# 2.0 OVERVIEW OF THE MANUAL

## 2.1 Introduction

The Executive Committee of the Water Directorate has developed a series of Operations and Maintenance (O&M) Manuals to assist Local Government authorities or other organisations in the delivery of a reliable and cost effective operations and maintenance regime across the water and sewerage functions.

Whilst it is conceded that most Local Government authorities have some form of an operations and/or maintenance regime, it appears that they generally do not include all the relevant components. Therefore, the Executive Committee commissioned the Wastewater Services Section of the NSW Department of Commerce to develop this O&M Manual. **It is intended that this manual will provide a template for users to modify to suit their specific local installations and conditions**.

This manual forms part of a series being prepared by the Water Directorate covering water and wastewater infrastructure. This manual deals with treatment facilities at the sewage treatment plant (STP). The user of this manual will be those Local Government authorities throughout NSW and Queensland responsible for the operation and maintenance of facilities at STPs.

**Councils need to be mindful of due diligence placed upon them with regard to hazard identification and risk management at their facilities. Of particular importance is whether Council wishes to classify some treatment units, or associated areas, as a 'confined space', bearing in mind the requirements of Clause 6 of Australian Standard AS 2865 *Safe Working in a Confined Space* (refer to *Appendix D*.7 of this manual for further details).**

In completing this O&M Manual, information, comments and assistance have been provided by a number of organisations and workgroups including the following:

- Water Directorate Sewer Sub-Committee.
- Queensland Water Directorate.
- Mechanical & Electrical Group, Wastewater Services Section, NSW Department of Commerce.

Information has also been extracted from various publications, including the following:

- *Occupational Health & Safety (OH&S) Act 2000* (NSW).
- Occupational Health & Safety (OH&S) Regulations 2001 (NSW).
- OHS&R Management System Guidelines, NSW Government Construction Agency Co-ordination Committee, 4th Edition, June 2004.
- Guidelines of Auditing Project OHS&R Management Systems (NSW WorkCover).
- *Protection of Environment Operations Act 1997* (NSW).
- The Open Learning Institute of TAFE, Queensland, April 1997.
- Operations & Maintenance Manual - Chlorination Facilities, Water Directorate, April 2001 (prepared by Albury City Council).
- Operations & Maintenance Manual – Sewer Reticulation, Water Directorate, July 2001 (prepared by Albury City Council).
- Operations & Maintenance Manual – Wet & Dry Well Sewage Pumping Stations, Water Directorate, December 2001 (prepared by Albury City Council).
- Wastewater Treatment Operator Training Course Notes, Level 1, 2004 (NSW Department of Energy Utilities and Sustainability).
- Australian Standard AS 2865 (Safe Working in a Confined Space).
- Australian Standard AS 3780 (The Storage and Handling of Corrosive Substances).
- Reading Labels and Material Safety Data Sheets, available from WorkCover NSW.
- Kew Kendall STP Operations and Maintenance Manual, October 2002 (prepared by Australian Water Technologies P/L for Hastings Council)

- Mittagong STP Operation and Maintenance Manual, October 2001 (prepared by Montgomery Watson/Transfield JV for Wingecaribee Shire Council)
- Moonee Water Reclamation Plant Operations and Maintenance Manual, July 2000 (prepared by Montgomery Watson (Brisbane) for Coffs Harbour Council)
- Murwillumbah STP Operational and Environmental Management Manual, 2000 (prepared by DPWS for Tweed Shire Council)
- Bonalbo STP Instruction for Operation and Maintenance (prepared by DPWS)
- Kyogle STP Regulations for Operation and Maintenance (prepared by DPWS)
- Woodenbong STP Instruction for Operation and Maintenance (prepared by DPWS)

## 2.2 Format of the Manual

The manual has been developed in sections as detailed below.

| | |
|---|---|
| Section 2 | Overview of the Manual. Sets out the structure of the manual, a detailed description of terms and abbreviations used and instructional information of the use of the manual. |
| Section 3 | STP Treatment Facilities. This section details the facilities that relate to the STP site as a whole, as opposed to individual treatment units provided in later sections. Councils are required to **identify and describe the details of their specific STP site.** |
| Section 4 to Section 16 | Unit treatment processes. These Sections require Councils to identify and detail information regarding their current treatment units, theory of relevant treatment processes, their operation modes, routine inspection, monitoring programs and planned maintenance programs.<br>Checklists are provided to assist Councils in identifying activities that can be developed and inserted in these sections of the manual. The **information** should be completed by relevant staff (such as operators, maintenance personnel and designers) and **should be specific to each particular treatment unit at an individual STP site**.<br>These sections include templates for **Safe Work Method Statements** (SWMS - sometimes referred to as Standard Operating Procedures) for operation and maintenance activities associated with sewage treatment. The templates can be **adapted or modified by Councils to suit their specific STP requirements**. Each SWMS **should be developed in consultation with relevant staff and management**. The signed statements should be retained by management in the master copy of this manual and copies only issued to all relevant employees. |
| Appendices A to G | These appendices provide information that will assist Councils in ensuring due diligence and compliance with the relevant legislative requirements with respect to the operation and maintenance activities associated with the STP. Councils are required to **complete** (**or consolidate** from Sections 3 to 16 of the manual) **essential relevant site-specific information**. |
| Appendices H to L | These appendices require Councils to **complete** (**or consolidate** from Sections 3 to 16 of the manual) the **relevant site-specific information and insert relevant drawings, plans etc. and technical information** provided from suppliers/manufacturers of equipment installed at the STP. |
| Templates | There are numerous **templates and examples** throughout the sections and appendices of the manual that **can be modified and/or adopted by users to suit Council's specific requirements, facilities, activities and/or conditions**. |

Specific operations and maintenance requirements with respect to each treatment unit within the STP are detailed within their respective sections of the manual.

### 2.2.1 Creating a New Section for the Manual

While a comprehensive range of common processes that are used n sewage treatment plants are included in this manual, there may be instances where a more specialised treatment process is encountered and needs to be included as a new section of the manual. Additionally, there may be instances where a section needs to address a process that is similar to another already included, such as where multiple separate chemical dosing systems are used for say chemical P removal and for pH correction.

