SOCIETY OF CHIEF OFFICERS OF ENVIRONMENTAL HEALTH IN SCOTLAND

Septic Tank System Designs in Scotland (For illustrative purposes only – still to be fact checked)

In areas without mains sewerage (common in **domestic rural Scotland**), several types of **on-site sewage treatment systems** are used:

- **Conventional Septic Tanks** – the classic system: a watertight underground tank (often two-chambered) that provides **primary treatment** by settling solids out of wastewater. As sewage enters, heavy solids sink (forming sludge) and fats float (scum); the clarified liquid effluent flows out for further treatment in the environment[1]. Septic tanks themselves **only partially treat sewage** – they typically remove >50% of suspended solids but **do little to reduce organic pollutants, ammonia, or pathogens**[1]. **Drainage field required:** Because the effluent is still polluted, it must discharge to a **soakaway (drainage field)** in the soil for natural filtration[1]. Septic tanks are simple, with **no power needed**, and relatively low installation and maintenance cost (aside from periodic emptying)[1][1]. However, **effluent from a septic tank alone is not clean enough to go straight into a burn or loch** – doing so would risk health and environment, so additional treatment or soil infiltration is required by law[1][1].
- **Packaged Sewage Treatment Plants** – modern **"all-in-one" treatment units** that provide secondary (and sometimes tertiary) treatment. These are sometimes called **"aerobic" septic systems or biological treatment units**, and include designs like **activated sludge tanks, submerged aerated filters, rotating biological contactors (RBC biodisc)**, sequencing batch reactors, etc.[1][1]. They typically have an aeration chamber (pumping air through wastewater to support bacteria that break down waste) and a settling chamber, all housed in a compact tank. **Effluent Quality:** Packaged plants can **achieve a much higher effluent quality** than a septic tank – for example, well-designed units can produce effluent with <20 mg/L BOD_5 and <20 mg/L ammonia, which is suitable for discharge to surface waters in many cases[1]. Because of this, they are often used when a direct discharge to a watercourse is proposed or where soil conditions for a soakaway are poor. **Power & maintenance:** Most packaged systems require an electricity supply (for pumps or motors) and regular maintenance servicing[1][1]. They cost more to install and operate than a simple septic tank, but they allow rural homes to meet environmental standards and SEPA requirements for cleaner effluent[1][1]. Packaged units in Scotland must

conform to British Standards (BS EN 12566-3 for small treatment plants) and be authorised by SEPA prior to use[1].

- **Modern "Natural" Systems (Constructed Wetlands & Reed Beds)** – these are **alternative or complementary treatment methods** that use natural processes. A **constructed wetland or reed bed** system channels septic tank effluent through a vegetated bed (lined to protect groundwater) where plants, soil, and microbes further purify the water[1]. In Scotland, reed beds are often used as a **polishing stage after** a septic tank (or sometimes after a package plant) to reduce nutrients (nitrogen, phosphorus) and biological oxygen demand in the effluent[1]. They are especially useful if discharging to a sensitive or small watercourse that needs a higher treatment level[2]. **Advantages:** Reed beds require **no electricity**, have low operating costs, and provide wildlife habitat[1]. **Drawbacks:** They need a **large land area** and can be less effective in cold, wet winter conditions when biological activity slows[1][2]. Regular upkeep (like weeding and ensuring flow is not obstructed) is needed[1]. In practice, a properly designed wetland bed can be very effective, but SEPA will scrutinise proposals – you may need to show it's suitably designed per the Building Research Establishment's guidelines (Good Building Guide 42 for reed beds)[2]. In sum, natural systems are a **sustainable supplement or alternative** when soil alone can't do the job and a high-tech plant is undesired.

