

ANNUAL NUTRIENT SURVEY for Local Government Authorities Results 2019



An initiative of the South East Regional Centre for Urban Landcare's
Phosphorus Awareness Project



Department of Biodiversity,
Conservation and Attractions



Annual Nutrient Survey for Local Government Authorities 2019

The Swan and Canning River systems, and many wetlands, are suffering from regular, and sometimes toxic, algal blooms. These blooms occur due to excessive inputs of nutrients, particularly phosphorus and nitrogen, combined with low water flows. The Phosphorus Awareness Project (PAP), supported by the Rivers and Estuaries Branch, Department of Biodiversity, Conservation and Attractions and managed by the South East Regional Centre for Urban Landcare (SERCUL), aims to raise awareness of the sources of nutrients, the need to minimise their use, and how this can be achieved.

Local authorities are responsible for nutrient use on turfed areas, reserves and in local planning decisions and thus can lead the community by setting examples in best practice. The Annual Nutrient Survey for Local Government Authorities was designed to determine Local Government Authority (LGA) practice with respect to nutrient use and to inform the local community.



Adenia Lagoon, Riverton

Each year thirty LGA's of the Perth Region are given the opportunity to take part in the Annual Nutrient Survey. Of the thirty LGA's invited to take part in this survey, twenty-seven touch upon the boundaries of the Swan Canning Catchment (refer to Map 1 over page). This was the eighteenth survey of these LGA's and the twentieth survey of the LGA's of the Canning Catchment. This year nineteen of the thirty LGA's responded to the survey, down from twenty-one in 2018. The LGA's that responded in 2019 were: Armadale, Belmont, Canning, Cambridge, Cockburn, Cottesloe, Gosnells, Kalamunda, Kwinana, Melville, Nedlands, Rockingham, Serpentine Jarrahdale, South Perth, Stirling, Subiaco, Swan, Victoria Park and Vincent. Seventeen of the LGA's that responded this year also participated in the 2018 survey. Bayswater, Cambridge, Joondalup and Perth LGA's participated in 2018, but not this year, and Gosnells and Serpentine Jarrahdale participated this year but not in 2018. It is important that *all* LGA's take the opportunity to participate in this annual survey each year as a way of monitoring their management practices over time and the impact they may be having on their catchment.

The results of the survey indicate that the LGA's surveyed are conducting varying degrees of Best Management Practices (BMP's) in nutrient management. Overall the LGA's are excelling in the implementation of BMP's in the areas of nutrient monitoring, turf type and wastewater systems, an above average level in nutrient management, nutrient education and development control and an average level in the areas of water quality monitoring and fertiliser applications. Compared to the 2018 survey, overall there has been an increase in the use of BMP's but there is definitely room for improvement. The Cities of Kwinana and Swan should be commended for being the first LGA's in the survey's history to have adopted all of the BMP's!

It is strongly recommended that every LGA reads the recommendations section at the end of this report. This section outlines the strategies that need to be implemented to achieve a high level of nutrient best management practice for all questions asked in this survey. All LGA's are encouraged to compare their individual responses to each question and implement recommendations that they do not currently undertake. Score Cards will be provided to LGA's that responded to this year's survey that clearly show where and how improvements can be made for each area. In response to feedback from several of the respondents to the 2018 survey, the way LGA's are scored has altered slightly to better suit what is happening in practice. We no longer penalise LGA's for having deciduous trees, but rather score them according to whether they have measures in place to prevent leaves entering drains. We also only score LGA's according to whether they impose NIMP conditions on developers, not whether they monitor compliance or prosecute non-compliance. These changes mean that this year's score cannot be directly compared to the one provided last year. We have, however, altered last year's score to reflect the changes and will provide the altered score for 2018 on this year's scorecard for comparative purposes. We will also provide an overall score based on results provided since 2000, those for the last five years and those for this year. This will allow LGA's to see how they are doing over the long-term, short-term and at the current time.

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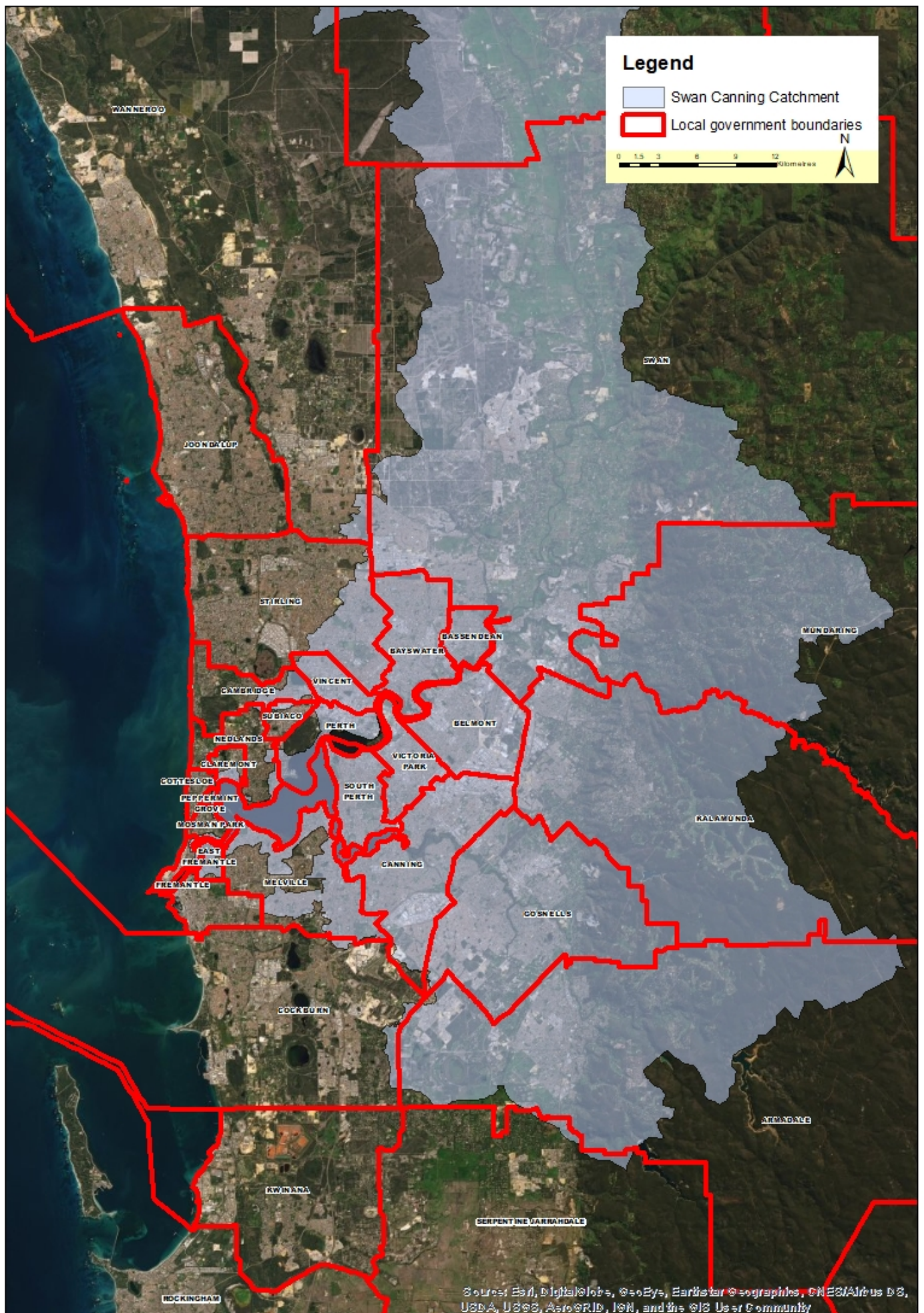
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Map 1: Swan Canning Catchment (grey) overlaid with LGA boundaries (red)

Nutrient Monitoring

Questions One and Two

Questions One and Two related to soil tests, leaf tissue analysis and moisture testing of nutrients in grassed and turfed areas. All of the LGA's that responded to the survey conducted at least one type of soil, leaf tissue and/or moisture testing in grassed and turfed areas, which has increased slightly (1-5% change) since 2018. Compared to the 2018 survey, the number of LGA's conducting moisture testing has increased slightly, whilst the number conducting soil and leaf testing has remained the same (0-1% change).

All LGA's are encouraged to conduct nutrient testing. This testing is extremely important as it provides information to determine whether nutrients are required and if required, the application rate and types of nutrients and fertiliser needed. It is strongly recommended that all LGA's regularly conduct these tests before applying fertiliser, so that unnecessary nutrient applications can be avoided. The leaf tissue nitrogen content should be maintained between 1.5% - 2% for passive turf and 2% - 3% for sports fields while the leaf tissue phosphorus content should be maintained between 0.2% - 0.4% (Ruscoe, Johnston & McKenzie, 2004). It is also strongly recommended that Parks and Gardens Officers attend the Fertilise Wise Fertiliser Training courses that are hosted by the Phosphorus Awareness Project in 2020 to fully understand the results of testing that may occur in the LGA's area.

Figure 1a shows the number of LGA's who performed at least one type of testing – soil, leaf and/or moisture – in each of the different areas.

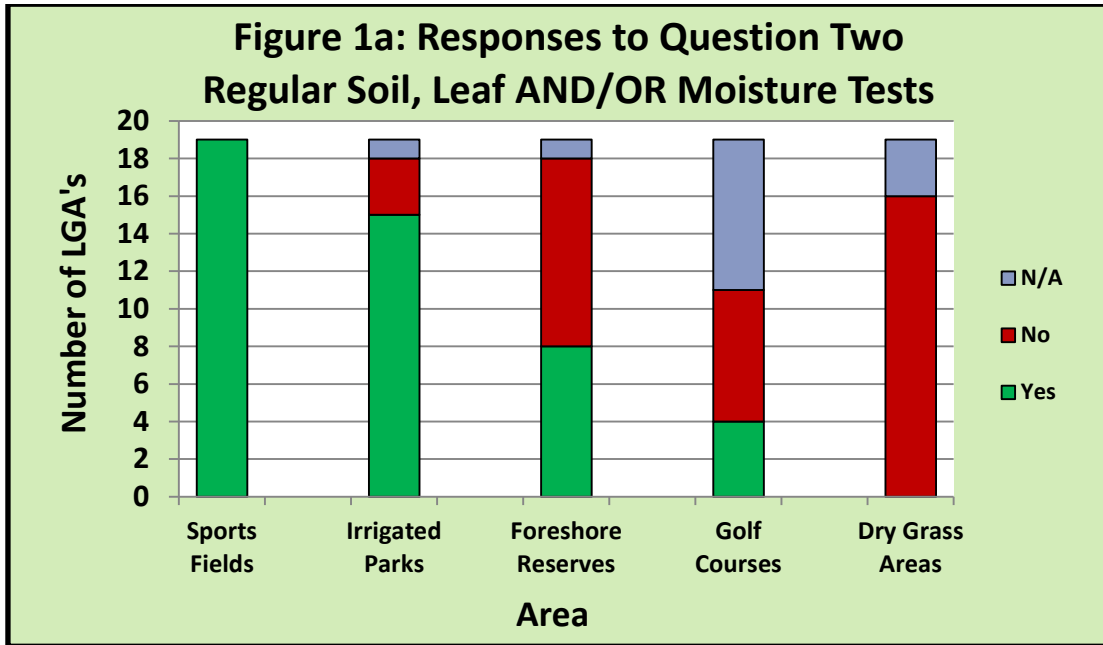
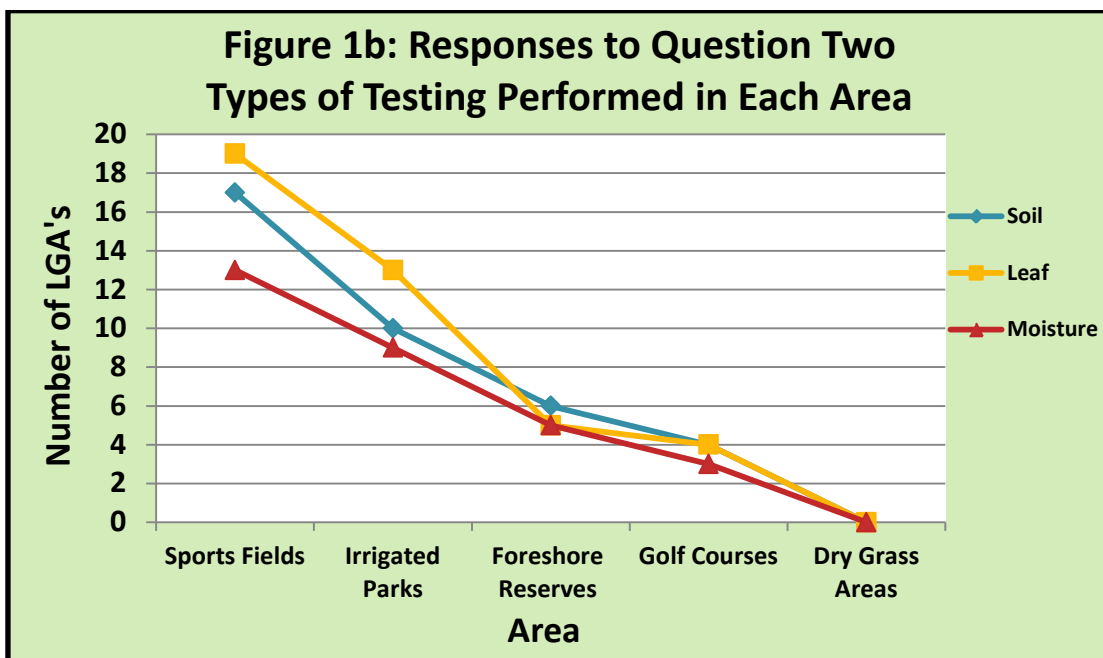


Figure 1b shows the number of LGA's that performed each of the different types of testing – soil, leaf tissue or moisture - in the five areas – sports fields, irrigated parks, foreshore reserves, golf courses and dry grass areas.



