CROWN MINERALS ACT 1991
MINERALS PROGRAMME FOR MINERALS (EXCLUDING PETROLEUM) 2013

Guidance on maximising value through robust data quality management

All activities carried out under the Crown Minerals Act 1991 (the "**Act**") are required to meet standards of good industry practice. A function of good industry practice is to have robust data quality management driven through comprehensive quality assurance processes and quality control protocols.

While New Zealand Petroleum and Minerals (**NZP&M**) only require Tier 1 mining permits (or applications) to be of a recognised resource classification code[1] standard, the principles of these codes are considered good industry practice for all permits – for example, the principles of **materiality, transparency and competence**.

Data quality management may consist of:

- Protocols and procedures
- Sampling practices
- Assay Quality Assurance and Quality Control (**QAQC**).

PURPOSE

This guideline is to assist all mineral permit holders to get maximum value from work programme activities, whether the permit is for prospecting, exploration or mining.

The guideline is intended to introduce quality management principles and practices in general terms. It is intended to provide details that are fit-for-purpose across the scale and complexities of different mineralisation styles and activities.

This guideline explains data management to enhance the quality of data as it relates to both permit applications and technical reports. It outlines in general terms what NZP&M would like to see in terms of quality within applications and technical reporting and, in particular, accompanying sampling results.

LEGISLATIVE CONTEXT

While QAQC is not prescribed under the Act or the Minerals Programme for Minerals (Excluding Petroleum) 2013 (the "**Minerals Programme**") the concept is inherently tied to good industry practice.

Good industry practice, in relation to an activity, is defined in the Act as "*acting in a manner that is technically competent and at a level of diligence and prudence reasonably and ordinarily exercised by experienced operators engaged in a similar activity and under similar circumstances, but (for the purposes of this Act) does not include any aspect of the activity regulated under environmental legislation*".

1 *NZP&M considers recognised resource classification codes to be one of the following; the Canadian National Instrument 43-101 standard of disclosure of minerals projects; the South African Code for the reporting of exploration results, mineral resources and mineral reserves (2007 edition as amended July 2009); the JORC Code (2012 edition).*

> Data quality management is vital for **all** prospecting, exploration and mining operations – it helps you make and save money.
>
> The level and complexity of the data quality management process may depend on the scale and complexity of the particular project e.g. small scale alluvial exploration versus large scale multi-discipline/element comprehensive hard rock exploration.
>
> Data quality management should be 'fit-for-purpose' but more is always preferable to less.

Section 1A(2)(c) of the Act requires the carrying out, in accordance with good industry practice, of activities in respect of the rights to prospect, explore, or mine.

Section 29A(2)(iii) of the Act requires that before granting a permit, the Minister must be satisfied that the proposed work programme is consistent with good industry practice in respect of the proposed activities.

Section 33(1)(b) of the Act requires that permit holders perform activities under the permit in accordance with good industry practice.

The concept of good industry practice applies to NZP&M's consideration of exploration work programme proposals under *clause 9.3(1)(d)* and mining work programme proposals under *10.2(1)(g)* of the Minerals Programme.

The Minerals Programme further interprets good industry practice under *clause 1.3(11)* to include (without limitation) the following:

Personnel and procedures

(a) At all times the permit operator, contractors and their staff have the skills, training and experience required to carry out all prospecting, exploration and mining operations in a competent, safe and effective manner.

Operational

(b) Exploration and appraisal activities, mine development and mining operations are designed and conducted to maximise economic recovery and minimise sterilisation and waste, within reasonable technical and economic constraints.

(c) Methods of prospecting, exploration or mining are suitable and will be technically effective and meaningful, given the objectives of the work programme, the geology of the area, and the results of previous prospecting, exploration or mining.

(d) In the case of mining, any ongoing appraisal and definition of the geology and structure of the mineral deposit will be in sufficient detail to facilitate the most suitable mine development and mining operations.

Risk management

(e) The operator has systems and processes in place to avoid, mitigate and manage operational risks, including health and safety risks.

Acquisition of data

(f) Prospecting and exploration/appraisal and mining operations are conducted so as to ensure that sufficient good-quality, objective data is acquired, within reasonable technical and economic constraints. Sufficient data needs to be acquired to test the understanding of a mineral prospect or mineral exploration target in an exploration permit. In appraisal and development, sufficient data needs to be acquired to understand mineral development and resolve uncertainties that affect the success of mineral recovery.

OTHER GUIDELINES

NZP&M have produced a number of guidelines for which data quality is important which can be found on the NZP&M website these include; Application processing, Design of work programme, Resource and reserve reporting, Scoping, pre-feasibility and feasibility studies, Preparing and acceptance of Tier 2 alluvial gold permit applications; Alluvial Exploration Permit Exemplar, Alluvial Mining Permit Exemplar, Work programme compliance, Annual Summary Reporting, Technical reporting, Minerals and Coal Data Submission Standards and reporting guideline, Introduction to the Crown Minerals Act and Good Industry Practice.

