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# *The Analysis and Solution Suggestions of Soil Environment Problems of Two Sites in Melbourne*

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***Abstract:*** The soil in cities often suffers from industrial pollution or structural changes due to construction and human activities. This soil often presents different problems for growing plants, such as insufficient nutrition or difficult drainage. This essay as the current situation of The University Square and The Sanctuary Lakes Parks as examples, has analyzed the soil environment problems of the two places for growing plants, and has given some solution suggestions. The University Square has problems with water shortage and difficult irrigation. It was proposed to remove some trees and replace the remaining tree by other varieties. *Corymbia maculate* is more suitable planted in the square than *Ulmus procera* because the former can reduce the water requirement in the square. In order to be more efficient and economical, irrigation can be combined with the recycling water and stormwater harvesting system. The soil of the seven parks of The Sanctuary Lakes Parks is difficult to grow plants. It was found after calculation that the PH of these parks were higher than ideal PH value, the electrical conductivity were high, and the cation exchange capacity were very low. The soils in the parks were strongly sodic and had low microelements, the Ca/Mg ratio were unbalanced in most parks. It is suggested that some peat or pinebark can be added in soil to reduce the PH, while mixing some clay and organic matter in the soil can increase the soil nutrient and improve the soil texture.

## 1. Introduction

Wang, Chen, Li & Liu (2003)[1] discuss that as a complex society-economy-nature system, the city is an extremely unstable artificial ecosystem. The soil is not only the indispensable resources in the production of food, fiber and forest products, but also the foundation for the common prosperity of human society and biosphere. However, in the process of urbanization, the large-scale of engineering construction, transportation and pollutants, especially the improper land use and management, due to the severe impact to the urban soil and some even are not reversible. In almost place of urban, the natural soil has been destroyed. Its soil parent material, climate, landform and vegetation have suffered severe changes. The most obvious manifestation of urbanization is its expansion in space, which is accompanied by the large-scale urban construction. Wang, et al. (2003)[1] argue that plenty of waste often generated in the process, the long-term repeatedly and disorderly underground construction into the soil and frequent turning of soil make the topsoil (or humus layer) has been stripped or buried. Yang & Tang (2006)[2] show that the other soil layers have been broken and there is no certain distribution, the depth of soil has become dramatically variated. At the same time, the soil has been mixed with a large number of artificial substances, such as the slag, the solidified lime solution and the pipelines. What's worse, some of the waste from the urban life will directly go into the soil; some can get through the atmosphere and water to enter the soil, which can result in the pollution of heavy metal, organic matter and pathogenic bacteria in urban soil. Yang & Tang (2006)[2] also talk about that all of these mentioned above will greatly change the composition, pore distribution and heat condition of the soil. Moreover, the soil structure and the profile level will be confused, some specific color may emerge in the soil, and the soil fertility will decline. Wang, et al. (2003)[1] show that the frequent factitious trampling and transportation can make the urban soil generally relatively tight, and with small porosity, poor permeability. The granular structure of the original soil is destroyed and replaced by some lamellar or block structure. Chen (1999)[3] mentions that in the situation of that the urban soil resources are becoming increasingly scarce and the environment quality is deteriorating, it has very important practical significance to strengthen the study of the influence of the urbanization on soil environment.

In this essay, The University Square and the Sanctuary Lakes Parks in the Melbourne city would be as the example to be analyzed about their problems and how to improve the soil environment. The research can provide the scientific guidance for the urban environment monitoring, the rational utilization of city land resources and the formulation of city planning. Meanwhile, the research of urban soil will promote the development of soil science.

