CHRYSOS CORPORATION

Assays at the speed of light

Technical Note TN-301

Chrysos PhotonAssay™ Technical Due Diligence

Revision 0 – September 2026

Executive Summary

This technical note presents a structured framework for technical due diligence associated with the evaluation and implementation of PhotonAssay™. The framework is designed to support organisations in establishing the level of evidence required to demonstrate alignment with their technical, operational and business objectives.

A three-layer due diligence pathway is outlined, progressing from existing knowledge and public evidence through to site-specific comparative studies and optimisation programs. The framework recognises that organisations differ in their governance requirements, risk tolerance, operating context, and decision-making pathways, and therefore require different levels of technical evaluation for implementation.

The objective of the framework is to support efficient and defensible decision-making by matching the scope of due diligence to the complexity of the application and the client's stated data quality objectives (DQOs). Where sufficient confidence can be established through existing evidence or targeted validation activities, implementation may proceed without the need for extensive study programs. Where additional assurance is required, the framework provides a pathway for progressively increasing the level of technical investigation.

The scalable approach of the framework outlined supports timely implementation while ensuring that the level of due diligence remains appropriate to the intended decision and operational context.

Revision History
Rev 0 - released September 2026

Related Technical Notes
TN-101 - PhotonAssay Measurement Performance for Gold in Ore samples
TN-302 – PhotonAssay Technical Due Diligence Statistical Framework (future)
TN-402 - PhotonAssay Calibration Process

Related Journal Papers

PhotonAssay™ — Techniques and Workflows to Establish Fitness for Purpose (Sterk et al., 2026)
Application of PhotonAssay™ to Coarse-Gold Mineralization: The Importance of Rig to Assay Optimization (Dominy et al., 2024)

Contents

Introduction

Accurate, precise and timely assay data underpins every critical decision across the Mining Value Chain (MVC). Fire assay has long been regarded as the industry benchmark for gold analysis and, for centuries, has been the dominant technique. However, fire assay is destructive, requires hazardous reagents, and involves extended turnaround times. In an era where occupational health & safety, operational agility, environmental stewardship, and data integrity are paramount, these limitations present significant challenges for modern mining operations. PhotonAssay™ introduces a fully digital approach to assaying, enabling real-time data capture and automated QA/QC. This digital workflow creates opportunities for optimisation across the MVC reducing delays and improving decision quality.

The purpose of this technical note is to provide a structured framework for technical due diligence associated with the evaluation and implementation of PhotonAssay™. The framework outlines a scalable pathway that allows organisations to apply a level of technical review aligned with their operational requirements, governance framework and stated data quality objectives (DQOs).

Data Quality Objectives (DQOs)

Data Quality Objectives (DQOs) define the level of accuracy, precision and confidence required for assay data to be fit for its intended use. In the context of assay method evaluation, DQOs are explicitly tied to the decision scale at which the data will be applied. Decision scale refers to the significance and potential business impact of the decisions taken across the MVC supported by the data.

In this technical note, DQOs are used to ensure that evaluations of PhotonAssay™ focus on fitness for purpose, rather than on absolute analytical agreement or statistical significance in isolation. All assessments of performance, bias and precision are interpreted relative to the client's stated DQOs and the materiality of any observed differences at the relevant decision scale (Sterk, 2026).

Technical Due Diligence

Technical due diligence is a structured process by which a client evaluates whether PhotonAssay™ is a suitable alternative to their current assaying, DQOs and decision-making requirements. The appropriate depth of due diligence depends on the client's existing assay performance. In this note, assay performance refers to the demonstrated ability of an assay workflow to produce data that are fit for the client's intended use. It includes accuracy, precision, bias, turnaround time, quality control performance and operational reliability. Accuracy refers to closeness to an accepted reference value or independent benchmark, while precision refers to the repeatability or reproducibility of results under defined conditions. The required level of accuracy and precision is not fixed, but depends on the client's stated DQOs, materiality criteria and decision scale. A structured due diligence process provides the evidence needed to support implementation. It also helps manage the transition to PhotonAssay™.

To accommodate the different requirements, this technical note presents a three-layer model shown in Figure 1, progressing from high-level assurance based on existing information through to site-specific validation and heterogeneity studies. Progression beyond each layer is only necessary where additional confidence is required.

