

Earth & Environmental Science subject report

2022 cohort

February 2023



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Introduction

Throughout 2022, schools and the QCAA worked together to further consolidate the new Queensland Certificate of Education (QCE) system. The familiar challenges of flood disruption and pandemic restrictions were managed, and the system continued to mature regardless.

We have now accumulated three years of assessment information, and our growing experience of the new system is helping us to deliver more authentic learning experiences for students. An independent evaluation will commence in 2023 so that we can better understand how well the system is achieving its goals and, as required, make strategic improvements. The subject reports are a good example of what is available for the evaluators to use in their research.

This report analyses the summative assessment cycle for the past year — from endorsing internal assessment instruments to confirming internal assessment marks, and marking external assessment. It also gives readers information about:

- how schools have applied syllabus objectives in the design and marking of internal assessments
- how syllabus objectives have been applied in the marking of external assessments
- patterns of student achievement.

The report promotes continuous improvement by:

- identifying effective practices in the design and marking of valid, accessible and reliable assessments
- recommending where and how to enhance the design and marking of valid, accessible and reliable assessment instruments
- providing examples, including those that demonstrate best practice.

Schools are encouraged to reflect on the effective practices identified for each assessment, consider the recommendations to strengthen assessment design and explore the authentic student work samples provided.

Audience and use

This report should be read by school leaders, subject leaders and teachers to:

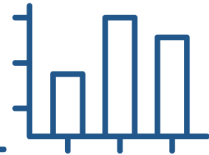
- inform teaching and learning and assessment preparation
- assist in assessment design practice
- assist in making assessment decisions
- help prepare students for external assessment.

The report is publicly available to promote transparency and accountability. Students, parents, community members and other education stakeholders can use it to learn about the assessment practices and outcomes for General subjects (including alternative sequences (AS) and Senior External Examination (SEE) subjects, where relevant) and General (Extension) subjects.

Report preparation

The report includes analyses of data and other information from endorsement, confirmation and external assessment processes. It also includes advice from the chief confirmer, chief endorser and chief marker, developed in consultation with and support from QCAA subject matter experts.

Subject data summary



Subject completion

The following data includes students who completed the General subject.

Note: All data is correct as at 31 January 2023. Where percentages are provided, these are rounded to two decimal places and, therefore, may not add up to 100%.

Number of schools that offered the subject: 22.

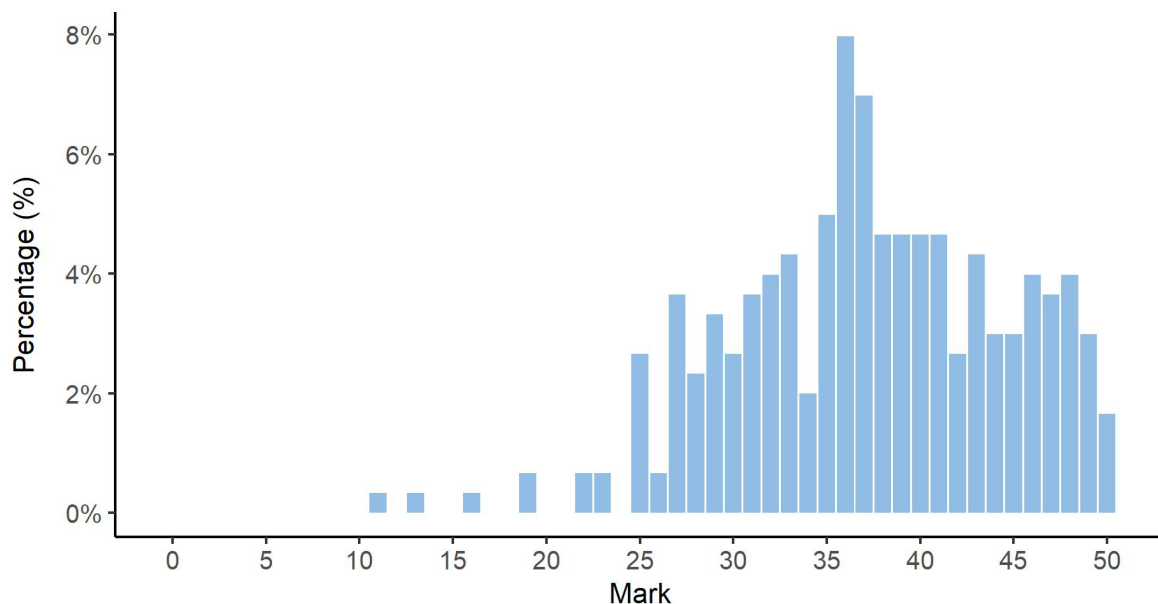
Completion of units	Unit 1	Unit 2	Units 3 and 4
Number of students completed	329	319	297

Units 1 and 2 results

Number of students	Satisfactory	Unsatisfactory
Unit 1	295	34
Unit 2	292	27

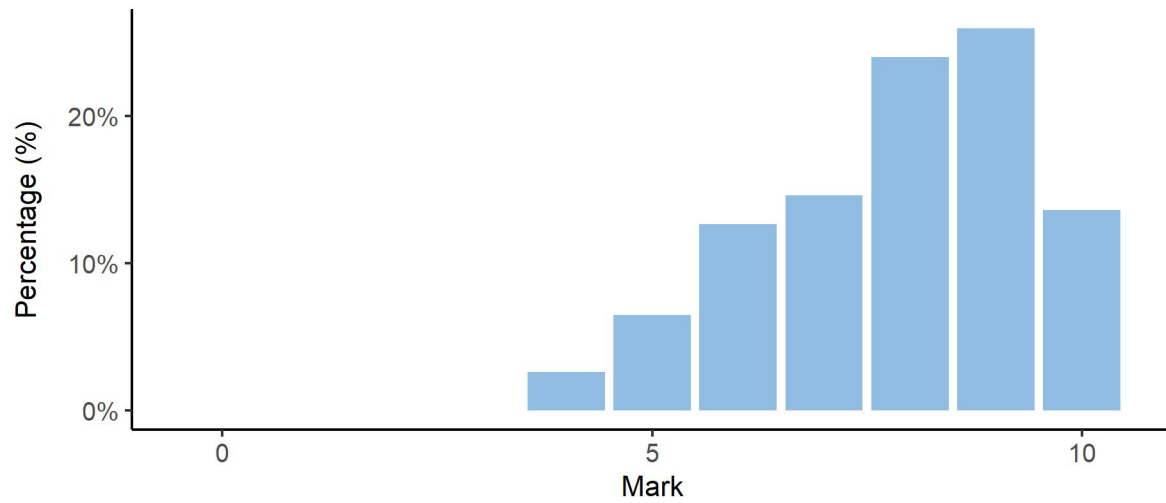
Units 3 and 4 internal assessment (IA) results