Good industry practice for prospecting and exploration permit applications, work programmes and reporting obligations

Proposed work programmes accompanying applications for prospecting and exploration permits are evaluated by NZP&M against the concept of good industry practice. Applicants must demonstrate an acceptable level of understanding of the geology of the permit area in order to construct appropriate work programmes.

NZP&M's expectations for the content of mineral technical report submissions is covered in the Minerals and Coal Digital Data Submission Standards & Reporting Guidelines 2017, which can be found on the NZP&M website and outlines the statutory information that is required to be reported and sets out the information that is to be included in technical reports.

Along with compliance under the legislation outlined in the data submission standards guideline, compliance on reporting on exploration and mining activities is also evaluated against the concept of good industry practice. For example, reporting on a drilling obligation would be expected to include information on the quality of data management even if there was no specific work programme obligation to do so.

Good industry practice for mining permit applications and reporting obligations

Feasibility studies[2] for minerals mining permit applications are the most important supporting information for applications and for judging whether a work programme proposal meets the standards of good industry practice. A well prepared feasibility study demonstrates the intention to continue in accordance with good industry practice over the life of the permit. External review is encouraged for mining projects regardless of scale, complexity or perceived risk.

The most important aspect of a feasibility study is the reliability of input information. This is where the quality of data management is important because, as the saying goes, rubbish in = rubbish out.

2 *The expectation of scoping, pre-feasibility and feasibility studies are covered in a separate guideline.*

Good industry practice and work programme monitoring and compliance

Once prospecting, exploration or mining begins, the obligation to meet acceptable standards of good industry practice applies to all activities carried out under the permit. Regulations require reports, records, samples, and related matters are required to be reported to NZP&M.

Providing information on quality data management will assist NZP&M establishing that good industry practice is being followed (section 33(1)(b) of the Act).

The NZP&M guideline on good industry practice can be found at the following location:

https://www.nzpam.govt.nz/assets/Uploads/permits/minerals-guidelines/guidance-good-industry-practice.pdf

WHAT IS QUALITY?

Quality can be defined as the collective of characteristics of a sampling or analytical process that bear on its ability to meet the stated or implied needs and expectations of the user. Quality data should be representative and is inextricably linked with sampling or collection methodology as well as measurement of analysis quality.

The quality required will depend on the intended use of the data. This intended use can be lost or changed with time: there is a risk that data may be used for purposes that it was never intended for. The consideration for future use increases the need for formal processes, particularly for good documentation of data quality.

Important considerations in relation to the quality of data management include, but are not limited to:

- Level of confidence in the results obtained
- Repeatability of results
- Confidence interval of results
- Data quality
- Accuracy
- Completeness
- Consistency
- Reliability

Different data types include, but are not limited to:

- Geological mapping
- Geological logging
- Geochemical data
- Geophysical
- Geotechnical (e.g. qualitative strength, fracture characteristics, rock quality designation (**RQD**))
- Structural (e.g. location, orientation, thickness and offsets of faults)
- Co-ordinate data (e.g. drilling collar locations, down hole surveys)
- Assay data

How data is acquired should be controlled by procedures or protocols (preferably formalised) that manage any quality issues and maintain consistency in the data collection.

WHY IS HAVING FIT-FOR-PURPOSE HIGH QUALITY DATA MANAGEMENT PRACTICES IMPORTANT?

Secure, accessible data that is accurate and precise allows a high level of confidence to be had in the interpretations or models that are based on those data. It is important to understand the limitations of results obtained and estimates made.

Attention also needs to be given to data collection, data representivity, data use, and database integrity. Workflows and protocols that ensure that data is of a sufficient standard are commonly referred to as QAQC. QAQC processes should be active, ongoing and regularly reviewed as data is collected, so that timely corrective action can be taken.

QUALITY ASSURANCE "QA"

Quality Assurance is a **proactive** approach to ensuring that chemical analyses of samples are correct and accurate. Quality assurance systems and procedures occur before a batch of samples is sent to the laboratory for analysis. Typically, quality assurance involves the addition of "check" samples including: blanks, duplicates, and Standard Samples.

QUALITY CONTROL "QC"

Quality control is a **reactive** process of analysing the data returned from the lab. This is crucial for determining the quality of data and for revealing any deviations from the norm.

This step needs to be conducted during the sampling campaign to ensure any issues identified are rectified in a timely manner.

