FIA TECHNOLOGY

VEGETATED FLOATING ISLANDS FOR WATER QUALITY IMPROVEMENT AND WILDLIFE HABITAT CREATION

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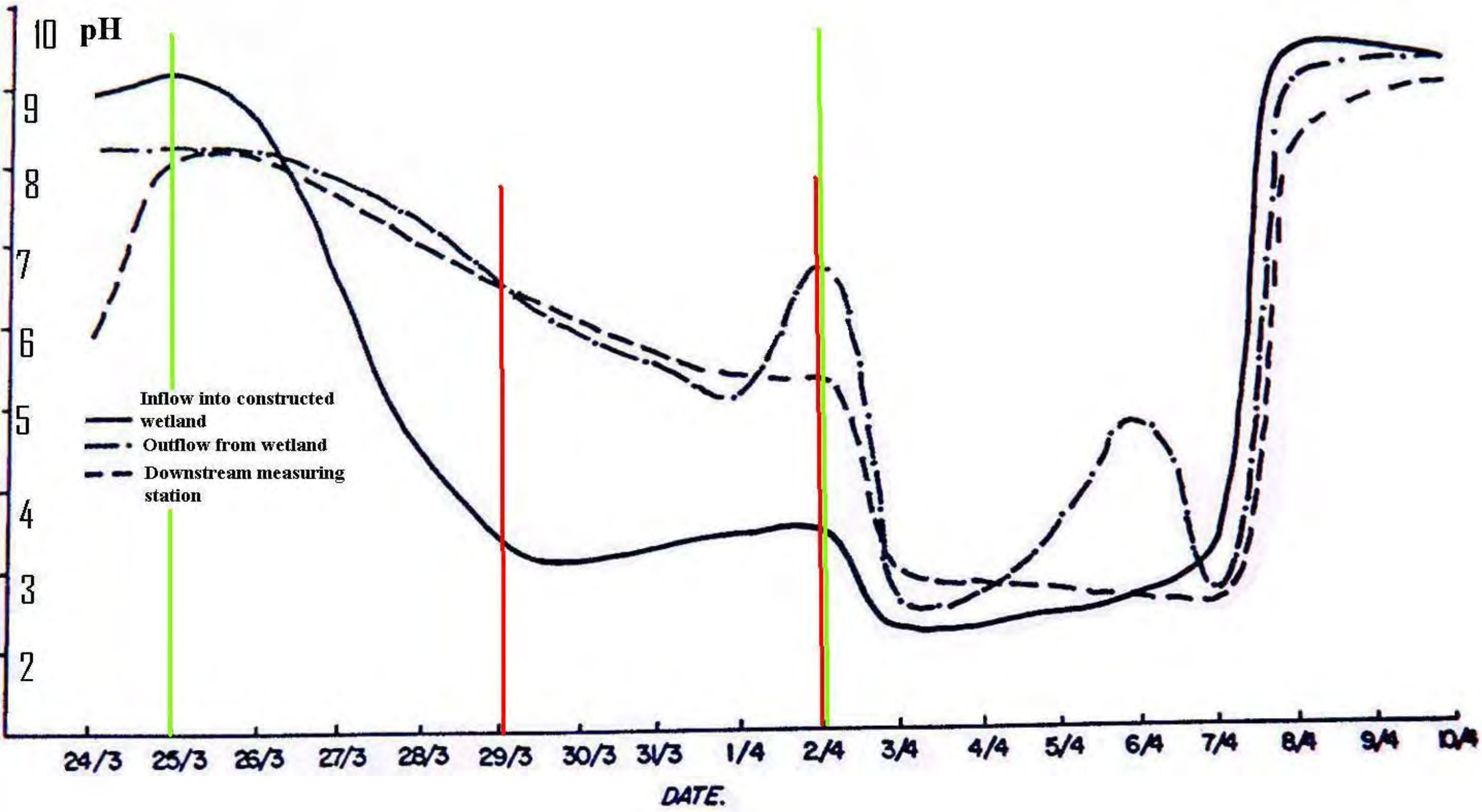
pH
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Inflow into constructed wetland
Outflow from wetland
Downstream measuring station
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DATE.

FII concluded best removal rates obtained by their floating islands under laboratory conditions were:

* NH4 - 1.3 kg/m2/year
* NO3 - 41.6 kg/m2/year
* PO3 - 1.7 kg/m2/year

Hammer (1990): “Water purification functions of wetlands are dependent upon four principle components – vegetation, water column, substrates and microbial populations”.

Multi-phase involvement of bacteria in nutrient removal was recognised by Fisher (1990): “Micro-organisms which proliferate in the aerobic root zone in an artificial wetland can stabilise organics and nitrify ammonium to nitrate. As the wastewater then flows into anoxic zones within the wetland, microbially mediated denitrification can convert nitrate to nitrogen gas which is then released to the atmosphere.”

IMPORTANCE OF PLANTS ON FLOATING ISLANDS

* Vegetation moves oxygen into the underlying substrate, stimulating nitrification of ammonia and the breakdown of biological oxygen demand (Gersberg et al 1986).
* Artificial wetland filters with plants had higher oxygen concentrations, pH, redox potential and metal retention than in systems without plants (Dunbabin 1988).
* Efficient nitrate removal from wetlands depends on denitrification which is supported by macrophytes which supply organic carbon (Weisner et al 1994).
* Planted sub-surface-flow treatment wetlands showed enhanced nitrogen and initial phosphorous removal, mainly by promoting transformations to gaseous forms and sequestration in accumulating organic matter (Tanner 2001).

