Submission to the Resource Consent application by Canterbury Landscape Supplies, 2017/18.

This submission is made on behalf of Anton and Christine Nikoloff, 43 Mandeville Park Drive, in reference to the Resource Consent application made by Canterbury Landscapes Supplies Limited (hereinafter referred to as CLS), in which we oppose Canterbury Landscape Supplies Ltd's Composting, Transfer Station activities, and all other activities operating from the site located at 97 Diversion Road, Swannanoa. (The property is also known as 949 South Eyre Road, Swannanoa). The applications are retrospective, relating to a compost operation at the property, at or about map reference NZTM2000 1560292 E 5192109 N.

Our Opposition to the application is for the following reasons:

I, Anton Nikoloff, have been involved in Horticulture and by association, agriculture, all my working life. Initially working at the DSIR, Lincoln for 18 years and then starting and operating a vegetable plant nursery in Kaiapoi for 30 years. We live at 43 Mandeville Park Drive, which is part of a new rural residential subdivision located on the corner of McHughes and North Eyre Rd's. W have lived at that address since November 2013. Our house is about 4kms (as the Crow files), in a Northerly direction, from the CLS composting site on Diversion Rd.

I have also been a regular visitor to the area for a number of reasons; I have traveled up and down South Eyre Rd and over the Eyre River bridge regularly (past Diversion Rd), for about 10 years, delivering plants to a client of mine, on South Eyre Rd. I also have visited, at different times of the day and for significant amounts of time, a block of Ecan land on Number 10 Rd, near the intersection of that road with South Eyre Rd, for a similar time period. In other words I have a reasonable knowledge of farming practices and have been a regular visitor to the vicinity of the CLS composting site on Diversion

Rd, for over 10 years. Over that period, in all my visits to the area, on some occasions, for 3- 4 hours at a time, I never noticed an objectionable smell in the area.

At 43 Mandeville Park Drive, over the period June, July, August, 2017, on occasions, we noticed an objectionable smell. The length of time I and my wife could detect the smell varied; sometimes it was noticeable for several hours, on other occasions for shorter periods. A number of occassions the smell penetrated into our house. Generally I detected the smell, when the wind was blowing from the South, or South/West direction. On one occasion I traced the smell to the South Eyre Rd area, near the Eyre river bridge. I couldn't work out where the smell was coming from. We also didn't know about the Ecan odour Hotline.

I would like to comment that no complaints regarding odour, doesn't mean there isn't a problem; some people don't like to complain, or don't know who to complain to.
In mid October 2017 I heard from a neighbor about CLS's application for a Resource Consent for the composting operation and was then able to tie source of the smell to the CLS composting site on Diversion Rd.
This was confirmed in late November and through December, when I could detect the same smell for periods, noticeably when a Southerly wind was blowing. This was the period when CLS were removing windrows of anaerobic compost from the site. (The removal of that compost was the result of an abatement notice issued by ECan in November 2017).

I made two visits to the composting site (along with some others from the area), one on the 11th November, and the other on the 7th December. During those visits personnel from CLS described how the operation was managed and explained the flow of products through the operation. Thus I'm familiar with how the composting operation is being carried out.
I'm not opposed to commercial enterprise and a well run composing operation has significant benefits for the economy. Throughout my working life I have been a regular visitor to different types of farms and farming operations so I'm familiar with the farm

type odours. The odour emanating from the CLS site on Diversion Rd was of a significantly different nature than any farm smell that I have ever experienced. I don't believe that any neighbours surrounding this composting operation should be asked to tolerate the odours produced by the operation.

General,

We have some significant concerns regarding CLS's application for consents to discharge to the air **(CRC175344)** and to land **(CRC175345).**

We were directly affected on some occasions, for a few months in 2017, by the objectionable odour coming from the CLS composting operation. Thus we're concerned about the potential for that to continue. We also have particular concerns regarding potential leachate discharge to land, with the high probability of contamination of wells and groundwater from the site, as well as the general operation and management of the composting operation. Those concerns are not only for ourselves but for the Eyreton/ South Eyre Rd area as whole, and for the wider community living in the Mandeville, Eyreton area While some of the other potential discharges do not affect me directly (eg dust, noise, traffic movements, fire hazard) I am concerned about their potential to affect the community which I live in and thus affect the amenity values in the area; being able to reside, without being affected by odour, or dust, the potential drop in property values as a result of odour, or being near an industrial complex discharging contaminants.

We are surprised that an operation of this size can start operating without any consultation with the wider community, or that it can start operating without obtaining a Resource Consent. We note that CLS has a history of operating their Kainga composting site without a Resource Consent. We also note that on the Resource Consent application Page 7, item 5, it says "Consultation before lodging your application is one of the best ways of identifying adverse effects"; surely that would mean consultation with residents/ neighbours close to the site? As far as I'm aware this has not been done.

With the visits and the discussions which occurred while on site, I have major concerns, regarding the apparent lack of fore thought that has gone into the CLS Diversion Rd, operation, with regards to the way it is managed, awareness of the technical challenges posed by an operation of this size and the approach to minimising some of the by-products generated by this operation.

The scientific and technical input that has been a part of the CLS consent application appears to have the focus of justifying what CLS are intent on doing, and not the mitigation of risk to the environment. The general attitude appears to be, *we're going to do the minimum we can get away with.* Hardly the attitude of people concerned about operating to a best practice standard

As a consequence of making this submission, I've undertaken a survey of some of the available scientific literature on composting facilities. What I've found is that Open Windrow compost operations (similar to the CLS operation) are quite common around the world. There are many such plants in Australia. In the USA indications are that there are thousands of such operations[1]. Because this system is quite common there has been a significant amount of scientific research undertaken and consequently a body of scientific and technical, published work exists, detailing the science in operating Open Windrow composting systems. A number of reference books[2] have been produced, describing potential problems with various raw materials and presenting mitigating strategies. In terms of New Zealand publications, there is a Best Practice Guide for composting operations[3] but

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[1] See Wilson, B.G. Harlampides, K. and Levesque, S. 2004

[2] Eg. Bioconversion of Waste Materials to Industrial Products. edited by A.M. Martin

[3] Introduction to Composting Science and Management for Industry Training, 2007.

it is just that, a guide. There is also a consenting guide available[4], which doesn't appears to have been consulted for this application.

With the Open Windrow compost system, odour emissions and discharge of leachate[5] to ground are the two most signicant problems that need to be mitigated; operators need develop their composting operation and its management practice with those in mind[6].

The science around windrow composting is well established. While the materials being composted may change, there are some general principals to ensure the operation has minimal impact on the environment. The first is that both leachate and stormwater need to be collected seperately, in holding ponds, and either treated before any discharge to the ground, or in the case of leachate returned to the stacks. The second is ensuring that the Carbon/ Nitrogen ration is kept in an adequate range (30:1-40:1 is suggested) minimizes discharges. Control of the water content in the piles is also important, for instance changing the water content from around 60% to 50 % slows the composting down but provides a safety margin, in terms of potential discharges from the stack.
Similarly with odour, there is the assumption that odour problems will occur unless there are adequate means of ensuring that the windrows are kept aerated. and throughout the course of the composting process, whatever precipitation occurs at the site. Anaerobic composting produces obnoxious odours. Consequently, for a number of reasons, the height of the windrows is an important management tool. So is managing in some way the precipitation falling on the windrows.

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[4] Consent guide for Composting Operations in New Zealand. Sinclair Knight Merz Ltd, on behalf of the Waste Management Institute New Zealand. May 2009.

[5] A liquid that has percolated through and/or been generated by decomposition of waste material. It includes water that comes into contact with waste and is potentially contaminated by nutrients, metals, salts and other soluble or suspended components and products of decomposition of the waste. Compost Guidelines. EPA, South Australia. 2013

[6] Department of Environment and Heritage protection. Guideline Open Windrow Composting. Version 1.02 Jun 2013.