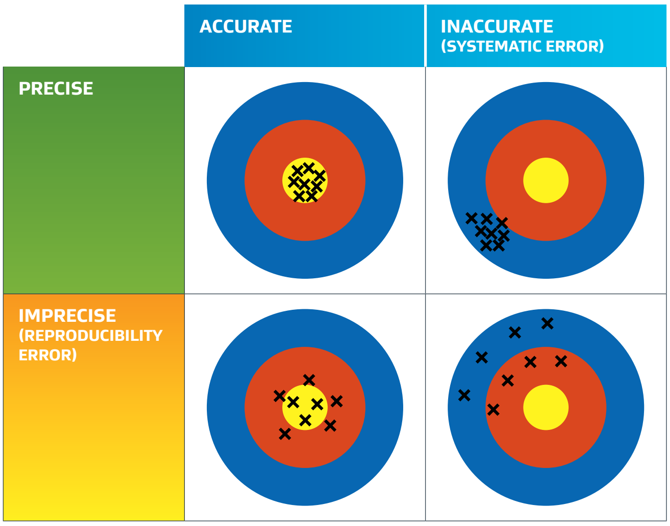
Assessment of all data streams to ensure that they pass their relevant QAQC protocols needs to be done at the time that data are being collected. For example, the monitoring of the survey (i.e. dip and azimuth) of a drill hole needs to be completed as the hole is being drilled, so that if it deviates corrective measures can be taken.

Likewise, QAQC of laboratory chemical data needs to be done as the data is received from the laboratory or instrument, so that if a batch or job fails QAQC parameters, the laboratory can be informed, corrective measures put in place if required, and the batch or job re-analysed. In both situations, if QAQC processes were completed significantly after the data was received or the programme had finished, options for corrective actions would be limited and the value of the data itself would be compromised.

ACCURACY AND PRECISION

Accuracy and precision are key to understanding data quality. Accuracy is independent of precision.

ACCURACY AND PRECISION		
ACCURACY	The degree to which an analysis is reflective of true value.	Sampling or analysis is said to be accurate when the mean error approaches zero.
PRECISION	The repeatability of the result.	Sampling or analysis is said to be precise when there is a small spread (or dispersion) of errors around the mean sampling error.



REQUIREMENTS OF GOOD DATA QUALITY MANAGEMENT

Good data management should consider the following components which are discussed in detail in the following sections.

1. Protocols and procedures
2. Sampling practices
3. Assay Quality Assurance and Quality Control

1. Protocols and procedures

Protocols or Standard Operating Procedures (**SOPs**) are created and used to ensure the consistent application of the data collection processes and that data is of sufficient quality, is fit-for-purpose, accurate and precise. Any sampling or analytical process aimed at collecting data used for either; resource estimation, grade control or reconciliation should be collected according to a formal, written protocol. Protocols need to comprise of well-defined and standardised processes and should be an official company document.

Project-specific protocols, often in the form of SOPs, should be in place before any data collection activities commence. SOPs should outline the procedures and operating practices to be implemented, from the initial set up of drill rigs through to the analysis of QAQC data upon receipt of the sampling results. SOPs help to ensure that a culture of QAQC is established throughout sampling programs, and also aid in identifying areas of risk within a procedure where errors could occur. An example of an image showing a high-level summary of an assaying protocol is given in Figure 1.

Protocols should contain

- Summary of key document information.
- Enough detail and clarity to ensure that different people can follow processes in exactly the same way.
- Specific procedures to carrying out tasks.
- Specific quality control steps and frequency.
- Explicit detail about equipment: design specifications set out.
- Be approved and signed by the appropriate authorising manager.
- Include a formal review and improvement process. And, most importantly;
- **Must detail controls, consequences and responses to out-of-control results (i.e. results that do not pass QAQC parameters).**

2. Sampling Practices

One of the key protocols a company should have to maximise value through robust data management is a sampling plan.

Sampling Plan

When developing a sampling plan it is important to keep the aims of the project in mind and to determine what constitutes a representative sample of the material being investigated.

Questions to consider may include:

- How many samples are required to appropriately detect the mineralisation style that is being explored for or to define the resource?
- What is the spatial resolution required?
- What is the minimum mass or volume of each sample needed to perform all necessary analyses, keeping in mind reserve splits may be necessary?
- What is the minimum number of samples required for statistical significance?
- What sorts of QAQC samples (e.g. blanks, duplicates, and standards) are appropriate?

In developing a sampling plan, a literature search may be required as researchers may have published information on proper sampling methods, preservation methods, potential pitfalls, and analytical techniques on similar topics or study areas. Field time is expensive, and developing a comprehensive sampling plan prior to collecting samples gives more time in the field to appropriately address the objectives of the work programme. The principles of sampling theory outlined in the following section are critical to determine the minimum mass required to obtain a representative sample.