Other variants and options exist (for example, **baffled septic reactors**, which are enhanced multi-chamber septic tanks with better solids separation[1], or **mound filtration systems** where a raised bed of sand/gravel is used if the water table is high). In general, all these systems aim to fit the needs of domestic/rural properties while protecting environmental quality. Table 1 below compares key features:

Table 1: Comparison of Septic System Designs

System Type	Description & Usage	Power?	Effluent Quality	Key Pros	Key Cons
Septic Tank (traditional settlement)	Simple buried tank (1–2 chambers) settles solids; effluent must go to a **soakaway** for treatment by soil[1][1].	No	**Low** – only primary treatment. Removes large solids (~50%), but effluent still high in organics,	Low cost, no energy; robust if properly sized; minimal mechanical parts[1][1].	Pollution risk if used without further treatment; not suitable for direct water discharge[1]. Requires regular **desludging**

System Type	Description & Usage	Power?	Effluent Quality	Key Pros	Key Cons
	Common for single homes.		nutrients, and microbes[1].		(typically annually) to prevent overflow[1][1].
Packaged Treatment Plant (mechanical biological unit)	Self-contained **"mini sewage works"** (aerators, filters, etc.) that can often discharge directly to a stream. Used where higher effluent standard is needed or multiple homes share a system[1].	Yes (usually) [1]	**High** – secondary treatment. Effluent can meet strict standards (e.g. <20 mg/L BOD_5, <20 mg/L NH_3)[1]; much cleaner and safer for waterways.	Allows compliance with SEPA rules for watercourse discharge; compact footprint; many models certified for UK use[1].	**More costly** to install and maintain; needs electricity (ongoing energy cost)[1]. Requires scheduled servicing (pumps, blowers) and responsive maintenance to keep performance. Potential for mechanical faults.
Reed Bed / Wetland ("green" tertiary stage)	**Natural filter bed** of reeds or wetland plants in gravel. Typically follows a septic tank to further treat effluent using plant uptake and microbial action[1]. Suitable for	No	**Moderate** – can reduce BOD, ammonia, and pathogens significantly[1], though results vary with seasonal temperature. Often used to polish effluent	Eco-friendly (zero energy use); low-tech operation; low ongoing cost. Enhances biodiversity; **no power or chemicals** needed[1].	Needs **large area** and correct design (lined bed)[2]. Performance can be weather-dependent (less efficient in winter)[1]. Requires gardening

System Type	Description & Usage	Power?	Effluent Quality	Key Pros	Key Cons
	environmentally sensitive discharges when land allows.		before final discharge[2].		upkeep (vegetation management) and periodic sludge removal from pre-tank.

*(Note: Other niche systems include **composting toilets** (which eliminate sewage generation) and **cesspools** (sealed holding tanks requiring frequent emptying), but these are generally last-resort solutions and not "treatment" systems. Cesspools merely store waste and are legally discouraged since they must be emptied often to avoid any discharge.)*

Discharge Methods: Soakaway vs. Watercourse

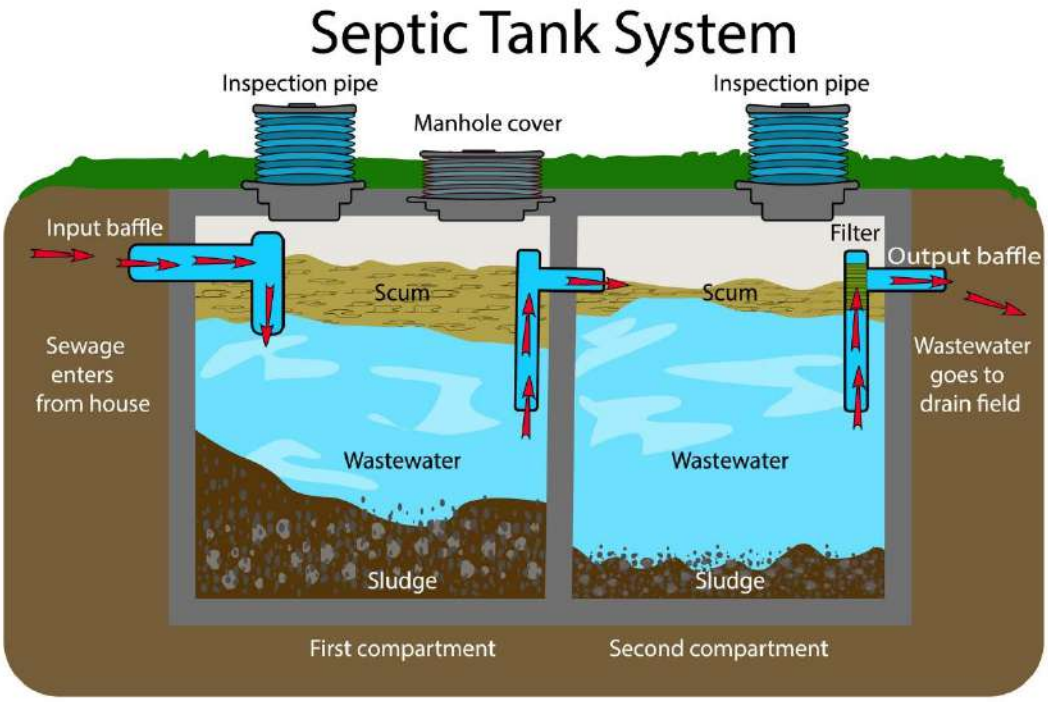
Once sewage has been treated by one of the above systems, the **treated effluent** needs to be released into the environment safely. In Scotland there are two main discharge routes: **to land** (into soil) or **to a water body** (stream, river, loch, or the sea). SEPA and Scottish Building Standards have a strong preference for **discharge to land** where feasible, because soil provides a good final treatment medium[1].