My conclusions are that managing a composting operation involves balancing a range of factors. My work experience tells me that some tools will be required to help with management. Some of the tools will be purpose built infrastructure.

With regard to CRC175345

We submit that the proposal by CLS to discharge leachate onto land, from the composting operation on Diversion Rd, is potentially significant in its effects.

The soil type (Darley Stoney, Silty loam), contrary to what is stated in the consent application, has been categorised as moderately well drained and permeable. Thus anything discharged onto, or into the ground could readily move through the soil profile, potentially contaminating water catchments, rivers and streams.

We also note that the list of the proposed ingredients for the operation, varies depending on which part of the CLS application you read.

When making compost, some rainfall would percolate through the windrows but most is shed by the windrows and ends up on the ground, around the base of the windrows.. Current research indicates that approximately 68% of the stormwater falling on windrows, eventually runs off[7]. From the definition of leachate given above the assumption is that stormwater which comes into contact with the windrows could contain nutrients, or minerals, generated by the composting process. Any water pooling around the base of windrows needs to be treated as leachate, not stormwater as it has the potential to carry leachates from the compost and deposit them into the soil profile. The CLS submission that states there is no there is no need to mitigate stormwater as there is no problem. That statement is ridiculous; obviously rainfall (stormwater) falls on the windrows. Thus there is a need to consider the potential affects of stormwater in developing a management plan.

[7] See for instance Wilson, B.G. Harlampides, K. and Levesque, S. 2004.

In high rainfall water could puddle around the base of the windrows before draining away. Thus there is potential for leachate to enter the soil profile. In April through to September, 2017, Eyrewell (the closest rainfall recording point, Kainga shows a similar pattern) experienced higher than average rainfall, in short periods of time, particularly in April, July and August, September.[8] This is not an unusual event there were similarly high periods of rainfall recorded in 2013 and 2014. In 2014 the rainfall and flooding that resulted was regarded as a Fifty year event. The rainfall in 2017 was not. The point is this; high rates of precipitation need to be factored into the management of a composting operation because there is a risk it will have an ongoing affect on the composting operation, as happened during 2017 at the Diversion Rd site. There appear to be two main ways of mitigating this problem. The first is to ensure that stormwater is conveyed from around the base of the windrows by some means. The second is to cover the windrows so that stormwater doesn't fall on the composting windrows.

During my first site visit in November 2017 it was obvious that water had been pooling around the base of some of the windrows. This was particularly so in the area of the operation, where the problem odour was coming from. I believe that that pooling of water, caused all the windrows in one corner (about ¼ the site), becoming saturated by water pooling around the bases. This resulted in the composting process becoming anaerobic as a consequence an objectionable odour was emitted. Those saturated windrows then needed to be removed

. CLS in an effort to mitigate pooling of stormwater and/ or leachate, and thus affecting the composting process as above, have started placing their windrows on a layer of sawdust. That sawdust may absorb some leachate. The sawdust, at some point, will then need to be either added to the composting windrows, as it starts decomposing, or taken away. If the sawdust is added to the composting windrows, there is then a considerable potential for the absorbed leachate in the sawdust to "dump" into the soil profile, through the windrow, as the compost won't be able to contain the nutrients in its bulk. My contention is that the use of sawdust is not a long term way of mitigating leachate, or stormwater draining into the soil profile. Not only that, it appears to me that there is an

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[8] See ECan rainfall figures, Kianga, Eyrewell, 2010- 2017.

assumption is that all the leachate draining from the windrows, will be absorbed by the sawdust; there is no evidence for that.

The approach by CLS appears to be let's monitor and see what happens. ie a wait and see strategy, rather than forseeing the potential risks and developing an overall strategy to mitigate them, as they are required to do under the Resource Management Act. The "wait and see" approach has significant potential for damage to the environment.

Cornell University have a site dedicated to the science of Composting. In the section dealing with water quality protection they make some comments regarding site selection, topography and soil structure; *If the soils are impermeable, groundwater is protected from nitrate pollution, but runoff is maximized which increases BOD, phosphorus and pathogen threat to surface water. On the other hand, highly permeable soils reduce the runoff potential but may allow excessive nitrate infiltration to groundwater. For large facilities handling challenging waste materials, ... a working surface of asphalt or concrete may be appropriate.*

The buffer between the site and surface or groundwater resources is the first line of defence against water pollution[9].

With both C:N ratios and moisture content , the optimum levels of water and nitrogen levels for rapid composting may create a greater than necessary water pollution threat[10].

Water quality protection at a composting site can be accomplished through proper site design, operations, and runoff management. Current indications are that runoff from composting windrows has BOD and nutrient levels comparable to low strength municipal waste water plants[11]

I suggest that rather than accepting sawdust as a collection medium, some sort of impermeable barrier needs to be laid, or formed over the site to enable runoff and

[9] Cornell composting; http//compost.css.cornell.edu/waterqual.html, p1
[10] Cornell composting; http//compost.css.cornell.edu/waterqual.html, p2
[11] Cornell composting; http//compost.css.cornell.edu/waterqual.html, p4

leachate collection into pond/s for further treatment. The South Australian, guidelines on composting operations present some generalized plans for forming an impermeable base to allow leachate to be collected[12].

Of concern to me also is that the application regarding nutrient discharge of the composting operation has concentrated on Nitrates and by extension Ammonium, but composting operations release significant amounts of Phosphate, and phosphorus compounds. Phosphate discharge into waterways and water catchments causes significant pollution in many parts of NZ. Composting operations also concentrate heavy metals[13]. Some way of containing and treating those discharges, so they cannot contaminate the soil profile, needs to be part of the management and operation of any compost facility. Allowing discharge directly from the windrows, into the soil is not acceptable given the shallowness of the water table and the permeable nature of the soil profile at Diversion Rd. Any discharge from this site has the potential to contaminate downstream wells, water ways and aquifers, given that it is located in a zone where the nutrient allocation levels have not been meet, there is likely to be a knock on effect, if discharges from this site are allowed. There is also the potential to contaminate the water catchment from which Christchurch draws most of its water.

We think that the current Resource Consent application to discharge into the ground should be turned down. The applicant needs to show that they are aware of the potential risks of their operation and will develop facilities and a practical management plan that will ensure any discharge to the ground is stopped and treated, so that the discharge will contain minimal amounts of nutrients, such as nitrates, nitrites, ammonium, phosphorous any heavy metals and not increase the BOD in the surrounding area. Best practice is zero discharge.

[12] Compost Guidelines. EPA, South Australia. 2013
[13] See for instance Guidelines for Safe Application of Biosolids to Land in NZ. August, 2003.

With regard to CLS CRC175344

The majority of landowners in the area, around the Diversion Rd site occupy lifestyle blocks, rural residential sections, or small to medium farms. The Consent application incorrectly states that the predominate neighboring use is Dairy. The nearest neighbours are horse breeders, vegetable growers and feedstock farmers.

In addition there is a significant rural residential subdivision, within 3kms of the CLS site which has been in planning and development for over 10 years. With nearly all the sections now having houses built on them. A subdivision on the corner of McHughes and North Eyre Rd, contains approximately 170 homes. There are also a significant number of older subdivisions and houses surrounding the CLS Diversion Rd site. All of the current residents in the area surrounding this site, existed prior to the arrival of Canterbury Landscapes.

In *McMillan V Waimakariri DC* a zone change to allow for a subdivision adjacent to two pig farms was turned down due to concerns over reverse sensitivity, whereby potential residents once settled in the subdivision could then start complaining about odour from the pig farms. I believe that reverse sensitivity will also apply in the current application; an odour producing operation cannot be consented without regard to the rights of the existing occupiers of land and ensuring they don't then need to deal with the ongoing effects of odours released from the operation.

