BRITISH WATER

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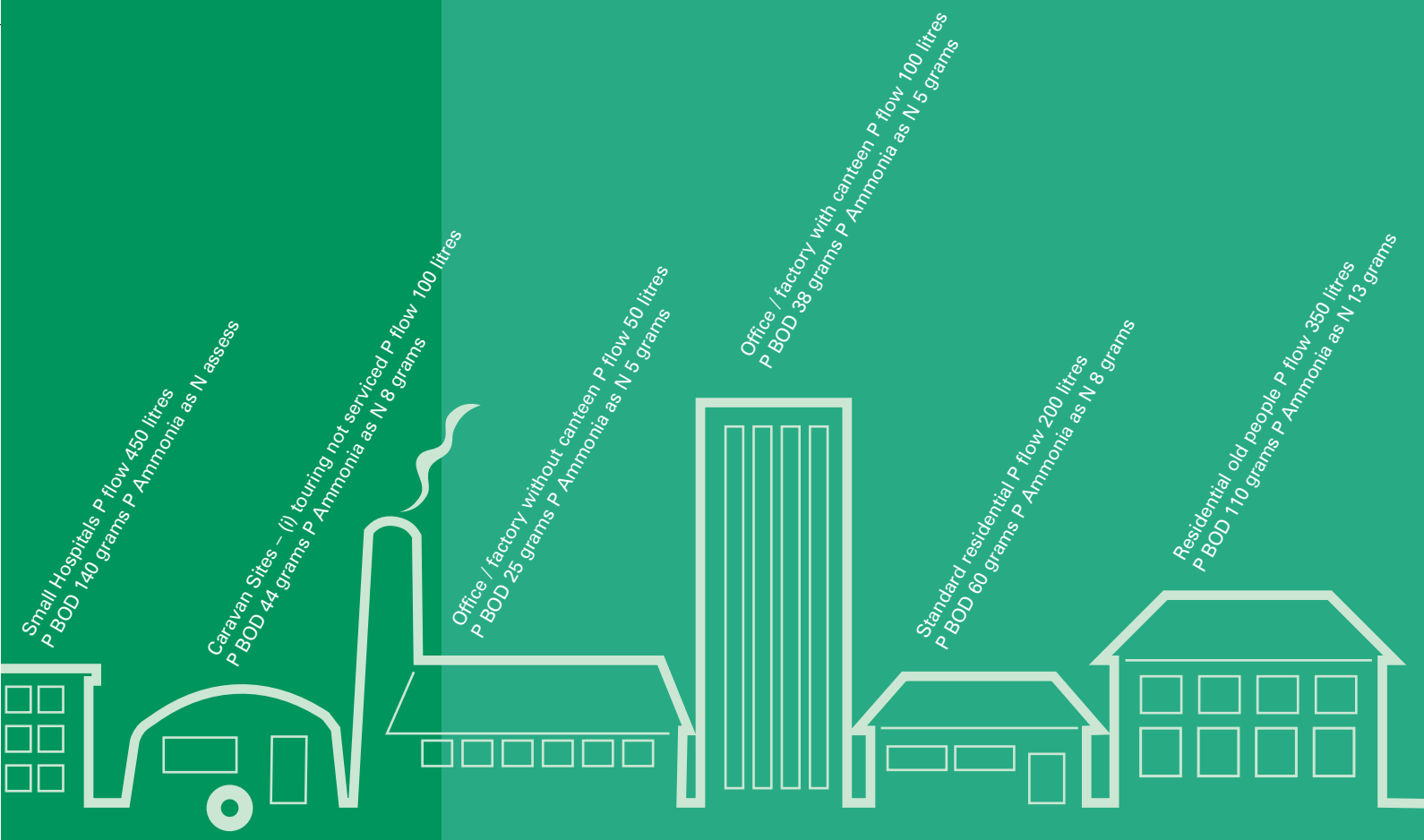
ENVIRONMENT AND HERITAGE SERVICE

Code of Practice

Flows and Loads – 2

Sizing Criteria, Treatment Capacity for Small Wastewater Treatment Systems (Package Plants)



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Code of Practice

Flows and Loads – Sizing Criteria, Treatment Capacity for Small Wastewater Treatment Systems (Package Plant)

This code of practice was produced by the British Water Package Sewage Treatment Plant Focus Group – for membership see the company logos on page 6.

