MINISTRY OF TRANSPORT AND COMMUNICATIONS
DIRECTORATE OF WATER RESOURCES AND IMPROVEMENT OF RIVER SYSTEMS (DWIR)

Improvement of River Systems in the Ayeyarwady Delta

1 June, 2017
CONTENTS

- Overview on the Ayeyarwady Delta
- Challenges
- Water Resources Management and Disaster Management in Myanmar
- Erosion protection work in the Ayeyarwady Delta
Visions of DWIR

1. To conserve and protect the water resources
2. To smooth and safety waterways navigation
3. to contribute to the development of State economy
4. To protect environmental impact
1. Yangon
2. Pathein
3. Bago
4. Magwe
5. Mandalay
6. Monywa
7. Sittwe
8. Mawlamyine
9. Dawei
10. Myitkyina
11. Hpaan
12. Taunggyi

(12) Regional offices
Responsibilities of DWIR

- To improve the navigation channel and to stabilize the inland river ports.
- To protect the river banks erosion.
- To cooperate with other organizations in demarcation of danger water level of the towns.
- To utilize the river water for domestic and agriculture all the year round.
- To protect bank erosion of border rivers.
- To observe the long term existence of the cross river bridges by river engineering point of views.
- To manage the prevention of the river water pollution.
- To achieve adequate depth for maximum loading capacity of the vessels.
### Major Rivers in Myanmar

<table>
<thead>
<tr>
<th>Name of River</th>
<th>Length (km)</th>
<th>Catchment (sq-km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayeyarwady</td>
<td>2100</td>
<td>288900</td>
</tr>
<tr>
<td>Chindwin</td>
<td>1100</td>
<td>115300</td>
</tr>
<tr>
<td>Sittaung</td>
<td>420</td>
<td>34395</td>
</tr>
<tr>
<td>Thanlwin</td>
<td>2410</td>
<td>158000</td>
</tr>
<tr>
<td>Kaladan</td>
<td>650</td>
<td>22611</td>
</tr>
</tbody>
</table>

**Navigable Length of Major Rivers**

<table>
<thead>
<tr>
<th>Name of River</th>
<th>Navigable Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayeyarwady</td>
<td>1534</td>
</tr>
<tr>
<td>Chindwin</td>
<td>817</td>
</tr>
<tr>
<td>Thanlwin and other rivers in Mon State</td>
<td>380</td>
</tr>
<tr>
<td>Delta Region</td>
<td>2404</td>
</tr>
<tr>
<td>Rivers in Rakhaing State</td>
<td>1602</td>
</tr>
<tr>
<td><strong>Total Length (km)</strong></td>
<td><strong>6737</strong></td>
</tr>
</tbody>
</table>
Overview of the Ayeyarwady Delta

- Delta can be divided into three portions
  - Lower Sea Fronts
  - Central Depressed Land
  - Upper Delta
- The lands in the upper delta are prevented by river dikes
- Irrigation and Water Utilization Management Department controls 64 dykes and 190 sluices

Related to Three Regions

- Ayeyarwady Region
- Yangon Region
- Bago Region
Overview of the Ayeyarwady Delta

Ayeyarwady river flows into the Andaman sea through (9) large distributaries:

1. Pathein,
2. Thetkethaung,
3. Ywe,
4. Pyamalaw,
5. Ayeyarwady,
6. Bogale,
7. Pyapon,
8. Toe and
9. Yangon rivers
Major Cities in Ayeyarwady Delta

**Yangon**
Capital of Yangon Region and Economic City of Myanmar
(5 million population in urban area - 2014 census)

**Pathein**
Capital of Ayeyarwady Region (over 287,000 population – 2014 census)

**Bago**
Capital of Bago Region (500,000 population – 2014 census)
Major Cities in Ayeyarwady Delta

Nyaung Done

- located at the bifurcation of the Ayeyarwady river coming from the north, into the continuation of the Ayeyarwady river (to the southwest) and the Pan Hlaing River (to the east)
- Population of about 198,046
- City area about 348.23 sq. – mile.
- The city located at the border of the Ayeyarwady region and Yangon Region
- The Ayeyarwady river is a highly dynamic, meandering/braiding river system with an average discharge of 13,000 m3/s
- The Pan Hlaing River bifurcates from the Ayeyarwady river main branch
- About 50% percent of the flow diverts into the Pan Hlaing.
Challenges

Cyclones

- Cyclone Nargis 2008
  - 84,537 people were killed and 53,836 went missing.
  - 2.4 million people were affected.
  - 800,000 houses were totally damaged.

