61 | 24.31 | 20 | 40400 | 25856 | 8.2 | Nil | 250 | 12049 | 380 | 1263.6 | 6411 | 6150 |
| 19 | MLOW-19 | 67.76 | 24.29 | 20 | 19310 | 12358 | 8.1 | Nil | 700 | 4531 | 80 | 619.65 | 3139 | 2750 |
| 20 | MLOW-20 | 67.92 | 24.28 | 20 | 57700 | 36928 | 7.5 | Nil | 650 | 12910 | 200 | 1567.4 | 10000 | 6950 |
| 21 | MLOW-21 | 67.63 | 24.19 | 20 | 9610 | 6150 | 7.9 | Nil | 400 | 2238 | 80 | 205.55 | 1705 | 1050 |
| 22 | MLOW-22 | 67.46 | 24.14 | 20 | 48200 | 30848 | 7.8 | Nil | 550 | 12475 | 140 | 1737.5 | 7575 | 7500 |
| 23 | MLOW-23 | 67.62 | 24.09 | 20 | 38400 | 24576 | 7.8 | Nil | 400 | 8681 | 140 | 1178.6 | 6380 | 5200 |
| 24 | MLOW-24 | 68.66 | 25.04 | 20 | 3350 | 2144 | 8.4 | 20 | 300 | 572 | 60 | 121.5 | 451 | 650 |
| 25 | MLOW-25 | 68.66 | 24.87 | 20 | 53600 | 34304 | 7.1 | Nil | 150 | 17472 | 3980 | 2636.6 | 4177 | 18300 |
| 26 | MLOW-26 | 68.50 | 24.82 | 20 | 5830 | 3731 | 9.1 | 60 | 900 | 873 | 20 | 60.75 | 1169 | 300 |
| 27 | MLOW-27 | 68.42 | 24.69 | 20 | 47700 | 30528 | 7.4 | Nil | 350 | 13240 | 180 | 716.85 | 9377 | 3400 |
| 28 | MLOW-28 | 68.67 | 24.69 | 20 | 13480 | 8627 | 7.9 | Nil | 450 | 2566 | 160 | 558.9 | 1921 | 2450 |
| 29 | MLOW-29 | 68.84 | 24.66 | 20 | 29200 | 18688 | 7.7 | Nil | 450 | 7917 | 200 | 826.2 | 4888 | 3900 |
| 30 | MLOW-30 | 68.49 | 24.49 | 20 | 113000 | 72320 | 7.4 | Nil | 250 | 35490 | 5560 | 3985.2 | 11919 | 30300 |
| 31 | MLOW-31 | 68.70 | 24.49 | 20 | 72700 | 46528 | 7.2 | Nil | 650 | 22428 | 780 | 2320.7 | 11349 | 11500 |
| 32 | MLOW-32 | 68.84 | 24.50 | 20 | 30800 | 19712 | 8.4 | 20 | 350 | 6692 | 100 | 741.15 | 5522 | 3300 |
| 33 | MLOW-33 | 68.88 | 24.34 | 20 | 69400 | 44416 | 7.2 | Nil | 400 | 18340 | 460 | 3061.8 | 9533 | 13750 |
| 34 | MLOW-34 | 69.04 | 24.33 | 20 | 75000 | 48000 | 7.2 | Nil | 400 | 22064 | 440 | 2964.6 | 11033 | 13300 |
| 35 | MLOW-35 | 69.04 | 24.47 | 20 | 5030 | 32192 | 8.2 | Nil | 500 | 1085 | 120 | 72.9 | 851 | 600 |
| 36 | MLOW-36 | 69.07 | 24.64 | 20 | 23400 | 14976 | 7.6 | Nil | 550 | 4480 | 220 | 959.85 | 3266 | 4500 |
| 37 | MLOW-37 | 69.20 | 24.68 | 20 | 10770 | 6892 | 7.9 | Nil | 750 | 2800 | 200 | 425.25 | 1105 | 2250 |
| 38 | MLOW-38 | 69.26 | 24.89 | 20 | 25100 | 16064 | 7.9 | Nil | 400 | 5880 | 300 | 1190.7 | 3122 | 5650 |
| 39 | MLOW-39 | 68.89 | 24.85 | 20 | 14530 | 9299 | 7.7 | Nil | 400 | 2884 | 300 | 826.2 | 1392 | 4150 |
| 40 | MLOW-40 | 68.82 | 25.05 | 20 | 51400 | 32896 | 7.7 | Nil | 400 | 12964 | 360 | 1676.7 | 8188 | 7800 |
| 41 | MLOW-41 | 68.43 | 25.04 | 20 | 2760 | 1766 | 8.8 | 40 | 600 | 140 | 60 | 97.2 | 359 | 550 |
| 42 | MLOW-42 | 68.47 | 25.20 | 20 | 872 | 558 | 9 | 50 | 200 | 112 | 80 | 24.2 | 58 | 300 |

## 5.19 Water Quality Analysis from 42 MLOWs during February 2018 (At 13 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 2 | MLOW-02 | 68.12 | 24.97 | 40 | 24100 | 15424 | 8 | Nil | 350 | 5623 | 120 | 704.7 | 4040 | 3200 |
| 3 | MLOW-03 | 68.18 | 24.79 | 40 | 13690 | 8761 | 7.8 | Nil | 500 | 3262 | 480 | 801.9 | 1041 | 4500 |
| 4 | MLOW-04 | 67.98 | 24.78 | 40 | 4000 | 2560 | 8.1 | Nil | 250 | 873 | 140 | 170.1 | 410 | 1050 |
| 5 | MLOW-05 | 68.07 | 24.72 | 40 | 46600 | 29824 | 7.5 | Nil | 500 | 12939 | 720 | 1919.7 | 6188 | 9700 |
| 6 | MLOW-06 | 67.59 | 24.71 | 40 | 1682 | 1076 | 8.7 | 20 | 300 | 245 | 80 | 48.6 | 197 | 400 |
| 7 | MLOW-07 | 67.77 | 24.74 | 40 | 11980 | 7667 | 8 | Nil | 700 | 2729 | 60 | 255.15 | 2177 | 1200 |
| 8 | MLOW-08 | 68.08 | 24.60 | 40 | 4300 | 2752 | 8 | Nil | 700 | 750 | 120 | 170.1 | 505 | 1000 |
| 9 | MLOW-09 | 68.30 | 24.62 | 40 | 84300 | 53952 | 6.9 | Nil | 350 | 26347 | 4120 | 3462.75 | 7991 | 24550 |
| 10 | MLOW-10 | 67.63 | 24.55 | 40 | 2620 | 1676 | 8.3 | 20 | 350 | 363 | 40 | 230.85 | 107 | 1050 |
| 11 | MLOW-11 | 67.82 | 24.61 | 40 | 34500 | 22080 | 7.2 | Nil | 450 | 9071 | 340 | 1579.5 | 4488 | 7350 |
| 12 | MLOW-12 | 67.89 | 24.57 | 40 | 1023 | 654 | 8.5 | 20 | 250 | 138 | 60 | 72.9 | 24 | 450 |
| 13 | MLOW-13 | 68.27 | 24.36 | 40 | 61200 | 39168 | 7.6 | Nil | 350 | 18676 | 500 | 2272.05 | 9131 | 10600 |
| 14 | MLOW-14 | 67.58 | 24.46 | 40 | 1814 | 1160 | 8.8 | 30 | 450 | 274 | 60 | 48.6 | 248 | 350 |
| 15 | MLOW-15 | 67.83 | 24.40 | 40 | 28200 | 18048 | 7.5 | Nil | 600 | 6019 | 60 | 1227.15 | 4040 | 5200 |
| 16 | MLOW-16 | 67.99 | 24.40 | 40 | 11170 | 7148 | 8.3 | 10 | 200 | 2566 | 100 | 218.7 | 2010 | 1150 |
| 17 | MLOW-17 | 68.14 | 24.27 | 40 | 57500 | 36800 | 7.3 | Nil | 300 | 16380 | 800 | 1409.4 | 9585 | 7800 |
| 18 | MLOW-18 | 67.61 | 24.31 | 40 | 57000 | 36480 | 7.2 | Nil | 400 | 17745 | 400 | 1883.25 | 8827 | 8750 |
| 19 | MLOW-19 | 67.76 | 24.29 | 40 | 95300 | 60992 | 7.2 | Nil | 800 | 30958 | 140 | 3705.75 | 14655 | 15600 |
| 20 | MLOW-20 | 67.92 | 24.28 | 40 | 56500 | 36160 | 7.6 | Nil | 700 | 13377 | 200 | 1664.55 | 9555 | 7350 |
| 21 | MLOW-21 | 67.63 | 24.19 | 40 | 14490 | 9273 | 7.6 | Nil | 350 | 3002 | 80 | 328.05 | 2590 | 1550 |
| 22 | MLOW-22 | 67.46 | 24.14 | 40 | 58000 | 37120 | 7.9 | Nil | 400 | 1523 | 140 | 1810.35 | 9680 | 7800 |
| 23 | MLOW-23 | 67.62 | 24.09 | 40 | 54400 | 34816 | 7.2 | Nil | 350 | 16052 | 560 | 1688.85 | 8601 | 8350 |
| 24 | MLOW-24 | 68.66 | 25.04 | 40 | 4390 | 2809 | 8.3 | 20 | 200 | 709 | 120 | 255.15 | 369 | 1350 |
| 25 | MLOW-25 | 68.66 | 24.87 | 40 | 54100 | 34624 | 7.3 | Nil | 100 | 18437 | 2680 | 1822.5 | 5837 | 14200 |
| 26 | MLOW-26 | 68.50 | 24.82 | 40 | 6980 | 4467 | 8.6 | 30 | 950 | 1146 | 40 | 48.6 | 1444 | 300 |
| 27 | MLOW-27 | 68.42 | 24.69 | 40 | 47000 | 30080 | 7.5 | Nil | 350 | 12967 | 220 | 801.9 | 9001 | 3850 |
| 28 | MLOW-28 | 68.67 | 24.69 | 40 | 15660 | 10022 | 7.7 | Nil | 350 | 3139 | 120 | 461.7 | 2555 | 2200 |
| 29 | MLOW-29 | 68.84 | 24.66 | 40 | 42500 | 27200 | 7.4 | Nil | 450 | 11550 | 380 | 1202.85 | 7005 | 5900 |
| 30 | MLOW-30 | 68.49 | 24.49 | 40 | 111800 | 71552 | 7.1 | Nil | 200 | 35380 | 5480 | 4228.2 | 11269 | 31100 |
| 31 | MLOW-31 | 68.70 | 24.49 | 40 | 74100 | 47424 | 7.4 | Nil | 650 | 22680 | 400 | 2612.25 | 11555 | 11750 |
| 32 | MLOW-32 | 68.84 | 24.50 | 40 | 31300 | 20032 | 8.4 | 20 | 400 | 7080 | 80 | 729 | 5688 | 3700 |
| 33 | MLOW-33 | 68.88 | 24.34 | 40 | 70000 | 44800 | 7.4 | Nil | 3500 | 19208 | 540 | 2916 | 9859 | 13350 |
| 34 | MLOW-34 | 69.04 | 24.33 | 40 | 75100 | 48064 | 7 | Nil | 450 | 21980 | 480 | 2758.05 | 11401 | 12550 |
| 35 | MLOW-35 | 69.04 | 24.47 | 40 | 48100 | 30784 | 7.4 | Nil | 350 | 13122 | 700 | 1968.3 | 6464 | 9850 |
| 36 | MLOW-36 | 69.07 | 24.64 | 40 | 60700 | 38848 | 7.7 | Nil | 1050 | 16296 | 280 | 2077.15 | 9615 | 9250 |
| 37 | MLOW-37 | 69.20 | 24.68 | 40 | 11760 | 7526 | 7.9 | Nil | 400 | 2996 | 160 | 388.18 | 1759 | 2000 |
| 38 | MLOW-38 | 69.26 | 24.89 | 40 | 13030 | 8339 | 7.9 | Nil | 300 | 3912 | 220 | 716.85 | 1350 | 3500 |
| 39 | MLOW-39 | 68.89 | 24.85 | 40 | 13030 | 8339 | 7.9 | Nil | 300 | 3912 | 220 | 716.85 | 1350 | 3500 |
| 40 | MLOW-40 | 68.82 | 25.05 | 40 | 50700 | 32448 | 7.5 | Nil | 400 | 12656 | 360 | 1494.45 | 8355 | 7050 |
| 41 | MLOW-41 | 68.43 | 25.04 | 40 | 2680 | 1715 | 8.6 | 40 | 650 | 196 | 140 | 24.3 | 388 | 250 |
| 42 | MLOW-42 | 68.47 | 25.20 | 40 | 4290 | 2745 | 8.5 | 40 | 150 | 1344 | 100 | 72.9 | 715 | 550 |

## 5.20 Water Quality Analysis from 42 MLOWs during March 2018 (At 20 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 2 | MLOW-02 | 68.12 | 24.97 | 60 | 32200 | 20608 | 7.6 | Nil | 550 | 8817 | 680 | 498.15 | 5652 | 3750 |
| 3 | MLOW-03 | 68.18 | 24.79 | 60 | 11780 | 7539 | 7.8 | Nil | 350 | 2688 | 260 | 607.5 | 1233 | 3150 |
| 4 | MLOW-04 | 67.98 | 24.78 | 60 | 4010 | 2566 | 7.8 | Nil | 300 | 845 | 140 | 170.1 | 422 | 1050 |
| 5 | MLOW-05 | 68.07 | 24.72 | 60 | 47800 | 30592 | 7.5 | Nil | 500 | 12940 | 180 | 1749.6 | 7404 | 7650 |
| 6 | MLOW-06 | 67.59 | 24.71 | 60 | 1777 | 1137 | 8.8 | 10 | 350 | 272 | 80 | 60.75 | 196 | 450 |
| 7 | MLOW-07 | 67.77 | 24.74 | 60 | 48400 | 30976 | 7.5 | Nil | 550 | 15821 | 160 | 1445.85 | 8149 | 6350 |
| 8 | MLOW-08 | 68.08 | 24.60 | 60 | 5730 | 3667 | 7.9 | Nil | 500 | 1119 | 40 | 218.7 | 839 | 1050 |
| 9 | MLOW-09 | 68.30 | 24.62 | 60 | 83600 | 53504 | 6.8 | Nil | 350 | 26207 | 3960 | 3657.15 | 7640 | 24950 |
| 10 | MLOW-10 | 67.63 | 24.55 | 60 | 4340 | 2777 | 8.3 | 20 | 400 | 699 | 80 | 218.7 | 465 | 1100 |
| 11 | MLOW-11 | 67.82 | 24.61 | 60 | 1108 | 709 | 8.4 | 20 | 250 | 124 | 40 | 85.05 | 40 | 450 |
| 12 | MLOW-12 | 67.89 | 24.57 | 60 | 63900 | 40896 | 7.6 | Nil | 500 | 19376 | 240 | 2557.8 | 9455 | 11200 |
| 13 | MLOW-13 | 68.27 | 24.36 | 60 | 1835 | 1174 | 8.7 | 20 | 450 | 342 | 60 | 60.75 | 233 | 400 |
| 14 | MLOW-14 | 67.58 | 24.46 | 60 | 16840 | 10777 | 7.7 | Nil | 600 | 4031 | 80 | 595.5 | 2619 | 2650 |
| 15 | MLOW-15 | 67.83 | 24.40 | 60 | 20800 | 13312 | 8.3 | 10 | 150 | 4176 | 180 | 486 | 3632 | 2450 |
| 16 | MLOW-16 | 67.99 | 24.40 | 60 | 62700 | 40128 | 7.2 | Nil | 250 | 18318 | 1200 | 1640.25 | 9870 | 9750 |
| 17 | MLOW-17 | 68.14 | 24.27 | 60 | 58200 | 37248 | 7.3 | Nil | 600 | 18727 | 300 | 1579.5 | 9988 | 7253 |
| 18 | MLOW-18 | 67.61 | 24.31 | 60 | 91200 | 58368 | 7.2 | Nil | 850 | 29948 | 240 | 3487.05 | 13900 | 14950 |
| 19 | MLOW-19 | 67.76 | 24.29 | 60 | 66700 | 42688 | 8.1 | Nil | 600 | 15288 | 260 | 2101.95 | 10990 | 9300 |
| 20 | MLOW-20 | 67.92 | 24.28 | 60 | 14280 | 9139 | 8.1 | Nil | 400 | 3920 | 80 | 315.9 | 2888 | 1500 |
| 21 | MLOW-21 | 67.63 | 24.19 | 60 | 57600 | 36864 | 7.7 | Nil | 500 | 14014 | 340 | 1688.85 | 9599 | 7800 |
| 22 | MLOW-22 | 67.46 | 24.14 | 60 | 56100 | 35904 | 7.6 | Nil | 450 | 16571 | 800 | 1858.95 | 8400 | 9650 |
| 23 | MLOW-23 | 67.62 | 24.09 | 60 | 4720 | 3020 | 8.3 | 20 | 100 | 7091 | 140 | 328.05 | 285 | 1700 |
| 24 | MLOW-24 | 68.66 | 25.04 | 60 | 52900 | 33856 | 7 | Nil | 200 | 17608 | 3920 | 1190.7 | 6526 | 12200 |
| 25 | MLOW-25 | 68.66 | 24.87 | 60 | 8850 | 5664 | 8.3 | 20 | 800 | 1801 | 80 | 72.9 | 1788 | 500 |
| 26 | MLOW-26 | 68.50 | 24.82 | 60 | 45900 | 29376 | 7.6 | Nil | 300 | 11274 | 140 | 704.7 | 9020 | 3250 |
| 27 | MLOW-27 | 68.42 | 24.69 | 60 | 33300 | 21312 | 7.8 | Nil | 650 | 9090 | 120 | 1032.75 | 5515 | 4550 |
| 28 | MLOW-28 | 68.67 | 24.69 | 60 | 45200 | 28928 | 7.5 | Nil | 300 | 12558 | 460 | 1409.4 | 6525 | 6950 |
| 29 | MLOW-29 | 68.84 | 24.66 | 60 | 113100 | 72384 | 7 | Nil | 200 | 35626 | 5900 | 3730.05 | 12060 | 30100 |
| 30 | MLOW-30 | 68.49 | 24.49 | 60 | 74000 | 47360 | 7.7 | Nil | 600 | 22680 | 240 | 2745.9 | 11481 | 11900 |
| 31 | MLOW-31 | 68.70 | 24.49 | 60 | 31400 | 20096 | 8.3 | 15 | 350 | 7140 | 140 | 729 | 5641 | 3350 |
| 32 | MLOW-32 | 68.84 | 24.50 | 60 | 69400 | 44416 | 7.4 | Nil | 450 | 18480 | 200 | 3316.95 | 9350 | 14150 |
| 33 | MLOW-33 | 68.88 | 24.34 | 60 | 75100 | 48064 | 7.3 | Nil | 400 | 21980 | 420 | 2648.7 | 11688 | 11950 |
| 34 | MLOW-34 | 69.04 | 24.33 | 60 | 57700 | 36928 | 7.1 | Nil | 400 | 13216 | 1180 | 2393.55 | 7299 | 12800 |
| 35 | MLOW-35 | 69.04 | 24.47 | 60 | 61100 | 39104 | 7.5 | Nil | 1100 | 16380 | 280 | 1895.15 | 10069 | 8500 |
| 36 | MLOW-36 | 69.07 | 24.64 | 60 | 12200 | 7808 | 7.7 | Nil | 350 | 2492 | 220 | 461.7 | 1649 | 2450 |
| 37 | MLOW-37 | 69.20 | 24.68 | 60 | 28600 | 18304 | 7.7 | Nil | 150 | 7224 | 420 | 959.85 | 4231 | 5000 |
| 38 | MLOW-38 | 69.26 | 24.89 | 60 | 28600 | 18304 | 7.7 | Nil | 150 | 7224 | 420 | 959.85 | 4231 | 5000 |
| 39 | MLOW-39 | 68.89 | 24.85 | 60 | 28600 | 18304 | 7.7 | Nil | 150 | 7224 | 420 | 959.85 | 4231 | 5000 |
| 40 | MLOW-40 | 68.82 | 25.05 | 60 | 50200 | 32128 | 7.5 | Nil | 350 | 11340 | 300 | 1883.25 | 7565 | 8500 |
| 41 | MLOW-41 | 68.43 | 25.04 | 60 | 2860 | 1830 | 8.4 | 30 | 600 | 280 | 80 | 24.3 | 269 | 300 |
| 42 | MLOW-42 | 68.47 | 25.20 | 60 | 7930 | 5075 | 8.3 | 30 | 150 | 2072 | 120 | 230.85 | 1233 | 1250 |