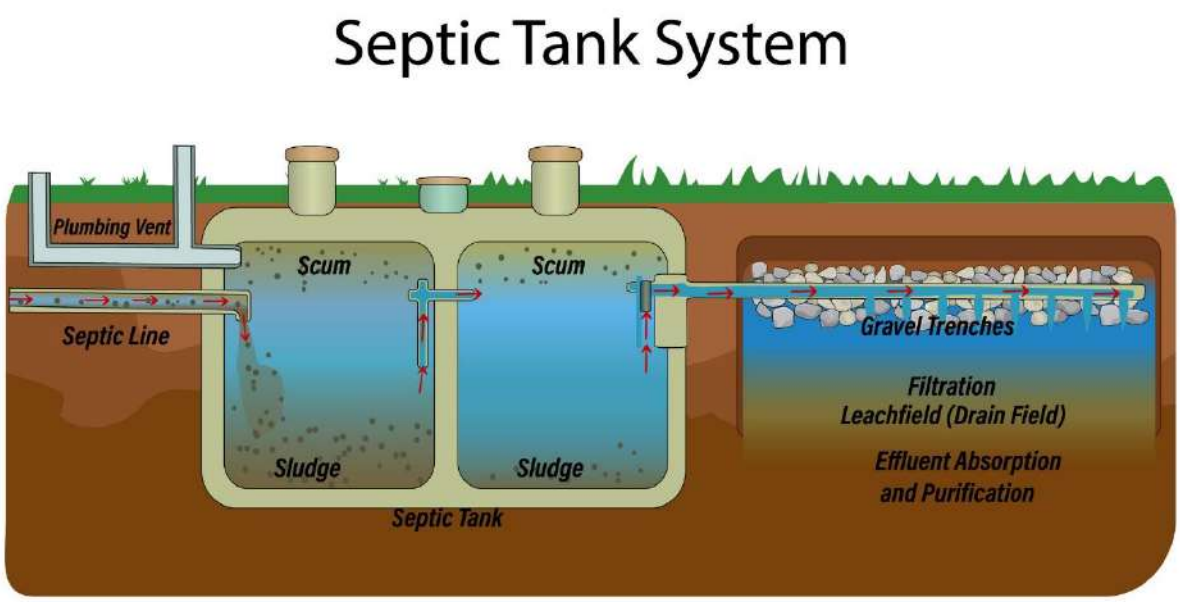
- **Discharge to Land (Soakaways)** – A **soakaway** is an underground dispersal system that allows effluent to **percolate into the soil**. Typically this is done via a **drainage field**: a network of perforated pipes laid in gravel trenches below ground, which distribute the septic tank or plant effluent over a wide area so it can soak into the subsoil[3]. The soil acts as a biological and physical filter, removing pathogens and nutrients as the liquid percolates downward. This process is crucial for septic tanks, which rely on soil absorption to achieve acceptable treatment levels[1]. **Regulations for soakaways:** In Scotland, soakaways must be designed and sited per the Building Standards **Technical Handbook Section 3.9**. Key rules include: maintaining at least **1 metre of unsaturated soil** between the soakaway trench base and the highest water table, to prevent direct contamination of groundwater[3]; and safe distances from water supplies and buildings – e.g. **≥50 m from any well or spring used for drinking**, **≥10 m from any watercourse or field drain**, and at least 5 m from buildings and boundaries[1][3]. A **percolation test** is required to verify the soil's infiltration capacity[3]. If the soil is too impermeable (percolation value >100 s/mm) or too porous (≤15 s/mm) the design must be adapted (e.g. use a raised *mound soakaway* in slow-draining clay, or ensure no untreated rapid bypass in very sandy soil)[3]. Local authority building control must approve and