All the LGA's in the 2019 survey conducted leaf tissue analysis in at least one of the 5 areas – sports fields, irrigated parks, foreshore reserves, golf courses and dry grass areas. All but one of the LGA's conducted soil testing and thirteen conducted moisture testing in

at least one of these areas. All the LGA's performed at least one type of testing (soil, leaf and/or moisture) on their sports fields, with leaf tissue analysis performed by all nineteen LGA's, soil testing by seventeen LGA's and moisture testing being undertaken by only thirteen LGA's. Thirteen LGA's tested irrigated parks, with leaf tissue analysis being the most common test performed in this area, followed by soil testing and then moisture testing. Foreshore reserves were tested by six LGA's, with soil testing being the most common type performed followed by leaf tissue analysis and moisture testing. Four LGA's performed at least one type of test on their golf courses, most commonly soil and leaf tissue analysis, followed by moisture testing. No LGA's performed any type of test in their dry grass areas.

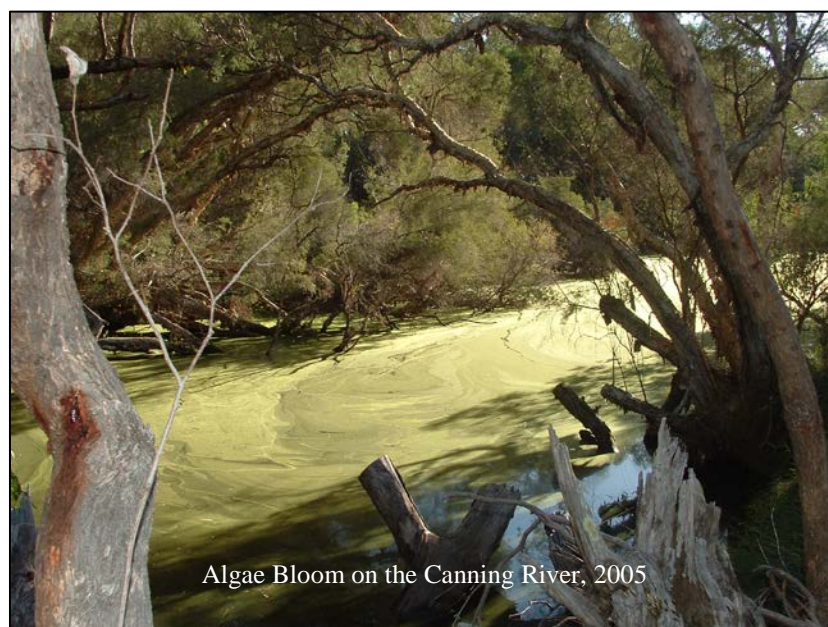
Compared to the 2018 survey, the number of LGA's testing foreshore reserves decreased slightly and the number testing irrigated parks and golf courses decreased moderately (6 - 15% change). The number of LGA's testing dry grass areas remained the same at zero, whilst the number testing sports fields increased slightly. For the different tests that LGA's conducted the use of leaf and soil tests in one or more of the areas mentioned remained the same from 2018 to 2019, whilst the number of LGA's conducting moisture testing in at least one area increased slightly.

These results are somewhat discouraging with testing decreasing or remaining at zero in each of the different areas, except sports fields where it increased slightly. It is encouraging that all LGA's perform at least one type of testing on their sports fields, however it would be preferable to see soil testing and leaf tissue analysis backed up with increased moisture testing. It is recommended that all LGA's conduct soil, leaf tissue and moisture content tests on sports fields as they are high use areas requiring good quality turf where overfertilising and overwatering could occur if not monitored appropriately. The number of LGA's testing irrigated parks needs improvement, particularly in the area of soil and moisture testing. Over watering and/or overfertilising of turfed areas can result in nutrients being leached beyond the root zone to groundwater. It is strongly recommended that irrigated parks are regularly tested, especially for moisture, so that irrigation schedules can be adjusted accordingly to avoid leaching of nutrients from these areas and the wasting of water.

It is disappointing that the number of LGA's conducting testing of foreshore reserves has decreased to an even lower level in 2019. Of the nineteen LGA's who responded, only two did not have foreshore reserves, making this question applicable to seventeen LGA's. Of the ten that have foreshore areas but don't test, only half of them don't fertilise, indicating that the remaining five should be testing. It is recommended that before fertiliser is applied to foreshore reserves that they are tested for nutrients, to avoid overuse of fertiliser, due to the close proximity of waterways.

The relatively low number of LGA's performing any type of testing on golf courses is discouraging as they are another area where inappropriate fertilising and watering could result in the leaching of nutrients, particularly given the large number of golf courses located near and around natural and man-made waterbodies. The low number who test, combined with the number who stated that this question was not applicable to their LGA, suggests that the maintenance of golf courses may be tendered out or that the golf course is acting independently of the LGA. It is recommended that all LGA's promote testing of golf courses in their areas because they can be a significant source of nutrients to waterways. The absence of dry grass areas testing could be an indication that fertiliser is not applied to these areas. If fertiliser is applied, it is recommended that regular testing occur as nutrients can leach to groundwater from these areas in the wetter months.

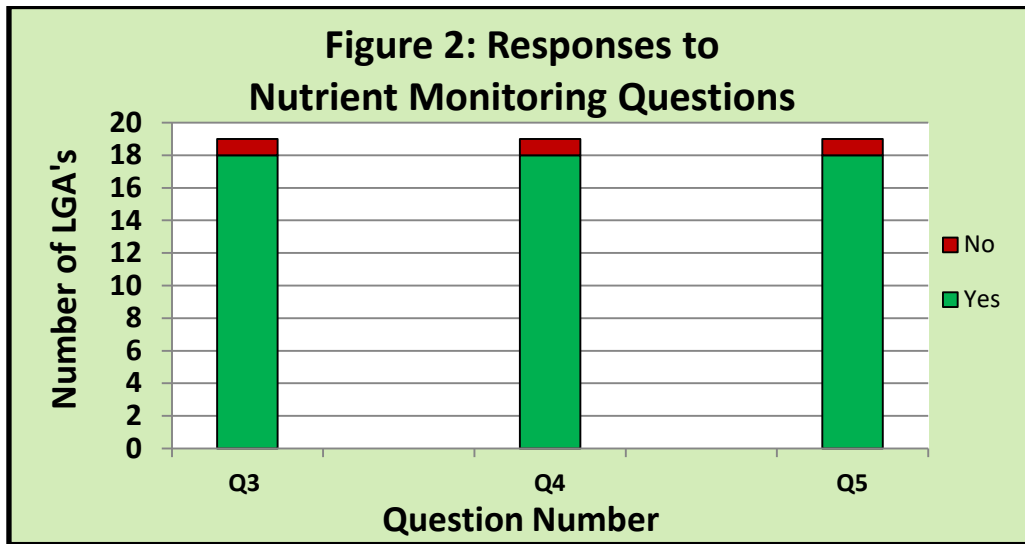
It is encouraging that all of the LGA's that responded are conducting soil tests and leaf tissue analysis in at least one of the areas that they are responsible for managing. This indicates that in those areas the majority of LGA's have scientific information to know exactly how much and what type of nutrient needs to be applied. Thus it is very unlikely that overfertilising would occur in these areas. However, it is disappointing that moisture testing is only conducted by just over half of the LGA's. If areas are overwatered then it is highly likely that nutrients in the soil will be washed past the root zones of turf and plants and enter the groundwater system. Thus, it is recommended that all areas that are irrigated have regular moisture testing to ensure that leaching does not occur.



Algae Bloom on the Canning River, 2005

Question Three

Figure 2 shows the responses from Questions Three, Four and Five.



Question Three asked whether the LGA had its analyses conducted by a laboratory affiliated with the *Australian Soil and Plant Analysis Council (ASPAC)*. Eighteen of the nineteen LGA's that carry out tests have their analyses conducted by these affiliated laboratories. This result has remained the same since 2018.

It is encouraging that the majority of LGA's that are testing are using ASPAC laboratories. ASPAC laboratories are independent, offer quality assurance and standard procedures from experienced staff. It is recommended that LGA's use these laboratories for their analyses to ensure accurate information is received.

Questions Four and Five

Questions Four and Five were directly related to the monitoring of phosphorus. Question Four asked whether available phosphorus was measured by the standard Colwell method. Question Five was about measuring of the Phosphorus Retention Index (PRI). Eighteen of the nineteen LGA's measured the available phosphorus in the soil by the standard Colwell method. Eighteen LGA's tested the Phosphorus Retention Index of the soil. Compared to the 2018 survey the number of LGA's that used the standard Colwell method has increased slightly, whilst those who measure the PRI of the soil has remained the same.

It is encouraging that in most LGA's both the Colwell method (standard method for Western Australian conditions) and the PRI of the soil are being measured together to determine phosphorus levels in soils. Without both tests being conducted, an accurate interpretation of phosphorus levels cannot be achieved, and thus inappropriate fertiliser regimes may be used. It is recommended that all LGA's use both tests, in conjunction, to determine phosphorus levels in soils and then apply results to the following table to determine if phosphorus applications are necessary. As a minimum, these tests should be conducted every second year.

Phosphorus Recommendations		
PRI (Allen & Jeffery method)	Soil Test P (Colwell test)	Recommendations
0 or negative		Do not apply P
0.1 - 0.5	< 5 ppm	Apply up to 5 kg P/ha
	> 5 ppm	Do not apply P
0.5 - 2	< 7 ppm	Apply up to 5 kg P/ha
	> 7 ppm	Do not apply P
3 - 5	< 10 ppm	Apply up to 10 kg P/ha
	> 10 ppm	Do not apply P
> 5	< 10 ppm	Apply up to 20 kg P/ha

Source: Ruscoe, Johnston & McKenzie 2004, *Turf Sustain – A Guide to turf management in Western Australia*. Sports Turf Technology, WA.