THREE KEY MESSAGES:

1.

Bacterial biofilms develop on all physical surfaces within a wetland and these bacteria, within and beneath floating islands, supplemented by oxygen and carbon from plants, do the bulk of the pollution-reduction work.

2.

While N generally escapes to the atmosphere after bacterial degradation of NH_4, NO_2 and NO_3, P is taken up within organic matter, eventually falling to the bottom of the wetlands where it can become biologically available under altered physical and chemical conditions.

3.

Vegetated floating islands massively increase the surface area of biofilm within a wetland, enhancing the wetland’s ability to reduce nutrient and other pollutants within inflowing water.

Stewart (2008): each square foot of floating island is about 8 times more effective than each square foot of wetland for removing nitrate.

FII's research gave removal rates in outdoor and laboratory test ponds of:

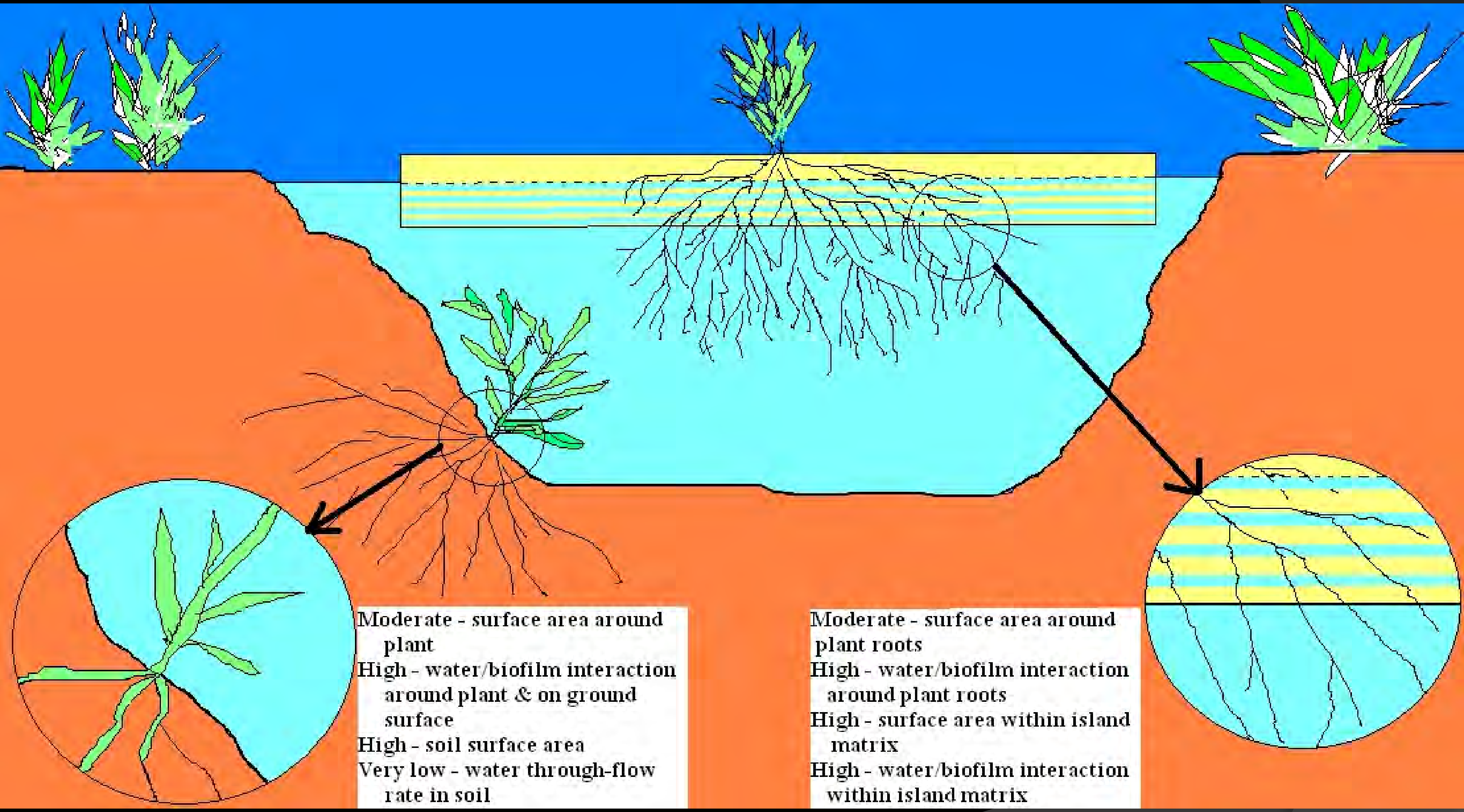
- ammonium - 1.3 to 3.0 kg/m^2/year
- nitrate - 3.0 to 41.6 kg/m^2/year
- phosphate - 0.4 to 1.7 kg/m^2/year
- BOD - 2.2 kg/m^2/year