## 5.21 Water Quality Analysis from 42 MLOWs during April 2018 (At 0.0 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^{3}$ (mg/l) | $HCO^{3}$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | 654 | 418 | 9.1 | 40 | 220 | 68 | 40 | 36.45 | 33.96 | 250 |
| 2 | MLOW-02 | 68.12 | 24.97 | 0 | 30000 | 19200 | 7.6 | 0 | 300 | 6388 | 420 | 874.8 | 4719 | 4650 |
| 3 | MLOW-03 | 68.18 | 24.79 | 0 | 7570 | 4844 | 7.7 | 0 | 150 | 1419 | 80 | 376.65 | 915 | 1750 |
| 4 | MLOW-04 | 67.98 | 24.78 | 0 | 3910 | 2502 | 7.7 | 0 | 150 | 982 | 100 | 279.45 | 245 | 1400 |
| 5 | MLOW-05 | 68.07 | 24.72 | 0 | 45400 | 29056 | 7.4 | 0 | 500 | 11766 | 180 | 16.3.8 | 7144 | 7050 |
| 6 | MLOW-06 | 67.59 | 24.71 | 0 | 2000 | 1280 | 8.8 | 30 | 250 | 354 | 40 | 255.15 | 74.98 | 1150 |
| 7 | MLOW-07 | 67.77 | 24.74 | 0 | 44300 | 28352 | 7.8 | 0 | 300 | 12967 | 160 | 765.45 | 8510 | 3550 |
| 8 | MLOW-08 | 68.08 | 24.60 | 0 | 4930 | 3155 | 8 | 0 | 300 | 737 | 60 | 85.05 | | 500 |
| 9 | MLOW-09 | 68.30 | 24.62 | 0 | 84200 | 53888 | 7 | 0 | 200 | 28146 | 4340 | 3559.95 | 7541 | 25500 |
| 10 | MLOW-10 | 67.63 | 24.55 | 0 | 3130 | 2003 | 8.4 | 30 | 200 | 600 | 90 | 127.57 | 366 | 750 |
| 11 | MLOW-11 | 67.82 | 24.61 | 0 | 26300 | 16832 | 7.6 | 0 | 250 | 5896 | 400 | 972 | 3707 | 5000 |
| 12 | MLOW-12 | 67.89 | 24.57 | 0 | 1431 | 915 | 8.8 | 30 | 150 | 218 | 40 | 97.2 | 94 | 500 |
| 13 | MLOW-13 | 68.27 | 24.36 | 0 | 58300 | 37312 | 7.4 | 0 | 300 | 11466 | 1120 | 1858.95 | 8539 | 10450 |
| 14 | MLOW-14 | 67.58 | 24.46 | 0 | 2100 | 1344 | 8.9 | 40 | 300 | 354 | 40 | 157.95 | 131 | 750 |
| 15 | MLOW-15 | 67.83 | 24.40 | 0 | 14870 | 9516 | 8.6 | 0 | 300 | 3084 | 80 | 449.55 | 2244 | 2050 |
| 16 | MLOW-16 | 67.99 | 24.40 | 0 | 18630 | 11923 | 7.6 | 0 | 200 | 2020 | 80 | 449.55 | 3315 | 2050 |
| 17 | MLOW-17 | 68.14 | 24.27 | 0 | 61600 | 39424 | 7.2 | 0 | 450 | 18018 | 540 | 2138.4 | 9433 | 10150 |
| 18 | MLOW-18 | 67.61 | 24.31 | 0 | 38500 | 24640 | 7.3 | 0 | 300 | 9445 | 140 | 1251.45 | 6266 | 5500 |
| 19 | MLOW-19 | 67.76 | 24.29 | 0 | 89500 | 57280 | 7.3 | 0 | 650 | 30030 | 480 | 3353.4 | 13555 | 15000 |
| 20 | MLOW-20 | 67.92 | 24.28 | 0 | 54000 | 3456 | 7.5 | 0 | 400 | 15752 | 240 | 1287.9 | 9661 | 5900 |
| 21 | MLOW-21 | 67.63 | 24.19 | 0 | 13810 | 8838 | 7.8 | 0 | 250 | 2893 | 80 | 267.3 | 2555 | 1300 |
| 22 | MLOW-22 | 67.46 | 24.14 | 0 | 57000 | 36480 | 7.6 | 0 | 450 | 16216 | 320 | 1579.5 | 9699 | 7300 |
| 23 | MLOW-23 | 67.62 | 24.09 | 0 | 57300 | 36672 | 7.7 | 0 | 200 | 16380 | 520 | 1992.6 | 8741 | 9500 |
| 24 | MLOW-24 | 68.66 | 25.04 | 0 | 4330 | 2771 | 8.6 | 30 | 200 | 627 | 100 | 157.95 | 565 | 900 |
| 25 | MLOW-25 | 68.66 | 24.87 | 0 | 56900 | 36416 | 7.5 | 0 | 250 | 16707 | 1600 | 3341.25 | 4821 | 17750 |
| 26 | MLOW-26 | 68.50 | 24.82 | 0 | 12550 | 8032 | 8.1 | 0 | 300 | 2402 | 40 | 230.85 | 2370 | 1050 |
| 27 | MLOW-27 | 68.42 | 24.69 | 0 | 45700 | 29248 | 7.6 | 0 | 350 | 12066 | 300 | 583.2 | 9025 | 3150 |
| 28 | MLOW-28 | 68.67 | 24.69 | 0 | 33000 | 21120 | 8.1 | 0 | 350 | 8463 | 80 | 801.9 | 5949 | 3500 |
| 29 | MLOW-29 | 68.84 | 24.66 | 0 | 38600 | 24704 | 8 | 0 | 600 | 8954 | 260 | 1190.7 | 6277 | 5550 |
| 30 | MLOW-30 | 68.49 | 24.49 | 0 | 105900 | 67776 | 7.1 | 0 | 250 | 31395 | 4400 | 2187 | 15055 | 20000 |
| 31 | MLOW-31 | 68.70 | 24.49 | 0 | 70300 | 44992 | 7.2 | 0 | 350 | 22755 | 180 | 2587.95 | 10978 | 11100 |
| 32 | MLOW-32 | 68.84 | 24.50 | 0 | 30100 | 19264 | 8.6 | 40 | 300 | 9555 | 120 | 716.85 | 5391 | 3250 |
| 33 | MLOW-33 | 68.88 | 24.34 | 0 | 68700 | 43968 | 7.3 | 0 | 400 | 19383 | 340 | 3013.2 | 9600 | 13250 |
| 34 | MLOW-34 | 69.04 | 24.33 | 0 | 69900 | 44736 | 6.9 | 0 | 200 | 22113 | 340 | 2916 | 10077 | 12850 |
| 35 | MLOW-35 | 69.04 | 24.47 | 0 | 57900 | 37056 | 7.9 | 0 | 200 | 19110 | 660 | 2515.05 | 7717 | 12100 |
| 36 | MLOW-36 | 69.07 | 24.64 | 0 | 60000 | 38400 | 7.8 | 0 | 400 | 16380 | 320 | 1628.1 | 10299 | 7500 |
| 37 | MLOW-37 | 69.20 | 24.68 | 0 | 7240 | 4633 | 8.1 | 0 | 250 | 1430 | 200 | 243 | 955 | 1500 |
| 38 | MLOW-38 | 69.26 | 24.89 | 0 | | | | | | | | | | |
| 39 | MLOW-39 | 68.89 | 24.85 | 0 | 40000 | 25600 | 7.8 | 0 | 300 | 8190 | 300 | 911.25 | 7080 | 4500 |
| 40 | MLOW-40 | 68.82 | 25.05 | 0 | 3170 | 2028 | 8.5 | 20 | 550 | 275 | 40 | 109.35 | 465 | 550 |
| 41 | MLOW-41 | 68.43 | 25.04 | 0 | 7800 | 4992 | 8.3 | 20 | 350 | 1595 | 120 | 279.45 | 1101 | 1450 |
| 42 | MLOW-42 | 68.47 | 25.20 | 0 | 1054 | 674 | 9.2 | 40 | 300 | 140 | 40 | 48.6 | 100 | 300 |
| | | | | Max | 105900 | 67776 | 9.2 | 40 | 650 | 31395 | 4400 | 3559.95 | 15055 | 25500 |

## 5.22 Water Quality Analysis from 42 MLOWs during April 2018 (At 6 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | 677 | 433 | 9 | 40 | 230 | 68 | 40 | 36.45 | 38.65 | 250 |
| 2 | MLOW-02 | 68.12 | 24.97 | 20 | 17780 | 11379 | 7.9 | 0 | 2500 | 2675 | 140 | 413.1 | 3121 | 2050 |
| 3 | MLOW-03 | 68.18 | 24.79 | 20 | 14090 | 9017 | 7.6 | 0 | 150 | 2566 | 480 | 789.75 | 1159 | 4450 |
| 4 | MLOW-04 | 67.98 | 24.78 | 20 | 3910 | 2502 | 7.9 | 0 | 150 | 982 | 60 | 206.55 | 418 | 1000 |
| 5 | MLOW-05 | 68.07 | 24.72 | 20 | 47600 | 30464 | 6.8 | 0 | 450 | 12148 | 580 | 1652.4 | 7109 | 8250 |
| 6 | MLOW-06 | 67.59 | 24.71 | 20 | 1707 | 1092 | 9 | 40 | 200 | 245 | 60 | 85.05 | 160.77 | 500 |
| 7 | MLOW-07 | 67.77 | 24.74 | 20 | 7020 | 4492 | 8.2 | 0 | 450 | 1310 | 60 | 48.6 | 1466 | 350 |
| 8 | MLOW-08 | 68.08 | 24.60 | 20 | 3150 | 2016 | 8 | 0 | 300 | 491 | 40 | 157.95 | 364 | 750 |
| 9 | MLOW-09 | 68.30 | 24.62 | 20 | 86800 | 55552 | 7 | 0 | 150 | 26699 | 4220 | 5151.6 | 5215 | 31750 |
| 10 | MLOW-10 | 67.63 | 24.55 | 20 | 1482 | 954 | 9.2 | 40 | 250 | 218 | 20 | 85.05 | 131 | 400 |
| 11 | MLOW-11 | 67.82 | 24.61 | 20 | 32600 | 20864 | 7.5 | 0 | 150 | 7534 | 700 | 1215 | 4333 | 6750 |
| 12 | MLOW-12 | 67.89 | 24.57 | 20 | 958 | 613 | 8.9 | 30 | 150 | 163 | 20 | 60.75 | 79 | 300 |
| 13 | MLOW-13 | 68.27 | 24.36 | 20 | 61700 | 39488 | 7.9 | 0 | 200 | 15015 | 1240 | 1871.1 | 9388 | 10800 |
| 14 | MLOW-14 | 67.58 | 24.46 | 20 | 1821 | 1165 | 9 | 40 | 400 | 245 | 60 | 60.75 | 222 | 400 |
| 15 | MLOW-15 | 67.83 | 24.40 | 20 | 36100 | 23104 | 7 | 0 | 250 | 7644 | 300 | 1591.65 | 4888 | 7300 |
| 16 | MLOW-16 | 67.99 | 24.40 | 20 | 5650 | 3616 | 8.3 | 20 | 200 | 1283 | 60 | 133.65 | 974 | 700 |
| 17 | MLOW-17 | 68.14 | 24.27 | 20 | 53100 | 33984 | 7.2 | 0 | 250 | 14196 | 200 | 923.4 | 10180 | 4300 |
| 18 | MLOW-18 | 67.61 | 24.31 | 20 | 57400 | 36736 | 7 | 0 | 650 | 14441 | 220 | 2442.15 | 8240 | 10600 |
| 19 | MLOW-19 | 67.76 | 24.29 | 20 | 15780 | 10099 | 8.2 | 0 | 500 | 3276 | 40 | 400.95 | 2800 | 1750 |
| 20 | MLOW-20 | 67.92 | 24.28 | 20 | 58900 | 37696 | 7.3 | 0 | 300 | 16380 | 240 | 1579.5 | 10222 | 7100 |
| 21 | MLOW-21 | 67.63 | 24.19 | 20 | 16370 | 10476 | 7.5 | 0 | 200 | 3439 | 100 | 328.05 | 3001 | 1600 |
| 22 | MLOW-22 | 67.46 | 24.14 | 20 | 50600 | 32384 | 7.6 | 0 | 550 | 12967 | 240 | 1482.3 | 8510 | 6700 |
| 23 | MLOW-23 | 67.62 | 24.09 | 20 | 39400 | 25216 | 7.7 | 0 | 200 | 9009 | 500 | 1032.75 | 6485 | 5500 |
| 24 | MLOW-24 | 68.66 | 25.04 | 20 | 4340 | 2777 | 8.2 | 20 | 150 | 709 | 60 | 121.5 | 679 | 650 |
| 25 | MLOW-25 | 68.66 | 24.87 | 20 | 57000 | 36480 | 7.5 | 0 | 300 | 15834 | 120 | 4847.85 | 2618 | 22500 |
| 26 | MLOW-26 | 68.50 | 24.82 | 20 | 5360 | 3430 | 9.3 | 70 | 250 | 709 | 40 | 36.45 | 1100 | 250 |
| 27 | MLOW-27 | 68.42 | 24.69 | 20 | 50100 | 32064 | 7.4 | 0 | 400 | 14196 | 180 | 838.35 | 9680 | 3900 |
| 28 | MLOW-28 | 68.67 | 24.69 | 20 | 13890 | 8889 | 7.6 | 0 | 250 | 2457 | 60 | 425.25 | 2296 | 1900 |
| 29 | MLOW-29 | 68.84 | 24.66 | 20 | 30500 | 19520 | 7.7 | 0 | 950 | 6552 | 140 | 923.4 | 5059 | 4150 |
| 30 | MLOW-30 | 68.49 | 24.49 | 20 | 117600 | 75264 | 7.3 | 0 | 200 | 36855 | 4400 | 3888 | 14499 | 27000 |
| 31 | MLOW-31 | 68.70 | 24.49 | 20 | 75000 | 48000 | 7 | 0 | 650 | 23361 | 460 | 2976.75 | 10988 | 13400 |
| 32 | MLOW-32 | 68.84 | 24.50 | 20 | 31700 | 20288 | 8.3 | 30 | 300 | 9691 | 160 | 753.3 | 5639 | 3500 |
| 33 | MLOW-33 | 68.88 | 24.34 | 20 | 70800 | 45312 | 7.1 | 0 | 450 | 21567 | 180 | 3073.95 | 10155 | 13100 |
| 34 | MLOW-34 | 69.04 | 24.33 | 20 | 77500 | 49600 | 7.7 | 0 | 400 | 23205 | 440 | 2964.6 | 11600 | 13300 |
| 35 | MLOW-35 | 69.04 | 24.47 | 20 | 7240 | 4633 | 7.7 | 0 | 350 | 1801 | 160 | 145.8 | 1180 | 1000 |
| 36 | MLOW-36 | 69.07 | 24.64 | 20 | 22000 | 14080 | 7.7 | 0 | 300 | 4777 | 280 | 656.1 | 3475 | 3400 |
| 37 | MLOW-37 | 69.20 | 24.68 | 20 | 11220 | 7180 | 7.9 | 0 | 200 | 2200 | 220 | 352.35 | 1585 | 2000 |
| 38 | MLOW-38 | 69.26 | 24.89 | 21.3 | 26000 | 16640 | 7.9 | 0 | 250 | 6215 | 480 | 1069.2 | 3360 | 5600 |
| 39 | MLOW-39 | 68.89 | 24.85 | 20 | 55800 | 35712 | 7.8 | 0 | 200 | 14162 | 520 | 1640.25 | 9080 | 8050 |
| 40 | MLOW-40 | 68.82 | 25.05 | 20 | 2760 | 1766 | 8.6 | 30 | 650 | 192 | 20 | 36.45 | 530 | 200 |
| 41 | MLOW-41 | 68.43 | 25.04 | 20 | 736 | 471 | 9.2 | 40 | 200 | 137 | 80 | 12.15 | 51 | 250 |
| 42 | MLOW-42 | 68.47 | 25.20 | 20 | 828 | 529 | 9.5 | 40 | 300 | 137 | 20 | 24.3 | 115 | 150 |
| | | | | Max | 117600 | 75264 | 9.5 | 70 | 2500 | 36855 | 4400 | 5151.6 | 14499 | 31750 |

