Section 11:
Evapotranspiration
Absorption Beds
11. **Evapotranspiration Absorption Beds**

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An evapotranspiration absorption (ETA) bed maximises loss of water by evapotranspiration, whilst reducing the reliance on absorption. ETA beds are often used where site limitations prevent the use of irrigation (lack of space) or absorption trenches (presence of clayey soils). An ETA bed is usually used to dispose of wastewater from a septic tank, but it can also be used to manage secondary treated effluent.

ETA beds are generally unlined beds with some deep seepage. Capillary action draws effluent up through the sand in the upper part of the ETA bed from the storage in the void spaces in the gravel bed beneath. This supplies the root zone of the vegetation (usually grass) on the top of the bed to optimise evapotranspiration. Effluent is distributed through the bed by a system of slotted pipes.

Vegetation cover must be well maintained to ensure strong growth for maximum uptake by transpiration. The surrounding landscape and vegetation must also be maintained to minimise shading and maximise exposure.

Figure 11.1 shows an ETA bed and Standard Drawing No.11A shows a cross section view.
11.1 Design

The ETA bed should be designed with consideration for the site and soil assessment detailed in Section 2 of this Manual. The ETA bed should be sized according to the recommendations in AS/NZS 1547:2012. Council approval is required to install an ETA bed requires council approval under the Local Government Act 1993 and it must comply with Sydney Catchment Authority and Council requirements for buffer distances and setbacks from significant site features. The following points should also be considered.

- All ETA beds should be designed using hydraulic balance modelling. This will ensure the best bed size and contain construction costs.
- The hydraulic balance determines the volume of storage in the gravel bed. This ensures the bed does not overtop in prolonged wet periods when evapotranspiration losses are lower than inputs from rainfall and effluent load.
- The bed must be turfed immediately following construction.
- ETA beds are constructed with a domed upper surface to shed rainfall. The steeper the slope the more rainfall that will be shed.
- The bed must be located where it will be well exposed to ensure maximum evapotranspiration.

**Designer accountability**

More accountability for the design is provided by the designer providing a Design Producer Statement where they warrant the design. Appendix 2 includes an example of a Design Producer Statement.

11.2 Installation

A number of installation techniques should be used for effective long term operation of an ETA bed. Common failures of ETA beds are often caused by poor installation practices. Follow the steps below when installing an ETA bed.
Step 1 Site preparation

- Obtain a copy of the Council approved plans and conditions of consent. Locate beds accurately as shown on the site plans and according to the specified and approved design and/or any covenant. If there is any change in their position from the site plans, a Section 96 application (from the Environmental Planning and Assessment Act 1979) must be made to council to alter their position.

Step 2 Positioning

- Beds must be built along the contours to ensure even distribution and avoid any one part of the bed being more heavily loaded. Failure to do this could lead to premature failure of the most heavily loaded part of the bed, followed by creeping failure as the effluent is forced to more distant parts of the bed.
- Avoid cutting beds through existing weakened ground (e.g., through the alignments of former underground pipes, cables, or conduits) as they may provide preferential pathways for effluent to escape from the bed. If these pathways cut downslope through the ground occupied by a series of beds, effluent may preferentially flow to the lowest bed causing it to fail or surcharge. Where the bed must be cut into an alignment or it is done accidentally, seal any weaknesses in the trench walls with cement or bentonite grout.

Step 3 Timing

- Beds should be built in fine weather. If rain does fall before the beds are completed, cover the beds to protect them from rain damage.
- Once dug, beds must be completed promptly to avoid foreign material being washed into the open excavation. Puddling (where clay settles at the bottom of a water-filled bed left exposed to rain) must be avoided, as the clay on the base of the bed will reduce its performance.

Step 4 Excavation

- The base of any bed should be carefully excavated and levelled with a dumpy or laser level. The bed must be level both along and across the line of the bed. Effluent will drain down any slope across the base of the bed and preferentially load the downslope side of the bed, which may then fail or surcharge.
- Where beds are dug along the contour on sloping ground, and by an excavator that does not have a pivoting bucket, the base of the bed will probably be cut parallel to the ground surface. In this case, the base of the bed will have a fall towards the down-slope side. The bed should be further hand dug to ensure a level base, and to prevent effluent accumulating against the downslope wall of the bed.
- Where beds are dug by an excavator in more clayey soils, scarify the bed walls to remove any smearing caused by the excavator bucket.