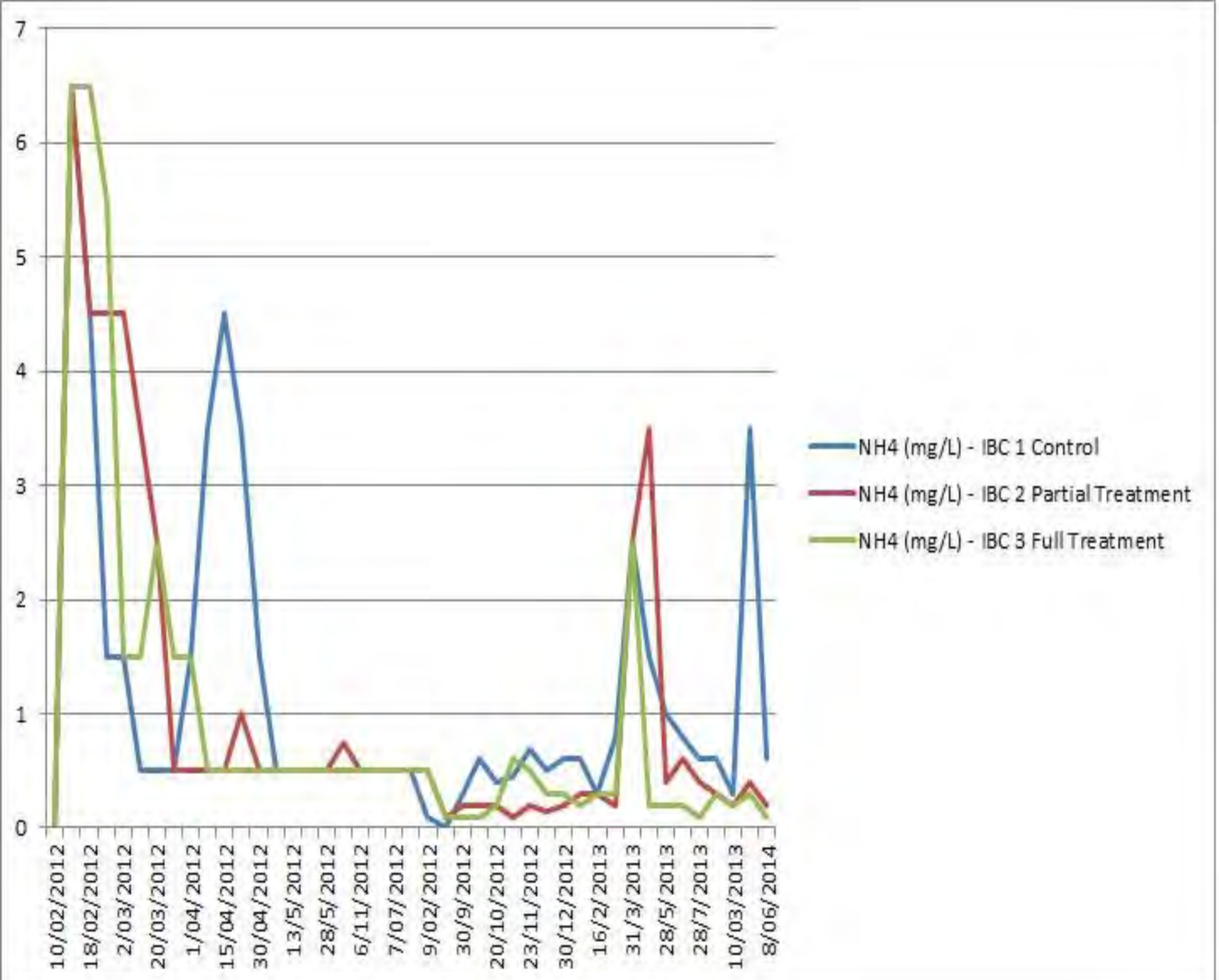
Dodkins and Mendzil (2014): vegetated floating islands have many benefits over free water surface wetlands:

* Plant roots filter and settle sediment-bound P and metals.
* Plant roots provide a large surface area for micro-organism activity in decomposition, nitrification and denitrification (removal of BOD and N).
* Floating islands assist denitrification by mildly acidifying water via release of humic acids and carbon.
* A longer retention time is possible as pond volume can be increased without submerging the vegetation.

Borne (2014) compared the performance of phosphorus in 2 stormwater retention ponds, one with a floating wetland and one without any vegetation:

* a vegetated floating island significantly improved P removal - 27% lower total P than the conventional pond
* the low redox potential sediment below the floating island did not induce P release probably due to the more neutral pH conditions allowing re-adsorption onto organics and/or clay minerals. This resulted in higher P sediment accumulation in the treatment pond.
* P uptake by plants is not thought to be a significant removal pathway


Moderate - surface area around plant
High - water/biofilm interaction around plant & on ground surface
High - soil surface area
Very low - water through-flow rate in soil
Moderate - surface area around plant roots
High - water/biofilm interaction around plant roots
High - surface area within island matrix
High - water/biofilm interaction within island matrix



