MONASH UNIVERSITY

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
CIV5178 ADVANCED WATER TREATMENT

Design Project- Wastewater treatment plant design.

Requirements: Written Report (Pg 2-8) and Presentation (Pg 9)

GENERAL INFORMATION

An area northwest of Melbourne is rapidly developing and now requires the construction of a new wastewater treatment plant. Upon developing this area, wastewater flows can be expected from the following sources:

- 340,000 PE from domestic contributions;
- {group number}$^{0.5}$ * 9,000 PE from commercial contributions, which average 280 L/PE/day;
- and infiltration/inflow (your group will define conditions to estimate infiltration/inflow).

Daily fluctuation of flow rates for a wastewater catchment with similar expected characteristics are defined by a peaking factor for each hour (Figure 1). The average flow rate for your catchment can be determined using the information above and multiplied by this peaking factor to determine the flow rate at each hour on a typical day.

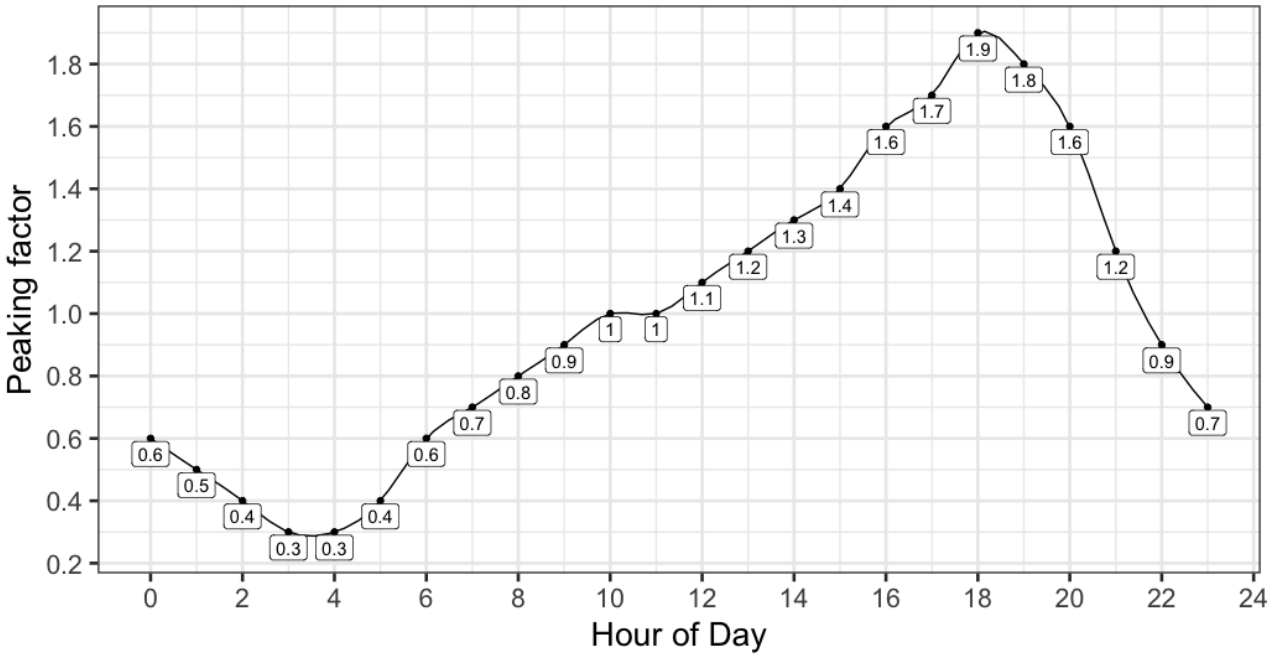

Figure 1. Daily fluctuation of peaking factors at each hour of the day for flow rates on an average day in a similar wastewater catchment. The flow rate for each hour can be found by multiplying the average flow rate (determined based on your catchment characteristics) by the peaking factors shown here.

This area is expecting an annual growth rate of {1+ group number*0.015}%. Your group will design a new secondary wastewater treatment plant to manage the wastewater from this wastewater catchment that will be operational from the time the development is completed until the end of life of the treatment plant.

Written Report (80% of Project marks)

In this assignment, your group should prepare a report assuming the role of an engineering consultant providing a design to the city engineer. You should describe your general approach and key findings in your report, organised in the following sections.