The Environment Agency, the Environment and Heritage Service (Northern Ireland) and the Scottish Environment Protection Agency support the use of this code of practice, but the Agencies do not specifically endorse any particular manufacturer's product.

The code provides a new table of loadings which allows the total daily load fed into a sewage treatment system to be calculated. These criteria will be widely disseminated and it is recommended that designers of small wastewater treatment systems should use this table of loadings.

The flow and load figures given represent current best practice within the UK but may change with time. British Water welcomes data to improve the content of this document.

Guidance notes are provided to assist the user to consider the nature of the sewage being received for treatment and to identify the various sources of the sewage.

Each manufacturer is aware of the capabilities of their own systems with respect to the individual wastes, but guidance is given so that the user is aware of performance inhibitors.

The table of loadings may be used for all sizes of package sewage treatment plant up to a maximum of 1000 population equivalents.

Use of this table by all UK manufacturers will

- Encourage collection of accurate and complete loading information
- Provide a consistent data collection approach
- Define site activity and sewage sources
- Provide consistent information to system purchasers regarding treatability and difficult effluents
- Reduce the problem of undersized systems

The loadings in this code of practice are revised and more comprehensive than previously published guidance (CIRIA PR72 2001, Environment Agencies PPG4): ammonia figures are included and loading figures are generally higher.

1 Scope

The purpose of this code of practice is to provide an improved table of loadings to allow the total daily load fed into a system to be calculated. The volume factors given are very similar to those previously published. BOD loading factors have been increased. Ammonia figures are included within the table.

2 Regulations

Early contact / license application with the Regulator to discuss the proposed discharge of sewage effluent is advisable.

- Planning requirements, eg *DETR Circular 3/99, site survey, etc.*
- Building regulations, eg part H *DTLR England & Wales, part M Scotland, Water Order (Northern Ireland) 1999 and Northern Ireland building regulations.*
- Discharge consent, Environmental Regulators (Agencies).
- Planning permission (Local Authority Planning Guidance).

3 Definitions of terms

- **Population (P)** – Number of inhabitants, e.g. of a settlement area.
- **Biochemical oxygen demand ($BOD_{(5)}$)** – Mass concentration of dissolved oxygen consumed under specified conditions (5 days at 20° C with nitrification inhibition) by the biological oxidation of organic and/or inorganic matter in water.
- **Ammonia expressed as mg/l N** – Ammonia is NH_3, Ammonium is NH_4OH. In wastewater we frequently refer to and use the word/symbol, ammonia/NH_3. The term ammonia usually includes ammonium as well.

4 Selection Considerations – All applications

- Values and conditions required by any regulatory permit or consent.
- The loading chart includes individual figures for each specified load.
- Loading figures are given for Flow, BOD and NH_3.
- The user/purchaser of the system must declare **ALL ACTIVITIES** to enable all loads entering the treatment to be identified and evaluated. The user/purchaser should be made aware that there is a risk of poor performance from the equipment if loads are understated. The accuracy of the declared loads is of paramount importance.
- Guidance points given under each category suggest questions to enable the specifier to recognise variable or unusual loads, particular to that site, to improve correct system selection.
- Total daily loadings are calculated based on the anticipated final maximum capacity of the site. New sites initially may have a reduced business level but the system suggested should reflect the full business potential, e.g. a system suggested for a hotel or caravan site or any other application, with an average 80% occupancy rate should be able to handle 100% occupancy. The equipment selected by the specifier should reflect the maximum potential of the site. Where a specifier is instructed to use lower occupancy rates, this should be recorded. Flow balancing should be considered where appropriate
- Excess disinfectants, chemicals, etc can affect the biological processes as can specific toxic substances from site activities e.g. photographic chemicals, weed killers, motor oils. It is assumed that these substances are excluded from the wastes to be treated.
- Some water treatment equipment effluents eg softeners, chlorinated backwashes, may not be acceptable; system designers should specifically accept or exclude their use. Many treatment plant designs will accept regenerants into their units, however this must be checked and agreed.