The overriding duty in Section 17 of the RMA , is that all activities have an obligation to avoid, remedy or mitigate adverse effects and contain adverse effects within their own boundaries. Another way of putting this is that it is the operator's responsibility to understand and manage the potential environmental risks and take all practical steps to prevent environmental harm.

Of concern in that regard to the way odour complaints were dealt with by CLS. The initial response by CLS was to deny the odour was coming from their Diversion Rd site. Once the source of the odour was pinpointed to the composting operation, with some reluctance CLS changed their approach to consulting with some concerned residents. This process took several months to work through, I understand that odour complaints were first made in April 2017, yet it took until November 2017 before CLS owned the odour problem. The odour emanating from the site wasn't a series of oneoff occurrences, when the windrows were being turned but a significant failure of the composting process, which had an ongoing affect, lasting for months. Given the sensitive nature of the operation, surely industry best practice would be to quickly own the problem and respond with strategies to deal with it? While CLS has made some steps to consult with local residents, industry good practice indicates that there should have been some public consultation, to discuss the problem and ascertain the impact on neigbouring properties, detailing the mitigation strategies.

The conclusion I draw from the way the odour complaints were handled by CLS is that they do not have a management plan regarding potential odour emanating from the Diversion road site. Nor it appears, were they ready to mitigate, or contain the adverse effects from the composting operation, until a restraining order was put on the operation; not the actions of a company concerned about their neighbours, and the affect they are having on the wider environment.

I note that recent Court decisions around the country have taken a firm approach to odour problems from composting and farming operations generating odours, with significant fines levied on a number of operations.
I note that in Hill v Matamata Piako and Waikato RC, the court stated;

We reiterate again in this decision that we are of the view that adverse effects such as objectionable odour emissions should be confined on site. People working in neighbouring rural properties adjacent to sites where intensive operations such as broiler chicken rearing is carried out should not be subjected to objectionable and *nauseating odours. It is incumbent upon individual farmers to so arrange their affairs in the way as siting, management, technology and feed formulation to ensure that objectionable odours are confined to site*[14].

While that court decision was in relation to a chicken farm, the principal point established is that it is the responsibility of operators to manage things so that neighbours aren't significantly affected by their operations.

Published research indicates that there is a direct link between height of windrows and the potential to produce odours, as the height of windrows determines via, a number of factors, the amount of aeration in the compost. Notes from the Consent application, show that windrows up to 4.5 meters in height will be used. In the Compost NZ Guide[15] it is noted the open windrow heights should range from 1.5 metre to 3 metres, those heights are similar to the recommendations from the Cornell University site[16]. The *Open Windrow Composting Guidelines produced by the Queensland Government*[17] indicate that windrows above 4 meters are not recommended, because it is harder to control the aeration of the windrows above that height. I think the windrow height proposed and used by CLS at their Diversion Rd, is too high for adequate aeration and may well have been a contributing factor in the odour problems experienced in 2017.

In the notes to the consent application there is reference to the plantation of trees in which the site is located. It is suggested that the trees will have a mitigating affect on odours from the operation. There is very little science, or data, to back up that claim. It could just as easily be claimed that the trees may have the effect of concentrating odours, so that when they eventually move off the site, they will affect a greater area.
But in any case any claims regarding the mitigation value the trees may have on the operation and the consent, is lacking in substance, as the trees are well advanced in their

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[14] Good Practice Guide for Assessing and Managing Odour in New Zealand, 2003.
[15] Introduction to Composting Science and Management for Industry Training, 2007
[16] Cornell Composting. http//compost.css.cornell.edu/composting info/Excessive Pile size.

[17] Department of Environment and Heritage protection. Guidelines Open Windrow Composting Version 1.02 Jun 2013, p5.

growth cycle and probably will not exist when the proposed consent expires in 35 years; it's likely they will be harvested within a the first years of the proposed consent's timeframe.

The way CLS dealt with the odour emission outlined above, I think shows, CLS's apparent lack of understanding that they have a general responsibility to manage and mitigate, or prevent environmental harm. CLS also appears to be ingnoring that the area where they have decided to set their operation up, has some rural aspects but is essentially a rural residential area; it is bounded on three sides by residences. In many respects their site at Kainga is more industrial and "isolated" with regard to people, than the Diversion road site.

I think that CLS need to be required to develop infrastructure on the site, in order to mitigate the known environmental risks. Before any consent to discharge is given, they need to demonstrate to the surrounding community that they take their responsibilities to manage and mitigate risks, seriously; that managing risk isn't about playing "catch-up" after the event but being proactive regarding the likely factors affecting the operation and management of a composting plant, particularly regarding one of the size proposed in this consent application. Part of the overall strategy that is needed is to develop plans for when a worst case scenario occurs. CLS are required to consult with their potential neighbours about whatever they intend.

One significant factor out of the control of any Open Windrow operation is the weather, in particular precipitation. Rainfall over a short period of time in Canterbury during 2017 showed how vulnerable Open Windrow operations are to rainfall. I think that potential high rainfall (not just 50 year events) need to be taken into consideration when considering the granting of any resource consent to this operation.
I think the current resource application by CLS to discharge to air, should be declined, on the basis that the proposed mitigation strategies do not meet the requirement for the granting of a consent; the affects are, even after the various proposed mitigation measures, significant. Best practice is zero, or minimal discharge.

Conclusion

I submit that to ensure this composting operation does not discharge to air, or ground, significant infrastructure is needed to ensure that the variables mentioned above are readily managed and maintained.

Those might include;

1) an impermeable layer/ barrier under the windrows.

2) Some form of stormwater control/ collection from between the windrows and around the site, ensuring that the stormwater doesn't come into contact with windrows and thus become leachate.

3) The ability to collect the leachate from the windrows and store it, either to treat it before discharge to the ground, or return it to the piles.

4) Treatment of leachate might consist of settling ponds, or vegetative filtration blocks, and/or sediment traps. Any such treatment also needs to be able to deal with heavy metals such as cadmium, zinc, copper, nickel, lead, chromium and silver.

5) The ability to maintain control of water falling on the windrows and the temperature of the stacks; the most reliable way of doing that is to cover the windrows, particularly in the initial part of the composting process.

6) Constant monitoring of all the parameters associated with the composting operation to ensure that the plant operates with minimal discharges; temperature, moisture levels, C:N ratio assays, composition of the leachate, etc. etc.

Water Quality Protection

Tom Richard

Composting has long been viewed as an environmentally beneficial activity. To maintain that positive reputation it is essential that compost facilities consider and mitigate any adverse environmental impacts. Water quality protection can be accomplished at most composting facilities by proper attention to siting, ingredient mixtures, and compost pile management.

The results of water quality monitoring studies at Cornell and elsewhere indicate that outdoor windrow composting can be practiced in an environmentally sound manner (Richard and Chadsey, 1994; Rymshaw et al., 1992; Cole, 1994). However, there are a few aspects of this process that can potentially create problems. For leaf composting, the primary concerns are BOD and phenol concentrations found in water runoff and percolation. Biochemical Oxygen Demand and phenols are both natural products of decomposition, but the concentrated levels generated by large-scale composting should not be discharged into surface water supplies. Additional potential concerns when composting nutrient rich materials such as grass, manure, or sewage sludge include nitrogen compounds such as nitrate and ammonia, and in some cases phosphorus as well. With manure or sewage sludge there may also be pathogen concerns. These concerns, while important, are readily managed, and can be mitigated through careful facility design and operation.

A water quality threat?