Total marks for IA

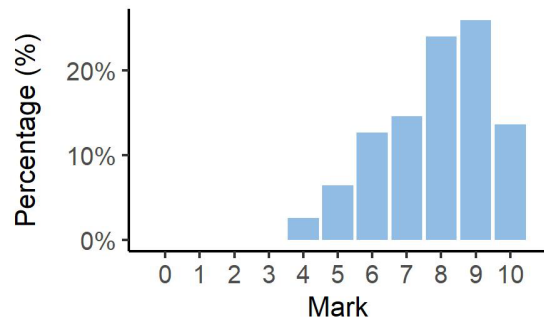


IA1 marks

IA1 total

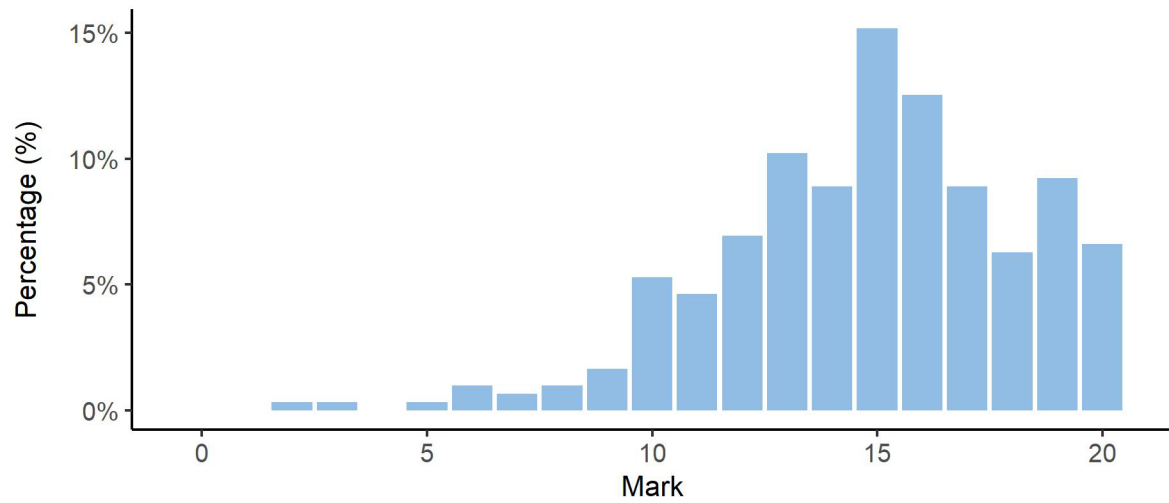


IA1 Criterion: Data test

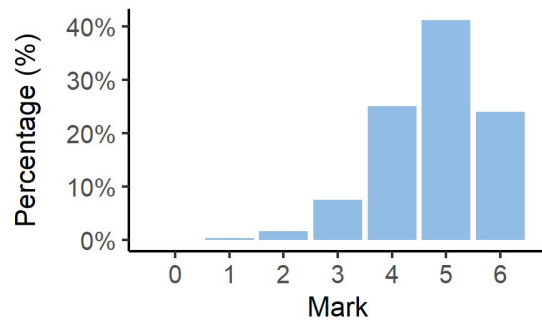


IA2 marks

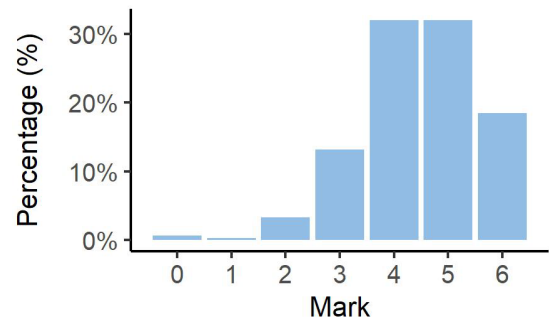
IA2 total



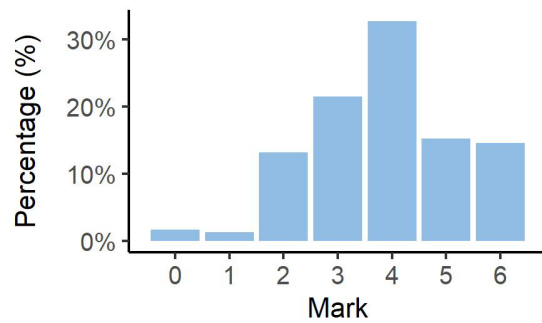
IA2 Criterion: Research and planning



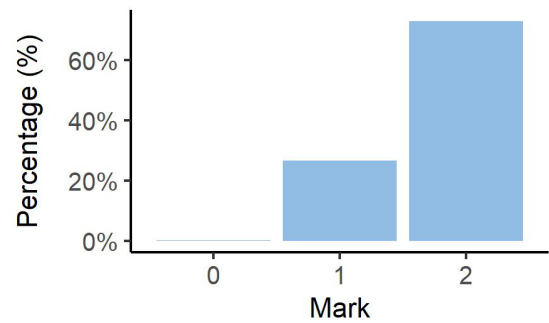
IA2 Criterion: Analysis of evidence



IA2 Criterion: Interpretation and evaluation

