

CIVL4140 ENVIRONMENTAL MODELLING
MIXING AND DISPERSION IN AN ESTUARINE SYSTEM
FIELD WORKS

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Erapah Creek, Redlands, Queensland on 16 Jan. 2003 around 1:30pm - Platform at end of Beveridge Rd (UBD 206 G19), downstream of sewerage plant and upstream of marinas (Site 2) - Looking downstream

1. Presentation

The purpose of the field work is to introduce undergraduate students to the complexity of an estuarine system, the difficulties associated with field experiments and the interactions between hydraulic engineering, biology and ecology. The students will monitor the water quality and hydraulics in the estuary of a small creek, as well as the bird and fish habitats during the same period. They will process and analyse their data, and compare these with the theory (CIVL3140, CIVL4120 & CIVL4140). The assignment will show also practical details which must be considered during the study of a system : e.g., tidal effects, ecological issues, public access, impact of a sewage plant. The creek system is located in the Redlands shire close to Brisbane QLD (Table 1-1).

This field work will be a group work to emphasise **team work, collaborative efforts and communication**. A total of 5 sites will be considered within the estuarine zone (Table 1-1, App. III). Each site will be surveyed and analysed by a group of 6-9 students on Friday 4 April 2003. The project will be concluded by a report submission on 11 April 2003 and an oral presentation on 14 June 2002 (Table 1-2). The latter will be assessed by both lecturers and peers.

Table 1-1 - Site locations on Eprapah Creek

Ref. No.	Description	Location UBD 2001	Comments
1	Point Halloran Conservation Area	206 G/H 17	Right bank. Access via Orana St. Walk along the Conservation area. Take the left branch. At boundary between forest ad mudflat, turn left toward the river bank.
2	End of Beveridge St	206 F 19	Left bank. Access via Beveridge St. At end follow foot track until platform.
3	Eprapah Environmental Training Centre Platform (d/s) end Boardwalk	206 E 20	Right bank. Access from Eprapah Environmental Training Centre.
4	Eprapah Environmental Training Centre Platform [4] Intersection Blue/Green trails	206 D 20	Right bank. Access from Eprapah Environmental Training Centre. Narrow creek section.
5	Eprapah Environmental Training Centre Platform [15] Platypus pool	206 D 20	Right bank. Access from Eprapah Environmental Training Centre.

Table 1-2 - Time table

Week	Date	Description	Remarks
	Mid-February 2003	Dates and site location posted on the Internet	
1	Monday 3 March	Preliminary instructions and dates.	
5	Monday 31 March	Final instructions.	Final day for group organisation.
5	Friday 4 April	Field works	Full day work from 6:00am to 6:00pm. Attendance is compulsory.
6	Friday 11 April	Report submission.	Deadline: 3:00 pm in Dr Chanson's hands.
7	Monday 14 April	Oral presentations for each group (from 12:00 noon).	Every student must attend.

2. Field works

2.1 Field works

The field works will take place on Friday 4 April 2003. Measurements shall be conducted from a low tide to the next low tide : i.e., between 6:00am and 6:00pm to make use of the daylight (Tables 2-1, 2-2 & 2-3). Some readings will be taken every 15 minutes while others may be taken every 20 minutes or every hour (see below, Table 2-3).

Table 2-1 - Tide times (Brisbane bar) {<http://ntf.flinders.edu.au/cgi-bin/tides2>}

Day	Time	Height (m)
Friday 4 April 2003	04:58	0.53
	10:49	2.02
	17:06	0.43
	23:17	2.20

Dr Hubert CHANSON and a number of Civil Engineering Department staff will be in the Eprapah catchment on Friday 4 April 2003 between 6:00am and 6:00pm. They will circulate among groups to provide advice. A headquarter will be based in the Mungara building, Landcare Group, Eprapah Environmental Training Centre (corner of Colburn Ave and Cleveland-Redland Bay Rd, Victoria Point). A safety officer will be on site with a first-aid kit between 6:00am and 6:00pm, and he will be contactable by phone (see paragraph 2.5).

Field equipments (see Table 2-2) will be available from Mr Clive BOOTH (Hydraulic Lab.) on Wednesday and Thursday 2-3 April 2003 between 8:00am and 3:00 pm. ALL the equipments must be returned undamaged no later than Monday 7 April 2003 before 4:00pm to Mr Clive BOOTH (Hydraulic Lab.). (Lateness in returning the equipment and damage to any equipment shall be heavily penalised.)