## 2. University Square

### 2.1 Introduction


Figure 1: The University Square in December 2015 (Nearmap 2017[4])

The University Square is located in 190-192 Pelham St, Carlton of Melbourne, Victoria, Australia as the Fig 1 showed. City of Melbourne (2016)[5] claims that it was designed as a part of gardens in the jurisdiction of Carlton and the University of Melbourne in 1850s. The square was firstly named as the Barry Square and has been changed many times after the first chancellor. In 1873, the square was formally named as the University Square and had been managed by the Melbourne City Council from then on. City of Melbourne (2017)[6] presents that recently a master plan for the University Square was proposed in 2016, which aims to create a 21st-century square to meet the needs of increasing population in the community, meet the needs of different groups of citizens. There are 12 Ulmus procera (English Elm) in every four lines from the north to south and another 6 in the south rank from the east to west. The grass turf is full of the square and is divided by three crossed road. The soil here is clay loam. There is the water depletion and irrigation problem of the square. In order to improve the soil environment of the square, the solution was considered to remove the 24 Ulmus procera in the central and replace the other 30 trees by Corymbia maculate, who have larger 25 diameters of the canopies. This essay will analyse if the method can allow the water using efficient after changing plants, and talk about the feasibility of irrigation method.

## 2.2 Calculation methods

From the Nearmap (2017)[4], choosing the biggest canopy area (CA) of trees in recently to indicate the most water using, namely in the December 2015. Recording and calculating the area of the whole square, roads and the turf by the marked lines and scale as the Fig 2 presented. In the same way, recording and calculating the canopy radius and area of trees by the marked circle and scale.

$$\text{Turf area}\left(m^2\right) = \text{Whole square area}\left(m^2\right) - \text{Road area}\left(m^2\right)$$

$$C_A\left(m^2\right) = \text{PI} \times r^2$$

The PI means π; the r means the radius of each tree.

Connellan (2013)[7] demonstrates that the water use of tree and turf can be calculated as followed:

$$\text{The tree water use}\left(\text{L/month}\right) = K_c \times C_A \times ET_O$$

$$\text{The turf water use}\left(\text{L/month}\right) = K_c \times ET_O \times A_T$$

The Kc means crop coefficient value and the Kc of tree can be found in Appendix 4.1 as Connellan (2013)[7] presented, the Ulmus procera is ‘Medium’ (Kc: 0.4-0.6), used the upper value——0.6, and the Corymbia maculate is ‘Very low to Low’ (Kc: <0.1 to 0.1-0.3), used the upper value——0.3. What the $K_C$ of turf as Connellan (2013)[7] showed on Page 120 is 0.3-0.6 because the grass in the square is the couch, and it can be founded that under the water stress, the $K_C$ of turf should use 0.42. The $ET_O$ (evaporation rate) in each month can be found in the Appendix 3.4 in the Connellan (2013)[7], according to the chosen December, it is 129mm. The $A_T$ is the area of turf (m2).

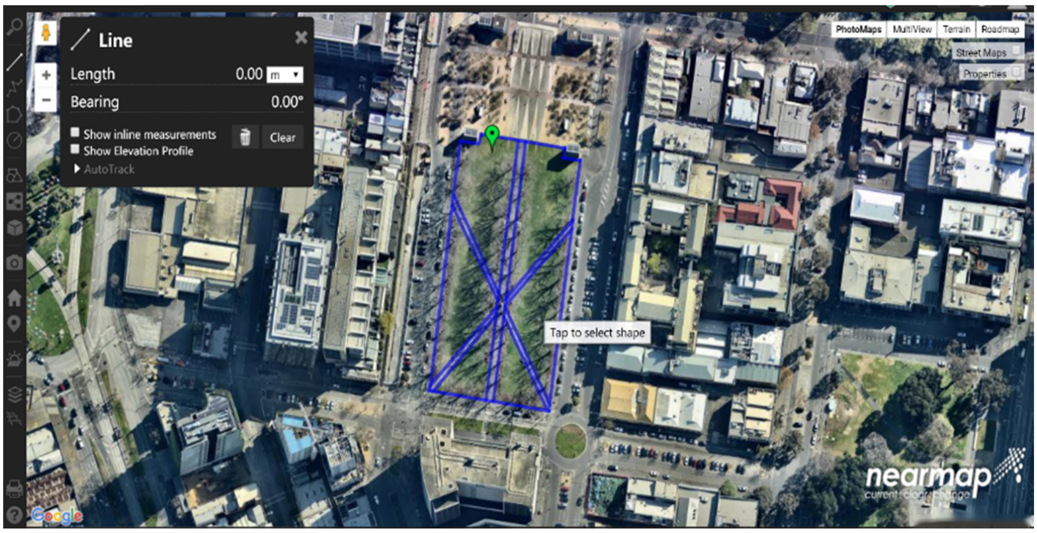


Figure 2: The marked area of turf and the whole University square (Nearmap 2017[4])