The new section is created as a separate Microsoft Word document. This is best done by opening the Word file for an existing section, saving it with a new file name relevant to the new section then editing/modifying the new section contents to suit the process it is to address.

### 2.2.2 Colour Coding and Shaded Areas

A simple colour-coding rule has been used throughout the document, to assist the users of the document. The majority of the text has a font colour of black, but there are some words and sentences that have a font colour of red. Since it is sometimes hard to distinguish between the two font colours, the red text has been highlighted.

***What is the text with red font and grey shading?***

This format is used to highlight text that the user of this manual is required to change to suit their specific STP. An example is given below.

The effluent target for total phosphorus is 0.5mg/L.

It is important to note that there are some specific text references that will require uniform changing throughout the Manual. This text helps tailor the O&M Manual to a specific STP facility. To update this text quickly and uniformly the ***Edit/Find/Replace*** option should be used.

A list of text to be changed on a uniform basis throughout the O&M Manual is below:

- Name of STP
- NAME OF STP
- Council/Company
- Sewerage Scheme
- O&M Manual for STPs Version 1.0

Once all the text has been changed to suit the specific site, the user should then change the text format to correspond with the main body of the document (make black font colour and unshaded) – this can be done easy by using the ***Format Painter***  icon on the standard toolbar.

***What is the hidden text with red font and blue shading?***

This text format is used to highlight instructional notes to the user of this manual. This type of text is often embedded in sections of the manual where there is choice to have different types of treatments systems. An example is given below:

**EXAMPLE DELETE THE SECTION BELOW IF GRAVITY FILTER IS NOT USED.**

Once the appropriate instruction is noted or acted upon and the section otherwise completed, the hidden text should be deleted.

Note: To print hidden text in a printout of the document, make sure that ***Hidden text*** is selected in the ***Include with document*** area of the ***Print*** tab window under ***Tools/Options***. Conversely deselect Hidden text if you do not want the hidden text instructions to be printed out.

### 2.2.3 Updating the Table of Contents

The overall table of contents will need to be updated to reflect any changes made to the document once it is complete. Sections that are no longer required should be deleted from the table of contents and new ones inserted. To update the existing table of contents for individual sections:

1. The cursor should be placed on the left hand margin of the first line of the table of contents in the open document and the mouse clicked to select the table of contents as a whole.
2. Press ***F9*** and select ***update page numbers only*** or ***Update entire table***.

To create a new table of contents for a new subdocument, the subdocument should be opened as a separate window. Click ***Insert/Index and Tables*** and select the ***Table of Contents*** tab. You can also copy the table of contents from another subdocument and follow the instructions for updating a Table of Contents above. (This latter approach will avoid the need to reformat the Table of Contents to match others within the manual).

## 2.3 Responsibilities

The users of this O&M Manual are management, engineering, technical staff and plant operations staff. This O&M Manual is intended to provide an understanding of:

- How the sewage treatment facilities work.
- Objectives to be met in plant operation.
- Factors that affect the various processes, their operation and performance.
- The principal monitoring requirements.
- The strategy to be used to control and optimise treatment process.
- Requirements for safe maintenance of the facilities
- Requirements for safe operation of treatment facilities.
- Requirements to ensure that plant operations do not have an unacceptable environmental impact.

## 2.4 Acronyms and Abbreviations

| | |
|---|---|
| # | number |
| % | percent |
| °C | degrees Celsius |
| A | Amperes, or area |
| ABS | acrylonitrile butadiene-styrene |
| ADWF | average dry weather flow |
| AEP | annual exceedance period |
| ANZECC | Australian & New Zealand Environment & Conservation Council |
| AOR | average oxygen requirement |
| AS | activated sludge |
| AS/NZS | Australian Standard/New Zealand Standard |
| Atm. | atmospheres |
| Ave | average |
| BA | breathing apparatus |
| BNR | biological nutrient removal |
| $BOD_5$ | biochemical oxygen demand |
| BWL | bottom water level |
| C | carbon, Celsius or centigrade |
| CABA | compressed air breathing apparatus |
| CAS | continuous activated sludge |
| CEA | continuous extended aeration |
| cfu | colony forming unit |
| COD | carbonaceous oxygen demand or chemical oxygen demand |
| cond. | conductivity |
| cu. | cubic |
| d | day, or depth |
| dia. | diameter |
| DDWF | design dry weather flow |
| DEC | Department of Environment and Conservation (former Environment Protection Authority) |
| DEUS | Department of Energy Utilities and Sustainability |
| DICL | ductile iron, cement lined |
| DO | dissolved oxygen |
| DOL | direct on-line |
| Dt | dry tonnes |
| DWWF | design wet weather flow |
| EA | extended aeration |
| EAT | extended aeration tank |
| EBPR | enhanced biological phosphorus removal |
| EC | electrical conductivity |
| EIA | Environmental Impact Assessment |
| EIS | Environmental Impact Statement |
| EMS | Environmental Management System |
| EP | equivalent person or equivalent population |
| ESD | ecologically sustainable development |
| ET | equivalent tenements |
| FC | faecal coliforms |
| Fe | iron |
| F/M | food to micro-organisms ratio |
| FRP | fibre reinforced plastic |
| g | grams |
| $gBOD_5/EP/d$ | grams of $BOD_5$ per EP per day |
| GRP | glass reinforced plastic |
| H | Hour, height or head |