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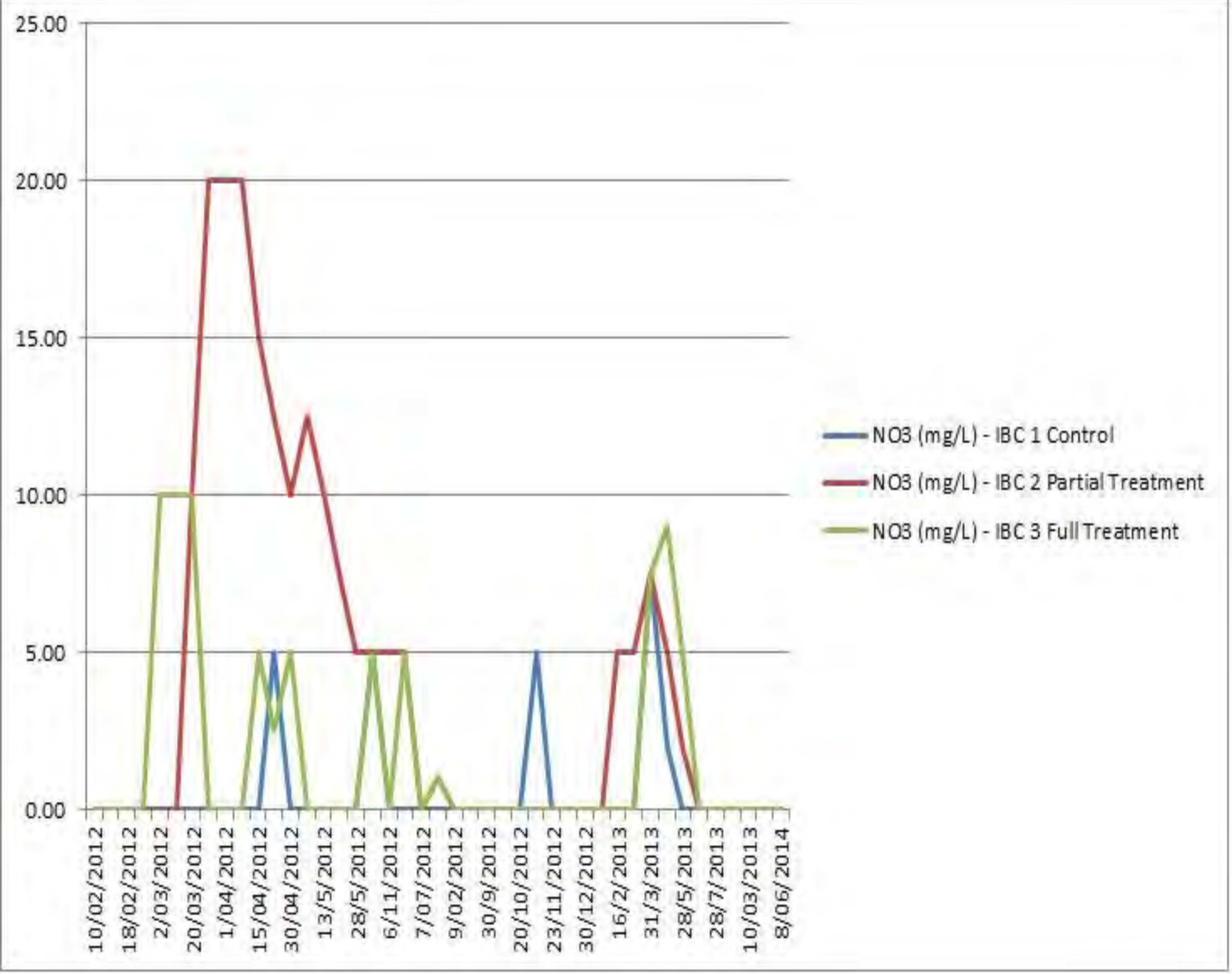
8/06/2014
NH4 (mg/L) - IBC 1 Control
NH4 (mg/L) - IBC 2 Partial Treatment
NH4 (mg/L) - IBC 3 Full Treatment



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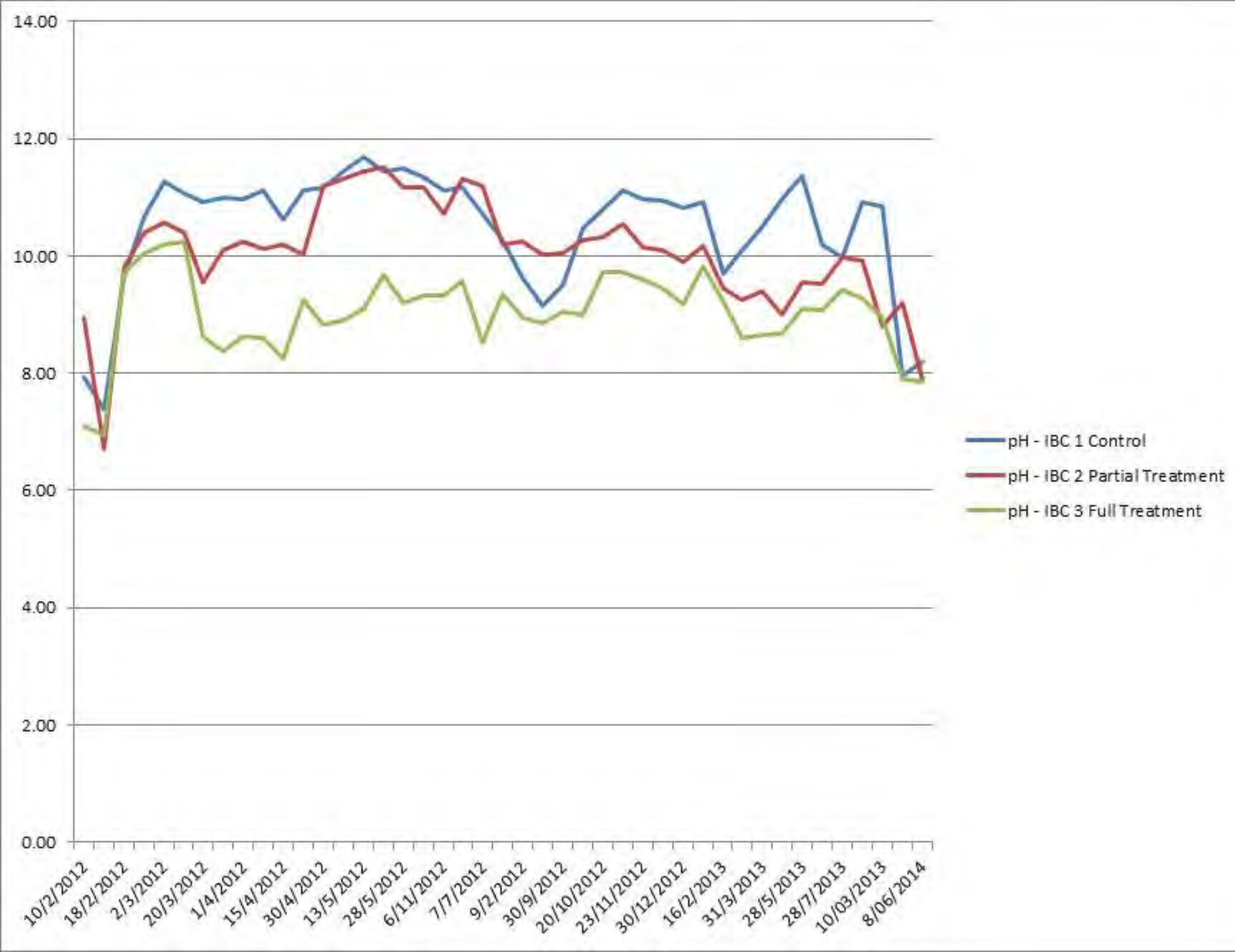
NO3 (mg/L) - IBC 1 Control
NO3 (mg/L) - IBC 2 Partial Treatment
NO3 (mg/L) - IBC 3 Full Treatment