## 5.23 Water Quality Analysis from 42 MLOWs during April 2018 (At 13 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | | | | | | | | | | | | |
| 2 | MLOW-02 | 68.12 | 24.97 | 40 | 23400 | 14976 | 7.9 | 0 | 300 | 3958 | 200 | 595.35 | 3985 | 2950 |
| 3 | MLOW-03 | 68.18 | 24.79 | 40 | 14270 | 9132 | 7.5 | 0 | 250 | 3030 | 400 | 857.3 | 1165 | 4500 |
| 4 | MLOW-04 | 67.98 | 24.78 | 40 | 4200 | 2688 | 7.6 | 0 | 200 | 955 | 100 | 243 | 380 | 1250 |
| 5 | MLOW-05 | 68.07 | 24.72 | 40 | 47700 | 30528 | 6.9 | 0 | 400 | 12039 | 500 | 1701 | 7118 | 8250 |
| 6 | MLOW-06 | 67.59 | 24.71 | 40 | 1672 | 1070 | 9 | 40 | 200 | 273 | 50 | 103.27 | 129.26 | 550 |
| 7 | MLOW-07 | 67.77 | 24.74 | 40 | 10210 | 6534 | 7.8 | 0 | 400 | 1829 | 40 | 170.1 | 1959 | 800 |
| 8 | MLOW-08 | 68.08 | 24.60 | 40 | 4950 | 3168 | 8.1 | 0 | 250 | 819 | 40 | 157.95 | 777 | 750 |
| 9 | MLOW-09 | 68.30 | 24.62 | 40 | 87400 | 55936 | 7.1 | 0 | 150 | 28228 | 4800 | 4860 | 5244 | 32000 |
| 10 | MLOW-10 | 67.63 | 24.55 | 40 | 2740 | 1753 | 8.4 | 20 | 150 | 382 | 60 | 109.35 | 347 | 600 |
| 11 | MLOW-11 | 67.82 | 24.61 | 40 | 32100 | 20544 | 7 | 0 | 200 | 9254 | 500 | 1142.1 | 4601 | 5950 |
| 12 | MLOW-12 | 67.89 | 24.57 | 40 | 928 | 593 | 8.9 | 30 | 100 | 82 | 40 | 36.45 | 95 | 250 |
| 13 | MLOW-13 | 68.27 | 24.36 | 40 | 63200 | 40448 | 7.3 | 0 | 250 | 14742 | 1040 | 2344.95 | 8822 | 12250 |
| 14 | MLOW-14 | 67.58 | 24.46 | 40 | 1821 | 1165 | 9 | 40 | 300 | 273 | 40 | 133.65 | 113 | 650 |
| 15 | MLOW-15 | 67.83 | 24.40 | 40 | 23900 | 15296 | 7.4 | 0 | 150 | 5378 | 180 | 862.65 | 3616 | 4000 |
| 16 | MLOW-16 | 67.99 | 24.40 | 40 | 9320 | 5964 | 8.4 | 20 | 200 | 1911 | 60 | 170.1 | 1733 | 850 |
| 17 | MLOW-17 | 68.14 | 24.27 | 40 | 57000 | 36480 | 7.7 | 0 | 250 | 17581 | 200 | 1458 | 10055 | 6500 |
| 18 | MLOW-18 | 67.61 | 24.31 | 40 | 57700 | 36928 | 7.1 | 0 | 400 | 16461 | 280 | 2296.35 | 8526 | 10150 |
| 19 | MLOW-19 | 67.76 | 24.29 | 40 | 99800 | 63872 | 7 | 0 | 600 | 31668 | 140 | 4118.85 | 14860 | 17300 |
| 20 | MLOW-20 | 67.92 | 24.28 | 40 | 57700 | 36928 | 7.3 | 0 | 400 | 16380 | 200 | 1567.35 | 10291 | 6950 |
| 21 | MLOW-21 | 67.63 | 24.19 | 40 | 17000 | 10880 | 7.4 | 0 | 300 | 3658 | 80 | 315.9 | 3191 | 1500 |
| 22 | MLOW-22 | 67.46 | 24.14 | 40 | 59100 | 37824 | 7.3 | 0 | 250 | 16489 | 280 | 1944 | 9527 | 8700 |
| 23 | MLOW-23 | 67.62 | 24.09 | 40 | 54000 | 34560 | 7.2 | 0 | 200 | 14196 | 340 | 1737.45 | 8686 | 8000 |
| 24 | MLOW-24 | 68.66 | 25.04 | 40 | 4490 | 2873 | 8.2 | 20 | 200 | 709 | 80 | 230.85 | 485 | 1150 |
| 25 | MLOW-25 | 68.66 | 24.87 | 40 | 56000 | 35840 | 7.3 | 0 | 250 | 15206 | 2700 | 3487.05 | 3070 | 21100 |
| 26 | MLOW-26 | 68.50 | 24.82 | 40 | 6700 | 4288 | 8.4 | 40 | 200 | 900 | 20 | 48.6 | 1414 | 250 |
| 27 | MLOW-27 | 68.42 | 24.69 | 40 | 48800 | 31232 | 7.5 | 0 | 450 | 13650 | 180 | 850.5 | 9359 | 3950 |
| 28 | MLOW-28 | 68.67 | 24.69 | 40 | 14550 | 9312 | 7.7 | 0 | 300 | 2757 | 80 | 437.4 | 2399 | 2000 |
| 29 | MLOW-29 | 68.84 | 24.66 | 40 | 34800 | 22272 | 7.6 | 0 | 1000 | 7234 | 160 | 1057.05 | 5777 | 4750 |
| 30 | MLOW-30 | 68.49 | 24.49 | 40 | 114500 | 73280 | 7.5 | 0 | 250 | 36036 | 3940 | 2320.65 | 17313 | 19400 |
| 31 | MLOW-31 | 68.70 | 24.49 | 40 | 76000 | 48640 | 7.2 | 0 | 400 | 23665 | 360 | 2709.45 | 11850 | 12050 |
| 32 | MLOW-32 | 68.84 | 24.50 | 40 | 32000 | 20480 | 8.3 | 30 | 250 | 10101 | 250 | 637.87 | 5825 | 3250 |
| 33 | MLOW-33 | 68.88 | 24.34 | 40 | 72100 | 46144 | 7.3 | 0 | 450 | 21840 | 120 | 3086.1 | 10500 | 13000 |
| 34 | MLOW-34 | 69.04 | 24.33 | 40 | 77200 | 49408 | 7.3 | 0 | 200 | 23205 | 420 | 3304.8 | 10905 | 14650 |
| 35 | MLOW-35 | 69.04 | 24.47 | 40 | 48200 | 30848 | 7.7 | 0 | 150 | 13104 | 540 | 2004.75 | 6600 | 9600 |
| 36 | MLOW-36 | 69.07 | 24.64 | 40 | 62300 | 39872 | 7.5 | 0 | 1050 | 16926 | 360 | 1931.85 | 10188 | 8850 |
| 37 | MLOW-37 | 69.20 | 24.68 | 40 | 13880 | 8883 | 7.8 | 0 | 250 | 3052 | 260 | 267.3 | 2375 | 1750 |
| 38 | MLOW-38 | 69.26 | 24.89 | 40 | 13020 | 8332 | 8.2 | 0 | 150 | 3135 | 320 | 619.65 | 1425 | 3350 |
| 39 | MLOW-39 | 68.89 | 24.85 | 40 | 54500 | 34880 | 7.4 | 0 | 250 | 14300 | 560 | 1591.65 | 8815 | 7950 |
| 40 | MLOW-40 | 68.82 | 25.05 | 40 | 2700 | 1728 | 8.6 | 30 | 600 | 247 | 20 | 36.45 | 517 | 200 |
| 41 | MLOW-41 | 68.43 | 25.04 | 40 | 3820 | 2444 | 8.5 | 30 | 200 | 880 | 100 | 72.9 | 610 | 550 |
| 42 | MLOW-42 | 68.47 | 25.20 | 40 | 944 | 604 | 9.5 | 40 | 300 | 137 | 20 | 60.75 | 75 | 300 |
| | | | | Max | 114500 | 73280 | 9.5 | 40 | 1050 | 36036 | 4800 | 4860 | 17313 | 32000 |

## 5.24 Water Quality Analysis from 42 MLOWs during April 2018 (At 20 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | | | | | | | | | | | | |
| 2 | MLOW-02 | 68.12 | 24.97 | 60 | 34100 | 21824 | 7.4 | 0 | 300 | 9009 | 260 | 1129.95 | 5353 | 5300 |
| 3 | MLOW-03 | 68.18 | 24.79 | 60 | 12310 | 7878 | 7.5 | 0 | 200 | 2184 | 160 | 583.2 | 1515 | 2800 |
| 4 | MLOW-04 | 67.98 | 24.78 | 60 | 4190 | 2681 | 7.7 | 0 | 100 | 928 | 60 | 267.3 | 376 | 1250 |
| 5 | MLOW-05 | 68.07 | 24.72 | 60 | 39300 | 31552 | 7.4 | 0 | 550 | 13104 | 200 | 1931.85 | 7360 | 8450 |
| 6 | MLOW-06 | 67.59 | 24.71 | 60 | 1704 | 1090 | 9 | 30 | 200 | 273 | 60 | 109.35 | 113.39 | 600 |
| 7 | MLOW-07 | 67.77 | 24.74 | 60 | 49100 | 31424 | 7.3 | 0 | 300 | 12776 | 220 | 619.65 | 9831 | 3100 |
| 8 | MLOW-08 | 68.08 | 24.60 | 60 | 5760 | 3686 | 7.7 | 0 | 300 | 1119 | 60 | 145.8 | 961 | 750 |
| 9 | MLOW-09 | 68.30 | 24.62 | 60 | 87900 | 56256 | 6.9 | 0 | 150 | 27791 | 4500 | 5224.5 | 5005 | 32750 |
| 10 | MLOW-10 | 67.63 | 24.55 | 60 | 4670 | 2988 | 8.4 | 20 | 300 | 819 | 60 | 182.25 | 644 | 900 |
| 11 | MLOW-11 | 67.82 | 24.61 | 60 | 31300 | 20032 | 7 | 0 | 150 | 6852 | 500 | 1324.35 | 4066 | 6700 |
| 12 | MLOW-12 | 67.89 | 24.57 | 60 | 972 | 622 | 8.9 | 30 | 100 | 83 | 40 | 36.45 | 105 | 250 |
| 13 | MLOW-13 | 68.27 | 24.36 | 60 | 64400 | 41216 | 7.4 | 0 | 250 | 16680 | 920 | 2259.9 | 9400 | 11600 |
| 14 | MLOW-14 | 67.58 | 24.46 | 60 | 1814 | 1160 | 8.6 | 30 | 450 | 250 | 40 | 97.2 | 180 | 500 |
| 15 | MLOW-15 | 67.83 | 24.40 | 60 | 15330 | 9811 | 7.6 | 0 | 400 | 2948 | 100 | 534.6 | 2366 | 2450 |
| 16 | MLOW-16 | 67.99 | 24.40 | 60 | 17870 | 11436 | 8.2 | 20 | 150 | 1965 | 100 | 425.25 | 3159 | 2000 |
| 17 | MLOW-17 | 68.14 | 24.27 | 60 | 64400 | 41216 | 7.2 | 0 | 300 | 18400 | 600 | 1992.6 | 10275 | 9700 |
| 18 | MLOW-18 | 67.61 | 24.31 | 60 | 60400 | 38656 | 7.2 | 0 | 350 | 17472 | 180 | 2624.4 | 8639 | 11250 |
| 19 | MLOW-19 | 67.76 | 24.29 | 60 | 99000 | 63360 | 7.2 | 0 | 600 | 30303 | 880 | 3438.45 | 15115 | 16350 |
| 20 | MLOW-20 | 67.92 | 24.28 | 60 | 67800 | 43392 | 7.2 | 0 | 300 | 18018 | 200 | 1992.6 | 11515 | 8700 |
| 21 | MLOW-21 | 67.63 | 24.19 | 60 | 18180 | 11635 | 7.7 | 0 | 250 | 4040 | 80 | 400.95 | 3301 | 1580 |
| 22 | MLOW-22 | 67.46 | 24.14 | 60 | 59200 | 37888 | 7.6 | 0 | 250 | 16107 | 240 | 1931.85 | 9609 | 8550 |
| 23 | MLOW-23 | 67.62 | 24.09 | 60 | 69400 | 44416 | 7.3 | 0 | 150 | 19110 | 300 | 2928.15 | 9979 | 12800 |
| 24 | MLOW-24 | 68.66 | 25.04 | 60 | 4780 | 3059 | 8.5 | 20 | 100 | 791 | 140 | 18.25 | 577 | 1100 |
| 25 | MLOW-25 | 68.66 | 24.87 | 60 | 55500 | 35520 | 7.1 | 0 | 400 | 17881 | 1840 | 3912.3 | 3131 | 20700 |
| 26 | MLOW-26 | 68.50 | 24.82 | 60 | 11780 | 7539 | 8.4 | 40 | 300 | 2074 | 20 | 170.1 | 2333 | 750 |
| 27 | MLOW-27 | 68.42 | 24.69 | 60 | 47500 | 30400 | 7.5 | 0 | 450 | 12967 | 120 | 789.75 | 9252 | 3550 |
| 28 | MLOW-28 | 68.67 | 24.69 | 60 | 33000 | 21120 | 7.9 | 0 | 200 | 6770 | 120 | 729 | 6039 | 3300 |
| 29 | MLOW-29 | 68.84 | 24.66 | 60 | 36900 | 23616 | 7.5 | 0 | 550 | 5924 | 160 | 1081.35 | 6212 | 4850 |
| 30 | MLOW-30 | 68.49 | 24.49 | 60 | 117300 | 75072 | 7 | 0 | 450 | 36745 | 4460 | 239.45 | 16637 | 22000 |
| 31 | MLOW-31 | 68.70 | 24.49 | 60 | 76300 | 48832 | 7.4 | 0 | 500 | 24272 | 360 | 2806.65 | 11808 | 12450 |
| 32 | MLOW-32 | 68.84 | 24.50 | 60 | 31900 | 20416 | 8.3 | 20 | 350 | 9118 | 180 | 801.9 | 5570 | 3750 |
| 33 | MLOW-33 | 68.88 | 24.34 | 60 | 71900 | 46016 | 7 | 0 | 350 | 21648 | 110 | 3177.22 | 10300 | 13350 |
| 34 | MLOW-34 | 69.04 | 24.33 | 60 | 77200 | 49408 | 7.3 | 0 | 250 | 23232 | 440 | 3073.95 | 11340 | 13750 |
| 35 | MLOW-35 | 69.04 | 24.47 | 60 | 59200 | 37888 | 7.2 | 0 | 250 | 15834 | 700 | 2903.85 | 7222 | 13700 |
| 36 | MLOW-36 | 69.07 | 24.64 | 60 | 63200 | 40448 | 7.6 | 0 | 750 | 18564 | 380 | 2016.9 | 10200 | 9250 |
| 37 | MLOW-37 | 69.20 | 24.68 | 60 | 13240 | 8473 | 7.8 | 0 | 200 | 3052 | 200 | 328.05 | 2161 | 1850 |
| 38 | MLOW-38 | 69.26 | 24.89 | 60 | 29100 | 18624 | 8 | 0 | 150 | 7122 | 420 | 1166.4 | 3939 | 5850 |
| 39 | MLOW-39 | 68.89 | 24.85 | 60 | 54000 | 34560 | 7.6 | 0 | 250 | 14200 | 560 | 1591.65 | 8720 | 7950 |
| 40 | MLOW-40 | 68.82 | 25.05 | 60 | 3160 | 2022 | 8.3 | 20 | 550 | 275 | 20 | 48.6 | 599 | 250 |
| 41 | MLOW-41 | 68.43 | 25.04 | 60 | 7890 | 5049 | 8.3 | 30 | 150 | 1512 | 120 | 205.55 | 1260 | 1150 |
| 42 | MLOW-42 | 68.47 | 25.20 | 60 | 913 | 584 | 9.5 | 40 | 300 | 137 | 40 | 48.6 | 69 | 300 |
| | | | | Max | 117300 | 75072 | 9.5 | 40 | 750 | 36745 | 4500 | 5224.5 | 16637 | 32750 |