Table 1: Phosphorus recommendations using PRI and P soil test results

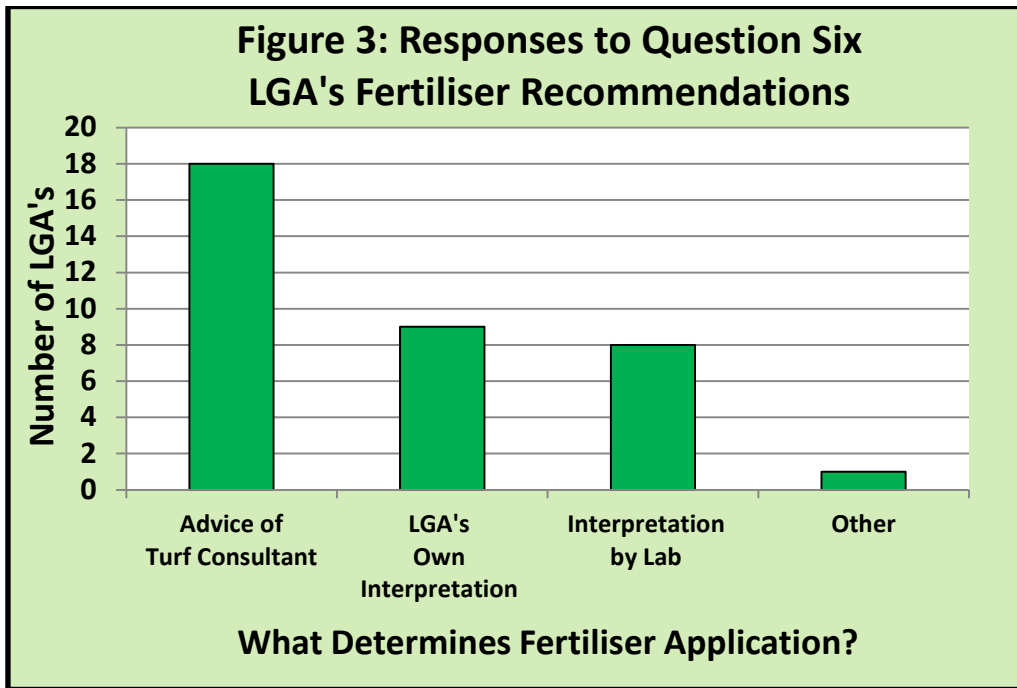
Fertiliser Applications

Question Six

Question Six asked where the LGA's obtained their fertiliser recommendations. Eleven LGA's had more than one response to this question. Figure 3 shows eighteen of the nineteen LGA's received advice from independent turf consultants, nine interpreted the results themselves, eight received interpretation from the laboratory and one indicated other, which was sometimes the supplier. Compared to the 2018 survey, LGA's obtaining their fertiliser recommendations from a turf consultant has increased slightly, the number interpreting the results themselves has remained the same and the number using other advice has decreased moderately. The biggest change came in the number of LGA's using advice from a laboratory, which increased significantly (>15% change) from 2018.

The multiple responses from some of the LGA's to this question indicated that experienced turf managers used their own judgement, blended with a consultant's or the laboratories advice, to decide on a fertiliser program for different turf areas. It is encouraging that a range of opinions were utilised to determine application rates of fertiliser, rather than single sources, and it is recommended that

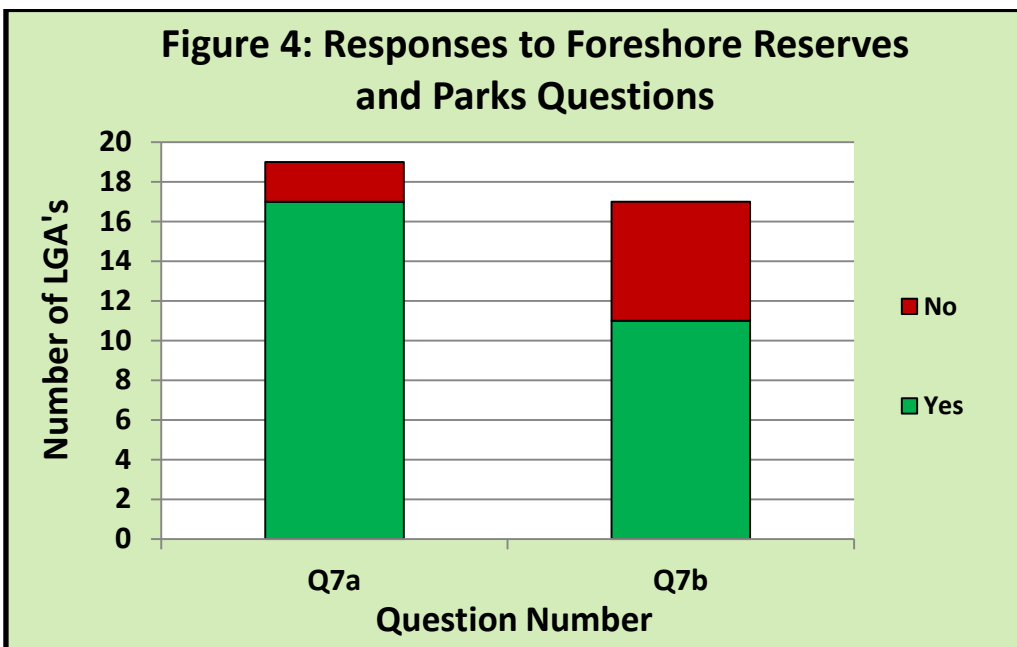
this continue. The high level of advice from turf consultants who are specifically trained in turf management and usually with many years of on ground experience is highly desirable, and it is recommended that LGA's use their expertise to determine appropriate fertiliser regimes. It is also encouraging that the number of LGA's taking laboratory advice into consideration has increased. It is strongly recommended that Parks and Gardens Officers attend the Fertilise Wise Fertiliser Training course hosted by the Phosphorus Awareness Project in 2020 to obtain a greater understanding of appropriate fertiliser and nutrient applications.



Question Seven

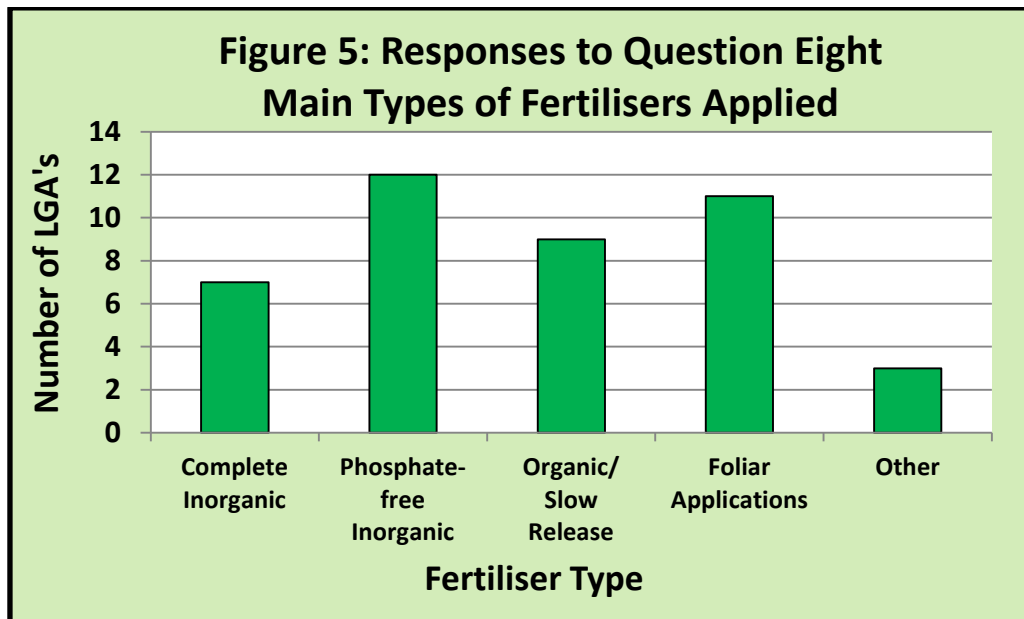
Question Seven asked if LGA's have foreshore reserves and parks and if they did whether fertiliser was added to foreshore reserves and parks. As can be seen from Figure 4 Question 7a, seventeen LGA's reported having foreshore reserves and parks. Figure 5 Question 7b shows that of the seventeen, eleven LGA's added fertiliser to their foreshore reserves and parks, with six LGA's not adding fertiliser. Compared to the 2018 survey, the number of LGA's fertilising foreshore reserves and parks has slightly decreased.

This response is discouraging as the raw results show that only five of the eleven LGA's that are applying fertiliser to their foreshore reserves and parks are analysing nutrient levels in either the soil and/or leaf tissue in these areas. Conversely, one LGA that doesn't add fertiliser to its foreshore reserves is still testing nutrient levels in this area which is to be commended. Foreshore reserves and parks are potentially high-risk areas where nutrients can enter waterways. It is recommended that all LGA's test foreshore reserves before they apply fertiliser to these sensitive areas to avoid unnecessary nutrient applications. If nutrients are required, then controlled release or low water soluble fertilisers should be applied. Fertiliser should not be applied in the winter months when heavy rainfall can wash nutrients into the waterway and irrigation needs to be carefully monitored so that overwatering does not add to the nutrients being washed into the waterway. Only one LGA reported applying fertiliser in winter. If possible, a 50 metre buffer zone should be established between fertilised areas and waterways (DoW, 2004-2007). LGA's can refer to 'Fertiliser application on pasture or turf near sensitive water resources (2010)' available from the Department of Water and Environmental Regulation for further information.



Question Eight

Question Eight determined exactly what types of fertilisers the LGA's applied to various areas as well as the percentages of Nitrogen (N) and Phosphorus (P) of the fertiliser, average application rates of the fertiliser, area (hectares) that was fertilised and the number of applications per season of the fertiliser that was applied. LGA's were asked to provide answers to these questions for fertiliser applications to active turf (eg. sports ovals), passive turf (eg. parks), foreshore areas, non-native gardens, native gardens and other areas. Thirteen of the LGA's had more than one response to the fertiliser type question. As can be seen from Figure 5, seven of the LGA's used complete inorganic fertiliser, twelve used phosphate-free inorganic, nine used organic/slow release, eleven used foliar applications and three used other types of fertilisers. Compared to the 2018 survey the use of complete inorganic and phosphate free inorganic has increased slightly, the use of organic/slow release and other types of fertiliser has decreased moderately and the use of foliar fertilisers has increased moderately.



For the fertiliser type question more than one response from thirteen of the nineteen LGA's indicated they were using specific fertilisers according to the soil's condition rather than using the same fertiliser for all conditions. It is recommended that all LGA's apply fertilisers in this way. Complete inorganic fertilisers can contain high levels of phosphorus and nitrogen and should only be applied if soil and leaf tissue testing reveal these nutrients are required. It is encouraging that phosphate-free inorganic fertiliser is being used by a large proportion of the LGA's that responded to the survey. Many turfed areas do not require phosphorus and thus it should only be applied if testing reveals that it is needed. It should also be noted that high nitrogen levels in fertiliser can also cause problems in waterway systems. Thus LGA's should only apply nitrogen when testing indicates that it is required. It is discouraging that the use of organic/slow release fertilisers has decreased moderately. These fertilisers generally release their nutrients slowly over a period of time, though some nutrients in the fertiliser may not be slow release, thus plants and turf have an extended opportunity to take up all the nutrients released. The use of organic fertilisers could also have the added benefit of improving the soil. Foliar applications are only being used by over half of the LGA's who responded, although this number has once again increased from last year. This method of spraying nutrients on to the foliage of turf and other plants means that nutrients will mostly be taken up into the leaves, with only minimal amounts entering soil where it can be leached to groundwater and waterways. Three of the LGA's indicated that they use other types of fertilisers. As stated previously, soil and leaf tissue testing should be conducted before any nutrients are applied to reduce the risk of leaching of nutrients to groundwater.

The responses from the nineteen LGA's to the percentage of Nitrogen (N) and Phosphorus (P) of the fertiliser, average application rates of the fertiliser, area (hectares) that was fertilised and the number of applications per season were collated and analysed to provide the results in Table 2 for each of the application areas including active turf, passive turf, foreshore reserves, non-native gardens, native gardens and other areas. As with all of the responses in this survey, these results are only as accurate as the data provided and this year much more complete data was provided than in 2018, which may account for a lot of the differences in values.

The average nutrient application rate of nitrogen and phosphorus for each area was calculated by multiplying the amount of fertiliser applied per hectare (application rate in kg/ha or l/ha) by the percentage of nutrient (either N% or P %) in the fertiliser, divided by 100 for each fertiliser that the LGA applied. The results from all LGA's who provided their data were collated in this way and then averaged. The applications per season were totalled from each LGA and then expressed as percentages for each application area. The average annual nutrient rate of nitrogen and phosphorus was calculated for each area by multiplying the average nutrient application rate for each fertiliser applied by the number of times it was applied over the year. The results from all LGA's who provided complete data were collated in this way and then averaged. The total nutrient applied on total area for nitrogen and phosphorus was calculated by multiplying the average annual nutrient rate for each fertiliser (Unit of measurement/ha/yr) by the number of hectares it was applied to each year. The results from all LGA's who provided complete data were then added together. The values that were given in litres are only included for informative purposes as the density of each liquid would need to be known to convert them to kilograms and use them for comparative purposes. Where a range of values were provided by LGA's, this is represented accordingly.