usually issue a building warrant for a new soakaway installation[3]. In summary, **land discharge is preferred** because it uses the soil's natural treatment ability, but it requires suitable site conditions. If a site fails the necessary ground tests (for example, high bedrock or water-table, or inadequate area), then a soakaway is not viable[1].

- **Discharge to Watercourse or Sea** – If a soakaway is **not feasible**, an effluent may be discharged to a **surface water** (such as a burn/stream, river, or coastal water) **but strict conditions apply**. First, connecting to a watercourse **absolutely requires effective treatment** – **SEPA will not allow raw or only-settled sewage to be piped straight into a stream**[4]. Typically, you would need a **package treatment plant** (or equivalent multi-stage system) producing high-quality effluent for a direct discharge[1]. Second, you must demonstrate the receiving water has sufficient **flow/dilution** to safely disperse the effluent without environmental harm[1]. **Small burns that dry up, or very sensitive waters, won't be accepted for discharge**[1]. SEPA's guidance (Regulatory Method WAT-RM-03) assesses dilution: for instance, in a **high-flow river**, it might be acceptable to discharge effluent from a septic tank with at least a partial soakaway or other buffer[1], whereas in moderate flows the effluent will likely need to meet stricter standards (meaning a more advanced treatment plant is required)[1]. If dilution is minimal (tiny stream), SEPA may **refuse permission altogether**[1]. **Additional constraints:** Discharges directly into enclosed freshwater lochs or ponds are generally not allowed under a simple registration – those usually require a full SEPA license or alternative arrangements[4]. Furthermore, some areas are designated **"phosphate-sensitive catchments"** (e.g. Loch Leven in Perth & Kinross) where even treated effluent can enrich the water with nutrients; new discharges in such zones face tighter controls or may be prohibited unless phosphate removal is included[4]. In practice, most rural homes in Scotland only consider a direct water discharge if a soakaway is impossible – and then they install a certified treatment unit that can produce near-clean water. The discharge point (outfall) into the water must be identified and constructed to prevent erosion and allow sampling, and SEPA will include conditions to ensure the system is properly maintained to protect the water environment[4].

Diagram: *Typical layout of a **septic tank with a drainage field soakaway** – Wastewater flows from the house into the underground septic tank, where solids settle. The liquid effluent then runs (via a distribution chamber) into perforated pipes buried in gravel trenches, allowing gradual infiltration into the surrounding soil[5][5].*





*(In coastal locations, a third option is discharge to the **sea** or tidal estuary. This still requires treatment – often a package plant – but dilution in the sea is high. Special rules apply if near designated bathing waters or shellfish waters to avoid health risks[1]. For any direct discharge, consultation with SEPA is essential.)*

SEPA Regulations and Guidance

The Scottish Environment Protection Agency (**SEPA**) is the regulatory body overseeing private sewage discharges in Scotland. Key elements of the **regulatory framework** for septic tanks and small sewage systems include:

- **Authorization (Registration or License):** By law, **all sewage discharges to the environment must be authorised by SEPA**[6]. Most domestic septic systems fall under a **registration** (a simpler permit) if they serve up to a certain size. As of current guidance, new discharges serving up to 15 population equivalent (approximately up to 3 domestic houses) can be covered by a registration, whereas larger systems need a **CAR licence**[1]. Existing older discharges serving up to 50 PE (about 9 houses) can be registered; anything bigger requires a license[1]. The registration process ensures SEPA has a record of your system and that it meets basic design conditions. There is a one-time fee (currently £190 for a small discharge) for registration[6]. A **license** involves a more detailed application and ongoing conditions, used for larger or environmentally sensitive cases[6][4]. For example, if you plan to discharge into a protected loch or serve a whole village, a license with site-specific limits would be needed. **Bottom line:** *if you have a septic tank or treatment plant serving your home, you are legally required to register it with SEPA* (unless it was already registered by a previous owner).
- **Connection to Sewer Rule:** Regulations require you to **use the public sewer if it is "reasonably practicable"** to do so[4]. Planning authorities and SEPA will check if a new house is near an existing mains sewer – if yes, you'll be expected to connect rather than install a septic tank. SEPA's online registration even checks sewer proximity via postcode[4]. This policy is to avoid unnecessary proliferation of septic systems where a public wastewater infrastructure exists.
- **No New Untreated Discharges:** It is **illegal to discharge raw sewage** (untreated or merely via a simple settler) to the environment. SEPA explicitly states it **"will not authorise new untreated sewage discharges"**[4]. This means at minimum you need a septic tank or similar primary treatment before any release. (In practice, as discussed, further treatment or a soakaway is then required in almost all cases.)
- **Building Standards and Local Approvals:** In addition to SEPA's environmental permit, **Scottish Building Regulations** apply to the installation of septic tanks and treatment plants. **Section 3.8** of the Domestic Technical Handbook lays out standards for private wastewater systems (for example, tanks must be designed to BS EN 12566 standards, sized appropriately, and installed to prevent leaks or health hazards)[7]. A building warrant from the local authority is typically needed

for a new septic system or material changes to one[3]. The Building Standards also enforce the separation distances and ground suitability tests for infiltration systems as noted earlier. During planning permission for a new development, the developer must often submit a drainage assessment detailing how sewage will be managed, and councils consult SEPA on these plans. **Planning Advice Note 79** (Water and Drainage) provides further guidance on locating and designing septic systems as part of rural development in Scotland.

- **Operational Duties (Maintenance):** Both SEPA and local authorities emphasise that **proper maintenance of septic systems is a legal responsibility** for owners[8]. When SEPA grants a registration, it comes with general binding conditions, one of which is to **maintain the system and avoid causing pollution**[6][6]. Failing to empty your tank or fix faults could lead to enforcement action if pollution occurs. Notably, **Scottish Water** (the national water company) offers septic tank emptying services in many areas and advises annual or biennial desludging as a rule of thumb. Homeowners should keep records of when the tank was emptied and serviced. It's also advised to clearly label the presence of a private sewage system in the home (SEPA suggests a notice near your utility meters) to alert future owners or servicing personnel about their responsibilities[1]. If multiple properties share a single system, a formal arrangement (deed or contract) should assign maintenance duties and cost-sharing among them[1].
- **Special Areas and Protections:** As mentioned, discharges in certain sensitive catchments (high ecological value or nutrient-sensitive waters) may be subject to additional requirements or refusal. Environmental Health officers may also get involved if a septic system poses a public health nuisance (e.g. leaking to a ditch near homes). Scotland has adopted the **General Binding Rules** similar to England & Wales for small sewage discharges, which include many of the siting and maintenance requirements – compliance with these is mandatory (they cover things like not causing nuisance odour, no discharge within 50 m of a drinking water source, etc.).
- **Registration of Old Systems:** If a property has an older septic tank that was never registered, the owner was required to register it during SEPA's drive (around 2011, when these rules came in). If one buys a rural property, it's wise to check that the septic tank is indeed registered and in good order. SEPA provides a public online tool to check registrations[1]. If not registered, the owner must apply, though no fee was charged for older existing systems in certain past schemes. This process brings legacy systems under regulatory oversight and helps SEPA map where septic tanks are (important for cumulative impact on groundwater).

Official Resources: For further detail, SEPA's website offers a **"Septic Tanks and Private Sewage Treatment Systems" guidance hub**[6], and the **NetRegs** platform (a partnership between SEPA and NIEA) provides easy-to-read guides for householders on septic tank responsibilities, installation, and troubleshooting. The Scottish Government's Building Standards division also publishes the full technical guidance for design and installation (Section 3.8 and 3.9 of the Building Standards Technical Handbook – available on gov.scot).

