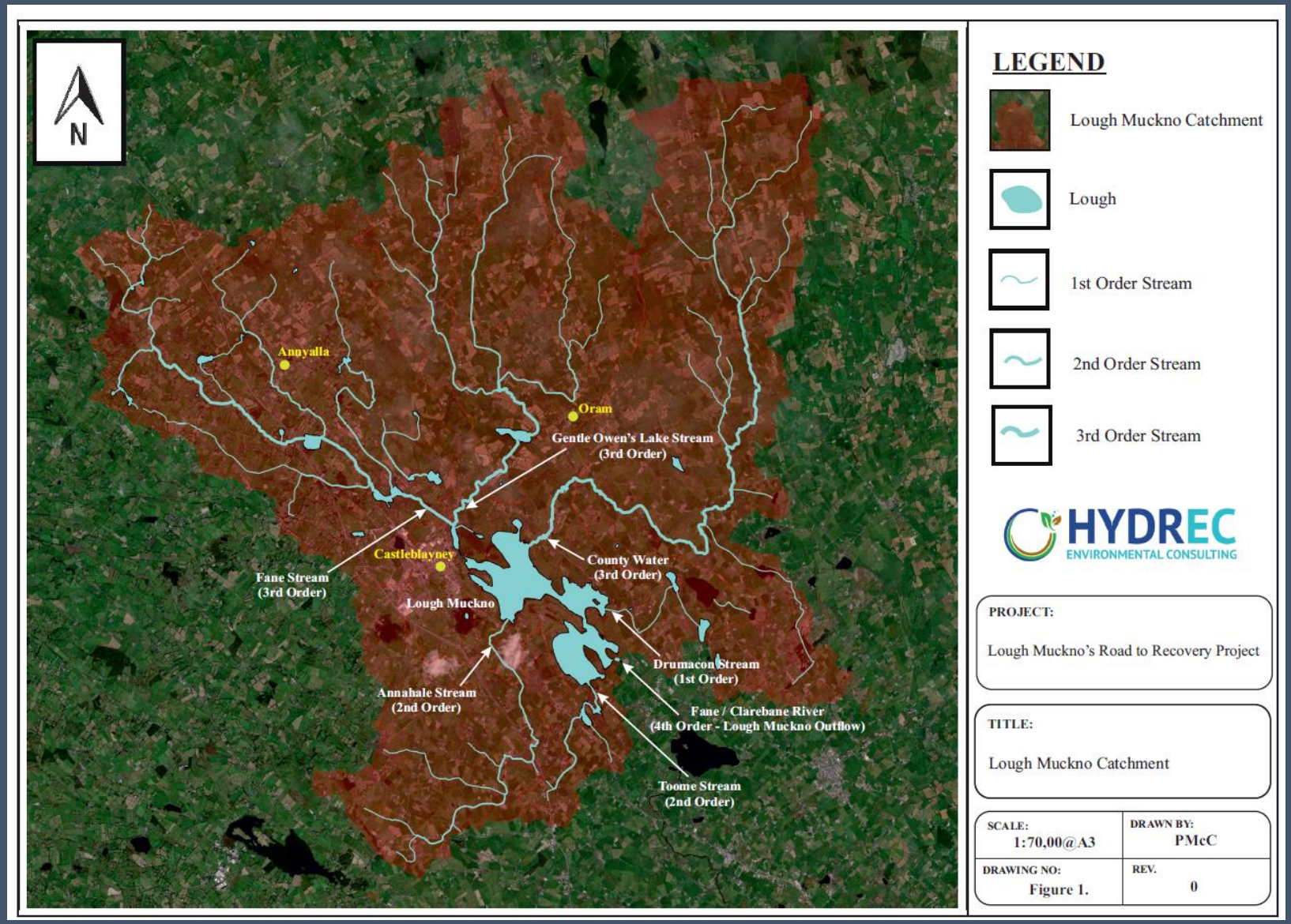
Lough Muckno – Road to Recovery Project

Paleolimnological Investigation

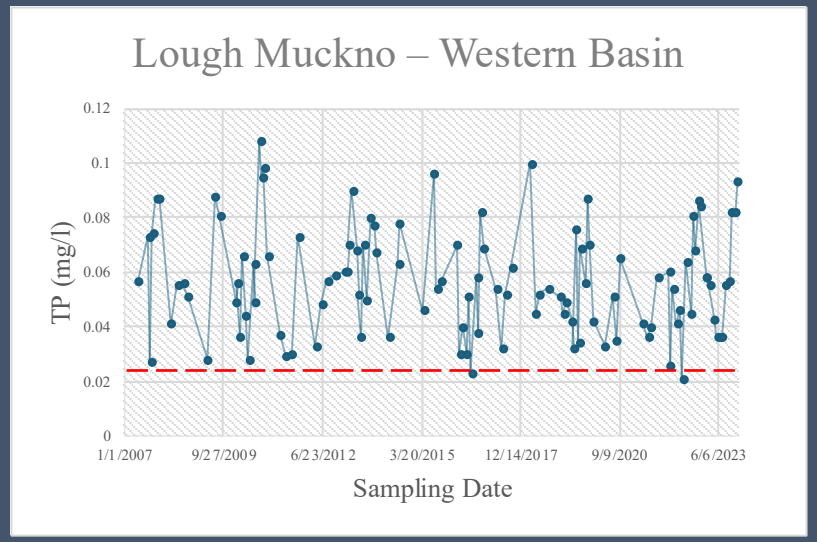
United Kingdom Ireland Lake Network Conference 2025

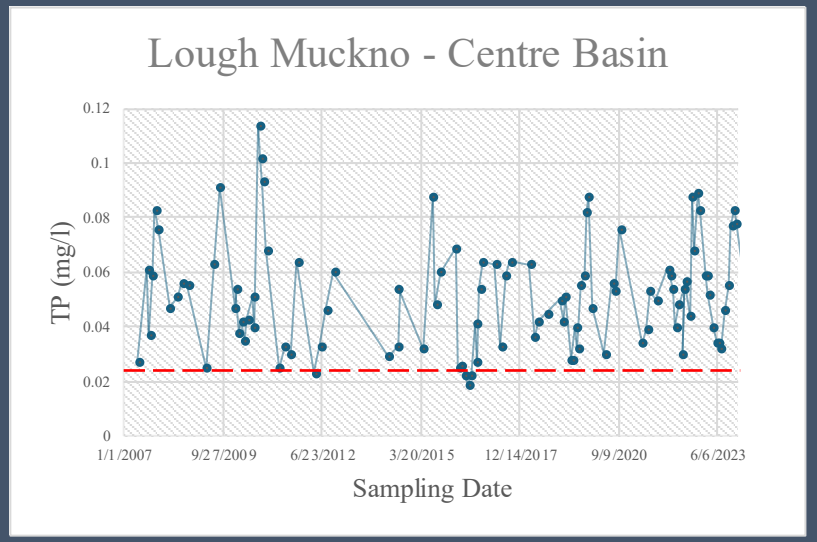
14th October 2025.

