Greywater Treatment and Discharge Design Report
Land at Lower Wych

This report answers the six greywater matters in NRW's letter of 3 September 2026 and the planner's request of 15 September 2026. Drawings GW-01 to GW-04, issued with this report, show a passive system of settlement, planted gravel treatment and discharge to ground, at the positions in our landscape layout of 7 October 2026.

The route is: household source controls, settlement tank, reedbed, planted gravel polishing cell, inspection and distribution, then the drainage field. A treated water store (ES1) holds water when the field is isolated or when the polishing cell transfers water in heavy rain. Stored water is pumped back to the polishing cell as the field recovers, so all treated water leaves through the drainage field. Treatment and discharge operate by gravity; water leaves the store by pump.

Document schedule

Item	Detail
Application	P/2026/0466, Land west of Lower Lanes Farm, Lower Wych
Responds to	NRW consultation response, 3 September 2026; Wrexham County Borough Council email, 15 September 2026
Document	Greywater Treatment and Discharge Design Report, 7 October 2026
Drawings	LW-GW-01 to LW-GW-04
Issued with	Landscape Plan A1.7; Ecology Response with drawing LW-EC-01

1 Percolation Tests and Receiving-Ground Capacity

We tested two holes, each 300 × 300 mm in plan and 900 mm deep, after overnight soaking. Each timed reading measures the 150 mm fall from 225 mm to 75 mm water depth. The percolation value, Vp, is the elapsed time in seconds divided by 150 mm.

Table 1-1: Percolation test readings

Hole	Date (2026)	Time	Vp (s/mm)
H1	17 September	52 min	20.8
H1	18 September	74 min	29.6
H1	21 September	89 min	35.6
H2	18 September	58 min	23.2
H2	21 September	84 min	33.6
H2	29 September	98 min	39.2



Figure 1-1: Percolation test hole H1 on the first day of the test: after excavation (left) and during pre-soaking (right).

H1 mean: 28.67 s/mm; H2 mean: 32.00 s/mm; combined mean: 30.33 s/mm. All readings are within the 15–100 s/mm range in NRW Part B6.5 guidance. Later readings were slower; the sizing therefore adopts the slowest single reading, 39.2 s/mm, rather than the mean the NRW method uses.

Required area: 5 persons × 39.2 s/mm × 0.25 = 49.00 m². Provided area: 4 runs × 21.0 m × 0.60 m = 50.40 m².

The conservative 0.25 coefficient is retained. The field exceeds the 49.00 m² required on the slowest reading and has a 33% margin over the 37.92 m² required at the mean Vp.

The field provides 84.0 m of trench with 2.0 m clear soil strips. The ground falls 0.28–0.45 m along the runs, so each run is laid in level sections that step down with the ground. The trench bases are 0.90–1.10 m below ground level, with at least 500 mm soil cover over the pipe crowns. The hole positions are plotted from our marked-up layouts of 1 and 7 October 2026: H1 at the west end of run R2 and H2 within run R4. GW-03 (view 4) dimensions each hole to the stem centres of the two retained trees on the boundary east of DC1, for setting out and checking on site. GW-03 gives the section levels and step positions. Soil strips and header pipes are excluded from the credited area.

The holes were dug to 900 mm. NRW's method asks for the hole base 300 mm below the pipe invert, which the trench base represents here (300 mm of stone below the pipe). The stepped runs keep the trench bases close to the tested depth. At H1, at the west end of run R2, the ground is 81.01 m AOD and the hole base 80.11, 0.02 m above the trench base there at 80.09. At H2, within run R4, the ground is 80.92 and the hole base 80.02, 0.05 m above the trench base there at 79.97. The sizing uses the slowest reading, and the soil tested is the clay loam that both holes showed throughout their depth.

The tests were made in ordinary early-autumn weather: showers and sunny spells from 10 to 19 September, dry days on 20 and 21 September and light morning rain on 29 September. The wettest day had about 7 mm of rain and there was no frost. Each hole was soaked overnight before timing, and no heavy rain, frost or drought affected the readings.

NRW, Guidance for environmental permit applications: Part B6.5, discharging treated domestic sewage effluent to ground (version 3, March 2017): test method, the 15–100 s/mm range (BS 6297) and the drainage-field formula A = p × Vp × 0.25. Approved Document H (Wales) gives 12–100 s/mm; every reading passes both.

