organics

Using Compost Materials in the Construction of Community Parklands

CASE STUDY

The use of compost manufactured from recycled organic material as a soil amendment can markedly improve the establishment of turf on sites converted into parklands and open space for the community.

Improved turf establishment using compost can help stabilise soils following earthworks and reduce the loss of soil and sediment into waterways. Compost can also reduce the need for costly rectification works where growth of turf has been poor or inadequate[1,2].

This case study summarises outcomes from a joint project with Penrith City Council to evaluate the benefits of compost in constructing parklands on a former landfill site at Gipps St, Claremont Meadows.

(Above) Parklands successfully established with the help of compost as a soil improver.

About the site

The former landfill site at Gipps St, Claremont Meadows was used by Council as its main waste facility from the mid 1950's to the mid 1980's. The site covers an area of 32 hectares and has undergone rehabilitation to provide a platform for future development for both passive and active recreational uses.

Council's Open Space Action Plan has identified the site as a regional sports facility to be managed in conjunction with the nearby Kingsway playing fields. The site will also provide an important public access point for South Creek.

The rehabilitation process is being completed in stages through the construction of an additional 100 mm cover of topsoil to provide a safety barrier between the clay cap and the surface. In stage 1, approximately 15,000 m^3 of recycled topsoil was applied to ~15 hectares at the rear of the site, derived from a civil construction project in Erskine Park.

The topsoil applied to the site was classified as a Virgin Excavated Natural Material (VENM) as defined in the *Protection of the Environment Operations Act 1997*. It consisted primarily of dark brown to red clay / clay loam material, consistent with the topsoil of a Red Podsolic soil overlying Bringelly Shale. These soils tend to be hard setting with low fertility status.

A trial was performed to evaluate the performance of a composted soil conditioner for improving turf establishment on a 5 hectare area of the site. The aim was to improve soil fertility, nutrient retention, texture and drainage.

Compost specifications

Soil testing performed on the topsoil showed that it was deficient in phosphorus (of ~230 kg/ha), potassium (of ~36 kg/ha), boron (of ~2.5 kg/ha) and was low in organic matter. The soil contained excess magnesium and was low in calcium (deficiency of ~1.6 t/ha). These types of soils can be hard setting and the imbalance in calcium and magnesium can cause plant growth disorders.

The application rate for the composted soil conditioner was based on the soil nutrient deficiencies and levels of organic matter. An application of 30 mm deep of composted soil conditioner certified to Australian Standard AS4454 (2003)[3] was specified to meet most of the nutrient deficiencies and supply organic matter to optimum levels.

This 30 mm deep application of composted soil conditioner was incorporated into a depth of 50 mm and would supply: 340 kg/ha of total phosphorus, 850kg/ha of potassium, 2.9 t/ha of calcium, and 1.9 kg/ha of boron. It would also increase organic matter levels from 3% to around 6% and supply 1.7 t/ha of nitrogen. Nitrogen present in the compost is largely in an organic form and would be slowly released over time. This slow release of nitrogen would assist in long-term growth of the turf established on the site. The compost application would meet most of the nutrient deficiencies present in the recycled soil used.

Works performed

A composted soil conditioner (Greenlife – Mulch and Compost™) certified to AS4454 (2003) was procured from Australian Native Landscapes at Eastern Creek. This product consisted of compost prepared from recycled garden organics, and was screened to a particle size grading of 0-15 mm.

Approximately 1,500 m^3 of compost was spread with truck spreaders over the 5 hectare trial area, to a depth of 30 mm in June 2006. The compost was incorporated to a maximum depth of 50 mm with tractor drawn harrows (Figure 1). Incorporation to this depth was performed to avoid bringing contaminants in the clay cap layer to the soil surface.

The entire 5 hectare area, including an adjacent 10 hectare control area (where compost was not applied) was treated with hydromulch in early July to revegetate the area with turf (via seed) by Spraygrass Landscapes Australia Pty Ltd. The hydromulch treatment contained woodfibre pulp (2 t/ha), turf seed (parkland blend / Ryecorn at 250 kg/ha), starter fertilizer (250 kg/ha) and a binder (Envirotack™ at 40 kg/ha).

A series of five replicate plots of 10 m x 10 m were randomly allocated in the 5 ha compost treated area and in the 10 ha untreated control area (received hydromulch but no compost). Replicated plots were established to account for possible soil variability across the site. A photo of the site after completion of works is given in Figure 1.

Figure 2 Photo of the trial three months after construction. Note the poor turf establishment and erosion occurring in the control area (foreground), and the very good turf establishment where compost was applied (background).