Facility Design

Selecting the right site is critical to many aspects of a composting operation, from materials transport and road access to neighborhood relations. From an environmental management perspective, the critical issues are soil type, slope, and the nature of the buffer between the site and surface or groundwater resources. Soils can impact site design in a variety of ways. If the soils are impermeable, groundwater is protected from nitrate pollution, but runoff is maximized which increases the BOD, phosphorus, and pathogen threat to surface water. On the other hand, highly permeable soils reduce the runoff potential but may allow excessive nitrate infiltration to groundwater. Intermediate soil types may be best for sites which are operated on the native soil. For some large facilities, or those handling challenging waste materials, a working surface of gravel, compacted sand, oiled stone or even asphalt or concrete may be appropriate. Such surfaces can improve trafficability during wet seasons considerably, but the surface or groundwater quality issues remain.

The buffer between the site and surface or groundwater resources is the first line of defense against water pollution. Deep soils, well above the seasonally high water table, can filter solid particles and minimize nitrate migration. Two feet of such vertical buffer are required by New York State regulations, and while a greater depth would be advantageous, such soils are rare in many parts of the state. Horizontal buffers are required to be a minimum of 200 feet from wells or surface water bodies and 25 feet from drainage swales in New York State. Although the nature of this horizontal buffer is not specified in the regulations, grass can help filter the runoff and minimize pollutant migration. Such vegetative filter strips are further described below.

Site design issues which may impact on water quality include the selection of a working surface (native soil or an improved surface), exclusion of run-on to the site by surface diversions, possible drainage of wet sites, and the possible provision of roofs over some or all of the composting area to divert precipitation and keep compost or waste materials dry. In all but fully roofed sites there will be surface runoff which may need to be managed as described below. Slope of the site a surface drainage to either divert uphill water away from the site or collect site runoff for management should be considered in the design process.

A number of factors combine to determine the quality of water running off compost sites. One obvious factor which is often overlooked is the excess water running onto the site from upslope. Diversion ditches and berms which divert that water around the site will minimize the runoff which needs to be managed. Siting the facility on a soil with moderate to high permeability will also significantly reduce the runoff generated on the site. For the runoff which remains, alternatives to surface discharge include such simple technologies as soil treatment, filter strips, or recirculation, so that sophisticated collection and treatment systems should not be needed.

These simple, low-cost treatment strategies have proven effective for a variety of wastewaters and organic wastes (Loehr et. al., 1979). Soil treatment forces the percolation of water through the soil profile, where these organic compounds can be adsorbed and degraded. Vegetative filter strips slow the motion of runoff water so that many particles can settle out of the water, while others are physically filtered and adsorbed onto plants. Recirculation would involve pumping the runoff water back into the compost windrows, where the organic compounds could further degrade and the water would be evaporated through the composting process. This last option should work very well during dry summer or early fall weather, when water often needs to be added, but would not be appropriate if the moisture content of the compost was already high.

Operations

The day to day operation of the composting site offers considerable opportunities to minimize water quality impacts. The proper selection, mixing, and management of materials can help control overall runoff, BOD, pathogen and nutrient movement. Assuring appropriate moisture and carbon to nitrogen (C:N) ratios throughout the composting process can be very effective at limiting these pollutants. A review of the basic principles of compost facility operations, with more detailed discussion of these issues as well as data on C:N ratios, water content, and bulk density of some common agricultural composting materials are provided in the NRAES On Farm Composting Handbook (Rynk et al., 1992) and the Getting the Right Mix section of these web pages.

Nitrate is most easily controlled by maintaining an appropriate C:N ratio in the composting mixture. Raw materials should normally be blended to approximately 30:1 carbon to nitrogen ratio by weight. The ratio between these key elements is based on microbial biomass and energy requirements. Inadequate nitrogen (a high C:N ratio) results in limited microbial biomass and slow decomposition, while excess nitrogen (a low C:N ratio) is likely to leave the composting system as either ammonia (odors) or nitrate (water pollution). In a nitrogen limited system microorganisms efficiently assimilate nitrate, ammonia and other nitrogen compounds from the aqueous phase of the compost, thus limiting the pollution threat.

The ideal ratio of carbon to nitrogen will depend on the availability of these elements to microbial decomposition. Carbon availability is particularly variable, depending on the surface area or particles and the extent of lignification of the material. Composting occurs in aqueous films on the surfaces of particles, so greater surface area increases the availability of carbon compounds. Lignin, because of its complex structure and variety of chemical bonds, is resistant to decay. For both of these reasons the carbon in large wood chips is less available than that in straw or paper, so greater quantities of wood chips would be required to balance a high nitrogen source like manure.

The data from experimental studies indicates low C:N ratio mixtures can generate nitrate levels above the groundwater standard (Rymshaw et al.; 1992, Cole, 1994) Much of this nitrate in runoff and leachate will infiltrate into the ground. While microbial assimilation and denitrification may somewhat reduce these levels as water passes through the soil, these processes will have a limited effect and are difficult to control. Proper management of the C:N ratio is perhaps the only practical way to limit nitrate contamination site short of installing an impermeable pad and water treatment system.

The other important factor to consider when creating a composting mixture is water content. From a microbial standpoint, optimal water content should be in the 40 to 60% range. This moisture content is a balance between water and air filled pore space, allowing adequate moisture for decomposition as well as airflow for oxygen supply. The ideal water content will vary somewhat with particle size and density, and fine, dense organic substrates should be drier if adequate aeration is to be assured. Excess water, in addition to increasing the odor potential via anaerobic decomposition, will increase the runoff and leachate potential of a composting pile during rainfall events.

With both C:N ratios and moisture content, the optimum water and nitrogen levels for rapid composting may create a greater than necessary water pollution threat. Increasing the C:N ratio from 30:1 to 40:1 and decreasing the water content from 60 % to 50% may slow down decomposition somewhat, but can provide an extra margin of safety in protecting water quality.

Once the materials are mixed and formed into a compost pile windrow management becomes an important factor. Windrows should be oriented parallel to the slope, so that precipitation landing between the windrows can move freely off the composting area. Pile shape can have a considerable influence on the amount of precipitation retained in a pile, with a flat or concave top retaining water and a convex or peaked shape shedding water, particularly in periods of heavy rain. These effects are most pronounced when the composting process is just starting or after a period of dry weather. In the early phases of composting a peaked windrow shape can act like a thatched roof or haystack, effectively shedding water. Part of this effect is due to the large initial particle size, and part is due to waxes and oils on the surfaces of particles. Both of these initial effects will diminish over time as the material decomposes. During dry weather the outer surface of even stabilized organic material can become somewhat hydrophobic, limiting absorption and encouraging runoff.

If a pile does get too moist, the only practical way to dry it is to increase the turning frequency. The clouds of moisture evident during turning release significant amounts of water, and the increased porosity which results from turning will increase diffusion and convective losses of moisture between turnings. This approach can be helpful during mild or warm weather, but caution must be exercised in winter when excessive turning can cool the pile.

Runoff management

Implementation of the preventative measures described above can considerably reduce the water pollution threat. However, some facilities may require additional management of runoff from the site. As indicated above, the runoff pollutants of primary concern are BOD and phosphorus, largely associated with suspended solids particles. Pathogenic cysts may either be absorbed on particles or be free in solution, and again the relative significance is not adequately researched. Four readily available strategies exist to help control these pollutants: vegetative filter strips, sediment traps or basins, treatment ponds, and recirculation systems.

This simplest runoff management strategy is the installation of a vegetative filter strip. Vegetative filter strips trap particles in dense surface vegetation. Grasses are commonly used, and must be planted in a carefully graded surface over which runoff can be directed in a thin even layer. Suspended particles flowing slowly through the grass attach to plants and settle to the soil surface, leading to a significant reduction in BOD levels.