| | |
|---|---|
| Ha | hectare |
| HazChem No. | hazardous chemical number |
| hr | hours |
| IDEA | Intermittent decant extended aeration |
| IPART | Independent Pricing and Regulatory Tribunal of New South Wales |
| ISO | International Standards Organisation |
| kg | kilogram |
| kg/day | kilogram per day |
| kg/h | kilogram per hour |
| $kgO_2$/day | kilogram of oxygen per day |
| kg $O_2$/h | kilogram of oxygen per hour |
| kg $O_2$/kWh | kilograms of oxygen per kilowatt hour |
| kL | kilolitres |
| kPa | kilopascal (unit measure of pressure) |
| kVA | kilovolt-amperes |
| kW | kilowatts |
| L | litre |
| L/EP.d | litres per EP per day |
| L/m/s | litres per metre per second |
| L/s | litres per second |
| m | metres |
| mA | milliamps |
| max. | maximum |
| MBAS | methylene blue active substances |
| MCC | motor control centre |
| m/d | metres per day |
| mg/L | milligrams per litre |
| m/hr | metres per hour |
| MH | manhole |
| min. | minimum or minutes |
| ML | megalitres |
| ML/d | megalitres per day |
| mL/g | millilitres per gram |
| MLR | mixed liquor recycle or mixed liquor return |
| MLSS | mixed liquor suspended solids |
| MLVSS | mixed liquor volatile suspended solids |
| mm | millimetres |
| mm/s | millimetres per second |
| m/s | metres per second |
| $m^3$/m/min | cubic metres per metre per minute |
| $m^3/m^2$/hr | cubic metres per square metre per hour |
| MPN | most probable number |
| MSDS | material safety data sheet |
| N | Nitrogen or No |
| NATA | National Association of Testing Authorities (Australia) |
| NFR | non-filtrable residue |
| $NH_3$ | ammonia |
| $NH_4$-N | ammonia nitrogen |
| No. | number |
| $NO_2$ | nitrite |
| $NO_3$ | nitrate |
| Nos | numbers |
| $NO_X$ | nitrites and nitrates (oxidised nitrogen) |
| NSCA | National Safety Council of Australia |
| NSW | New South Wales |

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|---|---|
| NTU | nephelometric turbidity unit (unit measure of the ability of water to scatter light) |
| O&G | oil and grease |
| O&M | operations and maintenance |
| OH&S | occupational health and safety |
| OCPs | organic-chlorine pesticides |
| OHS&R | occupational health, safety and rehabilitation |
| OUR | oxygen uptake rate |
| P | phosphorus |
| pa | per annum |
| PCB | polychlorinated biphenyls |
| PDWF | peak dry weather flow |
| pH | unit of measure of hydrogen ion activity in solutions |
| P&ID | process and instrumentation diagram |
| PLC | programmable logic controller |
| PMF | probable maximum flood |
| PPE | personal protective equipment |
| ppm | parts per million |
| ppt | parts per thousand |
| PRP | Pollution Reduction Programme |
| PS | pumping station |
| psi | pounds-force per square inch |
| PWWF | peak wet weather flow |
| Q | flow rate |
| Qld | Queensland |
| RAS | return activated sludge |
| REF | Review of Environmental Factors |
| RL | reduced level |
| s | seconds |
| SCA | switchgear control assembly |
| SCADA | supervisory control and data acquisition |
| SCBA | self contained breathing apparatus |
| SEPP | State Environmental Planning Policy |
| SOTR | standard oxygen transfer rate |
| SOUR | standard oxygen uptake rate |
| SPS | sewage pumping station |
| SRT | solids retention time |
| SS | suspended solids |
| STP | sewage treatment plant |
| STW | sewage treatment works |
| SWMS | Safe Work Method Statement |
| TDS | total dissolved solids |
| TF | trickling filter |
| TKN | total Kjeldahl nitrogen |
| TN | total nitrogen |
| TOR | total oxygen requirement |
| TP | total phosphorus |
| TSR | total solids residue |
| TSS | total suspended solids |
| TWL | top water level |
| UPS | uninterruptible power supply |
| uPVC | unplasticised polyvinyl chloride |
| µS | micro Siemens (unit measure of salinity) |
| UV | ultraviolet (light) |
| V | velocity |
| VSS | volatile suspended solids |

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|---|---|
| WAS | waste activated sludge |
| WES | Workplace Exposure Standards |
| Wt | wet tonnes |
| yr | year |
| Y | Yes |
| Y/N | Yes/No |

## 2.5 Glossary of Terms

**Absorption** - Uptake of liquid into a material.

**Activated carbon** - A highly absorbent and adsorbent form of carbon that is used to remove hydrocarbons from wastewater and to scrub odorous gasses.

**Activated sludge** - A flocculant microbial mass of bacteria, protozoa and other micro-organisms with a significant component of inert debris produced when sewage is continuously aerated.

**Activated sludge process** - A suspended floc method of sewage treatment process whereby a mixture of sewage and activated sludge is agitated and aerated to achieve removal of suspended and dissolved organic matter in the wastewater. When supplied with adequate dissolved oxygen they will aerobically decompose/oxidise the organic constituents in the wastewater. The activated sludge is then separated from the treated effluent by settlement, most of which is returned or recycled to the aeration tank to continue the process.

**Adsorption** - Increased concentration of molecules or ions on a surface, including exchangeable cations and anions on soil particles.

**Aeration** - The process of incorporation of air or oxygen into wastewater, sludge or effluent to increase its dissolved oxygen concentration to enable aerobic treatment to take place, maintain mixed conditions, prevent anoxic or anaerobic conditions or control generation of odorous gases.

**Aeration tank** - A treatment unit in which activated sludge is mixed and aerated with the wastewater for secondary biological treatment.

**Aerobic** - Where conditions provide for dissolved or free oxygen being present

**Aerobic bacteria** - Bacteria that live and reproduce only within an environment containing free or dissolved oxygen.

**Aerobic digestion** - The biochemical decomposition of the organic matter in sewage sludge into carbon dioxide and water by micro-organisms in the presence of oxygen.

**Amplification** - The construction of additional facilities to accommodate an increase in flow or load for which it is usually implied that treatment performance is unchanged.

**Anaerobic** - Where conditions provide for neither nitrates nor dissolved/free oxygen being present.

**Anaerobic bacteria** - Bacteria that live and reproduce only within an environment that contains neither nitrates nor dissolved/free oxygen. Anaerobic bacteria obtain the necessary oxygen by breaking down other chemical compounds which contain oxygen

**Anaerobic digestion** - The biochemical decomposition of the organic matter in sewage sludge into methane gas, carbon dioxide and water by micro-organisms in the absence of dissolved oxygen.