(continued on page 4)

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Table of Loadings – for Sewage Disposal Facilities

Per person / activity / day (unless otherwise specified)	FLOW (Litres)	BOD (Grams)	Ammonia as N (Grams)
DOMESTIC DWELLINGS			
Standard residential	200	60	8
Mobile home type caravans with full services	180	75	8
INDUSTRIAL			
Office / Factory without canteen	50	25	5
Office / Factory with canteen	100	38	5
Open industrial site, e.g. construction, quarry, without canteen	60	25	5
*Full-time Day Staff	90	38	5
*Part-time Staff (4 hr shift)	45	25	3
SCHOOLS			
Non-residential with canteen cooking on site	90	38	5
Non-residential without a canteen	50	25	5
Boarding school (i) residents	200	75	10
(ii) day staff (inc. mid-day meal)	90	38	5
HOTELS, PUBS & CLUBS			
Hotel Guests (Prestige hotels)	300	105	12
Hotel Guests (3* & 4* hotels)	250	94	10
Guests (Bedroom only – no meals)	80	50	6
Residential Training/Conference Guest (inclusive all meals)	350	150	15
Non residential Conference Guest	60	25	2.5
Drinkers	12	15	5
Holiday camp chalet resident	227	94	10
Resident Staff	180	75	10
Restaurants - Full Meals - luxury catering	30	38	4
- pre-prepared catering	25	30	2.5
- Snack Bars & bar meals	15	19	2.5
- Function Rooms including buffets	15	19	2.5
- Fast Food i.e. (roadside restaurants)	12	12	2.5
- Fast Food Meal (burger chain and similar)	12	15	4
Students (Accommodation only)	100	56	5
AMENITY SITES			
Toilet Blocks (per use)	10	12	2.5
Toilet (WC) (per use)	10	12	2.5
Toilet (Urinal) (per use)	5	12	2.5
Toilet Blocks in long stay car parks/lorry parks (per use)	10	19	4
Shower (per use)	40	19	2
Golf Club	20	19	5
Local community sports club, e.g. squash, rugby & football	40	25	6
Swimming (where a separate pool exists without an associated sports centre)	10	12	2.5
Health Club/Sports Centre	50	19	4
Tent sites	75	44	8
Caravan Sites - (i) Touring not serviced	100	44	8
(ii) Static not serviced	100	44	8
(iii) Static fully serviced	180	75	8
HOSPITALS & RESIDENTIAL CARE HOMES			
Residential old people / nursing	350	110	13
Small hospitals	450	140	Assess
Large hospitals	Assess individually		

**Staff figures also apply to other applications*

- Water saving devices affect sewage strength, the impact of their installation should be identified.
- Laundries affect sewage strength and treatability; their proportion should be identified.
- Surface/storm water is not permitted as part of the wastewater stream and must be excluded.
- It is assumed, unless stated, that waste disposal units (WDU) are not in use.
- Undersizing of equipment is to be avoided as it is always better to have a plant slightly oversized, rather than on the limit or undersized.

- *The owner of the equipment holds the consent to discharge and should be aware that he is responsible for the effluent quality discharged. Thus all sources of discharge into the equipment must be declared.*
- *After installation, if the equipment is overloaded, due to activities that were not previously identified by the owner/ purchaser of the equipment, then the manufacturer may not be able to assist with meeting the legal obligations of the consent provided by the regulator. Consents may change at intervals. The regulator has the right to review consents at regular intervals.*
- *All sewage treatment equipment should be maintained according to the manufacturer's instructions by a certified engineer trained in accordance with the British Water Maintenance and Service Code of Practice (in preparation).*

5 Domestic Housing

- A treatment system for a house with **up to and including 3 bedrooms** shall be designed for a minimum of 5 P.
- The size of a treatment system for a house with more than 3 bedrooms shall be designed by **adding 1 P** for **each additional bedroom** to the **minimum single house value of 5 P,** eg:

  - house with 3 bedrooms = **minimum 5 P system**

  - house with 4 bedrooms = **minimum 6 P system (5+1)**

  - house with 6 bedrooms = **minimum 8 P system (5+3).**
- A treatment system serving a group of houses shall be designed by adding together the P values for each house **calculated independently,** eg:

  - for a group of three houses (3, 4 and 6 bedrooms respectively) the system shall be for a minimum of 19 P (5+6+8)

  - an estate of thirty 4-bedroomed houses will need a treatment system for a minimum of 180 P (30 x 6).