Common Issues and Faults with Septic Systems

Despite their simplicity, septic tanks and small treatment systems can experience a range of **problems** if not designed, used, or maintained properly. Here are some of the most common issues observed in Scotland (and generally, anywhere septic systems are used), along with their typical causes and consequences:

- **Blockages and Backups:** The **most frequent problem** is blockage in the system – this can occur in the inlet pipe from the house, the outlet pipe to the soakaway, or within distribution pipes. Signs of a blockage include **sinks and toilets draining slowly, gurgling sounds, sewage backing up into plumbing, or effluent overflowing at the tank or soakaway**[9]. Blockages often result from **inappropriate items** flushed (e.g. nappies, wipes, sanitary products, which can snag and accumulate) or **excessive build-up of fats and grease** in pipes[9][9]. A clogged outlet or failed soakaway will cause the tank to fill up and could lead to sewage surfacing near the tank or backing up into the property. **Remedy:** Early on, a homeowner might attempt to clear an accessible blockage with drain rods or by pumping out the tank[9]. Usually, a professional septic tank emptying and jetting of pipes is needed. Regular desludging and not flushing solids can prevent most blockages. Scottish Water advises using only toilet paper and mild cleaners, and absolutely **no disposal of diapers, wipes, cooking oils, or other non-biodegradables into the system**[9][9] – these are top culprits for clogging and should be "bagged and binned" instead.
- **Sludge Overflow & Soakaway Failure:** If a septic tank is **not emptied (de-sludged) on schedule**, the sludge layer eventually builds up to the point that new wastewater pushes solids out of the tank. **Solid carry-over** will quickly **clog the soakaway pipes or pores in the soil**[8]. A clogged soakaway might manifest as **sewage pooling on the ground**, very **lush green grass growth** in the drain field area due to the nutrients, or foul smells near the outlet[8][8]. Once a drainage field is blocked with solids or grease, it can be very difficult to restore – it may require complete replacement of the gravel and pipes in a new location. To avoid this, **annual or biannual pumping** of the septic tank is recommended (the exact frequency depends on tank size and household usage, but **at least once every 1–2 years** is a common rule)[8][9]. If the soakaway does fail,

temporary measures include diverting flow to a holding tank or installing an aerobic unit to better treat the effluent before it enters the clogged field. Note that **tree roots** can also infiltrate and damage soakaway pipes over time, and heavy vehicles on the ground above can compact soil or crush pipes – so one preventative tip is **not to plant trees too close (keep deep-rooted plants 30m away)** and **never drive or build over a septic drain field**[8][9].

- **Odours:** A properly functioning septic system **should not produce strong odours** in the vicinity (aside from brief smell during pumping). **Foul odours** around the tank or drain field indicate a problem. This could be due to a blockage (causing stagnation), or a crack/leak in the system allowing partially treated sewage to surface. It might also occur if the tank's venting is inadequate – septic tanks produce gases (methane, hydrogen sulfide, etc.) and need a vent (usually via the soil vent pipe of the house plumbing) to dissipate them safely. If you notice septic smells indoors or near the tank, it's wise to inspect for blockages or have the tank emptied. Also, **after heavy rain**, a waterlogged drain field might not drain well and cause odors until it dries. Persistent bad smell is not only a nuisance but a sign that untreated effluent may be escaping – one should act promptly to diagnose it (often by calling a specialist).
- **Kill-off of Bacteria (Chemical Upset):** The waste in septic tanks is broken down by *anaerobic bacteria*. If these beneficial microbes are harmed, the tank's treatment efficiency plummets, leading to odors and poor quality effluent. A common cause is **toxic chemicals** being poured down drains. **Avoid** disposing of strong disinfectants, bleaches, solvents, pesticides, or medication in sinks/toilets[8]. Even excessive use of normal bleach or anti-bacterial cleaners can sterilise a septic tank. SEPA's guide and Scottish Water both advise using cleaning products **sparingly** and choosing those labeled "septic safe" (low- or no-phosphate, biodegradable)[9][8]. Oil and grease are also problematic – they're not broken down in the tank and instead form a scum layer that can wash into pipes, additionally "waterproofing" the soil in a soakaway and preventing percolation[8]. In essence, the **household's usage habits** critically impact septic health. Education on what not to flush and how to dispose of hazardous wastes is key. If a tank does get chemically upset (e.g. after a paint cleanup or chlorine accident), sometimes bio-additives can help re-seed bacteria, but usually the main solution is to stop the source and give the system time to recover (while perhaps pumping out to remove the toxic material).
- **Structural or Mechanical Faults:** Septic tanks (especially older brick or concrete ones) can suffer **structural damage** – cracks in walls or pipe connections that let wastewater leak out (or groundwater leak in). Ingress of groundwater can overload a system (particularly during floods or high