Sampling theory

Introduction

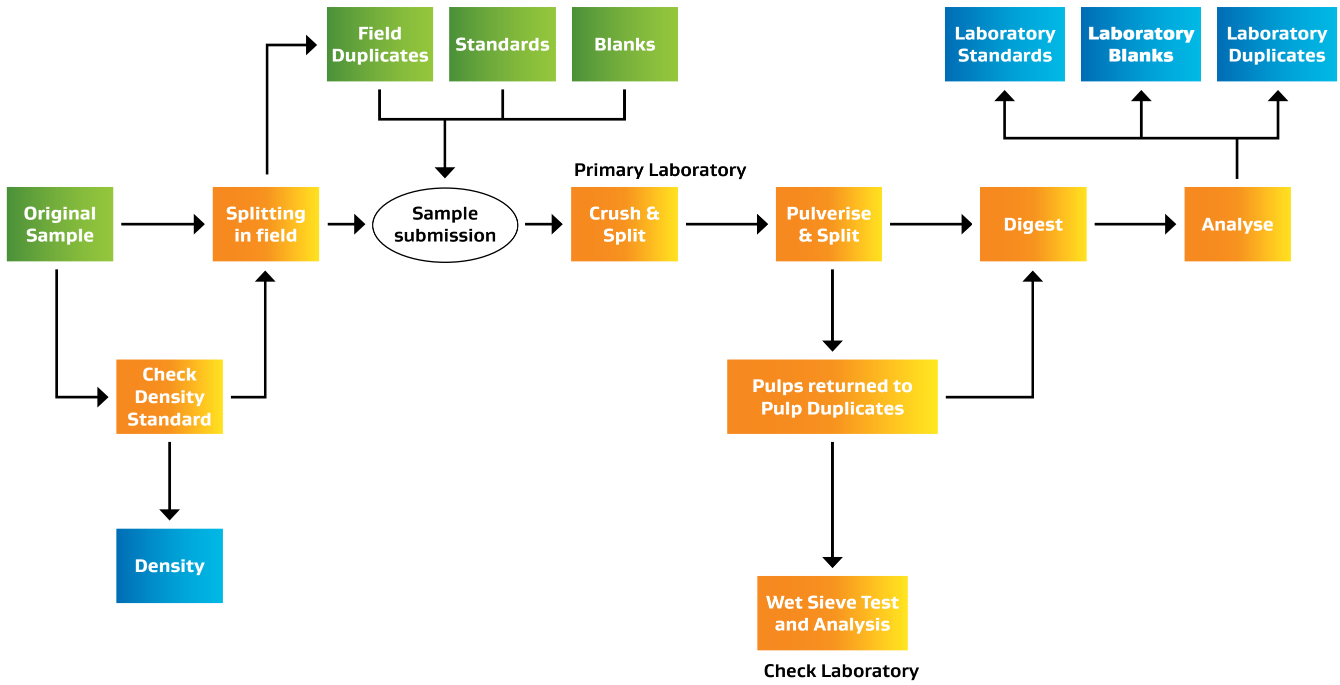
The following introduction to sampling theory is based on Gy (2004). The primary goal of sampling is to select a smaller subset population that is representative of the population as a whole for the parameter of interest. In the field of geochemistry, sampling and sub-sampling are fundamentally mass reduction techniques and the appropriate methods must be utilised to ensure the composition and characteristics of the whole are maintained.

When sampling correctly, all constituents making up the lot (the total material of interest) have an **equal probability of being selected**, and the integrity of the selected constituents is duly respected. Only correct sampling methodologies can provide samples (being representative of the lot); non-correct sampling provides specimens - not samples whose values might be indicative but not representative.

Sampling error

Pitard (1993) summarised Gy's seven sampling errors (Table 1, after Coombes, 2008), and presents the types of errors, a description of the error, and methods to mitigate them. Each of these sampling errors need to be considered throughout the entire process from generation of the sample through collection (e.g. drilling or test pitting), to the analysis of that sample; including sampling, sample handling and transfer, sample splitting and laboratory methodology. If the sample representivity is not maintained, the sample is compromised, or it is not possible to demonstrate representivity of that sample, it does not matter how good the analysis is, the data are of limited value.

Figure 1: Example of a high-level summary of an assaying protocol typical for a Tier 1 operation.



Two possible additional errors can be weighing error and analytical order.

Table 1: Pierre Gy's seven sampling errors (after Pitard, 1993; Coombes, 2008)

TYPE OF ERROR	DESCRIPTION	MITIGATION
FUNDAMENTAL SAMPLING ERROR (FSE) (FIGURE 2)	The error (or loss in precision) due to the physical composition and structure of the material being sampled. This error includes particle size distribution (constituent heterogeneity).	Use sampling nomogram to manage FSE for various crush-split protocols.
GROUPING AND SEGREGATION ERROR (FIGURE 3)	Attributed to non-random physical distribution of particles (distribution heterogeneity).	Managed by homogenising and splitting the sample.
LONG-RANGE HETEROGENEITY ERROR	Refers to the non-random differences due to location of sample within the orebody.	Using variograms to analyse spatial variability and manage the effect of spatial differences by taking several sub-samples to form a sample.
PERIODIC HETEROGENEITY ERROR	Describes spatial or temporal fluctuations (e.g. phases caused by periodic weathering).	Managed by compositing samples before analysing the grade relationships between samples.
INCREMENT DELIMITATION ERROR	The error due to inappropriate sampling design and/or incorrect sampling equipment selection.	Care in sample design and equipment selection.
INCREMENT EXTRACTION ERROR	Occurs when the correct sampling procedure is not followed.	Easiest to manage through correct sampling design and adherence.
PREPARATION ERROR	Occurs when some of the sample is lost, contaminated or altered.	Strict adherence to field and laboratory protocols is essential.