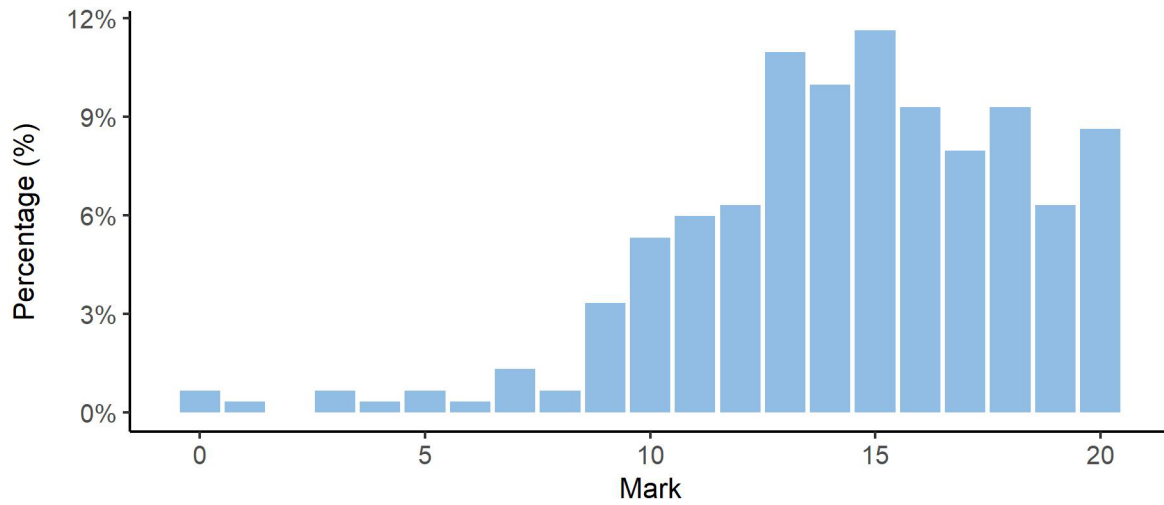


IA2 Criterion: Communication

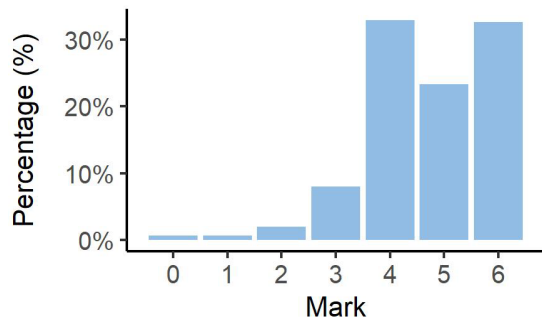


IA3 marks

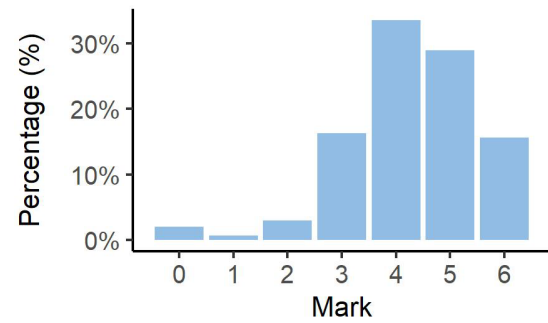
IA3 total



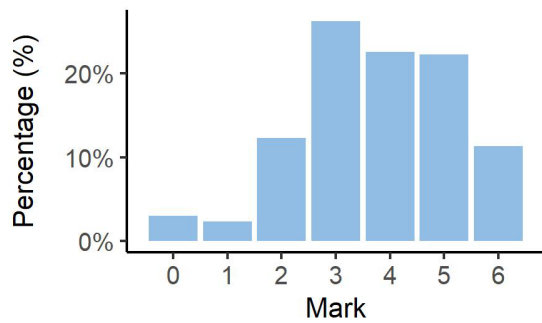
IA3 Criterion: Research and planning



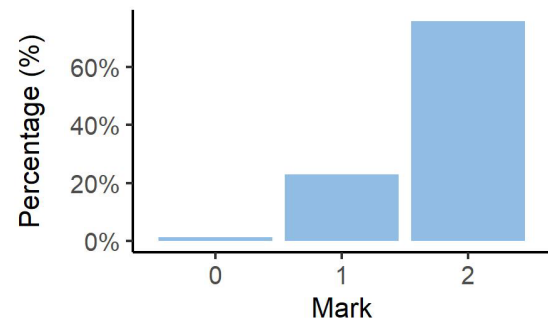
IA3 Criterion: Analysis and interpretation



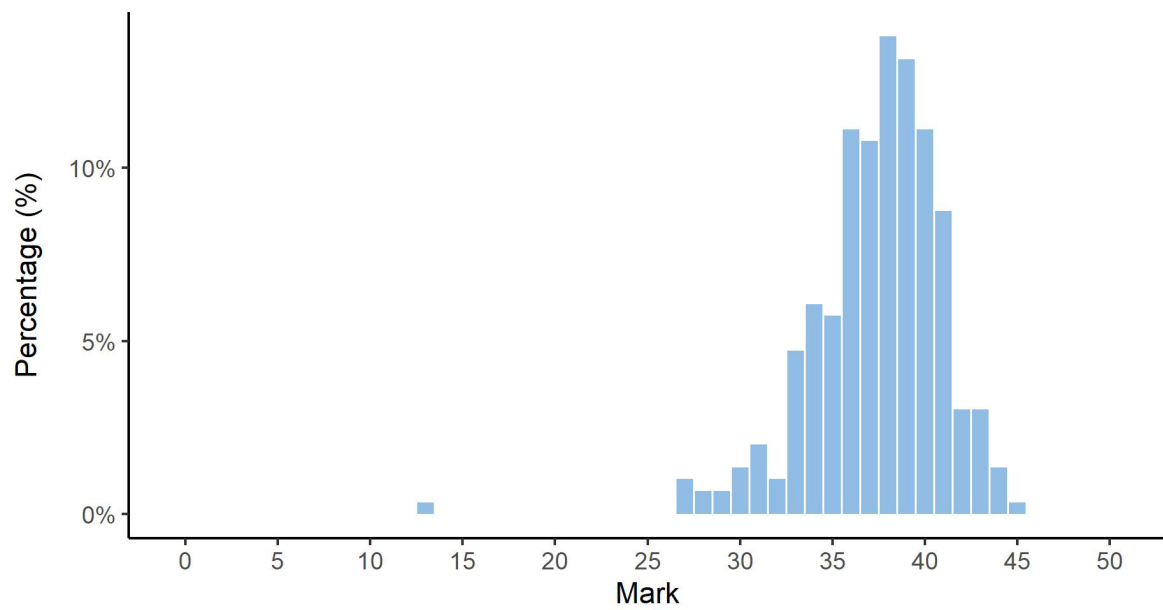
IA3 Criterion: Conclusion and evaluation