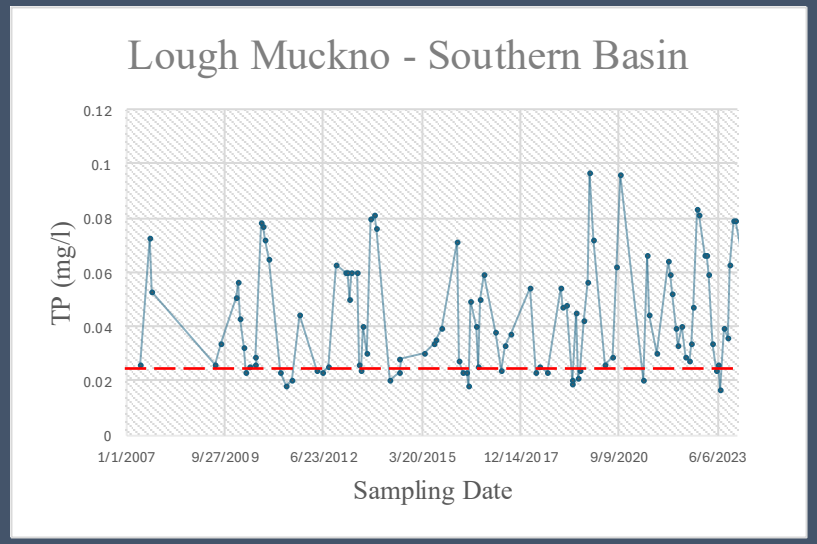
Lough Muckno – Environmental Setting



Lough Muckno – Phosphorus Results

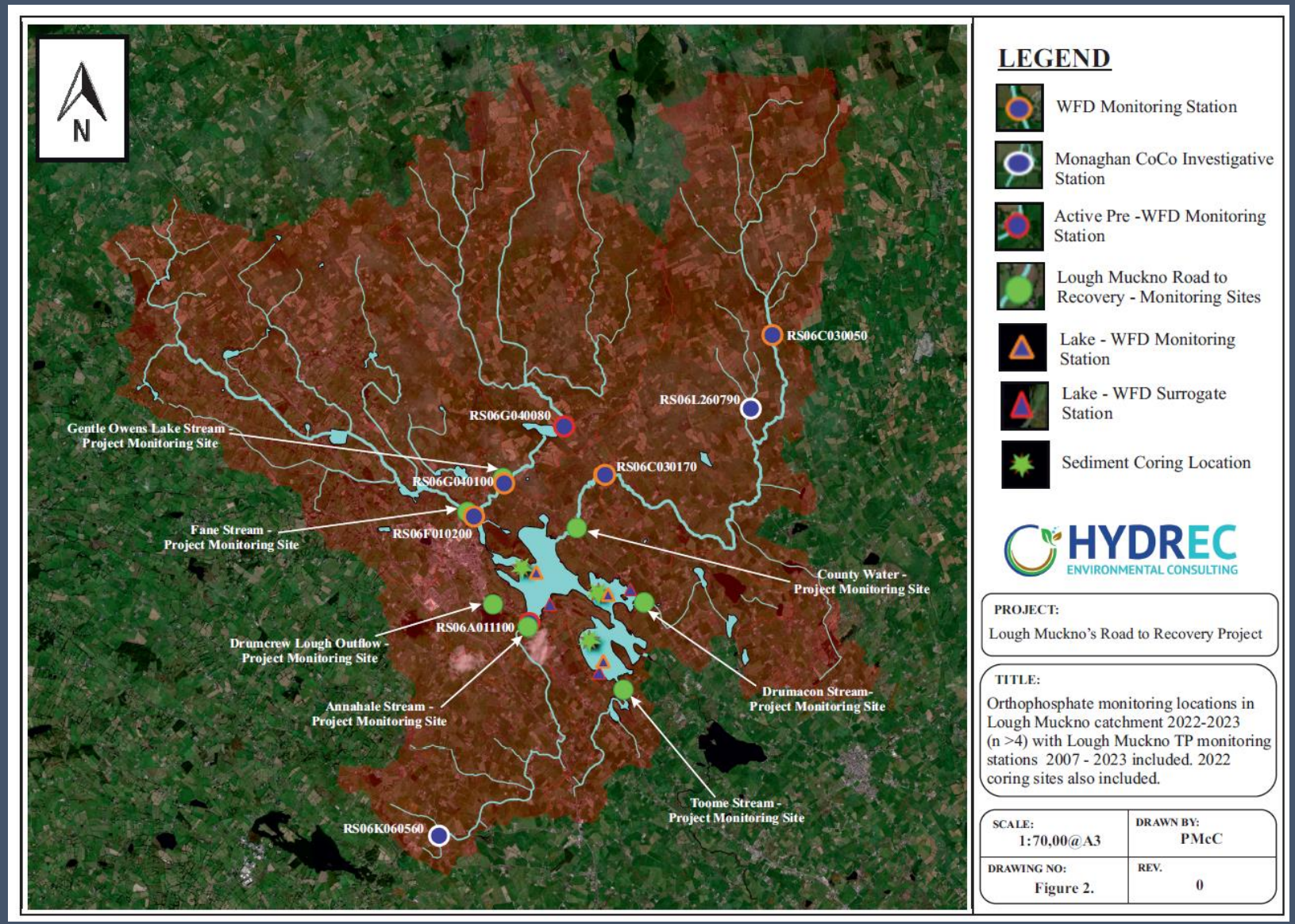




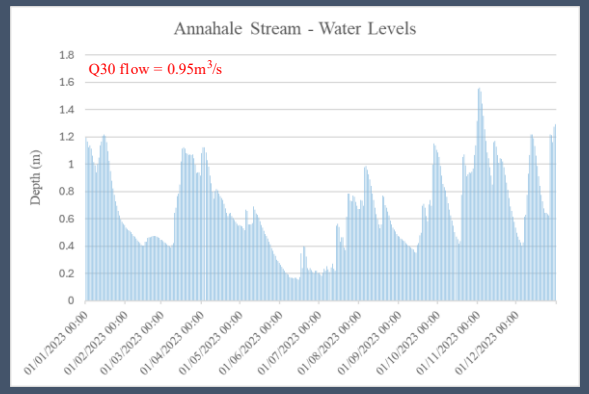


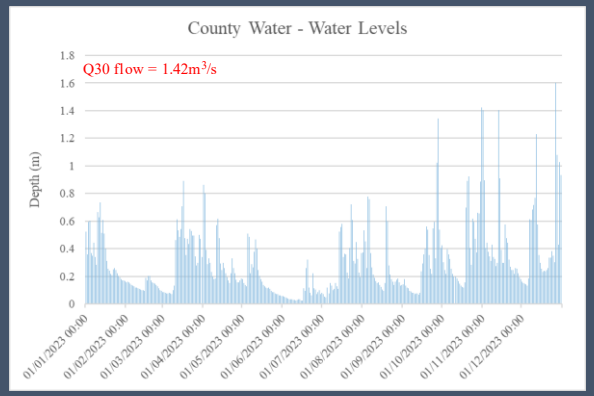
- *TP data for 2020-2022 for Lough Muckno Surrogate Shore Sites 1A, 2A & 3A used in graphs*