Note that some equipment was kindly lent by the Department of Zoology and Entomology (UQ) and it must be returned undamaged.

PLEASE clean all equipment before returning all the gears undamaged.

Further the field works will be conducted in Conservation Parks and Environmental Centre. Students are requested to take great care to the environment during the field works. (**All refuse and litter generated by the activity MUST be REMOVED from the reserve areas.**) Any damage attributable to the use of the reserves shall be heavily penalised.

Table 2-2 - List of equipments provided by the University of Queensland

Equipment	Purpose	Remarks
Thermometer/Conductivity meter (1 unit)	Temperature and conductivity measurements	The range of conductivity is limited. Water samples may need to be diluted with freshwater for conductivity measurements of saline waters.
pH paper	pH	
Secchi disk (1 unit)	Turbidity	
Fish trap (1 unit)	Fish habitat and behaviour	Bait (cat food) must be obtained by students.
Fish net (1 unit)	Fish habitat and behaviour	To be used in water no deeper than waist height.
DO titration consumables	dissolved oxygen measurements by titration	Chemicals to be used with care for DO titration only.

2.2 Field measurements

Each group will conduct a series of hydraulic, water quality and ecological measurements with the first reading at 6:00am and the last reading at 6:00pm. Some readings will be taken every 15 minutes while others will be taken at longer intervals (Table 2-3).

Table 2-3 - List of measurements to be conducted between 6:00am to 6:00pm by each group

Measurement	Timing	Remarks
Air Temperature	Every 15 minutes	
Water Temperature	Every 15 minutes	Take a water sample near the surface and one near the bottom. Thermometer/conductivity meter.
Water level	Every 15 minutes	Install a pole with graduation, from where the reading is taken. (Accuracy must be within 1 cm.)
Conductivity (water)	Every 15 minutes	Take a water sample near the surface and one near the bottom. Thermometer/conductivity meter
pH	Every 15 minutes	Take a water sample near the surface and one near the bottom. pH paper
Turbidity	Every 15 minutes	Secchi disk
Water surface velocity	Every 15 minutes	By timing suitable floats over a known distance. Using floating matters (e.g. branch, orange).
Climatic conditions	Every 15 minutes	Use water quality survey form (App. IV) based upon the EPA survey form.
<i>Dissolved Oxygen Content DOC</i>	<i>Every 15 minutes</i>	<i>Use a bucket full of water (closed bucket) for titratio tests.</i>
Fish number and type	Every 30 minutes	Fish trap installed for 20 minutes. Account for 10 minutes to count (and release) fish, clean trap and install bait. Use fish survey form (App. IV).
Fish number and type	Every 30 minutes	Fish net. Water depth must be less than waist height. Use fish survey form (App. IV).
Bird numbers and types	Continuously	Visual observations. May need binoculars. Use bird survey form (App. IV).
Fauna/wildlife numbers and types	Continuously	Visual observations. May need binoculars. Use bird survey form (App. IV).

In addition, students may keep an eye open with regards to special features like saltwater/freshwater fronts, water level surges, ... and record these details (incl. photographs).

Practical considerations

ALL THE DATA shall be recorded in writing. These data will constitute a key component of the final report and of the groupwork assessment. Students are very strongly encouraged to think beforehand how they will record the data and to prepare relevant books and notepads. Any loss of field data is not acceptable. Use carbon copies (e.g. accounting books) to backup your data regularly.

Field observations will include some hydraulic, environmental and ecological measurements.

Hydraulics measurements will include (1) the surface velocity by timing suitable floats over a known distance, and (2) the water level using a pole with graduations from where the reading is taken.

Water quality measurements will include (1) air and water temperatures, (2) water conductivity, (3) pH, (4) turbidity, (5) dissolved oxygen concentrations.

Ecological observations will include (1) fish habitat and behaviour observations using fish trap and net, (2) bird survey from a fixed point and (3) wildlife/fauna observations from a fixed point as well as in the surroundings of the group site.