Monitoring of trial

After 3 months the effect of the compost was assessed by evaluating turf establishment and soil and plant chemical properties.

Turf cover in each plot was visually estimated within a 400 x 400 mm quadrat. Above ground biomass was assessed by cutting all shoot material from within 5 mm of the soil surface in the quadrat and dried at 70^{0}C for approximately 2 days. A sub-sample of this material was analysed for foliar nutrient content.

Soil sampling was also undertaken to evaluate changes in fertility status. Three soil cores to a depth of 50 mm were taken from each plot and combined. Soil and foliar nutrient testing was performed by Sydney Environmental and Soil Laboratory.

Figure 1 The 5 ha trial site after spreading of 100 mm layer of topsoil (left). Spreading and incorporation of compost (centre). After incorporation of compost and surface seeding with hydromulch (right).

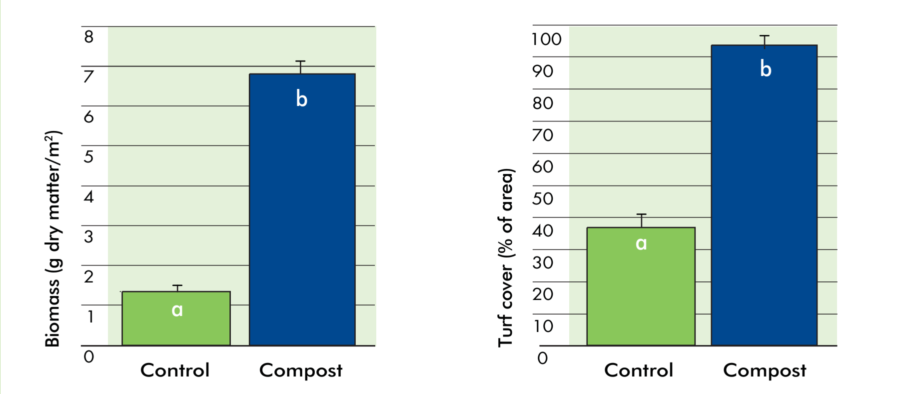


Figure 3 *Turf cover (left) and biomass produced (right) three months after works. Note the large difference between the control and when compost was applied. Results followed by a different letter are statistically significant at the P≤0.05 level. Bars represent standard error.*

Did compost improve turf establishment?

Turf establishment

Compost significantly improved turf establishment compared to the control (Figure 2). Three months after sowing, turf cover was estimated to be about 94% in areas where compost was applied, compared to relatively poor cover of 37% in control areas (Figure 3).

Sheet and rill erosion occurred in the control plots, caused by poor turf establishment and inadequate soil cover (Figure 2). Above average monthly rainfall in September (93.6 mm) * clearly resulted in the removal of soil into runoff, which could impact on local waterways. Compost aided in rapid turf establishment that largely prevented any soil erosion taking place. Areas not receiving compost may require follow up rectification works to assist in turf establishment.

Excellent turf growth in areas receiving compost was demonstrated by the amount of above ground biomass (amount of vegetation) produced after three months. In areas where compost was applied, five times the amount of turf biomass was produced compared to the control (Figure 3). This is also clearly shown in Figure 4.

Although the compost treated area should have been mowed earlier to encourage denser growth, the additional vegetative matter produced will help boost soil organic matter levels after mowing, aiding in moisture retention and nutrient cycling. Retention of soil moisture in the upper soil profile is critical to ensure good turf growth and survival over the hot summer period, particularly if the site is not irrigated.

Soil quality

After 3 months, compost significantly increased levels of soil organic matter in the upper 50 mm of the soil profile, with levels around 12.9% in the compost treated areas and 4.7% in the control. Although the organic matter levels in the compost treated areas is high, this is often the case in the upper few centimeters of good quality productive soils.

In areas receiving compost, the high organic matter levels established were much wetter on inspection compared to control areas. Increased moisture retention clearly helped in the establishment of the turf. Improved water holding capacity, better soil structure and improved drainage are commonly cited benefits of compost use[5].

The pH of the upper 50 mm of the soil profile was also improved following compost application, increasing from 5.7 in control areas to 6.6. A more neutral pH is a benefit and may have assisted in turf growth and establishment.

The effective cation exchange capacity (eCEC) also significantly increased through compost use. eCEC measures the ability of a soil to hold nutrients (cations) which are available for plant growth. eCEC increased significantly from a low level of 10.1 to a more moderate level of 16.4 cmol+/kg in compost treated areas. Better nutrient retention from the addition of compost has improved the quality of the soil and its ability to support turf establishment.

