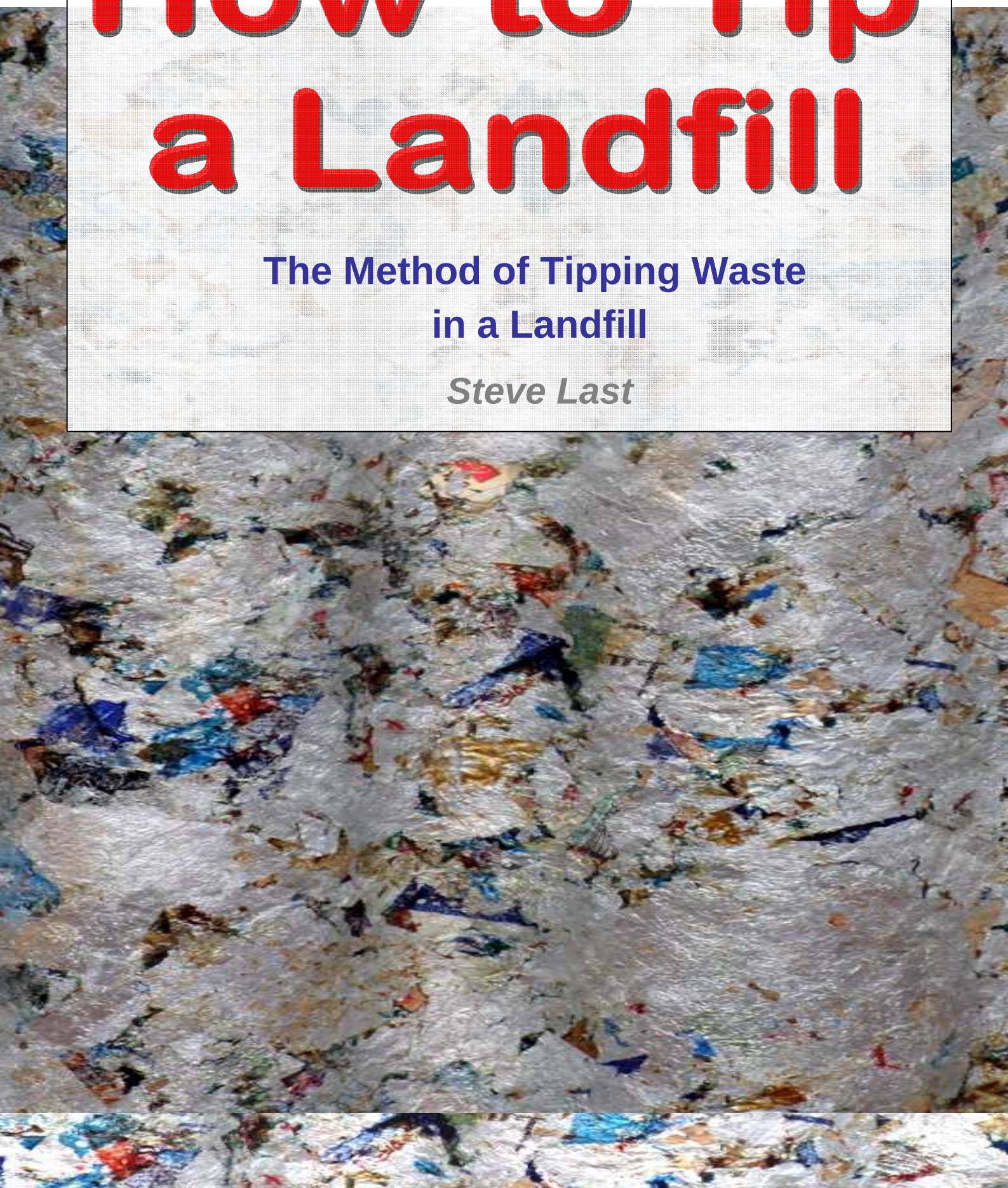
How to Tip a Landfill

The Method of Tipping Waste in a Landfill

Steve Last



How to Tip a Landfill

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Preface


Steve Last
The Waster!