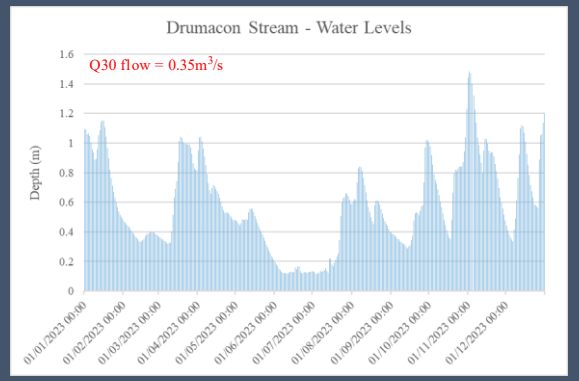
Lough Muckno – Catchment Sampling

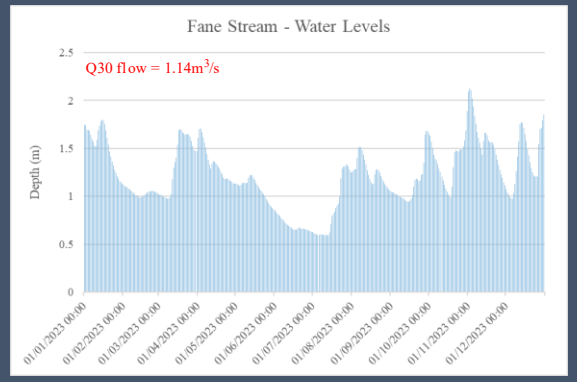


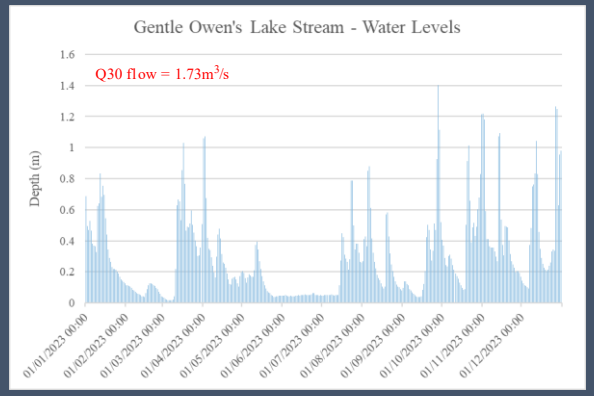
Lough Muckno – Tributary Water Levels

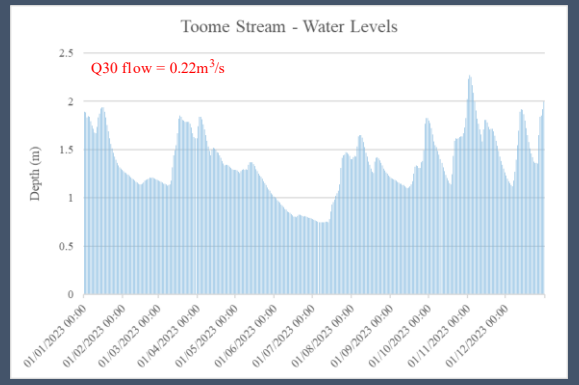






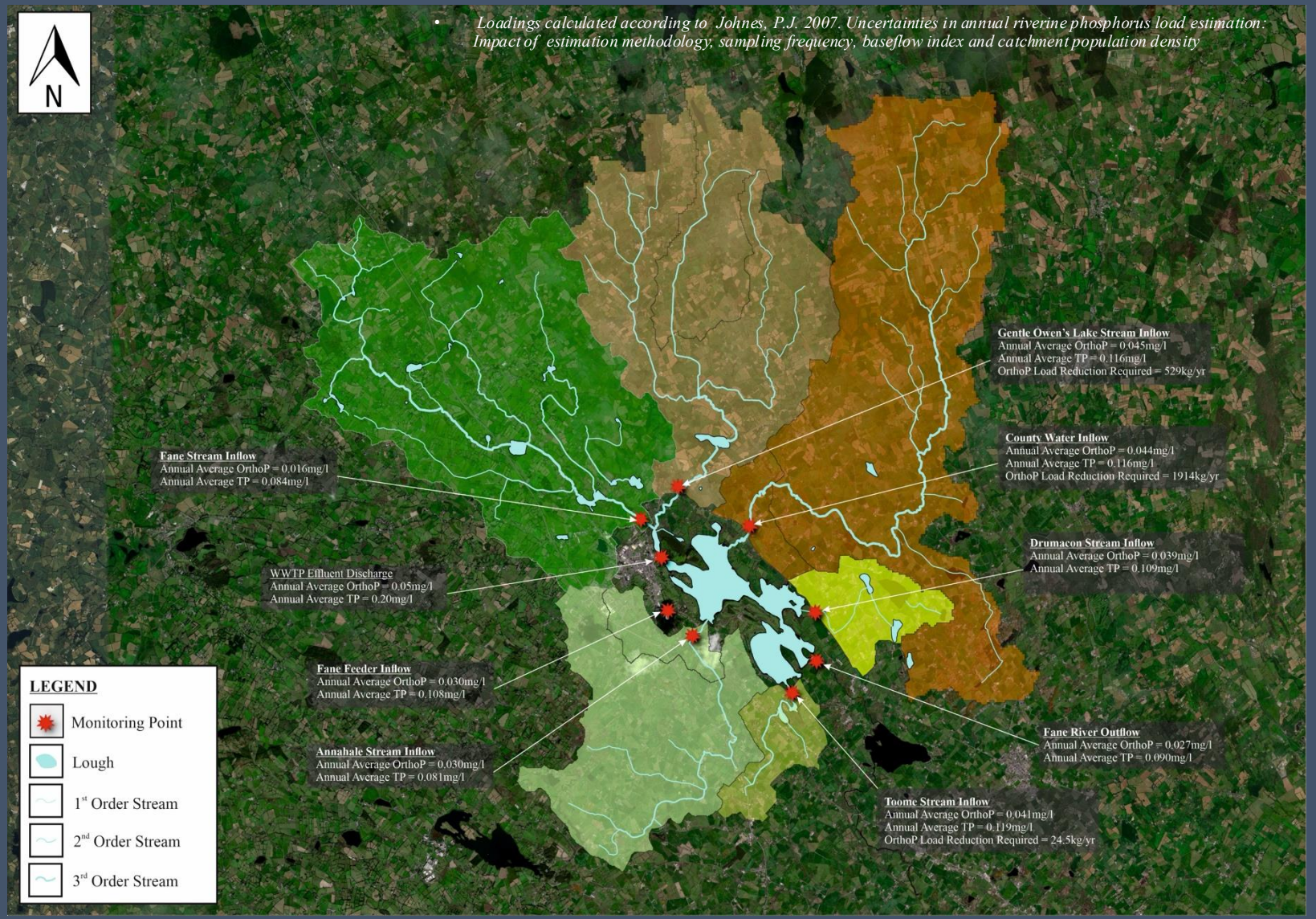




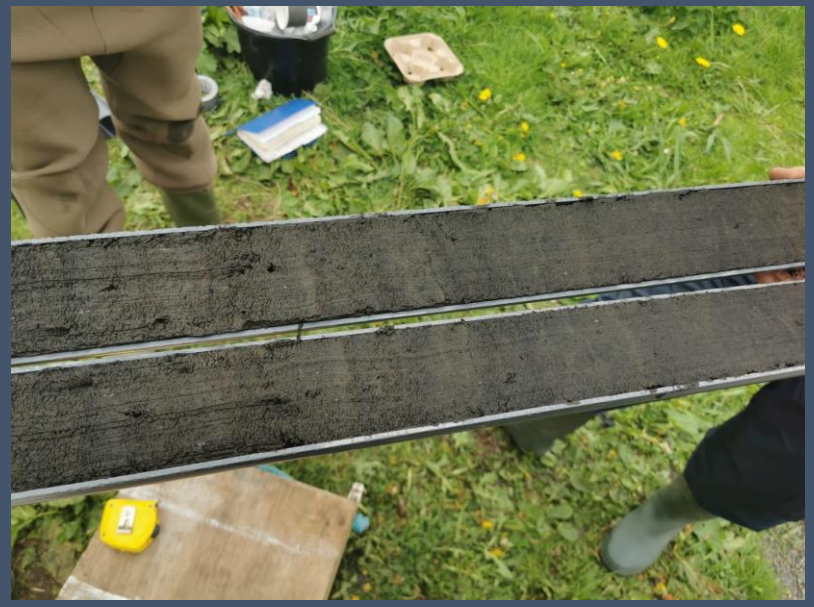


Lough Muckno – External Phosphorus Loading

- *Loadings calculated according to Johnes, P.J. 2007. Uncertainties in annual riverine phosphorus load estimation: Impact of estimation methodology, sampling frequency, baseflow index and catchment population density*