There will be 4ML (Megaliter) per year to irrigate the square. According to the requirements, the nutrient needs of the grass is 120kg N, 20kg P and 150kg K per hectare. And the nutrients content of the recycled water is as the Table 1 showed.

Table 1: The nutrients content values of the supplied recycled water

| Nutrients | Values |
|---|---|
| **Total Nitrogen, as N (mg/L)** | 15.4 |
| **Phosphorus, total as P (mg/L)** | 12.7 |
| **Potassium, as K (mg/L)** | 68.2 |

The nutrients content of offered recycled water and the requirements of turf can be calculated as followed:

$$\text{Nutrients}(\text{kg})(\text{offered}) = V_W \times \text{Nutrients content values}$$

$$\text{Nutrients}(\text{kg})(\text{requirement}) = A_T \times \text{Each nutrient need}$$

The VW is the volume of the water using of turf.

### 2.3 Result

The radius, CA and the water use (L/month) of each tree are presented in the Table 2.

Table 2: The radius, CA and the water use of each tree

| Canopy radius (m) | Canopy area ($m^2$) | Water use (L/month) | Canopy radius (m) | Canopy area ($m^2$) | Water use (L/month) |
|---|---|---|---|---|---|
| 5.4 | 91.52 | 7083.65 | 4.98 | 78.05 | 6041.07 |
| 5.87 | 108.22 | 8376.23 | 6.64 | 138.34 | 10707.52 |
| 4.93 | 76.22 | 5899.43 | 4.63 | 67.36 | 5213.66 |
| 4.45 | 62.31 | 4822.79 | 5.93 | 110.41 | 8545.73 |
| 4.69 | 69.09 | 5347.57 | 5.57 | 97.62 | 7555.79 |
| 7.52 | 177.69 | 13753.21 | 5.81 | 106.06 | 8209.04 |
| 7.28 | 166.71 | 12903.35 | 5.22 | 85.62 | 6626.99 |
| 4.93 | 76.22 | 5899.43 | 5.93 | 110.41 | 8545.73 |
| 6.34 | 126.32 | 9777.17 | 5.34 | 89.53 | 6929.62 |
| 4.69 | 69.09 | 5347.57 | 3.92 | 48.34 | 3741.52 |
| 5.63 | 99.69 | 7716.01 | 4.16 | 54.33 | 4205.14 |
| 5.16 | 83.69 | 6477.61 | 5.22 | 85.62 | 6626.99 |
| 6.11 | 117.09 | 9062.77 | 6.28 | 123.98 | 9596.05 |
| 4.93 | 76.22 | 5899.43 | 6.16 | 119.37 | 9239.24 |
| 6.81 | 145.82 | 11286.47 | 4.51 | 63.98 | 4952.05 |
| 6.58 | 135.89 | 10517.89 | 6.05 | 114.84 | 8888.62 |
| 5.87 | 108.22 | 8376.23 | 6.52 | 133.47 | 10330.58 |
| 6.81 | 145.82 | 11286.47 | 6.16 | 119.37 | 9239.24 |
| 5.46 | 93.53 | 7239.22 | 6.87 | 148.35 | 11482.29 |
| 6.05 | 114.84 | 8888.62 | 6.4 | 128.68 | 9959.83 |
| 6.64 | 138.34 | 10707.52 | 5.81 | 106.06 | 8209.04 |
| 5.69 | 101.79 | 7878.55 | 6.05 | 114.84 | 8888.62 |
| 5.46 | 93.53 | 7239.22 | 5.81 | 106.06 | 8209.04 |
| 5.93 | 110.41 | 8545.73 | 6.05 | 114.84 | 8888.62 |
| 5.81 | 106.06 | 8209.04 | 5.69 | 101.79 | 7878.55 |
| 4.63 | 67.36 | 5213.66 | 5.57 | 97.62 | 7555.79 |
| 6.28 | 123.98 | 9596.05 | 7.46 | 174.91 | 13538.03 |