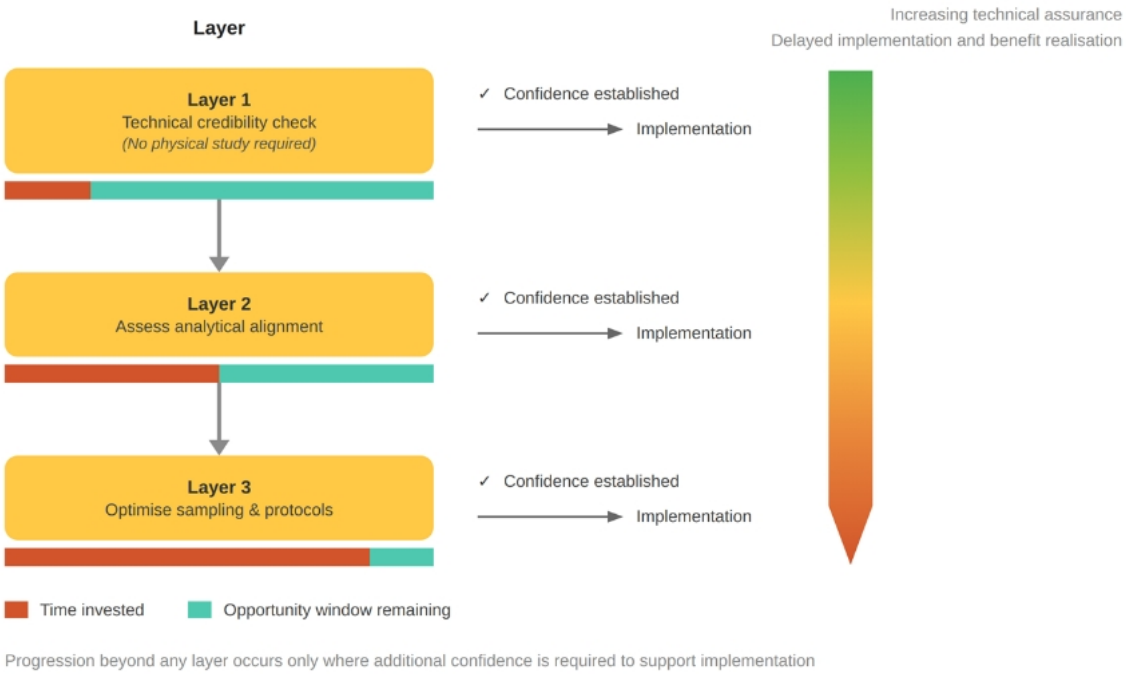


Figure 1: Technical Due Diligence framework hierarchy

Table 1 summarises the purpose, evidence requirements and decisions supported by each layer.

The three layers represent increasing levels of technical evidence, rather than mandatory sequential stages. Implementation may be supported at any stage where sufficient confidence has been established relative to the client's stated DQOs. Layer 1 typically underpins all evaluations, while Layers 2 and 3 may be undertaken independently, concurrently or in combination, depending on the client's DQOs, available evidence and decision-making requirements.

Table 1: Overview of the layered structure

Layer	Purpose	Primary question answered	Decision Supported
Layer 1	Establish high-level technical credibility using non-site-specific information	Is PhotonAssay™ technically credible for this material type and decision context?	Whether any further technical due diligence is required
Layer 2	Assess analytical alignment between PhotonAssay™ and the incumbent assay method under representative operating conditions.	Do PhotonAssay™ and the incumbent method agree sufficiently for this application?	Whether PhotonAssay™ can replace or coexist with the incumbent method without material bias
Layer 3	Characterise sampling-related variability and optimise assay protocols where heterogeneity dominates	What variability is fundamentally achievable, and how should the workflow be designed?	Decisions on assay mass, preparation strategy, sampling protocol, and optimisation

Desktop study

As part of technical due diligence, it is important to understand how the incumbent laboratory is performing against the client's stated DQOs so that the role PhotonAssay™ may play is assessed in the appropriate context. A desktop study provides this context by reviewing information that a prospective client can reasonably provide, such as a recent quarterly laboratory performance report and/or the supporting laboratory QA/QC data on which the report is based. For clients considering a Layer 2 transitional study and/or a Layer 3 heterogeneity study, this review helps establish the incumbent laboratory benchmark, relevant DQO context and any operational constraints already visible in routine performance reporting. The primary focus is analytical performance, including CRM performance, blank and contamination indicators, duplicate and repeatability outcomes, reported non-conformances and rework. These data provide a defensible basis for identifying where PhotonAssay™ may offer practical differentiation.