Step 5 Construction

- Do not use ETA beds if the soil is dispersive. However, if a degree of dispersiveness is identified after the trenches are dug, add gypsum to the trench base at the rate of one kilogram a square metre. ETA beds are not suitable for medium to heavy clay soils.
- Ensure that the sides of beds are not damaged or caused to collapse when the beds are filled.
Design and Installation of On-site Wastewater Systems

• Lay geotextile on top of the gravel media in a bed and beneath the sand to ensure that the sand does not penetrate and block the gravel media.
• Test piping with clean water before filling with gravel or sand to ensure that effluent is evenly and effectively distributed.
• Apply 150 millimetres of topsoil to the top of the bed and leave it mounded above the completed bed to allow for settlement and encourage rainfall to run off.
• Turf the top of the bed promptly after construction to ensure the best uptake of effluent by evapotranspiration. Ensure that deep rooting trees or shrubs are not planted close to the beds to reduce the chance of roots intruding and clogging the beds.
• Build a stormwater diversion berm/drain on sloping sites to avoid stormwater filling the ETA bed. Standard Drawing No. 11A provides detail about building a stormwater diversion drain.

Step 6 Dosing
• ETA beds may be gravity-fed or pressure-dosed using pumps or dosing siphons. Where there are shallow soil limiting layers present (eg bedrock or water table), and there is not enough separation distance (Section 2) from such layers, raised pressure-dosed ETA beds are a possible alternative. In these situations the linear loading rate must also be addressed.
• The annotated Standard Drawing No. 11B describes the installation of evapotranspiration absorption beds. Checklist 11.1 provides guidance on aspects of an evapotranspiration absorption system that should be checked by the installer and regulator.

System Design
Communication between the designer and installer is improved by the designer preparing a System Design. This report conveys critical details of the design to the installer. It describes and quantifies the design and illustrates the appropriate layout and configuration of the system with appropriate plans and sketches. Appendix 3 includes an example of a System Design.

Finally, the installer provides an Installation Certificate that confirms the system was installed as described in the relevant sections of the Design Producer Statement. Appendix 4 includes an example of an Installation Certificate.
Design and Installation of On-site Wastewater Systems

Inflow and take time to regenerate once higher flows restart. This can result in poor or ineffective treatment in the meantime.

For a proposed dwelling (including dual occupancies) the design wastewater loading must be determined using the ‘Neutral or Beneficial Effect on Water Quality Assessment Guideline 2011’ (Sydney Catchment Authority, 2011) based on:

- the number of potential bedrooms (which can’t change, unlike the number of occupants)
- the nature of the water supply ie whether the dwelling uses town or bore water, or tank water
- the wastewater loading per bedroom based on the nature of the water supply.

Table 2.1 should be used to calculate the daily wastewater load for a dwelling together with any specific requirements of the relevant local council. For other developments (non-dwelling) involving wastewater, refer to the ‘Septic Tank and Collection Well Accreditation Guideline’, (NSW Health, 2001) or other reference source approved by the Sydney Catchment Authority.

Table 2.1 – Design wastewater loading calculations (for a dwelling)

<table>
<thead>
<tr>
<th>Potential Bedrooms</th>
<th>Reticulated / bore water</th>
<th>Tank water</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>600L/d</td>
<td>400 L/d</td>
</tr>
<tr>
<td>3</td>
<td>900L/d</td>
<td>600L/d</td>
</tr>
<tr>
<td>4</td>
<td>1200L/d</td>
<td>800L/d</td>
</tr>
<tr>
<td>More than 4</td>
<td>1200L/d plus 150L for each additional bedroom</td>
<td>800L/d plus 100L/d for each additional bedroom</td>
</tr>
</tbody>
</table>

Source: NorBE Assessment Guideline (Sydney Catchment Authority, 2011).