IA3 Criterion: Communication

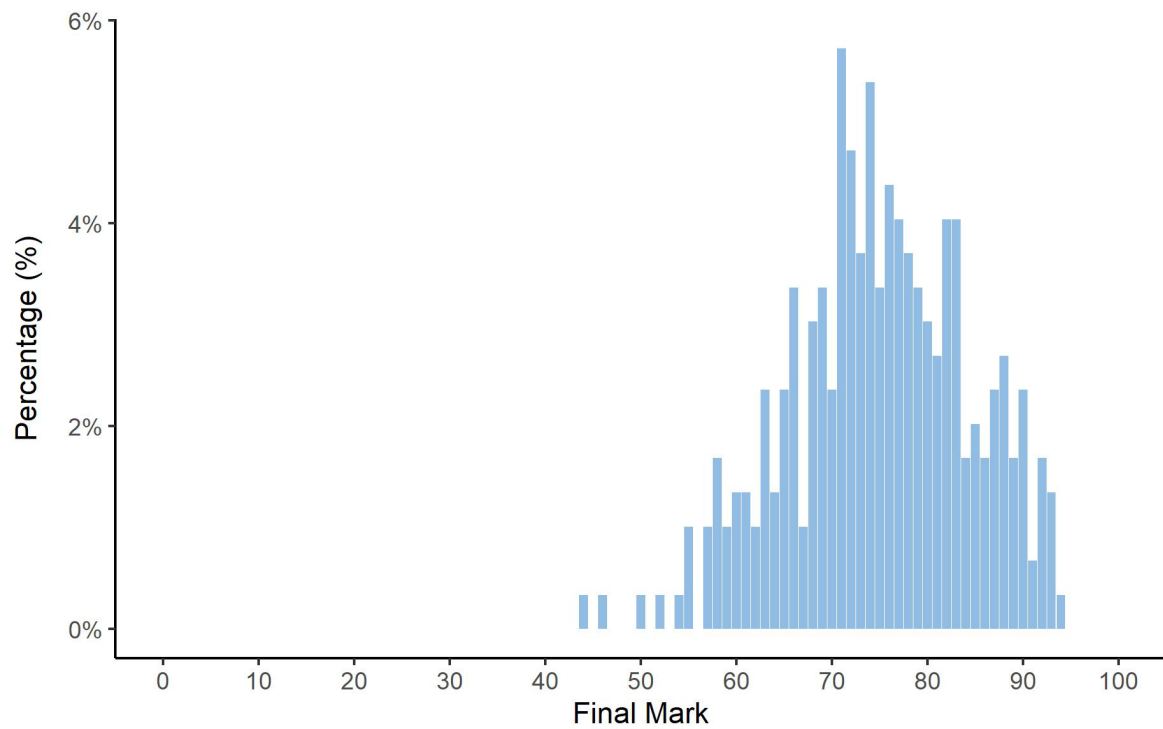


External assessment (EA) marks



Final subject results

Final marks for IA and EA



Grade boundaries

The grade boundaries are determined using a process to compare results on a numeric scale to the reporting standards.

Standard	A	B	C	D	E
Marks achieved	100–83	82–68	67–48	47–20	19–0

Distribution of standards

The number of students who achieved each standard across the state is as follows.

Standard	A	B	C	D	E
Number of students	67	169	59	2	0

Internal assessment



The following information and advice relate to the assessment design and assessment decisions for each IA in Units 3 and 4. These instruments have undergone quality assurance processes informed by the attributes of quality assessment (validity, accessibility and reliability).

Endorsement

Endorsement is the quality assurance process based on the attributes of validity and accessibility. These attributes are categorised further as priorities for assessment, and each priority can be further broken down into assessment practices.

Data presented in the Assessment design section identifies the reasons why IA instruments were not endorsed at Application 1, by the priority for assessments. An IA may have been identified more than once for a priority for assessment, e.g. it may have demonstrated a misalignment to both the subject matter and the assessment objective/s.

Refer to *QCE and QCIA policy and procedures handbook v4.0*, Section 9.5.

Percentage of instruments endorsed in Application 1

Number of instruments submitted	IA1	IA2	IA3
Total number of instruments	22	22	22
Percentage endorsed in Application 1	40%	72%	45%

Confirmation

Confirmation is the quality assurance process based on the attribute of reliability. The QCAA uses provisional criterion marks determined by teachers to identify the samples of student responses that schools are required to submit for confirmation.

Confirmation samples are representative of the school's decisions about the quality of student work in relation to the instrument-specific marking guide (ISMG), and are used to make decisions about the cohort's results.

Refer to *QCE and QCIA policy and procedures handbook v4.0*, Section 9.6.

The following table includes the percentage agreement between the provisional marks and confirmed marks by assessment instrument. The Assessment decisions section of this report for each assessment instrument identifies the agreement trends between provisional and confirmed marks by criterion.

Number of samples reviewed and percentage agreement

IA	Number of schools	Number of samples requested	Number of additional samples requested	Percentage agreement with provisional marks
1	22	133	0	90.91%
2	22	135	5	81.82%
3	22	134	0	86.36%

Internal assessment 1 (IA1)



Data test (10%)

This assessment focuses on the application of a range of cognitions to multiple provided items. Student responses must be completed individually, under supervised conditions, and in a set timeframe.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions*
Alignment	9
Authentication	0
Authenticity	0
Item construction	2
Scope and scale	3

*Each priority might contain up to four assessment practices.

Total number of submissions: 22.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- included datasets derived from practicals, activities or case studies that align to the teaching and learning of Unit 3
- had an appropriate number of datasets and questions for students to respond to in a 60-minute examination.