**Anion** - Negatively charged ion, can be a single element such as chloride ($Cl^-$) or a compound such as nitrate ($NO_3^-$).

**Anoxic** - Where conditions provide for nitrates but not dissolved or free oxygen being present.

**Application site** - The area over which effluent or biosolids are applied/used.

**Augmentation** - The upgrading of capacity, condition and/or performance of infrastructure to meet acceptable/required standards or accommodate current/proposed flows or loads.

**Average dry weather flow (ADWF)** - This is the average volume of wastewater experienced on a typical day in dry weather.

**Bacteria** - Living organisms, microscopic in size. Most bacteria use organic matter for their food and under suitable conditions can multiply very rapidly. They are of primary

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| | importance in most biological wastewater treatment processes. Micro-organisms which are harmful to man are called pathogens. There are many bacteria that do not cause disease and are called non-pathogenic. |
| **Balance tank** | - A treatment unit within which short duration high or fluctuating inflows are smoothed out to produce an outflow that is more constant and mitigates the adverse effects of sudden peaks in flow/strength on downstream treatment processes. |
| **Bar screen** | - Usually a set of parallel bars positioned at an angle across the flow within a channel for the purpose of collecting large objects contained in the flow that can subsequently be removed. |
| **Batch** | - A clearly identifiable and traceable quantity of material on which sampling, testing or classification or a process cycle may be undertaken. |
| **Batch sampling mode** | - A procedure involving the intermittent sampling of batches of material. |
| **Beneficial use or reuse** | - The use of water or nutrients in effluent or biosolids at or below the agronomic loading rate or in such a manner that improvement to the land being applied on is gained. |
| **Bioaccumulation** | - The build-up of substances/contaminants (eg heavy metals) in the tissue of an organism through being absorbed faster than they can be metabolised and excreted by the organism. |
| **Biochemical oxygen demand ($BOD_5$)** | - A measure of the quantity of oxygen used by bacteria to decompose the organic matter in the wastewater over a period of 5 days under specified conditions. |
| **Biodegradable** | - The nature of a substance that allows it to be converted by bacteria and other micro-organisms. |
| **Biological nutrient removal** | - Phosphorus and nitrogen removal by biological action in the activated sludge treatment process. |
| **Biological wastewater treatment** | - Forms of wastewater treatment in which the bacterial or biochemical action is intensified to stabilise the unstable organic matter present and remove non-settling solids. Contact beds, trickling filters and activated sludge processes are some examples. |
| **Biomass** | - The living organisms within a defined area or volume. |
| **Biosolids** | - Primarily an organic solid product produced by a municipal sewage treatment process and is also referred to as sewage sludge. Solids become biosolids when they come out of a digester or other treatment process and can be beneficially used, until which they are termed sewage sludge or sewage solids. |
| **Biosolids guidelines** | - Refers to Environmental Guidelines: Use and Disposal of Biosolids Products (NSW EPA, October 1997) |
| **Biosolids products** | - Material containing any component of biosolids including undiluted sewage in the form of liquid or cake, or derived materials such as compost, lime amended biosolids or pellets. |
| **Biosolids products – not suitable for use** | - Biosolids products which cannot be used on land outside the boundaries of the source sewage treatment plant because their quality has not been shown to have reached the standard required. |
| **Biosolids products – restricted use** | - Biosolids products that are limited in their application because they contain restrictive concentration of contaminants or do not have the required stabilisation characteristics. Restrictions on the products include loading rates and management practices, as well as limitations on the future uses of the land on which they are to be applied. |
| **Biosolids products –** | - Biosolids products that can be applied in an unrestricted manner on all lands (excluding 'sensitive' sites). Records must be maintained to verify the classification. |

**unrestricted use**

**Buffering capacity (soil)** - The ability of a soil or wastewater to resist pH changes.

**Bunded** - Where a wall structure is provided around an area to retain run-off from it.

**Catchment** - An area within which water supplied by precipitation is transferred to the ocean, lake or larger stream. Also the area of land from which water, stormwater or sewage is collected.

**Cation** - Positively charged ion, can be a single element such as potassium ($K^+$) or a compound such as ammonium ($NH_4^+$).

**Chemically assisted sedimentation** - A process in which the addition of flocculant chemicals such as alum creates larger flocs thereby improving settlement.

**Chemical oxygen demand (COD)** - A measure of the amount of oxygen required to oxidise both the organic and inorganic matter within wastewater.

**Chlorination** - The process of addition of chlorine, usually to treated wastewater, for the purpose of either disinfection (most common use) or for oxidation of ammonia.

**Clarifier** - A tank in which wastewater is held to allow secondary treated sludge solids to settle to the bottom and the resultant clarified effluent to overflow from the top of the tank. Also called a 'secondary settling tank' or 'secondary sedimentation tank'

**Classification** - The process of assessing material, equipment or processes and assigning them to classes based on comparative criteria such as their type, performance or quality.

**Coliform group bacteria** - A group of bacteria found in the intestines of man and animals, some plants, the air, soil and aquatic environments which are used to indicate pathogenic (disease causing) bacteria in water and wastewater.

**Collection system** - See reticulation.

**Composite sample** - A sample consisting of separate individual samples collected at prescribed intervals. Generally, unless noted or specified otherwise, a composite sample consists of 24 individual samples collected at hourly intervals and each having an equivalent volume.

**Compost** - The material produced by the aerobic biological decomposition of the organic constituents of a material.

**Composting** - The aerobic, biological decomposition of the organic constituents of biosolids and other organic products under controlled conditions. The rate of composting depends on a number of factors, key of which are moisture content, carbon to nitrogen ratio, aeration, temperature and microbial population.

**Constructed wetlands** - Areas that have been specifically constructed so that the water surface is near ground level for enough of the year to maintain saturated soil conditions and promote related vegetation.

**Conventional activated sludge (CAS)** - Normally refers to a conventional sewage treatment process train with mechanical aeration within an aeration tank followed by secondary sedimentation/clarification to achieve secondary treatment effluent quality. The resultant sludge generally requires further digestion for stabilisation purposes.