Note: the Sydney Catchment Authority adopts a conservative approach for wastewater design calculations.

Water saving fixtures should be standard in all new dwellings.

Determine the effluent design loading rates or design irrigation rates using the values for the identified soil description (texture and structure) in Tables L1, M1 and N1 of AS/NZS 1547:2012. Use the conservative design loading rates for septic tanks, absorption trenches and beds.

Septic tanks for residential developments must be at least 3,000 litres. Larger tank capacities must be based on design wastewater loads detailed in Table J1 in AS/NZS 1547:2012. If a spa bath is proposed as part of a development, the minimum septic tank size must be increased by 500 litres.

For greywater-only systems, use a value of 65% of the design wastewater load calculated above. Otherwise greywater systems are treated exactly the same as other wastewater systems.

Linear loading rate for beds, trenches, sand and amended soil mounds

The hydraulic linear loading rate is the amount of effluent that the soil around an effluent infiltration system can carry far enough away from the infiltration surface for it to no longer influence the infiltration of additional effluent (Tyler, 2001). It must be used in conjunction with the effluent design loading rates (DLR) from AS/NZS 1547:2012. DLRs assume there is no hydraulically limiting layer beneath the disposal area; the linear loading rate is designed to ensure that the effluent cannot return to the surface as it travels downslope due to the presence of a hydraulically limiting layer.
Evapotranspiration / Absorption Bed

Plan View: Typical ETA Bed Layout (applicable only if pressure-dosed)

- A The base of the bed must be level to ensure even distribution of effluent. It must also be scarified to overcome any smearing during excavation. Base levels should be checked with a dumpy / laser level.
- B 100 mm slotted PVC pipe.
- C 20-40 mm distribution aggregate.
- D 5-10 mm aggregate.
- E Clean local or imported topsoil (sandy loam to loam).
- F Allowance for settling after backfilling.
- G Grass must be established across the construction area as soon as possible. Trench / bed surface should be level or slightly mounded.
- H Inspection port on downhill side of the bed. Made from 50 mm PVC pipe with perforations in the aggregate level of the bed.
- I Fine sand (0.1 mm).
- J Bed dimensions are an example only. The basal area of the land application area must be determined according to the procedures set out in AS/NZS 1547:2012 and this Manual. The location and orientation of the area should be based on a site and soil assessment by a suitably qualified person. The system may comprise a single trench / bed or multiple smaller trenches / beds. It is essential that effluent is distributed evenly to all units on a daily basis.
- K Upslope stormwater diversion drain (see Standard Drawing No.10B for design detail). Subsoil drainage may be necessary on particular sites.
- L 100 mm PVC gravity dosing pipe.
- M Gravity splitter box to distribute effluent evenly between two to four separate trenches / beds. Should also be used to evenly dose multiple pipework within a single trench / bed.
- N Gravity, siphon or pump fed effluent from treatment system.

Note
1 More than two distribution pipes will be required in beds wider than 4,000 mm. Care should be taken with beds wider than 4,000 mm to ensure a level base.

Standard Drawing 11B - Evapotranspiration / Absorption Bed
(not to scale)
### Checklist 11.1 Installation of ETA beds for use by plumbers / installers and Council inspectors