Where the incumbent laboratory is performing well, the desktop study may show that current analytical performance already exceeds the level required by the client's DQOs. In this context, PhotonAssay™ can be evaluated against the required decision quality rather than only against the maximum analytical performance of the incumbent workflow. This creates an opportunity to assess whether a simplified PhotonAssay™ protocol, such as moving from pulverised to crushed material, can remain fit for purpose while enabling broader benefits through simplified preparation, faster digital data availability, reduced manual handling, improved sample-flow control and optimisation across the MVC.

Objectives

The objectives of a desktop assessment include:

- Benchmarking current laboratory precision and bias using the statistical framework described in TN-302.
- Establishing realistic expectations for achieved CV, rather than theoretical limits,
- Identifying dominant sources of variability already present in the data. For example, analysis of historical duplicate and CRM data may show that a large proportion of observed variability arises from sample heterogeneity and aliquot mass limitations, rather than analytical measurement error in the laboratory method.

This layer allows clients to contextualise PhotonAssay™ performance relative to their current state and often reveals that observed variability is driven by sample heterogeneity rather than analytical technique.

Scope

The scope of the desktop study is a review of a recent quarterly laboratory performance report and/or supporting laboratory QA/QC data provided by the client. The review is limited to analytical and assay-delivery information that can reasonably be obtained from routine laboratory reporting, including CRM performance, blank and contamination indicators, duplicate and repeatability outcomes, reported non-conformances, rework, and other workflow indicators directly relevant to assay data.

Where sufficient data are available, incumbent laboratory performance is critically assessed using the statistical framework described in TN-302. The assessment focuses on achieved accuracy, precision, repeatability, contamination control, data reliability and the materiality of observed performance relative to the client's stated DQOs. The output is a defensible benchmark for PhotonAssay™ evaluation and an evidence base for identifying where PhotonAssay™ may provide practical differentiation through analytical fitness for purpose, simplified preparation, faster digital data availability or improved workflow performance.

Three Layers of Technical Due Diligence

The three layers provide a scalable pathway for increasing technical assurance as required. Layer 1 uses existing knowledge and public evidence to establish baseline confidence, Layer 2 uses a site-specific transitional study to assess analytical alignment, and Layer 3 investigates heterogeneity and protocol optimisation where additional understanding is needed. Each layer is described below in terms of its purpose, evidence sources, scope and the decision it supports.

Layer 1 – Existing knowledge and public evidence

Purpose

The first layer relies on established, non-site-specific information to provide baseline technical assurance. It includes publicly available technical notes, peer reviewed studies and documented performance of PhotonAssay™ systems across a broad range of ore body type and environments.

Evidence Sources

Chrysos publications

- Technical Notes
- Performance Notes
- Peer reviewed papers
- Conference publications
- Existing operating site references
- Comparable deposit types
- Historical feasibility studies
- Publicly available performance datasets

Publicly available publications

- **Dominy et al. (2024):** coarse-gold mineralisation, heterogeneity, sampling and rig-to-assay optimisation.
- **Sterk et al. (2026):** fitness-for-purpose evaluation, comparative workflows, DQO alignment and implementation evidence.

Interpretation and Decision

Layer 1 due diligence is informational only and is typically sufficient where:

- The client already operates PhotonAssay™ at another site
- Published Technical and Performance Notes provide sufficient information
- Consequences of a bias or variability are limited at the decision scale being considered

Layer 2 – Transitional Study (Bias Assessment only)

Purpose

Layer 2 introduces a controlled, site-specific transitional study designed to evaluate analytical agreement between PhotonAssay™ and the incumbent assay method under representative operating conditions. The objective of this layer is to assess whether observed differences between methods are material relative to the client's stated DQOs.

Layer 2 is typically undertaken where additional site-specific evidence is required to establish confidence that the stated DQOs can be achieved, or where site-specific validation supports governance, reporting, or change management requirements.

Decision it Supports

This pathway supports the decision of whether PhotonAssay™ can replace the incumbent assay method without introducing material bias relative to the client's stated DQOs. Where Layer 1 has identified that the incumbent method may not consistently meet those DQOs, Layer 2 also provides an opportunity to demonstrate whether PhotonAssay™ offers improved fitness for purpose.