**Contaminant** - Metals and organic-chlorine pesticides occurring in sewage, sludge, effluent, biosolids and soils and (with organic and inorganic compounds) in effluent.

**Contaminant grade** - The classification category used to describe the quality of a biosolids product based on the concentration of any one contaminant.

**Continuous sampling mode** - A procedure involving the uninterrupted sampling of material.

**Denitrification** - Transformation of nitrate into the gaseous NO and N forms using micro-organisms in an anaerobic process.

**Desludging** - Withdrawing sludge, scum and liquid from a tank.

**Detention time** - The amount of time, on average, that material (eg. Water, sewage or effluent) will spend within a pipeline, treatment or storage unit.

**Dewatering** - The removal of a significant amount of water content from a material, eg from sludge or biosolids. This is generally undertaken to reduce the volume of material that requires further handling or treatment.

**Digestion** - The biochemical decomposition of the organic matter in sewage sludge into simple compounds such as carbon dioxide, water and methane without the addition of new food. Digestion makes the sludge more stable (less volatile solids), reduces its volume and makes it easier to dewater and less offensive (vector attraction and odours)

**Disinfection** - A process that destroys, inactivates or removes pathogenic (disease causing) micro-organisms. Note that not all of the micro-organisms are killed by disinfection

**Dissolved oxygen (DO)** - A measure of the quantity of free, non-chemically contained, atmospheric oxygen dissolved in water or wastewater.

**Dissolved solids** - Solids that are actually in solution in the liquid and therefore cannot be removed by settlement. In domestic wastewater typically half the dissolved solids are organic and half inorganic. Also referred to as 'total dissolved solids".

**Domestic wastewater** - Wastewater arising from household activities, including wastewater from bathrooms, kitchens and laundries.

**Dortmund siphon** - A facility for removal of sludge from a sedimentation tank that consists of a pipe extending to the bottom of the tank with a valved branch line fitted at about a metre below the tank water level. When the valve is opened the sludge surrounding the end of the pipe is forced into and up the pipe and along the branch due to the head of water above the valve.

**E. Coli** - Escherichia Coli, a species of coliform bacteria inhabiting the alimentary canal of a number of animals, including man.

**Effluent** - The liquid product after treatment of raw wastewater flowing from a tank treatment process or treatment plant.

**Electrical conductivity (EC)** - A measure of the concentration of salts in solution. The salts that occur in significant amounts are the chlorides, sulphates and bicarbonates of sodium, potassium, calcium and magnesium. In water these salts dissociate into charged ions and the EC of the solution is proportional to the concentration of these ions. The units of EC are deciSiemens per metre (dS/m) at 25$^{o}$C.

**Enhanced biological phosphorus removal (EBPR)** - Secondary treatment processes that are designed for removal of phosphorus to levels that are substantially below that normally expected within normal biological treatment processes through 'luxury uptake' whereby micro-organisms, under suitable, well managed conditions, assimilate phosphorus in excess of their metabolic process.

**Enteric** - Intestinal.

**Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS)** - Assessment of environmental impact is a specialised part of the decision making process, where environmental impact is considered in detail, together with consideration of other aspects of the development.

An "Environmental Impact Statement" is the detailed analysis required where the likely impact of development is significant. It is an aid to people preparing and deciding on proposals. It also helps the public understand the environmental effects of proposed development.

**Equivalent persons or equivalent population (EP)** - A unit for describing the sizing of various parts of a system, especially the sewage treatment plant. Flows and pollution loads from all sources (ie. Residential, commercial and industrial) are converted to a person equivalent basis.

**Equivalent tenement (ET)** An equivalent tenement is also a unit used to represent the loading on the sewerage system. Whilst the number of EP in a system reflects the biological loading on sewerage infrastructure, the number of ET reflects the hydraulic loading on the system which is also a measure of the potential for infiltration and thus wet weather hydraulic loads.

**Environment Protection Licence** - A licence that allows pollution of the environment but under controlled conditions regulated by the DEC.

**Evapo-transpiration** - Removal of water from soil by evaporation and from plants by transpiration.

**Exfiltration** - The leakage of material (eg. Water, sewage or effluent) from pipes, treatment or storage units to the surrounding soil and environment.

**Extended aeration** - A biological wastewater treatment process based on the activated sludge process often used for small treatment plants. In this process, the wastewater is aerated for much longer periods than in other processes. This means that the amount of sludge produced is reduced and the waste sludge is more stable because more time is allowed for decomposition.

**Facultative bacteria** - Bacteria that can live and grow actively in both aerobic (utilise dissolved oxygen) and anaerobic (utilising oxygen obtained from new food) conditions.

**Faecal coliform** - A group of organisms common to the intestinal tracts of man and animals. The presence of faecal coliform bacteria in water is an indicator of possible faecal pollution.

**Floc** - Larger particulate matter formed from the aggregation of smaller particles as a result of biological or chemical activity.

**Flow weighted composite sample** - A sample whose composites are sized in proportion to the flow at each composite's time of collection.

**F/M ratio** - This ratio can be used as a process control parameter in the activated sludge process and its variations. It compares the amount of incoming food (F) to the number of micro-organisms (M) consuming the food.

**Grab sample** - A single sample taken at a point at a single time.

**Grading** - A necessary input to classification, grading is the procedure of ranking in the order of a comparative criteria such as type, performance or quality

**Grit** - The heavy inorganic material present in wastewater. Examples are sand and gravel. This term is applied to settled solids in a grit removal unit (grit chamber or arrestor)

**Groundwater** - All underground waters saturating the void of rocks and soil; water in the zone of saturation of the earth's crust.

**Hardstand** - A compacted or formed surface for the purpose of minimising infiltration.

**Hazardous waste** - Material that is subject to a Schedule and Chemical Wastes Chemical Control Order issued under the NSW Environmentally Hazardous Chemicals Act 1985. It is any waste containing a quantity of a substance, which may endanger the life of any living organism when released into the environment or to the safety of humans or equipment if incorrectly handled.

**Heavy metals** - Metals of high atomic weight which can have a toxic effect in high concentrations and which may accumulate in the environment and the food chain.