FISH OBSERVATIONS

- Sites of fish trap and dip net must be changed regularly. Ideally, they must be placed at different types of cover and flow conditions. There are 4 basic combinations :

Vegetation cover	Main flow (Fast)
No cover	Recirculation zones (Slow)

Conduct the observations by rotating the sampling sites between 8 locations (i.e. not re-using a site within 2 hours). Each site must be at least 8-12 m away from the previous one.

- Vegetation cover and zones of flow recirculation are very important parameters affecting fish behaviour. Draw maps of instream habitat and micro-vegetation for low tide and high tide.

- Fish trap (bait trap) must be oriented toward the incoming flow. Fish bait is typically cat food (e.g. GoCat, dry bait, prawn flavour). It must be renewed every time.

- Fish net (dip net) are pushed ahead of you, inclined about 60 degrees and close to the bottom. A fish net pass is typically 3 m long (pushing the fish net in front of you).

- Combined use of bait trap and dip net : use bait trap first, then conduct dip netting at that site.

- When handling fish, use wet disposable gloves (e.g. latex gloves) to handle the fish to avoid damaging their mucus. Fish mucus are very sensitive and dry skin may damage these.

- Exotic fish must not be released into the stream system. Place these in a bucket with few drops of clove oil to put these asleep. Later freeze them to kill them.

NOTES

- Before each water quality reading, rinse once the bucket with creek waters before collecting the water samples.

- Collect water samples about 20 cm beneath the free-surface.

- Each series of measurements conducted every 15 minutes must be reported on a water quality survey form (App. IV).

- Each series of fish observations conducted every 30 minutes must be reported on a fish habitat/behaviour survey form (App. IV).

- For fish habitat and behaviour observations, each group is strongly advised to have the reference book ALLEN et al. (2002) [12].

- Constant monitoring of birds and wildlife must be reported on a bird/wildlife survey form (App. IV).

- For bird observations, each group is strongly advised to have a solid reference book (e.g. [8] SIMPSON et al. 1999; [9] SLATER 1989).

2.3 Preparation

Groups are advised to visit the site at least one week before the field work and to plan all practicalities associated with a 12-hour long field study.

It cannot be stressed enough that field works require a very thorough preparation.

Get a pole/stick and equipment to install strongly a graduated pole/stick for water level readings during the field work. A photograph of the sturdy benchmark (BM) will be included in the report.

Each group must organise a heavy sledge hammer or star picket driver for driving in star pickets and bench mark. The pole/stick must be removed after field works (i.e. after 6:00pm).

Prepare freshwater (if needed to dilute the brackish waters) for conductivity readings ⁽¹⁾. Take a graduated bucket to dilute saltwater samples if necessary.

There is no freshwater available on site. Each group is strongly advised to bring large amounts of fresh/drinking water on site (e.g. 5 L container).

Bring a bucket with a rope (for water collection from a platform).

Get a bucket with a lid (to carry samples for DOC measurements).

Bring ropes, and relevant tools and equipments.

Some groups may need to bring a robust ladder to climb down the bank (without damaging it) at low tide to collect water samples.

Bring Waste Bottles for Dissolved Oxygen Titration Test wastes. The bottle(s) must be **clearly labelled WASTE**.

For the 12 hour study, with 4 titration tests per hour, up to 4-5 litres of wastes may be generated.

Wastes may be discharged in a sink with a lot of running water.

Get bait for fish trap (for all the field work duration).

Bring a waterproof stopwatch to record free-surface velocity.

Free-surface velocities are measured by timing suitable floats (e.g. branch) over a known distance.

Bring a camera and films.

Photographic evidence may be useful to support your report and presentation.

Bring permanent marker pens for relevant marking.

Make up clear and waterproof log-in sheets for all the data recordings for all the day. Have a backup system. **Remember that the data set will constitute a substantial part of the report and assessment.**

Bring gum boots and fishing boots.

Bring any relevant equipment that may be needed. (For example., a ladder to climb down the river without damaging the banks.)

Be prepared for any type of weather (rain, sun, wind).

Bring lights and torches to setup and set down your site.

In Addition

You may find the nearest permanent survey marker and its coordinate.

Include photographs of the field works and of the permanent marker in your documentation.

Groups may consider obtaining aerial photographs.

Find relevant flood studies of the area

Photographs of flood events ...

¹The range of the conductivity meters is 0-20 μ S. (Check units in the documentation.) The upper range is less than 50% of seawater conductivity.