Three months after completion of works, compost had a relatively small effect on the levels of soil fertility, or the amount of soluble nutrients in the upper 50 mm of soil. Soluble calcium, phosphorus and potassium, however, increased substantially compared to the control and were at more optimum levels. The increased amount of calcium provided a better calcium to magnesium ratio for turf growth. Levels of soluble nitrogen (nitrate and ammonium) and sulfate reduced significantly in the soil, perhaps due to very effective uptake of these nutrients by the turf.

Turf nutrition

A range of turf leaf tissue nutrients were monitored to see whether compost had any effect on turf nutrition. Macronutrients (N, P, K, S, Ca, Mg), micronutrients (Fe, Mn, Zn, Cu and B) and others (Na) were generally at adequate levels for good turf growth in both the control and compost treated areas three months after works.

However, compost significantly increased plant uptake of potassium and phosphorus, and depressed levels of nitrogen, sulphur and magnesium. Whilst the improvements in potassium and phosphorus may have assisted in turf establishment, lower levels of nitrogen, sulphur and magnesium did not impact on turf establishment. Lower levels of these nutrients probably reflect strong root competition for these nutrients in the soil profile (Figure 5).

Minor changes in micronutrients occurred with the application of compost after three months (Fe, Mn, Zn, Cu, B and Mo), though most of these decreased slightly compared to the controls. This is perhaps due to dilution of these micronutrients in the amount of turf growth occurring in this period.

** Thirty-year average monthly rainfall for September at Orchard Hills is 37.7mm (Bureau of Meteorology, 2006).*

How did the works improve turf establishment?

The incorporation of a 30 mm deep application of composted soil conditioner into the soil profile clearly helped improve soil organic matter levels, nutrient levels and overall soil fertility.

Improved conditions for turf seed establishment encouraged strong turf germination and excellent growth. Although not measured, compost clearly provided better moisture retention and reduced the evaporatory loss of water compared to untreated control areas.

Areas not receiving compost have had poor turf establishment and have been subject to erosion. Untreated areas may now require some degree of rectification works to establish a viable turf cover to protect the soil from wind and water erosion, and to prevent the site impacting on the quality of local waterways.

In this project, the use of compost in the construction of parklands for the community has been highly successful and has enabled the establishment of a vigorous turfed cover likely to provide an excellent surface for future recreational uses by the community.

Results from the trial may be useful for others considering landfill rehabilitation or construction projects around the State that aim to establish a quality vegetative cover for a range of uses.

How to purchase compost

Compost can be purchased directly from composting facilities around NSW. Prices range from ~\$10 - 30 / m^3.

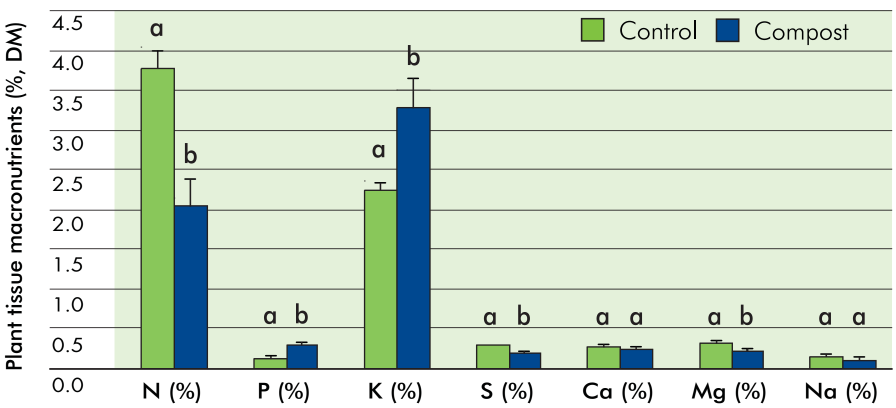
When purchasing compost, it is preferable that product certified to the Australian Standard AS 4454 (2003) be used to ensure that quality product is obtained. Ask the supplier to show their 'Standards Mark Licence Certificate' demonstrating that they can supply certified product to the Standard.

It is also recommended to discuss your project with the supplier as they may be able to assist in providing a tailored product for your application.

A full list of quality assured compost suppliers are given in the SAI Global Ltd Certification Register, available on-line at http://register.sai-global.com/ and type in "4454" in the "known standard" field.

Figure 4 *Comparison of turf growth three months after works in the control (top) and where compost was applied (bottom). Photo taken of a 400 x 400 mm quadrat.*

Figure 5 *(below) Levels of nutrients in the turf from control and compost treated areas. Results followed by a different letter are statistically significant at the P≤0.05 level. Bars represent standard error.*



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