Key considerations when designing a sampling programme

Two of the primary sampling errors that must be considered when designing a sampling programme are summarised in Figure 2 and Figure 3; fundamental sampling error (**FSE**) and grouping/segregation error.

Fundamental sampling error is caused by the fact that different particles in a lot will have different compositions; even in a completely random distribution (as shown in Figure 2), it is readily evident if the sample-size to particle-size ratio is not sufficient the sample will not be representative.

Grouping and segregation error is caused by the non-random physical distribution of particles either in the original material, or caused by physical processes during sample transport/handling. Both errors can be minimised by the selection of an appropriate sample size, fine comminution of the material and homogenisation prior to sampling/sub-sampling, discussed in detail below.

Figure 2: A depiction of the FSE due to the individual particles within a lot being very different to each other (Gerlach & Nocerino, 2003).

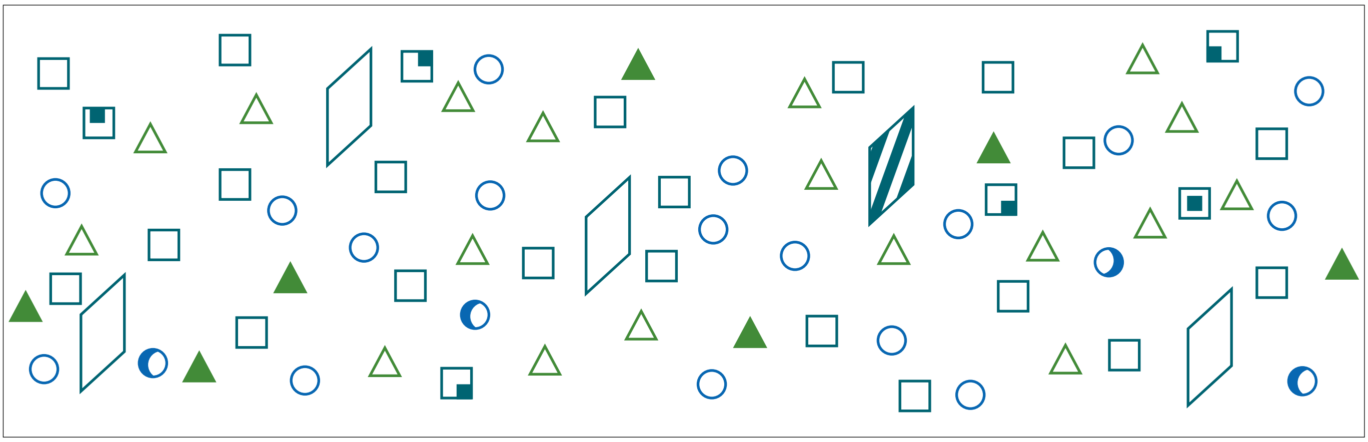
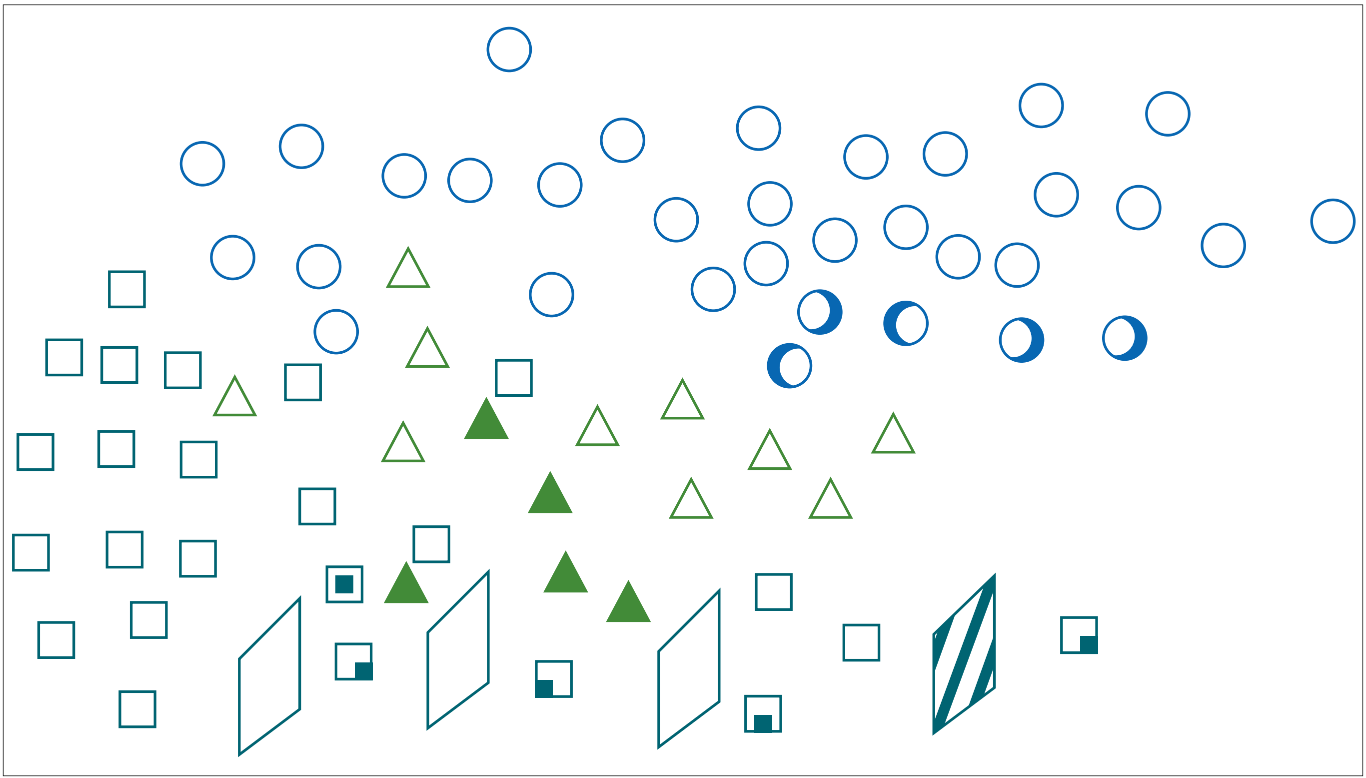