I wrote this document in December 2008 for professionals and students seeking information about landfills and landfill design, and I very much hope you will find it a useful introduction to this subject.

I am a UK Chartered Civil Engineer (MICE) and a member of the Chartered Institution of Waste Management (MCIWM) and Chartered Environmentalist (CEnv). I have over twenty years of waste management experience in landfill design, installation, and Construction Quality Assurance, and leachate treatment plant design and installation experience.

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Cover illustration: Recycled Tetra Pack® cartons after being processed and turned into roofing sheets.

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How to Tip a Landfill or the Method of Tipping Waste in a Landfill

Way back in the 1930s in the United Kingdom the Ministry of Health published a number of what they called "precautions" which should be taken when tipping domestic and trade wastes. That guidance remained the main document providing principles for controlled landfill in the United Kingdom until further guidance was issued in the late 1970s and 1980s when the first Recommended Code of Practice emerged.

The precautions or rules as provided in the Working Party Report on Refuse Disposal, Department of the Environment HMSO, 1976, are reproduced below.

The 1976 Recommended Code of Practice (CoP) is published below to provide a historic perspective on tipping practise. Most of the CoP has stood the test of time and the results of theses "rules" when fully applied have led to a great improvement in landfill acceptability.

Nevertheless, the equivalent to these rules could be applied to great benefit to all landfills, but are not yet being followed in many developing nations. So, where such standards are not currently being applied we suggest that the following might be a useful reference document for improvements to their "Method of Tipping" and general landfill operational control.

Following this guidance, or similar, has been shown over many years to greatly reduce the nuisance and direct public health risk of landfills.

Recommended Code of Practice

The person to whom the license to deposit solid refuse on the land has been granted should comply with the following:

1. Refuse should be formed into a layer as soon as possible after tipping and not later than the end of the working day on which the refuse is received.

2. The layer of refuse should be formed using a tractor equipped with a blade or other appropriate levelling device. Refuse should be deposited on the surface of the tip behind the face and partially compacted by the tractor before being pushed over the face.

3. The layer of refuse should be formed so that it does not exceed 8 ft. in depth after initial compaction. Where the material tipped is pulverized refuse, it may be necessary to restrict the depth of layer to 4 ft. after initial compaction on some sites close to development.

4. As tipping proceeds (and not less frequently than at the end of each working day), all tip faces and flanks should be consolidated and formed to a gradient not steeper than one in three by driving the tractor up and down the tip face.

5. The tipped material should be covered progressively so that all surfaces including the tip face and flanks are covered at the end of each working day with a layer of suitable sealing material spread so that it is not less than 9 in. thick, except that the thickness of covering material on layers formed solely of pulverized refuse need not exceed 6 in.

6. All large articles such as furniture or hollow containers should be tipped in front of the tip face. They should be crushed, broken up or flattened by the tractor and covered each day by other refuse, in such a position that they are not within 3 ft. of the tip surface or 6 ft. from the tip faces and flanks.

7. Any material consisting wholly or mainly of fish, animal wastes, condemned food, including tinned or packaged food, or highly obnoxious matter should be tipped in front of the tip face and covered immediately by other refuse in such a position that the material is not within 3 ft. of the tip surface or 6 ft. from the tip faces and flanks.

8. Screens should be erected at intervals near the tipping point, having regard to the direction of the prevailing wind so as to reduce to a minimum, loose paper, plastics sheeting, etc., being blown from the place of deposit.

9. Not less frequently than once each week, any loose refuse, tins, bottles, etc., which may be lying on the tip site should be gathered and removed.

10. Such action as may reasonably be necessary should be taken to prevent the deposit of mud on highways outside the tip area by vehicles travelling from the tip. Any deposits of refuse, mud, etc., on nearby highways or surrounding land caused through the tipping operations should be removed as necessary.