Your report should include the following:

(a) **Executive Summary**

(b) **Introduction and Conceptual Design Description**: Describe the wastewater catchment, estimation of design flow and pollutant loads, and provide an overall conceptual description of the various components of your wastewater treatment plant design, referring to the appropriate sections.

(c) **Preliminary treatment**: Develop the hydraulic design and size of suitable secondary screen chambers. Describe other facilities used in preliminary treatment.

This section should include the following subsections:

- Facility types
    - a justification for the type of facilities chosen;
- Design description
    - sizes and dimensions of secondary screens;
    - the hydraulic design and layout of screen chamber(s) including issues of head loss for providing sufficient head to operate the system (even when screens are partially blocked). The flow depth in the downstream channel is kept at 1 m during design peak flow. The screen chamber should remove particles > 10 mm;
- Equalisation basin (optional)
    - If used, provide volume of equalisation basin and refer to relevant section which indicates how the 'new peak flow rate' was determined
- Protection against failure
    - discussion on the protection against failure of key components in this treatment stage

(d) **Primary treatment**: Develop an outline of the primary clarifier design.

This section should include the following subsections:

- Facility types
    - a justification for the type of facilities chosen
- Design description
    - the number of tanks, tank sizes and specifications (including launders, overflow weirs etc.)

- also discuss the inlet design into the primary clarifier

- Pollutant removal
  - indicate the TSS and BOD_5 removal efficiency of your primary stage and provide justification

- Protection against failure
  - discussion on the protection against failure of key components

(e) **Secondary treatment**: Develop an outline of activated sludge process.

This section should include subsections:

- Facility types
  - a justification for the type of facilities chosen (e.g., aeration tanks, secondary clarifiers, sludge pump)

- Design description
  - the number of aeration tanks and sizes
  - a description of the secondary clarifier(s) which includes pump type for return sludge and inlet structure type (note: the secondary clarifier size does not need to be determined)
  - key aeration requirements needed to select an appropriate aerator

- Pollutant removal
  - indicate the TSS and BOD_5 removal efficiency of this stage and provide justification

- Protection against failure
  - discussion on the protection against failure of key components

(f) **Environmental Impact Assessment**: Discussion of impact of wastewater treatment plant on the environment.

- Impact on the receiving waterway.
  - This section should include an analysis of the effects and implications of effluent BOD on dissolved oxygen in a receiving stream with following characteristics (assume these will remain constant):

    Q_r = [{group number}$^{0.2}$ * 300,000] m^3/day; L_r = 4 mg/L; DO_{sat} = 8.5 mg/L;
    k_r = 0.71/d; k_d = 0.51/d; stream velocity = 0.07 m/s; D_0 = 0.8 mg/L

- Biosolids production and brief overview of appropriate treatment and disposal.

- Sources of carbon emissions related to the treatment plant operation and how these were minimised.

(g) **Summary** of your Wastewater Treatment Plant design.

Your summary should include:

- Brief descriptions of wastewater catchment, design flow, and overall treatment plant design.
- Conceptual diagram/schematic of the layout of your wastewater treatment plant (plan view). This diagram does not need to be to scale, but should show relative scale of various components, approximately. Hand drawn schematics are not appropriate for this assignment.
- Summary table of TSS and BOD_5 load reduction and removal efficiencies for each stage, and
- Distance downstream of treatment plant where dissolved oxygen recovers to DO_0.

The Water Environment Federation's 2018 *Design of Water Resource Recovery Facilities* manual is a helpful resource for determining values you will need to assume (such as SSr, MLSS, etc.). You are provided some examples in lecture and practice classes, but this manual will help provide some ranges for certain parameters which you can use in your design with justification (e.g., "we selected a SSr on the high end of typical values because we assume good settleability in the secondary clarifier."). You can access the manual online through the library:

https://go.openathens.net/redirector/www.monash.edu?url=https://www.accessengineeringlibrary.com/content/book/9781260031188

Additionally, the Metcalf & Eddy textbook Reading List will be very useful for your design.

The audience of your report is the city engineer and other technical staff in the wastewater and sanitation department of the city. You are preparing this report as a consultancy contracted by the city to design a new wastewater treatment plant.