Practices to strengthen

It is recommended that assessment instruments:

- use cognitive verbs that align to the assessment objectives as shown in the Mark allocations table (Syllabus section 4.5.1)
- categorise questions that require students to identify trends, patterns, relationships, limitations or uncertainty as assessment objective 3 (analyse evidence), not objective 2 (apply understanding)
- only include questions that require students to respond to the data within the data test.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions*
Bias avoidance	1
Language	3
Layout	1
Transparency	0

*Each priority might contain up to four assessment practices.

Total number of submissions: 22.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- used consistent language and ways of referring to figures across all datasets and questions
- presented data that was clear for students to read when responding to questions.

Practices to strengthen

It is recommended that assessment instruments:

- have consistent labelling of figures and tables across datasets and the questions that reference them
- include data that is accessible for students to interpret, without unnecessary figures or text, and with clearly readable axes, titles, labels and headings.

Additional advice

- Cues prompting the requirements for a student response should align to a cognition associated with the assessment objective related to the question, e.g. 'Justify your response' aligns to objective 4 (interpret evidence).

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Data test	90.91%	0%	9.09%	0%

Effective practices

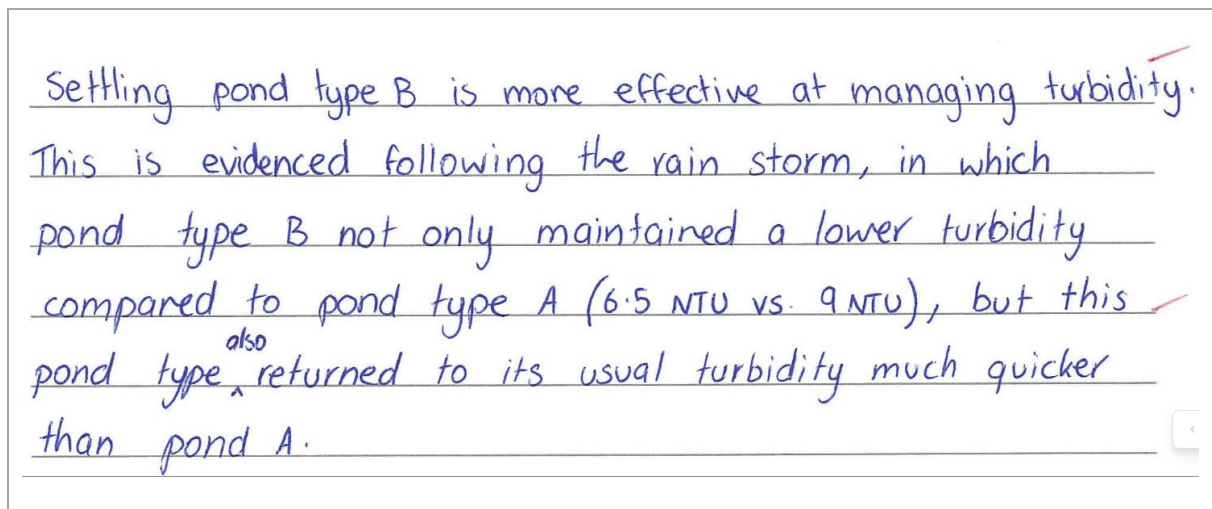
Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- schools developed marking schemes that clearly and consistently matched each mark to an important feature in the expected response and described how marks were allocated to alternative responses
- marking schemes were accurate, complete and matched to the endorsed instrument
- student responses were annotated to clearly indicate how the response was marked against the marking scheme (*QCE and QCIA policy and procedures handbook v4.0*).

Samples of effective practices

The following excerpt demonstrates the use of annotations on a student response to indicate where evidence matches the marking scheme in an objective 4 item that required students to interpret evidence from two different settling ponds and draw a conclusion about which pond was more effective at managing turbidity after a rain storm.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.



Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG for this IA, it is recommended that:

- mark totals and percentages are determined correctly, and the correct percentage cut-offs from the ISMG are used to determine the final mark (Making judgments webinar)
- schools update marking schemes to indicate how unexpected responses were marked.

Additional advice

- Schools may consider implementing internal quality assurance processes (e.g. cross marking) across large cohorts to ensure marker reliability.
- Schools should ensure that all pages are correctly scanned and are readable before uploading.
- Schools should provide a correct and accurate marking scheme for any comparable assessment and consistently apply this marking scheme across cohorts.



Student experiment (20%)

This assessment requires students to research a question or hypothesis through collection, analysis and synthesis of primary data. A student experiment uses investigative practices to assess a range of cognitions in a particular context. Investigative practices include locating and using information beyond students' own knowledge and the data they have been given.

Research conventions must be adhered to. This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions*
Alignment	6
Authentication	0
Authenticity	0
Item construction	0
Scope and scale	0

*Each priority might contain up to four assessment practices.

Total number of submissions: 22.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- directed students to modify an experiment that provided opportunities to collect primary data
- included practicals that aligned to Unit 3 subject matter, e.g. 'Conduct an experiment to model turbidity management strategies using settling ponds'.

Practices to strengthen

There were no significant issues identified for improvement.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions*
Bias avoidance	0
Language	0
Layout	0
Transparency	0

*Each priority might contain up to four assessment practices.

Total number of submissions: 22.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- provided direction for students to address all the task specifications (Syllabus section 4.5.2)
- demonstrated the alignment between task instructions and the ISMG
- avoided unnecessary jargon throughout scaffolding sections.

Practices to strengthen

There were no significant issues identified for improvement.