11. Suitable arrangements should be made for dealing satisfactorily with any material which may be permitted to be accepted at the tip after normal working hours, e.g. facilities provided under the Civic Amenities Act 1967.

12. (a) No waste materials should be burnt within the cartilage of the tipping site.

(b) Immediately on discovery, such emergency action as may be necessary should be taken to extinguish any fire in or on the tipped refuse.

13. To control infestation by insects and vermin, the entire tip should be inspected as often as is necessary and corrective action taken where required.

The above rules in an updated form, and referring to current legal statutes, still form the basis of most of the Landfill Site operational Plans submitted by landfill operators as part of the requirements for obtaining a waste permit to operate a controlled landfill, for a great many landfills both in the United Kingdom and worldwide.

Obvious changes to these rules for most landfill operators will be to substitute a purpose built compactor machine for the tractor used when the code was written, and to increase

the depth of each lift as it may be possible to use a greater lift now, given the much better compaction provided by modern compactor machines.

Temporary cover as described in 5. May be of varying thickness and materials, and it may make sense, in order to ensure the free flow of landfill gas through the site which a low gas permeability daily covering might otherwise impede, to remove the daily cover before placing more waste to optimise landfill gas production (subject to regulatory acceptance).

Sometimes the landfill regulator will allow car fragmentation waste (Frag Waste) to be used as daily cover, and left in place, which can be much cheaper than using soil materials.

At some sites, where it can be shown that there is not a vermin, bird, odour or litter etc problem when no daily cover is used the requirement may be waived altogether. However, once each waste cell vertical 'lift' is complete, or when a longer period of inactivity than 1 day will occur at a location, a temporary cover will be applied. Therefore, the presence at any time of large areas of exposed waste on a properly controlled landfill is never permissible.

General Notes on Good Practise in Landfill Management

The following is not written to comply with any specific national legal landfill operational requirements, but should represent good basic landfill operational practise throughout the world.

The CoP and these notes are very much about being a "good neighbour". Nobody likes a neighbour who is a nuisance, and a landfill can all too easily become a bad neighbour even if it is not releasing any emissions to land or the air which are causing gross pollution.

Many of these actions will be incorporated into the waste operator's permit or waste disposal licence, but some or all may not be, under some regulatory jurisdictions.

If any landfill operator allows their site to be a bad neighbour and causes a nuisance to those around, he or she may save some money in the short term. They may get away with it for a while, but you can be fairly certain that when the site operator then wishes to extend the landfill, or develop a new one once the old is full, they will be met by fierce opposition.

Believe it or not though, there have been numerous examples in the UK and elsewhere, where a well controlled and run landfill complies with these rules and ceases to be a bad neighbour. In such circumstances the landfill operator may find that opposition is mild or non-existent to further landfill development. The value that any good businessman or local authority should give to that is huge.

Therefore, we would like to suggest that compliance with the CoP, or exceeding, combined with some further good practise rules we have included below should not need the policing of these rules by a regulatory authority. On the contrary, compliance should be seen as simply enlightened self-interest on behalf of the landfill owner, as it will in any event make

the difference between short term gain, and providing the business with a long-long term future.

So, this is what all landfill operators should do:

(a) During windy weather tipping faces should located as far as possible from any occupied buildings close to the site or the vicinity of the site should be used. On some windy sites it may be necessary to manage the cellular development of the site so that some areas which are sheltered from the wind (low lying and in the central area of the site) are held available for windy periods. When high winds moderate then those waste cells on the top and perimeter can be filled. This can make the difference between continuing to accept waste or closing the site during high winds, and closing a site is always a revenue loser, so is best avoided if possible.

(b) Litter screens erected to contain light air-borne material should be cleared daily.

(c) To assist in control and screening in windy weather, tipping bays (formed in calm weather) help to create barriers. Barriers should be formed of soil stripped from the site, or innocuous material such as stabilized refuse (if allowed by the regulatory authority). These will also assist in temporary visual screening. Tyre bales to BS PAS 108 with a topsoil covering can also be useful and a low cost way to provide reinforced screening bunds with steep side slopes and which take up a minimum of space.