Figure 3: A depiction of grouping and segregation error due to the distribution heterogeneity of particles (Gerlach & Nocerino, 2003).



Sample preparation and analysis considerations

Specification of samples

- Sample type,
- Sample treatment e.g. drying temperatures or sieving,
- Size of sample to be processed,
- Crushing e.g. jaw crusher, Boyd crush, hammer mill or coarse disc grinding,
- Splitting e.g. riffle or rotary splitter or cone and quarter, and
- Pulverisation e.g. Keegor mill or ring grinder – quality control check for sizing.

Analytical Methodology

Identifying the optimal analytical methodology for the sample at hand is critical to ensure that the elemental results returned are truly representative of the amount of those elements in the sample.

- Dissolution procedure – partial leach, selective leach techniques, Mobile Metal Ion, "total acid digest", ore grade digestion, fusion,
- Analyte detection – gravimetric, atomic absorption spectrometry (AAS), graphite furnace atomic absorption spectrometry (GFAAS), hydride generation for As, Sb, Se, Te, etc., inductively coupled plasma atomic emission spectrometry (ICP-AES), inductively coupled plasma mass spectrometry (ICP-MS), X-ray fluorescence spectrometry (XRF), instrumental neutron activation analysis (INAA), classical chemical analysis.
- Detection limit and precision requirements, and
- Controls – replicates, duplicates, standards, frequency of use, control data used to demonstrate statistical control i.e. control chart.

Review

- Laboratory audit by client,
- Statistical review – Quality Control Report to client – turnaround performance, standard performance, blank performance, replicate and split performance, and
- Statistical review by client.

Sample Collection

A number of errors can occur during sample collection and can be difficult to detect and quantify. They include:

- Poor recovery
- Poor condition
- Abnormal drilling events
- Sampling errors
- Incorrect sample location

Any of these errors need to be recorded to assist in ongoing program activities and subsequent assessment of data reliability. This may be included in a QAQC protocol but typically included in drilling or sampling protocols or SOPs.

Alluvial and small operations – Fit-for-Purpose data quality management

While sampling theory is important at the high end of the exploration/mining scale, a lower threshold may be more appropriate and practical at the smaller end of the scale, such as alluvial gold projects.

At the lower end of the scale it may be sufficient to address the steps taken that demonstrate diligence on how sampling and testing were carried out and validation of the mineral resource estimates.

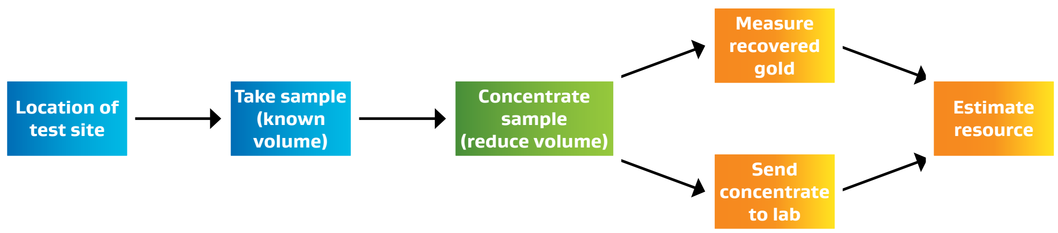
For example fit-for-purpose sampling at spatially representative locations, sampling geological units from top to bottom, reporting of methodology, documentation on how the sample was taken, and how the final grade was derived i.e. who did what, the tools used, the dimension and specifications of the equipment used, the location of all samples taken, how the co-ordinates were determined e.g. using google maps.