2 Final Treatment and Discharge Scheme

GW-01 locates the system against the topographic survey, our landscape plan of 7 October 2026, the submitted root protection areas and the water receptors. GW-02 gives the treatment plan, sections and levels; GW-03 gives the drainage field, its run levels and the test hole setting out; GW-04 explains the process in cut-away views.

Table 2-1: Components

Component	Purpose
Settlement tank (PT1): 3,000 L working capacity	Retains settleable solids and grease before the reedbed.
Reedbed (RB1): 25 m² base	Provides biological treatment through planted gravel.
Polishing cell (PC1): 6 m base diameter	A second planted gravel bed: further treatment and temporary storage; receives the pumped return from ES1 at its inlet end.
Inspection, diversion and distribution (SP1, DC1)	Allows sampling, manual isolation of the field and level distribution between its four runs.
Drainage field (DF1): 50.40 m²	Discharges treated water into the receiving ground.
Treated water store (ES1): 5,000 L usable	Holds water during interruption or heavy rain. Solar-powered pumped return to the polishing cell at up to 400 L/day. No outlet to ground; tanker emptying only while the field is out of use.

The gravity levels are: house outlet 81.75; settlement inlet/outlet 81.40/81.25; reedbed water 81.05; polishing-cell water 80.90; inspection outlet 80.78; distribution inlet/crest 80.72/80.70 m AOD. The field runs start at 80.65, 80.63, 80.47 and 80.27 m AOD at DC1 (R1 to R4) and step down to 80.57, 80.39, 80.18 and 79.98 m AOD at their far ends. These are proposed levels, distinct from survey ground.

Table 2-2: Shortest plan separations

Receptor	Distance
Western stream, mapped channel	Approximately 83 m
Clean pond C1	66.6 m
Clean pond C2	71.6 m
Existing pond P1	85.8 m
Eastern clean-water swale	64.1 m
Willow-planted contour swales (infiltration features, no outfall)	41.0 m
Dwelling (enclosing rectangle of the house group)	34.9 m
PT1 settlement tank to dwelling	15.7 m

DF1 is 3.41 m from the north-east boundary, measured to the inside edge of the site boundary. We confirm that the adjoining field is grazing, with no ditch, open drain or wet channel within 40 m and no known or evident buried land drain. The willow-planted contour swales are shallow vegetated infiltration features for surface runoff, included for completeness; they are not watercourses, ditches or drains. The nearest open water is ponds C1 and C2 at 66.6 and 71.6 m.

NRW's letter refers the planning authority to its Advice to planning authorities for planning applications affecting nutrient sensitive Special Areas of Conservation (version 5.1, 9 February 2026). The Advice treats a private system discharging to ground as unlikely to increase nutrient levels where five conditions hold. Table 2-3 sets them against the scheme.

Table 2-3: NRW nutrient-sensitive SAC screening criteria (Advice v5.1)

Criterion	Lower Wych	Evidence
Drainage field built to BS 6297:2007+A1:2008	DF1 is specified to BS 6297: four trench runs in level sections, 50.4 m² base	Section 1; GW-03
Maximum daily discharge below 2 m³	0.75 m³/day at the five-person design capacity; 300 L/day in normal use	Section 3
Drainage field more than 40 m from any surface-water feature (river, stream, ditch or drain)	Ponds 66.6 to 85.8 m; eastern swale 64.1 m; western stream about 83 m; the nearest willow-planted contour swale, an infiltration feature with no outfall, 41.0 m; no ditch, drain or land drain within 40 m	Table 2-2; GW-01; our confirmation, 6 October 2026
More than 50 m from an SAC boundary	River Dee and Bala Lake SAC about 7 km; Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses SAC about 5.5 km	NRW SAC dataset, 6 October 2026
At least 50 m from any other known discharge to ground	No registered discharge to ground within 200 m. Lower Lanes Farm's registered discharge (to surface water, registered 2012) is about 195 m east of the field; the nearest registered discharge to ground, at Higher Barnes Lodge, is about 310 m south-south-west	NRW water quality exemptions and permits layers, 7 October 2026

The adjoining land and the land immediately opposite the site are grazing fields. The register search identified no registered discharge to ground within 200 m of the proposed drainage field; the nearest identified registered discharge to ground is approximately 310 m away. This surrounding land-use context supports the assessment of a low density of sewage discharges in the vicinity.