**Heat drying** - A treatment process involving the application of heat to remove moisture from a material, such as biosolids, to a practical limit.

**Hydraulic loading** - A parameter used in the design and assessment of various treatments units. It relates the volume of flow to the size of the treatment unit over a time period, usually per day or per hour.

**Incorporation** - The use of one pass of a plough under favourable moisture conditions to combine material, such as biosolids, into the soil.

**Infiltration** - Flow that enters the wastewater collection system through cracks or loose joints in sewer lines or manholes – usually it is groundwater.

**Inflow** - Water which enters the wastewater collection system from illegal connections of roof guttering, from access covers or from cross connections with stormwater drains.

**Influent** - Wastewater or other liquid – raw or partially treated – flowing into a reservoir, tank, treatment unit or treatment plant.

**Inorganic solids** - Waste substances of mineral origin such as sand, salt, iron and calcium. These solids are inert and will not decompose.

**Intermittent decant extended aeration (IDEA)** - Refer to a secondary treatment process in which the treatment aeration, settlement and decanting occurs within a single process unit as phases occurring at sequenced time steps (intermittently) with sewage inflow to the process occurring uninterrupted in phases. IDEA configurations that vary with the shape of aeration tank include Pasveer channels (race track), Bathurst boxes (vertical walled) and Port Macquarie tanks (sloping sided basin).

**Land application** - Spraying or spreading material (effluent or biosolids) onto the land surface or its injection below the land surface.

**Land disposal** - Application of material (effluent or biosolids) where beneficial use is not an objective. Disposal will normally result in application rates that exceed the nutrient requirements of crops, pastures or plants or the requirements for organic matter.

**Lime and cement kiln dust (CKD) stabilisation** - Patented process whereby lime and CKD are added to biosolids to destroy or inhibit pathogens and micro-organisms involved in the decomposition of biosolids. The resulting alkalinity also assists immobilisation of metal ions.

**Lime stabilisation (biosolids)** - Addition of sufficient lime to biosolids to destroy or inhibit pathogens and micro-organisms involved in the decomposition of the biosolids.

**Liquid biosolids** - Biosolids containing sufficient water (ordinarily more than 90%) to permit flow by gravity or pumping.

**Macrophytes** - Large aquatic plants, such as seaweed, seagrass, mangroves.

**Manhole** - Large diameter inspection chamber that provides for man access.

**Mesophilic composting** - Composting at or below temperatures of $40^{o}C$

**Micro-organism** - Small living organisms, most of which can be seen only through a microscope. Micro-organisms use organic matter in wastewater for food and, in combination with dissolved air, afford biological treatment of the wastewater.

**Mixed liquor** - The mixture of activated sludge (bacteria and organic matter), effluent and wastewater in an aeration tank.

**Nitrification** - Transformation of inorganic ammonia ($NH_4^+$) into nitrate ($NO_3^-$).

**Non-filterable residue (NFR)** - The amount of physical solids not in solution that is present in a volume of liquid. These solids can be removed by settlement or filtration.

**Non-potable** - Water used for purposes other than drinking, washing and cooking.

**Nutrients** - Chemical elements that are essential for sustained plant and animal growth. If a biological system is to function properly, nutrients must be available in adequate amounts. The principle nutrients are nitrogen and phosphorus. Under certain circumstances, the presence of these nutrients in effluent discharges may promote the unbalanced growth of algae and aquatic plants in receiving waters, and in the case of nitrates, may pose a direct human health risk.

**Nutrient reduction** - Nutrient reduction involves reducing the levels of nutrients (usually nitrogen and phosphorus) using biological and/or chemical methods prior to discharge.

**Oxidation reduction potential** - A measure of reactivity between chemical constituents in a system to be reduced or oxidised.

**Organic solids** - Solids consisting of chemical compounds based upon carbon skeletons (proteins, carbohydrates and fats). It may be present in dissolved, suspended or colloidal form and is usually measured as $BOD_5$ in liquid. Also termed 'organic matter'.

**Overflow structure** - A structure designed to allow discharge of all or a portion of the design flow under specified conditions, eg discharge of all flows in excess of the design PWWF. The purpose of the overflow structure is to reduce the design flow at all points downstream of the overflow and prevent uncontrolled overtopping of treatment units in the event of an emergency.

**Oxidation pond** - A treatment pond that has an aerobic upper layer and an anaerobic lower layer. Aerobic bacteria convert dissolved organic matter to carbon dioxide and the settled solids are anaerobically digested.

**Pathogens** - Micro-organisms that are potentially disease causing to humans and include, but are not limited to, bacteria, protozoan and viruses. There are many types of bacteria which do not cause disease and which are not called pathogens.

**Parts per million (ppm)** - Units used to express the concentration of components. It refers to the number of parts of the component in each million parts of the wastewater. The term is essentially obsolete with milligrams per litre (mg/L) being the preferred units. One ppm is equal to one mg/L.

**Peak dry weather flow (PDWF)** - The maximum instantaneous sewage flow entering the treatment plant on a typical day during dry weather.

**Peak wet weather flow (PWWF)** - The maximum instantaneous sewage flow entering the treatment plant during wet weather, including storm allowance. This is necessary since water other than wastewater can enter the system. One of the most common ways for this to happen is for householders to illegally direct flows from roofs and/or paved areas into sewers.

**Percentile (in relation to concentration limit of samples)** - That percentage (eg. 50%) of the number of samples taken that must meet the concentration limit specified in the licence for the plant over a specified period of time.

**Percolation** - The descent of water through the soil profile or bed of other material under gravity.

**Permeability (soil)** - The general term used to describe the relative ease with which water can move through a soil profile or other material.

**pH** - A measure of hydrogen ion concentration that is an indicator of the intensity of acidic or alkaline strength of water. Measurements are in the range of 0 to 14, where 0 is the most acidic, 14 the most alkaline while 7 is neutral.

**Pollution** - A state of contamination in which water, soil or air quality has deteriorated to a point where its ability to support or maintain the existing or potential uses is diminished.

**Pollution reduction Program (PRP)** - An instrument used by DEC in conjunction with Environment Protection Licences to ensure progressive reduction in environmental impacts of the licensed operations.