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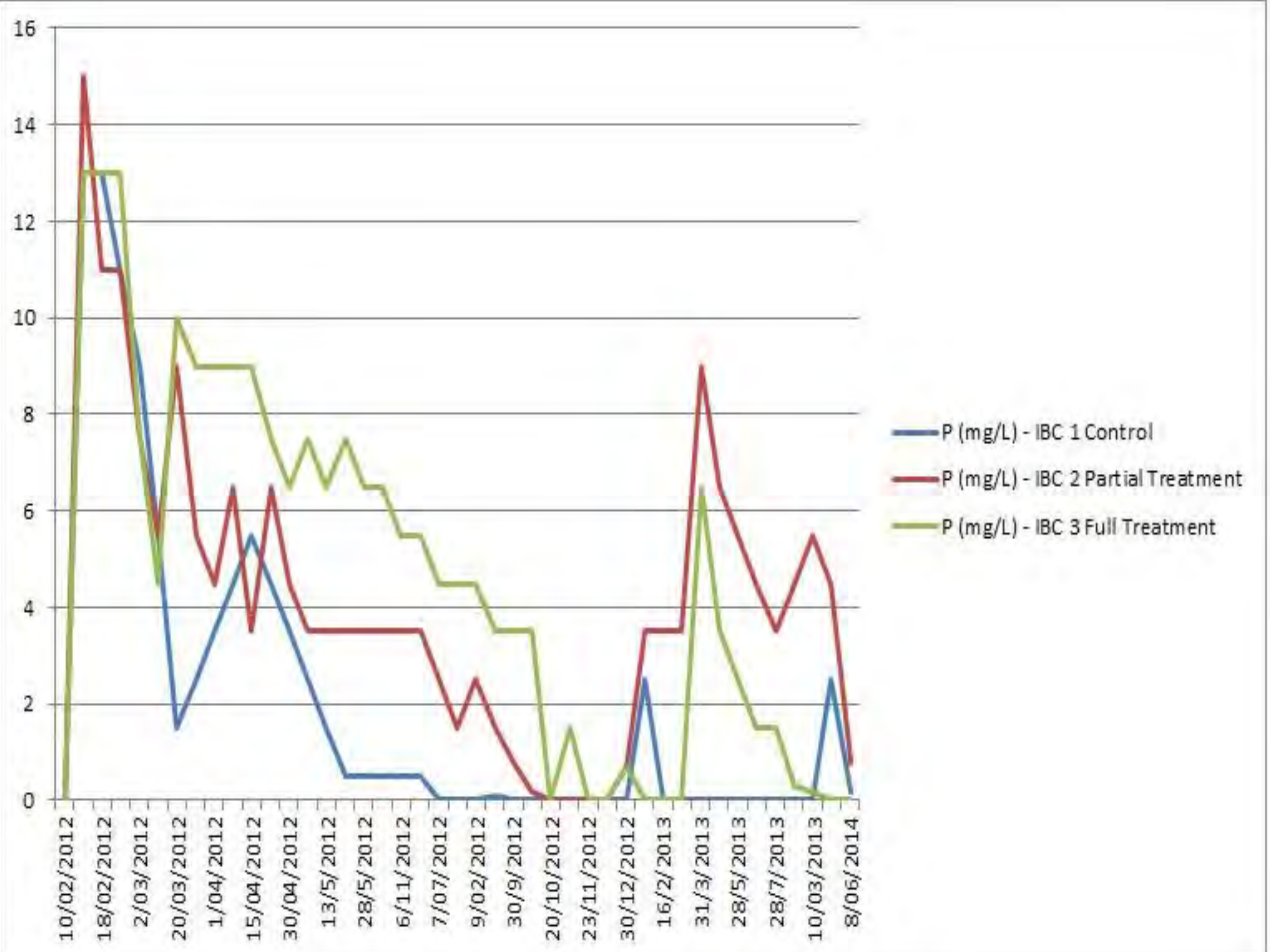
pH - IBC 1 Control
pH - IBC 2 Partial Treatment
pH - IBC 3 Full Treatment



