REGULATORY APPROACH FOR WATER QUALITY PROTECTION IN CHILE

KEY ASPECTS TO BE CONSIDERED
MEETING THE LAKE

- Is an oligotrophic lake located in the south of Chile, at the head of the Maullín River Watershed.
- Llanquihue means “submerged place”.
- Has a glacial origin, about 11,000 years ago.
- Its watershed is shared by 4 municipalities.
- Is one of the most important touristic destinations in the country.
- Is the first one to be protected by a water quality standard.
• Total Area of the Basin: 1.607 Km2

• 870,5 Km² - lake (53,9%)
• 357 Km² - praries (22,2%)
• 296 Km² - forest (18,4%)
• 28 Km² - srubs (2,8%)
• 10,6 Km² - snow (0,65%)
• 6,02 Km² - cities (0,43%)
Lake Llanquihue

**Morphology**
- Volume: 158.6 km³
- Surface Area: 870.5 km²
- Length and width: 42.3 km - 39.0 km
- Length of shoreline: 196.5 km
- Maximum depth: 317 m
- Mean depth: 182 m
- Change of Level: 0.75 m (average)
- Precipitation: 2033 mm/year (average)

**Inflow** (more than 9 small rivers)
- (RB) 4.9 m³/s; (RBA) 1.8 m³/s; (RT) 2 m³/s

**Outflow**
- One outlet: 79 m³/s

**Retention time**: 74 years

**Lake Llanquihue’s Water Quality**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Puerto Octay</th>
<th>Frutillar</th>
<th>Ensenada</th>
<th>Puerto Varas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductivity</td>
<td>µS/cm</td>
<td>87</td>
<td>86.7</td>
<td>87.3</td>
<td>85.9</td>
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<tr>
<td>Temperature</td>
<td></td>
<td>13.2</td>
<td>13.3</td>
<td>12.8</td>
<td>13.1</td>
</tr>
<tr>
<td>PH</td>
<td></td>
<td>7.5</td>
<td>7.6</td>
<td>7.6</td>
<td>7.6</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>mg/l</td>
<td>91.9</td>
<td>90.9</td>
<td>89.4</td>
<td>93.3</td>
</tr>
<tr>
<td>Dissolved Oxygen % Sat</td>
<td></td>
<td>1.6</td>
<td>1.7</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>1.4</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Silica</td>
<td>mg/l</td>
<td>8.2</td>
<td>7.0</td>
<td>9.3</td>
<td>7.7</td>
</tr>
<tr>
<td>COD</td>
<td>mg/l</td>
<td>13.5</td>
<td>13.9</td>
<td>16.0</td>
<td>12.5</td>
</tr>
<tr>
<td>Transparency</td>
<td>m</td>
<td>93.9</td>
<td>101.3</td>
<td>91.4</td>
<td>97.1</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>µg/l</td>
<td>7.4</td>
<td>7.5</td>
<td>8.5</td>
<td>7.9</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>µg/l</td>
<td>0.96</td>
<td>0.91</td>
<td>0.94</td>
<td>0.99</td>
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<tr>
<td>Chlorophyll a</td>
<td>µg/l</td>
<td>7.6</td>
<td>7.6</td>
<td>7.6</td>
<td>7.6</td>
</tr>
</tbody>
</table>

**Lake Llanquihue**

**Measurement**
- Inflow: 79 m³/s
- Outflow: 79 m³/s

**Retention time**: 74 years
At present time lake Llanquihue supports several uses of its waters, including recreation, drinking water supply, aquaculture, industrial water supply and esthetic contemplation.

The deterioration of its water quality will damage the actual uses of the lake and will implicate both economical and ecological consequences.

Since there are no severe problems with water quality, the willingness to implement environmental management is quite low.

Chile’s legal framework allows the establishment of environmental quality standards for use in environmental management.