2.4 Access

Eprapah Creek is located in Victoria point. The sites 3, 4 and 5 are located in the Eprapah Environmental Training Centre (Table 1-1). Site 1 is in Point Halloran Environmental Park. Site 2 is on the left bank (Table 1-1).

+ By car, go to Victoria Point.

+ By train/bus : Go to Cleveland train station and take the bus to Victoria point.

+ All the sites are accessible on foot. (Be careful to flooding during rain storm periods and storm surges). During the survey, be aware of local residents. Do not trespass on private properties. Be aware of the risk of bush fires.

Remark : There is a small shopping centre (incl. a Bi-Lo supermarket) at the corner of Colburn Ave and Cleveland-Redland Bay Rd, Victoria Point.

2.5 Safety

Safety is uppermost important during the field works.

+ **Students will be working in groups of no less than 3 people at any time on site.**

+ Students shall have at least two mobile phone on site and switched ON at any time. Each group will provide the lecturer with two contact mobile phone numbers by Monday 31 March 2003. These phone numbers shall be operational on Friday 4 April 2003 and may be used in case of emergency (e.g. bushfire, storms).

Do make sure that your batteries are charged.

+ No work shall be attempted into water more than waist deep. Persons going into the water must wear a life line secured to the bank. Only confident swimmers are to do the work in the water.

+ Good common sense is recommended to avoid any injury : e.g., do not jump from walls, watch your steps.

+ It is strongly advised to wear adequate shoes or boots. Strong clothing is recommended, incl. shorts and trousers.

+ Hat, sunglasses and sun screen are strongly advised. Bring also mosquito/insect repellent.

+ During or immediately before the field works, DO NOT consume alcohol or other intoxicating substances.

+ Drive safely to and back from the field work.

Contact phones

A safety officer will be based in the Mungara building with a first aid kit, for the duration of the field works from 6:00am to 6:00pm. In emergency, he will be contactable at the following number :

Mob. Ph.: **04129 54163**

For emergencies, dial 000.

To get Redland Bay Police Station (Weinman St, QLD 4165), dial (07) 3829 0450

To get Cleveland Police Station, dial (07) 3824 9333 .

To get Brisbane Police Headquarters, dial (07) 33 64 64 64.

2.6 Environmental issues

All field works will be conducted in Conservation Parks and Environmental Centre. Staff and students are requested to take care to the environment during the field works.

+ **All refuse and litter generated by the activity MUST be REMOVED from the reserve areas.**

Wastes from Dissolved Oxygen Titration Test wastes must be removed.

+ Noise and disturbance associated with the field works must be kept at a level which has no negative impact upon the environment (e.g. birds, fish) and surrounding properties.

+ Damage to the banks is not acceptable.

+ Any damage attributable to the use of the reserves will be rectified at cost and the relevant group(s) shall be heavily penalised.

- No vehicles are to access the reserve area.

- During fish observations, exotic fish must not be released into the stream system. Place these in a bucket with few drops of clove oil to put these asleep. Later freeze them to kill them.

- When handling fish, use wet disposable gloves (e.g. latex gloves) to handle the fish to avoid damaging their mucus. Fish mucus are very sensitive and dry skin may damage these.

3. Assignment

An estuary is a water body where the tide meets a river flow and where mixing of freshwater and seawater occurs. Estuaries may be classified as a function of the salinity distribution, and density stratification (CHANSON 2002). That classification does not express however the unique feature of each estuary, and it does not account for seasonal changes, nor for differences between neap and spring tides. The study of mixing in estuary remains a complex process (IPPEN 1966, FISCHER al. 1979, LEWIS 1997, CHANSON 2002).

Erapah Creek is a small system in the Redlands Shire. The estuary was subjected few years ago to major pollution. The problem was dealt with. The estuarine zone is characterised by two environmental parks (Erapah Environment Training Centre and Point Halloran Conservation Park), some marinas and boat yards, and a sewage plant.