Flood

- 2015 flood
  - 132 people were died.
  - 1,676,086 people were affected.
  - 38,954 houses were totally damaged.

Water scarcity in the dry season

River Bank erosion

Arsenic and saline contamination of ground water

Sea level rise

Subsidence
Some Measures

- Cyclone Shelter
- Hydromet Observation and Early Warning System
- Flood Hazard Mapping
- Water Supply System
- Embankment
- River Bank Erosion Protection
- City Development Planning
- Coastal Zone Management
- Drainage System
- Capacity Building and public awareness

13
International cooperation and some of the activities
Water Resources and Disaster Management in Myanmar

National Water Resources Committee (NWRC)

Hydro Informatics Center

Secretariat

Advisory Group

Ayeyarwady Delta Development Working Committee

Officers Expert Group

National Disaster Management Committee (NDMC)
Water Resources Management in Myanmar

Advisory Group

- To support NWRC in technical point of views
- Water experts from various backgrounds as members
- Chairperson, Secretary, and Joint Secretary of Advisory Group as members of NWRC

Ayeyarwady Delta Development Working Committee

- Members from Water Related Ministries and Regional Governments related to Ayeyarwady Delta, and some Advisory Group Member of NWRC
- Established in October 2016
- To facilitate and support cooperation, communication and information sharing for water related projects and activities in Ayeyarwady Delta among ministries, regional governments and international organizations
- Ayeyarwady delta development working groups
Water Resources and Disaster Management in Myanmar

**AIRBM Project**

(1) **Component 1**

Water Resources Institutions (NWRC, etc.), Decision Support Systems, Hydroinformatics Centre,

Ayeyarwady River Basin Master Plan, new Investments and Capacity Building

(2) **Component 2**

Hydromet Observation and Information Systems Modernization

(3) **Component 3**

Ayeyarwady River Navigation Enhancements from Mandalay to Nyaung U
Myanmar – Netherlands Cooperation

Learning by Doing Projects

- Meiktila Lake Area Development
- Pan Hlaing Control Sluice cum Navigation Lock
- Integrated Ayeyarwady Delta Strategy
- Leapfrogging Delta Management in Myanmar – New Innovation
- Flood Risk Management in Nyaung Done

Capacity Building Activities

- Young Water Professional Programme
- Myanmar Netherlands Water Challenge
- NICHE Project

- Bago-Sittaung Integrated Water System Analysis
- Feasibility Study on Mandalay-Bagan Navigability Improvement
- Bagan Multi-Purpose Pilot River Beautification
Some Development Activities in Ayeyarwady Delta

Flood Risk Management in Nyaung Done

Twante Canal Improvement Project

Pan Hlaing River Sluice

Water Supply System for Yangon
Erosion Protection places in Delta Region

- Myanaung Village
  - (1) No (1)
  - Near Thapyaybin
- Ingapu Village
  - (1) No (2)
  - Near Thapyaybin
  - (2) Gwaytaut
- Creek Village
  - Thatkalpyin Village
  - (3)
- Village
  - Thatkalpyin Village
  - (4)
- Kanbel Village
  - (5)
- Nyanggyo Village
  - (6)
- Laymyethna Village
  - Aithabyu
- Village
  - Yegyi Village
  - Kyein Chaung
- Village
  - Thabaung Village
  - Set daung Gyi
- Village
  - Kangyidaung Village
  - Shan Ngu
- Village
  - (1)
  - (2)
- Pathein Village
  - (1) Pathein Bridge
  - (2) Strand Road
  - (3) No (10) YayAoe
- Village
  - Sin
  - Pyapon, Strand Road
- Kyangin Village
  - (1) Yaynan Taung
  - Village
  - (2) Yaylel Kyun
  - Village
  - (3) Kyar inn Village
  - (4) Alon Village
- Village
  - Hinthada Village
  - (1)
  - (2) Zalun
  - Katoeseik Village
  - (2) Zalun
  - Pantanan Village
  - (3) Zalun
  - Yaylel Kyun Village
  - (4) Zalun
  - Anal Village
  - (1) Sarmalauk
  - Village
  - (2)
- Nyaungdon Village
  - (1) Sarmalauk
  - Village
  - (2)
- Shweaudaung monastary
  - (3)
  - Nyaungdon
  - Village
  - (4)
- Bomyattun
- Bridge
- Maubin Village
  - (1) No (10)
  - Village
  - (2)
  - Strand road
  - (3)
  - Maubin
  - Bridge
- Tontae Cannal Erosion protection works
- Dedaye Strand road