If uncertain the criteria can be discussed with NZP&M.

Figure 4: Example of the minimum requirement for a small scale Tier 2 operation

Tell us how you do the following steps and with what equipment.

X recovered gold out of Y volume which gives a grade of Z from a geological unit. The mineable geological unit is X dimensions in size and Y thickness. The extent of the mineable geological unit has been estimated by. . .



For an alluvial gold mining operation estimates of a mineral resource reported to NZP&M should show or include:

- A map showing the size and location of the gold deposit in relation to the application area
- The location of historical or recent exploration and type of exploration and sampling (e.g. drill holes, test pits etc.) used to estimate the resource.
- The thickness and depth of the gold bearing material.
- The volume of gold-bearing material in cubic metres.
- The gold grade, provided in units of milligrams of gold per cubic metre (mg Au/m^3).
- The quantity of gold in either kg or troy ounces.

Even for the smallest operations understanding limitations and conducting robust data quality management provides the opportunity for better scheduling, the ability to adopt appropriate equipment, efficient mining, and most importantly – save money.

More information for alluvial operations can be found in NZP&M's Alluvial Exploration and Mining Permit Application Exemplars found at https://www.nzpam.govt.nz/permits/minerals/guidelines/

3. Assay Quality Assurance and Quality Control

QAQC consist of four parts

1. Quality Assurance.
2. Quality Control.
3. Reporting and Review.
4. Continuous Improvement

1. Quality Assurance

Quality assurance is concerned with the future, i.e. avoidance of problems through the establishment of appropriate systems and practices (protocols). Quality assurance is what gives confidence in the data. Without quality assurance there may be a lack of confidence in the data, or anything that the data is used for. Quality assurance focuses on eliminating known or predictable causes of quality problems to prevent collection or saving of poor quality data in the first place. In a chemical analysis setting, quality assurance may take the following forms: blanks, standards, duplicates and replicates (see Table 3 for further information).

Table 3: Sample QA terminology. Note that different individuals or companies may use different terms for the QA terminology outlined below, but the purpose behind the use of each will remain the same.

	WHAT ARE THEY?	WHAT ARE THEY USED FOR?
STANDARDS (used for accuracy measurement)	Materials for which the content of the component(s) of interest (e.g. Au) is known within a quantified level of certainty (could consider blanks as a standard). › Can be certified or non-certified. › Matrix matched. › Off the shelf. › Salted to desired concentrations. Certified Reference Material (CRM) are standards that are accompanied by a certificate clearly describing the concentration of the standard, and a level of uncertainty.	Standards are used to ensure that the laboratory is reporting the correct concentrations for the samples that they are analysing. They may give insights into issues such as systematic bias within the laboratory, which can be addressed with the laboratory manager.
BLANKS (used mostly to test laboratory processes and equipment during analysis)	Material that is entirely devoid of the element of interest.	Blanks are used to determine laboratory cleanliness. This will determine if potential contamination at the lab setting is taking place. If a blank returns anomalous concentrations, action should be taken.
DUPLICATES (used for precision measurement)	A duplicate should be taken any time a sample is split – i.e. core is halved, material is run across a splitter, a sub-sample is taken at the pulveriser, or an aliquot is taken for analysis.	Duplicates are used to show that the split is representative, i.e. no bias has been introduced by the splitting process.
REPLICATES (used for precision measurement)	A replicate is a repeated analysis of the same material.	To show that the analysis methodology can produce the same result when the same material is analysed.

2. Quality Control

Quality control is measurement and evaluation of the accuracy and precision of results to indicate if corrective responses are needed, depending on the protocol controls. It is important in determining the quality of data and for revealing any deviations from the accepted norm. This step needs to be conducted during any sampling campaign (e.g. drilling) to ensure any issues identified are rectified in a timely manner. It is about detection through measurement systems and corrective strategies to minimise future error repetition; or continuation of detectable problems with quality.

> If you find out that there are issues in your process once all sampling and analysis is complete, it is too late.

Example of General Rules

Some general rules on typical rejection thresholds are listed below. These are examples only and each deposit is different and will require quality control rules to be tailored for the project and the project aims.

Typical thresholds for standards are:

- any point is three standard deviations outside the value as given;
- two out of three consecutive points are outside two standard deviation;
- four out of five consecutive points are outside one standard deviation; and
- nine consecutive points are either side of the established mean, indicating a trend.