Units of Measurement	Average Nutrient Application Rate (Units of Measurement/ha)		Applications per Season				Average Annual Nutrient Rate (Units of measurement/ha/yr)		Total Nutrient Applied on Total Area (Units of measurement/yr)	
	Nitrogen	Phosphorus	Winter	Spring	Summer	Autumn	Nitrogen	Phosphorus	Nitrogen	Phosphorus
Applications to active turf (e.g. Sporting ovals)										
Kilograms (kg)	29.22-30.79	3.50- 3.51	9%	31-32%	26-28%	30-31%	72.39 - 80.28	8.54 - 8.57	69122 - 77740	9079 - 9104
Litres (l)	3.49	0.21					11.62	0.61	2543	21
Applications to passive turf (e.g. Parks)										
Kilograms (kg)	26.21 - 26.76	1.98 - 2.25	10%	44%	20%	27%	48.52 - 49.62	4.27 - 4.81	47538	341
Litres (l)	3.20	0					3.20	0	62.72	0
Applications to foreshore areas										
Kilograms (kg)	22.43	1.36	4%	40%	24%	32%	50.89	3.64	5433	170
Applications to non-native gardens										
Kilograms (kg)	11.83	5.69	25%	37.5%	12.5%	25%	11.86	5.69	Not enough complete data	
Applications to native gardens										
Kilograms (kg)	25.94 - 29.44	2.42 - 4.12	7%	34.5%	24%	34.5%	27.58 - 31.08	2.46 - 4.16	21.60	0.40
Litres (l)	40.00	0					600	0	1200	0
Applications to other areas										
No usable results										

Table 2: Analysed responses from the nineteen LGA's to fertiliser questions for each application area

As can be seen from Table 2 there was variation between the average nutrient application rates for nitrogen between the different application areas, which is to be expected as different areas have different requirements. The maximum recommended application rate of nitrogen is 40 kg/ha (Ruscoe, Johnston & McKenzie, 2004) though 30 kg/ha is usually sufficient. Higher rates can be used if the fertiliser has a higher proportion of controlled release nitrogen (Ruscoe, Johnston & McKenzie, 2004). Average nitrogen application rates (in kg/ha) for all areas were under the recommended rate of 40 kg/ha, which is an improvement on the 2018 results where only the rates for active and passive turf were below this value. However, despite the average being below the recommended application rate, an analysis of the raw data showed that some LGA's were still applying rates of nitrogen at levels far in excess of the recommended rate. The highest rates of nitrogen applied to each area include 60 - 72 kg/ha on active turf, 57 kg/ha on passive turf, 50 kg/ha on foreshore reserves, 35 kg/ha on non-native gardens and 109 kg/ha on native gardens, although some of these values were for fertilisers with some proportion of slow release fertiliser. No usable results were obtained from any of the LGA's regarding the application rates of fertilisers to other areas due to some data not being provided or being provided in the wrong units of measurement. With the exception of active turf which increased, the average application rate of nitrogen decreased to all other areas from 2018 to 2019.

It is encouraging that average nitrogen application to active turf is below the recommended rate (40 kg/ha) and close to the sufficient (30 kg/ha) rate as this is a large turf area within most LGA boundaries. This result probably reflects the high level of nutrient testing performed in these areas as shown in Figures 1a and b. According to the data received, all of the remaining areas are receiving an average application rate of nitrogen below both the recommended and sufficient rates, which is encouraging. However, more accurate data would be obtained if LGA's kept records of the average application rate and area to which fertiliser is applied to gardens (both native and non-native) and other areas. It is highly recommended that every LGA determines the rate of nitrogen they are applying when they apply a particular fertiliser at a particular rate and do so before the fertiliser is applied so that the amount of nitrogen that is applied at one time does not exceed 40 kg/ha and is preferably closer to 30kg/ha.

There was also some variation between the average nutrient application rates for phosphorus between the different application areas. The maximum recommended application rate for phosphorus is 5 kg/ha (J. Forrest, pers. comm). As can be seen from Table 2 average applications to non-native gardens are slightly over this recommended rate while all other average applications were below recommended rates. This is an improvement on 2018, when average applications of phosphorus to non-native gardens were over double the maximum recommended rate. An analysis of the raw data, however, showed that some LGA's were applying rates of phosphorus at levels a lot higher than the recommended rates. The highest rates of phosphorus applied for each area include 24.5 kg/ha on active turf, 10.2 - 15.3 kg/ha on passive turf, 10 kg/ha on foreshore areas, 17 kg/ha on non-native gardens and 8.5 - 17 kg/ha on native gardens. Compared to the 2018 survey average phosphorus applications active turf, non-native gardens and native gardens have decreased, whilst those for passive turf and foreshore areas have increased.

It is encouraging that average phosphorus application rates to active turf, passive turf, foreshore reserves and native gardens are below, or in the case of non-native gardens, very close to the recommended 5 kg/ha application rates as they are large areas within LGA control. It is highly recommended that every LGA determines the rate of phosphorus they are applying when they apply a particular fertiliser at a particular rate and do so before the fertiliser is applied so that the amount of phosphorus that is applied at one time does not exceed 5 kg/ha.

The response to the number of applications per season question, as revealed by Table 2, shows that the majority of fertiliser applications are being made in the spring and autumn months for most of the application areas apart from non-native gardens which has the majority being applied in spring followed by an equal number of applications being made in autumn and winter. There are however, a large number of fertiliser applications being made in the summer months. An analysis of the raw data revealed that the majority of LGA's are applying fertiliser by multiple applications over the year rather than one large application per year. Compared to the 2018 survey fertiliser applications in winter have decreased in all areas except non-native gardens where they have stayed the

same and native-gardens where they have increased. Applications in spring have decreased to active turf areas, foreshore areas and native gardens and increased for passive turf areas and non-native gardens. Summer applications of fertiliser have increased to active turf areas and foreshore areas and decreased to passive turf areas and non-native gardens, whilst remaining the same to native gardens. Autumn applications have increased to active turf areas and foreshore areas and decreased to all other areas.

The responses to this part of question 8 are promising with a large number of LGA's applying fertiliser in the spring and autumn months when turf and plants are actively growing. Some LGA's applied fertiliser in the winter months which is disappointing as it is likely that nutrients applied will be leached from the soil in heavy rain. The majority of LGA's also have warm season grasses which are dormant during the winter months, thus any fertiliser applied will not be taken up by the grass during this period of dormancy. Although we didn't receive enough usable data for the other areas category, what was provided suggested that when planting trees fertiliser was often applied in winter. Planting trees in the winter months is highly recommended so they can establish themselves before the dry summer months so this is the only instance when applying fertiliser during winter is acceptable. Many LGA's stated that they fertilised in the summer months, though an analysis of the raw data revealed that only a small percentage of this fertiliser was from foliar applications. It should be noted that fertiliser should only be applied in summer if nutrient testing indicates it is required. Many turf types during the summer months will not take up nutrients from fertiliser if there is an extended period of high temperatures. It is encouraging that the majority of the LGA's are applying fertiliser by multiple applications over the year, rather than one large application per year, and it is recommended that this practice continues.

The average annual nutrient rate responses, as shown in Table 2, reveal that the maximum average annual active turf rates of 80 kg/ha/yr of nitrogen and 8.6 kg/ha/yr of phosphorus are either below or within the recommended levels of 100-200 kg/ha/yr for nitrogen and 0-50 kg/ha/yr of phosphorus for high maintenance active turf (Department of Environmental Protection & Water and Rivers Commission, 2001). For passive turf the maximum average annual nutrient rate of 50 kg/ha/yr of nitrogen was just within the recommended rate of 0-50 kg/ha/yr for nitrogen and the 4.8 kg/ha/yr of phosphorus applied fell within the recommended rate of 0-5 kg/ha/yr for phosphorus (Department of Environmental Protection & Water and Rivers Commission, 2001). The foreshore areas average annual application of 51 kg/ha/yr for nitrogen is just above the recommended rate which is 0-50 kg/ha/yr while the 3.6 kg/ha/yr average annual rate of phosphorus is within the recommended rate for this area which is 0-5 kg/ha/yr for phosphorus (Department of Environmental Protection & Water and Rivers Commission, 2001). The average annual nutrient rates for non-native gardens and native gardens can be viewed in Table 2 but it is difficult to determine if levels have been exceeded due to the vast variety of different plant species that fit into these categories. The maximum average annual nutrient rate of 31 kg/ha/yr of nitrogen and 4.2 kg/ha/yr of phosphorus applied to native gardens and the average annual nutrient rate of 12 kg/ha/yr of nitrogen and 5.7 kg/ha/yr of phosphorus applied to non-native gardens are an improvement on last year's excessive amounts, however as with last year the raw data suggests that these results are skewed by the small number of LGA's that provided usable data and the excessive application rates of a few of them. Compared to the 2018 survey, maximum average annual nitrogen application rates have increased to active turf areas, but decreased to all other areas, whilst average annual phosphorus application rates have increased to passive turf areas but decreased to all other areas.

It is encouraging that the average annual nitrogen and phosphorus rates applied to active turf areas are below or within the recommended levels for these areas and it is recommended that this continue. It is encouraging that the average annual nitrogen application rate to passive turf areas has decreased in 2019 and now falls within the recommended rate. It is also encouraging that the average annual application of nitrogen to foreshore areas has decreased from 77 kg/ha/year in 2018 to 51 kg/ha/year in 2019, which is just above the recommended rate. Hopefully this value will continue to fall in future years. Thankfully the application rate of phosphorus to passive turf and foreshore areas remains within the recommended rates. All LGA's are encouraged to keep a log book of their nitrogen and phosphorus applications over the year for all application areas to ensure that recommended rates for these areas are not exceeded.

The total nutrient applied, as can be seen in Table 2, on total area figures revealed that 69,122 - 77,740 kg/yr of nitrogen and 9079 - 9104 kg/yr of phosphorus have been applied on 1049 ha of active turf by the LGA's. Passive turf had 47,538 kg/yr of nitrogen and 341 kg/yr of phosphorus applied to 977 ha, foreshore areas had 5433 kg/yr of nitrogen and 170 kg/yr of phosphorus to 124 ha and native gardens had 22 kg/yr of nitrogen and 0.4 kg/yr of phosphorus to 2 hectares. A value for applications to non-native gardens could not be calculated due to an incomplete data set, with the majority of LGA's not recording the area to which fertiliser was applied. Overall 128,936 - 130,733 kg/yr of nitrogen and 9591 - 9616 kg/yr of phosphorus has been applied by the LGA's to a total of 2152 ha. This does not take into consideration the areas that LGA's stated that they were fertilising, however did not provide enough information to enable a calculation to be made of the amount of nitrogen and phosphorus being applied. It is difficult to compare this more complete data set with that of 2018, however a greater amount of nitrogen and phosphorus have been added in 2019 to a larger area.

The Swan Canning Water Quality Improvement Plan states that the maximum acceptable load of total nitrogen to the Swan and Canning Rivers is 130 tonnes per year and total phosphorus is 14 tonnes per year (Swan River Trust, 2009). Of the 30 LGA's asked to participate in this survey every year, only Joondalup, Kwinana and Rockingham don't have any part of their LGA within the Swan Canning Catchment (refer to Map 1). This means that up to 96,369 kg/year (96 tonnes) of nitrogen and 9616 kg/year (9.6 tonnes) of phosphorus that has been applied by the LGA's within the Swan Canning Catchment has the potential to enter the rivers through leaching to groundwater and by runoff onto hard surfaces and into stormwater drains or directly into waterways. It is recommended that LGA's implement the best management practices for fertiliser/nutrient applications recommended in this report to ensure that the majority of these applied nutrients do not enter the rivers.