Sediment traps operate by settling dense particles out of the runoff. Particles settle by gravity during passage through a basin of slowly moving water. This approach can be particularly effective for removing phosphorous associated with sediment. Because much of the BOD and nitrogen in compost site runoff will be in light organic particles, the effectiveness of this approach may be somewhat limited. However, it will help limit sediment movement off the site, and can be a useful adjunct to either a vegetative filter strip or a treatment pond, enhancing the effectiveness of each.

During dry periods of the year compost runoff can be recirculated to the compost piles themselves, or alternately used to irrigate cropland or pasture. The nutrients as well as moisture can thus serve a useful purpose, either by supplying needed moisture to the compost windrows or by providing nutrients and water to crops. However, a recirculation system requires both a pumping and distribution system and adequate storage capacity for prolonged wet periods. While this approach offers a closed system which appears ideal for pathogen control, care may need to be taken to separate runoff from the fresh manure to avoid contaminating finished compost or crops.

Storage requires the construction of a pond, which can also be used to treat the waste. Ponds can be designed for aerobic or facultative treatment of runoff water. In either case microorganisms continue the decomposition process started in the compost pile, but in an aqueous system. As the organic material stabilizes, the BOD levels will drop. Pathogen levels are also expected to drop, although the rate will be dependant on seasonal temperature variations and will be slow during winter in unfrozen portions of a pond. To be effective, ponds must be designed to contain the runoff from major storm events, with an adequate residence time for microbial stabilization.

Details of pond design vary with climate, runoff characteristics, and pond effluent requirements. The Natural Resources Conservation Service (NRCS) has considerable expertise in adapting treatment systems to the local situation.

Runoff collection pond

All these treatment options will help with nitrogen and phosphorus removal as well as BOD and pathogens. Sediment basins and ponds will settle out particulate matter, which includes bound nutrients such as phosphorus. However, these sedimentation mechanisms are not likely to remove nutrients or BOD as well as soil adsorption and crop uptake in a land treatment system. For nitrogen removal, vegetative filter strips and irrigation systems can both be effective, and either is enhanced by alternating flow pulses with rest periods. Phosphorus removal is most efficient under aerobic conditions, and irrigation systems generally show higher removal rates than vegetative filter strips although either can be effective. Although little is currently known about the effectiveness of these approaches in destroying the pathogens of concern, increased opportunities for adsorption, desiccation, and other forms of environmental and microbiological stress are integral to the physical and biological treatment processes described. An appropriate combination of these removal mechanisms can be designed to address the pollution parameters of local concern.

Summary

Water quality protection at a composting site can be accomplished through proper site design, operations, and runoff management. Composting facilities vary widely in size, materials processed, and site characteristics, and all these factors will effect the design of appropriate preventative measures. Although the available evidence is limited, current indications are that runoff from composting windrows has BOD and nutrient levels comparable to low strength municipal wastewaters. Land treatment systems which have proven effective for these alternative wastewaters we can expect to be effective for windrow composting facilities as well.

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For specific comments related to this page, please contact the Cornell Waste Management Institute (format and style), or Tom Richard (technical content).

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KISTERS

Environment Canterbury HYMONTH V114 Output 30/10/2017

Site 324201 Eyrewell (Sinai) at Poyntzs Rd Site 324201.TONY
Variable 10.00 Total Rainfall in Millimetres
Figures are for period ending 24:00

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Monthly	Annual Total	Missing Days	Yr
2010	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[13.0]	40.5	49.0	46.5	[37.2]	[149.0]	258	2010
2011	43.5	62.0	42.5	55.5	62.0	36.0	30.0	43.5	31.5	103.0	69.0	91.5	55.8	670.0	0	2011
2012	44.0	45.0	61.0	39.0	35.5	70.0	63.5	117.5	29.5	76.5	51.5	34.5	55.6	667.5	0	2012
2013	48.0	30.5	37.0	86.0S	73.5	217.5	56.5	64.0	54.5	108.0	40.5	127.0	78.6S	943.0S	0	2013
2014	19.0	25.0	118.5	185.0	33.5	105.5	30.5	24.0	29.5	39.0	37.5	30.5	56.5	677.5	0	2014
2015	6.0	21.0	46.0	84.5	22.5	105.0	67.0	40.5	59.0	13.5	22.5	38.0	43.8	525.5	0	2015
2016	106.5	19.5	44.5	22.0	97.5	22.5	19.0	42.0	33.5	59.0	69.0	46.5	48.5	581.5	0	2016
2017	52.5	5.0	97.0	127.5	49.5	30.5	168.0	94.5	67.5	[92.0]	[ ]	[ ]	[78.4]	[784.0]	67	2017

Mean	45.6	29.7	63.8	85.6S	53.4	83.9	62.1	60.9	[39.7]	[66.4]	48.4	59.2	[56.8]	[624.7]		Mean
Med.	44.0	25.0	46.0	84.5S	49.5	70.0	56.5	43.5	[32.5]	[67.7]	49.0	46.5				Med.
Max	106.5	62.0	118.5	185.0S	97.5	217.5	168.0	117.5	[67.5]	[108.0]	69.0	127.0	[78.6]	[943.0]		Max
Min	6.0	5.0	37.0	22.0S	22.5	22.5	19.0	24.0	[13.0]	[13.5]	22.5	30.5	[37.2]	[149.0]		Min
Total	319.5	208.0	446.5	599.5S	374.0	587.0	434.5	426.0	[318.0]	[531.5]	339.0	414.5	[454.4]	[4998]	325	Total
OK	100%	100%	100%	100%	100%	100%	100%	100%	94%	98%	100%	100%	99%	99%		OK
Cnt	7	7	7	7	7	7	7	7	8	8	7	7	8	8		Cnt

Notes

All recorded data is continuous and reliable
except where the following tags are used...
[ ] Data Not Recorded
S ... Synthetic Data

KISTERS

Environment Canterbury

HYMONTH V114 Output 30/10/2017

Site 324611 Waimakariri at Kainga Yard
Variable 10.00 Total Rainfall in Millimetres
Figures are for period ending 24:00

Site 324611.TONY

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Monthly	Annual Total	Missing Days	Yr
2010	25.5	26.5	19.0	17.0	148.5	73.0	58.5	68.5	25.5	18.5	36.0	31.5	45.7	548.0	0	2010
2011	68.5	27.5	45.0	47.0	48.0	33.5	31.5	51.0	25.5	66.0	48.5	64.0	46.3	556.0	0	2011
2012	33.5	35.0	48.0	34.0	10.5	72.5	77.0	107.5	27.0	54.0	39.5	38.5	48.1	577.0	0	2012
2013	46.5	15.0	33.5	66.0	70.5	186.5	42.0	30.5	27.0	56.5	38.0	106.5	59.9	718.5	0	2013
2014	7.0	49.0	125.0	182.0	32.0	114.0	33.5	8.5	25.0	12.0	36.0	24.5	54.0	648.5	0	2014
2015	[0.0]	[2.5]	23.5	31.0	19.5	49.0	31.5	27.0	40.5	11.5	10.0	33.0	[23.2]	[279.0]	25	2015
2016	94.5	15.5	36.5	5.5	76.0	15.0	20.0	27.0	27.5	48.5	40.0	44.5	37.5	450.5	0	2016
2017	30.5	8.0	73.0	138.5	36.0	33.0	106.5	65.0	37.0R	[64.0]	[ ]	[ ]	[59.1]	[591.5]	67	2017