Scope

Layer 2 involves a controlled, site-specific comparative study using paired analyses of PhotonAssay™ and the incumbent assay method on representative samples. Where available, desktop assessment outcomes may be used to provide context for the comparison, including the performance currently achieved by the incumbent laboratory.

The scope of a Layer 2 transitional study includes:

- Paired analysis of PhotonAssay™ and the incumbent assay method on a representative suite of site-specific samples. This typically includes between 50 and 100 samples per geological domain or sample type.
- Application of consistent sample preparation protocols appropriate to each method
- Use of certified reference materials (CRMs) and blind CRMs to independently monitor analytical performance during the study. Blind to PhotonAssay™ and blind to incumbent method i.e. fire assay.
- Statistical evaluation of analytical alignment between PhotonAssay™ and the incumbent assay method using the framework described in TN-302.
- Escalation to an independent umpire laboratory where statistically significant and potentially material bias is identified.

The transitional study is intentionally focused on the assessment of method bias and analytical comparability.

The analytical and decision workflow for a Layer 2 transitional study is shown in Appendix A.

Interpretation and Decision

Results from the transitional study are evaluated against the client's stated DQOs, with materiality assessed. Evidence of statistically significant differences is interpreted using a range of statistical analyses, such as mean ratio plots (Tukey plots), effect size and operational materiality, rather than t-statistics and p-values alone, as outlined in TN-302.

Where the results demonstrate analytical agreement within the established materiality criteria, PhotonAssay™ may be adopted as the primary assay method for the defined application. Layer 3 heterogeneity and optimisation studies provide an additional pathway for evaluating observed differences and developing optimised sampling, preparation and analytical protocols where further site-specific understanding is beneficial.

Layer 3 – Heterogeneity Studies

Purpose

Layer 3 addresses situations where additional site-specific understanding is required to determine how sample heterogeneity, sampling practice and sample preparation influence the ability to achieve the client's stated DQOs. The scope of this layer is tailored to the technical question being addressed and may range from broad heterogeneity characterisation through to targeted evaluation of preparation and measurement conditions that influence achievable precision, practicality and cost.

Layer 3 extends beyond analytical alignment by evaluating the sources of variability that influence achievable precision in heterogeneous systems. It considers the relative contribution of sample heterogeneity, sampling practice, sample preparation and analytical measurement to the total variability observed in the data, including Fundamental Sampling Error (FSE), sub-sampling and analytical variance where these factors are material to the intended application. Detailed study design options and statistical methods are described in TN-302.

Decision it Supports

This pathway supports decisions relating to sampling strategy, assay mass, preparation protocol, and analytical replication required to achieve the target precision (CV) defined by the client's stated DQOs. Where target precision requirements are being established, this layer supports evaluation of the achievable precision of PhotonAssay™ and fire assay (or the incumbent method) on the same material to inform selection of an assay protocol aligned with the intended decision scale

Scope

The heterogeneity and optimisation option may build on the outcomes of Layers 1 and 2 and, where required, include comparative testing alongside additional investigation to characterise heterogeneity and optimise assay performance.

The scope may include:

Laboratory performance benchmarking (accuracy)

- Review of incumbent laboratory CRM performance data to establish achieved accuracy and bias under routine operating conditions

Precision and heterogeneity characterisation

- Analysis of existing duplicate pair data from the incumbent laboratory to establish achieved precision under routine operating conditions
- Multiple PhotonAssay™ jar measurements on the same material to characterise within-sample variability and heterogeneity
- Evaluation of PhotonAssay™ performance on both crushed and pulverised material
- Comparative assessment of achievable CV for PhotonAssay™ and fire assay on the same material

Sampling optimisation

- Development of trade-off tables relating CV performance to sample mass, sample particle size and if necessary the number of PhotonAssay measurement cycles.
- Definition of optimised assay protocols aligned to the client's stated DQOs

The analytical and decision workflow for a Layer 3 heterogeneity and optimisation study is shown in Appendix B.

Interpretation and Decision

Results from the heterogeneity and optimisation study are interpreted against the client's stated DQOs and operational requirements. Where the study demonstrates that an optimised PhotonAssay™ protocol can achieve the required precision for the intended application relative to the client's stated DQOs, PhotonAssay™ should be accepted as a suitable alternative to the current analytical approach. Recommendations are made for implementation, including the appropriate preparation conditions, assay mass and measurement approach for PhotonAssay™.