Due to the difficulty in assessing overall level of best management practices because of differences in LGA areas including (but not limited to): soil type, turf type, passive vs active turf, age of turf, location of turf, percentage of nutrients in fertiliser and whether nutrient monitoring of turf occurred, it is recommended that LGA's implement the following strategies to ensure management practices approach a high level:

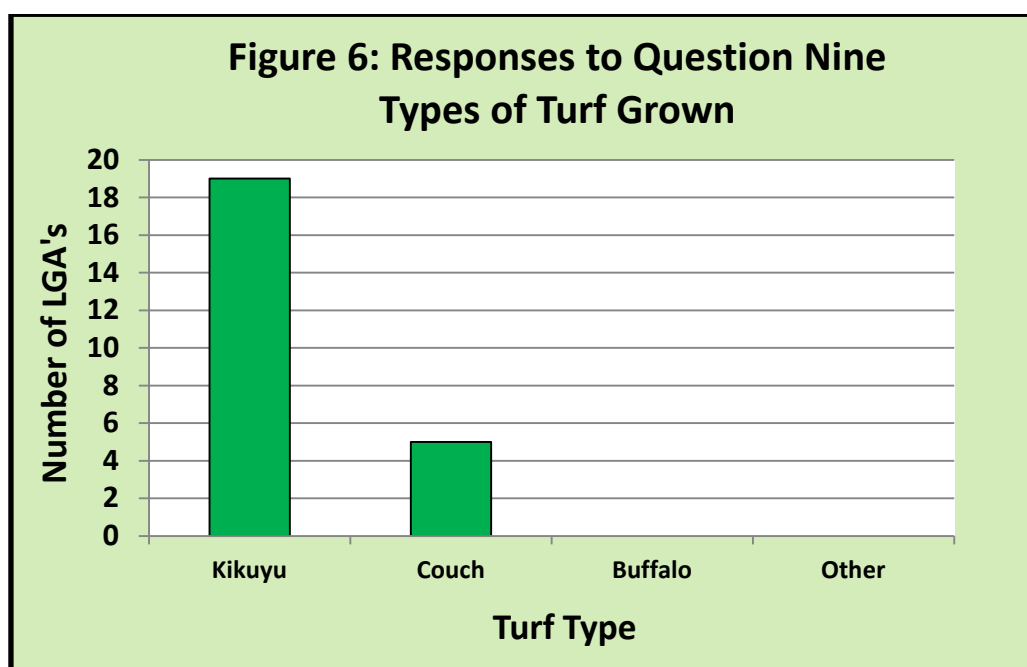
- Determine the rate of each nutrient of the fertiliser they intend to apply before application to ensure that over application of phosphorus and nitrogen does not occur. The formula to determine the rate of nutrient is to multiply the amount of fertiliser to be applied per hectare by the percentage of that nutrient (either N% or P%) in the fertiliser, divided by 100.
- The maximum nitrogen rate for a single application is 40 kg nitrogen/hectare (Ruscoe, Johnston & McKenzie, 2004) though 30 kg nitrogen/hectare is usually sufficient.
- The maximum phosphorus rate for a single application is 5 kg phosphorus/hectare (J. Forrest, pers. comm).
- High maintenance active turf should not exceed applications of 100-200 kg/ha/yr for nitrogen and 0-50 kg/ha/yr for phosphorus.
- Passive turf and foreshore area applications should not exceed 0-50 kg/ha/yr for nitrogen and 0-5 kg/ha/yr for phosphorus.
- Keep a log book to record details of fertiliser and nutrient applications over the year for each application area including details such as weather conditions and monitoring information.
- If fertiliser is required, apply in spring and/or early autumn (September, October, November, March and April) when grass grows rapidly. Apply the fertiliser in small amounts and often over these months instead of a single application. This will ensure all nutrients can be utilised by the turf.
- Do not fertilise in summer or winter (with the exception of native trees that are planted in winter). Summer fertilising encourages over use of water and turf may grow excessively while fertiliser applied during winter will be washed into stormwater drains or leached into groundwater.
- Do not apply fertiliser too close to hard surfaces such as roads. Fertiliser on hard surfaces will be washed into stormwater drains and end up in waterways. Also, do not apply fertiliser around the edges of wetlands and rivers where it can directly be washed into these waterways.
- Avoid applying fertiliser before heavy rainfall and do not over water turf as both actions could result in leaching of nutrients to groundwater and waterways.
- LGA Parks and Gardens Officers should attend the Fertilise Wise Fertiliser Training, which is hosted by the Phosphorus Awareness Project, in 2020 to learn fertiliser best management practices specific for the Perth Metropolitan Area.
- LGA's should refer to the following publications (see Reference section for full publication details) to obtain more information on fertiliser and irrigation best management practices:
 - * *Turf Sustain – A guide to turf management in Western Australia*
 - * *Western Australian environmental guidelines for the establishment and maintenance of turf grass areas (2014)*
 - * *Stormwater Management Manual for Western Australia.*

Turf Type

Question Nine

Question Nine asked for the main type of turf grown in the LGA's area. Five of the LGA's had more than one response to this question. As can be seen from Figure 6, all of the LGA's had kikuyu listed as a turf type. Fourteen of the LGA's used kikuyu exclusively, whilst five combined its use with couch. None used couch exclusively and no LGA's reported using either Buffalo or any other type of turf. Compared to the 2018 survey the number of LGA's using kikuyu remained the same, the number using couch decreased moderately and the use of buffalo decreased to zero.

The response to this question is very encouraging as all the LGA's are using kikuyu. It is recommended that LGA's continue to use kikuyu as their first choice for turfed areas due to its low fertiliser requirements, medium water usage, drought and wear tolerance and long growing season. Using kikuyu results in less nutrients and water having to be applied to turfed areas with less chance of leaching of nutrients occurring compared to other turf types. The LGA's that stated that they also use couch should note that fertiliser should not be applied to these areas in the winter months as the couch could be dormant and thus would not take up nutrients. Three of the LGA's that reported using couch indicated that they apply fertiliser in winter, mostly to active turf areas and in the case of one LGA to passive turf areas as well, although it is not clear if those areas to which it is applied contain kikuyu or couch turf.



Nutrient Management

Question Ten

Question Ten Part A enquired if measures are in place to prevent grass clippings from entering stormwater drains and if so Part B asked respondents to list these measures. As can be seen from Figure 7, all of the LGA's stated that they have measures in place to prevent grass clippings from entering stormwater drains. Fifteen LGA's had more than one response to this question. The measures the LGA's have taken can be seen in Table 3. Compared to the 2018 survey the numbers of LGA's with measures in place has increased moderately, whilst the types of measures taken are similar.

It is encouraging that all of the LGA's who responded to this year's survey have measures in place to prevent grass clippings from entering stormwater drains, as grass clippings are high in nutrients and can end up in waterway systems if they are left on hard surfaces and enter stormwater drains. Most measures that the LGA's indicated they undertook to prevent clippings from entering drains are best management practices. It should be noted, however, that Gross Pollutant Traps (GPTs), drainage sumps and soakwells will not prevent nutrients from grass clippings from entering waterways. Reassuringly, all of the LGA's that indicated that they have GPTs, drainage sumps and/or soakwells also indicated that they use other measures to prevent grass clippings entering drains and many indicated that they have landscaping rather than turf around their GPTs or that they clean them regularly.

Measure Taken	Number of LGA's Using Measure
Clippings cleared/blown from hardstand areas	7
Street sweeping	7
Direct debris away from road/path/waterways	6
Excess clippings put on cut lawn	6
Frequency of mowing	4
Gross Pollutant Traps (GPTs)	4
All clippings left on lawn	3
Catchers used on mowers	3
Clippings removed from site	3
Sweeping of ovals	2
Use of sumps and soakwells	2
Landscaping of GPT's	2
GPT's cleaned regularly	1
Quarterly gully e-ducting	1
Vegetated drains	1
Vegetated buffer zones around lakes	1
Turf machinery cleaned down after use	1
Mowing operator training	1
Tool box meetings to inform of correct procedures	1
Mulching decks/blades	1
Water Sensitive Urban Design (WSUD) – interceptor traps	1
Application of growth retardant	1
Clippings composted	1
Lab testing of streetsweeper debris for petroleum and hydrocarbons	1

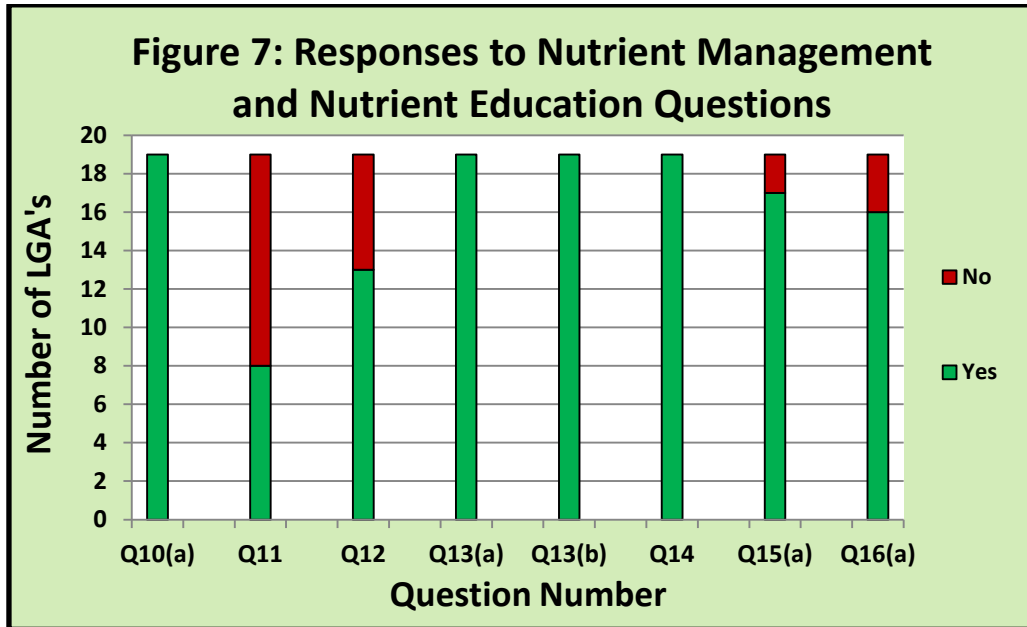
Table 3: Measures taken by the Eighteen LGA's to prevent grass clippings entering stormwater drains.

It is recommended that LGA's take the following measures to prevent grass clippings entering stormwater drains:

- Where practical LGA's should leave grass clippings on the mowed turf which returns the nutrients contained in the clippings back to the soil thus reducing fertiliser requirements. Clippings left in piles should be removed to disperse clippings.
- When mowing, clippings should be thrown away from hard surfaces and waterways.
- When mowing median strips and small areas near hard surfaces or waterways a catcher should be used.
- If clippings need to be removed they should be composted and then utilised as a soil amendment.
- Grass clippings that end up on hard surfaces such as roads and driveways should be swept up and removed (either manually or with a street sweeper) or blown off the hard surface back onto the turfed area.
- Grass clippings should never be blown, hosed or swept onto hard surfaces such as roads or driveways as they can be washed or blown into stormwater drains ending up in waterway systems.
- Mowing equipment should be cleaned down before going to the next location.
- When hosing down mowing equipment ensure that this water does not enter stormwater drains.

Further information can be obtained from the Department of Water's '*Stormwater Management Manual for Western Australia*' and the Swan River Trust's (Fertiliser Partnership Urban Users Working Group) '*Western Australian Environmental Guidelines for the Establishment and Maintenance of Turf Grass Areas*'.

Figure 7 shows the responses to Questions Ten through to Sixteen.



Question Eleven

Question Eleven asked if Nutrient and Irrigation Management Plans (NIMP) are implemented for streetscapes. Eight of the nineteen LGA's that responded had a NIMP for their streetscapes. Compared to the 2018 survey the number of LGA's with NIMP for their streetscapes has increased significantly.

Whilst it is encouraging that the number of LGA's with NIMP has increased from last year, it is disappointing that it remains below 50% of all LGA's and it is recommended that NIMP be implemented by all LGA's for streetscapes. Streetscapes include median strips, roundabouts, entry statements, car park landscaping and road verges, which when combined are large areas within a LGA where nutrients and water usage should be controlled more appropriately. The use of local native species in streetscapes would reduce the need to water and fertilise in these areas. Refer to question twelve for information on using local native species in streetscapes.

Information about NIMP is available from the Department of Water and Environmental Regulation's website where the following documents can be located:

- * *Water Quality Protection Note 33 (June 2010) Nutrient and Irrigation Management Plans*
- * *Water Quality Information Sheet 04 (August 2010) Nutrient and Irrigation Management Plan Checklist*

Question Twelve

Question Twelve asked if LGA's have a policy to use local native plants as the first choice in public and private (Developers) landscaping. Thirteen LGA's had a local native plant policy as the first choice in landscaping. Compared to the 2018 survey the number of LGA's with local native plant policies has increased moderately.

Although the number of LGA's utilising local native plants has increased, it is recommended that every LGA adopts this policy. The use of local native species in landscaping is encouraged as they require low levels of water and fertiliser and once established may require no further applications. This will result in reduced applications of water and nutrients in landscaped areas with less chance of leaching of nutrients from these areas.

Information on local native plant policies and using local native species is available from the Eastern Metropolitan Regional Council's Landscaping with Local Plants Policy and Guidelines section of their 'Local Government Natural Resources Management Policy Manual' and from 'Sustainable Landscaping: Using Local Plants for Nutrient Reduction and Water Conservation' available from Perth NRM. SERCUL's Phosphorus Awareness Project produces 'Grow Local Plants' leaflets for the five main soil types in Perth. These leaflets contain species lists of local plants that are found on each soil type from groundcovers and climbers through to trees.