groundwater periods) and cause overflows. Egress of sewage can contaminate soil or groundwater directly. Regular inspection (for example, checking the tank water level isn't mysteriously low, which might indicate leakage) is recommended[1]. Modern plastic (GRP or polyethylene) tanks avoid rust but must be installed correctly (anchored if in high water table) to prevent shifting or collapse. **Packaged treatment units** have moving parts (pumps, compressors) which can fail or lose power. An aeration pump failure, for instance, will turn a package plant into anoxic mode and effluent quality will drop – often there is an alarm on these systems to alert owners of malfunctions. Routine servicing (typically annual) by qualified engineers can preempt many mechanical issues. In sum, like any infrastructure, **age and wear** can take a toll: concrete baffles can erode, inlet tees can break off, etc., which is why periodic professional inspection is wise, especially for systems older than 20–30 years.

- **Environmental Impacts:** If any of the above issues are not addressed, a septic system can pollute the environment. **Leaking or overflowing systems** may introduce harmful bacteria (like E. coli) into nearby streams or ditches, posing health risks to people and livestock[8]. Nutrient-rich effluent can cause algal growth in burns and ponds. In extreme cases, contamination of groundwater can occur – for instance, if a tank is uphill of a shallow well, a leak could introduce pathogens into the water supply. That's why regulations enforce minimum distances and why **diligent maintenance is both a legal and social responsibility**[8]. Homeowners should be vigilant for any signs of trouble (smells, slow drains, unusually green grass, wet patches) and act quickly. Remember, a well-maintained septic system is quite safe and innocuous;

problems usually only arise from neglect or misuse. Local authorities have the power to require fixes if a septic system is causing nuisance or public health concerns (sometimes grant schemes are available to upgrade faulty septic tanks, especially if multiple homes in an area need improvements to protect a water supply).

Illustrative Photo: *Below is an example of a septic tank being installed in a rural property (the concrete/plastic tank is lowered into an excavation) – after connecting the inlet and outlet, it will be backfilled and attached to a drainage field*[10].[10]

In conclusion, **septic tanks** remain a vital wastewater solution for Scotland's rural areas, but they must be properly designed (following SEPA and building standards guidance), sited with a suitable discharge method (ideally a land soakaway), and maintained regularly to function well. Modern packaged treatment systems and natural reed beds offer enhanced treatment where needed, helping meet environmental standards even in sensitive locations. By adhering to SEPA's rules and best practices – registering your system, emptying it routinely, and watching what goes into it – you can ensure your septic system protects both your property and Scotland's environment for the long term.

Sources:

- Scottish Environment Protection Agency (SEPA) – *"Septic tanks and Private Sewage Treatment Systems"*, including **registration guidance and discharge guidelines**[6][4][1].
- Scottish Government Building Standards Division – *Technical Handbook 2020: Section 3.8 & 3.9 (Private wastewater treatment systems)*[1][3].
- CREW (Centre of Expertise for Waters) Report (2022) – *"Guidance on Small Sewage Systems in Scotland"* (comprehensive reference on system types and selection)[1][1].
- Scottish Water – *"Looking After Your Septic Tank"* advice (maintenance tips)[9][9].
- NetRegs (SEPA/EA) – *"Treatment of septic tank discharge where no soakaway is possible"* (on package plants and reed beds)[2][2].
- SEPA & Dee Catchment Partnership – *"The Septic Tank Guide"* (illustrated leaflet on how septic tanks work and how to maintain them)[8][8].

References

[1] Guidance on Small Sewage Systems in Scotland - CREW

[2] Treatment of septic tank discharge where no soakaway is possible

[3] Discharging to land via a soakaway - beta.sepa.scot

[4] Private sewage treatment system registration guidance

[5] Visualising Septic Tank Systems: Diagrams and Images

[6] Septic tanks and Private Sewage Treatment Systems

[7] Building standards technical handbook 2020: domestic

[8] YOUR QUESTIONS ANSWERED THE

[9] Looking After Your Septic Tank - Scottish Water

[10] File:Septic tank 1.jpg - Wikimedia Commons