Wrexham County Borough Council's published Dee-catchment criteria also ask for 200 m from any other discharge to ground and no more than one discharge to ground per 4 ha. So far as the register and the surrounding land use show, both are satisfied.

Groundwater and other receptors. The field is not within any groundwater Source Protection Zone (NRW Source Protection Zones layer, 7 October 2026; the nearest zone is about 3 km to the south-east) and lies in the Dee Triassic Mercia Mudstone groundwater body, which NRW assesses as not at risk. We confirm that no well, spring or borehole used for water supply lies within 50 m of the field. The field is outside Flood Zones 2 and 3 of the Flood Map for Planning and clear of mapped surface-water flood risk, and the nearest Ancient Woodland Inventory site is about 60 m to the west; the field is outside it.

The scheme differs from the July 2026 Management Plan in the respects in Table 2-4. This report, drawings GW-01 to GW-04 and Landscape Plan A1.7 supersede the Management Plan entries listed in Table 2-4 and are to be read with it as part of the application.

Table 2-4: Changes from the July 2026 Management Plan

Item	Management Plan	This response	Reason
Reedbed	15 m², 3 × 5 m, bed sloped about 1:100 (Tables 6-10, 7-3)	25 m² (6.25 × 4 m), level base, 21 m² active	Sized for the five-person design flow with the BOD check (section 3); NRW point 3

Item	Management Plan	This response	Reason
Polishing stage	6 m open polishing pond / planted wetland cell, W4 (Tables 5-19, 6-10)	6 m lined sub-surface gravel cell PC1, reed planted; water 100 mm below the gravel; no open water	Contained treatment and storage; removes an open-water attraction for newts near the dwelling; NRW point 5 and the planner's comment
Design flow	300 L/day planning allowance (Table 6-10)	750 L/day design capacity (five persons, NRW method); 300 L/day in normal use	NRW population method; the field and bed are sized to the dwelling's capacity
Discharge	Infiltration / non-edible planting as a back-up route	Designed drainage field DF1: four runs × 21 m, 50.4 m², sized from the September tests	NRW points 1 and 2
Overflow	Adjustable outlet with overflow protection (Table 7-3)	High-level transfer to the 5,000 L treated water store ES1; pumped return to PC1; tanker only while the field is out of use	NRW point 5
Reuse	Reuse route: coppice, willow, hedgerow (Table 6-10)	Not proposed: all treated water discharges through the drainage field; the coppice blocks do not depend on greywater	A single discharge route for treated water
Monitoring	Quarterly polishing-pond inspection (Table 6-12)	Quarterly checks of PC1, SP1 and ES1, also after heavy rain and at the annual service (sections 4 and 5.3)	Same frequency; the open pond is replaced by PC1 and the store is added
Landscape plan	A1.7 as submitted (12 July 2026)	A1.7 updated 7 October 2026: drainage at the new positions; 13 coppice trees inside root protection areas removed; barn owl box and rough grassland shown	Coordination of the greywater layout; the planner's ecology comments

3 Reedbed Size and Treatment Design

The July household allowance remains 300 litres/day for four occupants. The dwelling has three bedrooms (drawing A1.5), so the minimum assumed population under NRW's Guidance for the registration of small sewage effluent discharges, section 2.2, is five; design capacity is five × 150 litres/day = 750 litres/day. This population-based sewage flow is below 2 m³/day. Direct rainfall onto the lined beds is not sewage flow; its temporary storage is checked in section 5.

The reedbed has a 6.25 × 4.00 m base = 25.00 m². Two 500 mm coarse inlet/outlet zones leave a 5.25 × 4.00 m = 21.00 m² active base. The gravel is 600 mm deep; its 550 mm normal wetted depth leaves water below the surface. Washed 5–10 mm gravel forms the active bed, with 20–40 mm distribution stone at the ends.

The organic-load check uses conservative design values: an inlet of 300 mg/l BOD, the conventional figure for settled domestic sewage, an outlet of 20 mg/l, the conventional secondary-treatment standard, and a removal coefficient of 0.10 m/day:

$A = 0.75 \times \ln(300 / 20) / 0.10 = 20.31$ m².

