Trench^{TM} 3.0 - A COMPUTER APPLICATION FOR SITE ASSESSMENT AND SYSTEM SIZING

Bill Cromer
Senior Consultant, Environmental & Technical Services Pty. Ltd., Hobart

Abstract

A computer application has been developed to aid in the assessment of sites for wastewater management. Trench^{TM} 3.0 supports all Australian guidelines and standards. Within the Windows environment, it uses buttons and menus to assess a comprehensive set of site and environmental factors, review and edit the limitations of each factor for wastewater disposal, select an appropriate disposal and treatment method, and apply a water balance or nutrient balance approach to help size trench dimensions or irrigation and effluent re-use areas.

Keywords

absorption trenches, computer application, environmental sensitivity, irrigation and effluent re-use areas, site assessment, site capability, system sizing, wastewater,

1 Introduction

Assessing land for on-site wastewater management is a vitally important facet of an environmental health professional's job, but never before has it been quite so demanding. Stringent environmental legislation, differing state guidelines, an increasing complexity of site assessment procedures, and a litigious society, all highlight the need for a national approach which is systematic, professional and defensible.

To promote standardisation in the way sites are assessed, and to complement professional judgement, the computer application Trench^{TM} 3.0 is offered nationally and internationally by the Australian Institute of Environmental Health (AIEH) to environmental engineers, environmental health officers, hydrologists, engineering geologists, regulators, site evaluators and academics.

2 The Concept of Trench^{TM} 3.0

Trench^{TM} 3.0 adopts the desired outcomes and aims of Australian Standard 1547 (1994) and recent guidelines from Victoria (Vic EPA, 1996), New South Wales (NSW EPA, 1998) and Tasmania (Tas Div AIEH, 1998). Each of these promotes professionalism (but not standardisation) in the way land is evaluated for on-site wastewater management, to achieve acceptable environmental and human health outcomes.

There are differences, however, between state-to-state regulatory frameworks, and differing protocols and procedures for site evaluation in the various guidelines. To circumvent this complexity, Trench^{TM} 3.0 allows users complete freedom to alter default settings to suit local conditions or to comply with specific state regulations and guidelines.

3 The Structure of Trench^{TM} 3.0

Trench^{TM} 3.0 is written using Microsoft Excel 97, and is a menu- and button-driven application in the familiar Windows environment. Structurally, it comprises two parts. Part 1 is a comprehensive checklist of 35 factors widely recognised as potentially important for on-site wastewater management. Part 2 uses the information entered in Part 1 to aid in sizing and designing a wastewater management system most appropriate for the site.

Part 1 itself comprises three sets of colour-coded pages running together. A central and fundamental set of *Site Assessment Pages* records information derived from site investigations and office reviews. As an aid to this data input, dozens of *Information Pages* provide definitions, comments, diagrams, graphs, equations or references. Each of the 35 site factors evaluated in the Assessment Pages is linked to its own *Options Page*, where users record the confidence level of their input and inspect or amend its default limitation.

Trench summarises all information and interpretations in three Report Pages, which are intended for presentation as tables or appendices in site evaluation reports.

4 Capabilities of Trench^{TM} 3.0

Trench^{TM} 3.0 is designed for either full site evaluations, or part-assessments where these are more appropriate. A range of separate modules allows users to:

- estimate soil permeability from field permeameter tests or soil texture;
- derive Long Term Acceptance Rates and Monthly Disposal Rates;
- estimate monthly evapotranspiration rates by one or both of two methods (crop factors and pan evaporation figures, or mean maximum daily temperatures);
- calculate or review various soil chemical properties, such as sodium adsorption ratios, cation exchange capacities, exchangeable sodium percentages and phosphorus adsorption capacities;
- use simple nutrient models to allocate sources and sinks for nitrogen and phosphorus species in soils and groundwater;
- record the risk of slope instability of a site;
- estimate the radius of influence of water bores;
- estimate setback distances to sensitive features, using the viral die-off method and one or more of four simple groundwater models; and
- use monthly and daily water balance calculations to determine appropriate sizes for absorption trenches, evapotranspiration beds, mounds, irrigation or effluent re-use areas, or treatment lagoons, and estimate wet weather overflow (for on-site storage requirements) from above-ground systems.