First Priority
Bank Erosion Protection Work in the Ayeyarwady Delta Region
(2016 – 2017 Fiscal Yr., Union Special Budget for Natural Disaster)

(1). Pathein bridge (Ngawon)

(2). Mayanchaung village (Danuphyu)

(3). Sankin village

(4). Laymyathna township, Htuparyone Pagoda

(5). Bomyathtun bridge waterway
1. Pathein bridge (Ngawon) bank erosion protection
1. Pathein bridge (Ngawon) bank erosion protection

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>Length</th>
<th>Cost (Mil MMK)</th>
<th>Progress</th>
<th>Starting date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bored pile based R.W</td>
<td>95 ft</td>
<td>93.263</td>
<td>100 %</td>
<td>20.1.2017</td>
<td>31.3.2017</td>
</tr>
<tr>
<td>2</td>
<td>Steel Cable Groyne</td>
<td>250 ft</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Mayanchaung village (Danuphyu) Bank erosion protection work
2. Mayanchaung village (Danuphyu) Bank erosion protection work

<table>
<thead>
<tr>
<th>No</th>
<th>Type</th>
<th>Vol.</th>
<th>Cost (Mil MMK)</th>
<th>Progress</th>
<th>Starting date</th>
<th>To be Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bored pile R.W</td>
<td>1120 ft</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Stone filled Myaw groyne</td>
<td>1150 ft</td>
<td>973.498</td>
<td>90 %</td>
<td>20.1.2017</td>
<td>10.6.2017</td>
</tr>
<tr>
<td>3</td>
<td>Steel Cable Groyne</td>
<td>1000 ft x 10 nos</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Floating Unit</td>
<td>11000 sq -ft</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Sankin village (Danuphyu) Bank erosion protection work
3. Sankin village bank erosion protection work

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>Vol.</th>
<th>Cost (Mil MMK)</th>
<th>Progress</th>
<th>Starting date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bored pile R.W</td>
<td>925 ft</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Toe protection stone filled Myaw groyne</td>
<td>1300 ft</td>
<td>971.578</td>
<td>97 %</td>
<td>20.1.2017</td>
<td>31.5.2017</td>
</tr>
<tr>
<td>3</td>
<td>Myaw post work</td>
<td>26000 sq - ft</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Coconut post groyne</td>
<td>720 ft x 2 nos</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After construction
4. Laymyathna township, Htuparyone Pagoda bank erosion protection work
4. Laymyathna township, Htuparyone Pagoda erosion protection work
### 4. Laymyathna township, Htuparyone Pagoda erosion protection work

<table>
<thead>
<tr>
<th>No</th>
<th>Type</th>
<th>Vol.</th>
<th>Cost (Mil MMK)</th>
<th>Progress</th>
<th>Starting date</th>
<th>To be Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bored pile R.W</td>
<td>500 ft</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Toe protection stone filled Myaw groyne &amp; Soda Mattress</td>
<td>500 ft x 2 nos</td>
<td>918.832</td>
<td>86 %</td>
<td>20.1.2017</td>
<td>10.6.2017</td>
</tr>
<tr>
<td>3</td>
<td>Dredging</td>
<td>126362 cu - m</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Location of Bomyathun bridge waterway conservation work, Nyaungdon township
### 5. Bomyahtun bridge waterway conservation work, Nyaungdon township