**Ponding** - Blockage of the spaces or void within material or media that prevent drainage of water or wastewater through it and cause build up of pools on the surface.

**Potable** - Where water is used for drinking, washing and/or cooking purposes.

**Precipitation** - Deposits of water, either in liquid (rain) or solid (sleet, hail or snow) form that reaches the earth from the atmosphere. Also refers to the action of chemical binding of elements in a liquid solution to form insoluble compounds that settle out from the solution.

**Preliminary treatment** - The use of racks, screens and grit removal devices to remove, or decrease in size, the inorganic solids present in the wastewater such as rags, plastic, metal, rocks, sand and large material that may hinder the treatment plant operation.

**Pre-treatment** - The treatment of industrial or high strength wastewater to remove contaminants or bring it to an acceptable condition appropriate for discharge to the sewerage system. The term can also be used for a process that is used to improve the treatability in, or performance/efficiency of a subsequent treatment process.

**Primary sludge** - The wastewater solids removed by settlement in a primary sedimentation tank.

**Primary treatment** - The first stage of treatment following preliminary treatment in a sewage treatment plant, usually involving the separation and removal of floatable and settleable solids.

**Receiving water** - A stream, river, pond, lake, harbour, ocean or groundwater aquifer into which wastewater discharges flow.

**Recirculation** - The pumping of a portion of the effluent from a treatment unit or process back to an upstream point to combine with influent for treatment. Recirculation is generally undertaken to buffer fluctuations in inflow and maintain a minimum level of flow to achieve improved performance and efficiency of the treatment unit.

**Reclaimed water** - Water derived from sewage and treated to a standard that is acceptable for its intended reuse application.

**Recurrent costs** - On-going costs that continue to recur usually on an annual basis such as operating and maintenance costs.

**Regulator** - An organisation that sets regulations and standards that are required to be met. Examples are DEC, IPART and Department of Health.

**Remote Monitoring Facility** - Relates to alarm systems such as that operating on a SCADA system.

**Residual** - The waste product left over following treatment.

**Residual chlorine** - Chlorine remaining in solution after a specific period of contact between the solution and the chlorine.

**Reticulation** - A network of pipes that is provided to households for provision of water supply to or wastewater from households.

**Return activated sludge** - Activated sludge that is recirculated to the aeration tank to maintain an adequate quantity of active biomass within the treatment process.

**Reverse osmosis** - Treatment process for the removal of primarily soluble contaminants in wastewater by passage through a physical semi-permeable membrane at high pressure

**Rising main** - Pressure pipeline in which water, sewage, effluent or other fluid flows due to pumping action.

**Risk assessment** - The process by which scientific data are analysed to define the form, magnitude and characteristics of any risks that may cause harm to humans or the environment.

**Runoff** - Surface water flow.

**Sand filter** - Treatment of pre-treated wastewater by percolation through graded sand.

**Screenings** - The material collected on screening equipment, either static or mechanical. They are removed from the wastewater flow to prevent blockage of downstream equipment and improve the quality of effluent or biosolids produced by the plant. Screenings are usually buried.

**Scum** - Material that has collected at the top of liquid within tanks, including oils, grease, soaps and plastics.

**Secondary treatment** - The biological treatment that includes both stabilisation of organic material and the separation of both solid and dissolved contaminants from the wastewater. A common and effective form of secondary treatment is the activated sludge process where treatment is largely carried out by a living biomass of micro-organisms (mixed liquor) fed organic matter in the wastewater. Other forms of secondary treatment include biological filtration and facultative lagoon (oxidation pond) processes.

**Secondary sludge** - Wastewater solids from the secondary treatment facilities of a sewage treatment plant.

**Sediment** - Particulate organic and inorganic matter that settles to the bottom of streams, lakes, rivers, oceans or other surface waters.

**Sedimentation** - The separation of suspended and settleable material from a liquid. This takes place via the effect of gravity under calm conditions without any agitation.

**Sensitive area** - A site which may contain one or more of the following characteristics: high biological diversity, importance as a habitat for rare, threatened or endangered species, importance as breeding or nursery areas for animals or birds, importance for public usage and recreation and hence public health, importance for commercial and industrial economic development, or an area recognised and protected in legislation.

**Septage** - Material removed from a septic tank during desludging that contains partially decomposed scum, sludge and liquid.

**Septic** - A condition in which the wastewater or sludge turns black and odorous through prevalence of anaerobic conditions due to absence of dissolved oxygen.

**Septic tanks** - Wastewater treatment device that provides a preliminary form of treatment comprising sedimentation of settleable solids, floatation of oils and fats and anaerobic digestion of sludge.

**Sewage (wastewater)** - Refers to all water borne waste materials that have been discharged to a sewerage system. Its origin may be domestic, industrial or commercial. Domestic sewage is 99.9% water and 0.1% solids. About half of the dissolved solids are organic, and the other half inorganic. Normal domestic sewage also contains inorganic solids, grease, oils, gases and micro-organisms.

**Sewage treatment plant** - The processing facility that treats sewage to render it acceptable for discharge into the environment and which as a result produces effluent, biosolids and minor residuals (grit and screenings).

**Sewerage** - The system of sewers and treatment facilities that contain, transport and treat the sewage.

**Sewerage reticulation** - System for collection and transport of sewage/wastewater.

**Sludge** - The solid, semi-solid or liquid residue generated during the treatment of sewage in a treatment plant. Also known as ‘sewage solids’ or ‘wastewater solids’.

**Soil conditioner** - A substance use to improve the physical (eg. soil structure) or chemical (eg. pH) properties of soil.

**Solid waste** - Any biodegradable (putrescible) or inert wastes generated at domestic, commercial, industrial or construction sites including night soil or spreadable biosolids. Liquid and hazardous wastes are not included in this definition.

**Solid waste landfill** - A site for the disposal of solids wastes by landfill.

**Spadeable** - Able to be moved by loading onto a spade at normal outdoor temperatures. Normally applicable to sludge and biosolids within sewage treatment plants.