Question Thirteen

Question Thirteen asked if LGA's have deciduous trees in parks or streetscapes, if they have measures in place to prevent deciduous leaves from entering stormwater drains and if so what are these measures. All of the LGA's had deciduous trees in parks or streetscapes and had measures in place to prevent leaves from entering stormwater drains. Ten LGA's had more than one measure in place. The responses to what measures are taken to prevent leaves from entering drains can be seen in Table 4. Compared to the 2018 survey the number of LGA's with deciduous trees has increased slightly, whilst the number of LGA's with measures in place to prevent leaves from entering drains has increased moderately.

Whilst it is disappointing that nearly all of the LGA's have deciduous trees in parks and streetscapes given that their falling leaves decompose quickly releasing excessive nutrients in to waterways in the late autumn/early winter months, it is understood that the majority of these trees would have been planted many years ago. It is recommended that LGA's opt to plant native, evergreen trees where new trees are required. At the very least they should minimise their use of deciduous trees to prevent leaves from entering

waterways and definitely not plant them along waterways or roads where their falling leaves can enter stormwater drains and then waterways. Refer to question twelve for information on using local native species in parks and streetscapes.

Measure Taken	Number of LGA's Using Measure
Regular road/park/path sweeper	16
Road gullies/drains/sumps/soak wells cleaned/vacuumed	6
Leaf litter collections by raking/mowers with catchers/Turf Tidy Sweeping Machine	4
Use of Gross Pollutant Traps (GPT)	3
Rain Gardens	1
Water Sensitive Urban Design (WSUD) (Interceptor Traps)	1
Use of sumps and soakwells	1
Vegetated drains	1
Drains are independent sumps/soakwells and don't flow back into river	1

Table 4: Measures taken by the nineteen LGA's to prevent deciduous leaves from entering stormwater drains.

It is encouraging that all of the LGA's have measures in place to prevent leaves from entering drains. Most of these measures are best management practices. Many LGA's undertake regular street sweeping which is increased in frequency during the late autumn/early winter months when leaf drop occurs. As stated previously with regard to leaf clippings, Gross Pollutant Traps, soakwells and sumps would not prevent deciduous leaves (or nutrients from leaves) from entering waterways unless they are cleaned out on a regular basis during the autumn and early winter months as deciduous leaves decompose readily. Even those that are independent from the river will contribute nutrients to the groundwater and ultimately to waterways if leaves are left to decompose within them. Reassuringly most of the LGA's that listed that they had GPT, sumps and/or soak wells indicated that they were regularly cleaned or had other measures in place to prevent leaves from entering drains, such as street sweeping.

Question Fourteen

Question Fourteen asked whether the council provided dog poo bins and bags in parks and foreshore reserves. All nineteen LGA's provided these bags and bins in their parks. Compared to the 2018 survey the number of LGA's providing bins and bags has remained the same.

The results from this question are encouraging, and should be continued, as dog poo is the second greatest source of phosphorus to waterways after fertiliser in urban areas. It is recommended that every park or reserve have dog poo bins and bags provided.

Nutrient Education

Question Fifteen

Question Fifteen Part A asked if measures are taken in foreshore reserves and parks to educate the public about not feeding bread to waterbirds and if yes Part B asked what measures are taken. Seventeen of the LGA's had measures in place and nine LGA's had more than one response to what measures are taken. Of the two LGA's that did not have measures in place, one stated that they did not have foreshore reserves and parks and the other stated that these measure were not required as they did not have any river foreshore. The latter LGA does, however, have ocean foreshore which attracts waterbirds and their mobility means that they should not be fed bread in that location either as they can still travel to other areas where wetlands and lakes are located and excrete their waste products. The measures that the LGA's used to educate the public on not feeding bread to waterbirds can be seen in Table 5. Compared to the 2018 survey the number of LGA's with measures in place to educate the public moderately decreased, while the measures being taken have remained similar.

Measure Taken	Number of LGA's Using Measure
Informative signage	16
Pamphlets	6
Website information	4
Verbal communication	2
Education program	2
Community events	1
Newsletters/social media	1
Participation in the EMRC's Healthy Wildlife, Healthy Lives project	1
Workshop	1
Signage stating that feeding ducks attracts a \$100 fine (Urban Environment and Nuisance local law)	1

Table 5: Measures taken by the seventeen LGA's to educate the public about not feeding bread to waterbirds.

The response to this question is promising with nearly all of the LGA's that require measures to educate the public about not feeding bread to waterbirds having them in place. The high use of interpretative signage is very encouraging with information about the effects of feeding being provided at the site where it is occurring. The use of enforcement by one LGA is an important strategy to deter persistent bird feeders and it is recommended that other LGA's also adopt this practice. At a minimum, it is strongly recommended that all LGA's erect signage in river and ocean foreshore reserves and parks educating the public about the effects of bread on waterways (eg. increased phosphorus levels and algal blooms) and waterbirds (eg. malnutrition, botulism and aggressive behaviour). SERCUL's Phosphorus Awareness Project has a brochure which outlines this issue that could be the basis for signage. It is also recommended that LGA's use other strategies to educate ratepayers about the effects of bread on waterways and waterbirds

such as local media, environmental workshops, LGA newsletters, websites and brochures and Rangers advising people of the disadvantages of this activity.

Question Sixteen

Question Sixteen Part A asked if advice was provided to ratepayers about best practice in fertiliser management according to soil type and if so Part B outlined the strategies used to provide this advice. Sixteen of the LGA's stated that they provide advice to their ratepayers and twelve had more than one response to this question. The responses as to how they provided this advice can be seen in Table 6. Compared to the 2018 survey the number of LGA's providing advice has increased moderately while how they provided this advice is similar.

Measure Taken	Number of LGA's Using Measure
Workshop	7
Pamphlets	6
Verbal advice	4
Information on website	3
Free native plants scheme	3
SERCUL/Fertilise Wise information on website	3
SERCUL/Fertilise Wise brochures	2
Information at community events	2
Native plant lists	2
Newsletter	1
Social media	1
Website provides contact details to Parks Services	1
Verge policy encouraging use of native plants	1
Rural property stocking rates	1
Information given at native plants sales	1
Catchment Friendly Garden Competition Category	1
Promote native plantings and park upgrades on website	1

Table 6: Measures taken by the sixteen LGA's to advise ratepayers about best practice in fertiliser management.

It is encouraging that the majority of LGA's are providing some sort of advice to their ratepayers. Ratepayer's lawns, when combined, would form the largest turfed area in a LGA. Householders generally have limited knowledge of best practice fertiliser management. It is recommended that LGA's provide advice to ratepayers on fertiliser practices. This will help to reduce the high levels of nutrients from fertilisers that leach through the sandy soils of the Swan Coastal Plain and into groundwater and waterways.

The Phosphorus Awareness Project produces 'Fertilise Wise' leaflets for the five main soil types in Perth. These leaflets contain information on fertiliser best management practices targeted at homeowners and are available for LGA's to distribute to their ratepayers. The PAP and SERCUL have also developed a website, www.fertilisewise.org.au, that contains Fertilise Wise and other gardening information specific to the Perth region. LGA's are encouraged to link this website to their own website. The 'Sustainable Landscaping: Using Local Plants for Nutrient Reduction and Water Conservation' initiative is available to help LGA's provide information to ratepayers on using local plants in gardens. LGA's could also host a 'Great Gardens' or 'Beyond Gardens' workshop to educate ratepayers on fertiliser and water management and other garden issues. Workshops can be organised by contacting The Forever Project or the Beyond Gardens team.

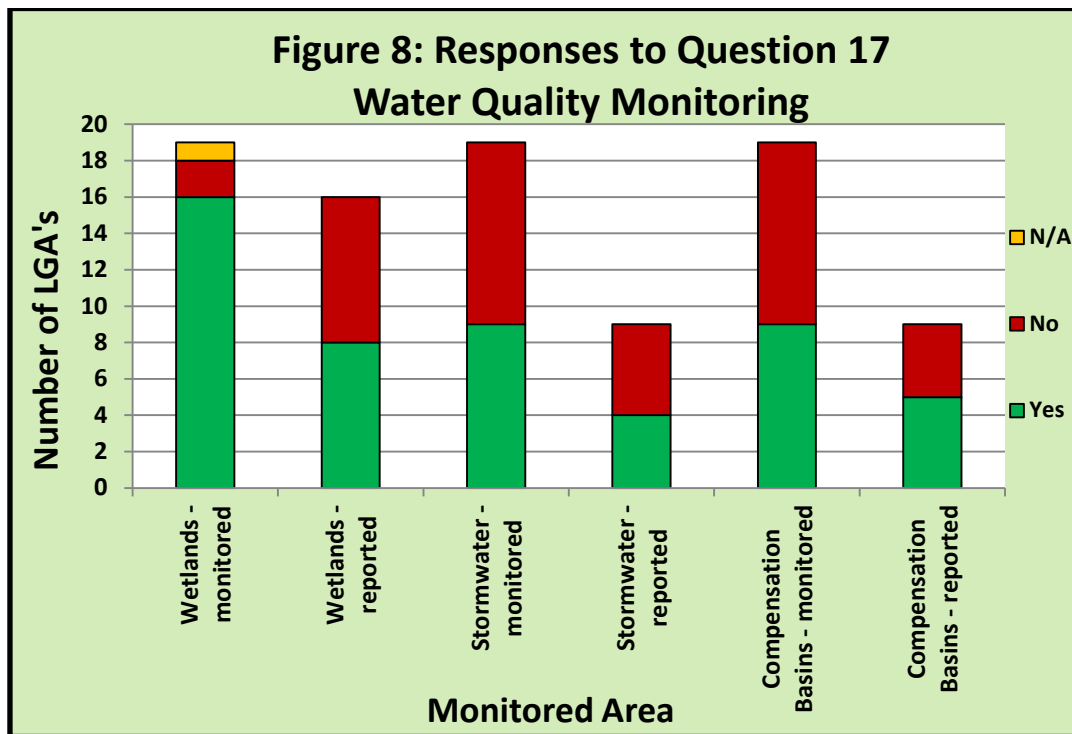
Water Quality Monitoring

Question Seventeen

Question Seventeen Part A asked whether regular monitoring of wetlands, stormwater drains and compensation basins was performed for nutrient levels and if so, Part B asked whether these results were reported to the local community. As can be seen from Figure 8, sixteen LGA's monitored wetlands and nine monitored stormwater drains and compensation basins. One LGA stated that the monitoring of wetlands was not applicable to them as they do not have any in their jurisdiction. Of those that monitored the various areas, eight reported on the results of at least one area, with eight reporting their wetland monitoring results, four reporting their stormwater monitoring results and five reporting their compensation basin monitoring results. Compared to the 2018 survey, the monitoring of wetlands, stormwater drains and compensation basins have all increased moderately as has reporting of these results to the community.

It is encouraging that there has been an increase from 2018 in the number of LGA's monitoring in each of these areas. However, the number of LGA's monitoring stormwater and compensation basins is still quite low. It is recommended that monitoring of all these areas occur as they may all be influenced by fertiliser applications on surrounding areas and monitoring could also help pinpoint the sources from which pollution is entering waterways. Stormwater drains, compensation basins and wetlands are connected to the river systems through ground or surface water. There is a high potential that nutrients, algal blooms or other pollutants from these areas could enter the rivers.

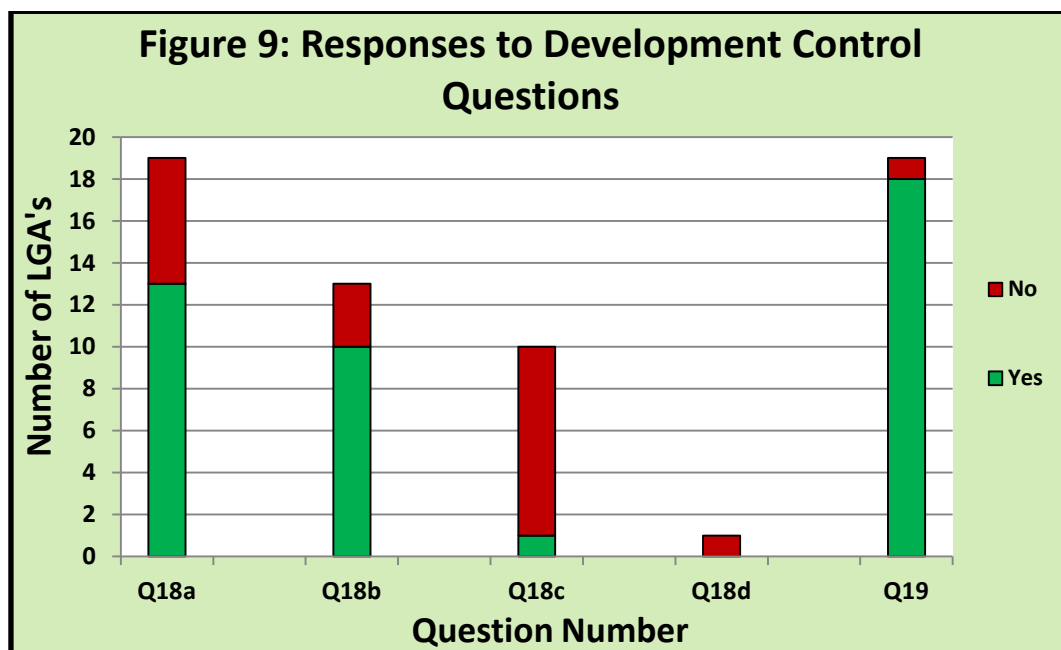
Greater reporting of the results of this monitoring to the public is to be encouraged. Reporting these results to the community would reflect the LGA's commitment to the environment and provide important information to community catchment and environment groups. These groups could use this information to determine where rehabilitation of waterways and education of general community members needs to occur.