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Research and planning	95.45%	4.55%	0%	0%
2	Analysis of evidence	90.91%	9.09%	0%	0%
3	Interpretation and evaluation	90.91%	9.09%	0%	0%
4	Communication	100%	0%	0%	0%

Effective practices

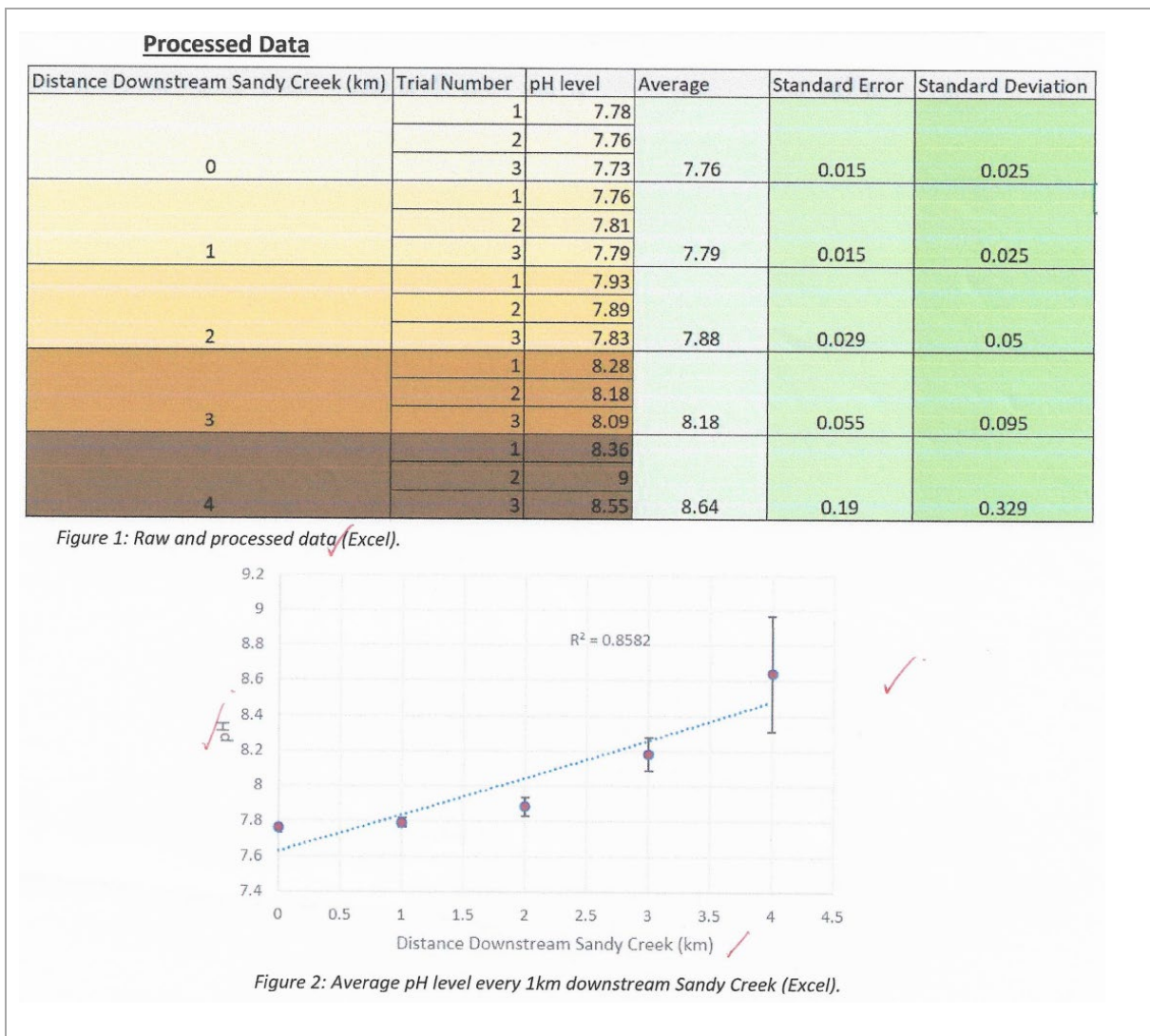
Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- in the Analysis of evidence criterion
 - *thorough* identification of trends, patterns or relationships involved
 - explanation — rather than restatement — of descriptive statistics, e.g. mean, standard deviation and standard error
 - identification of trends within correlation (if appropriate to research question), including the strength and direction of the relationship based on Pearson's correlation coefficient or Spearman's rank correlation coefficient
 - *thorough and appropriate* identification of uncertainty and limitations of evidence involved scrutinising the evidence rather than discussing problems with methodology
- in the Interpretation and evaluation criterion
 - conclusions were *justified* by referring to the trends, patterns or relationships and the uncertainty and limitations identified in the analysis of evidence to determine how the evidence matched with the theoretical concepts identified in the rationale
 - suggested improvements to the experiment were *logically derived* from the limitations of evidence identified in the analysis to improve the reliability and validity of the experiment.

Samples of effective practices

The following excerpt demonstrates correct processing of data, including the addition of error bars to the graph.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.



Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG for this IA, it is recommended that:

- in the Research and planning criterion
 - *justified* modifications to the methodology should explicitly identify meaningful refinements, redirections or extensions of a practical and ensure that sufficient, relevant data is collected to draw valid conclusions, e.g. at least five data points to establish a trend
 - a *considered* rationale should clearly connect the research question to Unit 3 subject matter, clearly identify the experiment to be modified, communicate the experiment's purpose and introduce research to support altered variables
 - a *specific* research question clearly identifies an independent and dependent variable and is explicit enough to be answered within the required response length.

Additional advice

- Research questions should be based on practicals that consider only one dependent variable (e.g. mandatory or suggested practicals from the syllabus) rather than complicated practicals that consider more than one dependent variable or involve complex systems in which external variables are difficult to control.
- Schools should review advice about how to determine provisional marks using the best-fit model. Refer to the Making judgments webinar in the QCAA Portal.
- Schools should use the ISMG from the syllabus without making any changes to wording or formatting.
- Teachers should provide students with opportunities to engage with a variety of inquiry skills and analytical process (e.g. collect, process, analyse, interpret and evaluate data) as part of their ongoing teaching and learning.
- Schools must use appropriate strategies to manage response length and promote academic integrity (*QCE and QCIA policy and procedures handbook v4.0*, Sections 8.1 and 8.4).



Research investigation (20%)

This assessment requires students to evaluate a claim. They will do this by researching, analysing and interpreting secondary evidence from scientific texts to form the basis for a justified conclusion about the claim. A research investigation uses research practices to assess a range of cognitions in a particular context. Research practices include locating and using information beyond students' own knowledge and the data they have been given.

Research conventions must be adhered to. This assessment occurs over an extended and defined period of time. Students may use class time and their own time to develop a response.

