SET Portfolio
Learning Package

Environmental Elective
Mining and the Environment
ENVI1038
This Learning Package is part of the study materials for ENVI1038 Environmental Elective, which is a course offered by the Science, Engineering and Technology Portfolio at RMIT University. It was written by:

- Rebecca Rose
- Jeff Hughes

and is revised annually by the School of Applied Sciences SET Portfolio.

Published by RMIT University, Melbourne, Victoria, Australia 3000.
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COMMONWEALTH OF AUSTRALIA

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Course Outline

Introduction

Course – Mining and the Environment

Welcome to the unit ‘Mining and the Environment’

The mining industry has a big impact on the economies of resource-rich countries like Australia. However in the mining and processing of minerals there is the potential for significant impacts on the environment.

This unit focuses on the way mining can impact on the environment, with a focus on the impacts on the soil and water environments. Methods used for remediation of mine cites, including specific case studies, are examined.

This course also provides you with an opportunity to appreciate the relevance of the course material in a social, cultural and international context. It will help you assess critical factors necessary to solve environmental problems and critically evaluate reports presented in the media on environmental issues, that will help you communicate ideas and information about the environment in a clear, concise way.

Course Development

Jeff Hughes

From his teachings in both science and the environment, Jeff knows that there is a need for students to have an understanding of the science behind environmental issues. So they are able to make informed decisions about environmental issues after they graduate. The Mining and the Environment course is one of nine courses that were developed.
to give students from other disciplines a chance to broaden their knowledge in an environmental area. Each course has been designed by calling on elements from the existing environmental science program and adding new elements.

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**Phone:** 9925 3370  
**Mailing Address:** School of Applied Sciences  
Level 1, Building 3  
RMIT University  
Latrobe Street, Melbourne 3001

Jeff has a Bachelor of Science majoring in Chemistry and a PhD from Latrobe University (1975). He was a foundation student at Latrobe. He also has degree in mathematics and computing from University of Central Queensland. After teaching for 7 years at Rockhampton he came to RMIT in 1987 and has since taught Chemistry and Environmental Science.

**Name: Rebecca Rose**

**Email:** rebecca.rose@rmit.edu.au

After completing the Bachelor of Applied Science (Environmental Science), at RMIT University, Rebecca completed her honours in waste management. She has also worked as a Landcare Salinity Officer in the Westernport Catchment, and is currently working as an Environmental Scientist, developing an Environmental Management System (EMS) for
a prestigious company within the Olive industry. In the near future, Rebecca will be completing a Master in Environmental Planning.
Conceptual Background

This course assumes that you have:

- Some basic knowledge of science is useful but not essential
- A working knowledge of computers and accessing the internet
- A working knowledge of Microsoft™ WORD or similar packages

Progress Through the Course

Use the Planning and Time Management chart at the end of Course Outline to assist you in working through the course. The chart lists all your topics and their learning outcomes, and the activities and assessments to complete. Make sure you use the Time Management chart as a way of scheduling your time, and assessing your progress.

You will be studying this course over a suggested duration of 13 weeks (approximately 3 hours per week).

When you have completed the course Learning Guide, put aside some time for review before the examination. You will be informed of the examination time by your course coordinator via the Online Classroom.

Communicating with your Course Coordinator

Whenever you have a problem or a question, you will be able to contact your coordinator via email. The email contact is available through http://www.rmit.edu.au/ online using the Online Classroom.
Resources

Computer Access:

You will be able to have online access as a student of RMIT University. You will be given a generic password, which you can then change if you wish.

This will enable you to:

• Ask your coordinator questions via email
• Register and send your assessments when indicated in the Learning Guide
• Access programs online where indicated in the Learning Guide
• Talk to students at other campuses in forums or as part of a group activity
• Access announcements relevant to your study. Make sure you access announcements at least once a week.

Set Text and Resources:

There is no set text for this unit. Some introductory notes are included in ‘Course Documents’ on the DLS site for ENVI 1038. Handouts on resource material are available from the course coordinator. A detailed list of other resources can be found on the DLS site.

Weblinks:

Throughout this course you will be directed to many websites to enhance your studies by using the resources of the Internet. While most of these websites are provided as additional to your study, we recommend that you look at them at least briefly. They have been selected for their quality and innovative approach to the material you are studying. You should find many of them to be illuminating if not fun.

If you are studying online you will be able to click on a weblink to go immediately to the website and the document of interest at that website. In a few cases you may be linked to a Home Page from which you will have to follow a number of prescribed steps to get to the document we would like you to look at.
If you are not studying online you will need to type in the weblink name (its URL) to your browser’s Location (Netscape) or Address (Internet Explorer) bar. You may find it useful to add the website to a Bookmarks (Netscape) or Favourites (Internet Explorer) folder for future reference after you have opened the website.

As with all websites there may be occasions when you try to open the website but are unable to do so. You should consider this no different to when you get busy tone when trying to make a telephone call. Your best advice is to wait a little while and try again. From time to time, however, websites do change and sometimes a resource is withdrawn. We will be monitoring all websites recommended during this course, and if any of them are permanently taken down we will advise you.

**Further Reading:**

The following provide additional references for exploration and are available from the RMIT library:

- RMIT (2005) *Essay Writing Tutorial*, RMIT University Study and Learning Centre. Click on the link or copy and paste the following link into your internet browser: [http://www.dlsweb.rmit.edu.au/lsu/content/2_AssessmentTasks/assess_tuts/essay_LL/index.html](http://www.dlsweb.rmit.edu.au/lsu/content/2_AssessmentTasks/assess_tuts/essay_LL/index.html)

**Study Needs**

Although studying can be difficult at times, you can help yourself by being organised and allocating specific times for your study. There are some general guidelines which may help you:

- Plan your week. Schedule the times when you will be working through the Learning Guide. Use the suggested time allocation in the chart above to estimate how long to plan for each session of study.
• Ask questions of your tutor and institution. Don’t wait until you feel swamped or overwhelmed. Ask questions when you first have a problem.