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Monthly	Annual Total	Missing Days	
Mean	[38.2]	[22.4]	50.4	65.1	55.1	72.1	50.1	48.1	29.4R	[41.4]	35.4	48.9	[46.7]	[546.1]		Mean
Med.	[32.0]	[21.0]	40.8	40.5	42.0	60.7	37.7	40.7	27.0R	[51.2]	38.0	38.5				Med.
Max	[94.5]	[49.0]	125.0	182.0	148.5	186.5	106.5	107.5	40.5R	[66.0]	48.5	106.5	[59.9]	[718.5]		Max
Min	[0.0]	[2.5]	19.0	5.5	10.5	15.0	20.0	8.5	25.0R	[11.5]	10.0	24.5	[23.2]	[279.0]		Min
Total	[306.0]	[179.0]	403.5	521.0	441.0	576.5	400.5	385.0	235.0R	[331.0]	248.0	342.5	[373.9]	[4369]	92	Total
OK	95%	94%	100%	100%	100%	100%	100%	100%	100%	98%	100%	100%	99%	99%		OK
Cnt	8	8	8	8	8	8	8	8	8	8	7	7	8	8		Cnt

Notes

All recorded data is continuous and reliable except where the following tags are used...
[ ] Data Not Recorded
R ... Raw Data

Excessive Pile Size

Tom Richard

Composting comes in many shapes and sizes, from 1 liter vacuum bottles to warehouse sized industrial systems. In all of these systems, the correct pile size balances the heat generated by microbial decomposition with the heat lost through conduction, convection, and radiation, keeping most of the compost between 40°C and 60°C (for more on the mechanisms of heat loss, see the physics page in our background information section).

Passively aerated systems, which depend on diffusion and natural convection for oxygen transport, usually have a large open surface area to encourage air movement, with corresponding convective heat losses. This large surface area also results in conductive and radiant heat loss. Because heat loss in these systems is largely a function of exposed surface area (as well as ambient temperatures), and microbial heat generation largely a function of volume (assuming the environmental conditions are near optimum), for any material and configuration there will be an ideal surface to volume ratio. Larger piles, with a smaller surface to volume ratio, will tend to overheat, while small piles will be too cool. For materials in a typical windrow configuration (where the width of the windrow is about double the height), the ideal height will usually be in the range of 1 to 3 meters. Rapidly degrading, dense mixtures that include grass clippings, food scraps or manure will be at the lower end of this range, while porous, slowly degrading piles of leaves will be at the upper end.

With a forced aeration system, convective heat loss can be increased by increasing the aeration rate. Although this will reduce the average temperature of the pile, one also has to be careful to insure that the temperature extremes are not too great. With very large piles, regions near the air inlet will be excessively cooled and dried, while other regions near the exhaust may be to hot. As with passively aerated systems, the ideal size of a forced aeration pile depends on the characteristics of the material being composted and the geometry of the composting system. For most materials, in systems using ambient air (air once through), the maximum height (or airflow path length) is 2 to 3 meters. Tunnel reactor systems, which can recycle the airflow, typically operate at higher airflow rates with a smaller temperature difference between the inlet and the outlet. Recycling the airflow, or using pre-heated air, thus allows an increase in reactor size while still maintaining a tolerable degree of process control.




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Stormwater runoff from open windrow composting facilities

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Abstract

Most of the 4000 composting sites in North America employ open windrow composting techniques in which rainfall often comes into contact with the compost. The resulting runoff can leach contaminants from the compost, making the runoff unsuitable for direct release into receiving waters. Stormwater from these facilities is usually collected in a detention pond and treated prior to release. There is little guidance for determining the appropriate size of these runoff detention ponds. One barrier to modelling the hydrology of composting sites is a lack of basic information regarding rainfall–runoff relationships for compost. This note describes the results of laboratory and field experiments designed to estimate the fraction of rainfall incident on a compost windrow that leaches from the windrow onto the composting pad and into the detention pond. The results indicate that approximately 68% of the rainfall incident on a saturated compost windrow will eventually run off. *Key words:* solid waste management, composting, runoff, detention pond.

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Environment Protection Authority

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Abbreviations and definitions

100-year floodplain	Land where the chance of flood occurring in any given year is at least one in 100
(The) EP Act	*Environment Protection Act 1993*
aerobic	In the presence of air (oxygen)
AHD	Australian Height Datum in metres is the reference level for defining reduced levels adopted by the National Mapping Council of Australia. The level of 0.0 m AHD is approximately mean sea level
anaerobic	In the absence of air (oxygen)
APVMA	Australian Pesticides and Veterinary Medicines Authority
AS	Australian Standard
As Constructed Report (ASR)	An 'As Constructed Report' is a documentation of work performance, Construction Quality Control (CQC) and Construction Quality Assurance (CQA) associated with a construction project.
bioremediation	An accelerated process using micro-organisms (indigenous or introduced) and other manipulations to degrade and detoxify organic substances to harmless compounds, such as carbon dioxide and water, in a confined and controlled environment.
biosolids	Stabilised organic solids derived totally or in part from wastewater treatment processes which can be managed safely to utilise beneficially their nutrient, soil conditioning, energy or other value. The term biosolids does not include untreated wastewater sludges, industrial sludges or the product produced from the high temperature incineration of sewage sludge. It should also be noted that many other solid waste materials are not classified as biosolids, eg animal manures; food processing or abattoir wastes; solid inorganic wastes; and untreated sewage or untreated wastes from septic systems/sullage wastes.
carbon:nitrogen ratio	The ratio of the weight of organic carbon (C) to that of total nitrogen (N) in an organic material
compost	Pasteurised material resulting from the controlled microbiological transformation of compostable organic waste under aerobic and thermophilic conditions for not less than six weeks.
composting	The controlled process whereby compostable organic wastes are pasteurised and microbiologically transformed under aerobic and thermophilic conditions for a period not less than six weeks, including the pasteurisation phase.
composting works	The conduct of works at which mushroom or other compost is produced or is capable of being produced at a rate exceeding 200 tonnes per year.
controlled waste	Waste as defined in the *National Environment Protection (Movement of Controlled Wastes between States and Territories) Measure 1998*

Construction Quality Assurrance (CQA)	Construction Quality Assurance is third party verification of quality. The objectives of a CQA plan is to ensure that the construction materials used, construction methods and completed works comply with the approved technical specifications.
Construction Quality Control (CQC)	Construction Quality Control is a measure taken by the installer or contractor to ensure compliance with the installation specifications.
DEWNR	Department for Environment, Water and Natural Resources
EIP	An environment improvement program for the purposes of the *Environment Protection Act 1993*
EPA	South Australian Environment Protection Authority
feedstocks	Wastes approved by the EPA for composting
green waste	The vegetative portion of the waste stream arising from various sources including waste from domestic and commercial premises and municipal operations.
hazardous waste	Listed waste having a characteristic described in Schedule A list 2 of the National Environment Protection (Movement of controlled waste between States and Territories) *Measure*. Hazardous waste includes any unwanted or discarded material (excluding radioactive material) which because of its physical, chemical or infection characteristics can cause significant hazard to human health or the environment when improperly treated, stored, transported, disposed of or otherwise managed.
kerbside collected green waste	Green waste collected during the regular domestic council waste collection
leachate	A liquid that has percolated through and/or been generated by decomposition of waste material. It includes water that comes into contact with waste and is potentially contaminated by nutrients, metals, salts and other soluble or suspended components and products of decomposition of the waste
liquid waste	Waste classified as liquid waste in accordance with the assessment process set out in the guideline *Liquid waste classification test* (EPA 2003)
listed waste	Waste listed in Part B of schedule 1 of the *Environment Protection Act 1993*
moisture holding capacity	The ability of the compost to absorb and hold water
mulch	Dry green waste that has been processed by way of chipping, shredding or similar mechanical process, but does not contain putrefying material. The *Australian Standard 4454–2012 for compost, soil conditioners and mulches*, specifies properties for mulch including that it needs to be pasteurised. Pasteurisation reduces the risks from pathogens and plant propagules.
organic waste	Component of the waste stream derived from living organisms (including wood, garden, food, animal, vegetative and natural fibrous material wastes and biosolids)
pasteurisation	A process whereby organic materials are treated to significantly reduce the numbers of plant and animal pathogens and plant propagules