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>Vol.</th>
<th>Cost (Mil MMK)</th>
<th>Progress</th>
<th>Starting date</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dredging (3) places</td>
<td>428575 cu - m</td>
<td>251.103465</td>
<td>100 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sand cored groyne</td>
<td>150 M</td>
<td>232.679687</td>
<td>100 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sand cored groyne</td>
<td>300 M</td>
<td>448.113052</td>
<td>100 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sand cored groyne</td>
<td>400 M</td>
<td>596.963720</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Porcupine groyne</td>
<td>13 nos (2830 ft)</td>
<td>165.670253</td>
<td>100 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Steel Cable Groyne</td>
<td>150 ft x 14 nos.</td>
<td>38.838789</td>
<td>100 %</td>
<td>20.1.2017</td>
<td>20.5.2107</td>
</tr>
<tr>
<td>7</td>
<td>(i) Porcupine toe protection</td>
<td>1300 ft x 2 nos.</td>
<td>117.350451</td>
<td>100 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ii) Porcupine short spur</td>
<td>60 ft x 14 nos.</td>
<td>25.822186</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Bored pile R.W</td>
<td>615 ft</td>
<td>730.367534</td>
<td>98 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Steel Basket based R.W</td>
<td>225 ft</td>
<td>377.994864</td>
<td>97 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Tot.</strong></td>
<td></td>
<td><strong>2984.904</strong></td>
<td><strong>99 %</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Bomyathturn bridge waterway conservation work, Nyaungdon township
5. Bomyathun bridge waterway conservation work, Nyaungdon township

Bored pile R.W (615 ft) under construction

Steel basket based revetment (225 ft) under struction
5. Bomyahtun bridge waterway conservation work, Nyaungdon township

Steel basket based revetment (225 ft) & Bored pile R.W (615 ft) after construction

21 Aug, 2016

20 Jan, 2017

20 May, 2017
5. Bomyathun bridge waterway conservation work, Nyaungdon township
5. Bomyathun bridge waterway conservation work, Nyaungdon township

Porcupine installation
5. Bomyathun bridge waterway conservation work, Nyaungdon township

Sand cored groynes (3 nos. - 150 M, 300M & 400M)
Ayeyarwady delta region is flooded and eroded because of high sedimentation and composed by sandy soil. It is essential to implement 12 bank protection works in 2016-2017 financial year to prevent 1900 houses, 1,000 acres of land, 2 religious buildings, 14 monasteries, 2 Bridges, 10 schools and 9 earth fill dikes from erosion.
Improvement of Twante Canal Project
**Project Scope (Phase 1: Channel Training & Flood Embankment)**

- **Channel Training**: to reduce the flow velocity at the tidal flow and to stabilize the flow field along Twante Canal

- **Flood Embankment**: to secure the design flood level during the largest spring tide
Multi-purpose Barrages: to secure constant safe ship navigation, mitigate the flood risk during the largest spring tide, and provide abundant fresh water from the upper Ayeyarwady
Water Quality Test places in the Ayeyarwady Delta
### 2011 Water Quality Result Data (Delta Area)