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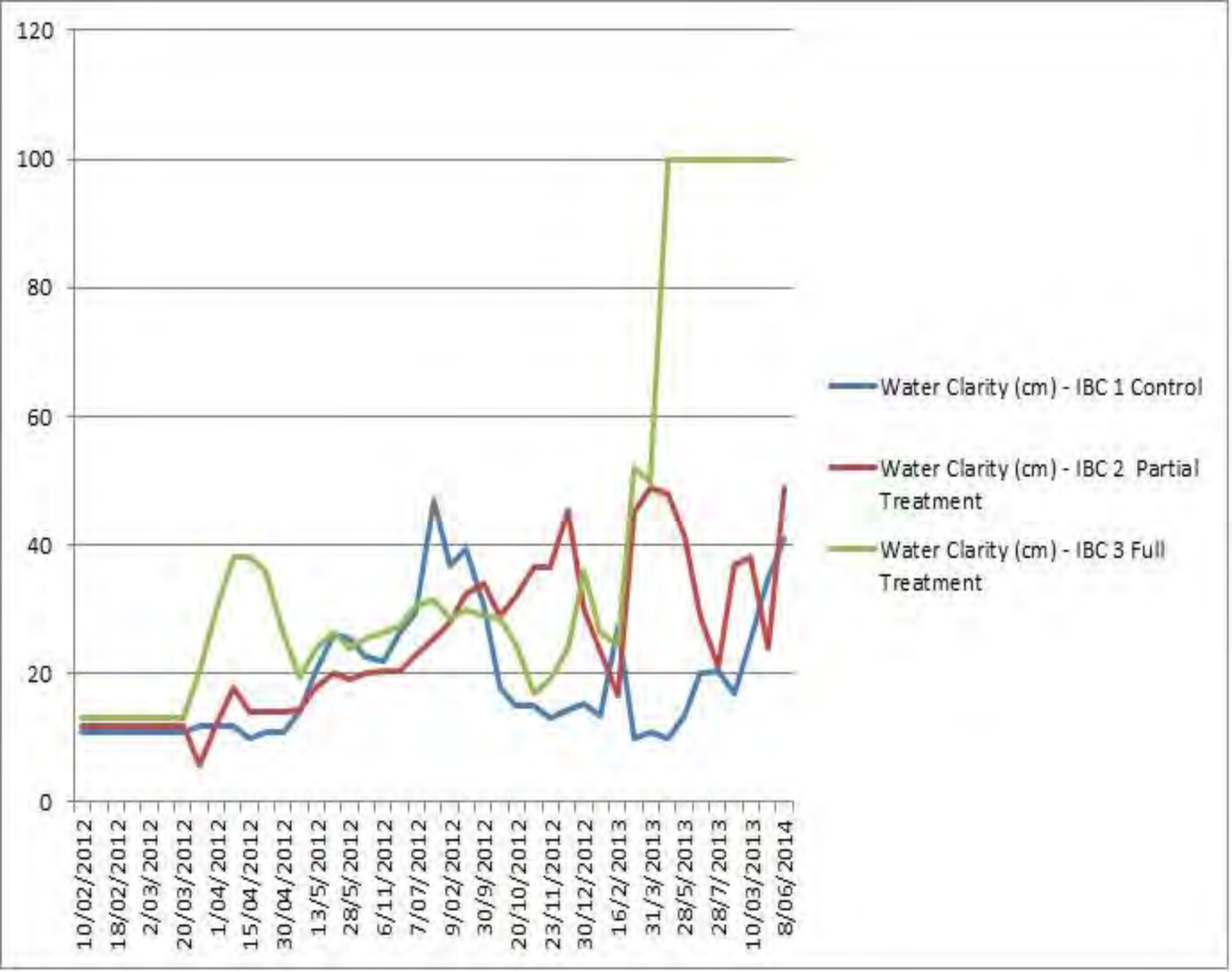
8/06/2014
P (mg/L) - IBC 1 Control
P (mg/L) - IBC 2 Partial Treatment
P (mg/L) - IBC 3 Full Treatment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