## 5.25 Water Quality Analysis from 42 MLOWs during May 2018 (At 0 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 0 | 818 | 523 | 8.8 | 30 | 230 | 81 | 60 | 24.3 | 70 | 250 |
| 2 | MLOW-02 | 68.12 | 24.97 | 0 | 26200 | 16768 | 7.6 | 0 | 400 | 5832 | 300 | 1081.4 | 3591 | 5200 |
| 3 | MLOW-03 | 68.18 | 24.79 | 0 | 12120 | 7756 | 7.9 | 0 | 200 | 2727 | 160 | 656.1 | 1331 | 3100 |
| 4 | MLOW-04 | 67.98 | 24.78 | 0 | 4040 | 2585 | 7.7 | 0 | 500 | 1080 | 80 | 303.75 | 251 | 1450 |
| 5 | MLOW-05 | 68.07 | 24.72 | 0 | 38000 | 24320 | 7.9 | 0 | 400 | 6966 | 80 | 1445.9 | 5855 | 6150 |
| 6 | MLOW-06 | 67.59 | 24.71 | 0 | 2300 | 1472 | 9.1 | 40 | 450 | 405 | 40 | 182.25 | 130 | 850 |
| 7 | MLOW-07 | 67.77 | 24.74 | 0 | 42300 | 27072 | 7.7 | 0 | 550 | 13014 | 80 | 1470.2 | 6805 | 6250 |
| 8 | MLOW-08 | 68.08 | 24.60 | 0 | 4530 | 2899 | 8 | 0 | 450 | 700 | 60 | 267.3 | 450 | 1250 |
| 9 | MLOW-09 | 68.30 | 24.62 | 0 | 87400 | 55936 | 6.9 | 0 | 600 | 27945 | 6960 | 3730.1 | 4930 | 32750 |
| 10 | MLOW-10 | 67.63 | 24.55 | 0 | 3260 | 2086 | 8.4 | 30 | 450 | 675 | 140 | 157.95 | 278 | 1000 |
| 11 | MLOW-11 | 67.82 | 24.61 | 0 | 29100 | 18624 | 7.4 | 0 | 550 | 7452 | 100 | 1871.1 | 2975 | 7950 |
| 12 | MLOW-12 | 67.89 | 24.57 | 0 | 1198 | 766 | 8.7 | 30 | 350 | 135 | 80 | 60.75 | 66 | 450 |
| 13 | MLOW-13 | 68.27 | 24.36 | 0 | 55200 | 35228 | 7.5 | 0 | 250 | 11420 | 1060 | 1670.6 | 8200 | 9500 |
| 14 | MLOW-14 | 67.58 | 24.46 | 0 | 1990 | 1273 | 9.2 | 30 | 300 | 351 | 100 | 97.2 | 155 | 650 |
| 15 | MLOW-15 | 67.83 | 24.40 | 0 | 13540 | 8665 | 7.9 | 0 | 250 | 3229 | 40 | 571.05 | 1960 | 2450 |
| 16 | MLOW-16 | 67.99 | 24.40 | 0 | 17360 | 11110 | 8.5 | 10 | 250 | 2322 | 220 | 425.25 | 2905 | 2300 |
| 17 | MLOW-17 | 68.14 | 24.27 | 0 | 60300 | 38592 | 7.6 | 0 | 350 | 16899 | 1100 | 1859 | 9020 | 10400 |
| 18 | MLOW-18 | 67.61 | 24.31 | 0 | 48500 | 31040 | 7.5 | 0 | 450 | 14850 | 360 | 1725.3 | 7420 | 8000 |
| 19 | MLOW-19 | 67.76 | 24.29 | 0 | 96900 | 62016 | 7.4 | 0 | 600 | 32535 | 300 | 3705.8 | 14805 | 16000 |
| 20 | MLOW-20 | 67.92 | 24.28 | 0 | 58500 | 37440 | 7.7 | 0 | 400 | 17280 | 100 | 1506.6 | 10430 | 6450 |
| 21 | MLOW-21 | 67.63 | 24.19 | 0 | 17210 | 11014 | 7.5 | 0 | 300 | 4725 | 100 | 425.25 | 3010 | 2000 |
| 22 | MLOW-22 | 67.46 | 24.14 | 0 | 57500 | 36800 | 7.4 | 0 | 300 | 16146 | 180 | 1919.7 | 9325 | 8350 |
| 23 | MLOW-23 | 67.62 | 24.09 | 0 | 64600 | 41344 | 7.8 | 0 | 450 | 17710 | 160 | 2770.2 | 9646 | 11800 |
| 24 | MLOW-24 | 68.66 | 25.04 | 0 | 4460 | 2854 | 8.3 | 20 | 250 | 1080 | 60 | 218.7 | 533 | 1050 |
| 25 | MLOW-25 | 68.66 | 24.87 | 0 | 52400 | 33536 | 7.47 | 0 | 500 | 15430 | 3000 | 2673 | 3460 | 18500 |
| 26 | MLOW-26 | 68.50 | 24.82 | 0 | 9300 | 5952 | 8.3 | 10 | 800 | 2420 | 60 | 109.35 | 1847 | 600 |
| 27 | MLOW-27 | 68.42 | 24.69 | 0 | 47300 | 30272 | 7.6 | 0 | 450 | 15125 | 260 | 777.6 | 9066 | 3850 |
| 28 | MLOW-28 | 68.67 | 24.69 | 0 | 23400 | 14976 | 8 | 0 | 400 | 5747 | 140 | 595.35 | 4060 | 2800 |
| 29 | MLOW-29 | 68.84 | 24.66 | 0 | 40300 | 25792 | 7.6 | 0 | 500 | 10587 | 220 | 1470.2 | 6173 | 6600 |
| 30 | MLOW-30 | 68.49 | 24.49 | 0 | 114800 | 73472 | 7.2 | 0 | 450 | 33660 | 5080 | 4325.4 | 12250 | 30500 |
| 31 | MLOW-31 | 68.70 | 24.49 | 0 | 74400 | 47616 | 7.4 | 0 | 350 | 23325 | 220 | 3025.4 | 11666 | 13000 |
| 32 | MLOW-32 | 68.84 | 24.50 | 0 | 31500 | 20160 | 7.8 | 0 | 450 | 9796 | 110 | 868.72 | 5440 | 3850 |
| 33 | MLOW-33 | 68.88 | 24.34 | 0 | 71300 | 45632 | 7.9 | 0 | 500 | 22392 | 280 | 3353.4 | 9635 | 14500 |
| 34 | MLOW-34 | 69.04 | 24.33 | 0 | 75900 | 48576 | 7 | 0 | 300 | 26435 | 260 | 3280.5 | 10841 | 14150 |
| 35 | MLOW-35 | 69.04 | 24.47 | 0 | 60200 | 38528 | 7 | 0 | 250 | 20215 | 328 | 3300.3 | 7122 | 14500 |
| 36 | MLOW-36 | 69.07 | 24.64 | 0 | 61100 | 39104 | 7.9 | 0 | 700 | 17727 | 340 | 2029.1 | 9755 | 9200 |
| 37 | MLOW-37 | 69.20 | 24.68 | 0 | 10600 | 6784 | 7.9 | 0 | 300 | 3146 | 72 | 374.22 | 1623 | 1720 |
| 38 | MLOW-38 | 69.26 | 24.89 | 0 | | | | | | | | | | |
| 39 | MLOW-39 | 68.89 | 24.85 | 0 | 40300 | 25792 | 7.6 | 0 | 400 | 11411 | 180 | 1093.5 | 6944 | 4950 |
| 40 | MLOW-40 | 68.82 | 25.05 | 0 | 3100 | 1984 | 8.4 | 20 | 540 | 268 | 16 | 58.32 | 570 | 280 |
| 41 | MLOW-41 | 68.43 | 25.04 | 0 | 7870 | 5036 | 8.3 | 20 | 180 | 2179 | 104 | 233.28 | 1230 | 1220 |
| 42 | MLOW-42 | 68.47 | 25.20 | 0 | 958 | 613 | 8.8 | 40 | 280 | 108 | 32 | 38.88 | 106 | 240 |

## 5.26 Water Quality Analysis from 42 MLOWs during May 2018 (At 6 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 20 | 846 | 541 | 8.9 | 30 | 200 | 81 | 60 | 36.45 | 96 | 300 |
| 2 | MLOW-02 | 68.12 | 24.97 | 20 | 17630 | 11283 | 7.9 | 0 | 250 | 2781 | 160 | 449.55 | 2995 | 2250 |
| 3 | MLOW-03 | 68.18 | 24.79 | 20 | 14920 | 9548 | 8.2 | 0 | 200 | 3240 | 640 | 838.35 | 1066 | 5150 |
| 4 | MLOW-04 | 67.98 | 24.78 | 20 | 4150 | 2656 | 7.7 | 0 | 150 | 1026 | 80 | 291.6 | 296 | 1400 |
| 5 | MLOW-05 | 68.07 | 24.72 | 20 | 48400 | 30976 | 7.1 | 0 | 450 | 12690 | 680 | 2272.1 | 5985 | 11050 |
| 6 | MLOW-06 | 67.59 | 24.71 | 20 | 1630 | 1043 | 8.8 | 30 | 300 | 243 | 60 | 85.05 | 139 | 500 |
| 7 | MLOW-07 | 67.77 | 24.74 | 20 | 6990 | 4473 | 8.2 | 0 | 500 | 1593 | 160 | 48.6 | 1315 | 600 |
| 8 | MLOW-08 | 68.08 | 24.60 | 20 | 3220 | 2060 | 7.9 | 0 | 400 | 675 | 100 | 206.55 | 222 | 1100 |
| 9 | MLOW-09 | 68.30 | 24.62 | 20 | 89100 | 57024 | 7.2 | 0 | 350 | 28620 | 6240 | 4471.2 | 4728 | 34000 |
| 10 | MLOW-10 | 67.63 | 24.55 | 20 | 1902 | 1217 | 8.4 | 20 | 450 | 351 | 60 | 55.89 | 255 | 380 |
| 11 | MLOW-11 | 67.82 | 24.61 | 20 | 28700 | 18368 | 7.4 | 0 | 400 | 7695 | 120 | 1458 | 3639 | 6300 |
| 12 | MLOW-12 | 67.89 | 24.57 | 20 | 883 | 565 | 8.8 | 30 | 200 | 108 | 80 | 24.3 | 64 | 300 |
| 13 | MLOW-13 | 68.27 | 24.36 | 20 | 62600 | 40064 | 7.7 | 0 | 300 | 15525 | 520 | 2417.9 | 8888 | 11250 |
| 14 | MLOW-14 | 67.58 | 24.46 | 20 | 1823 | 1166 | 8.6 | 20 | 400 | 324 | 80 | 85.05 | 160 | 550 |
| 15 | MLOW-15 | 67.83 | 24.40 | 20 | 39300 | 25152 | 7.2 | 0 | 300 | 9072 | 80 | 2199.2 | 4720 | 9250 |
| 16 | MLOW-16 | 67.99 | 24.40 | 20 | 6140 | 3929 | 8.6 | 10 | 200 | 1485 | 100 | 279.45 | 759 | 1400 |
| 17 | MLOW-17 | 68.14 | 24.27 | 20 | 54200 | 34688 | 7.8 | 0 | 300 | 15660 | 420 | 1057.1 | 9939 | 5400 |
| 18 | MLOW-18 | 67.61 | 24.31 | 20 | 59100 | 37824 | 7.1 | 0 | 500 | 16929 | 680 | 2332.8 | 8322 | 11300 |
| 19 | MLOW-19 | 67.76 | 24.29 | 20 | 18200 | 11648 | 8 | 0 | 650 | 3834 | 60 | 449.55 | 3240 | 2000 |
| 20 | MLOW-20 | 67.92 | 24.28 | 20 | 59200 | 37888 | 7.5 | 0 | 400 | 17712 | 100 | 1640.3 | 10350 | 7000 |
| 21 | MLOW-21 | 67.63 | 24.19 | 20 | 16370 | 10476 | 7.5 | 0 | 250 | 4239 | 60 | 413.1 | 2890 | 1850 |
| 22 | MLOW-22 | 67.46 | 24.14 | 20 | 53500 | 34240 | 7.3 | 0 | 700 | 15120 | 180 | 1846.8 | 8530 | 8050 |
| 23 | MLOW-23 | 67.62 | 24.09 | 20 | 40300 | 25728 | 7.7 | 0 | 400 | 8910 | 120 | 1239.3 | 6740 | 5400 |
| 24 | MLOW-24 | 68.66 | 25.04 | 20 | 3610 | 2310 | 8.3 | 20 | 200 | 1026 | 60 | 182.25 | 405 | 900 |
| 25 | MLOW-25 | 68.66 | 24.87 | 20 | 57100 | 36544 | 7.2 | 0 | 600 | 16170 | 3240 | 3013.2 | 3611 | 20500 |
| 26 | MLOW-26 | 68.50 | 24.82 | 20 | 5060 | 3238 | 9.6 | 60 | 500 | 770 | 60 | 36.45 | 1025.1 | 300 |
| 27 | MLOW-27 | 68.42 | 24.69 | 20 | 50800 | 32512 | 7.6 | 0 | 500 | 13750 | 280 | 899.1 | 9615 | 4400 |
| 28 | MLOW-28 | 68.67 | 24.69 | 20 | 14880 | 9523 | 7.8 | 0 | 350 | 3135 | 80 | 558.9 | 2247 | 2500 |
| 29 | MLOW-29 | 68.84 | 24.66 | 20 | 30400 | 19456 | 7.6 | 0 | 450 | 7012 | 160 | 972 | 4929 | 4400 |
| 30 | MLOW-30 | 68.49 | 24.49 | 20 | 120400 | 77056 | 7.1 | 0 | 450 | 33302 | 6000 | 4082.4 | 12940 | 31800 |
| 31 | MLOW-31 | 68.70 | 24.49 | 20 | 76600 | 49024 | 7.1 | 0 | 400 | 23947 | 380 | 3098.3 | 10700 | 13700 |
| 32 | MLOW-32 | 68.84 | 24.50 | 20 | 32200 | 20603 | 8.1 | 0 | 250 | 9796 | 100 | 826.2 | 5610 | 3650 |
| 33 | MLOW-33 | 68.88 | 24.34 | 20 | 72700 | 46528 | 7.2 | 0 | 200 | 24600 | 200 | 3402 | 9945 | 14500 |
| 34 | MLOW-34 | 69.04 | 24.33 | 20 | 78400 | 50176 | 6.8 | 0 | 450 | 26746 | 440 | 3560 | 10692 | 15750 |
| 35 | MLOW-35 | 69.04 | 24.47 | 20 | `5220 | 3340 | 8.4 | 0 | 350 | 1119 | 100 | 133.65 | 815 | 800 |
| 36 | MLOW-36 | 69.07 | 24.64 | 20 | 24000 | 15360 | 8.3 | 0 | 650 | 6188 | 180 | 923.4 | 3529 | 4250 |
| 37 | MLOW-37 | 69.20 | 24.68 | 20 | 13710 | 8774 | 7.8 | 0 | 200 | 4169 | 120 | 388.8 | 2262 | 1900 |
| 38 | MLOW-38 | 69.26 | 24.89 | 20 | 28900 | 18496 | 8 | 0 | 400 | 8008 | 180 | 899.1 | 4716 | 5800 |
| 39 | MLOW-39 | 68.89 | 24.85 | 20 | 46100 | 29504 | 7.7 | 0 | 250 | 12298 | 120 | 1397.3 | 7775 | 6050 |
| 40 | MLOW-40 | 68.82 | 25.05 | 20 | 2690 | 1721 | 8.6 | 20 | 600 | 171 | 8 | 34.02 | 531 | 160 |
| 41 | MLOW-41 | 68.43 | 25.04 | 20 | 744 | 476 | 9 | 40 | 240 | 85 | 24 | 24.3 | 95 | 160 |
| 42 | MLOW-42 | 68.47 | 25.20 | 20 | 753 | 481 | 8.4 | 20 | 220 | 63 | 32 | 14.58 | 104 | 140 |

## 5.27 Water Quality Analysis from 42 MLOWs during May 2018 (At 13 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 40 | | | | | | | | | | |
| 2 | MLOW-02 | 68.12 | 24.97 | 40 | 25300 | 16192 | 7.5 | 0 | 600 | 4860 | 240 | 923.4 | 3765 | 4400 |
| 3 | MLOW-03 | 68.18 | 24.79 | 40 | 15200 | 9728 | 7.5 | 0 | 450 | 3267 | 580 | 996.3 | 909 | 5550 |
| 4 | MLOW-04 | 67.98 | 24.78 | 40 | 4580 | 2931 | 7.9 | 0 | 200 | 1053 | 140 | 182.25 | 535 | 1100 |
| 5 | MLOW-05 | 68.07 | 24.72 | 40 | 48600 | 31104 | 7.2 | 0 | 550 | 12960 | 600 | 2527.2 | 5631 | 11900 |
| 6 | MLOW-06 | 67.59 | 24.71 | 40 | 1633 | 1045 | 9 | 40 | 300 | 243 | 80 | 72.9 | 139 | 500 |
| 7 | MLOW-07 | 67.77 | 24.74 | 40 | 8850 | 5664 | 7.9 | 0 | 450 | 1890 | 160 | 85.05 | 1669 | 750 |
| 8 | MLOW-08 | 68.08 | 24.60 | 40 | 5320 | 3404 | 8 | 0 | 500 | 1080 | 80 | 437.4 | 285 | 2000 |
| 9 | MLOW-09 | 68.30 | 24.62 | 40 | 89900 | 57536 | 6.9 | 0 | 550 | 28620 | 6200 | 4422.6 | 5050 | 33700 |
| 10 | MLOW-10 | 67.63 | 24.55 | 40 | 2550 | 1632 | 8.7 | 20 | 250 | 540 | 80 | 157.95 | 185 | 850 |
| 11 | MLOW-11 | 67.82 | 24.61 | 40 | 28700 | 18368 | 7.2 | 0 | 300 | 7776 | 120 | 1567.4 | 3441 | 6750 |
| 12 | MLOW-12 | 67.89 | 24.57 | 40 | 1021 | 653 | 8.5 | 20 | 250 | 113 | 40 | 60.75 | 71 | 350 |
| 13 | MLOW-13 | 68.27 | 24.36 | 40 | 64100 | 41024 | 7.8 | 0 | 350 | 16065 | 600 | 2490.8 | 9266 | 11750 |
| 14 | MLOW-14 | 67.58 | 24.46 | 40 | 1790 | 1145 | 8.8 | 30 | 350 | 378 | 40 | 109.35 | 155 | 550 |
| 15 | MLOW-15 | 67.83 | 24.40 | 40 | 25400 | 16256 | 7.5 | 0 | 250 | 5400 | 60 | 1117.8 | 3612 | 4750 |
| 16 | MLOW-16 | 67.99 | 24.40 | 40 | 9780 | 6259 | 8 | 0 | 200 | 2160 | 120 | 206.55 | 1701 | 1150 |
| 17 | MLOW-17 | 68.14 | 24.27 | 40 | 59300 | 25152 | 7.8 | 0 | 300 | 17658 | 820 | 1433.7 | 9930 | 7950 |
| 18 | MLOW-18 | 67.61 | 24.31 | 40 | 58800 | 37632 | 7.3 | 0 | 550 | 16764 | 560 | 2345 | 8370 | 11050 |
| 19 | MLOW-19 | 67.76 | 24.29 | 40 | 101500 | 64960 | 7.2 | 0 | 500 | 33480 | 80 | 3900.2 | 15757 | 16250 |
| 20 | MLOW-20 | 67.92 | 24.28 | 40 | 58700 | 37568 | 7.9 | 0 | 400 | 17280 | 150 | 1537 | 10365 | 6700 |
| 21 | MLOW-21 | 67.63 | 24.19 | 40 | 17120 | 10956 | 7.6 | 0 | 250 | 4050 | 60 | 425.25 | 3035 | 1900 |
| 22 | MLOW-22 | 67.46 | 24.14 | 40 | 60200 | 38528 | 7.3 | 0 | 300 | 17550 | 240 | 2029.1 | 9660 | 8950 |
| 23 | MLOW-23 | 67.62 | 24.09 | 40 | 63500 | 40640 | 7.3 | 0 | 450 | 16605 | 200 | 2697.3 | 9185 | 11600 |
| 24 | MLOW-24 | 68.66 | 25.04 | 40 | 4420 | 2828 | 8.3 | 20 | 250 | 1080 | 40 | 230.85 | 515 | 1050 |
| 25 | MLOW-25 | 68.66 | 24.87 | 40 | 56800 | 36352 | 7.3 | 0 | 650 | 15911 | 2880 | 2466.5 | 5005 | 17350 |
| 26 | MLOW-26 | 68.50 | 24.82 | 40 | 7630 | 4883 | 9.1 | 50 | 700 | 1457 | 60 | 72.9 | 1536 | 450 |
| 27 | MLOW-27 | 68.42 | 24.69 | 40 | 49900 | 31936 | 7.8 | 0 | 500 | 14025 | 260 | 777.6 | 9676 | 3850 |
| 28 | MLOW-28 | 68.67 | 24.69 | 40 | 17990 | 11513 | 7.7 | 0 | 500 | 3520 | 60 | 595.35 | 2915 | 2600 |
| 29 | MLOW-29 | 68.84 | 24.66 | 40 | 33200 | 21248 | 7.5 | 0 | 500 | 7947 | 120 | 1020.6 | 5525 | 4500 |
| 30 | MLOW-30 | 68.49 | 24.49 | 40 | 117400 | 75136 | 7 | 0 | 450 | 33000 | 5280 | 4325.4 | 12615 | 31000 |
| 31 | MLOW-31 | 68.70 | 24.49 | 40 | 76900 | 49216 | 7.2 | 0 | 450 | 24320 | 360 | 3134.5 | 11249 | 13800 |
| 32 | MLOW-32 | 68.84 | 24.50 | 40 | 32400 | 20736 | 7.3 | 0 | 250 | 10729 | 92 | 891.8 | 5622 | 3900 |
| 33 | MLOW-33 | 68.88 | 24.34 | 40 | 72800 | 46592 | 7.4 | 0 | 550 | 25035 | 170 | 3481 | 9859 | 14750 |
| 34 | MLOW-34 | 69.04 | 24.33 | 40 | 78200 | 50048 | 6.8 | 0 | 300 | 26590 | 220 | 3632.9 | 10747 | 15500 |
| 35 | MLOW-35 | 69.04 | 24.47 | 40 | 62200 | 39808 | 7.5 | 0 | 750 | 16918 | 180 | 1980.5 | 10288 | 8600 |
| 36 | MLOW-36 | 69.07 | 24.64 | 40 | 50100 | 32064 | 7.2 | 0 | 550 | 15550 | 400 | 1822.5 | 7549 | 8500 |
| 37 | MLOW-37 | 69.20 | 24.68 | 40 | 14820 | 9484 | 8.1 | 0 | 200 | 4290 | 128 | 408.24 | 2454 | 2000 |
| 38 | MLOW-38 | 69.26 | 24.89 | 40 | 14140 | 9049 | 8.1 | 0 | 250 | 3946 | 100 | 947.7 | 1299 | 4150 |
| 39 | MLOW-39 | 68.89 | 24.85 | 40 | 43000 | 27520 | 7.9 | 0 | 300 | 12155 | 140 | 1202.9 | 7404 | 5300 |
| 40 | MLOW-40 | 68.82 | 25.05 | 40 | 2670 | 1708 | 9.4 | 30 | 580 | 177 | 16 | 24.3 | 530 | 140 |
| 41 | MLOW-41 | 68.43 | 25.04 | 40 | 1390 | 889 | 8.7 | 30 | 180 | 268 | 24 | 14.58 | 260 | 120 |
| 42 | MLOW-42 | 68.47 | 25.20 | 40 | 854 | 546 | 8.7 | 30 | 280 | 91 | 16 | 29.16 | 118 | 160 |