5 Site and Environmental Factors

A handful of factors (such as soil permeability and thickness, and rainfall excess or deficit) rank as fundamental inputs to on-site wastewater evaluations. A host of others (like bulk density, soil pH, and exchangeable sodium percentage) have recently appeared in some Australian guidelines, and, while they may be important for some sites and some disposal applications, are what might otherwise be classed as of second-order significance. As a nationally-distributed application, Trench^{TM} 3.0 includes a full range of factors for assessment, but it simplifies the growing complexity by dividing the list into Site Capability and Environmental Sensitivity factors.

Site Capability is the *physical* ability of a site and its soils to accept applied wastewater. Environmental Sensitivity describes the possible *off-site* environmental (and human health) effects of a disposal system. Some factors arguably fit into either or both categories, but the concept is useful because it focuses attention on the twin goals of wastewater management – appropriately-designed systems which work *on-site*, and which produce acceptably low impacts *off-site*.

The factors assessed in Trench^{TM} 3.0 are:

Site Capability factors
Expected design area
Disposal system density
Slope angle
Slope form
Aspect
Surface drainage
Flood potential
Frequency of heavy rain events
Frequency of strong winds
Wastewater volume
Septic effluent sodium adsorption ratio
Sullage sodium adsorption ratio
Thickness of soil
Depth to bedrock
Percent of surface outcrop
Percent volume of cobbles in soil
Soil pH
Soil bulk density
Soil dispersion
Soil permeability
Long Term Acceptance Rate

Environmental Sensitivity factors
Cation exchange capacity
Phosphorus adsorption capacity
Annual rainfall excess
Depth to seasonal water table
Annual nutrient load
Groundwater environmental value
Min. separation distance required
Risk to adjacent water bores
Surface water environmental value
Risk to nearest surface water
Distance to nearest other surface features
Risk of slope instability
Distance to nearest landslip

6 What do I do with my data?

How to classify field or office data has been a long-standing problem for site evaluators. To this end, ranking systems have evolved to categorise factors and describe whether or not they are suitable for wastewater disposal on a site. This approach is now being replaced by 'outcomes' focussed methods, but the need remains for some form of ranking to act as a primary screen for site factors. Unfortunately, two old problems persist.

First, there is no nationally agreed set of rankings, or of acceptability criteria. For example, it is confusing that a depth to seasonal groundwater of 1.1 metres is a 'moderate limitation' for on-site wastewater disposal in New South Wales and a 'moderately high limitation' in Tasmania, but renders a site 'incapable' in Victoria. Furthermore, many of the rankings appear to be ad-hoc, or at best, scientifically dubious. For example, on what basis does New South Wales require a setback of 250 metres between a disposal area and a domestic water bore?

Second, and just as important, the recipe-like use of 'magic numbers' to make decisions about site acceptability obscures interrelationships between factors which may alter their rankings and acceptabilities. For example, disposing of wastewater into a relatively permeable soil poses a greater risk of groundwater contamination than in a less permeable soil. Indeed, in Victoria, a permeability of 2 metres per day or more renders a site 'incapable'. But are we to classify such a site as incapable of receiving wastewater if no groundwater exists, or if its soil is sufficiently thick to reduce the risk to groundwater to acceptably low levels? Similarly, it would be foolish and indefensible to classify a particular phosphorus adsorption capacity of a soil as a 'major limitation' if the wastewater it receives has been treated beforehand to render its phosphorus level so low as to be immaterial.

Trench^{TM} 3.0 addresses these and other potential conflicts in three ways:

- first, it assigns to all Site Capability and Environmental Sensitivity factors its own set of default rankings (which are either the same as, or are a reasonable compromise between, those in current national guidelines);

- second, it allows, and indeed encourages, the user to alter the default rankings so as to recognise interrelationships between factors, and allow for site modifications or system designs aimed at making a particular factor more acceptable; and

- third, it records all default rankings and any amended rankings, and flags all factors which retain high or very high limitations so that they may be addressed in system design or site modification.

This 'flagging' approach of Trench^{TM} 3.0 moves from the artificial limitations of prescriptive numbers towards a risk assessment methodology. It thus involves increased work and requires more professional judgement and responsibility. In this sense it is akin to the concept of 'trigger values' canvassed by Swinton (1999) in relation to the new ANZECC Draft Environmental Water Quality Guidelines.

The overall flexibility of Trench^{TM} 3.0 ensures its general applicability irrespective of the differing assessment procedures at state, national and international levels.

Trench^{TM} 3.0 may be previewed and ordered from the Australian Institute of Environmental Health web site at http:/ / www.aieh.org.au

7 References

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