pasteurised product	An organic product that has undergone pasteurisation but is relatively immature and lacking in stability
PIRSA	Department of Primary Industries and Resources South Australia
quarantine waste	Quarantine waste means material or goods of quarantine concern as determined by the Australian Quarantine and Inspection Service (AQIS) and which is subject to and or identified under Commonwealth Legislation *(Quarantine Act 1908)* and associated regulations and proclamations
sensitive use	As defined in section 3(1) of the *Environment Protection Act 1993*, sensitive use means – a use for residential purposes; or b use for a pre-school within the meaning of the *Development Regulations 1993;* or c use for a primary school; or d use of a kind prescribed by regulation.
source separation	Physical sorting of the waste at the point of generation into specific components suitable for resource recovery from the residual component
stormwater	Means rain or melted precipitation that runs off land or structures on land
structural integrity	The ease in which the feedstock will break down during the compost process
surface waters	Means (a) marine waters; and (b) all other waters in the state other than underground water
waste	As defined in section 3(1) of the *Environment Protection Act 1993*, waste means– – any discarded, rejected, abandoned, unwanted or surplus matter, whether or not intended fro sale or for recycling, reprocessing, recovery or purification by a separate operation from that which produced the matter; or – anything declared by regulation (after consultation under section 5A) or by an environment protection policy to be waste, whether of value or not.
wastewater	As defined in clause 3(1) of the *Environment Protection (Water) Quality Policy 2003*, wastewater means waste principally consisting of water, and includes wash down water, cooling water, effluent, irrigation run off and contaminated stormwater.
wastewater management system	As defined in clause 3(1) of the *Environment Protection (Water) Quality Policy 2003*, wastewater management system is a system designated and operated for the purpose of collecting and managing waste water so as to minimise any adverse impacts of the waste water on the environment.
Water Quality Policy	*Environmental Protection (Water Quality) Policy 2003*

2 Siting of compost works

Objective

Composting facilities should be located so as to reduce the potential risks of adverse environmental impacts and offsite nuisance impacts.

Minimum expectations

The conduct of composting works has the potential to generate offsite nuisance impacts including dust, noise and odour. The type of feedstocks to be received, the composting process employed at a site, the scale of operation and site topography are some of the factors that can influence the generation of offsite nuisance.

Separation distances will be assessed during the planning stage[6] only and will not be retrospectively applied to existing licensed facilities.

Separation distances should be determined to provide a basic level of environmental protection for the surrounding areas and take into consideration impacts which may arise from time to time as a result of accidents, abnormal weather conditions and equipment breakdown.

Separation distances are not an alternative to appropriate onsite management practices.

The EPA recommends that the operation of composting facilities is avoided in the following locations:

- 1,000 m to land that is for sensitive use
- Within the floodplain known as the '1956 River Murray Floodplain' or any floodplain subject to flooding that occurs, on average, more than one in every 100 years
- Within the Mount Lofty Ranges Water Protection Area and the South East Water Protection Area as declared under Part 8 of the EP Act
- Within 100 m of a bank of a major watercourse (eg Murray, Torrens and Onkaparinga Rivers), or within 500 m of a high-water mark.

Greater separation distances may be necessary based on site-specific conditions, including the environmental risk of the proposed operation or the technologies and processes employed. The EPA may require odour modelling to be undertaken at the planning stage to assess the potential for offsite nuisance impacts where the separation distances are close to the recommended minimum.

Existing composting facilities should be protected from encroachment from new developments. In the absence of site-specific risk information an effective buffer is 1,000 m between new developments and composting facilities, measured from the outer boundary of the area licensed to undertake composting.

The separation distance should be measured from the boundary of the composting activity (including the wastewater lagoon) at the site to the nearest receptor (refer Figure 1).

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6 Development applications lodged and referred to the EPA under the Development Act 1993 and Development Regulations 2008.

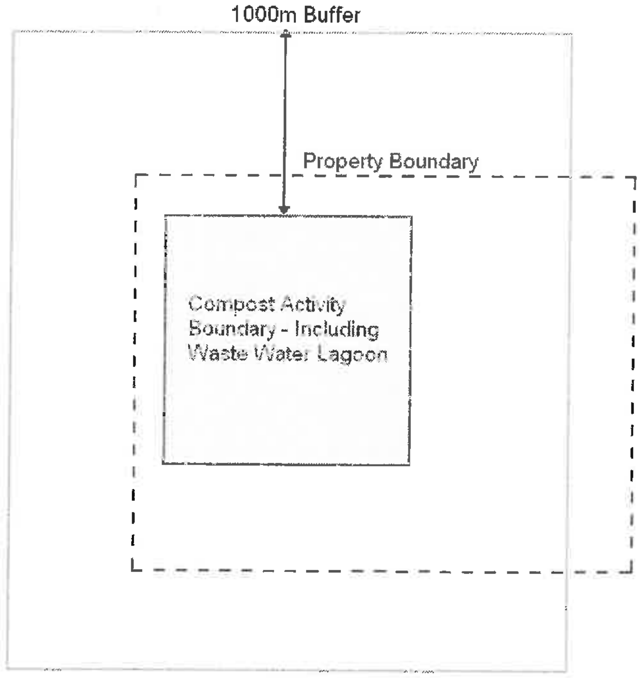

Figure 1 **Example of a 1,000-m separation distance from the active composting area of the site**

Further information regarding the siting of composting facilities can be obtained from Guidelines for separation distances.

3 Design of composting facilities

Windrow liner

Objective

Open windrow composting facilities should receive, store and process incoming feedstocks on a low permeability liner with a 2% minimum drainage gradient that directs wastewater to a leachate collection system. The liner should be constructed to minimise infiltration of leachate into the soil, subsoil, surface water and groundwater.

Finished compost product should be stored on a designated hardstand area that has a minimum 2% drainage gradient to direct the potentially nutrient rich runoff into a wastewater management system capable of removing the sediments and nutrients.

Minimum performance criteria for a compost liner are listed below. Please see Appendix 2 for the EPA's minimum design criteria.

Minimum expectations

1 The receipt, storage and processing of incoming feedstocks should be undertaken on a low permeability material such as compacted clay, asphalt or concrete over a sub-grade which is able to support, without sustained damage, the load of material on it and the load of any machinery used in the composting facility.

2 Technical specifications including design drawings, a Construction Quality Assurance Plan and Construction Management Plan should be submitted for assessment and approval by the EPA prior to commencing construction works.

3 A suitable protective layer should be maintained over the constructed liner so as to protect the constructed liner from damage as a result of day-to-day activities.

4 Prior to the use of the compost liner an As Constructed Report should be submitted to the EPA for assessment which details the requirements listed in Appendix 3.

5 The design of the compost facility should ensure access to all areas of the site irrespective of weather conditions.

6 The design and maintenance of a minimum 2% drainage gradient for all areas that receive, store and process feedstocks, and the orientation of windrows, to ensure the free drainage of leachate to a designated wastewater collection system.

7 Finished compost product should be stored on a designated hardstand area that has a minimum 2% drainage gradient to direct the potentially nutrient rich runoff[7] into a stormwater management system capable of removing sediments and nutrients.

8 A maintenance program should be implemented that is suitable to maintain the effective working condition of all working surfaces. Any compromise to the working surfaces identified should be repaired as soon as practicably possible. Records should be maintained of all inspection and repair work performed and made available to the EPA upon request.

[7] Finished compost product that has been processed in accordance with this guideline, and is ready for immediate sale, is not considered a waste. Therefore surface water that comes into contact with finished compost product is not considered leachate.