## 5.28 Water Quality Analysis from 42 MLOWs during May 2018 (At 20 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 60 | | | | | | | | | | |
| 2 | MLOW-02 | 68.12 | 24.97 | 60 | 35900 | 22976 | 7.4 | 0 | 350 | 8100 | 400 | 1202.9 | 5751 | 5950 |
| 3 | MLOW-03 | 68.18 | 24.79 | 60 | 15150 | 9696 | 7.5 | 0 | 300 | 3225 | 600 | 862.65 | 1125 | 5050 |
| 4 | MLOW-04 | 67.98 | 24.78 | 60 | 4580 | 2931 | 7.7 | 0 | 250 | 1053 | 120 | 206.55 | 511 | 1150 |
| 5 | MLOW-05 | 68.07 | 24.72 | 60 | 49700 | 31808 | 7.4 | 0 | 550 | 13176 | 100 | 2089.8 | 7291 | 8850 |
| 6 | MLOW-06 | 67.59 | 24.71 | 60 | 1679 | 1074 | 9 | 40 | 200 | 270 | 60 | 97.2 | 128 | 550 |
| 7 | MLOW-07 | 67.77 | 24.74 | 60 | 47900 | 30656 | 7.3 | 0 | 750 | 12015 | 100 | 1591.7 | 7844 | 6800 |
| 8 | MLOW-08 | 68.08 | 24.60 | 60 | 6120 | 3916 | 8.1 | 0 | 550 | 1188 | 60 | 267.3 | 818 | 1250 |
| 9 | MLOW-09 | 68.30 | 24.62 | 60 | 90000 | 57600 | 6.8 | 0 | 500 | 29160 | 6400 | 4677.8 | 4355 | 35250 |
| 10 | MLOW-10 | 67.63 | 24.55 | 60 | 5310 | 3398 | 8.6 | 20 | 300 | 1080 | 100 | 206.55 | 695 | 1100 |
| 11 | MLOW-11 | 67.82 | 24.61 | 60 | 30200 | 19328 | 7.3 | 0 | 500 | 8019 | 180 | 1093.5 | 4626 | 4950 |
| 12 | MLOW-12 | 67.89 | 24.57 | 60 | 1066 | 682 | 8.5 | 20 | 250 | 113 | 60 | 48.6 | 81 | 350 |
| 13 | MLOW-13 | 68.27 | 24.36 | 60 | 65100 | 41664 | 7.8 | 0 | 350 | 16227 | 320 | 2660.9 | 9491 | 11750 |
| 14 | MLOW-14 | 67.58 | 24.46 | 60 | 1835 | 1174 | 8.4 | 20 | 400 | 378 | 100 | 72.9 | 164 | 550 |
| 15 | MLOW-15 | 67.83 | 24.40 | 60 | 16390 | 10489 | 7.7 | 0 | 350 | 4698 | 180 | 510.3 | 2560 | 2550 |
| 16 | MLOW-16 | 67.99 | 24.40 | 60 | 19600 | 12544 | 8.1 | 0 | 200 | 2821 | 60 | 631.8 | 3215 | 2750 |
| 17 | MLOW-17 | 68.14 | 24.27 | 60 | 65200 | 41728 | 7.7 | 0 | 350 | 18634 | 1280 | 2029.1 | 9609 | 11550 |
| 18 | MLOW-18 | 67.61 | 24.31 | 60 | 59200 | 37888 | 7 | 0 | 550 | 16889 | 500 | 2470.8 | 8248 | 11500 |
| 19 | MLOW-19 | 67.76 | 24.29 | 60 | 100500 | 64320 | 7.4 | 0 | 650 | 33188 | 60 | 3730.1 | 15870 | 15500 |
| 20 | MLOW-20 | 67.92 | 24.28 | 60 | 67500 | 43200 | 7.4 | 0 | 600 | 18090 | 140 | 2272.1 | 10972 | 9700 |
| 21 | MLOW-21 | 67.63 | 24.19 | 60 | 17660 | 11302 | 8.2 | 0 | 250 | 4104 | 80 | 400.95 | 3185 | 1850 |
| 22 | MLOW-22 | 67.46 | 24.14 | 60 | 62600 | 40064 | 7.9 | 0 | 500 | 18090 | 320 | 2065.5 | 10050 | 9300 |
| 23 | MLOW-23 | 67.62 | 24.09 | 60 | 69900 | 44736 | 7.3 | 0 | 550 | 21330 | 260 | 2685.2 | 10600 | 11700 |
| 24 | MLOW-24 | 68.66 | 25.04 | 60 | 4720 | 3020 | 8.4 | 30 | 300 | 1134 | 120 | 218.7 | 520 | 1200 |
| 25 | MLOW-25 | 68.66 | 24.87 | 60 | 51500 | 32960 | 7.2 | 0 | 550 | 15270 | 1620 | 3086.1 | 4067.1 | 16750 |
| 26 | MLOW-26 | 68.50 | 24.82 | 60 | 25200 | 16128 | 8.4 | 20 | 400 | 5335 | 400 | 364.45 | 4620 | 2500 |
| 27 | MLOW-27 | 68.42 | 24.69 | 60 | 47900 | 30656 | 7.5 | 0 | 450 | 15125 | 260 | 765.45 | 9225 | 3800 |
| 28 | MLOW-28 | 68.67 | 24.69 | 60 | 32400 | 20736 | 7.9 | 0 | 500 | 7012 | 100 | 789.75 | 5800 | 3500 |
| 29 | MLOW-29 | 68.84 | 24.66 | 60 | 35100 | 22464 | 7.7 | 0 | 450 | 8250 | 220 | 1142.1 | 5612 | 5250 |
| 30 | MLOW-30 | 68.49 | 24.49 | 60 | 118900 | 76096 | 7.1 | 0 | 400 | 33137 | 6240 | 3912.3 | 12660 | 31700 |
| 31 | MLOW-31 | 68.70 | 24.49 | 60 | 77300 | 49472 | 7.1 | 0 | 350 | 25191 | 340 | 3116.8 | 11333 | 13800 |
| 32 | MLOW-32 | 68.84 | 24.50 | 60 | 32400 | 20736 | 7.3 | 0 | 500 | 10169 | 80 | 777.6 | 5855 | 3400 |
| 33 | MLOW-33 | 68.88 | 24.34 | 60 | 72300 | 46272 | 7 | 0 | 500 | 24880 | 220 | 3438.5 | 9768 | 14700 |
| 34 | MLOW-34 | 69.04 | 24.33 | 60 | 78000 | 49920 | 7 | 0 | 450 | 26497 | 360 | 3341.3 | 11100 | 14650 |
| 35 | MLOW-35 | 69.04 | 24.47 | 60 | 60100 | 38464 | 6.9 | 0 | 450 | 16296 | 860 | 3183.3 | 6715 | 15250 |
| 36 | MLOW-36 | 69.07 | 24.64 | 60 | 63500 | 40640 | 7.6 | 0 | 850 | 19593 | 440 | 2102 | 10044 | 9750 |
| 37 | MLOW-37 | 69.20 | 24.68 | 60 | 15310 | 9798 | 8.2 | 0 | 150 | 4576 | 140 | 437.4 | 2505 | 2150 |
| 38 | MLOW-38 | 69.26 | 24.89 | 60 | 29600 | 18944 | 7.8 | 0 | 300 | 8580 | 120 | 1506.6 | 3005 | 6500 |
| 39 | MLOW-39 | 68.89 | 24.85 | 60 | 42100 | 26944 | 7.7 | 0 | 150 | 11726 | 140 | 1081.4 | 7438 | 4800 |
| 40 | MLOW-40 | 68.82 | 25.05 | 60 | 4290 | 2745 | 8.4 | 10 | 420 | 509 | 8 | 72.9 | 829 | 320 |
| 41 | MLOW-41 | 68.43 | 25.04 | 60 | 7810 | 4998 | 8.3 | 20 | 120 | 2202 | 96 | 218.7 | 1240 | 1140 |
| 42 | MLOW-42 | 68.47 | 25.20 | 60 | 767 | 490 | 9 | 30 | 200 | 85 | 16 | 29.16 | 100 | 160 |

## 5.29 Water Quality Analysis from 42 MLOWs during June 2018 (At 0 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 0 | 895 | 572 | 9 | 40 | 200 | 84 | 80 | 24.3 | 67 | 300 |
| 2 | MLOW-02 | 68.12 | 24.97 | 0 | 33700 | 21568 | 7.9 | 0 | 500 | 8899 | 160 | 1287.79 | 5071 | 5700 |
| 3 | MLOW-03 | 68.18 | 24.79 | 0 | 13220 | 8460 | 7.9 | 0 | 200 | 3020 | 380 | 692.55 | 1255 | 3800 |
| 4 | MLOW-04 | 67.98 | 24.78 | 0 | 4260 | 2726 | 7.7 | 0 | 300 | 1054 | 100 | 230.85 | 412 | 1200 |
| 5 | MLOW-05 | 68.07 | 24.72 | 0 | 50000 | 32000 | 7.8 | 0 | 600 | 14403 | 160 | 2089.8 | 7290 | 9000 |
| 6 | MLOW-06 | 67.59 | 24.71 | 0 | 2080 | 1331 | 8.9 | 30 | 200 | 530 | 60 | 97.2 | 215 | 550 |
| 7 | MLOW-07 | 67.77 | 24.74 | 0 | 37300 | 23872 | 7.4 | 0 | 600 | 12345 | 60 | 1300.05 | 5999 | 5500 |
| 8 | MLOW-08 | 68.08 | 24.60 | 0 | 4060 | 2598 | 8.7 | 20 | 250 | 643 | 120 | 85.05 | 622 | 650 |
| 9 | MLOW-09 | 68.30 | 24.62 | 0 | 88800 | 56832 | 7 | 0 | 350 | 28292 | 4900 | 4021.65 | 7050 | 28800 |
| 10 | MLOW-10 | 67.63 | 24.55 | 0 | 2880 | 1843 | 8.7 | 30 | 250 | 643 | 100 | 133.65 | 280 | 800 |
| 11 | MLOW-11 | 67.82 | 24.61 | 0 | 28800 | 18432 | 7.3 | 0 | 400 | 8564 | 100 | 1470.15 | 3670 | 6300 |
| 12 | MLOW-12 | 67.89 | 24.57 | 0 | 1227 | 785 | 8.5 | 20 | 200 | 205 | 60 | 24.3 | 161 | 250 |
| 13 | MLOW-13 | 68.27 | 24.36 | 0 | 62100 | 39744 | 7.7 | 0 | 250 | 15817 | 1240 | 2162.7 | 8688 | 12000 |
| 14 | MLOW-14 | 67.58 | 24.46 | 0 | 1980 | 1267 | 8.3 | 20 | 550 | 360 | 60 | 133.65 | 127 | 700 |
| 15 | MLOW-15 | 67.83 | 24.40 | 0 | 23400 | 14976 | 7.5 | 0 | 550 | 6584 | 160 | 923.4 | 3411 | 4200 |
| 16 | MLOW-16 | 67.99 | 24.40 | 0 | 18490 | 11833 | 8.1 | 0 | 500 | 4835 | 140 | 510.3 | 3098 | 2450 |
| 17 | MLOW-17 | 68.14 | 24.27 | 0 | 62700 | 40128 | 7.5 | 0 | 500 | 18480 | 700 | 2223.45 | 9300 | 10900 |
| 18 | MLOW-18 | 67.61 | 24.31 | 0 | 56900 | 36416 | 7.2 | 0 | 600 | 16660 | 300 | 2636.55 | 7666 | 11600 |
| 19 | MLOW-19 | 67.76 | 24.29 | 0 | 94300 | 60352 | 8.1 | 0 | 650 | 30090 | 260 | 3730.05 | 14222 | 16000 |
| 20 | MLOW-20 | 67.92 | 24.28 | 0 | 58100 | 37184 | 8.2 | 0 | 500 | 16725 | 160 | 1907.55 | 9466 | 8250 |
| 21 | MLOW-21 | 67.63 | 24.19 | 0 | 18000 | 11520 | 8 | 0 | 400 | 5100 | 160 | 486 | 3005 | 2400 |
| 22 | MLOW-22 | 67.46 | 24.14 | 0 | 59800 | 38272 | 7.4 | 0 | 450 | 17544 | 300 | 2029.05 | 9500 | 9100 |
| 23 | MLOW-23 | 67.62 | 24.09 | 0 | 60500 | 38720 | 8.2 | 0 | 250 | 17977 | 260 | 2527.2 | 8751 | 11050 |
| 24 | MLOW-24 | 68.66 | 25.04 | 0 | 5310 | 3398 | 8.3 | 10 | 300 | 1453 | 140 | 340.2 | 405 | 1750 |
| 25 | MLOW-25 | 68.66 | 24.87 | 0 | 54200 | 34688 | 7.3 | 0 | 350 | 15529 | 3240 | 2527.2 | 3878 | 18500 |
| 26 | MLOW-26 | 68.50 | 24.82 | 0 | 5620 | 3597 | 9 | 40 | 1000 | 1275 | 40 | 157.95 | 936 | 750 |
| 27 | MLOW-27 | 68.42 | 24.69 | 0 | 47600 | 30464 | 7.7 | 0 | 650 | 15172 | 140 | 1044.9 | 8769 | 4650 |
| 28 | MLOW-28 | 68.67 | 24.69 | 0 | 32300 | 20672 | 8.2 | 0 | 650 | 6375 | 100 | 899.1 | 5575 | 3950 |
| 29 | MLOW-29 | 68.84 | 24.66 | 0 | 36600 | 23424 | 7.9 | 0 | 450 | 8874 | 160 | 1166.4 | 5988 | 5200 |
| 30 | MLOW-30 | 68.49 | 24.49 | 0 | 118000 | 75520 | 7.1 | 0 | 350 | 33915 | 4600 | 5346 | 11591 | 33500 |
| 31 | MLOW-31 | 68.70 | 24.49 | 0 | 75800 | 48512 | 7.5 | 0 | 700 | 23587 | 1360 | 2806.65 | 10471 | 14950 |
| 32 | MLOW-32 | 68.84 | 24.50 | 0 | 29300 | 18752 | 8.2 | 0 | 350 | 8670 | 540 | 449.55 | 5242 | 3200 |
| 33 | MLOW-33 | 68.88 | 24.34 | 0 | 69400 | 44416 | 6.9 | 0 | 600 | 21420 | 1540 | 2721.6 | 8957 | 15050 |
| 34 | MLOW-34 | 69.04 | 24.33 | 0 | 79600 | 50944 | 6.8 | 0 | 6500 | 25755 | 1680 | 4058.1 | 8570 | 20900 |
| 35 | MLOW-35 | 69.04 | 24.47 | 0 | 59000 | 37760 | 7 | 0 | 400 | 16830 | 1960 | 2575.8 | 6374 | 15500 |
| 36 | MLOW-36 | 69.07 | 24.64 | 0 | 61100 | 39104 | 7.5 | 0 | 700 | 17467 | 840 | 692.55 | 11739 | 4950 |
| 37 | MLOW-37 | 69.20 | 24.68 | 0 | 11110 | 7110 | 8.2 | 0 | 550 | 3315 | 216 | 403.38 | 1515 | 2200 |
| 38 | MLOW-38 | 69.26 | 24.89 | 0 | | | | | | | | | | |
| 39 | MLOW-39 | 68.89 | 24.85 | 0 | 40800 | 26112 | 7.5 | 0 | 1150 | 11985 | 280 | 1251.45 | 6645 | 5850 |
| 40 | MLOW-40 | 68.82 | 25.05 | 0 | 3240 | 2074 | 8.8 | 30 | 700 | 277 | 24 | 131.22 | 444 | 600 |
| 41 | MLOW-41 | 68.43 | 25.04 | 0 | 7820 | 5005 | 8.3 | 10 | 450 | 2116 | 244 | 191.97 | 1132 | 1400 |
| 42 | MLOW-42 | 68.47 | 25.20 | 0 | 953 | 610 | 9.3 | 40 | 280 | 96 | 44 | 46.17 | 79 | 300 |