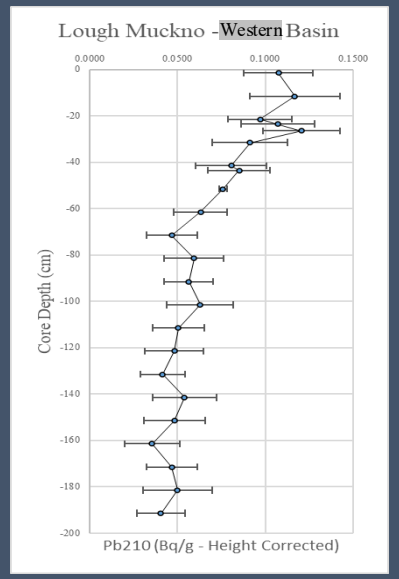


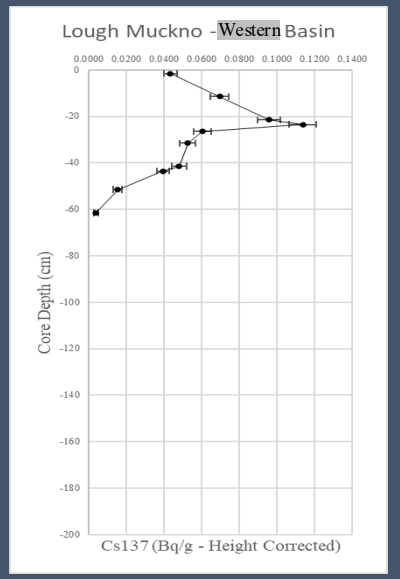
Lough Muckno – Deep Sediment Coring

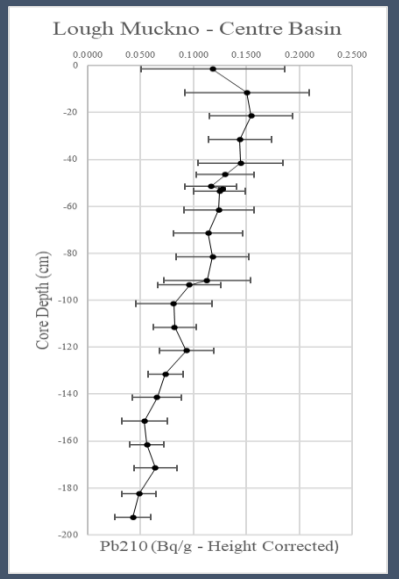


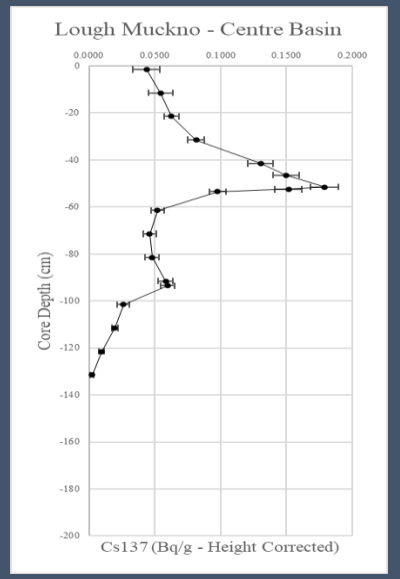
Coring lead by the team at the Ryan Institute, University of Galway

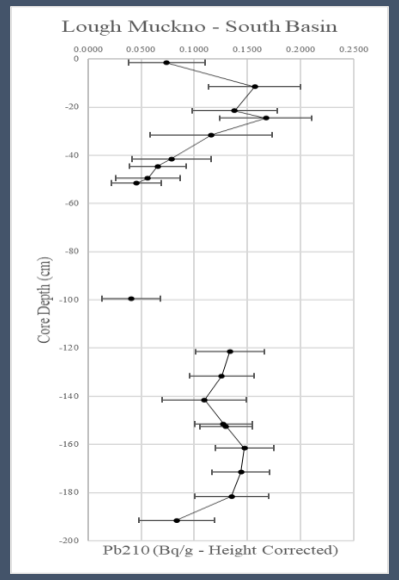
Lough Muckno – Sediment Dating / Chronology

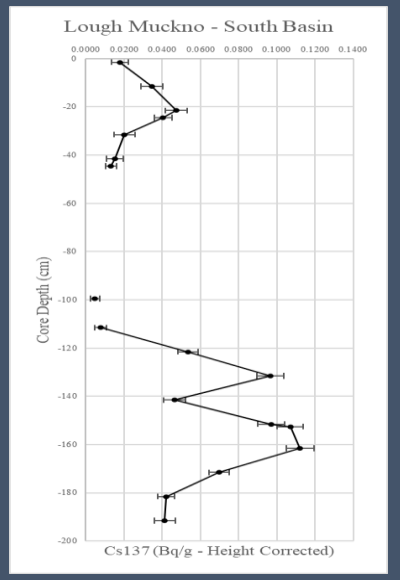










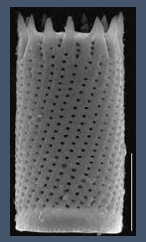


LMIII – Western Basin = 8.9mm/yr

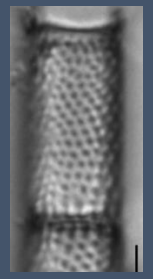
LMIV = Centre Basin = 17.2mm/yr

Lough Muckno – Historic Ecological Conditions

2021 / 2022

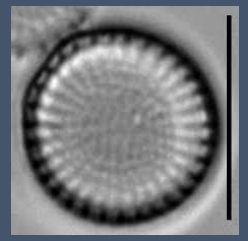


Aulacoseira subartica



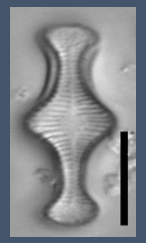
Aulacoseira ambigua