Typical thresholds for duplicates are:

- blind pulp resubmission to primary laboratory is plus or minus 10% relative difference to original;
- pulp duplicate to check laboratory is plus or minus 20% relative difference to original; and
- field duplicate is plus or minus 30% relative difference to original.

There are many examples of how to present QAQC data published in literature.

Other considerations for sample QAQC

- Sample locations
- Collar pick-ups
- Paired downhole surveys
- Wet sieve analysis (to check sample grind meets specification)
- Density
- Sample preparation and drying temperature
- Sample security/chain of custody
- Laboratory inspections

3. Reporting & Review

Continuous reviewing and reporting is important to ensure that processes are monitored for quality in order to identify problems and improve systems. To ensure consistency, guidance on frequency of reporting and the actions to be taken when issues are identified should form part of protocols for all to follow. QAQC procedures and protocols should be viewed as risk identification and reduction mechanisms, not extra paperwork.

Any QAQC procedure or protocol should be concerned with, but not limited to, data verification, sample recovery, sample size, sample preparation, analytical methods, the use of QAQC samples (duplicates, blanks, and standards), effects of multiple periods of data acquisition and consistency of interpretation in three dimensions. Finally, the results from the analysis of samples must be considered in their geological context to ensure that they make sense.

4. Continuous Improvement

Quality data management should be dynamic; protocols, procedures, sampling practices, quality assurance and quality control should be continually improved. It is important to have ongoing examination of all relevant processes and systems with the aim of removing sources of error and quality degradation.

5. Possible questions to answer when designing quality data management practise

Data Collection

› What is 'fit-for-purpose'? What are suitable measures and quality limits for the data?
› What makes you think that the information is correct?

Resource Estimation

› How did you arrive at a resource estimate, and what are the limitations on this estimate?
› What key data requirements and variables/elements are needed to be used in any resource estimate or other form of geological modelling?
› What levels of confidence are needed (perhaps for different levels of resource classification) and how is that confidence best demonstrated?

Presentation/demonstration of confidence

› How should the information be stored, analysed and reported and at what frequency?
› What are the risks if your predictions are incorrect?

Consequences of not considering data management as a priority

There are visible and hidden costs arising from poor quality data management. In deciding how robust or rigorous a QAQC protocol or procedure should be, those making decisions should be aware of the ramifications of poor quality data. There are the visible costs, such as having to recollect data which was of poor-quality, which may include re-drilling drill holes, and the risk of having to remove data from datasets that is of low or dubious quality. Hidden costs are those associated with the data resulting in poor decision making, such as poor ore/waste designation, sub-optimal mine planning or scheduling and incorrect or unnecessary project investment decisions.

Poor quality data and associated effects on models and designs may also impact applications for any subsequent mineral permits. Providing full details and quality management information will help demonstrate to NZP&M an applicant's understanding of the geology and resource, key criteria for application evaluation.

Summary

Quality data management is important for permit holders as it is critical for project success and the cost of not doing it well is potentially very high. It is also important to be able to demonstrate that quality as a project progresses while there is still an opportunity to react to 'out of control' results, that is to say results that fall outside acceptable variation for the project. For larger scale, or Tier 1 projects there is a need for a formal quality management system (not just for assay QAQC) with a comprehensive protocol for measuring and reacting to accuracy and precision results. Ultimately, if you find problems once sampling and analysis is complete then it is too late.

The purpose of NZP&M is to promote prospecting for, exploration for, and mining of Crown owned minerals for the benefit of New Zealand. This is done through the efficient allocation of rights to prospect for, explore for, and mine Crown owned minerals; the effective management and regulation of the exercise of those rights; and the carrying out, in accordance with good industry practice, of activities in respect of those rights; and a fair financial return to the Crown for its minerals. To achieve this objective quality data management is important to NZP&M. As stated, even for the smallest operations understanding limitations and conducting robust data quality management provides the opportunity for better scheduling, the ability to adopt appropriate equipment, efficient mining, and most importantly – save money.

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NEW ZEALAND PETROLEUM & MINERALS

www.nzpam.govt.nz
nzpam@mbie.govt.nz

PO Box 1473, Wellington 6140, New Zealand

FREEPHONE (WITHIN NEW ZEALAND): 0508 263 782
INTERNATIONAL CALLS: +64 3 962 6179 FAX: +64 4 471 0187

NZP&M is a division of the Ministry of Business, Innovation and Employment. We lead and actively manage New Zealand's petroleum and minerals portfolio ensuring the country's economic interests and assets are comprehensively protected. Our goal is to use our wider understanding of the energy and resources sector to increase national and regional prosperity via petroleum and minerals exploration and production.

As a government agency, we engage with Councils, iwi and communities about petroleum and minerals development and regulation of the industry. We manage compliance and revenue collection on behalf of the Crown and aim to maximise the return that these important industries deliver for the benefit of all New Zealanders.

We report to the New Zealand public through the Minister of Energy and Resources.