<table>
<thead>
<tr>
<th>2011-March</th>
<th>PH</th>
<th>Temp (°C)</th>
<th>D.O. (mg/L)</th>
<th>Iron (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Chlorine (mg/L)</th>
<th>Alkalinity (mg/L)</th>
<th>Hardness (mg/L)</th>
<th>Ammonia (mg/L)</th>
<th>Nitrate (mg/L)</th>
<th>Fluoride (mg/L)</th>
<th>Turbidity (NTU)</th>
<th>Nitrite (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed National Drinking Water Quality Standard</td>
<td>6.5-8.5</td>
<td>-</td>
<td>5</td>
<td>1</td>
<td>250</td>
<td>&lt;0.5</td>
<td>&gt;20</td>
<td>500</td>
<td>1.5</td>
<td>50</td>
<td>1.5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>1 Kyankhin</td>
<td>7.2</td>
<td>27.7</td>
<td>4.6</td>
<td>0.015</td>
<td>58</td>
<td>0.04</td>
<td>135</td>
<td>42</td>
<td>0.91</td>
<td>0.32</td>
<td>1.25</td>
<td>30</td>
<td>5</td>
</tr>
<tr>
<td>2 Myaung</td>
<td>7.38</td>
<td>32.4</td>
<td>3.99</td>
<td>0.23</td>
<td>315</td>
<td>0.04</td>
<td>130</td>
<td>65</td>
<td>0.07</td>
<td>0.2</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3 Hinthada</td>
<td>7.18</td>
<td>32</td>
<td>5.22</td>
<td>0.12</td>
<td>211</td>
<td>0.04</td>
<td>150</td>
<td>65</td>
<td>&gt;1.0</td>
<td>0.7</td>
<td>1.5</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>4 Zalun</td>
<td>7.18</td>
<td>32.3</td>
<td>6.08</td>
<td>0.15</td>
<td>355</td>
<td>0.04</td>
<td>145</td>
<td>65</td>
<td>0.11</td>
<td>0.8</td>
<td>1.5</td>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td>5 Aphauk</td>
<td>7.21</td>
<td>30.4</td>
<td>5.7</td>
<td>0.15</td>
<td>410</td>
<td>0.05</td>
<td>155</td>
<td>56</td>
<td>0.47</td>
<td>0.1</td>
<td>1.1</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>6 Danuphyu</td>
<td>7.15</td>
<td>31.5</td>
<td>5.7</td>
<td>0.12</td>
<td>260</td>
<td>0.18</td>
<td>155</td>
<td>60</td>
<td>0.96</td>
<td>0.8</td>
<td>1.35</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>7 Naungdone</td>
<td>7.25</td>
<td>29.9</td>
<td>5.71</td>
<td>0.165</td>
<td>270</td>
<td>0.04</td>
<td>160</td>
<td>70</td>
<td>0.77</td>
<td>0.24</td>
<td>1.5</td>
<td>22</td>
<td>5</td>
</tr>
</tbody>
</table>