• Use your student group as a network and assistance. It has been proven many times that a group of students can help each other to keep motivated and working to schedule.

**Course-specific Study Needs**

Feedback will be provided in the following manner:

General comments of relevance to all students undertaking the course will be posted on the Course Discussion Board via the Online Classroom.

Specific comments of relevance to a particular group or student will be sent directly via Student Emails.
Submission of Assessment

You will be submitting your assessments and activities as indicated by the Learning Guide, through the Online Classroom. Your coordinator will provide feedback through the Online Classroom as well.

All work must be presented as specified in the instructions and guidelines in Assessment. You are required to be professional in both presentation and attitude, including meeting of deadlines. Please check the plagiarism statement in the Course Outlines online, and ensure that you follow the guidelines provided.

A schedule of when assessments are due can be found at the start of Assessments.

Plagiarism

RMIT University requires that you present your own work for assessment. The rules against plagiarism – representing the work of others (published or unpublished) as your own – are strict and will be enforced diligently. Here is the RMIT’s current plagiarism statement. Read it and make sure you understand its importance.

Plagiarism statement

Plagiarism is a form of cheating in assessment. Plagiarism may occur in oral, written or visual presentations. It is the presentation of the work, idea or creation of another person, without appropriate referencing, as though it is your own. Plagiarism is not acceptable. The use of another person's work or ideas must be acknowledged. The penalties for cheating in assessment are severe, whether the cheating involves plagiarism, fabrication, falsification of data, copyright infringement or some other method. Penalties can include chargers of academic misconduct, cancellation of results and exclusion from your course. It is also a disciplinary offence for you to allow your work to be plagiarised by another student. You are responsible for keeping your work in a secure place.

Legal Office (university solicitor)

You can keep informed about the University's plagiarism requirements at http://mams.rmit.edu.au/1oavdg0bdd1.pdf.
Evaluation Process

There is an evaluation form available at the Online Classroom on the RMIT website. Please complete and return as indicated at relevant times indicated by your coordinator. Your comments will assist us in improving and refining the materials and resources.

Feedback

Each Learning Outcome in this course is associated with a set of activities to help you master the knowledge and skills required. Some of these activities are self-assessment questions for which answers are provided so that you can assess your achievement throughout your study. We encourage you to attempt these questions before looking at the provided solutions, which you will find at the end of Learning Guide of this Learning Package. (For those studying online you will be able to link directly to the provided solution.)

In some cases activities will be exercises from your prescribed text book. Answers to these questions will, in most cases, be in your text book rather than in this Learning Guide.

You may be asked to prepare descriptive answers to some self-assessment questions. Since there is no one perfect answer to such questions, the provided answer will be an indication of a good response against which you can judge your own response. The provided answer may be a list of key points that your answer should cover, rather than a descriptive answer.
Use of Icons

The following icons have been used throughout this Learning Guide to indicate what you need to do next.

Reference/reading/resource/research – this may be printed and available in: Resources, an additional recommended text, audio or video tape or web site.

Individual Activity – may be self assessment questions, problem solving, demonstration, simulation, lab, checklist/short answer after reading, case study. Complete the activity following instructions given.

Group Activity – may be problem solving, lab, case study, demonstration. Complete the activity following instructions given.

Feedback – turn to Feedback section at end of: Learning Guide to check answers and responses for the activities.

Frequently Asked Questions – provides some responses to key areas students have highlighted as queries or difficulties.

Summary and Outcome Checklist – what has been learnt, in preparation for assessment

Assessment – must be achieved to pass topic or group of topics. Turn to: Assessment for details of assessment requirements.

Additional reading and research to extend knowledge of key area

Evaluation – tool to gain student feedback on course content, structure and/or implementation issues
Generic Attributes of Graduates

The environmental courses in this elective at RMIT are designed to provide the community with graduates who:

- Communicate ideas with a well developed level of written communication
- Identify the factors necessary to aid a solution of an environmental problem
- Critically assess and evaluate factual information on environmental problems
- Are aware of the social and environmental implications of an environmental problem
- Are entrepreneurial and international in outlook and enjoy a challenge

This course integrates development and demonstration of these attributes into the various topics, indicated through outcomes stated at the beginning and statements in the Summary and Outcome Checklist for each topic.
### Planning and Time Management Guide: Environmental Elective – Mining and the Environment

<table>
<thead>
<tr>
<th>Week(s) of study</th>
<th>Topic</th>
<th>Learning outcomes</th>
<th>Approx. hours</th>
<th>Activities</th>
<th>Assessment</th>
<th>Assessment submission week:</th>
</tr>
</thead>
</table>
| Wk 1             | Impact of mining on the Environment The Mining Industry | • Identify the difference between mining and mineral exploration  
• Define the economic importance of the Australian Mineral Industry | 2 Hours | Complete Activity 1 A | Hand Out  
Assessment 1: Impact of mining on the environment 50% due end week 7 Friday at 5pm via Jeff Hughes pigeon hole (3.1.02) and email to [jeff.hughes@rmit.edu.au](mailto:jeff.hughes@rmit.edu.au)  
Assessment 2: Essay on a Case study on the applications of environmental management 50% due end week 12 |
<p>| | | | |</p>
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</thead>
</table>

Friday at 5pm via pigeon hole and electronic copy emailed to jeff.hughes@rmit.edu.au

Reference
The mining and its impact on the Environment-Resource Material Handout posted collected from course coordinator after enrolment in the course.