Aulacoseira granulata



Stephanodiscus parvus

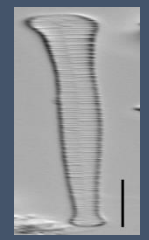
Early 1900s



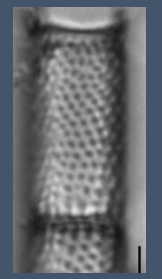
Tabellaria flocculosa

Achnanthes minutissima

Aulacoseira subartica

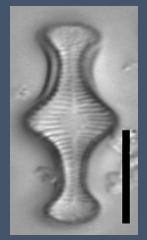


Asterionella formosa



Aulacoseira ambigua

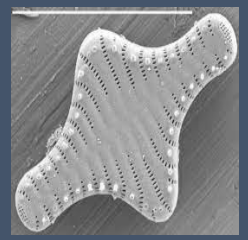
1830s



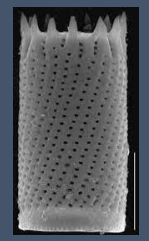
Tabellaria flocculosa

Achnanthes minutissima

Eunotia incisa



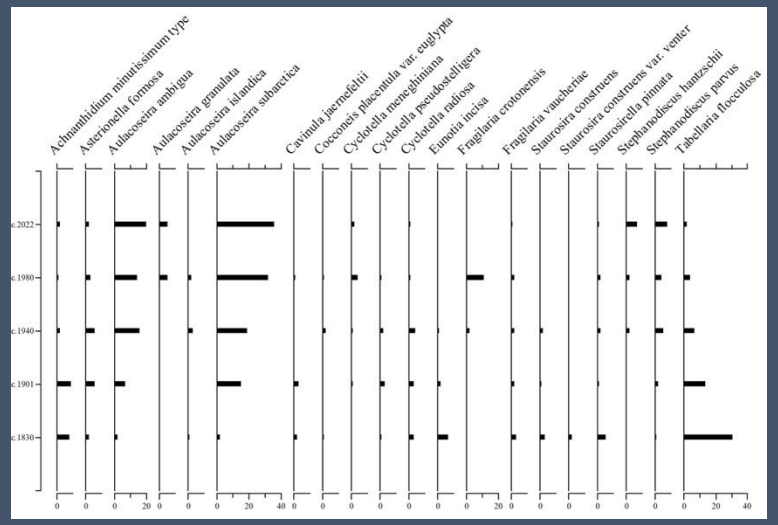
Staurosira construens



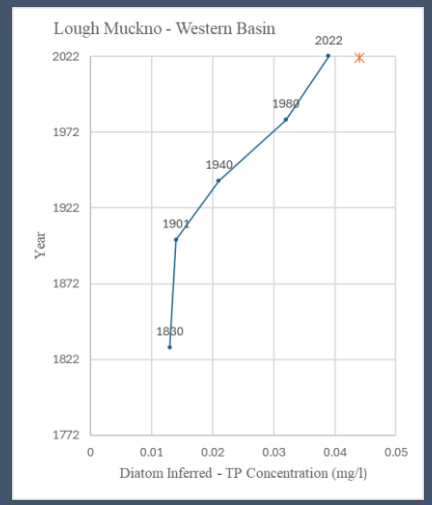
Aulacoseira subartica

Spaulding et al. 2021. Diatoms.org: supporting taxonomists, connecting communities. Diatom Research 36(4): 291-304. https://doi.org/10.1080/0269249X.2021.2006790