Development Control

Questions Eighteen and Nineteen

Questions Eighteen and Nineteen related to new developments. Question Eighteen Part A asked if conditions are imposed on developments which include a Nutrient and Irrigation Management Plan. Monitoring for compliance (Qu 18b), results of monitoring (Qu 18c) and prosecution for lack of compliance (Qu 18d) were also addressed by this question. As can be seen from Figure 9, thirteen LGA's imposed conditions on developments, but only ten of the thirteen LGA's monitored these for compliance. Of the ten that monitor for compliance only one LGA reported that developments had been found to be non-compliant in the last 12 months and none had made a prosecution for lack of compliance in the last 12 months. Compared to the 2018 survey the number of LGA's imposing conditions has significantly increased, monitoring has remained the same and the number of prosecutions has remained at zero. A new part was added to this question (Question 18 c) asking if any developments had been found to be non-compliant in the last 12 months and only one council answered in the affirmative, however they did not prosecute and did not indicate an intention to prosecute.



It is encouraging that the number of LGA's imposing conditions on development has increased and that most of those who impose conditions monitored their developments for compliance. It is unclear why the one LGA who monitors compliance and found a development or developments to be non-compliant did not prosecute. The raw results show that another LGA who indicated that they did not monitor for compliance did report that they had a development or developments that were found to be non-compliant but they have not made any prosecutions in the last 12 months. It is not clear how these non-compliances were discovered given that monitoring is not actively undertaken. This result was not reported in the graphs due to the fact that they should not have answered this question given that they answered no to part a of the question.

It is imperative, however, that all LGA's impose conditions, monitor compliance to these conditions and prosecute for non-compliance. Potentially these conditions are being imposed but they are included in Urban Water Management Plans and are not clearly defined as a NIMP. Many new developments, especially subdivisions, are major sources of nutrients to waterways and this could be reduced by monitoring for compliance and prosecuting developers for their lack of compliance, not only to recoup costs for environmental damage but to deter the developers from not complying on future projects.

Question Nineteen asked if the LGA had provisions in the Town Planning Scheme or Planning Policies to enforce environmental conditions on development. Eighteen LGA's had provisions to enforce environmental conditions. Compared to the 2018 survey the number of LGA's that have these provisions has remained the same.

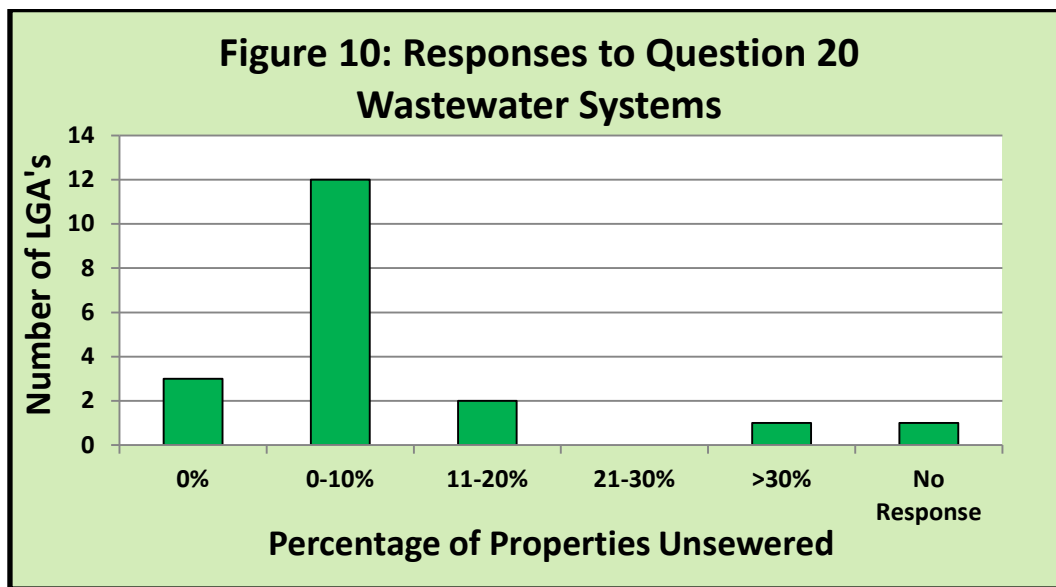
The number of LGA's that have provisions to enforce environmental conditions is very encouraging and it is recommended that all LGA's introduce these provisions. This may prevent environmental harm from occurring and will allow the LGA to prosecute if developers are not adhering to best management practices. As stated above, it is however imperative that if they have the provisions to enforce environmental conditions that they monitor for compliance and prosecute for non-compliance.

Wastewater Systems

Question Twenty

Question Twenty asked what percentage of properties in the LGA's urban zone were not connected to the sewer. As can be seen from Figure 10, three LGA's had 0% not connected to sewer, twelve had 0-10%, two had 11-20%, none had 21-30%, and one had greater than 30%. One LGA did not respond. Compared to the 2018 survey, the LGA's with 0% not connected to sewer has slightly increased, 0-10% not connected has moderately increased, those with 11-20% not connected has slightly increased, those with greater than 30% has slightly decreased while those with 21-30% has remained the same.

Over the next few years, it is expected that the infill sewerage program will increase the number of LGA's that have 0% of properties unsewered. It is recommended that LGA's encourage householders to connect to the main sewerage line as leaking septic tanks can contribute nutrients to the river systems, although it is acknowledged that this will be more difficult for areas located in the Darling Range.



Additional Information

Question Twenty-One

Question Twenty-One asked whether the LGA implemented any other strategies in relation to nutrient management that they felt were not adequately captured in the survey. Six of the LGA's provided additional information relating to various approaches to nutrient management that they have in place including nutrient stripping treatment trains, sub catchment-wide water quality monitoring programs, working with soil hydrologists to ensure best practice on future sports ground sites, lysimeter monitoring of leachate before and after fertiliser applications, generic NIMP based around water licences and the monitoring of developer sediment discharges. The information specific to those LGA's will be summarised on their scorecard.

Annual Nutrient Survey for Local Government Authorities 2019

Recommendations

The following recommendations for each question, if implemented, will help LGA's to achieve a high level of nutrient best management practice.

Nutrient Monitoring

Question One – Does your LGA conduct regular soil tests and/or leaf tissue analysis for nutrients in grassed and turfed areas?

Recommendations

1. LGA's should regularly conduct soil tests and/or leaf tissue analysis before applying fertiliser to determine if nutrients are required, and if required, the application rate and type of nutrients needed. This testing will result in unnecessary fertiliser applications being avoided.
2. The leaf tissue nitrogen content should be maintained between 1.5% - 2% for passive turf and 2% - 3% for sports fields (Ruscoe, Johnston & McKenzie, 2004).
3. The leaf tissue phosphorus content should be maintained between 0.2% - 0.4% (Ruscoe, Johnston & McKenzie, 2004).
4. LGA Parks and Gardens Officers should attend the Fertilise Wise Fertiliser Training course that is hosted by the Phosphorus Awareness Project in 2020.

Question Two – If yes for question no.1, for which areas? Areas - sports fields, golf courses, irrigated parks, dry grass areas and foreshore reserves. Tests – soil tests, leaf tissue analysis and moisture testing.

Recommendations

1. LGA's conduct soil testing and leaf tissue analysis of sports fields, irrigated parks, dry grass areas and foreshore reserves before applying fertiliser. This will result in unnecessary fertiliser applications being avoided.
2. LGA's regularly conduct moisture testing of these areas to avoid overwatering and the potential leaching of nutrients from these areas.
3. LGA's promote testing of golf courses in their areas because they can be a significant source of nutrients to waterways.

Question Three – Are analyses carried out by a laboratory affiliated with the *Australian Soil and Plant Analysis Council (ASPAC)*?

Recommendations

1. LGA's use ASPAC laboratories for their analyses so that accurate information is received.

Question Four - Is available phosphorus in the soil measured by the standard Colwell method?

Recommendations

1. LGA's measure the available phosphorus in the soil using the Colwell method (standard method for Western Australian conditions) to determine accurate levels of phosphorus, thus preventing unnecessary nutrient applications.

Question Five - Is the Phosphorus Retention Index (PRI) of soil measured?

Recommendations

1. LGA's measure the PRI of soil to determine the capacity of the soil to hold on to phosphorus, thus preventing unnecessary nutrient applications.
2. LGA's apply the analyses obtained from the Colwell method and PRI to the following table to determine if phosphorus applications are necessary. As a minimum, these tests should be conducted every second year.

Phosphorus Recommendations		
PRI (Allen & Jeffery method)	Soil Test P (Colwell test)	Recommendations
0 or negative		Do not apply P
0.1 - 0.5	< 5 ppm	Apply up to 5 kg P/ha
	> 5 ppm	Do not apply P
0.5 - 2	< 7 ppm	Apply up to 5 kg P/ha
	> 7 ppm	Do not apply P
3 - 5	< 10 ppm	Apply up to 10 kg P/ha
	> 10 ppm	Do not apply P
> 5	< 10 ppm	Apply up to 20 kg P/ha

Source: Ruscoe, Johnston & McKenzie 2004, *Turf Sustain – A Guide to turf management in Western Australia*. Sports Turf Technology, Como, Western Australia.

Fertiliser Applications

Question Six - Are fertiliser recommendations based on either: advice from an independent turf consultant, LGA's own interpretation of results and experience, interpretation by the laboratory or other?

Recommendations

1. LGA's use a range of opinions to determine application rates and types of fertiliser, rather than single sources to ensure appropriate fertiliser regimes are being conducted.
2. LGA's use a turf consultant's expertise to determine fertiliser regimes as they are specifically trained in turf management, usually with many years on ground experience.
3. LGA Parks and Gardens Officers attend the Fertilise Wise Fertiliser Training course that is hosted by the Phosphorus Awareness Project in 2020.

Question Seven – (a) Do you have foreshore reserves and parks? (b) Do you add fertiliser to foreshore reserves and parks?

Recommendations

1. If LGA's have foreshore reserves and parks they test these areas before applying fertiliser to avoid unnecessary nutrient applications which could leach into groundwater and nearby waterways.
2. If nutrients are required then controlled release or low water soluble fertilisers should be applied to reduce leaching.

- Fertiliser should not be applied in the winter months when heavy rainfall can wash nutrients into the waterway and irrigation needs to be carefully monitored so that overwatering also does not wash nutrients into the waterway.
- If possible, establish a 50 metre buffer zone between fertilised areas and waterways (DoW, 2004-2007).
- LGA's refer to '*Fertiliser application on pasture or turf near sensitive water resources (2010)*' available from the Department of Water and Environmental Regulation.

Question Eight - In general, what are the main types of fertilisers applied to established turf and other areas either: complete inorganic, phosphate-free inorganic, organic/slow release, foliar applications or other? If applied: Fertiliser brand name, N%, P%, Average application rate in kg/hectare, Area, Number of applications per season - winter, spring, summer, autumn? Applications were categorised in the following areas: active turf, passive turf, foreshore areas, non-native gardens, native gardens and other areas.