Any information you present which is not provided here should be based on well-reasoned assumptions and/or supported with citations. Citations should be published materials, ***not the lecture slides****. Remember to cite your source in the figure caption if you use an image or figure which you did not create. Otherwise, you are claiming that you created that duplicated image/figure, which is plagiarism.*

SUBMISSION REQUIREMENTS

Submission from each design group is to be in the form of a PDF document submitted via Moodle by one of the group members. You may also submit an appendix in PDF or spreadsheet format, but you must take care to properly refer to and label sections so the reader can follow your work. If you have used any code in your design, please copy this into a document and include this in your appendix. Detailed calculations should only be included in the appendix. The report should:

- **not exceed 20 A4 pages** (this limit excludes title page, table of contents, and appendices), with minimum margins of 2cm, either with Times New Roman (12pt) or Arial (11pt). The formatting of the report is to be as a professional report prepared for a city council engineering department.

Submissions with fewer than 20 pages are acceptable if they provide all of the necessary information.

- outline the methodology and assumptions (with justifications shown for each assumption) used in the design;
- where applicable, present a summary of results of calculations you completed in the body of the report and show the detailed calculations in the appendix of the report. Summarise key results in tabular form.
- explain why the chosen design approach was used over the other design (types of screens, type of grit chamber, types of clarifiers selected, etc.).
- Appendices should be used where detailed calculations need to be shown. Reference the appendices in the main text when necessary.

The basic structure of the report for your project should be as follows:

Title page
This states the name of the unit, the lecturer's name, the project title, the names and email addresses of all the students in the team, the date submitted.

Executive Summary
This is a brief (< 1 page) statement of the topic of the report and a brief summary of the key outcomes of your project. In this case, the key outcomes will be a description of major features of your design, including the determination of inflows and pollutant loads and description of environmental impact from effluent.

Table of Contents
This sets out the numbered sections and subsections of your report and gives their corresponding page numbers. Try to make the headings for each section as informative as possible in order to give the reader an immediate understanding of the logical structure of your report.

Introduction and Conceptual Design Description
This gives a description of the problem, the motivation for the design, details about the municipality and the conceptual layout of your design. A diagram showing the main components of your treatment plant should be included here.

Middle Sections
These sections present the development of your design with information organised logically under appropriate numbered headings (e.g., Preliminary Treatment, Primary Treatment, etc., with appropriate sub-headings).

Besides text, a technical report typically includes drawings and numerical and graphical data in figures and tables. Small drawings can be included in the middle sections. Large drawings should be kept together in one Appendix but referred to in the Middle Sections.

Figures and tables are used to summarise your work. They must be given clear titles and be clearly labelled. Do not include figures or tables that are not referenced in your text. When you include figures and tables, you must write something about each one in the text of your report, for example:

Bad example: *Figure 1 shows the screen chamber. Table 2 describes its design parameters.*
Good example: *The screen chamber (Figure 1) will be 2.1 m wide with 4-mm wide bars (Table 2).*

In your report you should refer to detailed information contained in an appendix rather than include all details in the main report. Detailed calculations should not be provided in the main report. Rather,

provide an overview of your approach and key formulas, where appropriate, so the reader can understand your design approach.

You must cite the references that you have used for your work (e.g., textbooks, published design guidelines and manuals, professional society manuals, government regulations, etc.; **N.B.: lecture slides and non-government websites are not appropriate references**).

The preferred method for citations is to list the author of the reference and the publication date. You then list the authors in alphabetical order in your list of references.

Summary
This provides a brief summary of the key aspects of your design. The material in this section should match item (f) above.

References
This is a list of the sources of information cited in the report. The preferred system of referencing is by author and date. Further information on referencing is available at the following website:
https://www.monash.edu/rlo/research-writing-assignments
https://guides.lib.monash.edu/citing-referencing/csiro

Appendices
This section contains material that is too detailed to include in the main report. Each appendix must be referred to at the relevant point in the text.

A good reference for report writing:
Silyn-Roberts, H. (1996) *Writing for Science: A practical handbook for science, engineering and technology students* Longman, N.Z.

Assignment submission

Online Submission: Use only the Moodle assignment submission tool. One group member will submit the report for the entire group. Submissions via email will not be accepted.

- Only the following file formats will be accepted: .**pdf** and .**xls***;
- You will be able to check the submission status online;

The report must be submitted via the Turnitin project on the Moodle website.

USE OF AI

Generative AI may be used to assist with report preparation. However, the use of AI must be acknowledged clearly in your report as a separate statement attached to the document. You must follow the Monash guidelines for responsible use of AI. https://www.monash.edu/student-academic-success/build-digital-capabilities/create-online/acknowledging-the-use-of-generative-artificial-intelligence

MARKING

All members of the respective project teams will receive the same mark. However, in some cases groups may submit a marking distribution that they believe represents the relative contribution of each group member. In these cases, **the group must decide on a percentage for each group member that reflects their relative contribution. The sum of these percentages must equal zero** (see table below). **Every group member will be required to sign the marking distribution indicating they agree to their weighted percentage mark**. If your group members agree to equal weighting, which is common, there is no need to submit this marking distribution. The course coordinator reserves the right to change your weighting distribution in certain cases.