The 21.00 m² active base exceeds the 20.31 m² required.

The 0.10 m/day coefficient is the value used in UK reed bed design practice for settled sewage and equals the median rate measured across the largest published data set of operating horizontal-flow beds. The 300 mg/l inlet is towards the upper end of the published range for domestic greywater (90 to 360 mg/l), so the check is conservative.

BOD removal in a gravel bed is done by the biofilm on the gravel and roots and shows no consistent fall in winter: the published data sets show no net loss of BOD removal at low temperature, and a study of sixteen operating reed beds in England found no correlation between temperature and BOD removal. Nitrogen removal is the temperature-sensitive process, and this scheme does not rely on it. The standing stems and litter insulate the bed surface in winter.

The polishing cell PC1 is planted in the same way, so the water passes through two planted gravel beds in series before the drainage field: 21 m² in RB1 and about 28 m² in PC1, about 10 m² of planted gravel per person against the usual allowance of about 5 m². Section 5 describes the cell.

Sources: Cooper et al. (1996) Reed Beds and Constructed Wetlands for Wastewater Treatment, WRc; Vymazal (2010) Water 2(3); Kadlec and Wallace (2009) Treatment Wetlands, 2nd edition, CRC Press; Kadlec and Reddy (2001) Water Environment Research 73(5); Manios et al. (2000) Water Environment Research 72(3); Eriksson et al. (2002) Urban Water 4(1); Brix (1997) Water Science and Technology 35(5).

Both gravel cells have a protected EPDM liner on 1:1 inner banks, turfed earth banks with a 300 mm crest and 1:3 outer face, and accessible level-control standpipes (OC1 on RB1, OC2 on PC1). They use gravel and compacted earth, without concrete walls or bases. Prefabricated polyethylene tanks and lightweight plastic chambers must be approved by their manufacturer for the proposed granular installation; the drawings show capacity envelopes, with final installation to the selected manufacturer's design.

Solid connecting pipes have at least 600 mm soil cover; where short links at the chambers and banks have less, they are bridged with slabs over a granular surround. Field pipes have at least 500 mm cover.

4 Phosphorus Management and Maintenance

The household will use zero-phosphorus, plant-friendly liquid laundry and dishwashing detergents, scrape food into the separate compost/waste route, and exclude cooking oils, concentrated cleaners and toilet waste. The assessment retains the July gross allowance of 1.05 kg phosphorus/year, or 1.31 kg/year at the five-person design capacity. No numerical removal credit is claimed for detergents, reeds, ordinary gravel or soil. Urine and toilet waste, the main source of phosphorus in domestic sewage, never enter the greywater system; they are managed under the Management Plan's sanitation and nutrient-recovery provisions (section 7 and Appendix L).

Philip Handley is responsible for the maintenance record:

- Quarterly, and after heavy rain or abnormal operation: check scum, grease, distribution, water levels, covers, leaks, the field surface and the bed banks. Clear screens as needed.
- At the annual service: inspect sludge depth and desludge under the supplier's instructions; check liners, penetrations, standpipes, the diversion valve, the store level indicator/alarm, the store pump, float switch, return main, panel and battery. Records are kept for at least five years.
- Cut back the reeds in both beds in late winter, removing the cut material without damaging the liners. Keep the field grassed and free of woody planting or vehicle loading.

5 Polishing Capacity, Overflow and Monitoring

The earlier open polishing pond is replaced by a planted subsurface gravel cell. Its 6.0 m base diameter supports 450 mm of gravel, with normal water at 80.90 m AOD, 100 mm below the gravel surface. The protected liner follows shaped earth banks, with a minimum top of lining of 81.45 m AOD. Treated greywater remains contained until it enters the drainage field.

The cell is planted like the reedbed, Phragmites australis dominant at four plants per m². Planting it:

- gives a second planted stage, so the drainage field receives water that has passed twice through planted gravel;
- carries the biofilm on the roots and rhizomes and keeps the gravel open, which slows clogging and keeps solids out of the field;
- insulates the bed in winter under the standing stems and litter, and takes up water by transpiration in summer, so less reaches the field in dry spells;
- keeps the water below the gravel surface, so there is still no open water and no pond.