The mining and the Environment Handout collected from course coordinator after enrolment of the course.
<table>
<thead>
<tr>
<th>Wk 2</th>
<th>Impact of mining on the Environment</th>
<th>Impact of Mining</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Discuss the impact mining has on the environment</td>
<td>2 Hours</td>
</tr>
<tr>
<td></td>
<td>• Discuss the methods to lessen the environmental impact of mining operations/processes</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Wk 3</th>
<th>Impact of mining on the Environment</th>
<th>Acid Mine Drainage</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>• Discuss the formation of Acid Mine Drainage and its associated impact</td>
<td>2 Hours</td>
</tr>
<tr>
<td></td>
<td>• Discuss the methods to lessen the environmental impact of mining operations/processes</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Wk 4</th>
<th>Impact of mining on the Environment</th>
<th>Remediation at a Glance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Discuss the methods to lessen the environmental impact of mining operations/processes</td>
<td>2 Hours</td>
</tr>
<tr>
<td></td>
<td>• List and detail remediation strategies in the mining industry</td>
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</table>

<table>
<thead>
<tr>
<th>Wk 5</th>
<th>Impact of mining on the Environment</th>
<th>Biological Remediation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Discuss the use of biological remediation of mine sites, such as wetlands or phytoremediation</td>
<td>2 Hours</td>
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</table>

<table>
<thead>
<tr>
<th>Wk 6</th>
<th>Impact of mining on the Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Research and evaluate the general impacts of mining, the use of</td>
</tr>
</tbody>
</table>

Environmental Elective – Mining and the Environment
| Essay on the Impact of Mining on the Environment | biological remediation, the impacts and remediation strategies of acid mine drainage and/or the process and impacts of copper extraction
- Discuss the impact mining has on the environment
- Discuss the methods to lessen the environmental impact of mining operations/processes | | environment 50% due end week 6 Friday at 5pm via Jeff Hughes pigeon hole (3.1.02) and email to jeff.hughes@rmit.edu.au |

| Wk 7 | Mining Operations and their Management
Mining Operations: Gold and Copper Mining | - Identify mining operations and discuss the impact they have on the environment, remediation strategies and methods to lessen the environmental impact of operations/processes
- Evaluate the impact mining has on social, environmental and economic values
- Discuss the process of extracting copper mineral from the ore body
- Describe the ways in | 2 Hours Complete Activity 2 A |
### Wk 8

**Mining Operations and their Management**

**Mining Operations: Uranium Mining**

- Identify mining operations and discuss the impact they have on the environment, remediation strategies and methods to lessen the environmental impact of operations/processes
- Evaluate the impact mining has on social, environmental and economic values
- Describe the ways in which uranium mining can impact the environment

| 2 Hours | Complete Activity 2 B |

### Wk 9

**Mining Operations and their Management**

**Environmental Management of Mining Operations**

- Identify the mining environmental management systems and associated assessments

<p>| 2 Hours | Complete Activity 2 C |</p>
<table>
<thead>
<tr>
<th>Wk 10</th>
<th>Case Studies on the Applications of Environmental Management</th>
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<tbody>
<tr>
<td></td>
<td>• Identify and compare environmental issues and policy of two annual Environment Progress Reports</td>
</tr>
<tr>
<td></td>
<td>• Discuss whether the mining company has been successful in achieving its environmental goals</td>
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<tr>
<td></td>
<td>• Identify and discuss the considerations that you would not have expected in the Environmental Impact Assessment</td>
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<tr>
<td></td>
<td>• Clarify whether the mining of uranium should occur at Jabiluka</td>
</tr>
<tr>
<td></td>
<td>• Critically discuss the impact of the Ok Tedi copper mine</td>
</tr>
<tr>
<td></td>
<td>• Evaluate environmental management reports using the knowledge gained of mining environmental management systems and associated assessments</td>
</tr>
<tr>
<td></td>
<td>• Evaluate the impact mining has on social,</td>
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<tr>
<td>4 Hours</td>
<td>Complete Activity 3 A</td>
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**Environmental Elective – Mining and the Environment**
<table>
<thead>
<tr>
<th>Wk 11</th>
<th>Case Studies on the Applications of Environmental Management</th>
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<tbody>
<tr>
<td></td>
<td>environmental and economic values</td>
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<tr>
<td></td>
<td>• Identify and compare environmental issues and policy of two annual Environment Progress Reports</td>
</tr>
<tr>
<td></td>
<td>• Discuss whether the mining company has been successful in achieving its environmental goals</td>
</tr>
<tr>
<td></td>
<td>• Identify and discuss the considerations that you would not have expected in the Environmental Impact Assessment</td>
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<tr>
<td></td>
<td>• Clarify whether the mining of uranium should occur at Jabiluka</td>
</tr>
<tr>
<td></td>
<td>• Critically discuss the impact of the Ok Tedi copper mine</td>
</tr>
<tr>
<td></td>
<td>• Evaluate environmental management reports using the knowledge gained of mining environmental management systems and</td>
</tr>
<tr>
<td></td>
<td>4 Hours Complete Activity 3 B</td>
</tr>
</tbody>
</table>
| Wk 12 | Case Studies on the Applications of Environmental Management | **associated assessments**  
- Evaluate the impact mining has on social, environmental and economic values  
- Identify and compare environmental issues and policy of two annual Environment Progress Reports  
- Discuss whether the mining company has been successful in achieving its environmental goals  
- Identify and discuss the considerations that you would not have expected in the Environmental Impact Assessment  
- Clarify whether the mining of uranium should occur at Jabiluka  
- Critically discuss the impact of the Ok Tedi copper mine  
- Evaluate environmental management reports using the knowledge | 4 Hours | Complete Activity 3 C | Assessment 2: Essay on a Case study on the applications of environmental management 50% due end week 12, Friday at 5pm via pigeon hole and electronic copy emailed to jeff.hughes@rmit.edu.au |
<table>
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<tr>
<th></th>
<th>gained of mining environmental management systems and associated assessments</th>
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<tbody>
<tr>
<td></td>
<td>• Evaluate the impact mining has on social, environmental and economic values</td>
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</tbody>
</table>
Assessment
## Assessment