Table 3-1 - Internet resources on Erapah Creek

<u>Website</u>	<u>Url</u>
Redlands Shire	http://www.redlands.qld.gov.au/
Redlands Shire, Tourism at Victoria Point	http://www.redlands.net.au/redlandstourism/seeVictoriaPt.htm
Qld EPA Water Quality Monitoring in Redlands Shire	http://www.env.qld.gov.au/environment/science/water/redlands.html

Water quality and ecology are closely monitored at Erapah Creek. For example, the Qld EPA Water Monitoring Group has been surveyed the water quality monthly for years, while Waterwatch and landcare groups regularly monitor aquatic and bird lives. This system and the interactions between hydraulic engineering, water quality and ecology are the topics of the mixing and dispersion field work of the CIVL4140 Environmental Modelling subject. Each group will produce :

- 1- a detailed survey of hydraulic, water quality and ecological parameters monitored during a 12 hour period on Fri. 4 April 2003,
- 2- a complete analysis of the data over a tidal cycle, identifying clearly key features of the estuarine system,
- 3- a comparison of these data with previous observations, and
- 4- recommendations for optimum environmental management of the system.

4. Assessment

4.1 Presentation

The assessment of field works will take place as :

- a group work during the semester (**25% of CIVL4140 subject**), and
- some individual examination at the end of semester examination.

During the semester, students will work in groups of **6-9 people**. The groups will be finalised no later than Monday 31 March 2003 by 1:50 pm. Five sites will be investigated at the locations listed in Table 1-1. This gives room for personal preference in the choice of group number (i.e. site number).

Each student has the responsibility to examine the list of sites (Table 1-1), to find his/her preferred group and to sign up in this group. (The composition of a group shall remain un-changed after Monday 31 March 1:00pm, unless exceptional considerations after discussion with Dr CHANSON.)

4.2 Assessment

The group work will be assessed as a combination of report submission and oral presentation. The group report will be assessed by the lecturer. The oral presentation will be assessed by the lecturers and by the other groups.

Group report	65% (Note the penalty for lateness below)
Presentation (lecturers' assessment)	20%
Presentation (peers' assessment)	15%

4.3 Instructions for report submission

Each report will be assessed upon :

- the field data of the group (35%)
- the data quality and presentation (15%)
- the technical contents, accuracy and soundness (35%)
- the presentation style (15%)

4.3.1 Report submission and instructions

For each group, three copies of the report must be submitted to Dr CHANSON by Friday 11 April 2003. The report will be reviewed by the lecturer.

+ Page Limits

Each report must be complete within a limit of 20 pages including front page, table of contents, main text, figures and references (but excluding appendices and drawings attachments). Reports that exceed this limit will be penalised by **5% penalty per extra page**. Shorter reports of significance will be given preferences.

Each report will be single-sided. Each page must be numbered. The text is to be **single-spaced, 12 pt** Times Roman or similar. The paper is to be printed on plain A4 size paper. The manuscripts must be typed within the area of 255 mm by 170 mm. With a normal A4 size paper, the distances between the edge of the sheet and the text become as follows:

- top: 2.0 cm
- bottom: 2.0 cm
- sides: 2.0 cm

+ Layout of Text

The front page must follow the template given in Appendix II.

The report should contain as a minimum :

- the front page (see Appendix II), followed by
- a table of contents,
- an introduction followed by the text,
- conclusions,
- list of references (bibliography),
- the Appendix I containing all the group data.
- the Appendix II containing all the survey forms (App. IV).

+ Figures and tables

Figures and tables must be placed in the text next to the first reference. These figures and tables would be referred to as "Figure 1" and "Table 1". Titles of figures and tables are to be in 12pt Times Roman.

+ Format for references

Reference should be listed at the end of the paper and should include the following information: Author's family name, Initials. : Paper title, Journal's title, Volume No., (year), pages.

For example :

APELT, C.J. (1983). "Hydraulics of Minimum Energy Culverts and Bridge Waterways." *Australian Civil Engrg Trans.*, I.E.Aust., Vol. CE25, No. 2, pp. 89-95.

CHANSON, H. (1999). "The Hydraulics of Open Channel Flows : An Introduction." *Butterworth-Heinemann*, Oxford, UK, 512 pages. (Reprinted in 2001)

+ **Digital data**

Each group is asked to submit at least one CD containing all their data set in a digital form.

The CD-ROM may also include relevant photographs (JPEG format), some data analysis and a copy of the group report (e.g. PDF format).

