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3.16 Nitrogen and phosphorus concentration or load

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Water Quality: Nitrogen and phosphorus concentration or load	**Water Management**
Description and justification	Nutrients, including nitrogen (N) and phosphorus (P), can have significant impact on water quality, including effects on plant growth, oxygen concentration, water clarity, and sedimentation rates. Some major anthropogenic sources of nutrients are agricultural and industrial emissions, discharged wastewater and atmospheric deposition. Nitrogen and phosphorus are present in water in many different forms, or as many different chemical species. The forms of N and P that are quantified can include some or all of the following: • Nitrogen: total N (N_{tot}), total Kjeldahl N (TKN), dissolved organic N (DON), nitrate (NO_3^-), nitrite (NO_2^-) and ammonia/ammonium (NH_3/NH_4^+) • Phosphorus: total P (P_{tot}), acid-hydrolysable P (AHP), orthophosphate (PO_4^{3-})
Definition	Nitrogen and phosphorus in surface water and/or groundwater (%, expressed as total annual N or P load and/or reduction of maximum annual concentration)
Strengths and weaknesses	+ Laboratory analyses are accurate but can be quite costly. A full suite of analyses can be done for multiple chemical species of N and P. + Ion selective electrodes (ISEs) are less expensive and easier to use alternative. Whilst ISEs for various N species (NO_2^-, NO_3^-, NH_3/NH_4^+) are readily available from multiple suppliers,

	ISEs for phosphate are less common. ISEs have a potential for permanent installation at a given sampling point. - Test kits obtain a rapid result, but are in general less accurate than analyses performed in an accredited laboratory. Photometers are generally quite accurate but can be expensive to purchase and maintain. Test kits based on colour comparison, either of test strips or solutions, are relatively less costly but can have limited accuracy at low nutrient concentrations
Measurement procedure and tool	Different nitrogen and phosphorus species can be quantified in a water sample either in the field, using a test kit or ion selective electrode (ISE), or via laboratory analyses. Laboratory analyses can be done for multiple chemical species of N and P. Ion selective electrodes are analogous to a pH electrode and are used in much the same way as a pH electrode (pH electrodes are essentially ion selective electrodes that are sensitive to the H^+ ion) ISEs have a potential for permanent installation at a given sampling point. It is possible to program a data logger connected to an *in-situ* ISE to measure and record a value at a prescribed frequency. Test kits are usually used on site (in the field). Test kits typically involve the addition of chemical reagents to a water sample and yield results based on test strip colour comparison, solution colour comparison to a colour wheel or colour chart, or measurement with a photometer. The spectrophotometer measures the quantity of a chemical based on its characteristic absorption spectrum.
Scale of measurement	Plot scale to district scale, depending on location of sampling point
Data source	
Required data	Measurement data of a water sample
Data input type	Quantitative
Data collection frequency	Daily, weekly, monthly or annually
Level of expertise required	Low to moderate
Synergies with other indicators	Synergies with the other water quality indicators in the *Water management* indicator group
Connection with SDGs	SDG 13 Climate action, SDG 14 Life below water

Opportunities for participatory data collection	Participatory data collection possible with test kits and ion selective electrodes under supervision
Additional information	
References	EPA method 300.1: Determination of inorganic anions in drinking water by ion chromatography; https://www.epa.gov/sites/production/files/2015-06/documents/epa-300.1.pdf ISO 29441:2010: Water quality — Determination of total nitrogen after UV digestion — Method using flow analysis (CFA and FIA) and spectrometric detection, https://www.iso.org/standard/45480.html ISO 15681-1:2003 Water quality — Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) — Part 1: Method by flow injection analysis (FIA), https://www.iso.org/obp/ui/#iso:std:iso:15681:-2:ed-2:v1:en ISO 15681-2:2018 Water quality — Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) — Part 2: Method by continuous flow analysis (CFA), https://www.iso.org/standard/66474.html Orhel, R.L., & Register, K.M. (2006). Volunteer Estuary Monitoring. A Methods Manual. Second edition. Washington, D.C: United States Environmental Protection Agency. Reedyk, S., & Forsyth, A. (2006). *Using field chemistry kits for monitoring nutrients in surface water*. Publication number PRO-121-2006-1. Ottawa, Ontario, Canada: Agriculture and Agri-Food Canada PFRA. Retrieved from http://pfra.ca/doc/Water%20Quality/Water%20Quality%20Protection/using_field_chem_kits_final.pdf