Normal wetted gravel provides approximately 4.22 m³ of pore volume, assuming 0.38 porosity. Between normal water at 80.90 m and the high-level transfer at 81.00 m AOD, at the gravel surface, the gravel provides a further 1.38 m³ buffer. The transfer falls to the treated water store ES1 at 80.65 m AOD. Its 5.00 m³ usable volume gives 6.38 m³ combined temporary storage when the store is empty and the cell starts at its normal level.

5.1 Rainfall and Temporary Storage

The lined beds have a 104.22 m² rain catchment. Direct rainfall follows the wastewater route; roof and ground runoff are excluded. An illustrative 50 mm / 24-hour rainfall adds 5.21 m³; with 0.75 m³ household input, the total is 5.96 m³. This is within the 6.38 m³ temporary capacity, leaving 0.42 m³, provided PC1 starts at normal level, ES1 is empty and diversion/isolation operates correctly. No field outflow is credited. This is an illustrative storage check; the combined figure depends on the selected store being suitable for the levels shown.

5.2 Operating Modes

Table 5-1: Operating modes

Condition	Action
Normal	Diversion valve at FIELD. Treated water passes by gravity to the distribution chamber and four trench runs.
Heavy rain, PC1 transfer	Water above 81.00 m AOD in the polishing cell transfers to ES1 and is held there. As the field recovers, pump it back to the polishing cell at up to 400 L/day, a maximum used only when the field has capacity after the other inflows. Pump off while PC1 is above normal level.
Field saturation, backing-up or breakout	Set the valve to STORE, isolating the field. Reduce or stop household inflow and investigate. No return pumping until the field is sound.
Store high level	Alarm at 4,000 L (80.35 m AOD). Stop household inflow. Pump back to the polishing cell if the field is sound; otherwise arrange emptying through the accessible suction connection.
Field failure, or a blocked or frozen stage	A registered waste carrier empties ES1. Stop household inflow while a blocked or frozen stage is restored. Do not bypass treatment or discharge stored water to the landscape.

ES1 has no gravity outlet to ground. Its submersible pump and float switch feed a 32 mm rising main that discharges into the polishing cell at its inlet end, so returned water passes through the gravel again before SP1 and the field. The pump is a 12 V DC unit powered by a photovoltaic panel and battery at the store, with the high-level alarm on the same supply; it is started by hand or on a timer, and the float switch stops it at low level. At the 400 L/day return rate and about 2 m of lift the pumping energy is under 30 Wh a day. The bolted watertight cover is at 81.64 m AOD, approximately ground level, and the screened vent terminates at 82.36 m. The field is isolated manually at SP1 if it fails.

5.3 Monitoring

SP1 is an inspection and sampling chamber; a sample can be taken there if required. Quarterly checks, remedial work and any store emptying are recorded; if appearance, odour or levels indicate a problem, the cause is investigated and corrected. Protected liners, sealed penetrations and insulated covers reduce damage and frost risk.

6 Separation from Clean Water

Only household greywater from showers, basins, laundry and ordinary kitchen use enters the settlement tank. Urine, toilet solids and humanure remain on their separate system. Roof drainage, clean ground runoff, irrigation ponds and swales remain independent. There are no wastewater cross-connections to clean ponds, a swale, land drain or watercourse.

The drainage field is the only discharge to ground from the greywater system and the only outlet for treated greywater. The discharge will be registered with NRW as a small sewage discharge to ground before use: treated domestic effluent from a BS EN 12566-1 settlement tank with further planted-gravel treatment, discharged through a BS 6297 drainage field at under 2 m^3/day, outside any Source Protection Zone and more than 50 m from any well, spring or borehole. The polishing cell and the store remain contained, with no pipe to a clean-water feature, the western stream, the market garden or the polytunnel irrigation. Direct rain falling onto the lined beds is accounted for in section 5 and follows the wastewater route.

The greywater works involve no pond works: the drainage field is 67 to 86 m from the ponds, and the nearest treatment component, the settlement tank PT1, is about 44 m from pond C1.

Welsh Government Circular 008/2018 asks first for connection to a public sewer, and no public foul sewer is available to the site. The system is settlement in a BS EN 12566-1 tank, two planted gravel beds and a BS 6297 drainage field.

Issued with this report: drawings LW-GW-01 to LW-GW-04; Landscape Plan A1.7; Ecology Response with drawing LW-EC-01.