<table>
<thead>
<tr>
<th>Type of system:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Method of application</strong></td>
<td>□ Gravity □ Pump □ Siphon</td>
</tr>
<tr>
<td><strong>Configuration</strong></td>
<td>□ Trench □ Absorption bed</td>
</tr>
<tr>
<td><strong>Pre-construction considerations</strong></td>
<td></td>
</tr>
<tr>
<td>Is the soil moisture too wet for construction?</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td><strong>Site preparation</strong></td>
<td></td>
</tr>
<tr>
<td>Bed area marked according to site plan / conditions of consent including buffer and setback distances</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Bed is positioned according to design requirements for contours</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td><strong>Bed dimensions</strong></td>
<td></td>
</tr>
<tr>
<td>Number of beds:</td>
<td></td>
</tr>
<tr>
<td>Width: mm</td>
<td>Length: mm</td>
</tr>
<tr>
<td>Bed dimensions are consistent with council's consent</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Confirm all system elevations</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Stake bed boundaries with elevations</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Method of excavation:</td>
<td></td>
</tr>
<tr>
<td>Bed bottom graded to specifications</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td><strong>Inspection ports</strong></td>
<td></td>
</tr>
<tr>
<td>Type:</td>
<td>Diameter: mm</td>
</tr>
<tr>
<td>Perforations:</td>
<td>□ Slotted □ Drilled</td>
</tr>
<tr>
<td>Grade(1) from tank to trench</td>
<td>□ Above grade (a pump will be needed) □ Below grade</td>
</tr>
<tr>
<td><strong>Media</strong></td>
<td></td>
</tr>
<tr>
<td>Coarse aggregate specifications and source:</td>
<td>Fine aggregate specifications and source:</td>
</tr>
<tr>
<td>Gravel type:</td>
<td>Aggregate type:</td>
</tr>
<tr>
<td>Depth:</td>
<td>Depth:</td>
</tr>
<tr>
<td>Cleaned and graded</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Cleaned and graded</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Total media depth: mm</td>
<td></td>
</tr>
<tr>
<td>Amount of media used: m³</td>
<td></td>
</tr>
</tbody>
</table>
### Design and Installation of On-site Wastewater Systems

#### Distribution system

**Distribution device:**

- □ Gravity
- □ Pressure

**Type:**

- □ Splitter box
- □ Drop box (for serial distribution)

**Type:**

- □ Pump
- □ Siphon

**Description of header:**

**Installation level:**

- □ Alternating / sequencing
- □ Gate ball
- □ Other

**Type of stable bedding material used:**

**Manual valve (describe):**

### Access

- □ Riser
- □ In valve box in the field
- □ In bedding material
- □ In dosing tank
- □ Other (give details):
- □ None

**Pressure manifold Specification:**

**Lateral feed configuration**

- □ End
- □ Top
- □ Centre
- □ Bottom
- □ Other (give details):

**Type**

**Diameter:** mm  **Length:** mm

**Orifices specifications / spacing / size / orientation (describe):**

**Access / protection:**

- □ Yes
- □ No

**Describe:**

**Laterals**

**Specification:**

**Type:**

**Diameter:** mm  **Spacing:** mm  **Length:** mm

### Installation

**Geotextile/fabric cover placed over gravel**

- □ Yes
- □ No

**Final topsoil cover**

**Depth of topsoil cover:** mm

**Imported material used**

- □ Yes
- □ No

**Nature of material (describe; should be clay loam-sandy loam):**

**Stormwater diversion berm/drain constructed**

- □ Yes
- □ No

**Turf planted:**

**Nature of protection of ETA beds (describe):**
| **Service provider:** |  |
| **Contact number:** |  |

**Comments or repairs needed:** (Where a response in the above Checklist needs extra information or action, specify the action plan and/or the process to fix the problem, or specify an alternative that is being offered)

| **Name / title of inspector:** |  |
| **Signature:** | **Date:** |
11.3 Testing
Test ETA beds with clean water before placing any media to ensure even distribution. If pressure-dosed, pressure test the piping to ensure uniform squirt height at each orifice and that any sequencing valve is working (Figure 11.2).

11.4 Operation
The owner should inspect the bed regularly. This detailed maintenance inspection should include:

- checking any pumps or siphons are working correctly. If the system includes a standby pump, it should be alternated with the working pump regularly to ensure that the work hours on both are approximately equal
- checking any splitter or drop down boxes are working effectively, and/or manual valves are switched between beds
- inspecting the control system and ensuring that it is set to deliver appropriate volumes of effluent to specific irrigation fields according to the design hydraulics
- checking around the bed for signs of leakage
- checking the water level in any inspection ports to ensure the bed is not flooded. Beds are designed to hold water for evapotranspiration, but if the bed becomes flooded the turf covering will die off.