Assessment design

Validity

Validity in assessment design considers the extent to which an assessment item accurately measures what it is intended to measure and that the evidence of student learning collected from an assessment can be legitimately used for the purpose specified in the syllabus.

Reasons for non-endorsement by priority of assessment

Validity priority	Number of times priority was identified in decisions*
Alignment	1
Authentication	1
Authenticity	2
Item construction	0
Scope and scale	9

*Each priority might contain up to four assessment practices.

Total number of submissions: 22.

Effective practices

Validity priorities were effectively demonstrated in assessment instruments that:

- provided students with a range of claims clearly derived from Unit 4 subject matter, e.g. 'Endangered species cannot survive prolonged drought'
- constructed claims which allow students to develop a range of specific research questions, e.g. 'Tsunami early warning systems save lives'.

Practices to strengthen

It is recommended that assessment instruments:

- include claims that are within the scope of the syllabus and have an appropriate scale for an IA3 instrument.

Accessibility

Accessibility in assessment design ensures that no student or group of students is disadvantaged in their capacity to access an assessment.

Reasons for non-endorsement by priority of assessment

Accessibility priority	Number of times priority was identified in decisions*
Bias avoidance	0
Language	0
Layout	0
Transparency	1

*Each priority might contain up to four assessment practices.

Total number of submissions: 22.

Effective practices

Accessibility priorities were effectively demonstrated in assessment instruments that:

- included scaffolding that supports students to address the assessment specifications (Syllabus section 5.5.1).

Practices to strengthen

There were no significant issues identified for improvement.

Assessment decisions

Reliability

Reliability is a judgment about the measurements of assessment. It refers to the extent to which the results of assessments are consistent, replicable and free from error.

Agreement trends between provisional and confirmed marks

Criterion number	Criterion name	Percentage agreement with provisional	Percentage less than provisional	Percentage greater than provisional	Percentage both less and greater than provisional
1	Research and planning	86.36%	9.09%	4.55%	0%
2	Analysis and interpretation	90.91%	4.55%	4.55%	0%
3	Conclusion and evaluation	90.91%	4.55%	4.55%	0%
4	Communication	95.45%	4.55%	0%	0%

Effective practices

Accuracy and consistency of the application of the ISMG for this IA was most effective when:

- in the Research and planning criterion
 - a *considered* rationale clearly connected the research question to the claim and Unit 4 subject matter
 - *sufficient and relevant* sources from a variety of scientifically credible outlets were identified and not limited to peer-reviewed journal articles
- in the Analysis and interpretation criterion
 - *relevant* evidence was presented in a manner that allowed for *thorough* identification of trends, patterns or relationships to answer the research question
 - limitations of evidence were *thoroughly and appropriately* identified with respect to the research question, e.g. weak points of the data
 - scientific arguments were *justified* using concepts from Unit 4 subject matter and evidence from the analysis.

Samples of effective practices

The following excerpt demonstrates a justified conclusion linked to the research question and extrapolation of credible findings to the claim

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

Conclusion

Findings from the report contribute to the answering of the research question: 'Has anthropogenic climate change had an influence on the frequency and severity of harmful algal blooms and therefore impacted the overall biodiversity of ocean fauna?'. The report has found that anthropogenic climate change which has occurred since the industrial revolution has had an impact on the growth rate and bloom season of toxic algae blooms. Correlations were found between an increased global average atmospheric and therefore ocean temperatures induced by humans and an increased growth rate (severity) and bloom season length (frequency) of toxic algal blooms in the north atlantic ocean. Findings then linked these increases to an increase in marine fauna being vulnerable to extinction in the same time period. Therefore, overall findings show anthropogenic climate change has had an influence on an increased frequency and severity of harmful algal blooms and these trends have a correlation with increased ocean fauna vulnerability risks and decreased ocean fauna biodiversity in the same timeframe. This conclusion supports and agrees with the claim as it shows that ocean temperatures do affect the distribution patterns of flora and fauna.

The following excerpt demonstrates concise examples of improvements and extensions that are considered and relevant.

Note: The characteristic/s identified may not be the only time the characteristic/s has occurred throughout a response.

Improvements and extensions

To improve the research report, further research could have been done to verify the influences that anthropogenic atmospheric climate change has on ocean temperatures in order to verify whether Figure 1's trends were accurate to an ocean temperature context. Another improvement that could be made to the report would be to investigate more direct correlations between harmful algal blooms and the extinction of species. Findings from the report found an increased number of vulnerable ocean fauna has taken place with anthropogenic climate change, however all of the sources and their impacts on these increased numbers were unknown and likely were not exclusively to do with an increase in toxic algal bloom occurrences.

Considered + relevant

An extension that could be made to the report would be to investigate the effects that harmful algal blooms have on flora. The claim includes the words flora and fauna, however for this investigation only algal bloom's effects on fauna were investigated. Another extension that could be made to the report would be to investigate additional impacts on flora and fauna that a change in ocean temperatures bring such as coral reefs; a home of many ocean flora and fauna. This would provide more insight into the impacts that ocean temperatures have on the distribution patterns of flora and fauna.

Practices to strengthen

To further ensure accuracy and consistency of the application of the ISMG for this IA, it is recommended that:

- in the Conclusion and evaluation criterion
 - conclusions should be *justified* using the scientific arguments developed in the analysis and interpretation of the evidence rather than restating trends, patterns or relationships
 - an *insightful* discussion of the quality of the evidence should
 - be clearly related to the research question
 - refer to the limitations identified in the analysis of the evidence
 - suggested extensions and improvements that are *considered and relevant* should
 - be based on the discussion of the quality of the evidence
 - have a direct bearing on the claim.

Additional advice

- Teachers should use resources and teaching strategies that enable students to understand the specific requirements of a research investigation (IA3 effective processes and practices resource).
- Schools must use appropriate strategies to manage response length and promote academic integrity (*QCE and QCIA policy and procedures handbook v4.0*, Sections 8.1 and 8.4).
- Schools should use the ISMG from the syllabus without making any changes to wording or formatting.