The digital data must be properly presented. The material may be sub-divided into sub-directories while a text file, acting as map of the CD-ROM contents, must be placed of the top of the directory tree.

Note : Each group will record a lot of information on the day (4 April 2003). All the information needs to be recorded, including relevant handwritten comments, (The CD-ROM may include a scanned version of the handwritten log-in sheets.)

4.3.2 Deadlines

The group reports are due on **Friday 11 April 2003 before 3:00pm**. The reports must be submitted directly to Dr Hubert CHANSON who will write down, on the cover page, the submission date and time. (It is the responsibility of each group to find the lecturer and to hand him the report.)

Penalty for lateness are 5% per hour of lateness on Friday 11 April 2003 and 50% for submission on Monday 14 April 2003. Note that no assignment/report will be collected on Sat. 12 April nor Sun. 13 April 2003 and that no report will be accepted after Monday 14 April 2003 12:00noon (or start of the first oral presentation).

4.4 Instruction for oral presentation

Presentations will take place on Monday 14 April 2003 between 12:00 noon and 1:30 pm in Room 50-C406 (Civil Engineering Seminar Room). Each group will be given **12 minutes for presentation followed by up to 5 minutes for discussion**. Lecturers and fellow students will contribute to the discussion.

Groups may use Powerpoint presentations, overhead projector transparencies and/or slides. (The Powerpoint files must be provided on a CD-ROM to Dr CHANSON no later than Friday 11 April 2003 3:00 pm. 35-mm slides must be provided to Dr Hubert CHANSON no later than Monday 14 April 2003 11:00 am.)

Each presentation will be judged upon :

- the quality of the data set (15%),
- the technical content (30%)
- the presentation style (20%)
- the expertise and ability to answer questions during the discussion (35%)

4.5 Deadlines

Friday 11 April 2003 before 3:00 pm Complete hydraulic design report

(in Dr CHANSON's hands)

**Monday 14 April 2003 between 12:00 noon
and 1:30 pm**

Room 50-C406 (Civil Engineering Seminar
Room)

Penalty for lateness :

- 5% per hour of lateness on Friday 11 April
- 50% for submission on Monday 14 April

Notes :

- No report will be accepted after Monday 14 April 2003 12:00noon (or start of the first oral presentation)
- No assignment/report will be collected on Sat. 12 nor Sun. 13 April.

Group presentation

Penalty for lateness :

- Presentation time and marks reduced accordingly (e.g. 8 minutes lateness = only 9 minutes for presentation & discussion = 50% penalty)
- Presentation cancelled and zero marks for any group not ready 15 minutes after the official start time.

5. References

- [1] CHANSON, H. (1999). "The Hydraulics of Open Channel Flows : An Introduction." *Butterworth-Heinemann*, Oxford, UK, 512 pages (ISBN 0 340 74067 1). (Reprinted in 2001)
{<http://www.uq.edu.au/~e2hchans/reprints/errata.htm>}
- [2] CHANSON, H. (2002). "Turbulent Mixing and Dispersion in Streams and Estuaries: an Introduction." *Lecture Notes*, Subject CIVL4140, Dept. of Civil Engrg., Univ. of Queensland, Australia, 138 pages.
- [3] CHANSON, H. (2002). "Hydraulic Modelling of Unsteady Open Channel Flows." *Lecture Notes*, Subject CIVL4120, Dept. of Civil Engrg., Univ. of Queensland, Australia, 132 pages.
- [4] "Bird of Eprapah" (1978).
- [5] "ARTHINGTON, A. (1980). "The Freshwater Environment"
- [6] "The Eprapah Visitors' Booklet" (1997)
- [7] Flora and Fauna of Eprapah Creek" (1996)
- [8] SIMPSON, K., DAY, N. and TRUSLER, P. (1999). "Field Guide to the Birds of Australia." (6th ed.) *Penquin Books*, Australia. (UQ Library Call Number : QL693 .B573 1999)
- [9] SLATER, P. (1989). "Field Guide to Australian Birds."(1989 revised edition) *Landsdowne-Rigby*, Willoughby, NSW, Australia. (UQ Library Call Number : QL693 .S63 2001)
- [10] IPPEN, A.T. (1966). "Estuary and Coastal Hydrodynamics." *McGraw-Hill*, New York, USA.
- [10] FISCHER, H.B., LIST, E.J., KOH, R.C.Y., IMBERGER, J., and BROOKS, N.H. (1979). "Mixing in Inland and Coastal Waters." *Academic Press*, New York, USA.
- [11] LEWIS, R. (1997). "Dispersion in Estuaries and Coastal Waters." *John Wiley*, Chichester, UK.312 pages.
- [12] ALLEN, G.R., MIDGLEY, S.H. and ALLEN, M. (2002). "Field Guide to the Freshwater Fishes of Australia." *Western Australian Museum*, Perth, Australia, 394 pages. (UQ Library Call Number : QL636 .A436 2002)