(The yellow data is the 6 trees in the south rank of the square, the green data is the 12 trees on the east line, the blue data is the 12 trees in the central east line, the gray data is the 12 trees in the central west line, the orange data is the 12 trees on the west line.)

The table 3 illustrates the area of University Square as well as the area and water use of the turf, original trees and the trees after replacing.

Table 3: The area of the university square and the area and water use of the turf, original trees and the trees after replacing

| | | |
|---|---|---|
| **The University Square area ($m^2$)** | | |
| 10022.62 | | |
| | | |
| **Turf area ($m^2$)** | **Water use (L/month)** | **Water use (ML/year)** |
| 9157.86 | 496172.85 | 5.95 |
| | | |
| **Trees canopy area ($m^2$)** | **Water use (L/month)** | **Water use (ML/year)** |
| 5725.52 | 443155.25 | 5.32 |
| | | |
| **Trees canopy area ($m^2$) (After changing)** | **Water use (L/month) (After changing)** | **Water use (ML/year) (After changing)** |
| 3887.53 | 150447.56 | 1.81 |

$$\left(\text{Water use}\left(\text{ML/year}\right)=\text{Water use}\left(\text{L/month}\right)\times 12/10^{6}\right)$$

In the Table 4, it shows the supplied N, P, K content of recycled water and the required content of N, P, K of the couch grass in the University Square.

Table 4: The comparison of the offered and required content of N, P, K

| | **N** | **P** | **K** |
|---|---|---|---|
| **Water offered (kg)** | 61.6 | 50.8 | 272.8 |
| | | | |
| **Soil requirement (kg)** | 110 | 18.4 | 138 |

## 2.4 Analysis

It can be seen in the table 3, the turf area in the University Square is 9157.86$m^2$, which can maximumly use 5.95ML per year. The original trees canopy area is 5725.52 $m^2$ and the water using in each year is 5.32ML at most. After removing the central two lines' trees and planting other trees to replace the other Elms, the trees canopy area is 3887.53$m^2$, and they can use maximum 1.81ML in each year, which are both less than before changing. This consideration can increase the activity areas for people and can decrease the water using.

Because the water use of turf is calculated as 5.32ML, which is bigger than the recycled water can be offered. The nutrient of water offered is calculated by 4ML multiple the nutrients content values. From the table 4, the recycled water will result in the deficiency of N in the site. Territory and Municipal Services (nd)[8] assert that the original tree, Ulmus procera should grow in fertile and well-drained soil. While the soil of the University Square has poor drainage and may occur waterlogging as the Robert & Chris (2017)[9] showed. The new tree, Corymbia maculate is described by Association of Societies for Growing Australian Plants (ASGAP) (2007)[10] that it can grow in a range of soil type even in the infertile soil, but it cannot be waterlogged. All in all, the Corymbia maculate is more suitable planted in the square than Ulmus procera.

The recycled water will result in N deficient, as well as the P and K will be too much. Khalid, Javaid & Muhammad (2016)[11] claim that the deficiency of N of the irrigation water will affect the production of plants. Because the root of turf (Root zone depth: 250mm) is usually in the top soil, it is possible that the N will be absorbed by grass' root so that hard to leach. The clay soil is also the reason that N is difficult to leach. After several years, the soil of the square will be very infertile. Rowell (1994)[12] asserts that excessive phosphorus causes the soil to be deficient in sulphur, excessive potassium can lead to the lower absorption of calcium and magnesium and lower yield. Prolonged apply of over-phosphorus and over-potassium can damage the balance of nutrients in the soil and can worsen the characteristics of the soil.