In spite of this favorable legal scenario, setting the standard has required many years and has caused many controversies.
MANAGEMENT SYSTEM BASED ON ENVIRONMENTAL QUALITY STANDARDS

There are two kinds of environmental standards: Primary to protect human health and Secondary to protect the environment.

Once an environmental standard is established, the compliance must be evaluated through monitoring.

According to the monitoring results, the government MUST dictate a Latent or a Saturated zone (if values are above 80% or 100% of the standard value, respectively).

If a zone is classified as Latent or Saturated, the government MUST elaborate a Prevention or Decontamination Plan, respectively.
Water quality standards must satisfy a regulated procedure before its formal establishment.

The adequate completion of every stage helps to build a more effective regulation.

The realization of studies to collect data and conduct its further interpretation will help to foster “lake experts” and build strong technical arguments to support the initiative.

The formation of public-private committees and the citizen participation helps to build governance for the further application of the standard.
GENERATING A COMPREHENSIVE CONCEPTUAL MODEL TO BUILD CONSENSUS

When working with groups or committees, it is important to rise agreement on basic objectives.

This simple model helped not only to understand the importance of working on a water quality standard, but also to actively involve several actors from different disciplines.

It is important to dedicate time to manage a common language and to listen and understand all involved actors.
UNDERSTANDING A LAKE’S ESSENTIAL CHARACTERISTICS CAN HELP TO IMPROVE MANAGEMENT

Lakes have......

Integrating Nature:
• Build strong relation with Science and Investigation
• Encourage Cause-Effect research.

Long Retention Time:
• Go beyond administrative boundaries
• Seek for coherence and coordination of different actors and their capacities.

Complex Dynamics:
• Build local awareness and long term commitment.
• Establish long term monitoring
• Ensure long term financing.
• Build strong relation with Science and Investigation
• Encourage Cause-Effect research.
In big, clean lakes such as lake Llanquihue, nutrients concentration starts to increase at a very slow rate, in a beginning (A-B).

When symptoms of eutrophication can be observed (B), concentrations of nutrients have increased significantly.

Preventive monitoring can detect small changes in water quality that can be more easily reverted.

Reactive monitoring will reveal quick and significant changes in water quality, more complex to manage.

Adapted from: “Managing Lakes and their Basins for Sustainable Use” (ILEC- 2005)
ADVANTAGES OF WATER QUALITY STANDARD CONTROL AS A PREVENTIVE INSTRUMENT

If monitoring accuses water quality changes, a management plan can be implemented.

In a preventive approach, it can be seen that for a significant reduction of nutrients concentration it will take shorter time and resources if compared with a reactive approach.

Waiting for a lake to become a problem can become “the” biggest problem to be solved.

Prevention of a lake becoming a problem can help to save time and resources for its management.
ADVANTAGES OF WATER QUALITY STANDARD CONTROL AS A PREVENTIVE INSTRUMENT

ECONOMIC BENEFITS OF REGULATION

• Stability or increase of properties value.
• Stability or increase of abatement costs for drinking water supply.
• Long time viability for turistic and recreational activities (bathing, fishing, navigation).
• Major development of turistic investments.
• Conservation of biodiversity and environmental services related to the lake’s water quality.

ECONOMIC RISKS OF NO ACTION

• Management of uncomforted lake’s users.
• Decrease of properties value.
• Decrease of turistic activities and investments.
• Viability risk for aquaculture and sport fishing.
• Loss of biodiversity and environmental services.
LESSONS OF THE PROCESS:

• 1: Know and understand if the legislative system supports (or not) a project for water quality management and build powerful and simple statements based on that.

• 2: “Watchening” (watch + listen) every opinion and make a more complex classification of them instead of “agree or disagree” will help a more constructive coordination.

• 3: Ensuring good quality data will ensure good quality decisions.

• 4: Starting with a simple management tool such as a water quality standard can lead to the establishment of a more complex and integrated tool.

• 5: Interacting and working closely with the community can significantly help to improve and ensure management effectiveness.