### Schedule

<table>
<thead>
<tr>
<th>Topic covered</th>
<th>Major Assessment Task</th>
<th>Proportion of final assessment</th>
<th>Submission Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Assessment 1:– Impact of Mining on the Environment, Essay</td>
<td>50 %</td>
<td>Wk 7</td>
</tr>
<tr>
<td>2</td>
<td>Assessment 2:– Essay on a Case study on the Applications of Environmental Management</td>
<td>50 %</td>
<td>Wk 12</td>
</tr>
</tbody>
</table>
Assessment Tasks

Major Assessment 1: Impact of Mining on the Environment, Essay

<table>
<thead>
<tr>
<th>DUE: Friday of week 7, by 5pm AEST (Australian Eastern Standard Time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact of Mining on the Environment, Essay</td>
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</table>

- Answer two of the four questions
- The assessment should be written in the format of an essay
- Your discussion should give a balanced overview of the topic (looking at all sides)
- Your essay should use a variety of references
- The total length of the assignment should be 2000 words.
- The essay questions are located in the document ‘Assessment 1’ in the ‘Mining and the Environment’ folder in ‘Course Documents’
- An assessment guide is included in ‘Course Documents’ in the Online Learning Hub.
- A cover sheet and directions for submitting assignments is also in ‘Course Documents’ in the Online Learning Hub.
Major Assessment 2: Essay on a Case Study on the Applications of Environmental Management

<table>
<thead>
<tr>
<th>DUE: Friday of week 12, by 5pm AEST (Australian Eastern Standard Time)</th>
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</thead>
<tbody>
<tr>
<td>Essay on a Case Study on the Applications of Environmental Management</td>
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</table>

- Answer two of the four questions
- The assessment should be written in the format of an essay
- Your discussion should give a balanced overview of the topic (looking at all sides)
- Your essay should use a variety of references
- The total length of the assignment should be 2000 words.
- The essay questions are located in the document ‘Assessment 2’ in the ‘Mining and the Environment’ folder in ‘Course Documents’
- An assessment guide is included in ‘Course Documents’ in the Online Learning Hub.
- A cover sheet and directions for submitting assignments is also in ‘Course Documents’ in the Online Learning Hub.
Learning Guide
Learning Guide

You are now beginning the course. Please turn to Topic 1 and work your way through the sessions. Remember to use the chart in Course Outline if you are unsure about the next activity or section of work to complete.
Topic 1: Impact of mining on the Environment

Learning Outcomes

Upon successful completion of this topic you will be able to:

- Identify the difference between mining and mineral exploration
- Define the economic importance of the Australian Mineral Industry
- Discuss the impact mining has on the environment
- Discuss the formation of Acid Mine Drainage and its associated impact
- Discuss the methods to lessen the environmental impact of mining operations/processes
- List and detail remediation strategies in the mining industry
- Discuss the use of biological remediation of mine sites, such as wetlands or phytoremediation
- Research and evaluate the general impacts of mining, the use of biological remediation, the impacts and remediation strategies of acid mine drainage and/or the process and impacts of copper extraction

Introduction to the Topic

Mining and its subsequent activities are carried out under the provisions of the Mineral Resources Development Act 1990 and undertaken in accordance to a work authority granted by the Department of Primary Industries. The Australian minerals industry is one of the top five producers of the world’s mineral commodities and injected around $91 billion into the Australian economy in 2006-07.

In this topic you will understand the different types of mining, how mining impacts the economy, the impacts on the soil and water environments and look at attempts that have been tried to
lessen this impact. You will also look at the way Acid Mine Drainage is formed, the conditions necessary for its formation and attempt to treat the problem. Remediation strategies (including wetlands and phytoremediation) for treating mining contamination of land and water will be discussed.

**Background Skills and Knowledge**

Basic knowledge of science  
Ability to use the computer

**Session 1.1 The Mining Industry**

In this session, you are given a variety of references to understand the basics of the mineral industry. The references detail the difference between mining and mineral exploration, the different types of mining processes and the activities and processes for assessing mining proposals, previous and current statistics related to the Australian mineral industry.

**Learning Outcomes**

Upon successful completion of this session, you will be able to:

- Identify the difference between mining and mineral exploration
- Define the economic importance of the Australian Mineral Industry
Activity 1 A

The Mining Industry

Read
The sections “What is mining”, “What is mineral exploration”, “How does mining take place” and “How is mining regulated” in the document “Assessing mining proposals” at the following Link:

to obtain an overview of the mining industry

View
Diagrams 15, and 17-19, in the “Mining and its impact on the environment” resource material collected from the course coordinator, to see a schematic diagram of the typical processes in mining operations and the major components of minerals, respectively

Read
Page 11 of the “Mining and the Environment” handout collected from the course coordinator, to comprehend mining and its affects on Australia’s economy. A 2007 estimate on the impact mining has on the economy is located in the document “The Australian Minerals industry and the Australian Economy” at the following link:

Complete
Self Assessment Quiz: Mining (multiple choice questions), located in the online learning hub under the Course Documents button in the Mining and the Environment folder

Optional
Watch
A 3 minute video on a geologist discussing the difference between mining and mineral exploration that also shows the typical equipment used for underground mining and mineral exploration at the following link:
http://www.youtube.com/watch?v=J0iLuDJfhHU&feature=related

Session 1.2 Impact of Mining

The impacts of mining on the environment can be substantial and varied. In this session we focus on impacts on the soil and water environments and look at attempts that have been tried to lessen this impact.