It is recommended by Robert & Chris (2017)[9] that adding some sands, organic matter and the gypsum in the soil to improve the soil structure before replanting trees. Besides, according to The State of Victoria (2017d)[13], it is needed to test the compaction, the PH, the salt content, the nutrient status, the potential toxicity and the drainage before planting and after it now and then to manage the square better and in time. Also, the soil texture, structure, colour, stability and porosity are also needed to test on time to monitor the soil. The irrigation system can be changed flexibly and combine the water sensitive urban design (WSUD) to satisfy the changes of soil. Irrigated water can combine the recycled water and the stormwater.

## 3. The Sanctuary Lakes Parks

### 3.1 Introduction

The Sanctuary Lakes Parks is at 72 Greg Norman Dr, Point Cook Victoria, approximately 28km away from the CBD of Melbourne. Sanctuary Lakes Club (2017)[14] presents that it is built on the former Cheetham Salt Works. In the 1980s, the salt site was closed by the company and then was built to become the Sanctuary Lakes Parks. Thus, there are many problems of the soil. In order to restore this site, this place has been managed by Parks Victoria to be the ‘Cheetham Wetlands’, which has offered a habitat for many birds especially some rare birds. The design of wetlands has protected the place in a degree and has become the basis of the later Sanctuary Lakes Parks. The essay will show and explain the chemistry characteristics of seven parks of the Sanctuary Lakes Parks, and then give some suggestion about improving one of the seven parks——the Half Moon Park.

### 3.2 Calculation methods

The PH, electrical conductivity (EC) (1:5 ds/m) and each element content (mg/kg) are tested by the comprehensive Mehlich 3 method by Endeavour Turf Products Pty Ltd.

Table 5: The element content (mg/kg) of the soil in the 7 parks

| | Na | K | Ca | Mg | Cl | $NO_3$ | $PO_4$ | $SO_4$ | Fe | Mn | Zn | Cu | B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Signature Park | 41.2 | 9.0 | 47.2 | 18.2 | 30.2 | 0.7 | 1.7 | 0.5 | 5.6 | 1.7 | 0.2 | 0.06 | 0.08 |
| Times Square Park | 42.7 | 9.5 | 55.9 | 13.4 | 26.6 | 0.8 | 1.6 | 0.5 | 7.6 | 0.6 | 0.4 | 0.04 | 0.06 |
| 7C Park | 85.0 | 9.5 | 54.9 | 19.6 | 72.4 | 0.5 | 1.7 | 0.9 | 6.0 | 1.4 | 0.4 | 0.06 | 0.10 |
| Jardin Park | 156.4 | 6.7 | 48.5 | 27.7 | 133.0 | 0.5 | 0.5 | 1.2 | 3.1 | 2.7 | 0.1 | 0.05 | 0.06 |
| Oyster Bay Park | 53.0 | 3.6 | 111.3 | 11.2 | 51.7 | 0.0 | 0.8 | 1.5 | 3.8 | 0.9 | 0.6 | 0.08 | 0.07 |
| Half Moon Park | 105.0 | 14.5 | 106.8 | 21.6 | 75.4 | 0.5 | 1.0 | 0.8 | 3.9 | 1.8 | 0.2 | 0.07 | 0.17 |
| Adventure Park | 46.2 | 8.1 | 44.9 | 9.9 | 50.0 | 0.8 | 1.7 | 1.1 | 8.9 | 0.3 | 0.2 | 0.01 | 0.05 |

So, the cation exchange capacity (CEC) (cmol(+)/kg), the exchangeable sodium percentage (ESP) (%) and the Ca/Mg ratio can be calculated.

$$\text{CEC}\left(cmol(+)/kg\right) = \text{Capacity of Na}^{+} + \text{K}^{+} + \text{Ca}^{2+} + \text{Mg}^{2+}$$

$$\text{ESP}(\%) = \left(\text{Exchangeable Na}^{+}/\text{CEC}\right) \times 100$$

### 3.3 Result

The PH, EC, CEC, ESP and Ca/Mg ratio of the soil in the seven parks are as the table 5 presented. The table 6 shows the chemical element content of the soil in the seven parks.