## 5.30 Water Quality Analysis from 42 MLOWs during June 2018 (At 6 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 20 | 750 | 480 | 9 | 40 | 100 | 76 | 80 | 12.15 | 57 | 250 |
| 2 | MLOW-02 | 68.12 | 24.97 | 20 | 23200 | 14848 | 7.8 | 0 | 500 | 6095 | 80 | 765.45 | 3755 | 3350 |
| 3 | MLOW-03 | 68.18 | 24.79 | 20 | 14640 | 9369 | 7.9 | 0 | 400 | 3255 | 140 | 1166.4 | 957 | 5150 |
| 4 | MLOW-04 | 67.98 | 24.78 | 20 | 4250 | 2720 | 7.9 | 0 | 150 | 1057 | 80 | 255.15 | 388 | 1250 |
| 5 | MLOW-05 | 68.07 | 24.72 | 20 | 49100 | 31424 | 7.3 | 0 | 550 | 14274 | 1400 | 1944 | 5939 | 11500 |
| 6 | MLOW-06 | 67.59 | 24.71 | 20 | 1628 | 1041 | 9.2 | 40 | 200 | 462 | 80 | 48.6 | 181 | 400 |
| 7 | MLOW-07 | 67.77 | 24.74 | 20 | 7420 | 4748 | 8.2 | 0 | 600 | 2314 | 180 | 170.1 | 1161 | 1150 |
| 8 | MLOW-08 | 68.08 | 24.60 | 20 | 2880 | 1843 | 8.7 | 20 | 250 | 617 | 60 | 194.4 | 214 | 950 |
| 9 | MLOW-09 | 68.30 | 24.62 | 20 | 89800 | 57472 | 7 | 0 | 300 | 28703 | 5420 | 3973.05 | 6780 | 29900 |
| 10 | MLOW-10 | 67.63 | 24.55 | 20 | 2320 | 1484 | 8.4 | 20 | 350 | 462 | 80 | 97.2 | 250 | 600 |
| 11 | MLOW-11 | 67.82 | 24.61 | 20 | 28300 | 18112 | 7.9 | 0 | 300 | 8410 | 100 | 1312.2 | 3860 | 5650 |
| 12 | MLOW-12 | 67.89 | 24.57 | 20 | 1053 | 673 | 8.7 | 30 | 200 | 180 | 80 | 24.3 | 96 | 300 |
| 13 | MLOW-13 | 68.27 | 24.36 | 20 | 62300 | 39872 | 7.4 | 0 | 250 | 15946 | 1180 | 2344.95 | 8474 | 12600 |
| 14 | MLOW-14 | 67.58 | 24.46 | 20 | 1857 | 1188 | 8.3 | 20 | 500 | 334 | 60 | 97.2 | 165 | 550 |
| 15 | MLOW-15 | 67.83 | 24.40 | 20 | 40000 | 25600 | 7.2 | 0 | 600 | 11959 | 920 | 1506.6 | 5222 | 8500 |
| 16 | MLOW-16 | 67.99 | 24.40 | 20 | 7130 | 4563 | 7.8 | 0 | 300 | 1960 | 100 | 133.65 | 1250 | 800 |
| 17 | MLOW-17 | 68.14 | 24.27 | 20 | 55700 | 35648 | 7.9 | 0 | 500 | 16240 | 400 | 972 | 10688 | 5000 |
| 18 | MLOW-18 | 67.61 | 24.31 | 20 | 60000 | 38400 | 7.1 | 0 | 600 | 18340 | 200 | 2648.7 | 8477 | 11400 |
| 19 | MLOW-19 | 67.76 | 24.29 | 20 | 21400 | 13696 | 7.9 | 0 | 600 | 5992 | 140 | 704.7 | 3391 | 3250 |
| 20 | MLOW-20 | 67.92 | 24.28 | 20 | 59700 | 38208 | 7.5 | 0 | 500 | 17238 | 200 | 1883.25 | 9870 | 8250 |
| 21 | MLOW-21 | 67.63 | 24.19 | 20 | 17430 | 11155 | 7.5 | 0 | 450 | 4845 | 140 | 522.45 | 2828 | 2500 |
| 22 | MLOW-22 | 67.46 | 24.14 | 20 | 50800 | 32512 | 7.3 | 0 | 600 | 16575 | 220 | 1664.55 | 8220 | 7400 |
| 23 | MLOW-23 | 67.62 | 24.09 | 20 | 32400 | 20736 | 7.9 | 0 | 350 | 8925 | 380 | 996.3 | 5090 | 5050 |
| 24 | MLOW-24 | 68.66 | 25.04 | 20 | 3900 | 2496 | 8.4 | 20 | 300 | 1020 | 160 | 145.8 | 427 | 1000 |
| 25 | MLOW-25 | 68.66 | 24.87 | 20 | 59400 | 38016 | 7.1 | 0 | 350 | 16575 | 3100 | 3244.05 | 3860 | 21100 |
| 26 | MLOW-26 | 68.50 | 24.82 | 20 | 4760 | 3046 | 9.5 | 60 | 1100 | 1147 | 40 | 157.95 | 739 | 750 |
| 27 | MLOW-27 | 68.42 | 24.69 | 20 | 50900 | 32576 | 8 | 0 | 550 | 15300 | 140 | 1081.35 | 9460 | 4800 |
| 28 | MLOW-28 | 68.67 | 24.69 | 20 | 8880 | 5683 | 8.2 | 0 | 400 | 3213 | 140 | 279.45 | 1335 | 1500 |
| 29 | MLOW-29 | 68.84 | 24.66 | 20 | 30200 | 19328 | 8.2 | 0 | 400 | 7777 | 80 | 1044.9 | 4842 | 4500 |
| 30 | MLOW-30 | 68.49 | 24.49 | 20 | 123300 | 78912 | 7.4 | 0 | 400 | 34935 | 6200 | 4738.5 | 12128 | 35000 |
| 31 | MLOW-31 | 68.70 | 24.49 | 20 | 78900 | 50496 | 7.6 | 0 | 700 | 24352 | 1080 | 3207.6 | 10720 | 15900 |
| 32 | MLOW-32 | 68.84 | 24.50 | 20 | 24000 | 15360 | 8.2 | 0 | 450 | 7650 | 372 | 332.91 | 4444 | 2300 |
| 33 | MLOW-33 | 68.88 | 24.34 | 20 | 72300 | 46272 | 7.1 | 0 | 450 | 21930 | 1580 | 2685.15 | 9643 | 15000 |
| 34 | MLOW-34 | 69.04 | 24.33 | 20 | 79500 | 50880 | 7.1 | 0 | 650 | 25882 | 1740 | 3195.45 | 10141 | 17500 |
| 35 | MLOW-35 | 69.04 | 24.47 | 20 | 5120 | 3277 | 9.2 | 30 | 750 | 1555 | 20 | 170.1 | 818 | 750 |
| 36 | MLOW-36 | 69.07 | 24.64 | 20 | 26300 | 16832 | 7.4 | 0 | 600 | 6375 | 164 | 1249.02 | 3448 | 5550 |
| 37 | MLOW-37 | 69.20 | 24.68 | 20 | 14920 | 9549 | 8 | 0 | 350 | 4335 | 152 | 503.01 | 2285 | 2450 |
| 38 | MLOW-38 | 69.26 | 24.89 | 20 | 28800 | 18432 | 8.3 | 10 | 650 | 7105 | 736 | 1266.03 | 3333 | 7050 |
| 39 | MLOW-39 | 68.89 | 24.85 | 20 | 47500 | 30400 | 7.6 | 0 | 350 | 13642 | 728 | 1477.44 | 7248 | 7900 |
| 40 | MLOW-40 | 68.82 | 25.05 | 20 | 2630 | 1683 | 9.1 | 40 | 500 | 178 | 20 | 72.9 | 440 | 350 |
| 41 | MLOW-41 | 68.43 | 25.04 | 20 | 604 | 387 | 9.5 | 50 | 250 | 76 | 16 | 51.03 | 22 | 250 |
| 42 | MLOW-42 | 68.47 | 25.20 | 20 | 638 | 408 | 9.1 | 40 | 260 | 57 | 28 | 43.74 | 30 | 250 |

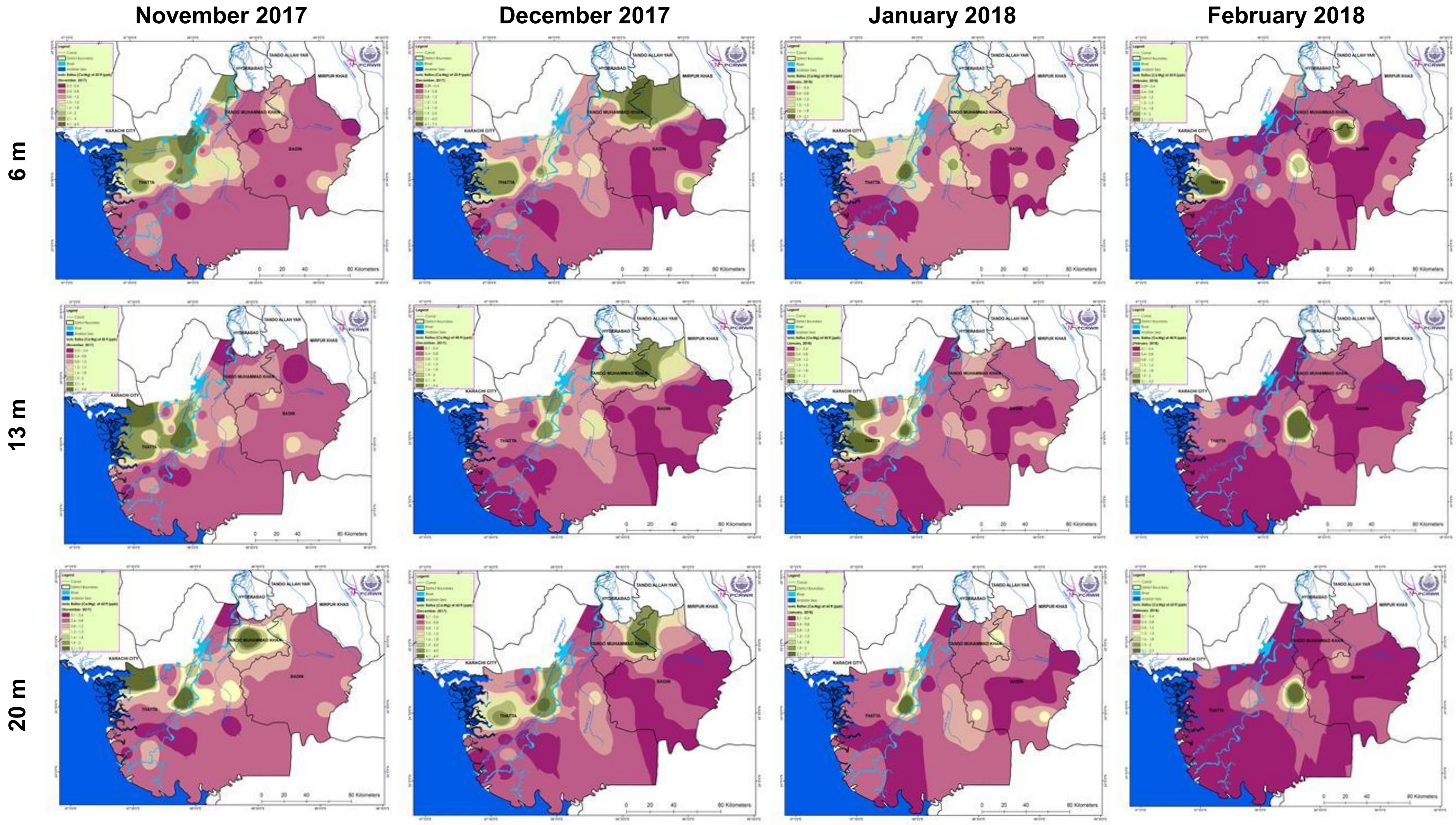
## 5.31 Water Quality Analysis from 42 MLOWs during June 2018 (At 13 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 40 | | | | | | | | | | |
| 2 | MLOW-02 | 68.12 | 24.97 | 40 | 35800 | 22912 | 7.9 | 0 | 300 | 9439 | 220 | 1470.15 | 5139 | 6600 |
| 3 | MLOW-03 | 68.18 | 24.79 | 40 | 14750 | 9440 | 7.6 | 0 | 500 | 3112 | 400 | 984.15 | 1033 | 5050 |
| 4 | MLOW-04 | 67.98 | 24.78 | 40 | 4450 | 2848 | 8.2 | 0 | 200 | 1183 | 80 | 255.15 | 429 | 1250 |
| 5 | MLOW-05 | 68.07 | 24.72 | 40 | 49300 | 31552 | 7.4 | 0 | 450 | 14326 | 860 | 2332.8 | 5858 | 11750 |
| 6 | MLOW-06 | 67.59 | 24.71 | 40 | 1695 | 1084 | 8.9 | 30 | 200 | 488 | 100 | 48.6 | 175 | 450 |
| 7 | MLOW-07 | 67.77 | 24.74 | 40 | 9960 | 6374 | 8.6 | 10 | 600 | 2803 | 180 | 133.65 | 1808 | 1000 |
| 8 | MLOW-08 | 68.08 | 24.60 | 40 | 4790 | 3065 | 8.6 | 10 | 350 | 1003 | 60 | 170.1 | 647 | 850 |
| 9 | MLOW-09 | 68.30 | 24.62 | 40 | 92700 | 59328 | 7 | 0 | 350 | 29578 | 5560 | 3790.8 | 7648 | 29500 |
| 10 | MLOW-10 | 67.63 | 24.55 | 40 | 2470 | 1580 | 8.8 | 40 | 300 | 411 | 60 | 145.8 | 209 | 750 |
| 11 | MLOW-11 | 67.82 | 24.61 | 40 | 29400 | 18816 | 7.2 | 0 | 300 | 8873 | 180 | 1336.5 | 3970 | 5950 |
| 12 | MLOW-12 | 67.89 | 24.57 | 40 | 871 | 557 | 8.7 | 30 | 200 | 154 | 40 | 48.6 | 60 | 300 |
| 13 | MLOW-13 | 68.27 | 24.36 | 40 | 65500 | 41920 | 7.6 | 0 | 350 | 16589 | 1160 | 2527.2 | 8859 | 13300 |
| 14 | MLOW-14 | 67.58 | 24.46 | 40 | 1839 | 1176 | 8 | 0 | 550 | 335 | 80 | 85.05 | 165 | 550 |
| 15 | MLOW-15 | 67.83 | 24.40 | 40 | 34100 | 21824 | 7.6 | 0 | 600 | 10030 | 720 | 1081.35 | 4688 | 6250 |
| 16 | MLOW-16 | 67.99 | 24.40 | 40 | 11260 | 7206 | 8.3 | 10 | 300 | 2520 | 140 | 218.7 | 2311 | 1250 |
| 17 | MLOW-17 | 68.14 | 24.27 | 40 | 58100 | 37184 | 7.5 | 0 | 600 | 16940 | 560 | 1215 | 10366 | 6400 |
| 18 | MLOW-18 | 67.61 | 24.31 | 40 | 59900 | 38336 | 7.3 | 0 | 600 | 18200 | 200 | 2449.44 | 8830 | 10850 |
| 19 | MLOW-19 | 67.76 | 24.29 | 40 | 102600 | 65664 | 7.2 | 0 | 750 | 31875 | 240 | 4361.85 | 14941 | 18550 |
| 20 | MLOW-20 | 67.92 | 24.28 | 40 | 58700 | 37568 | 7.5 | 0 | 500 | 16830 | 240 | 1749.6 | 9855 | 7800 |
| 21 | MLOW-21 | 67.63 | 24.19 | 40 | 17740 | 11353 | 8 | 0 | 350 | 4896 | 180 | 473.85 | 2949 | 2400 |
| 22 | MLOW-22 | 67.46 | 24.14 | 40 | 59700 | 38208 | 7.3 | 0 | 300 | 17595 | 300 | 2029.05 | 9479 | 9100 |
| 23 | MLOW-23 | 67.62 | 24.09 | 40 | 55400 | 35456 | 7.3 | 0 | 500 | 17340 | 580 | 2138.4 | 7960 | 10250 |
| 24 | MLOW-24 | 68.66 | 25.04 | 40 | 4560 | 2918 | 8.4 | 20 | 400 | 1096 | 180 | 267.3 | 325 | 1550 |
| 25 | MLOW-25 | 68.66 | 24.87 | 40 | 58500 | 37440 | 7.4 | 0 | 450 | 16524 | 3220 | 3025.35 | 3941 | 20500 |
| 26 | MLOW-26 | 68.50 | 24.82 | 40 | 7850 | 5024 | 8.4 | 30 | 950 | 2320 | 60 | 97.2 | 1535 | 550 |
| 27 | MLOW-27 | 68.42 | 24.69 | 40 | 49900 | 31936 | 7.7 | 0 | 600 | 14994 | 140 | 1008.45 | 9365 | 4500 |
| 28 | MLOW-28 | 68.67 | 24.69 | 40 | 20000 | 12800 | 8.1 | 0 | 750 | 5227 | 160 | 668.25 | 3126 | 3150 |
| 29 | MLOW-29 | 68.84 | 24.66 | 40 | 34000 | 21760 | 8.2 | 0 | 450 | 8542 | 80 | 1129.95 | 5541 | 4850 |
| 30 | MLOW-30 | 68.49 | 24.49 | 40 | 121000 | 77440 | 7.4 | 0 | 300 | 34425 | 48000 | 5273.1 | 12188 | 33700 |
| 31 | MLOW-31 | 68.70 | 24.49 | 40 | 79600 | 50944 | 7.6 | 0 | 600 | 24607 | 1200 | 3110.4 | 10939 | 15800 |
| 32 | MLOW-32 | 68.84 | 24.50 | 40 | 27400 | 17536 | 7.8 | 0 | 350 | 8542 | 448 | 444.69 | 4921 | 2950 |
| 33 | MLOW-33 | 68.88 | 24.34 | 40 | 72200 | 46208 | 7.6 | 0 | 700 | 21802 | 1468 | 3093.39 | 8966 | 16400 |
| 34 | MLOW-34 | 69.04 | 24.33 | 40 | 79500 | 50880 | 6.9 | 0 | 550 | 25882 | 1840 | 2770.2 | 10843 | 16000 |
| 35 | MLOW-35 | 69.04 | 24.47 | 40 | 51100 | 32704 | 7.4 | 0 | 450 | 15045 | 1600 | 2101.95 | 5869 | 12650 |
| 36 | MLOW-36 | 69.07 | 24.64 | 40 | 62100 | 39744 | 7.6 | 0 | 800 | 17850 | 760 | 2332.8 | 8905 | 11500 |
| 37 | MLOW-37 | 69.20 | 24.68 | 40 | 15750 | 10080 | 7.8 | 0 | 850 | 4580 | 220 | 425.25 | 2525 | 2300 |
| 38 | MLOW-38 | 69.26 | 24.89 | 40 | 14890 | 9530 | 8.1 | 0 | 600 | 4080 | 524 | 848.07 | 1177 | 4800 |
| 39 | MLOW-39 | 68.89 | 24.85 | 40 | 48700 | 31168 | 8 | 0 | 500 | 14152 | 760 | 1433.7 | 7560 | 7800 |
| 40 | MLOW-40 | 68.82 | 25.05 | 40 | 2690 | 1722 | 8.8 | 30 | 1050 | 183 | 16 | 51.03 | 499 | 250 |
| 41 | MLOW-41 | 68.43 | 25.04 | 40 | 4520 | 2893 | 8.9 | 40 | 350 | 1173 | 112 | 138.51 | 633 | 850 |
| 42 | MLOW-42 | 68.47 | 25.20 | 40 | 580 | 371 | 9.3 | 40 | 250 | 51 | 20 | 36.45 | 40 | 200 |