Learning Outcomes

Upon successful completion of this session, you will be able to:

- Discuss the impact mining has on the environment
- Discuss the methods to lessen the environmental impact of mining operations/processes

Activity 1 B

Impact of Mining

Read
Power point presentation: Environmental Impact of Mining located in the online learning hub under the Course Documents in the Mining and the Environment folder

Read
Pages 20-21 of the “Mining and the Environment” handout collected from the course coordinator, for a summary of the possible impacts of mining, including physical, ecological,
land use, social, infrastructure and heritage aspects

View
Diagrams 1, 2, 4 and 6 - 9 in the “Mining and its impact on the environment” resource material handout collected from the course coordinator, to see the basic water use flow sheet for metal extraction mines and concentrations of heavy metal and other parameters in mine effluent, water use by mineral exploration and mines, concentrations of cations and anions in river water and a guide to the toxic thresholds for freshwater.

Complete
Self Assessment Quiz: Impact of Mining (multiple choice questions), located in the online learning hub under the Course Documents button in the Mining and the Environment folder

Session 1.3 Acid Mine Drainage

Acid Mine Drainage (AMD) is probably the most serious and widespread impact that mining has on water and soil. It occurs whenever sulphide minerals are mined for metals such as gold, copper, lead and silver. We look at the way AMD is formed, the conditions necessary for its formation and attempt to treat the problem.

Learning Outcomes
Upon successful completion of this session, you will be able to:

- Discuss the formation of Acid Mine Drainage and its associated impact
- Discuss the methods to lessen the environmental impact of mining operations/processes
Activity 1 C

Acid Mine Drainage

Read
Power point presentation: Acid Mine Drainage located in the online learning hub under the Course Documents in the Mining and the Environment folder to obtain an overview of Acid Mine Drainage.

View
Diagrams 3 and 5 in the “Mining and its impact on the environment” resource material handout collected from the course coordinator, to see the US EPA classification of acid mine drainage and the concentration of various parameters from a range of mine effluent/discharge.

Read
The section “About this document” at the following link http://www.environment.gov.au/ssd/publications/ssr/125.html to appreciate the extent and potential future liability of acid mine drainage in Australia. Click on the link “discussion and recommendations” to further investigate technologies for managing wastes, transfer and awareness, climatic affects and groundwater, and comparisons with other mines and environmental costs.

Complete
Self Assessment Quiz: Acid Mine Drainage (multiple choice questions), located in the online learning hub under the Course Documents button in the Mining and the Environment folder

Optional
Read
The executive summary of “Remediation options to reduce
acid drainage from historical mining operations at Mount Lyell, Western Tasmania” at the following link: http://www.environment.gov.au/ssd/publications/ssr/108.html that discusses using a conventional neutralization water treatment plant by Solvent Extraction/Electro winning (sx/ew), for another remediation strategy of acid mine drainage.

Session 1.4 Remediation at a Glance

This session introduces the remediation generally and looks at the various options for treating mining contamination of land and water.

Learning Outcomes

Upon successful completion of this session, you will be able to:

- Discuss the methods to lessen the environmental impact of mining operations/processes
- List and detail remediation strategies in the mining industry

Activity 1 D

Remediation at a Glance

Read

Pages 26-28 of the “Mining and the Environment” handout collected from the course coordinator, for the major factors and stages in rehabilitation programs.

Read

Pages 30-31 of the “Mining and the Environment” handout collected from the course coordinator, for a summary of the environmental issues, proposed management and the
anticipated outcomes of the management strategies.

View
Diagrams 10, 14 and 24 of the “Mining and its impact on the environment” resource material handout collected from the course coordinator, to see the advantages and disadvantages of tailings dams, treatment of cyanide waste and treatment methods for sulphidic waste.

Complete
Self Assessment Quiz: Remediation Strategies (multiple choice questions), located in the online learning hub under the Course Documents button in the Mining and the Environment folder

**Session 1.5 Biological Remediation**

Biological remediation is a fairly new approach to mine site remediation but offers many advantages. The use of wetlands and phyto-remediation are gaining increased popularity as they do not involve major additions of chemicals or removal and treatment of large quantities of soil.

**Learning Outcomes**

Upon successful completion of this session, you will be able to:

- Discuss the use of biological remediation of mine sites, such as wetlands or phytoremediation
Activity 1E

Biological Remediation

Read
The document “Constructed wetlands” at the following link:
to get an overview of a typical wetland system, applicability and limitations.

Read
The article “Phytoremediation” at the following link:
http://www.ars.usda.gov/is/AR/archive/jun00/soil0600.pdf
to get an overview of how plants clean up soil and their applicability to mine sites

Complete
Self Assessment Quiz: Biological Remediation (multiple choice questions), located in the online learning hub under the Course Documents button in the Mining and the Environment folder

Optional
Read
The articles “Remediation in Constructed wetlands “, “Constructed wetland technology “, “Evaluation of Substrate Clogging Processes
In Vertical Flow Constructed Wetlands “ and “Screening of plant species for phyto-treatment of wastewater” in the “Remediation of contaminated water by constructed wetlands” document at the following link:
to obtain an overview of using wetlands as remedial strategies discussed at a variety of contaminated sites and a phytoremediation strategy.
Session 1.6 Essay on the Impact of Mining on the Environment

In this session, you are required to select two of the questions from the assignment sheet and research them. Either write about general impacts of mining, the use of biological remediation, the impacts and remediation strategies of acid mine drainage and/or the process and impacts of copper extraction.