### 2012 Water Quality Result Data (Delta Area)

<table>
<thead>
<tr>
<th>2012-March</th>
<th>PH</th>
<th>Temp (°C)</th>
<th>D.O. (mg/L)</th>
<th>Iron (mg/L)</th>
<th>Chloride (mg/L)</th>
<th>Chlorine (mg/L)</th>
<th>Alkalinity (mg/L)</th>
<th>Hardness (mg/L)</th>
<th>Ammonia (mg/L)</th>
<th>Nitrate (mg/L)</th>
<th>Fluoride (mg/L)</th>
<th>Turbidity (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed National Drinking Water Quality Standard</td>
<td>6.5-8.5</td>
<td>-</td>
<td>5</td>
<td>1</td>
<td>250</td>
<td>&lt;0.5</td>
<td>&gt;20</td>
<td>500</td>
<td>1.5</td>
<td>50</td>
<td>1.5</td>
<td>5</td>
</tr>
<tr>
<td>1 Kyankhin</td>
<td>6.81</td>
<td>28.7</td>
<td>6.81</td>
<td>0.645</td>
<td>166</td>
<td>0.29</td>
<td>197</td>
<td>90</td>
<td>0.59</td>
<td>&gt;1.0</td>
<td>0.2</td>
<td>140</td>
</tr>
<tr>
<td>2 Myaung</td>
<td>8.68</td>
<td>27.3</td>
<td>6.57</td>
<td>0.515</td>
<td>232</td>
<td>0.23</td>
<td>197</td>
<td>102</td>
<td>&gt;1.0</td>
<td>1</td>
<td>1.3</td>
<td>145</td>
</tr>
<tr>
<td>3 Hinthada</td>
<td>8.23</td>
<td>28.8</td>
<td>6.75</td>
<td>0.59</td>
<td>&gt;500</td>
<td>0.13</td>
<td>214</td>
<td>122</td>
<td>&gt;1.0</td>
<td>0.9</td>
<td>1.2</td>
<td>150</td>
</tr>
<tr>
<td>4 Zalun</td>
<td>8.07</td>
<td>28.3</td>
<td>5.66</td>
<td>0.375</td>
<td>335</td>
<td>0.14</td>
<td>180</td>
<td>106</td>
<td>0.74</td>
<td>0.65</td>
<td>0.1</td>
<td>95</td>
</tr>
<tr>
<td>5 Aphauk</td>
<td>8.07</td>
<td>29.1</td>
<td>6.6</td>
<td>0.33</td>
<td>&gt;500</td>
<td>0.05</td>
<td>165</td>
<td>47</td>
<td>&gt;1.0</td>
<td>0.47</td>
<td>0.35</td>
<td>140</td>
</tr>
<tr>
<td>6 Zokargyi</td>
<td>8.16</td>
<td>28.9</td>
<td>6.4</td>
<td>0.15</td>
<td>100</td>
<td>0.18</td>
<td>145</td>
<td>0</td>
<td>&gt;1.0</td>
<td>0.42</td>
<td>0.55</td>
<td>58</td>
</tr>
<tr>
<td>7 Dhanuphyu</td>
<td>7.91</td>
<td>28.4</td>
<td>6.83</td>
<td>0.365</td>
<td>112</td>
<td>0.11</td>
<td>170</td>
<td>56</td>
<td>0.16</td>
<td>0.42</td>
<td>1.3</td>
<td>25</td>
</tr>
<tr>
<td>8 Naungdone</td>
<td>8.89</td>
<td>28.4</td>
<td>12.99</td>
<td>0.95</td>
<td>182</td>
<td>0.19</td>
<td>208</td>
<td>70</td>
<td>0.16</td>
<td>1</td>
<td>1.4</td>
<td>65</td>
</tr>
<tr>
<td>9 Maubon</td>
<td>8.38</td>
<td>28.3</td>
<td>9.78</td>
<td>0.385</td>
<td>211</td>
<td>0.19</td>
<td>130</td>
<td>35</td>
<td>0.13</td>
<td>&gt;1.0</td>
<td>1.1</td>
<td>45</td>
</tr>
<tr>
<td>10 Twante</td>
<td>7.95</td>
<td>26.6</td>
<td>12.85</td>
<td>1.895</td>
<td>206</td>
<td>0.11</td>
<td>352</td>
<td>355</td>
<td>&gt;1.0</td>
<td>0.43</td>
<td>1.1</td>
<td>200</td>
</tr>
</tbody>
</table>
## 2013 Water Quality Result Data (Delta Area)

<table>
<thead>
<tr>
<th>2013-March</th>
<th>Chloride (mg/l)</th>
<th>Chlorine (mg/l)</th>
<th>Iron (mg/l)</th>
<th>Ammoniac (mg/l)</th>
<th>Hardness (mg/l)</th>
<th>Nitrate (mg/l)</th>
<th>Alkalinity (mg/l)</th>
<th>Fluoride (mg/l)</th>
<th>pH</th>
<th>Temp (°C)</th>
<th>D.O. (mg/l)</th>
<th>Turbidity (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed National Drinking Water Quality Standard</td>
<td>250</td>
<td>&lt;0.5</td>
<td>1</td>
<td>1.5</td>
<td>500</td>
<td>50</td>
<td>&gt;20</td>
<td>1.5</td>
<td>6.5-8.5</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Kyankhin</td>
<td>180</td>
<td>0.21</td>
<td>0.66</td>
<td>0.95</td>
<td>95</td>
<td>1</td>
<td>197</td>
<td>0.25</td>
<td>7.4</td>
<td>17.3</td>
<td>16.81</td>
</tr>
<tr>
<td>2</td>
<td>Myaungaung</td>
<td>500</td>
<td>0.13</td>
<td>0.95</td>
<td>1</td>
<td>110</td>
<td>0.12</td>
<td>214</td>
<td>1.5</td>
<td>7.3</td>
<td>27</td>
<td>16.7</td>
</tr>
<tr>
<td>3</td>
<td>Hinthada</td>
<td>500</td>
<td>0.52</td>
<td>0.9</td>
<td>0.45</td>
<td>85</td>
<td>0.15</td>
<td>145</td>
<td>1.5</td>
<td>8</td>
<td>26.8</td>
<td>6.9</td>
</tr>
<tr>
<td>4</td>
<td>Zalun</td>
<td>240</td>
<td>0.49</td>
<td>0.185</td>
<td>0.02</td>
<td>108</td>
<td>0.26</td>
<td>165</td>
<td>0.4</td>
<td>8</td>
<td>27</td>
<td>7.7</td>
</tr>
<tr>
<td>5</td>
<td>Dhanuphyu</td>
<td>120</td>
<td>0.14</td>
<td>0.31</td>
<td>0.23</td>
<td>85</td>
<td>0.24</td>
<td>160</td>
<td>1.5</td>
<td>7.8</td>
<td>29.6</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>Naungdone</td>
<td>500</td>
<td>0.13</td>
<td>0.12</td>
<td>0.26</td>
<td>115</td>
<td>0.35</td>
<td>160</td>
<td>1.45</td>
<td>8.2</td>
<td>28</td>
<td>10.33</td>
</tr>
<tr>
<td>7</td>
<td>Maubon</td>
<td>120</td>
<td>0.02</td>
<td>0.39</td>
<td>0.03</td>
<td>80</td>
<td>1</td>
<td>150</td>
<td>1.4</td>
<td>8.5</td>
<td>28.5</td>
<td>13.35</td>
</tr>
<tr>
<td>8</td>
<td>Twante</td>
<td>200</td>
<td>0.12</td>
<td>1.92</td>
<td>1</td>
<td>300</td>
<td>0.42</td>
<td>250</td>
<td>1.2</td>
<td>27.5</td>
<td>27.5</td>
<td>16.12</td>
</tr>
</tbody>
</table>