Example of a group's marking distribution:

Student Name	Weighting %	Student Signature
Jane Doe	110	[signature]
John Doe	100	[signature]
Max Power	80	[signature]
Mary Curie	110	[signature]

Penalties for late assignments will apply (5% per day). Exceptions to late assignments will only occur if **every group member** has an approved special consideration request. This is a group project and is worth 20% of your total marks for the unit.

General Marking Criteria	**HD**	**D**	**C**	**P**	**F**	**Marks**
	80-100%	**70-79%**	**60-69%**	**50-59%**	**0-49%**	
Executive summary	• Highest level of description of all key components required. • Design choices are fully justified: Calculations and assumptions for design choices are clearly and completely described. All appropriate redundancies are described. All potential failures are discussed. • Clear and accurate description of how components will operate over lifetime of system. • Only and all necessary diagrams are shown. • References to figures, tables, and appendices are necessary and appropriate; references contribute to the overall description.	• Complete, accurate, and well-written descriptions of content required in this section. 1-2 elements are extraneous or missing. • Design choices are mostly justified: Calculations and assumptions for design choices are clearly and mostly completely described. Most appropriate redundancies are included and described. Potential failures are discussed. • Only necessary diagrams are shown. • References to figures, tables, and appendices are necessary and appropriate; references contribute to the overall description.	• Mostly complete, accurate, and well-written descriptions of content required in this section. 2+ elements are extraneous or missing. • Design choices are mostly justified: Calculations and assumptions for design choices are described but lack some appropriate details. Some redundancies are included and mostly described. Some potential failures are discussed. • 1-2 extra or missing diagrams. • References to figures, tables, and appendices contribute to the overall description.	• Mostly complete and accurate descriptions of content required in this section. 2+ elements are extraneous or missing. • Design choices are mostly justified: Calculations and assumptions for design choices are described but lack many appropriate details. Some redundancies are included, but some are not well justified or described. Some potential failures are discussed. • 2+ extra or missing diagrams. • References to figures, tables, and appendices somewhat contribute to the overall description.	• Incomplete and inaccurate descriptions of content required in this section. • Design choices are sometimes justified: Calculations and assumptions for design choices are not described to the extent they can followed. Redundancies and potential failures not well described or excluded. • Several diagrams were extraneous, missing, or inaccurate. • References to figures, tables, and appendices do not contribute to the overall description.	5%
Introduction and Conceptual Design Description						10%
Preliminary treatment						15%
Primary treatment						15%
Secondary treatment						20%
Environmental impact assessment						10%
Summary						5%
Presentation quality: **Organisation, writing, clarity**	• Students present the designs using appropriate technical terminology; detailed and accurate description throughout entire document. Document is easy to follow and professional in appearance. • Diagrams rendered in high quality.	• Students present the designs using mostly appropriate technical terminology; detailed and accurate description present throughout most of the document. Document is mostly easy to follow and professional in appearance. • Diagrams rendered in high quality.	• Students present the designs using some appropriate technical terminology; description of design was mostly clear, but difficult to follow in some sections. Document is somewhat easy to follow and was generally professional in appearance. • Diagrams are mostly clear and moderate quality.	• Students present the designs using some correct terminology; description of design was somewhat clear, but difficult to follow in some sections. Document can be followed and was generally professional in appearance. • Diagrams are mostly clear, but low quality.	• Students present the designs using mix of correct and incorrect terminology; description of design was sometimes unclear. Document difficult to follow and was generally not professional in appearance. • Several diagrams are low quality and unclear.	20%

Presentation (20% of Project marks)

Groups will deliver a 7-minute (maximum) presentation providing an overview of your group's design will be held during the Week 11 workshop and practice class periods. Each group member must participate in the presentation and will be awarded individual marks for presentation based on the marking criteria below.

The presentation should contain the following:

- Wastewater catchment description
- Treatment process overview
- Preliminary treatment design
- Primary treatment design
- Secondary treatment design
- Environmental impact

The presentation will be marked based on overall presentation quality, communication of each of the sections listed above, and ability to answer questions about the design. Each group member must participate in delivering the presentation in order to receive a mark for the presentation.