Then you are required to discuss your topic in detail to form a coherent, linear argument. Your discussion should give a balanced overview of the topic (looking at all sides) and utilise a number of references.

Start with working out the focus and tasks required to answer the questions. It is a good idea to start reading general texts to gain an overview of the topic and look for potential ways to structure your essay. Write down the main points/arguments of the topic and then find further information on these points/arguments.

Take the time to work through the activities and examples in the essay writing tutorial it will help you structure, plan and order your essays in a logical and coherent manner.

To make writing more efficient, you shouldn’t worry about spelling, grammar, sentence structure or finding the ‘right’ word until you have finalised the content of the essay. It may also be easier to concentrate on the body of the essay first, and then the conclusion followed by the introduction.

Learning Outcomes

Upon successful completion of this session, you will be able to:

- Research and evaluate the general impacts of mining, the use of biological remediation, the impacts and remediation strategies of acid mine drainage and/or the process and impacts of copper extraction
- Discuss the impact mining has on the environment
- Discuss the methods to lessen the environmental impact of mining operations/processes
Activity 1F

Essay on the Impact of Mining on the Environment

Research
Choose two of the four questions listed in the assignment sheet that relate to the impact mining has on the environment. To answer the copper question (d) relevant references are in first session of the next topic ‘Mining Operations and their Management’.

Complete
A 30min to 1 hour essay tutorial located in the online Learning Lab at the following link
http://www.dlsweb.rmit.edu.au/lsu/content/2_AssessmentTasks/01essays.htm

to gain knowledge on how to write an essay. Take the time to work through the activities and examples to aide learning.

Complete
Write an essay on your chosen questions and submit to course coordinator by Friday end of week 7.

Complete
Self Assessment Quiz: “Essay on an environmental problem” located in the online Learning Hub under the Course Documents section in the Hazardous Waste and Contaminated Sites folder.
Summary and Outcome Checklist

Over the past six weeks the way the mining and processing of minerals can have an impact on the environment has been discussed. In particular, Acid Mine Drainage – its causes and potential treatments – has been examined. We have looked at biological methods used to remediate mine sites such as wetlands and phytoremediation.

You may not be able to tick all the statements because they relate to every question in each assessment. In assessment 1 you only answer two of the questions as part of your assessment, therefore you may have some boxes unchecked.

Tick the box for each statement with which you agree:

I can now...

- Identify the difference between mining and mineral exploration
- Define the economic importance of the Australian Mineral Industry
- Discuss the impact mining has on the environment
- Discuss the formation of Acid Mine Drainage and its associated impact
- Discuss the methods to lessen the environmental impact of mining operations/processes
- List and detail remediation strategies in the mining industry
- Discuss the use of biological remediation of mine sites, such as wetlands or phytoremediation
- Research and evaluate the general impacts of mining, the use of biological remediation, the impacts and remediation strategies of acid mine drainage and/or the process and impacts of copper extraction
Assessment

This topic will be assessed as part of the Major Assessment task: 1 (see: Assessment for more detail). This aims to ensure understanding of key concepts of the impacts of mining on the environment.
Topic 2: Mining Operations and their Management

Learning Outcomes

Upon successful completion of this topic you will be able to:

- Identify mining operations and discuss the impact they have on the environment, remediation strategies and methods to lessen the environmental impact of operations/processes
- Evaluate the impact mining has on social, environmental and economic values
- Discuss the process of extracting copper mineral from the ore body
- Describe the ways in which copper mining can impact the environment
- Identify the mining environmental management systems and associated assessments

Introduction to the Topic

In this topic we look at the principles of mine management and the implementation of Best Practices. This is accomplished by examining case studies of mining operations in Australia and PNG.

Background Skills and Knowledge

Basic knowledge of science

Ability to use the computer
Session 2.1 Mining Operations: Gold and Copper Mining

The mining of Gold and Copper has particular impacts on the environment. As both metals occur as sulphide ores or are found with sulphide minerals the potential for Acid Mine Drainage is a very real problem. The use of extremely toxic cyanide in the extraction of gold presents challenging problems to manage, contain and treat the wastes from this process.

Learning Outcomes

Upon successful completion of this session, you will be able to:

- Identify mining operations and discuss the impact they have on the environment, remediation strategies and methods to lessen the environmental impact of operations/processes
- Evaluate the impact mining has on social, environmental and economic values
- Discuss the process of extracting copper mineral from the ore body
- Describe the ways in which copper mining can impact the environment
- Describe the ways in which uranium mining can impact the environment

Activity 2 A

Mining Operations: Gold and Copper Mining

Read
Pages 32-59 of the “Mining and the Environment” handout collected from the course coordinator, for the recovery of copper from ores, the potential impacts of copper processes, an article on a disaster of a copper mine in the Philippines
and associated details of the site and their impacts. The handouts also detail the impacts from the Mt Lyell and Ok Tedi mines.

Read
The Australian industry structure of Gold mining and Copper mining, smelting and refineries at the following link: http://www.ret.gov.au/resources/mining/australian_mineral_commodities/Pages/gold_copper.aspx

View
The diagrams in ‘gold mining.pdf’ (course documents, mining folder), to see a schematic flow sheet of a gold mine and associated descriptions of the processes in a gold mine operation, the treatment of cyanide water, the advantages and disadvantages of tailing ponds and the typical operation of smelting copper.