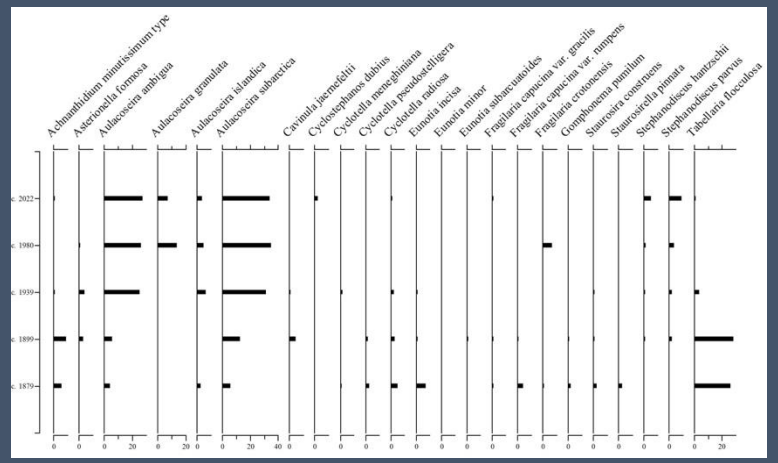
Lough Muckno – Historic Ecological & TP Conditions



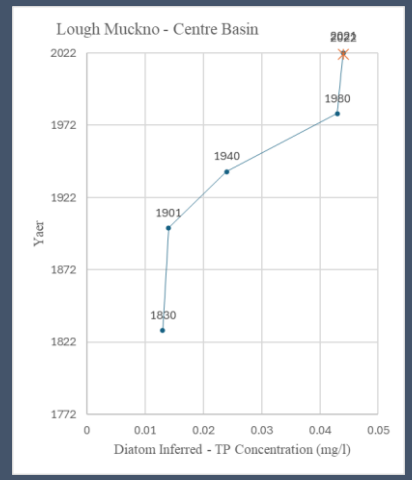
Diatom Stratigraphy for Core LMIII (Lough Muckno Western Basin)



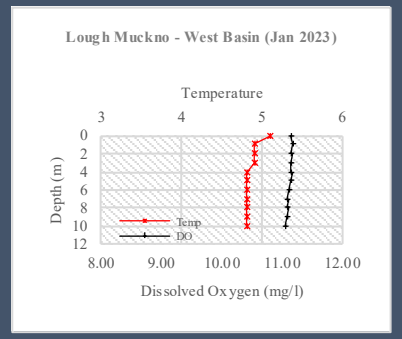
- Diatom inferred total phosphorus (DI-TP) concentrations calculated according to Chen et al 2008.
- DI-TP transfer function reconstruction completed by Prof. Chen with raw data supplied back to the project.

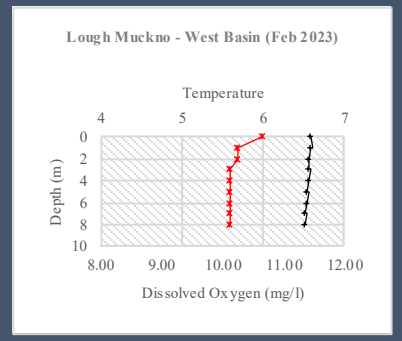


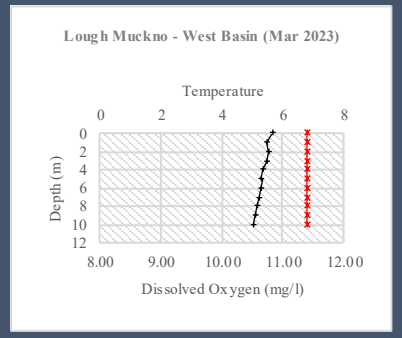
Diatom Stratigraphy for Core LMIII (Lough Muckno Centre Basin)

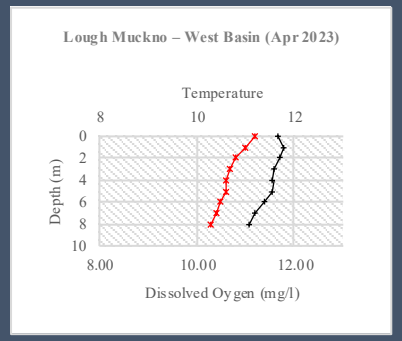


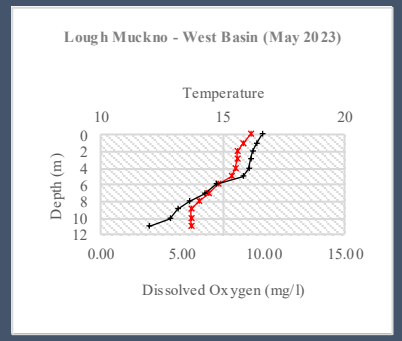
Lough Muckno – Temperature & DO Profiling