- Normal Range
- Below Normal Range
- Above Normal Range

## 2014 Water Quality Result Data (Delta Area)

<table>
<thead>
<tr>
<th>2014-March</th>
<th>PH</th>
<th>Temp (°C)</th>
<th>D.O. (mg/l)</th>
<th>Iron (mg/l)</th>
<th>Chloride (mg/l)</th>
<th>Chlorine (mg/l)</th>
<th>Alkalinity (mg/l)</th>
<th>Hardness (mg/l)</th>
<th>Ammonia (mg/l)</th>
<th>Nitrate (mg/l)</th>
<th>Fluoride (mg/l)</th>
<th>Turbidity (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed National Drinking Water Quality Standard</td>
<td>6.5-8.5</td>
<td>5</td>
<td>1</td>
<td>250</td>
<td>&lt;0.5</td>
<td>&gt;20</td>
<td>500</td>
<td>1.5</td>
<td>50</td>
<td>1.5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Kyankhin</td>
<td>5.8</td>
<td>–</td>
<td>–</td>
<td>0.805</td>
<td>380</td>
<td>0.14</td>
<td>202</td>
<td>115</td>
<td>0.1</td>
<td>0.33</td>
<td>1.55</td>
</tr>
<tr>
<td>2</td>
<td>Myaungaung</td>
<td>6.5</td>
<td>–</td>
<td>–</td>
<td>0.165</td>
<td>94</td>
<td>0</td>
<td>135</td>
<td>95</td>
<td>0.07</td>
<td>0.37</td>
<td>0.05</td>
</tr>
<tr>
<td>3</td>
<td>Hinthada</td>
<td>4.4</td>
<td>–</td>
<td>–</td>
<td>0.685</td>
<td>205</td>
<td>0.19</td>
<td>150</td>
<td>108</td>
<td>0</td>
<td>0.26</td>
<td>1.2</td>
</tr>
<tr>
<td>4</td>
<td>Zalun</td>
<td>5.9</td>
<td>–</td>
<td>–</td>
<td>0.025</td>
<td>410</td>
<td>0.74</td>
<td>120</td>
<td>95</td>
<td>0.01</td>
<td>0.37</td>
<td>1.55</td>
</tr>
<tr>
<td>5</td>
<td>Dhanuphyu</td>
<td>6.2</td>
<td>–</td>
<td>–</td>
<td>0.02</td>
<td>285</td>
<td>0.18</td>
<td>135</td>
<td>80</td>
<td>0</td>
<td>0.23</td>
<td>1.06</td>
</tr>
<tr>
<td>6</td>
<td>Naungdone</td>
<td>8.4</td>
<td>–</td>
<td>–</td>
<td>0.025</td>
<td>335</td>
<td>0.05</td>
<td>160</td>
<td>130</td>
<td>0</td>
<td>0</td>
<td>1.4</td>
</tr>
<tr>
<td>7</td>
<td>Maubon</td>
<td>8.9</td>
<td>–</td>
<td>–</td>
<td>0.35</td>
<td>150</td>
<td>0.12</td>
<td>150</td>
<td>100</td>
<td>0.05</td>
<td>0.35</td>
<td>1.3</td>
</tr>
<tr>
<td>8</td>
<td>Twante</td>
<td>8.5</td>
<td>–</td>
<td>–</td>
<td>1.85</td>
<td>230</td>
<td>0.16</td>
<td>250</td>
<td>370</td>
<td>1.8</td>
<td>0.45</td>
<td>1.5</td>
</tr>
</tbody>
</table>