Complete
Self Assessment Quiz: Copper and Gold Mining (multiple choice questions), located in the online learning hub under the Course Documents button in the Mining and the Environment folder

Reference
Watch
A 10 minute documentary on Ok Tedi copper mine in Papua New Guinea at the following link: http://www.youtube.com/watch?v=bj.qPaOubSqQ that discusses the positive and negative impacts of the mine. The full version of the four corners documentary (44 min) is located in the Swanston Library Audiovisual collection AV 622.18409953 A258

Watch
A video on copper mining at the following link: http://www.youtube.com/watch?v=z6TVCzd2W8&feature=related
to see a landscape view of an open pit copper mine and inside the processing plant in the United States of America,
and a video on copper mining in Australia at the following link:
http://www.youtube.com/watch?v=MOTpg_znKuY
to see an overview of Prominent Hills copper mine and its impact on the Australian economy

Session 2.2 Mining Operations: Uranium Mining

Uranium mining has particular importance for Australia. We have some of the world’s largest reserves but some of these reserves occur adjacent to significant heritage areas such as Kakadu. The competing interests of economic benefits and environmental damage need to be carefully balanced. In this session you look at the approaches that have been taken to managing the environment at the Jabiluka mine in the NT as a particularly important case study.

Learning Outcomes

Upon successful completion of this session, you will be able to:

- Identify mining operations and discuss the impact they have on the environment, remediation strategies and methods to lessen the environmental impact of operations/processes
- Evaluate the impact mining has on social, environmental and economic values
- Describe the ways in which uranium mining can impact the environment
Activity 2 B
Mining Operations: Uranium Mining

Read
The document ‘Impacts of Mining.pdf’ (mining folder, course documents) for the chemical parameters monitored in surface water and groundwater at Jabiluka.

View
The diagram on the typical operations at a Uranium mine in ‘Mining of Copper and Uranium.pdf’ (mining folder, course documents) to see the typical operations at a Uranium mine.

Complete
Self Assessment Quiz: Uranium Mining (multiple choice questions), located in the online learning hub under the Course Documents button in the Mining and the Environment folder.

Research
Watch a 62 minute video on the impact the Jabiluka mine had on an aboriginal community located in the Swanston Library Audiovisual collection AV 305.89915 J11.

Optional
Watch
A video on uranium mining at the following link: http://www.youtube.com/watch?v=lgIWB6I1P-s to see the environmental impacts of uranium mining at Olympic Dam.

Read
to observe the environmental recommendations and requirements for the proposed Uranium mine. There is also a summary of the EIS in the mining folder, course documents.

Read
The assessment of Jabiluka Project from a supervising scientist to the World Heritage Committee at the following link: http://www.environment.gov.au/ssd/publications/ssr/138.html

Session 2.3 Environmental Management of Mining Operations

In this session you look at the environmental management systems that have been set up for mining operations, using Best Practices principles and how they can be assessed.

Learning Outcomes

Upon successful completion of this session, you will be able to:

• Identify the mining environmental management systems and associated assessments

Activity 2 C

Environmental Management of Mining Operations

Read
Pages 2-10 of the “Mining and the Environment” handout collected from the course coordinator to gain an insight to the best practices in environmental management of mining and the principles of the Australian Mineral Industry Code. There is also a media release that emphasises the major deficiencies in the mining code of conduct.
Read
Pages 12-19 of the “Mining and the Environment” handout collected from the course coordinator to gain awareness of the reports required by a mining company prior to exploration and mining, the common features of an environmental Impact Statement including the methodology and the elements required in an Environmental Impact Assessment.

Read
Pages 22-24 of the “Mining and the Environment” handout collected from the course coordinator for a summary of an effective monitoring program and the design and costs associated with an environmental monitoring program.

Complete
Self Assessment Quiz: Management Systems (multiple choice questions), located in the online learning hub under the Course Documents button in the Mining and the Environment folder

Summary and Outcome Checklist
Over the last three weeks the way Best Practices environmental management systems can be implemented to protect the environment has been studied. The mining and processing of gold, copper and uranium have been looked at as specific case studies.

You may not be able to tick all the statements because they relate to every question in each assessment. In both assessments you only answer two of the questions from each of the assignment questions; therefore you may have some boxes unchecked.

Tick the box for each statement with which you agree:

I can now...

☐ Identify mining operations and discuss the impact they have on the environment, remediation strategies and methods to lessen the environmental impact of operations/processes
- Evaluate the impact mining has on social, environmental and economic values
- Discuss the process of extracting copper mineral from the ore body
- Describe the ways in which copper mining can impact the environment
- Identify the mining environmental management systems and associated assessments

**Assessment**

This topic will be assessed as part of the Major Assessment task: 1 and 2 (see: Assessment for more detail). This aims to ensure understanding mining operations their impact and management strategies.
Introduction to the Topic

If the activities of a mining company have the potential to contaminate the surrounding area, the mining company is compelled to produce an environmental impact statement (EIA). The EIA is conducted to integrate environmental aspects into project planning and decision making. Likewise if mining operations contaminates the surrounding area it is the responsibility of that mining company to remediate the site, so that the environment is not degraded.

As an Environmental Scientist employed or contracted by the mining industry, it is your responsibility as an employee or consultant to provide a rationale discussion of the situation and provide relevant recommendations in the format of a report (e.g. environmental improvement plan or environmental impact
statement). However before, you can write such a plan, you need to understand how to interpret previous reports.