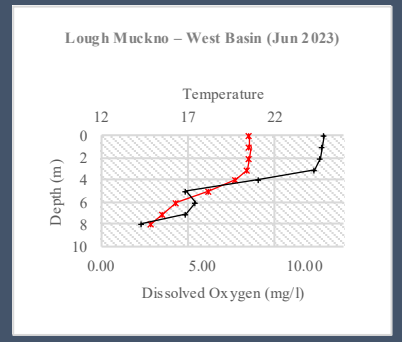


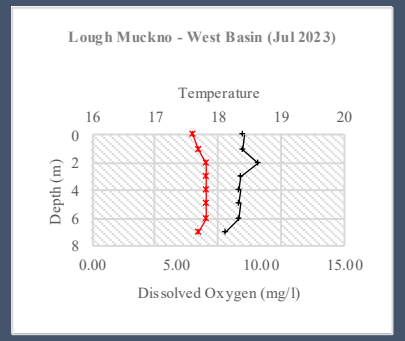


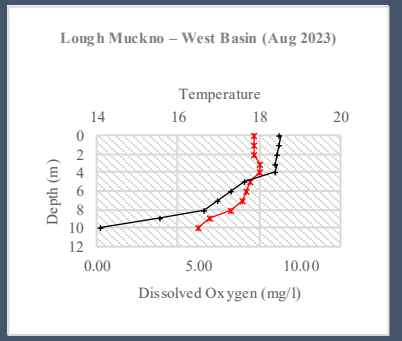


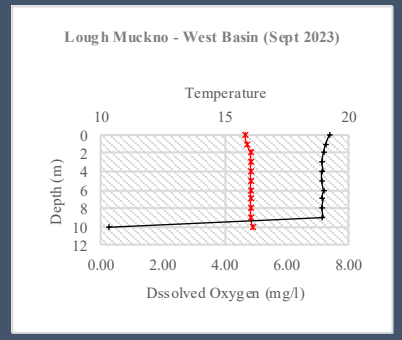


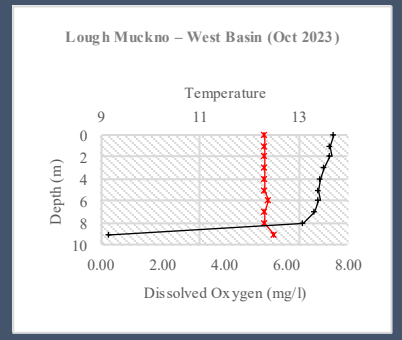


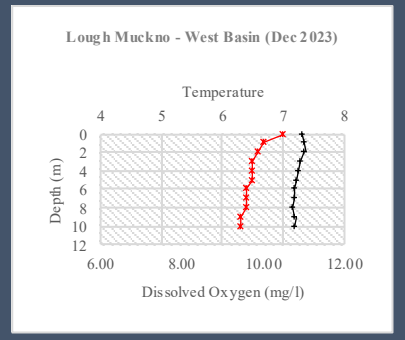




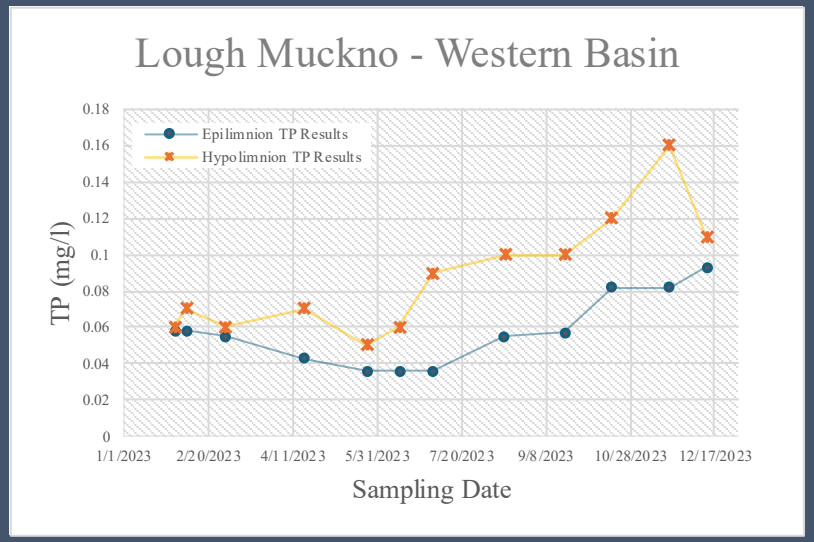


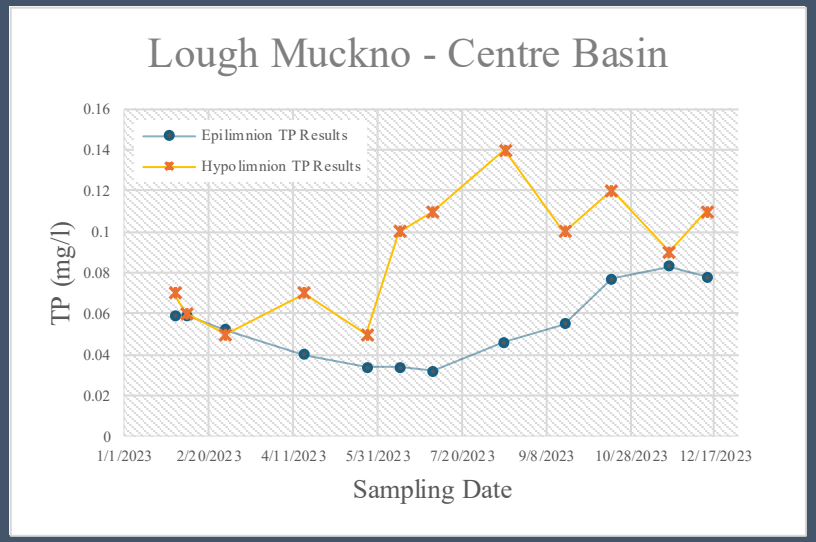


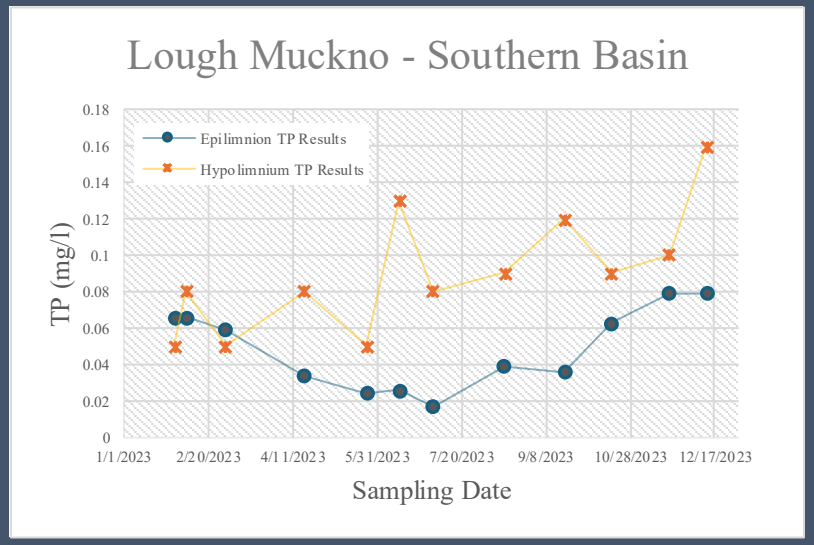




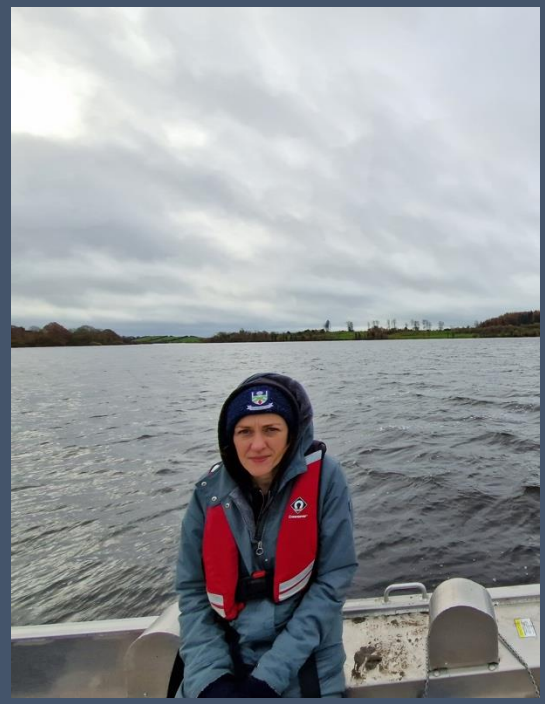
Lough Muckno – Internal Phosphorus Loading



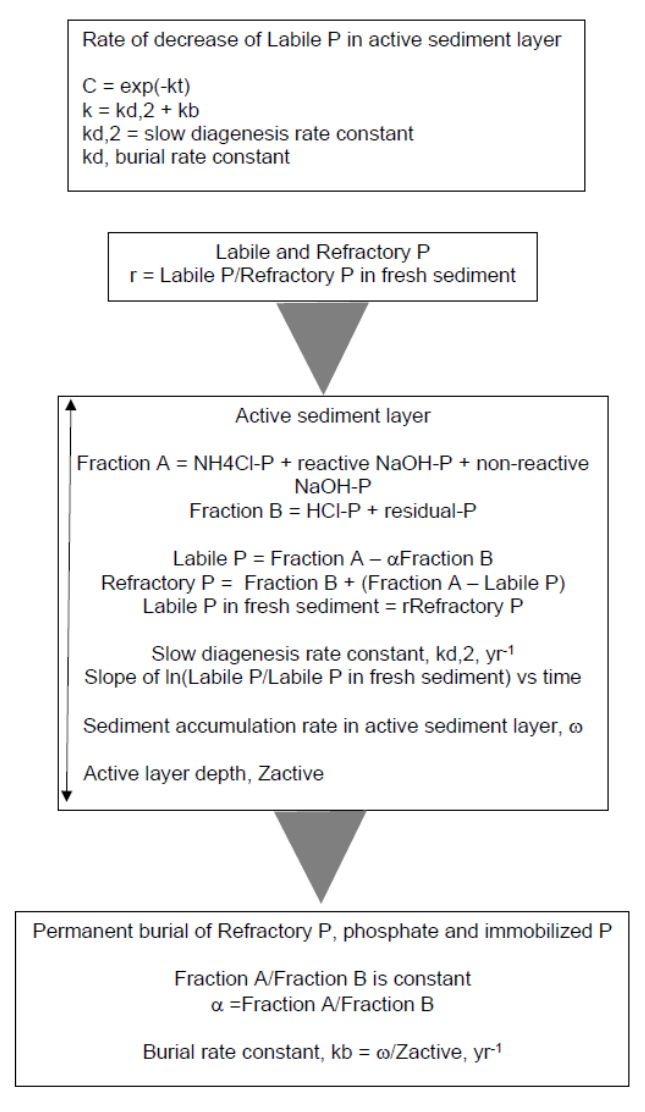




Lough Muckno – Gravity Coring / Phosphorus Fractionation



Lough Muckno – Gravity Coring / Phosphorus Fractionation



- Lewis / Penn Model
- Figure / chart taken from Rippey et al 2021
- P fractions calculated using SEDEX P sequential extraction method (O'Connell et al. 2020) with laboratory analysis completed by Trinity College Dublin with results supplied back to the project for modelling

Lough Muckno – Lake Recovery Predictions

Core Depth (cm)	P Fractions						
	Pex	Phum	Pfe	Pcfa	Pdetr	Presi	Total P
1.00	0.012	0.304	0.555	0.228	0.12	0.575	1.794
5.00	0.01	0.259	0.49	0.093	0.094	0.543	1.489
10.00	0.005	0.168	0.425	0.092	0.16	0.505	1.355
15.00	0.003	0.148	0.199	0.09	0.089	0.504	1.033
19.00	0.024	0.145	0.169	0.084	0.229	0.452	1.103

Sediment Acc Rate , cm yr-1	Zactive (cm)*	kd,2, yr-1	kb, yr-1	k, yr-1	t_{90}, yr
1.72	19	0.1	0.090526	0.190526316	12

- Assumed