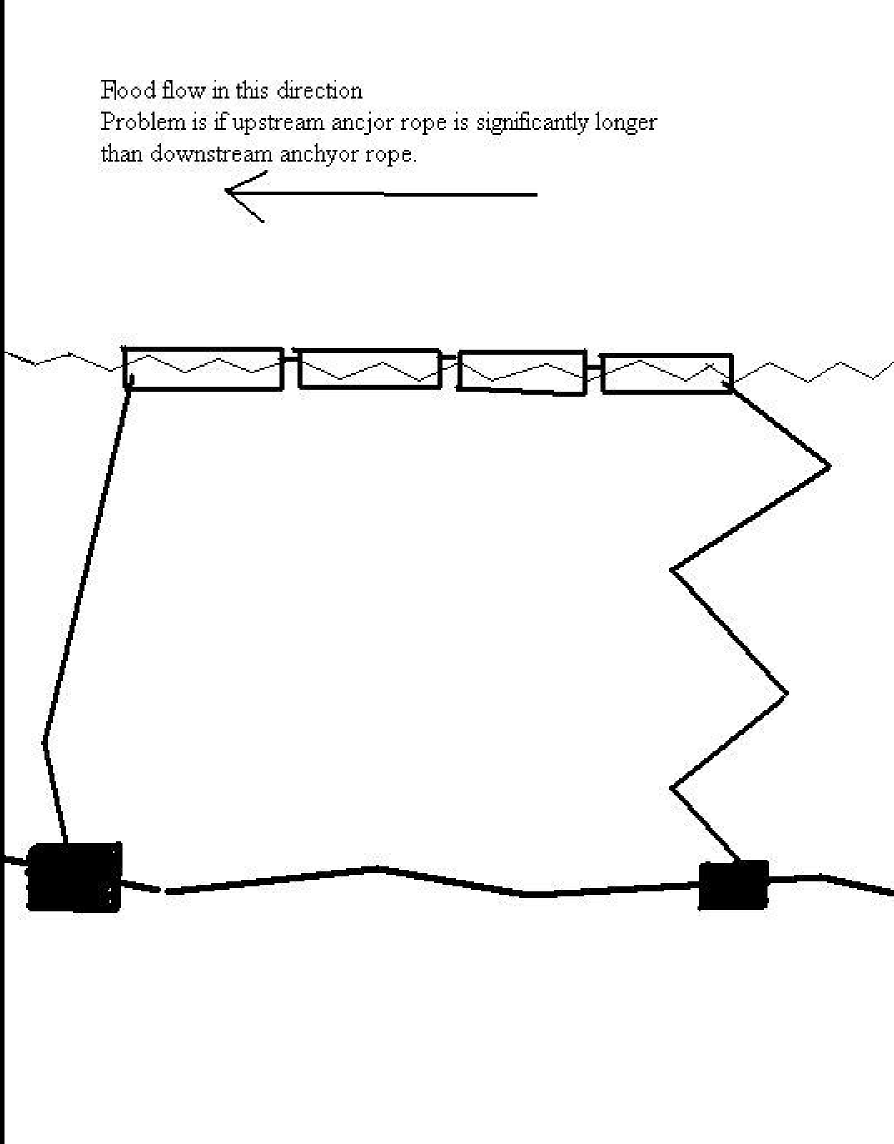
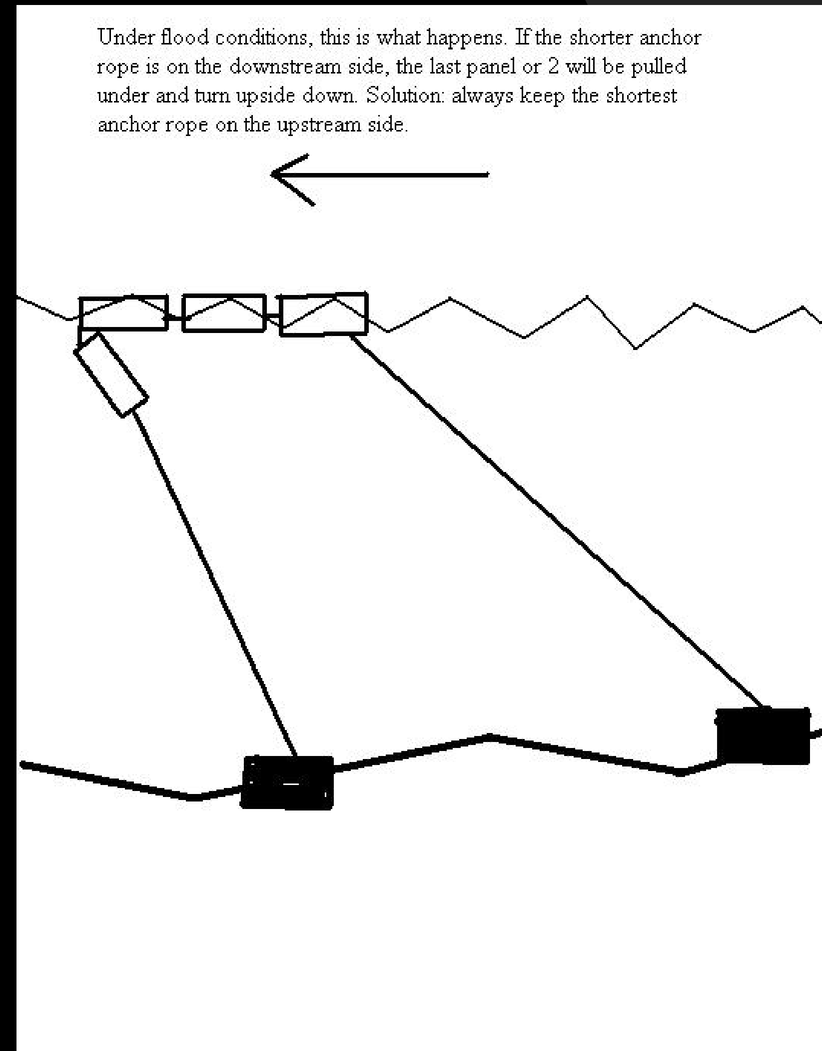
Water Clarity (cm) - IBC 1 Control
Water Clarity (cm) - IBC 2 Partial Treatment
Water Clarity (cm) - IBC 3 Full Treatment