Note : the booklets [4], [5], [6] and [7] may be purchased at discount price from the Landcare group/Waterwatch group.

Internet resources

CHANSON, H. (1999). "CIVL4140 Environmental Modelling. Mixing and Dispersion in Rivers and Estuaries" *Internet resource*.
(Internet address : <http://www.uq.edu.au/~e2hchans/civ4140.html>)

Appendix I - Maps

I-1 UBD Maps 206 & 226

I-2 The Eprapah Visitor's Booklet, pp. 8-9.



Point Halloran Conservation park, Eprapah Creek, Redlands, Queensland (Site 1)

Appendix II - Template of the report front page

Multidisciplinary study of the Site 1 (AMD ??? km) at Eprapah Creek on Friday 4 April 2003 between 6:00am and 6:00pm

<u>Site Ref. No.</u>	<u>Description</u>	<u>Location</u>	<u>Comments</u>
1			

	<u>Initials</u>	<u>Family name</u>	<u>Student ID No.</u>	<u>Signature</u>
1	I.R.	WOOD	20021978	
2				
3				
4				
5				
6				
7				
8				
9				
10				

<u>Submission date</u>	<u>Time</u>	<u>H. CHANSON's initials</u>

Note : Each student who did the field works and contributed to the group report must sign the report. Absence of signature shall mean that the person did not contribute to the field work or to the report preparation.

Appendix III - Photographs of field work sites

Fig. III-1 - Eprapah Creek, Redlands, Queensland on 20 Jan. 2003 around 2:30pm - Downstream of marinas on right bank (Site 1)



Fig. III-2 - Eprapah Creek, Redlands, Queensland on 16 Jan. 2003 around 1:30pm - Platform at end of Beverage Rd (UBD 206 G19), downstream of sewerage plant and upstream of marinas (Site 2) - Looking downstream



Fig. III-3 - Eprapah Creek, Redlands, Queensland on 16 Jan. 2003 around 1:30pm - Looking downstream from the platform at Site 3



Fig. III-4 - Eprapah Creek, Redlands, Queensland on 16 Jan. 2003 around 1:30pm - View from the platform at Site 4



Fig. III-5 - Eprapah Creek, Redlands, Queensland on 16 Jan. 2003 around 1:30pm - View from the platform at the Platypus pool (Site 5)



Fig. III-6 - Koala in Point Halloran Conservation park, Eprapah Creek, Redlands, Queensland on 20 Jan. 2003



Appendix IV - Field work survey forms

IV- 1 Water quality survey form

The following form is based upon the water quality survey form used by the Queensland EPA Water Monitoring Group in their fieldworks.

{<http://www.uq.edu.au/~e2hchans/civ4140/>}

File : TCI402a.pdf

Alternative : {<http://www.uq.edu.au/~e2hchans/civ4140.html>} [Field work]

IV-2 Fish habitat/behaviour survey form

The following document was elaborated by Dr Kevin WARBURTON for Waterwatch groups.

{<http://www.uq.edu.au/~e2hchans/civ4140/>}

File : Fish_sampl.pdf

Alternative : {<http://www.uq.edu.au/~e2hchans/civ4140.html>} [Field work]

IV-3 Bird/wildlife survey form

Bird survey

{<http://www.uq.edu.au/~e2hchans/civ4140/>}

Files : Bird1.pdf

Alternative : {<http://www.uq.edu.au/~e2hchans/civ4140.html>} [Field work]

Fauna observations

{<http://www.uq.edu.au/~e2hchans/civ4140/>}

Files : Fauna1.pdf or Fauna2.pdf

Alternative : {<http://www.uq.edu.au/~e2hchans/civ4140.html>} [Field work]