- Time for concentration to reach steady state (i.e. 90% reduction) defined according to Chapra (1997).

Summary & Conclusions

- Total Phosphorus concentrations in Lough Muckno have been in excess of EQS (Good Status) for each of the 3 basins since 2007 (i.e. monitoring period);
- The orthophosphate EQS (Good Status) was exceeded in 2023 in the Gentle Owens Stream, County Water, Toome Stream & Drumacon Stream – Loadings calculated to inform on reduction targets;
- Lake model for TP indicates that further TP loadings are also required;
- Lake ecology has changed since pre famine / early 1900s from a more diverse benthic assemblage of diatoms to dominance of planktonic forms in recent sediments;
- Diatom inferred TP (DI-TP) concentrations found pre-agricultural intensification in the 1950's estimated to be equivalent to concentrations just within modern 'Good Status' EQS – 0.024mg/l;
- Pre-Famine DI-TP concentrations found to be c. 0.013mg/l - 0.014mg/l (i.e. outside 'High Status' EQS);
- Internal phosphorus loading found to be occurring within the lough, which will hinder lake recovery after external loading sufficiently reduced;
- P fractionation analysis and modelling would indicate that it will take a minimum period of 12 years to reach a 90% reduction in labile sedimentary P – <u>After external load reduction;</u>
- Potentially longer – further coring both in terms of location and depths would be valuable.