**Specific oxygen uptake rate (SOUR)** - The mass of oxygen consumed per unit time per mass of total solids (dry weight basis) in sewage sludge.

**Stabilisation** - The process of eliminating the potential for putrefaction that, as a result, reduces pathogens, vector attraction and offensive odours.

**Stabilisation grade** - The classification category used to describe the quality of a biosolids product based on its microbiological characteristics, vector attraction and potential to generate offensive odours.

**Stormwater** - Rainwater that runs off urban and agricultural catchments.

**Supernatant** - The liquid fraction of a settling tank above a sludge blanket. Usually applies to sludge lagoons and digesters.

**Surface waters** - Any river, stream, lake, lagoon, swamp, wetland, unconfined water body, dam or tidal waters. A river or stream may be perennial or intermittent, flowing in a natural channel with an established bed or in an artificially modified channel that has changed the course of the stream.

**Suspended solids (SS)** - The mass of suspended matter in wastewater retained on a standard glass fibre filter under specified conditions. (Also called NFR).

**Telemetry** - Transmission of information by radio waves and/or telephone cable.

**Tertiary treatment** - Any one or combination of several treatment processes implemented to further improve specific characteristics of effluent from secondary treatment processes. For example, tertiary treatment processes can reduce the level of dissolved salts, nutrients, faecal coliforms and/or BOD. Common tertiary treatment processes include disinfection, filtration, and nutrient reduction. Some of these processes may be integrated with secondary treatment processes.

**Thermophilic composting** - Composting at or above temperatures of 40$^{o}$C.

**Total dissolved solids (TDS)** - A measure of salinity that expresses the combined concentration of sodium, calcium, potassium, magnesium, boron, sulphate, carbonate and bicarbonate in effluent or wastewater.

**Total Kjeldahl nitrogen (TKN)** - A measure of organic nitrogen plus ammonia nitrogen. Organic nitrogen is readily converted to ammonium nitrogen during aerobic treatment processes.

**Total organic carbon (TOC)** - A measure of all the organic carbon present in the wastewater determined laboratory analysis method, which involves oxidation of carbon to carbon dioxide.

**Total phosphorus (TP)** - A measure of phosphorus found in wastewater in the form of orthophosphate, polyphosphate and organic phosphorus compounds. In a well-treated secondary effluent, a large fraction of the phosphorus is present as orthophosphate.

**Trade waste** - A liquid discharged to the sewerage system that contains wastes, chemicals or other impurities from any business, trade or manufacturing premises other than domestic

sewage, stormwater or unpolluted water

**Trickling filter** - A biological filter used as a secondary treatment unit. Treatment is achieved by micro-organisms that live on the filter media and utilise the organic material in the wastewater for growth, energy and reproduction. Also called a bacteria bed or biological filter.

**Unstabilised solids** - Organic materials in sewage sludge that have not been treated in an aerobic, anaerobic or other treatment process to stabilise them.

**Vectors** - Insects and animals, such as flies, mosquitos and rodents, which are attracted to putrescible organic material and which may spread pathogens.

**Volatile solids** - The amount of total solids in sewage sludge that is lost when the sludge is heated to 550$^{o}$C in the presence of excess air.

**Wastewater** - Water that contains waste products.

**Watertable** - The surface of an underground water body at which the pressure is atmospheric.

**Weir** - A wall or plate that is positioned across a channel or tank, specifically designed to control wastewater flow.

**Wetlands** - Habitats where the influence of surface or groundwater results in plant or animal communities that are adapted to aquatic or intermittently wet conditions.

## 2.6 Manual Amendment Record

ADD DETAILS OF NEXT VERSION NO. WHEN UPDATED MANUAL IS TO BE ISSUED

| REVISION No. | AMENDMENTS TO (PAGE No.) | AUTHORISING OFFICER | | DATE |
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## 2.7 Feedback Form

The Water Directorate welcomes comments and feedback on the use of this Operations & Maintenance Manual. Please tick the appropriate box and write any additional comments you may have regarding the format, content or practical use of this manual.

| | VERY USEFUL | USEFUL | NOT USEFUL |
|---|---|---|---|
| How useful is **Section 2** Overview of the Manual ? | ☐ | ☐ | ☐ |
| How useful is **Section 3** STP Treatment Facilities? | ☐ | ☐ | ☐ |
| How useful is **Section 4** Inlet Works? | ☐ | ☐ | ☐ |
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| How useful is **Section 13** Chemical Dosing Systems? | ☐ | ☐ | ☐ |
| How useful is **Section 14** Sludge Lagoons? | ☐ | ☐ | ☐ |
| How useful is **Section 15** Digestors? | ☐ | ☐ | ☐ |
| How useful is **Section 16** Sludge Dewatering? | ☐ | ☐ | ☐ |
| How useful is the Maintenance Schedule? | ☐ | ☐ | ☐ |
| How useful are the Safe Work Method Statements? | ☐ | ☐ | ☐ |
| How useful is the Record of Training? | ☐ | ☐ | ☐ |
| How useful are the Environment Management Flow Charts? | ☐ | ☐ | ☐ |
| How useful is Appendix A Emergency Contact Information? | ☐ | ☐ | ☐ |
| How useful is Appendix B Routine Inspection, Monitoring, Testing and Maintenance? | ☐ | ☐ | ☐ |
| How useful is Appendix C Asset Management? | ☐ | ☐ | ☐ |
| How useful is Appendix D OHS&R Requirements? | ☐ | ☐ | ☐ |
| How useful is Appendix E Environmental Management Systems? | ☐ | ☐ | ☐ |
| How useful is Appendix F Quality Certification? | ☐ | ☐ | ☐ |
| How useful is Appendix G Education and Training? | ☐ | ☐ | ☐ |
| How useful is Appendix H Operating Modes? | ☐ | ☐ | ☐ |
| How useful is Appendix I Treatment Unit Design Data? | ☐ | ☐ | ☐ |
| How useful is Appendix J Plant & Equipment Technical Information? | ☐ | ☐ | ☐ |
| How useful is Appendix K Electrical & PLC Equipment Technical Information? | ☐ | ☐ | ☐ |
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