  - Where there are larger groups of houses, the P should be estimated using both the expected total load and the flow, considering both peak and total flow
- These are minimum recommended population (P) loads, they should not be modified downwards: upward modification may be necessary because of particular characteristics of each property or groups of properties.

- *For groups of small 1 and 2 bedroom flats , a total P load shall be calculated specifically for each group and consider the maximum possible occupancy and flow.*

- The above assessments of population (P) should be used for both existing and new properties,
- Larger luxurious houses tend to have greater loads and increased water consumption with variability.
- Holiday homes tend to have higher occupancies with perhaps lounges also acting as bedrooms. Holiday lets and second homes may be used intermittently
- Check for unusual water uses such as spa baths, home brewing or home photo processing.
- Waste disposal units increase biological load.
- Laundry chemicals and toxic substances will affect the performance. (See below) It is assumed that laundry is not brought in, i.e. Team strips.

6 Commercial Premises

- Identify **ALL** the sources of waste.
- Identify final maximum site usage/business expectations.
- The individual values provided for each function within the table assume that 100% of every application and load is quantified. **DO NOT** reduce values based on reduced expectations.
- All catering applications require the installation of adequately sized grease separators, removal or retention systems up-stream of the biological treatment equipment.

7 Catering premises

- Establish maximum (and minimum) daily load based on a 24 hour cycle.
- Check period of operation.
- Identify dates of maximum loads, e.g. Mothering Sunday, Easter, Bank holidays, Fridays etc.
- Identify load peaks, usually at lunch or evening.

- *Flow balancing may provide an appropriate solution.*
- *Where WDU and potato peelers are to be used calculate/document the load.*
- *Identify the nature(s) of the catering in order to select the correct loading, eg*

Bar snacks	- ploughmans, sandwiches, basket meals, etc.
Pre-prepared catering	- frozen and chilled meals (not prepared on site).
Home cooked meals	- fresh soups, fresh vegetables, casseroles, etc.
Luxury catering	- fully prepared on site with cream sauces, home made desserts.
Takeaways	- Indian, Chinese, fish and chips, etc.
Fast food	- roadside restaurants, burger chains, etc.
Function room catering	- Establish "normal" style, may be sandwiches, or full buffet, home cooked meals, conference, wedding banquets, etc.

- *The biological unit must be protected from grease and fats. Modern cooking uses light oils, which may not separate. The collection and containment of all forms of grease prior to the biological equipment is vital. Operate any grease system in full accordance with the manufacturer's instructions.*
- *Individual kitchen practices affect loads, i.e. leftovers on plates may be scraped into bins, or wet rinsed into system, the former to be encouraged, the latter should be discouraged or factored into the treatment plant design.*
- *Premises serving beers may produce toxic caustic effluents due to the hygiene and cleaning regimes.*
- *The proportion of wastes from some sources can produce an effluent which is difficult to treat, e.g. some Drive Through Fast Food establishments can have an effluent with a low organic content.*

8 Hotels & Residential Centres

- Establish "style and type" of hotel e.g. Prestige (5*), Bedroom only accommodation, Conference Centres, Resort Hotels with Sports and Spas, Treatment Centres, etc.
- Calculate total loading based on occupancy of at least 2 people per room.

- *Some hotels regularly have 4 occupants per room.*

- Consider and add other hotel activities and waste functions.

- *The volume/BOD figures are based on an expectation that guests have an evening meal, drink and breakfast and that good kitchen practices are in place.*

- Add all other loads, considering non-resident uses, ie Lunches, Functions, Visiting Drinkers, Diners, etc.
- Consider periodicity of loads.
- Ensure residential and training centre loadings reflect the complete meal plan, i.e. allow for lunch and afternoon tea, sports, etc.
- Special Events. Check provision of temporary facilities, e.g. summer marquees and allow for appropriate loading.
- Consider any loads from outside catering.

9 Laundries

- Excepting domestic premises, it is assumed that all laundry functions are additional.
- For each premises, identify which laundry items are done in house or sent off site.
- Calculate the laundry load on the basis of the number of machines and the period of use.
- Sites with laundries must fit and maintain lint filters.