This topic has been designed so that you have to read environmental documents produced by a mining company and critically evaluate the document, which will provide you with a real-life example of an issue and/or problem, and give you the opportunity to relate theoretical concepts to practical situations.

Writing an essay/report on a case studies such as these, allows you to use analytical and problem solving skills to examine what has happened and why it has happened, as well as detailing the solutions and recommendations to fix the issue and/or problem.

Background Skills and Knowledge

Basic knowledge of science
Ability to use the computer

Session 3.1 Research Case Study One

Over the next three weeks, you are required to select two of the questions from the assignment sheet, research and then discuss your topic in detail to form a coherent, linear argument. Each discussion should give a balanced overview of the topic (looking at all sides) and utilise a number of references.

In this session it is recommended that you begin with researching your first topic, and in the following session write your essay. However you can use this session to research both topics, it’s up to you.

However, you should start with working out the focus and tasks required to answer the questions. It is a good idea to start reading general texts to gain an overview of the topic and look for potential ways to structure your essay. Write down the main points/arguments of the topic and then find further information on these points/arguments.

Take the time to work through the activities and examples in the essay writing and literature review tutorials to help you structure, plan and order your essays in a logical and coherent manner.
**Learning Outcomes**

Upon successful completion of this session, you will be able to:

- Identify and compare environmental issues and policy of two annual Environment Progress Reports
- Discuss whether the mining company has been successful in achieving its environmental goals
- Identify and discuss the considerations that you would not have expected in the Environmental Impact Assessment
- Clarify whether the mining of uranium should occur at Jabiluka
- Critically discuss the impact of the Ok Tedi copper mine
- Evaluate environmental management reports using the knowledge gained of mining environmental management systems and associated assessments
- Evaluate the impact mining has on social, environmental and economic values

**Activity 3 A**

**Research Case Study One**

Research

Choose one of the questions from Assessment 2 and critically examine and evaluate the topic.

Optional

Complete

An interactive tutorial “literature review” located in the online Learning Lab at the following link

http://www.dlsweb.rmit.edu.au/lsu/content/2_AssessmentTasks/04literature.htm

The tutorial provides tips and guidelines for researching and writing a literature review and four steps to take into

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consideration when reading literature. In short, the tutorial will guide the reader to understand the difference between a poorly and well written literature review. It also shows how to locate, evaluate and read relevant research and how to summarise, analyse and organise literature.

Complete
Self Assessment Quiz: “Essay on an environmental case study” located in the online Learning Hub under the Course Documents section in the Hazardous Waste and Contaminated Sites folder.

**Session 3.2 Write First Report**

In this session, you are required to discuss one of your topics in detail to form a coherent, linear argument. You need to carefully read the relevant documents such as the Best Practices principles or the Jabiluka EIS executive summary. Then you need to look at the questions asked and develop your arguments about the issues presented.

To make writing more efficient, you shouldn’t worry about spelling, grammar, sentence structure or finding the ‘right’ word until you have finalised the content of the essay. It may also be easier to concentrate on the body of the essay first, and then the conclusion followed by the introduction.

**Learning Outcomes**

Upon successful completion of this session, you will be able to:

- Identify and compare environmental issues and policy of two annual Environment Progress Reports
- Discuss whether the mining company has been successful in achieving its environmental goals
- Identify and discuss the considerations that you would not have expected in the Environmental Impact Assessment
- Clarify whether the mining of uranium should occur at Jabiluka
• Critically discuss the impact of the Ok Tedi copper mine
• Evaluate environmental management reports using the knowledge gained of mining environmental management systems and associated assessments
• Evaluate the impact mining has on social, environmental and economic values

Activity 3 B
Write First Report

Write
A report on your first Case Study Assessment

Session 3.3 Research and Write Case Study 2

The second case study should follow the principles discussed for the first report. Remember that it is not just what is in the reports that you should be writing about but also your reactions/comments/ opinions of the measures taken that you should be writing about.

Learning Outcomes

Upon successful completion of this session, you will be able to:

• Identify and compare environmental issues and policy of two annual Environment Progress Reports
• Discuss whether the mining company has been successful in achieving its environmental goals
• Identify and discuss the considerations that you would not have expected in the Environmental Impact Assessment
• Clarify whether the mining of uranium should occur at Jabiluka
• Critically discuss the impact of the Ok Tedi copper mine
• Evaluate environmental management reports using the knowledge gained of mining environmental management systems and associated assessments

• Evaluate the impact mining has on social, environmental and economic values

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**Activity 3 C**

**Research and Write Case Study Two**

**Research**

Choose one of the questions from Assessment 2 and critically examine and evaluate the topic.

**Write**

A report on the second Case Study assessment

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**Summary and Outcome Checklist**

Over the past three weeks we have been looking at how to write a report evaluating issues to do with the management of mining operations and their environmental impact.

You may not be able to tick all the statements because they relate to every question in each assessment. In assessment 2 you only answer two of the questions as part of your assessment, therefore you may have some boxes unchecked.

Tick the box for each statement with which you agree:

I can now...

- Identify and compare environmental issues and policy of two annual Environment Progress Reports
- Discuss whether the mining company has been successful in achieving its environmental goals
- Identify and discuss the considerations that you would not have expected in the Environmental Impact Assessment

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☐ Clarify whether the mining of uranium should occur at Jabiluka

☐ Critically discuss the impact of the Ok Tedi copper mine

☐ Evaluate environmental management reports using the knowledge gained of mining environmental management systems and associated assessments

☐ Evaluate the impact mining has on social, environmental and economic values

Assessment

This topic will be assessed as part of the Major Assessment task: 2 (see: Assessment for more detail). This aims to ensure understanding of key concepts prior to undertaking the end of the semester examination.