Flood flow in this direction
Problem is if upstream ancjor rope is significantly longer than downstream anchyor rope.


Under flood conditions, this is what happens. If the shorter anchor rope is on the downstream side, the last panel or 2 will be pulled under and turn upside down. Solution: always keep the shortest anchor rope on the upstream side.

CURRENT SUPPLIERS IN AUSTRALIA OF VEGETATED FLOATING ISLANDS:

Aqua Biofilter

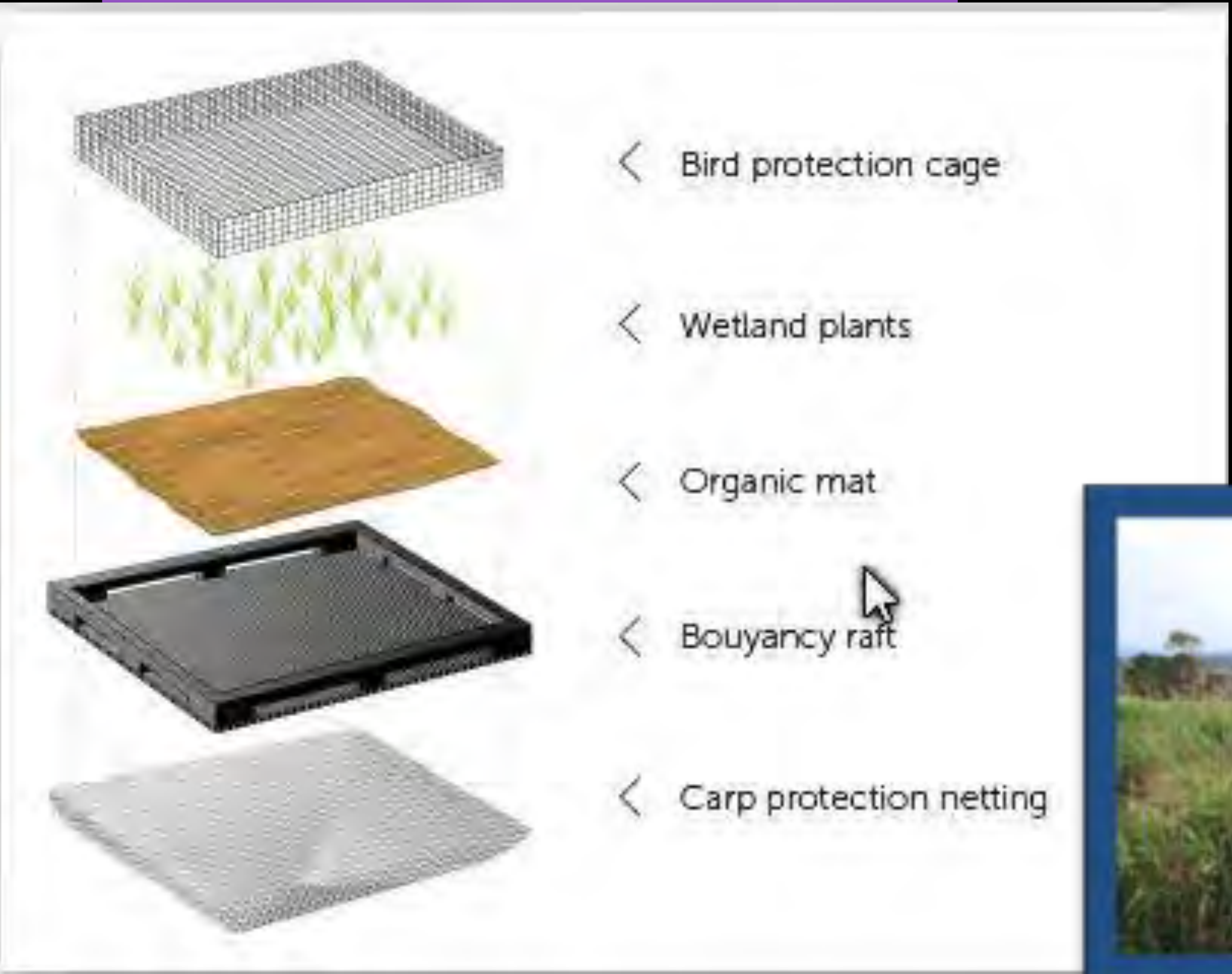
www.aquabiofilter.com

Spel Environmental

www.spel.com.au

Harris Environmental – Rafted Reed Beds

www.naturaft.com.au



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3 Final Take-Home Messages:

- Bacterial biofilms develop on all physical surfaces within a wetland - these bacteria within and beneath floating islands, supplemented by oxygen and carbon from plants, do the bulk of the pollution-reduction work.

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- While nitrogen generally escapes to the atmosphere after bacterial degradation of ammonia, nitrite and nitrate compounds, phosphorous is taken up within bacterial and other organic matter, eventually falling to the bottom of the wetlands where it can become biologically available under altered physical and chemical conditions.

3 Final Take-Home Messages:

- Vegetated floating islands massively increase the surface area of biofilm within a wetland, enhancing the wetland's ability to reduce nutrient and other pollutants within inflowing water. They also modify the chemistry at the sediment-water interface and restrict P mobilisation.

BEFORE: poor water quality, unhealthy goldfish, poor waterlily growth

AFTER: greatly improved water quality, healthy goldfish, excellent waterlily growth, little supplementary feeding of fish

The End – a happy one!