- Normal Range
- Below Normal Range
- Above Normal Range
## 2015 Water Quality Result Data (Delta Area)

<table>
<thead>
<tr>
<th>2015-March</th>
<th>Chloride (mg/l)</th>
<th>Iron (mg/l)</th>
<th>Ammonia (mg/l)</th>
<th>Hardness (mg/l)</th>
<th>Nitrate (mg/l)</th>
<th>Alkalinity (mg/l)</th>
<th>Fluoride (mg/l)</th>
<th>pH</th>
<th>Temp (°C)</th>
<th>D.O (mg/l)</th>
<th>Turbidity (NTU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed National Drinking Water Quality Standard</td>
<td>250</td>
<td>1</td>
<td>1.5</td>
<td>500</td>
<td>50</td>
<td>&gt;20</td>
<td>1.5</td>
<td>6.5-8.5</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Kyankhinn</td>
<td>180</td>
<td>0.66</td>
<td>0.95</td>
<td>95</td>
<td>1</td>
<td>197</td>
<td>0.25</td>
<td>7.4</td>
<td>17.3</td>
<td>16.81</td>
</tr>
<tr>
<td>2</td>
<td>Myaungaung</td>
<td>500</td>
<td>0.95</td>
<td>1</td>
<td>110</td>
<td>0.12</td>
<td>214</td>
<td>1.5</td>
<td>7.3</td>
<td>27</td>
<td>16.7</td>
</tr>
<tr>
<td>3</td>
<td>Hinnthata</td>
<td>500</td>
<td>0.9</td>
<td>0.45</td>
<td>85</td>
<td>0.15</td>
<td>145</td>
<td>1.5</td>
<td>8</td>
<td>26.8</td>
<td>6.9</td>
</tr>
<tr>
<td>4</td>
<td>Zalun</td>
<td>240</td>
<td>0.185</td>
<td>0.02</td>
<td>108</td>
<td>0.26</td>
<td>165</td>
<td>0.4</td>
<td>8</td>
<td>27</td>
<td>7.7</td>
</tr>
<tr>
<td>5</td>
<td>Danuphyu</td>
<td>120</td>
<td>0.31</td>
<td>0.23</td>
<td>85</td>
<td>0.24</td>
<td>160</td>
<td>1.5</td>
<td>7.8</td>
<td>29.6</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>Naungdone</td>
<td>500</td>
<td>0.12</td>
<td>0.26</td>
<td>115</td>
<td>0.35</td>
<td>160</td>
<td>1.45</td>
<td>8.2</td>
<td>28</td>
<td>10.33</td>
</tr>
<tr>
<td>7</td>
<td>MaUbin</td>
<td>120</td>
<td>0.39</td>
<td>0.03</td>
<td>80</td>
<td>1</td>
<td>150</td>
<td>1.4</td>
<td>8.5</td>
<td>28.5</td>
<td>13.35</td>
</tr>
<tr>
<td>8</td>
<td>Twante</td>
<td>200</td>
<td>1.92</td>
<td>1</td>
<td>300</td>
<td>0.42</td>
<td>250</td>
<td>1.2</td>
<td>7.5</td>
<td>27.5</td>
<td>16.12</td>
</tr>
</tbody>
</table>

[Normal Range] [Below Normal Range] [Above Normal Range]