(d) Landfill access roads and surfaces should be treated and sprayed with water as necessary throughout dry weather to limit dust dispersal.

(e) The entrance to the landfill site should be prepared and maintained so as to give an attractive appearance and, where necessary to avoid the deposition of mud on the highway, an efficient wheel cleaning device should be installed.

(f) Site preparatory soil stripping (applicable for land raised sites on green-field natural containment sites only), when required, should be done in stages and only to the extent necessary to maintain an adequate low permeability barrier lined and developed area reasonably adequate area of tipping surface at any one time.

(g) Completed areas of tipping should be maintained in a tidy condition and in cases where the planned further use is to be delayed for some time, appropriate action should be taken to control or destroy weeds in accordance with the local statutory requirements. A suitable temporary use of the site will help to keep it tidy.

(h) The old guidance said; "To permit settlement and dispersal of gases, as long an interval as practicable, preferably at least three months, should be allowed to elapse before a further layer of refuse is tipped upon a previous layer." However, that is out of date for modern waste it would not be adequate, and thus most landfills will inevitably produce methane gas and such sites are required by the local environmental regulatory authority to have an actively pumped landfill gas extraction system, to minimise carbon emissions. Most such sites will also be required to operate a leachate treatment plant, or

provide a discharge to a public sewer where the sewage treatment plant operator has agreed to accept the discharge. So, most site operators no longer apply a delay before further layers are added.

(h) Where a site is within public view, a tip face should be screened by tipping progressively away from a viewpoint. This will reduce the nuisance to the public and neighbours.

So, operate your landfill to these and other rules specific to your site, and be a good neighbour!

Landfill Phasing and Cellular Progression

No filling should commence on any landfill until a landfill phasing and cellular development plan has been developed in 3-dimensions. To provide this and obtain acceptance of the plan is normally a requirement of the landfill regulator.

To limit leachate generation rates (as required by the EU Landfill Directive) and incidentally to maximise landfill gas (LFG) collection/minimise escape of methane to the atmosphere without flaring or LFG utilisation, landfills are organised in phases. Each phases is made up of many daily tipping cells. The size of a phase is frequently designed to be one year's waste input, or thereabouts.

Each phase shall have as small a footprint area as possible, not leak leachate into undeveloped phases, be (at least temporarily) separately leachate drained, and wherever possible be taken the full height of the landfill and covered with low permeability material, before another phase filling is started.

Each 2 to 3 m cell raises the waste level by one lift.

If you think about the way in which compaction machinery can be used there are only two basic physical methods of forming a waste tip cell at the active face, as follows:

1. Proceed in layers, with the discharging of wastes on the top of the tip face to be pushed over the face by site machinery; consolidation taking place by compression from the site compactor(s) and the waste delivery vehicles.

2. The second method is also a layering process, the refuse being deposited at ground level and pushed up the face to layer height at an angle in shallow sub-layers, the site compaction machinery being used to form the shallow sub-layers and to actively provide compaction.

Working from the top, the tip should not normally be formed in layers (lifts) of more than 2 metres in depth, it being necessary during waste spreading to start construction with an additional depth to allow for the amount of squashing down of the material. So, this means that during tipping waste to an initial volume providing a re-compaction depth of up to 3m, or thereabouts, will be needed to allow for compaction.

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Each layer should be formed by bays (or fingers) of at least 15 metres. in width at the top running in fingers across, one side of the phase each successively rising above the area indicated by the first lift, and then each rising above the preceding lift below. When all the lifts created by each cell join they are said to complete a layer. The layer is the sum of each of the individual daily cellular lifts across the whole area of a phase.