External assessment



External assessment (EA) is developed and marked by the QCAA. The external assessment for a subject is common to all schools and administered under the same conditions, at the same time, on the same day.

Examination (50%)

Assessment design

The assessment instrument was designed using the specifications, conditions and assessment objectives described in the summative external assessment section of the syllabus. The examination consisted of two papers:

- Paper 1, Section 1 consisted of multiple choice questions (15 marks)
- Paper 1, Section 2 consisted of short response questions (27 marks)
- Paper 2, Section 1 consisted of short response questions (33 marks)
- Paper 2, Section 2 consisted of an extended response question (14 marks).

The examination assessed subject matter from Units 3 and 4. Questions were derived from the context of Use of renewable and non-renewable Earth resources and The cause and impact of Earth hazards and global climate change.

The assessment required students to respond to multiple choice and short response questions.

Assessment decisions

Assessment decisions are made by markers by matching student responses to the external assessment marking guide (EAMG). The external assessment papers and the EAMG are published in the year after they are administered.

Multiple choice question responses

There were 15 multiple choice questions in Paper 1.

Percentage of student responses to each option

Note:

- The correct answer is **bold** and in a blue shaded table cell.
- Some students may not have responded to every question.

Question	A	B	C	D
1	3.75	86.35	9.56	0.34
2	17.41	8.53	40.96	33.11
3	5.46	24.57	53.24	16.72
4	18.09	18.09	31.4	32.42

Question	A	B	C	D
5	2.39	1.37	89.42	6.83
6	30.72	13.99	43	12.29
7	4.78	45.05	49.83	0.34
8	5.12	5.8	19.45	69.62
9	5.8	7.85	24.57	61.77
10	17.75	13.65	10.58	58.02
11	43.69	27.99	21.16	7.17
12	23.55	49.83	13.99	12.63
13	27.3	27.3	20.14	24.91
14	19.11	44.71	10.58	25.6
15	17.06	22.53	44.71	15.7

Effective practices

Overall, students responded well to:

- questions that related to the causes and impacts of global climate change
- opportunities to apply their understanding of the connections between syllabus topics and units
- questions that required application of knowledge in familiar situations.

Samples of effective practices

Short response

The following excerpts are from Question 2a from Paper 2. It required students to contrast the climatic conditions expected for continental configurations and explain the expected differences in climate at a later time period.

Effective student responses:

- identified three pieces of evidence to demonstrate the difference in climatic conditions
- identified the relative difference in temperature at different time periods
- explained how the Antarctic Circumpolar Current prevents warm currents from reaching the current
- provided reasoning using data from the stimulus.

These excerpts have been included:

- to demonstrate effective reasoning and explanations using data from the stimulus.

Excerpt 1

Map A is made of 1 big super continent known as pangea whereas Map B has oceans separating continents. The coast of a continent is usually more humid and receives more rainfall than the center. Map B has a higher surface area of coast so the continental conditions will be more humid with higher rainfall. The latitude also changes climate conditions, latitude of 0° at the equator experiences more rainfall whereas latitudes of 30° N/S are more arid. In Map A there is more continent exposed at 0° so there would be increased wet conditions. There is also more continents around 60° N or S in Map B so there would be lower temperatures in Map B compared to A. Map A doesn't have ocean between the South American and Australian continents so there would be no trade winds or El Niño Southern Oscillation so there would be more consistent climates rather than periodical droughts and floods caused by the Southern Oscillation Index. And Map B would have these cyclic climates of floods and droughts due to El Niño's and La Niña's.

Excerpt 2

The Antarctic circumpolar current is a thermohaline current that also controls climate as it brings cooler Antarctic waters further north. Because of this Map B would have more extreme temperature differences and Antarctica would be cooler in Map B than C because it isn't receiving any warm water from the current.

The following excerpt is from Question 3c from Paper 2. It required students to infer how the runoff coefficient would evolve in the short and long term for an area.

Effective student responses:

- inferred the run-off coefficient increased in the short term and decreased in the long term
- justified the conclusion with respect to the short term
- justified the conclusion with respect to the long term.

This excerpt has been included:

- to demonstrate a justified conclusion that considers the differences in long and short term expressed in the stimulus.

After May 2021 it is likely Plant will begin to repopulate the region. Once this occurs ~~runoff~~ runoff will decrease due to the particles being held together by the plant's roots after this the values will stabilise and runoff coefficient will return to normal as supported by October 2020 in stimulus 3 where runoff spiked to 22 m³/s then restabilised. Short term will slowly improve over long term normal values will return.

Extended response

The following excerpt is from Question 6b. It required students to describe the impact of a mine and the associated environmental monitoring strategies.

Effective student responses:

- described strategies to monitor the impacts of the mine on the
 - hydrosphere
 - geosphere
 - biosphere
 - atmosphere.

This excerpt has been included:

- to demonstrate a description that includes each of the four systems.

Hydrosphere:- water is necessary for the separation of coal ^{because} for the ~~coal floats~~ ^{coal floats} and gangue ~~sinks~~ ^{sinks} however turbid water can ~~damage river ecosystems~~ ^{kill plants and animals}. A turbidity ~~meter~~ ^{meter} can monitor the turbidity of the local waterways

Geosphere:- Mine sites use chemicals that are toxic that can leach into geosphere causing soil to be infertile. Using pH tests on soil can monitor any changes from the baseline

Biosphere:- ~~Removing trees and animals to build mine is bad for~~ the biosphere as well as noise pollution can cause animals to migrate and leave their ecosystems. Transects and quadrats can be used to monitor species distributions and see changes from baseline recordings

Atmosphere:- Noise pollution can enter the atmosphere which can be monitored with ^{in decibels} noise ~~AA~~ ^{using} instruments to compare with baseline. Toxic chemicals can also pollute the atmosphere from the ~~coal~~ mine. air sampling can monitor the compositions of chemicals and discover anomalies.

All strategies should have a baseline recording to compare with recording during mine operation.

Practices to strengthen

It is recommended that when preparing students for external assessment, teachers consider:

- using multiple choice questions that require interpretation of evidence
- showing students how to provide reasoning and conclusions that use data from stimulus
- encouraging students to provide descriptions that consider all aspects of the context stated in the question.