Table 6: The basic features of the soil in the 7 parks

| | PH | EC 1:5 (ds/m) | CEC (cmol(+)/kg) | ESP (%) | Ca/Mg ratio |
|---|---|---|---|---|---|
| **Signature Park** | 7.4 | 0.34 | 0.59 | 30.51 | 1.60 |
| **Times Square Park** | 7.3 | 0.45 | 0.59 | 30.51 | 2.55 |
| **7C Park** | 8.1 | 0.60 | 0.83 | 45.12 | 1.69 |
| **Jardin Park** | 9.1 | 0.92 | 1.16 | 58.62 | 1.04 |
| **Oyster Bay Park** | 9.2 | 0.43 | 0.89 | 25.84 | 5.96 |
| **Half Moon Park** | 8.9 | 0.51 | 1.21 | 38.02 | 2.94 |
| **Adventure Park** | 6.8 | 0.43 | 0.53 | 87.17 | 4.54 |

The Table 7, Table 8, Table 9 and Table 10 respectively present the rating standard and the soil type according to each ranging of CEC (cmol(+)/kg), the sodicity rating standard of each ranging of the ESP (%) in Australia, the situation description of each ranging of the Ca/Mg ratio and the ideal ranges of EC (1:5 ds/m) and several microelements (mg/kg).

Table 7: The CEC (cmol(+)/kg) standard (Soil Quality Pty Ltd 2017[15] and The university of Melbourne 2017[16])

| Rating | CEC (cmol(+)/kg) |
|---|---|
| Very low | <6 |
| Low | 6 to 12 |
| Moderate | 12 to 25 |
| High | 25 to 40 |
| Very High | >40 |
| | |
| **Soil type** | **CEC (cmol(+)/kg)** |
| Pure sand | <2 (Very low) |
| Sand & silt | 2 μm/2 mm (Low) |
| Claying sandy soil | 10 to 100 (High) |
| Organic matter | 250 to 400 (Very high) |

Table 8: The ESP (%) standard (The university of Melbourne 2017[16])

| Sodicity rating | ESPs proposed Australia |
|---|---|
| Non-sodic | 0 to 6 |
| Marginal to sodic | 6 to 12 |
| Strongly sodic | >12 |

Table 9: The Ca/Mg ratio standard (The university of Melbourne 2017[16])

| Description | Ca/Mg ratio |
|---|---|
| Ca deficient | <1 |
| Ca low | 1 to 4 |
| Balanced | 4 to 6 |
| Mg low | 6 to 10 |
| Mg deficient | >10 |

Table 10: The ideal range of EC (1:5 ds/m) and microelement (mg/kg) (Peter 2017[17])

| | EC 1:5 (ds/m) | S | Zn | Cu | Mg | Fe | B | Cl |
|---|---|---|---|---|---|---|---|---|
| **Ideal range** | <0.27 | 10 to 50 | 1 to 10 | 1 to 10 | 1 to 4 | 10 to 75 | 0.3 to 1.0 | <100 |

## 3.4 Analysis

As The State of Victoria (2017b)[18] showed, the optimal PH usually 5.5-6.5 for most plants.

While the PH of the seven parks in the Table 5 are all too high, especially the Oyster Bay Park has the highest PH, 9.2. The higher PH may cause the deficient of Fe, Mn and B, what's worth, it may influence the plants to absorb nutrients.

From the Table 5 and the Table 10, the EC (1:5 ds/m) of the seven parks are all higher than the ideal range (<0.27 ds/m). This means the soils in the seven parks have high salinity, which may because of the works of Cheetham Salt Works in there before. High salinity can lead to the slow growth of plants, the death of older leaves of plants as The State of Victoria (2017b)[18] showed.