## 5.32 Water Quality Analysis from 42 MLOWs during June 2018 (At 20 m)

| S. # | Sample ID | X | Y | Depth (ft) | EC (µS/cm) | TDS (mg/l) | pH | $CO^3$ (mg/l) | $HCO^3$ (mg/l) | Cl (mg/l) | Ca (mg/l) | Mg (mg/l) | Na (mg/l) | Hardness (mg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NEQS Permissible Limit for Drinking | | | | | NGVS | 1000 | 6.5 - 8.5 | NGVS | NGVS | 250 | NGVS | NGVS | NGVS | < 500 |
| 1 | MLOW-01 | 68.26 | 25.22 | 60 | | | | | | | | | | |
| 2 | MLOW-02 | 68.12 | 24.97 | 60 | 40900 | 26176 | 7.4 | 0 | 600 | 10725 | 200 | 1676.7 | 5944 | 7400 |
| 3 | MLOW-03 | 68.18 | 24.79 | 60 | 14770 | 9452 | 8 | 0 | 300 | 3575 | 400 | 1008.45 | 996 | 5150 |
| 4 | MLOW-04 | 67.98 | 24.78 | 60 | 4520 | 2892 | 8.3 | 0 | 200 | 1188 | 60 | 255.15 | 469 | 1200 |
| 5 | MLOW-05 | 68.07 | 24.72 | 60 | 50100 | 32064 | 7.5 | 0 | 650 | 14531 | 140 | 2709.45 | 6143 | 11500 |
| 6 | MLOW-06 | 67.59 | 24.71 | 60 | 1847 | 1182 | 8.4 | 30 | 200 | 530 | 100 | 60.75 | 186 | 500 |
| 7 | MLOW-07 | 67.77 | 24.74 | 60 | 50600 | 32384 | 7.2 | 0 | 750 | 15689 | 360 | 1506.6 | 8309 | 7100 |
| 8 | MLOW-08 | 68.08 | 24.60 | 60 | 6220 | 3980 | 8.7 | 20 | 400 | 1286 | 100 | 121.5 | 1065 | 750 |
| 9 | MLOW-09 | 68.30 | 24.62 | 60 | 92600 | 59264 | 7.1 | 0 | 200 | 29526 | 6020 | 3960.9 | 6767 | 31350 |
| 10 | MLOW-10 | 67.63 | 24.55 | 60 | 3120 | 1996 | 8.3 | 20 | 300 | 540 | 80 | 194.4 | 247 | 1000 |
| 11 | MLOW-11 | 67.82 | 24.61 | 60 | 2930 | 1875 | 7.4 | 0 | 350 | 9130 | 160 | 1798.2 | 3091 | 7800 |
| 12 | MLOW-12 | 67.89 | 24.57 | 60 | 944 | 604 | 8.5 | 20 | 150 | 167 | 60 | 36.4 | 71 | 300 |
| 13 | MLOW-13 | 68.27 | 24.36 | 60 | 67400 | 43136 | 7.5 | 0 | 250 | 17129 | 1740 | 2126.25 | 9393 | 13100 |
| 14 | MLOW-14 | 67.58 | 24.46 | 60 | 2010 | 1286 | 7.9 | 0 | 500 | 462 | 80 | 97.2 | 179 | 600 |
| 15 | MLOW-15 | 67.83 | 24.40 | 60 | 17930 | 11475 | 7.9 | 0 | 600 | 4732 | 160 | 583.2 | 2805 | 2800 |
| 16 | MLOW-16 | 67.99 | 24.40 | 60 | 21300 | 13632 | 7.4 | 0 | 500 | 6720 | 160 | 583.2 | 3576 | 2800 |
| 17 | MLOW-17 | 68.14 | 24.27 | 60 | 66400 | 42496 | 7.1 | 0 | 350 | 19880 | 1300 | 1858.95 | 11687 | 10900 |
| 18 | MLOW-18 | 67.61 | 24.31 | 60 | 60800 | 38912 | 7.8 | 0 | 500 | 18480 | 300 | 2527.2 | 8888 | 11150 |
| 19 | MLOW-19 | 67.76 | 24.29 | 60 | 103500 | 66240 | 7.4 | 0 | 750 | 32130 | 200 | 4203.9 | 15491 | 17800 |
| 20 | MLOW-20 | 67.92 | 24.28 | 60 | 68900 | 44096 | 7.6 | 0 | 500 | 18360 | 280 | 2187 | 11315 | 9700 |
| 21 | MLOW-21 | 67.63 | 24.19 | 60 | 18230 | 11667 | 8.2 | 0 | 400 | 5227 | 180 | 400.95 | 3219.77 | 2100 |
| 22 | MLOW-22 | 67.46 | 24.14 | 60 | 60500 | 38720 | 7.2 | 0 | 400 | 17850 | 240 | 2284.2 | 9241 | 10000 |
| 23 | MLOW-23 | 67.62 | 24.09 | 60 | 70900 | 45376 | 7.5 | 0 | 450 | 21420 | 680 | 2928.15 | 9898 | 13750 |
| 24 | MLOW-24 | 68.66 | 25.04 | 60 | 4730 | 3027 | 8.5 | 20 | 200 | 1147 | 160 | 267.3 | 385 | 1500 |
| 25 | MLOW-25 | 68.66 | 24.87 | 60 | 46500 | 29760 | 7.6 | 0 | 300 | 12750 | 1960 | 2940.3 | 2790 | 17000 |
| 26 | MLOW-26 | 68.50 | 24.82 | 60 | 14620 | 9357 | 8.3 | 20 | 750 | 4335 | 100 | 218.7 | 2819 | 1150 |
| 27 | MLOW-27 | 68.42 | 24.69 | 60 | 46600 | 29824 | 8 | 0 | 450 | 13744 | 160 | 741.15 | 9100 | 3450 |
| 28 | MLOW-28 | 68.67 | 24.69 | 60 | 34100 | 21824 | 8.2 | 0 | 700 | 7395 | 180 | 972 | 5760 | 4450 |
| 29 | MLOW-29 | 68.84 | 24.66 | 60 | 37600 | 22144 | 7.9 | 0 | 500 | 8925 | 140 | 1312.2 | 5955 | 5750 |
| 30 | MLOW-30 | 68.49 | 24.49 | 60 | 122700 | 78528 | 7 | 0 | 300 | 34680 | 5560 | 4884.4 | 12444 | 34000 |
| 31 | MLOW-31 | 68.70 | 24.49 | 60 | 79400 | 50816 | 7.1 | 0 | 700 | 24480 | 1100 | 3292.65 | 10670 | 16300 |
| 32 | MLOW-32 | 68.84 | 24.50 | 60 | 28300 | 18112 | 7.4 | 0 | 600 | 8619 | 440 | 461.7 | 5100 | 3000 |
| 33 | MLOW-33 | 68.88 | 24.34 | 60 | 71600 | 45824 | 7 | 0 | 600 | 21726 | 1720 | 2976.75 | 8763 | 16550 |
| 34 | MLOW-34 | 69.04 | 24.33 | 60 | 79400 | 50816 | 7.7 | 0 | 450 | 25758 | 1600 | 3159 | 10333 | 17000 |
| 35 | MLOW-35 | 69.04 | 24.47 | 60 | 61200 | 39168 | 6.9 | 0 | 600 | 17340 | 2120 | 2806.65 | 6240 | 16850 |
| 36 | MLOW-36 | 69.07 | 24.64 | 60 | 63300 | 40512 | 7.6 | 0 | 750 | 18130 | 328 | 2412.99 | 9540 | 10750 |
| 37 | MLOW-37 | 69.20 | 24.68 | 60 | 15930 | 10195 | 7.9 | 0 | 550 | 4641 | 124 | 580.77 | 2371 | 2700 |
| 38 | MLOW-38 | 69.26 | 24.89 | 60 | 29200 | 18688 | 8.2 | 0 | 550 | 8211 | 732 | 1329.21 | 3310 | 7300 |
| 39 | MLOW-39 | 68.89 | 24.85 | 60 | 48000 | 30720 | 7.7 | 0 | 700 | 13897 | 504 | 1406.97 | 7741 | 7050 |
| 40 | MLOW-40 | 68.82 | 25.05 | 60 | 7610 | 4870 | 8.3 | 20 | 700 | 2040 | 144 | 289.17 | 1018 | 1550 |
| 41 | MLOW-41 | 68.43 | 25.04 | 60 | 7610 | 4870 | 8.3 | 20 | 250 | 2065 | 260 | 194.4 | 1078.7 | 1450 |
| 42 | MLOW-42 | 68.47 | 25.20 | 60 | 687 | 440 | 9.1 | 40 | 280 | 63 | 24 | 34.02 | 64 | 200 |