General maintenance
The system owner must complete a number of general maintenance and operational tasks, including:

- addressing maintenance issues identified by the service provider
- ensuring all products used in the household are safe for the system (bleaches and many household cleaning products are not safe)
- ensuring the tank is regularly desludged to limit the amount of solids carried over into the bed. Section 3 of this Manual contains details on desludging a septic tank
- inspecting and cleaning the outlet filter of any septic tank every three months
- managing vegetation around the tank and bed (including mowing and trimming back bushes for maximum exposure)
- ensuring the system has a continuous power supply. The system power should not be turned off when the house is unoccupied
- ensuring a plumber is contacted as soon as practicable if an alarm activates.

11.5 Inspection
The ETA bed and all associated pipe and drainage work should be inspected by a Council inspector before backfilling, to ensure all components are correctly positioned and installed according to ‘PCA 2004 Plumbing Code of Australia’. Council should make a final installation inspection to ensure compliance with all conditions of consent before issuing an approval to operate the system.

Checklist 11.2 can be used by plumbers, council inspectors and system owners to inspect operating ETA beds.

11.6 Common technical issues
Plumbers, property owners and regulatory authorities have observed a number of common problems with ETA bed installations including:

- inadequate hydraulic design resulting in undersized beds
• uneven distribution on flat sites, commonly caused by gravity feeding through a slotted pipe where most effluent escapes from the first few slots and is not evenly distributed throughout the bed. This can be fixed by pressure dosing through a smaller aperture drilled pipe
• inadequate ‘in-bed’ storage that causes surface saturation and surcharging
• beds that are built too large in surface area to sustain the surface vegetation in dry weather
• beds that are built too short along the contour (linear loading rate)
• inadequate exposure to wind, or shading by shrubs and trees lowering the rate of evapotranspiration
• accumulated salts due to a lack of deep seepage that is needed to ensure salts are periodically flushed from the system.
### Checklist 11.2 Operation of ETA beds for use by plumbers, Council inspectors and system owners

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there evidence of surface water or soggy ground on the trench / bed area (eg after emptying a bath)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are some trenches or beds greener than others?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there evidence of stormwater intrusion?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there any indication that water on the surface of the trench or bed is effluent (can test for using Nessler’s reagent)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there an indication of poor drainage on or near the bed area?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there evidence of vehicle, human or animal traffic over the trench / bed area?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there evidence of protective measures to prevent trench / bed damage (eg shrubs, fencing)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is a good vegetation cover established over the trench / bed surface?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the trench / bed have good exposure to wind and sun?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the inspection port interiors clear (ie no standing water suggesting trench flooding) and in good condition?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the dosing siphon or splitter box working properly and not blocked or clogged?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is any pump or siphon operating correctly?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the control system set correctly to deliver appropriate volumes of effluent to specific irrigation fields according to the hydraulic design?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are regular desludges of the tank undertaken?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has the septic tank outlet filter been cleaned by way of hosing the filter off?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Service provider:**

**Contact number:**

**Comments or repairs needed:** (Where a response in the above Checklist needs extra information or action, specify the action plan and/or the process to fix the problem, or specify an alternative that is being offered)

**Name / title of inspector:**

**Signature:**

**Date:**
11.7 Case study

An ETA bed was installed on a flat site with limited available area for on-site wastewater management. A few months later the bed began to show signs of surface seepage at one end.

Problem

The bed was not pressure-dosed or dosed by a siphon. All effluent was seeping out of the first few holes in the distribution laterals and not reaching the other end of the bed. The soil at the upstream end of the bed became saturated and could not accommodate the daily wastewater load from the house. The other end of the bed was not receiving any effluent.

Solution

A pump well was installed to pump or siphon the clarified effluent to the ETA bed. The pump was hydraulically sized taking into account the head needed from the pump well to the bed, pressure loss in the pipes, and the desired flow pressure needed from the laterals to evenly distribute effluent throughout the bed. Once pressurised, the ETA bed was restored to operation and it continues to work well. Figure 11.2 shows the testing for squirt height from the distribution laterals to ensure even distribution of effluent. Gravity feeding a bed may be acceptable on sloping sites.

Figure 11.2 Pressure testing the distribution laterals for even distribution of effluent (www.inwater.com.au)