According to the Table 5 and the Table 7, the CEC (cmol(+)/kg) of the seven parks are all very low (<6 cmol(+)/kg). The soil in the seven parks may be more sand (CEC < 2 cmol(+)/kg), this is also can be seen in the Fig 3. The State of Victoria (2017a)[19] and Soil Quality Pty Ltd (2017)[15] argue that the CEC (cmol(+)/kg) often reflect the type of clay and the amount of organic matter. Soil Quality Pty Ltd (2017)[15] also talks about that lower CEC (cmol(+)/kg) may cause the less clay and organic matter, thus less ability to hold water and absorbing nutrients.

(No: 5 – Oyster Bay Park)

Figure 3: The sandy soil in the Oyster Bay Park

In the Table 5 and Table 8, the ESP (%) of the soils in the seven parks are all more than 12, which means the soils are strongly sodic. The State of Victoria (2017c)[20] asserts that high ESP (%) will result in the damage of soil structure, lower hydraulic conductivity and the dispersion of soil aggregates. Sometimes the erosion will occur.

Comparing the Table 5 and the Table 9, only the Ca/Mg ratio of the Oyster Bay Park and the Adventure Park are balanced, the other parks are all have low Ca. The State of Victoria (2017a) [19]argues that the deficient of Ca will reduce the stability of soil.

From the Table 6 and the Table 10, most content of microelement of the seven parks are lower than the ideal ranges, except for the contents of Mg and the Cl. The Mg contents of the seven parks are all higher than the ideal range, while the contents of Cl in the seven parks nearly meet the requirements except the Jardin Park is higher than ideal range. EcoChem (2014)[21] shows that the deficient of micronutrients usually occur in over-alkaline or over-acid sandy soil, which may influence the growth of plants.

To the most parks, the high PH, low CEC (cmol(+)/kg), low Ca content, low micronutrients, high EC (1:5 ds/m) and high ESP (%) of the soil are usual problems. The State of Victoria (2017b)[18] mentions that the high PH can be decreased by adding some peat or pinebark. Rowell (1994)[12] claims that adding the gypsum into the soil can increase the Ca content and improve the soil structure. Furthermore, mixing some clay and organic matter in the soil can increase the soil nutrient and improve the soil texture. It is also useful to test other feature of soil in the park to further management, such as the drainage, the potential toxicity, the soil texture and stability. Besides, monitoring and managing the soil on time is needed.

## 4. Conclusion

### 4.1 The University Square

There is a changing plan about the University Square, namely removing the central 24 trees and replacing the other Elms by Corymbia maculate. After analysis, the later trees are more suitable than the former trees because the Corymbia maculate can grow in infertile soil. The recycled water which will be used to irrigate the turf may lead to the deficient of N and over-load of P and K. After a long time, the soil structure will be damaged under the irrigation of the recycled water. It is suggested that improving the soil texture before replacing, undertaking the further texts of the soil on time to monitor it better in the future. Besides, combining the stormwater and the recycled water to change the irrigation method based on the WSUD is also needed.

### 4.2 The Sanctuary Lakes Parks

According to the chemistry characteristics of the soil in the seven parks, these parks have the common problems of high PH, low CEC (cmol(+)/kg), low Ca content, low micronutrient content, high EC (1:5 ds/m) and high ESP (%). High PH will lead to the deficient of other nutrient elements. Low CEC (cmol(+)/kg) can affect the soil texture and structure. Low Ca content will cause the damage of soil structure. Low micronutrient may result in the slow grow even the death of plants. High EC (1:5 ds/m) will also decrease the growth of plants. High ESP (%) may damage the soil structure, reduce the hydraulic conductivity and disperse the soil aggregates. It is recommended that mixing some clay, organic matter and gypsum with the soils to improve the soil structure and texture. Adding some components like the peat can modify the high PH. Additionally, the further tests and monitoring of the soils are necessary to improve their quality.

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