Reducing nutrients: what to do in the catchment

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CRC for Water Sensitive Cities

Strategy 1. Reduce nutrient inputs

Suitability of strategy: no generic advice for this strategy. See individual actions for their suitability and effectiveness.

Action	Explanation	Conditions where action is most likely to be suitable andeffective	Other references recommending action	Guidelines for implementation
1a. Educate residents to minimise their use of nutrients, especially fertilisers	Human use of fertilisers and detergents are a major source of the nutrients found in urban waterways. Educating residents so that they minimise fertiliser use, particularly during high rainfall months, will reduce the total nutrient load. Where wastewater treatment plants discharge into waterways, educating residents to use low-phosphorous detergents is also important.	Most areas, particularly on sandy soils where nutrients leach rapidly into the groundwater. Where the catchment has medium density residential housing (i.e. lots are large enough to allow gardens). Less effective where prior land use (e.g. agriculture) has left a legacy of high soil nutrients.	[1-3]	[1]
1b. Educate residents about pet manure	Dog and cat manure contains nitrogen and phosphorus and is easily washed into urban waterways.	All areas	[4]	
1c. Phase out septic systems	Septic systems leak nutrients into local groundwater, creating a diffuse source of nutrient pollution. Where possible these systems should be replaced by connected sewage. If this is not possible, we recommend they be maintained and monitored.	Where houses with septic tanks are close to a waterway (< 100 m).	[5-7]	Not applicable
1d. Relocate nutrient-exporting land uses (e.g. golf courses)	Nutrient exporting land uses, such as golf courses and other industry, should be relocated to areas remote from urban waterways.	New development areas where planning can prevent inappropriate land uses being established close to waterways or in areas with shallow groundwater susceptible to contamination.		WA: use UNDO tool in planning

Action	Explanation	Conditions where action is most likely to be suitable andeffective	Other references recommending action	Guidelines for implementation
1e. Permanently or seasonally disconnect wetlands that are nutrient sources	Wetlands containing a large amount of nutrients can export nutrients to the waterway rather than store them. These wetlands should not be connected to flowing waters as nutrient issues will be exacerbated.	Sites where wetlands are nutrient sources and are connected to the waterway year-round or during high flows. Note that wetlands are most likely to be sources if they have been receiving elevated nutrients from stormwater or agriculture for decades.		
1f. Avoid urban development on land with a legacy of high soil nutrients	The land surrounding urban areas often has an agricultural past and associated elevated soil nutrients. This land should be avoided for new urban development as soil nutrients are likely to find their way to waterways.	Sites where the watertable is high should be avoided, because subsurface drainage put in place to prevent local flooding will efficiently transport soil nutrients to waterways. DO NOT interpret this action as a recommendation to develop or clear remnant vegetation.	[8]	
1g. Improve nutrient retention in wastewater treatment plants	Wastewater treatment plants remove nutrients from the water they treat, however the process is not 100 per cent effective. Improvements in the treatment process will reduce nutrient loads to urban waterways.	Where wastewater treatment plants discharge into an urban waterway. Nutrients in the effluent of these plants has the greatest potential to cause problems if the waterway is naturally intermittent.	[9-11]	As per state and federal best management practice
1h. Preferentially select natives as street trees	Deciduous trees have higher leaf nutrient levels than native tree species and create unnaturally large inputs of nutrients into waterways during autumn.	New residential developments. Also older suburbs where old trees are dying and being replaced. Most appropriate for streets where stormwater pipes are directly piped into waterways.	[12]	

Strategy 2. Reduce the volume of stormwater directed to waterways

Suitability of strategy: this strategy will be easiest to implement in small catchments where relatively few impervious areas exist (i.e. not a lot of urban land needs to be retrofitted). However, we encourage the adoption of this strategy in all urban areas given that all efforts to reduce the volume of nutrient-rich water travelling to waterways will contribute to lowering nutrient loads in downstream receiving waters.

Action	Explanation	Conditions where action is most likely to be suitable andeffective	Other references recommending action	Guidelines for implementation
2a. Reduce flow volume by harvesting rainwater and infiltrating; detaining and disconnecting stormwater. See *Repairing flow: what to do in the catchment* factsheet, Strategy 1, actions 1a–1g	Stormwater carries soluble nutrients to urban waterways. Reducing the volume of stormwater reaching the waterway will reduce the nutrient load being transported to the waterway.	See *Repairing flow: what to do in the catchment* factsheet, Strategy 1, actions 1a–g for advise on the suitability of specific actions.	[6, 13-17]	See associated factsheet

Strategy 3. Increase nutrient biofiltration of stormwater at the source (i.e. lot and street scale)

Suitability of strategy: this strategy is suitable for streets with wide verges that can accommodate swales/raingardens and where the residents are supportive. New residential developments should take this strategy into account at the design stage.

Action	Explanation	Conditions where action is most likely to be suitable andeffective	Other references recommending action	Guidelines for implementation
3a. Install raingardens and vegetated swales along streets	The vegetation and soil in raingardens and vegetated swales takes up or binds nutrients, reducing the nutrient load of street stormwater.	Most sites, particularly streets with verges wide enough to accommodate the raingardens. Most effective where vegetation naturally has a high growth rate and is periodically harvested. Where raingardens have enough storage capacity to absorb a large fraction of overland flow before it is redirected into stormwater drainage. Where raingardens can be installed on most roads.	[18-21]	[22-25]

Strategy 4. Increase nutrient biofiltration of stormwater at the precinct scale

Suitability of strategy: this strategy is suitable for urban areas that have sufficiently large areas of low-lying land to accommodate the wetland biofilters, and where excess nutrients are predominantly inorganic and derived from stormwater. It is less suitable where most excess nutrients are inorganic and derived from groundwater.