- *The chemical load (detergents) inhibits biological treatment, the laundry waste percentage of the normal maximum Flow usually needs to be less than 30% of the total load.*
- *Where the laundry percentage >30%, manufacturers select equipment on a different basis.*
- *As a guide, where the hydraulic load from laundries is between 1-10%, system size increases by 10%, 11-20% increases by 20%, 21-30% increases by 30%.*
- *Excess/surplus detergents (above the recommended quantities) can affect the biological process.*
- *Discharge quality may be improved if operators use low/zero phosphate detergents.*

10 Toilet Blocks

- Figures can also be assessed according to the sanitary equipment and control system installed.

- *Automatically flushed urinals use 10 litres per hour; a single flush should not use more than 1.5 litres.*
- *Consider ladies and gents toilet facilities separately.*

11 Sports Clubs

- Calculate loadings on 100% usage for the sporting facility. The figure provided includes showering and toilet use by the sports person.
- Consider also the non-sporting uses, i.e. spectators' toilet use.
- Add drinkers, social members and staff.
- Add values for catering facilities.
- Check normal and exceptional catering provisions.
- A swimming pool with no associated sports centre may be calculated using the number of swimmers, assume a toilet use per person, and by adding values for showers and spectators. Check duration of visits and modify for extended use.

- *Consider separate treatment or disposal of backwash waters from ancillary equipment, such as types of filtration and disinfectant removal in swimming pools.*

12 Golf Clubs

- The values within the data table allow for light snacks and toilet use.
- Calculate additional allowances for showers.
- Add values for other catering facilities (if other than light snacks).

13 Hospitals

- The nature of the facility affects the design values. Some nursing homes have very high hydraulic loads as a result of the use of bedpans and their sanitation. Consider any disinfection equipment installed.
- With drugs and hygiene requirements of hospitals adjust the equipment size to compensate for treatability factors.

- *Disposal of unused/waste medicines is not permitted via the treatment facility.*

14 Caravan Sites

- Establish nature of communal blocks, i.e. toilet, shower usage, laundry, etc.
- Where laundry equipment is installed, count the number of machines on site and period of use. Where possible, identify specific commercial machine details for volume and wash cycle duration.

- *Hydraulic loads of 100 litres per hour for 12 hours are not unusual.*

- Loading figures quoted assume that wastes from chemical toilets do not enter the system as they must not be allowed to enter into the treatment plant.

- *A cesspool may be installed to receive chemical toilet waste for separate disposal.*

15 Installation

The following may affect which equipment is offered.

- The site.
- Location of treatment plant within the site.
- Invert depth of installation (where possible, locate to permit gravity flow into and out of the system).
- Pumping equipment.
- Installation requirements.

- *Refer to manufacturer's specifications and installation manual.*

- Access for maintenance and servicing.

- *Refer to manufacturer's specifications and maintenance instructions.*

- The need for a sample chamber.
- Discharge point.
- Soil percolation area or other tertiary treatment.

16 Documentation

Records of the loads used to select and recommend the type and size of treatment systems should be maintained by the specifier and the customer. A typical example follows.

Package Plant Enquiry Sizing Sheet

Our Ref. 123456 **Date** 10th August 2003 **Site** ABC Hotel 3* Hotel **Client** New Architects & Consultants

SOURCE OF WASTE				FLOW LITRE / DAY		BOD GRAMS / DAY		NH_3	
Description	No of rooms	Occupancy	No	Per Head	TOTAL	Per Head	TOTAL	Per Head	TOTAL
Rooms	80	2	160	250	40000	94	15040	10	1600
Bar drinkers			120	12	1440	15	1800	5	600
Non resident luxury meals			150	30	4500	38	5700	4	600
Staff, full-time day staff			30	90	2700	38	1140	5	150
Staff, part-time			20	45	900	25	500	3	60
Laundry – all sent off site Domestic washing machine for tea towels only					800				
Total load(s)					**50340**		**24180**		**3010**
Effluent Quality Requested					**20 mg/l BOD**		**30 mg/l SS**		**20 mg/l NH_3 N**

Suggested type of plant: XYZ. **Invert:** 1.0m. **Power:** 3-phase. **Surface water:** all to be excluded from foul sewer. **Consent to discharge:** to be obtained from the Regulator. **Waste Disposal Units:** assumed that none are fitted. **Grease trap:** required size "125".

Notes

Swimming pool – present, used for guests only, all backwash wastes to be excluded. No function rooms or catering

Further information and guidance can be obtained from the British Water website – **www.britishwater.co.uk**

Company contact details are in the member list on the British Water website www.britishwater.co.uk

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