Recommendations

- LGA's use specific fertilisers according to the soil and leaf tissue analyses for each site rather than using the same fertiliser for all sites to ensure that all the nutrients are utilised by the turf and not leached into groundwater.
- LGA's only apply phosphorus and nitrogen when testing indicates it is required to avoid leaching of nutrients that are not required by the turf.
- LGA's determine the rate of each nutrient of the fertiliser they intend to apply before application to ensure that over application of phosphorus and nitrogen does not occur. The formula to determine the rate of nutrient is to multiply the amount of fertiliser to be applied per hectare by the percentage of that nutrient (either N% or P%) in the fertiliser, divided by 100.
- The maximum nitrogen rate for a single application is 40 kg nitrogen/hectare (Ruscoe, Johnston & McKenzie, 2004) though 30 kg nitrogen/hectare is usually sufficient.
- The maximum phosphorus rate for a single application is 5 kg phosphorus/hectare (J. Forrest, pers. comm).
- High maintenance active turf should not exceed applications of 100-200 kg/ha/yr for nitrogen and 0-50 kg/ha/yr of phosphorus.
- Passive turf and foreshore area applications should not exceed 0-50 kg/ha/yr for nitrogen and 0-5 kg/ha/yr for phosphorus.
- Keep a log book to record details of fertiliser and nutrient applications over the year for each application area including details such as weather conditions and monitoring information.
- If fertiliser is required, apply in spring or early autumn (September, October, November, March and April) when grass grows rapidly. Apply the fertiliser in small amounts and often over these months instead of a single application. This will ensure all nutrients can be utilised by the turf.
- Do not fertilise in summer or winter. Summer fertilising encourages over use of water and turf may grow excessively while fertiliser applied during winter will be washed into stormwater drains or leached into groundwater.
- Do not apply fertiliser too close to hard surfaces such as roads. Fertiliser on hard surfaces will be washed into stormwater drains and end up in waterways.
- Avoid applying fertiliser before heavy rainfall and do not over water turf as both actions could result in leaching of nutrients to groundwater and waterways.
- LGA Parks and Gardens Officers attend the Fertilise Wise Fertiliser Training course that is hosted by the Phosphorus Awareness Project in 2020.
- LGA's refer to the following publications (see Reference section for full publication details) to obtain more information on fertiliser and irrigation best management practices:
 - Turf Sustain – A guide to turf management in Western Australia*
 - Western Australian environmental guidelines for the establishment and maintenance of turf grass areas (2014)*
 - Stormwater Management Manual for Western Australia.*



Turf Type

Question Nine - What is the main type of turf grown in your area: kikuyu, couch, buffalo or other?

Recommendations

- LGA's use kikuyu as the first choice for turfed areas as it has low fertiliser requirements, requires a medium water usage and is drought and wear tolerant.
- LGA's with couch and buffalo in their area should not fertilise this turf in the winter months as it could be in its dormant phase.

Nutrient Management

Question Ten - Do you have measures in place to prevent grass clippings from entering stormwater drains? If yes, please state what measures are taken.

Recommendations

- LGA's have measures in place to prevent grass clippings from entering stormwater drains as they are high in nutrients and will end up in waterway systems.
- Where practical LGA's should leave grass clippings on the mowed turf which returns the nutrients contained in the clippings back to the soil thus reducing fertiliser requirements. Clippings left in piles should be removed to disperse clippings.
- When mowing clippings should be thrown away from hard surfaces.
- When mowing median strips and small areas near hard surfaces or waterways a catcher should be used.
- If clippings need to be removed they should be composted and then utilised as a soil amendment.
- Grass clippings that end up on hard surfaces such as roads and driveways should be swept up and removed (either manually or with a street sweeper) or blown off the hard surface back onto the turfed area.
- Grass clippings should never be blown, hosed or swept onto hard surfaces such as roads or driveways as they can be washed or blown into stormwater drains ending up in waterway systems.
- Mowing equipment should be cleaned before going to the next location.
- When hosing down mowing equipment ensure that this water does not enter stormwater drains.



Question Eleven - Do you have a Nutrient and Irrigation Management Plan (NIMP) implemented for your streetscapes? (i.e. for median strips, roundabouts, entry statements, car park landscaping, road verges, etc.)

Recommendations

1. LGA's implement NIMP for streetscapes, as they are large areas within a LGA where nutrients and water usage should be controlled more appropriately.
2. Information about NIMP is available from the Department of Water and Environmental Regulation's website where the following documents can be located:
 - * 'Water Quality Protection Note 33 (June 2010) Nutrient and Irrigation Management Plans'
 - * 'Water Quality Information Sheet 04 (August 2010) Nutrient and Irrigation Management Plan Checklist'

Question Twelve - Do you have a policy to use local native plants as the first choice in public and private (Developers) landscaping?

Recommendations

1. LGA's have a local native plant policy and plant local native species in their management areas as they require low levels of water and fertiliser and once established may require no further applications.
2. Information on local native plant policies and using local native species is available from the Eastern Metropolitan Regional Council's Landscaping with Local Plants Policy and Guidelines section of their 'Local Government Natural Resources Management Policy Manual', from 'Sustainable Landscaping: Using Local Plants for Nutrient Reduction and Water Conservation' available from Perth NRM and the Phosphorus Awareness Projects 'Grow Local Plants' leaflets.



Question Thirteen - Do you have deciduous trees in your parks or streetscapes? If yes, please state what measures, if any, are taken to prevent deciduous leaves from entering stormwater drains.

Recommendations

1. LGA's minimise the use of deciduous trees as their leaves decompose quickly releasing excessive nutrients in waterways.
2. LGA's do not plant deciduous trees along roads where their falling leaves can enter stormwater drains and then waterways.
3. LGA's use a street sweeper, on a regular basis, during the autumn months when deciduous leaves lose their leaves to prevent leaves entering stormwater drains and then waterways.

Question Fourteen - Do you provide dog poo bins and bags in your parks and foreshore reserves?

Recommendations

1. LGA's provide dog poo bins and bags in parks and foreshore reserves as dog poo is a major contributor of nutrients to groundwater and waterways.

Nutrient Education

Question Fifteen - Are measures taken in foreshore reserves and parks to educate the public about not feeding bread to waterbirds? If yes, please state what measures are taken.

Recommendations

1. LGA's erect signage in foreshore reserves and parks educating the public about the effects of bread on waterways (eg. increased phosphorus levels and algal blooms) and waterbirds (eg. malnutrition and aggressive behaviour). The Phosphorus Awareness Project has a brochure which outlines this issue that could be the basis for signage.
2. LGA's distribute information to their ratepayers about the effects of bread on waterways and waterbirds through local media, environmental workshops, LGA newsletters, website, brochures and Rangers talking to people about the disadvantages of feeding when it occurs.
3. LGA's introduce Local Laws (and enforce those laws) that prohibit the feeding of birds.



Question Sixteen - Do you provide advice to ratepayers on best practice in fertiliser management according to soil type? If yes, please state how advice is provided to ratepayers.

Recommendations

1. LGA's provide advice to ratepayers on fertiliser practices as ratepayers generally have limited knowledge of fertiliser management and would, when combined, have the largest turfed area in the LGA.
2. 'Fertilise Wise' leaflets are available from the Phosphorus Awareness Project to distribute to ratepayers.
3. LGA's link the Fertilise Wise website - www.fertilisewise.org.au to their own website.
4. LGA's host a 'Great Gardens' or 'Beyond Gardens' workshop to educate their ratepayers on fertiliser and water management and other garden issues. Workshops can be organised by contacting The Forever Project or the Beyond Gardens team.
5. 'Sustainable Landscaping: Using Local Plants for Nutrient Reduction and Water Conservation' initiative is available from Perth NRM to help LGA's provide information to ratepayers on using local plants in gardens.

Water Quality Monitoring

Question Seventeen - Do you regularly monitor the following areas under your control for nutrient levels and do you report these results to your local community? Areas: wetlands, stormwater drains, compensation basins.

Recommendations

1. LGA's regularly monitor wetlands, stormwater drains and compensation basins for nutrient levels to determine if pollution is occurring and potentially pinpoint sources.
2. LGA's report these results to the local community reflecting their commitment to the environment and providing important information to community catchment and environment groups to determine where rehabilitation of waterways and education of general community members needs to occur.

Development Control

Question Eighteen – (a) Do you impose conditions on developments which include Nutrient and Irrigation Management Plans (NIMP)?

(b) Do you monitor these for compliance?

(c) Have you made any prosecutions for lack of compliance in the last 12 months?

Recommendations

1. LGA's impose NIMP conditions on developments, monitor these for compliance and prosecute for lack of compliance as new developments are potentially major sources of nutrients to groundwater and waterways.

Question Nineteen - Do you have provisions in the Town Planning Scheme or Planning Policies to enforce environmental conditions on development?

Recommendations

1. LGA's introduce Town Planning Scheme provisions or Planning Policies to enforce environmental conditions on developments to prevent environmental harm and allow the LGA to prosecute if developers are not adhering to best management practices.

Wastewater Systems

Question Twenty - What percentage of properties in your urban zoned land is either unsewered or if sewer is not connected to sewer? (Subdivisions less than 1 ha) Percentages - 0%, 0-10%, 11-20%, 21-30% or >30%.

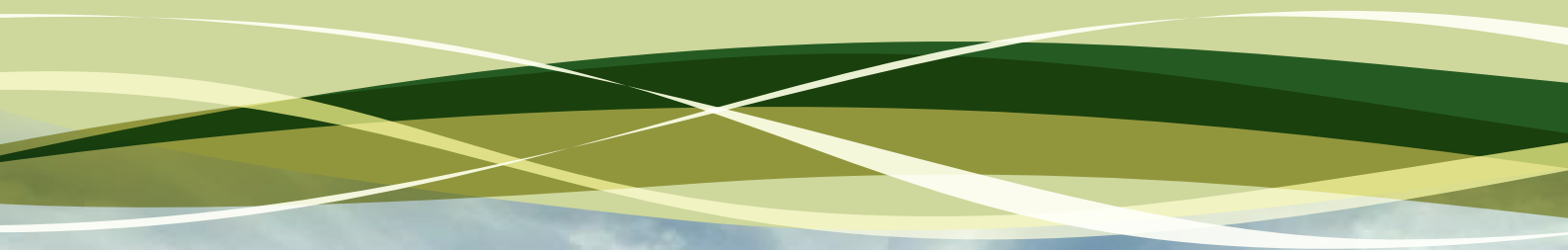
Recommendations

1. LGA's encourage householders to connect to the main sewerage line when or if the infill sewerage program comes into the area as leaking septic tanks can contribute nutrients to groundwater and waterways.

References and Contacts for Further Information

- Beyond Gardens Workshops
Available from the Beyond Gardens team - www.beyondgardens.com.au or by phoning 1300 369 833.
- Department of Water (2004-2007) *Stormwater Management Manual for Western Australia*. Department of Water, Perth, WA.
Available from the Department of Water and Environmental Regulation - www.water.wa.gov.au
- *Fertiliser application on pasture or turf near sensitive water resources (2010)*
Available from the Department of Water and Environmental Regulation - www.water.wa.gov.au
- Fertilise Wise Fertiliser Training, Fertilise Wise guides, Fertilise Wise website, Grow Local Plants leaflets and Feeding Water Bird brochures.
Available from the Phosphorus Awareness Project, South East Regional Centre for Urban Landcare – www.fertilisewise.org.au and www.sercul.org.au/our-projects/pap/ or by phoning 9458 5664.
- Great Gardens Workshops
Available from The Forever Project – www.theforeverproject.com.au or by phoning 0409625299.
- *Landscaping with Local Plants Policy and Guidelines - Local Government Natural Resources Management Policy Manual*.
Available from the Eastern Metropolitan Regional Council by phoning 9424 2222.
- Ruscoe, Johnston & McKenzie (First Published 2004, Reprinted 2014) *Turf Sustain – A Guide to turf management in Western Australia*. Sports Turf Technology, Como, WA.
Available from Sports Turf Technology - www.sportsturf.net.au or by phoning 9367 1600.
- *Sustainable Landscaping: Using Local Plants for Nutrient Reduction and Water Conservation*
Available from Perth NRM by phoning 9374 3333.
- Swan River Trust (2009) *Swan Canning Water Quality Improvement Plan*. Swan River Trust, East Perth, WA.
Available from the Department of Biodiversity, Conservation and Attractions - www.dpaw.wa.gov.au or by phoning 9219 9000.
- Swan River Trust (2014) *Western Australian environmental guidelines for the establishment and maintenance of turf grass areas*. Swan River Trust with support from organisations represented on the Fertiliser Partnership Urban Users Working Group, Kensington, WA.
Available from the Department of Biodiversity, Conservation and Attractions - www.dpaw.wa.gov.au or by phoning 9219 9000.
- *Water Quality Protection Note 33 (June 2010) Nutrient and Irrigation Management Plans*
Water Quality Information Sheet 04 (August 2010) Nutrient and Irrigation Management Plan Checklist
Available from the Department of Water and Environmental Regulation - www.water.wa.gov.au





This report has been prepared for the Phosphorus Awareness Project,
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www.sercul.org.au and www.fertilisewise.org.au