Action	Explanation	Conditions where action is most likely to be suitable andeffective	Other references recommending action	Guidelines for implementation
4a. Direct stormwater into wetland biofiltration basins	Biofiltration basins trap stormwater and create an artificial wetland-like environment that promotes nutrient uptake and transformation.	Where the precinct has large unused pieces of land in low-lying areas that can be transformed into biofiltration basins. Where excess nutrients are predominantly inorganic and from stormwater – less suitable where most excess nutrients are inorganic and derived from groundwater. Note, that the efficiency of basins is also likely to change with time (age of wetland, season).	[18, 26, 27]	[22-25, 28-32]
4b. Strategically place biofiltration basins	Biofiltration basins are most effective when placed in areas that receive large amounts of stormwater, particularly stormwater with high concentrations of nutrients (i.e. high nutrient load).	All areas	[33]	WA: use UNDO tool in planning
4c. Align water sensitive design features so they work cumulatively to protect the receiving waterway	The serial alignment of features, such as actions 3a and 4a, progressively reduce nutrients and result in greater nutrient attenuation and protection of the downstream waterway.	All areas	[34]	WA: use UNDO tool in planning

Strategy 5. Reduce the volume of nutrient-rich groundwater entering the waterway

Suitability of strategy: most suitable where the channel is narrow (< 10 m wide) and the natural vegetation is treed OR where the floodplain is wide with a low gradient (especially where wetlands are present).

Action	Explanation	Conditions where action is most likely to be suitable andeffective	Other references recommending action	Guidelines for implementation
5a. Avoid development on land with a shallow water table or build houses on stilts	If the water table is shallow and likely to cause seasonal flooding of the built environment, then the land should not be developed or houses should be constructed on stilts so they are protected from flooding.	Where urban development has not yet taken place, i.e. early in the planning process.	[35]	

Action	Explanation	Conditions where action is most likely to be suitable andeffective	Other references recommending action	Guidelines for implementation
5b. Lower the watertable. See all actions in *Repairing flow: what to do in the catchment* factsheet, Strategy 5, actions 5i–5p	If the groundwater is rich in nutrients, particularly bio-available forms, subsurface flows can contribute the majority of nutrients to urban waterways. Lowering the water table reduces the amount of nutrients delivered to urban waterways.	Where development has already occurred. See *Repairing flow: what to do in the catchment* factsheet, Strategy 5: actions 5i–5p for the suitability of individual actions.	[35, 36]	See associated factsheet
5c. Surround subsurface drains with amended soil	Certain soils, such as IMG a brown loamy soil that is rich in iron, can be effective in bonding to phosphorous and other dissolved organic nutrients and removing them from subsurface soil water.	Where urban development has not yet occurred – i.e. there is opportunity to lay the soil amendment around the subsurface drain. Where nutrients are predominantly organic and where the natural soil has a poor nutrient binding capacity, e.g. sandy soils of the Swan Coastal Plain, WA.	[36, 37]	[37]
5d. Redirect subsurface drains away from waterways and into biofiltration basins	The delivery of nutrient-rich groundwater from subsurface drainage exacerbates instream nutrient issues. Directing nutrient-laden groundwater into biofiltration basins may reduce nutrient loads.	Where there is unused land along the subsurface drainage path that may be used to create a detention basin. Where nutrients are predominantly inorganic. Where urban development has already taken place.	[38]	
5e. Disconnect subsurface drains from waterways and install bioreactors and P-sorbent soil at their outlet	Bioreactors promote nutrient transformation and sorbent soils bind to nutrients reducing nutrient loads exported from subsurface drainage into receiving waterways in the catchment.	Most sites, particularly where there is space adjacent to the receiving waterway to install the bioreactor and the sorbent soil. Where the existing soil adjacent to the receiving waterway is low in soil carbon and low in iron (e.g. sandy).	[36]	[39]
5f. Hard-line urban drainage channels	If the local groundwater is elevated and rich in nutrients, then any newly constructed urban drain will exacerbate nutrient issues downstream. In these circumstances a concreted or piped urban drain should be considered, as it prevents the inflow of nutrient-rich groundwater and its drainage downstream.	New developments, where no existing drainage channel (i.e. creek) exists. Where the groundwater is rich in nutrients that will flow into the newly created urban drain unless it is hard-lined. Where the nutrient load of the downstream receiving water is a management priority. Where the stormwater travelling along the hard-lined channel is relatively low in nutrients and/or will be treated by a biofiltration basin lower in the system.		As per standard techniques

Supporting documents

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Biofiltration guidelines

Australia Wide

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Other useful tools

Urban Nutrient Decision Outcomes (UNDO): a decision support tool that evaluates nutrient reduction decisions for urban developments on the sandy Swan Coastal Plain, WA. http://www.water.wa.gov.au/planning-for-the-future/water-and-land-use-planning/undo-tool

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