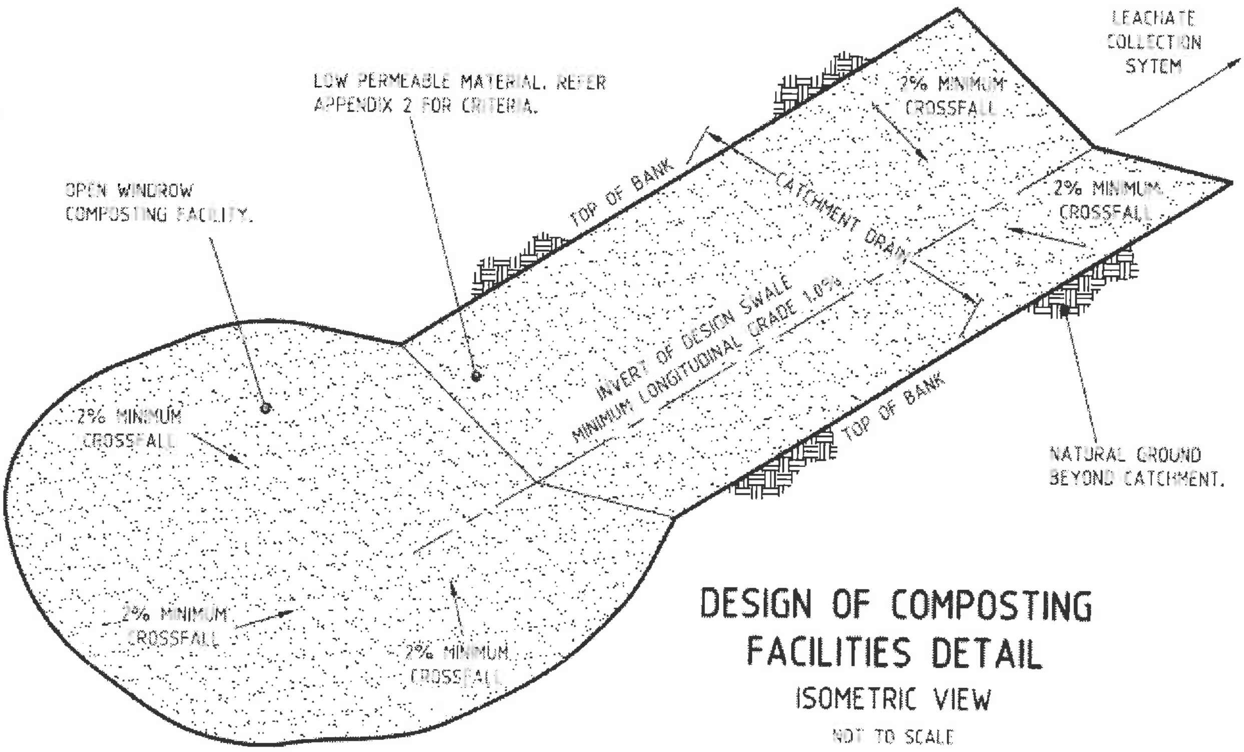

Figure 2 Design options for achieving drainage gradients

Design of wastewater management system[8]

Objective

Composting facilities must comply with clause 24 of the Environment Protection (Water Quality) Policy 2010. It is critical to design compost facilities to separate stormwater from wastewater (including leachate) management systems.

Minimum expectations

1 Wastewater from composting facilities is reasonably expected to contain elevated organics, nutrients, and to a lesser degree salts, metals and microbiological organisms which need to be appropriately managed so as to prevent impacts to the soil, subsoil, surface and groundwater.

2 Design of the wastewater management system should include an assessment of the following factors:

- the maximum potential leachate generation
- rainfall, climate conditions including storm events
- sampling and inspection access
- ongoing maintenance, including an assessment of potential odour.

To assist composting facilities to meet the minimum design criteria for their wastewater lagoons the EPA has developed a risk assessment matrix (Appendix 4) and suggested construction and lining categories (Appendix 5) so as to meet the general environmental duty and obligations under the Water Quality Policy.

8 Wastewater management systems are designed to manage all leachate at the composting facility. This is different to the management of stormwater which is addressed under 'Stormwater' of this guideline.

Further information on the design and construction of wastewater lagoons can be obtained from draft guideline on wastewater lagoons.

Stormwater

Objective

Composting facilities should be designed to divert clean stormwater from pooling or draining towards areas where feedstocks and finished compost product are received, sorted, stored or processed.

Minimum expectations

1 Composting facilities should not have direct connection to stormwater systems.

2 Composting facilities should be designed to prevent clean stormwater from entering into areas where feestocks are received, stored and processed and areas where finished product is stored.

3 All stormwater which comes into contact with incoming feedstocks and compost windrows should be handled and treated as wastewater.

4 Composting facilities should have a separate stormwater management system which:

- is fit for purpose
- sized appropriately for site conditions
- suitably maintained.

5 Design criteria for the stormwater management system should consider:

- the 1–in–25 year recurrence interval
- 24-hour duration storm event for design of drainage features.

5 Quality assurance

Objective

Product quality assurance should be implemented to ensure that the composting processes are fit for purpose for the site's proposed use.

Minimum expectations

1 Compost facilities should be designed and operated to ensure that the whole mass of the windrow is subject to a minimum of three turns and the core temperature is maintained in excess of 55°C for three consecutive days following each turn to eliminate pathogens, weeds and seeds.

2 Where compost windrows contain manure, animal waste, food or grease trap waste and biosolids and/or their sludges, the whole mass of the windrow should be subject to a minimum of five turns and the core temperature maintained in excess of 55°C for 15 consecutive days to eliminate pathogens, weeds and seeds[9].

Refer to the Biosolids guideline for the safe handling and reuse of biosolids for further information.

3 Manual and/or mechanical sorting is necessary for the removal of physical contaminants/inclusions such as litter, plastic, glass and stones.

4 Feedstock, oversized materials, screened contaminants and finished compost products should be stored in a separate designated area at the facility to avoid cross-contamination.

5 Residual waste and/or incoming feedstocks that are unsuitable for use in the composting process should be categorised in accordance with the *Current criteria for the classification of waste – including industrial and commercial waste (listed) and waste soil* (EPA 2010), prior to being removed offsite and transported to a suitably licensed facility to receive and/or dispose of that waste.

6 Finished compost product should be tested to demonstrate compliance with the criteria specified in Table 2.

Table 2 Contaminant testing for finished compost product[10]

Chemical contaminant	Maximum concentration (mg/kg)
Aldrin/dieldrin	0.02
Arsenic	20
Cadmium	1
Chromium	100
Copper	150
Lead	150
Mercury	1
Chemical contaminant	**Maximum concentration (mg/kg)**

9 This requirement is consistent with the requirement specified in section 3.2.1(a) of the Australian Standard 4454-2012 (4th edition)

10 Testing criteria are taken from Australian Standard 4454–2012 (4th edition), Table 3.1(c) 'unrestricted use upper limits for chemical contaminants'.

Nickel	60
Zinc	300
Physical contaminant	**% dry matter w/w**
Glass, metal and rigid plastics	0.5
Plastics–light and flexible or film	0.05

7 Where composting facilities incorporate Category B feedstocks into their compost process, quality control processes should comply with sections 5.3 and 6 of the Standard for the production and use of waste derived soil enhancer.

8 Where biosolids are incorporated into the compost process, quality control processes should comply with the requirements of the Biosolids guideline for the safe handling and reuse of biosolids.

The EPA recommends that the following Australian Standards be adopted in setting environmental goals and quality parameters for compost products:

- *AS 4454–2012 Compost, soil conditioners and mulches*
- *AS4419–2003 Soils for landscaping and garden use*
- *AS 3743–2003 Potting mixes*
- *AS/NZS 5024 (INT)–2005 Potting mixes, composts and other matrices: examination for legionellae.*