## Annex-6: Spatial and temporal variation of $Ca^{2+}$:$Mg^{2+}$ ratio in Indus Delta

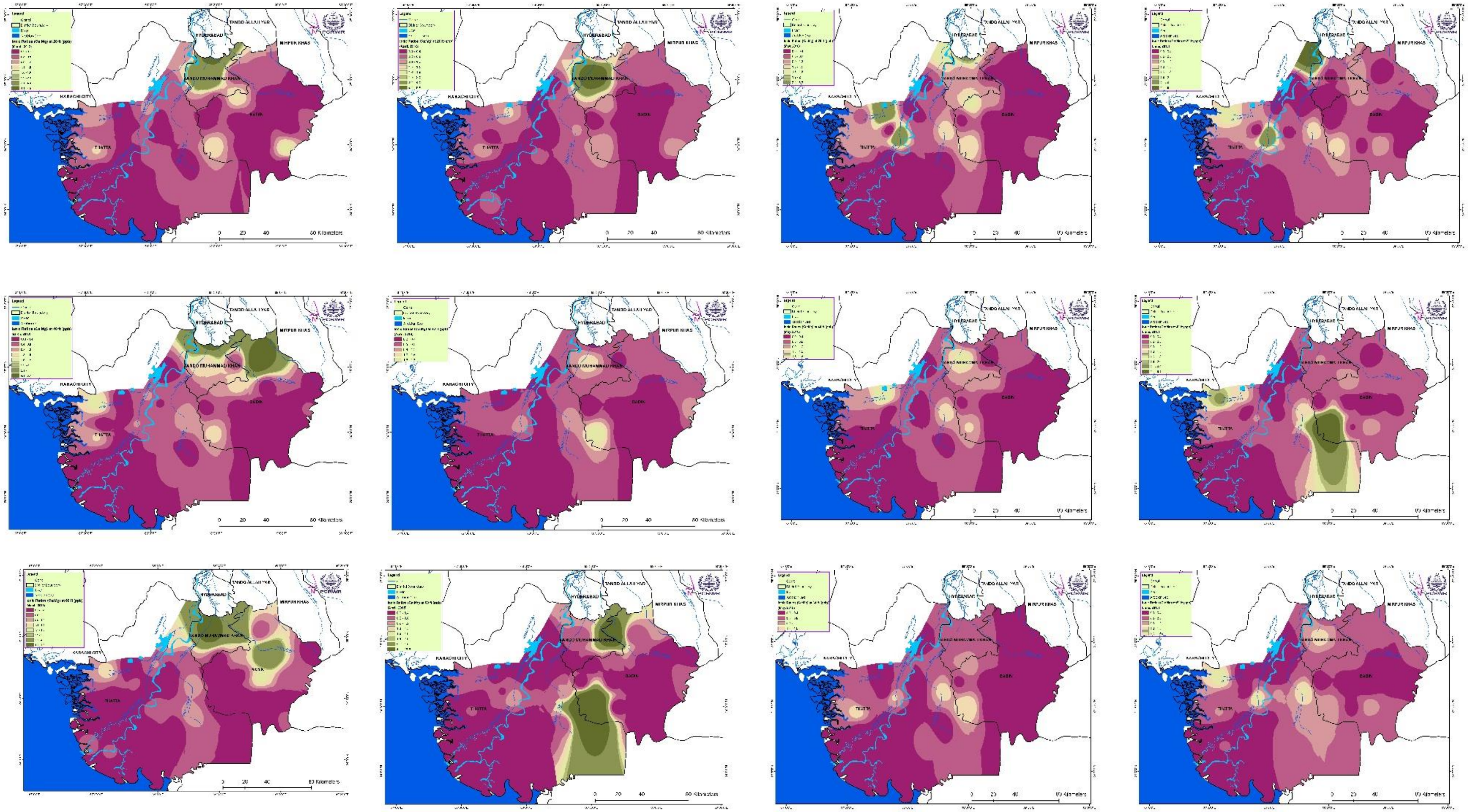


March 2018 | April 2018 | May 2018 | June 2018

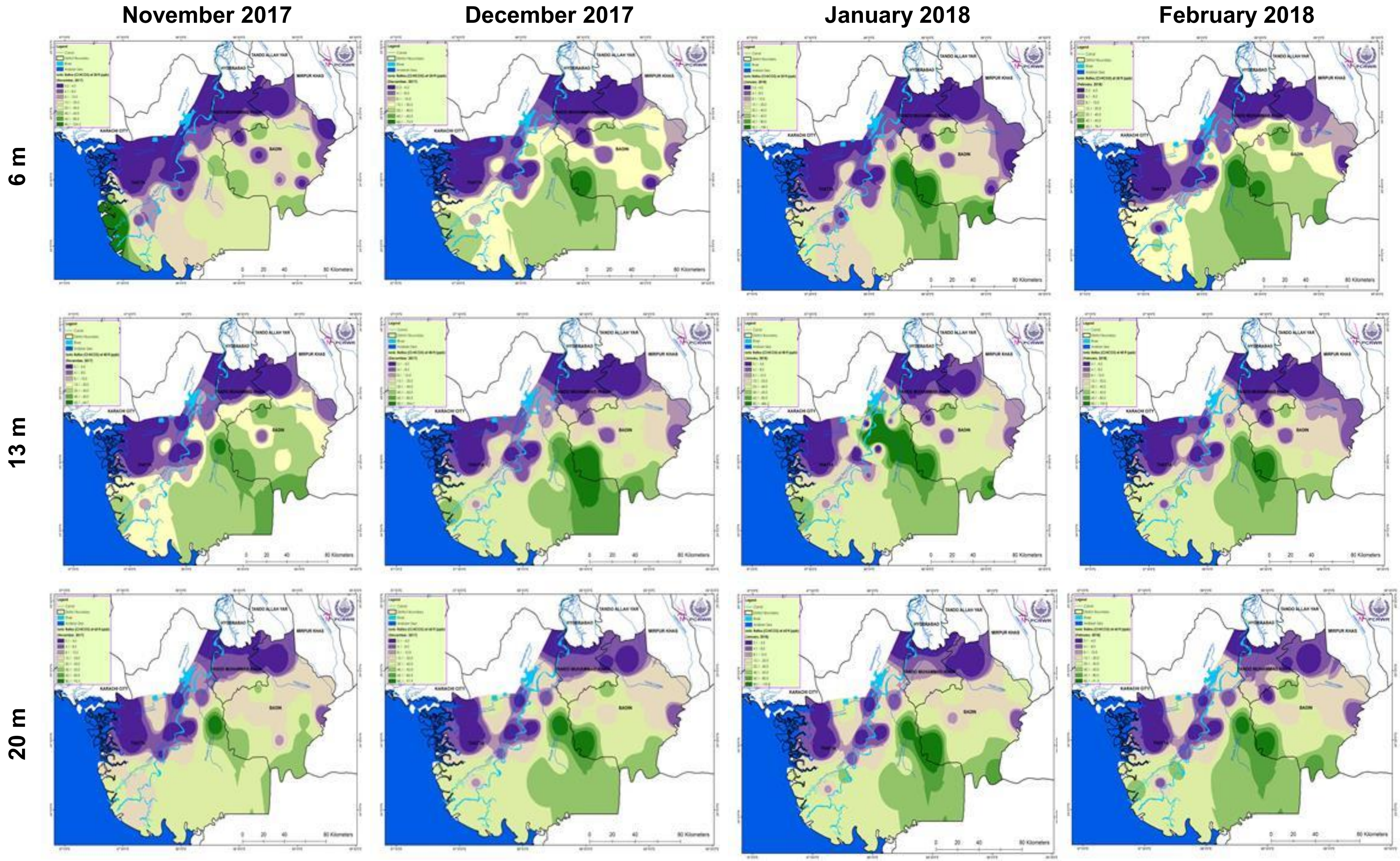
6 m

13 m

20 m



## Annex-7: Spatial and Temporal variation of $Cl^{-}$ :$HCO^{-3}$ ratio in Indus Delta

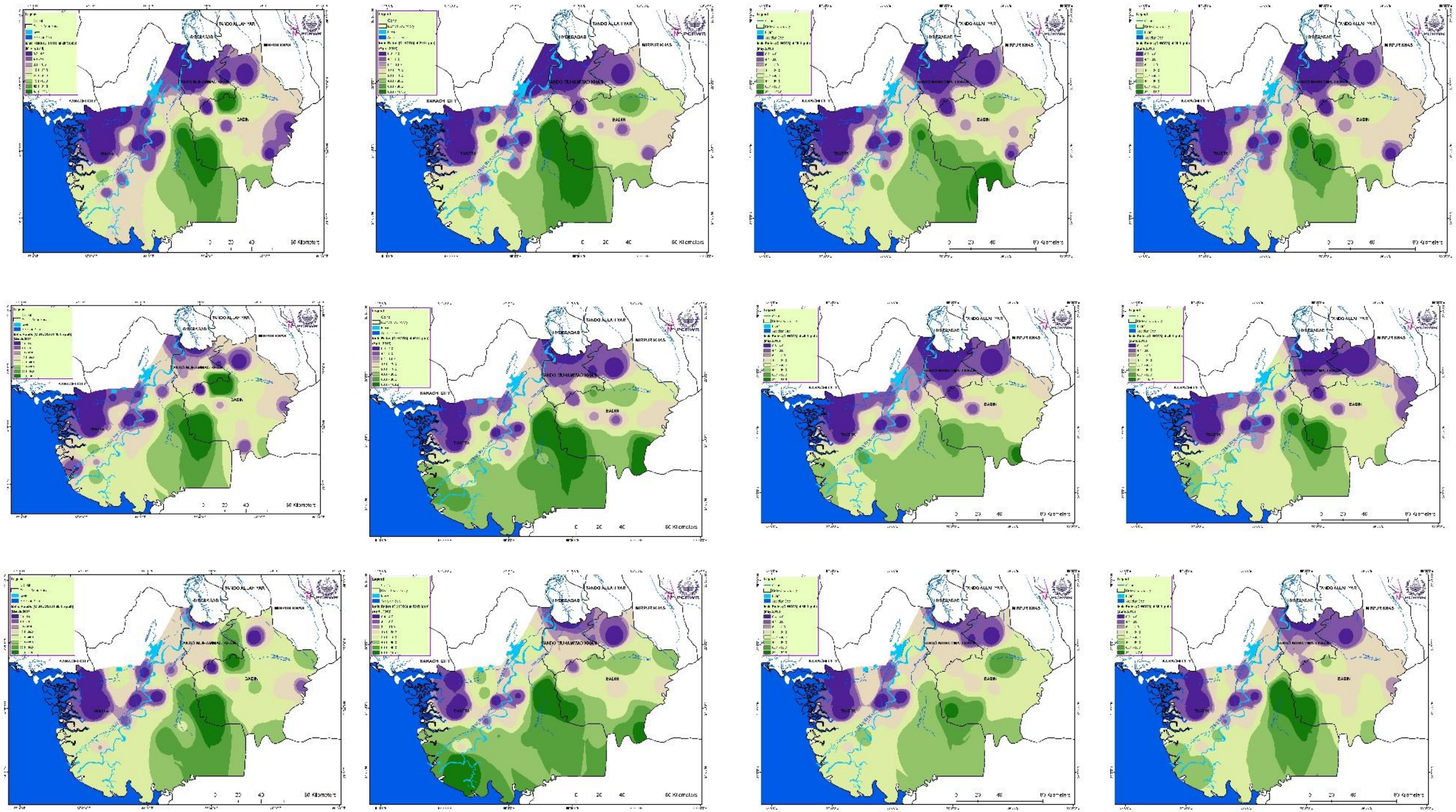


March 2018 | April 2018 | May 2018 | June 2018

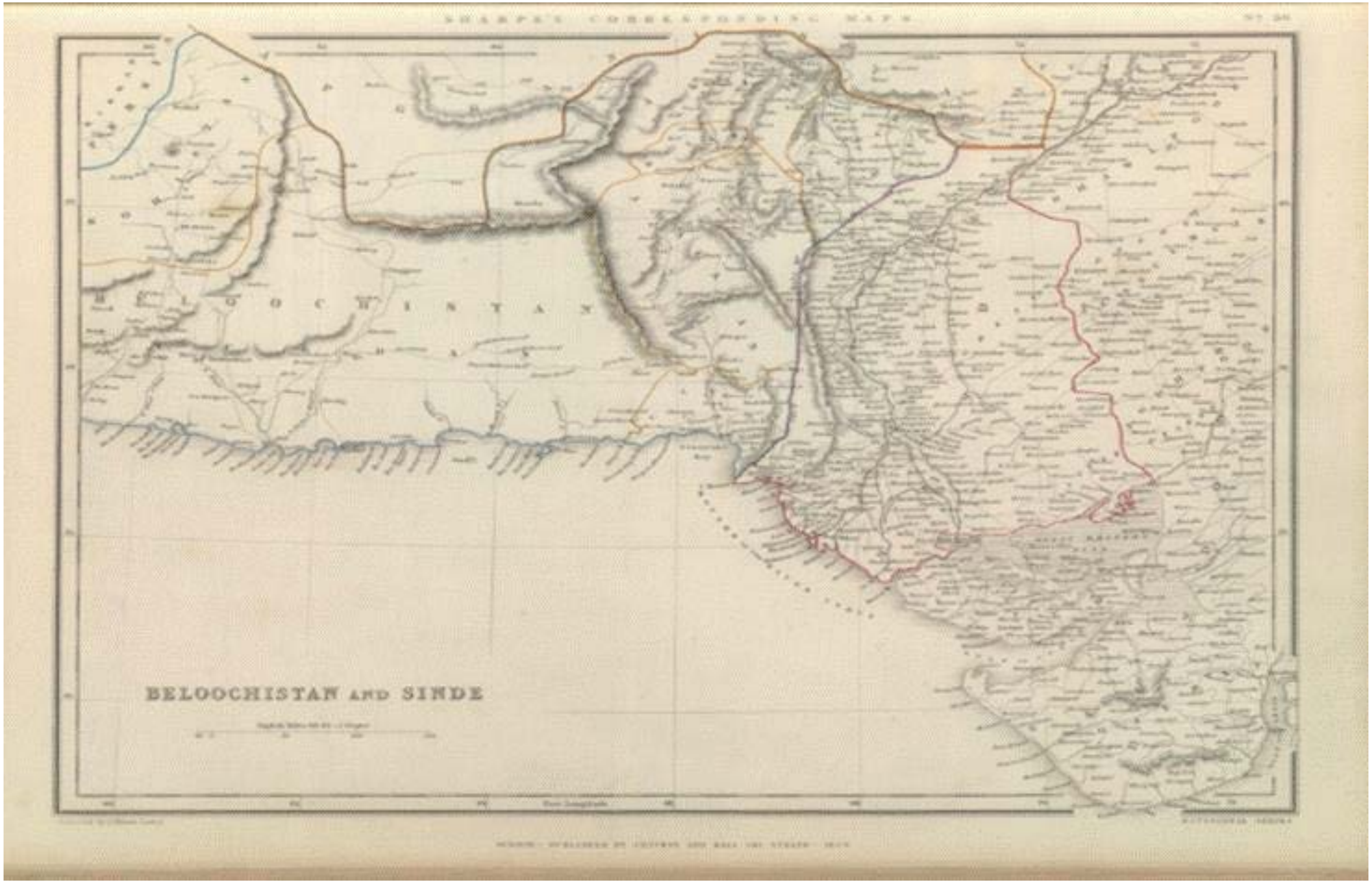
6 m

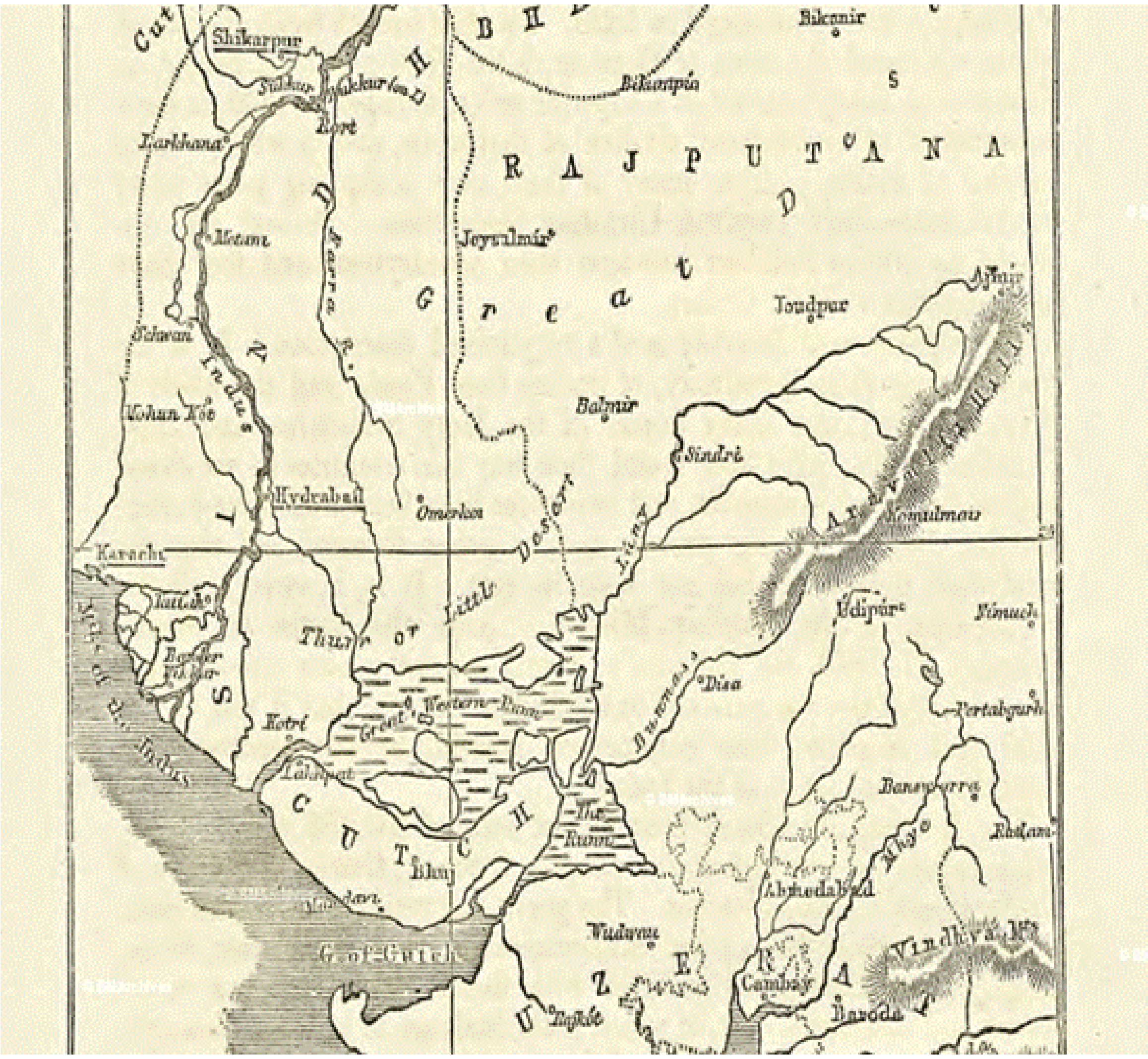
13 m

20 m

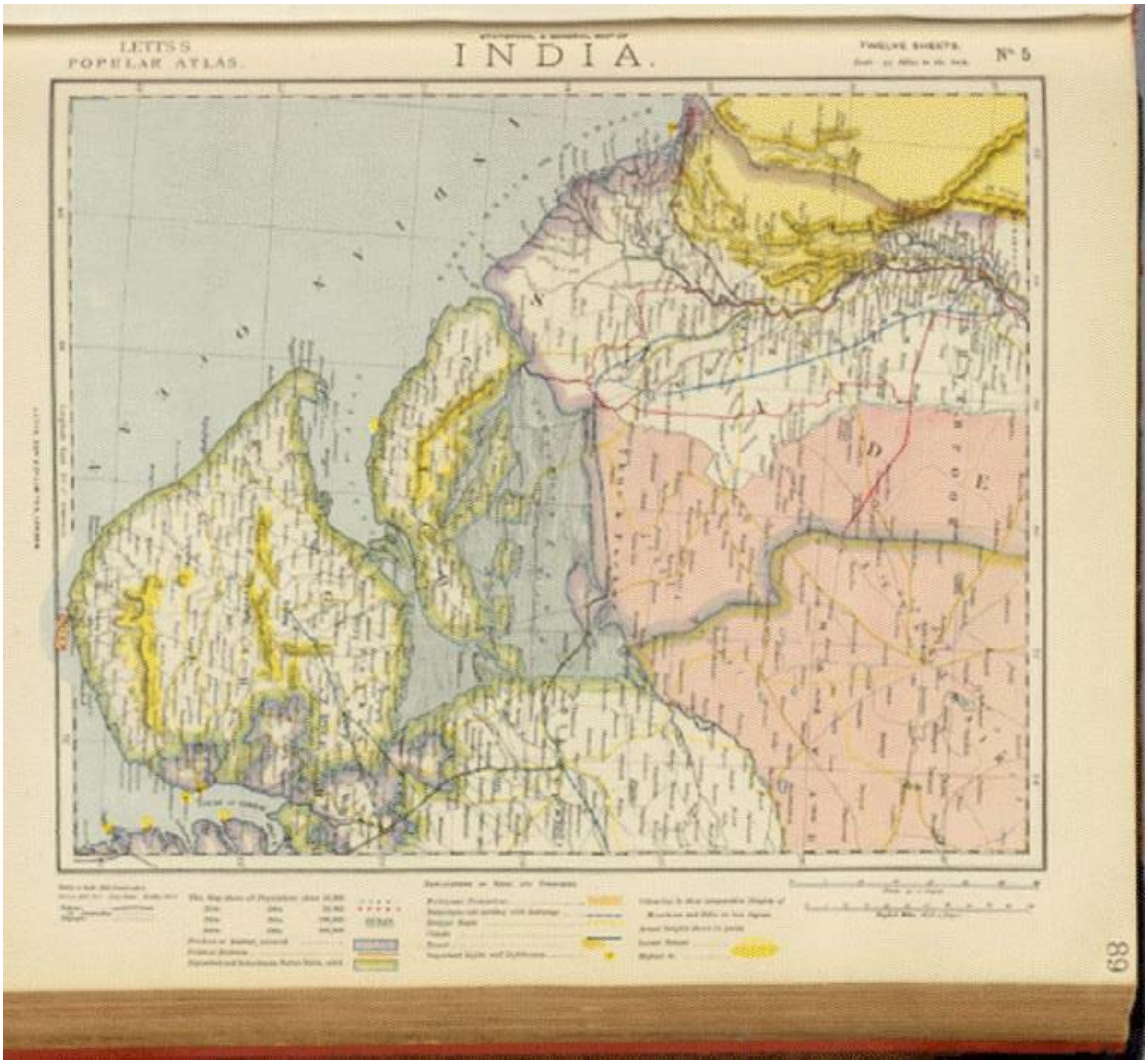


## Annex-8: Historical Maps of Indus Delta for Geo-spatial Analysis






## Annex-9: Church Missionary Atlas: Part of the Bombay Presidency, 1857




## Annex-10: India 5., Letts Sons and Co., 1883

## About the Authors

**Dr. Ashfaq Ahmed Sheikh** is a Professional Engineer and Hydrologist, worked as Director General (Research & Coordination) at Pakistan Council of Research in Water Resources, Ministry of Science and Technology, Pakistan. He graduated from University of Agriculture, Faisalabad in 1993, followed by MS Engineering in Hydrology and PhD Civil Engineering with specialization in Hydrology from United Kingdom. While working in various positions and organizations, he has 25-year professional, research and management experience in water sector under different hydrological and climatic conditions. His professional areas of working are hydrological assessment and design, water resources management and innovative solutions. During his career, he has undertaken large number of research and development projects and collaborative initiatives with several institutions and international partners. He has more than 25 international and national publications with two international books and reviewer of several journals. He is also active Member of several international and national Institutions and forums.

Dr. Kamrani Ansari is a Professor in water resources in US-Pakistan Center for Advanced Studies in Water. He has extensive experience of working on Hydrological and Hydraulic studies from time to time. He is a Civil Engineer by training and graduated from Mehran University of Engineering and Technology, Jamshoro in 1993. He went on to do his M. E. in Hydrology and Water Resources from University Technology Malaysia followed by PhD Civil Engineering with specialization in Open Channel Hydraulics from Nottingham University, United Kingdom. His professional areas of working are hydrological assessment and design, water resources management and open channel hydraulics, hydrological and hydraulic modeling and irrigation engineering. He has around 25 international and national publications. He is also worked as member on many technical committees related to water resources issues formed by Government of Sindh as well as Government of Pakistan.

Main thrust of Applied Research component of the Water Center is to stimulate an environment that promotes multi-disciplinary research within the broader context of water-development nexus to support evidence-based policy making in the water sector. This is pursued using the framework provided by the six targets of the Sustainable Development Goal on Water i.e. SDG-6.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