The fingers should be separated by about 15 metres, and the sides and top covered by not less than 150 mm of daily cover. All plan dimensions are subject to the need for space for the plant to operate, trucks to turn and discharge, and compaction equipment to manoeuvre safely on the top of the working face, including once the combination of all the individual lifts reach the top restoration contours and levels.

Daily cover should be applied before the end of the day's work, thus keeping to a minimum the amount of refuse exposed. This method of cellular and phased infilling controls the width of the face, ensures good compaction by the action of vehicles running over the refuse in confined areas and severely limits any outbreak of fire.

The bays filled progressively or gaps may be left between the bays to be tipped into later to complete the layer. Some operators will infill the bay left between when they are short of cover material, as cover use is reduced in these bays. This is because cover is not needed for the sides, and these bays can be indispensible on windy days when the existing bays form shelter. Such shelter helps to control the problem of windblown refuse when otherwise the regulatory authority might require the site to be closed to stop litter being blown out of the landfill site from the uncovered waste and disturbance arising from the tipping face activity.

It is essential that the width of the face should be strictly controlled in order to economize on covering materials, and as far as possible it should be covered at the end of each day's work. A good Landfill Site Manager or Foreman will watch the bay width regularly, otherwise the face will tend to widen.

It is advisable that each layer is compacted well to limit settlement.

In the past it used to be possible to leave each lift for as long as possible before commencing the next layer, to allow for settlement. This period will vary with the availability of alternative finger and cell positions which may be used whilst the first layer, or lift, is settling. The number of lifts will depend on the number needed to bring the waste up to the finished restoration levels.

When planning the run of fingers for a new layer John Skitt (Waste Disposal Management and Practice, 1979, Charles Knight) suggests adopting a different angle to the layer immediately below them. The idea of this is to give an interlacing effect to avoid the possibility of one bay being immediately aligned above another, which could give rise to uneven settlement. However, modern compaction equipment is now far better than the bulldozers and tractors available in those times, so this is less essential.

Care must also be taken to ensure that rain water is not trapped behind bays on the daily and temporary cover by tipping, and that water of this kind flows naturally away from the tipping operations, wherever possible shedding off the phase area without first draining into leachate and increasing the volume of leachate .

Temporary phase perimeter ditches which may need to be used in combinations with temporary and permanent bunds can help in this. Early attention to such details can avoid big problems with seasonal leachate build-up which can easily otherwise occur, after wet weather periods.

Site weighbridge staff should be trained by management to keep a keen look-out for any material delivered which is suitable for daily and also permanent restoration cover. Some sites have installed mirrors at the weighbridge to enable initial visual inspection of potential cover material, and some also now install CCTV cameras for this and general waste type verification and monitoring purposes.

Suitable material for cover will need to be stored at well signed and labelled location. The closer this material is stockpiled to the point of use the less the operator will spend in moving it to the point it is needed.

Conclusion

Compliance with the guidance in this document does bear a cost when compared with less controlled waste deposition and reduced site management. But, the price of non-compliance in terms of nuisance, risk to public health from vermin-spread disease, and potential for increased pollution are very high.

In most developed nations the landfill operator would not be allowed to open his landfill gate unless these and better standards were applied.

As stated earlier the compliance with the standards outlined here should be considered a basic minimum for landfill operation worldwide.

Furthermore, to follow this operational guidance is a necessary first step for a developing nation/community before any implementation of important but much more expensive engineering containment measures.

Engineering to provide landfill containment to minimise environmental and the social impact of all landfills, is the next step after the above standard of operational control is achieved.

Acknowledgements

This ebook was inspired by, and is partly based upon, Waste Disposal Management and Practice, J Skitt, 1979, Charles Knight, the Wikipedia (landfill pages) various CWIM publications, and my personal experience.

How to Tip A Landfill

If you need a professional consultant to assist you in your design or operational management of a landfill, this is a service we provide regularly through our associated consultants. Just Contact Steve Last by email at info [at] wastersblog.com (Please replace [at] with @) - and explain your requirements and a free quotation for this service will be provided.)