Expectation of Alignment

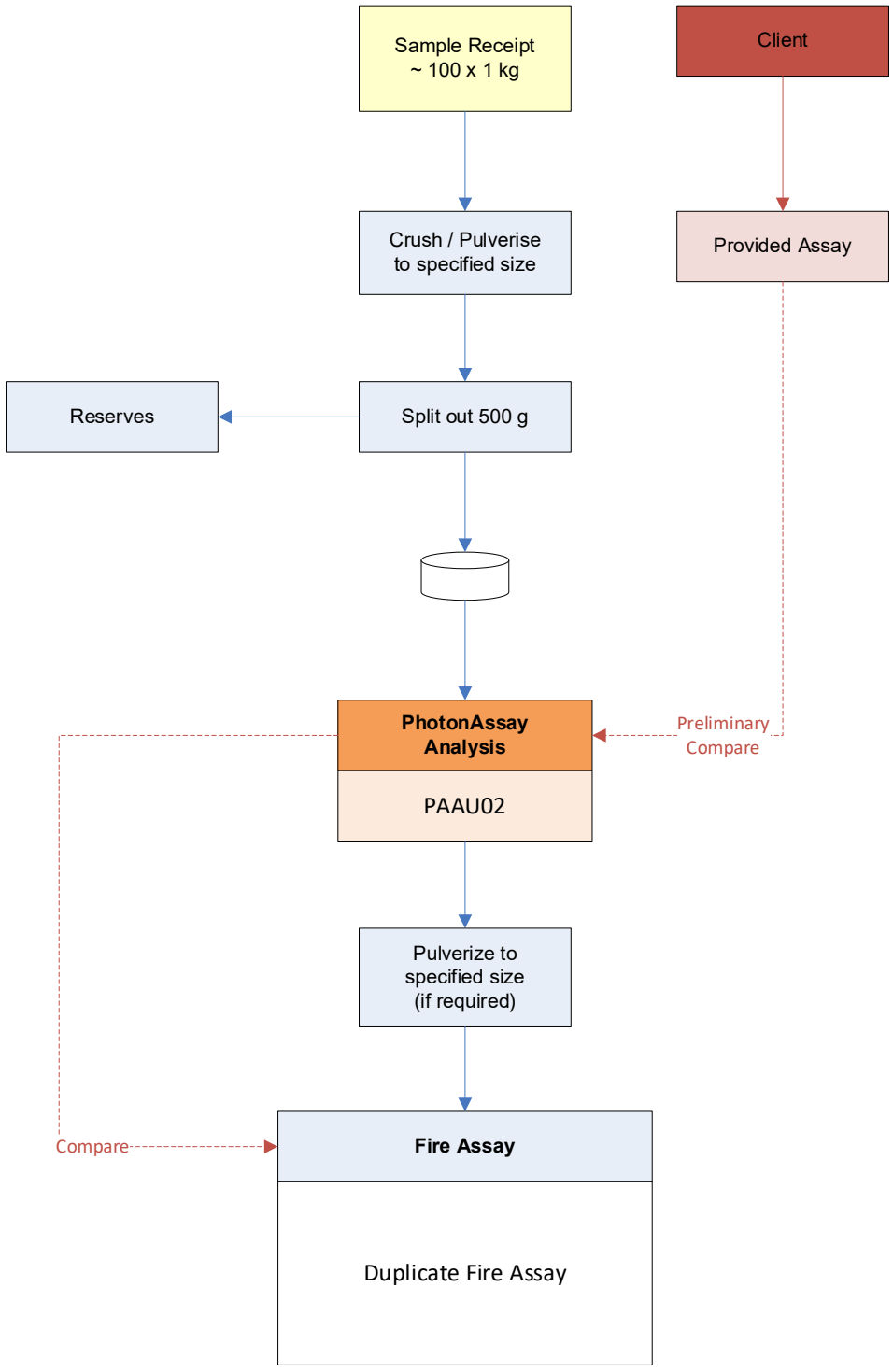
It is important to recognise that PhotonAssay™ and fire assay are fundamentally different analytical techniques. Variations in sample mass, particle size and measurement principles mean that perfect alignment between the two methods is not possible. Minor differences will occur due to inherent variability in sampling, analytical processes and instrument uncertainty.

The objective of an implementation study is to demonstrate that any observed differences are both statistically insignificant and operationally immaterial to decision-making across the MVC. Materiality thresholds will be applied to determine whether observed differences are relevant at the intended decision scale.

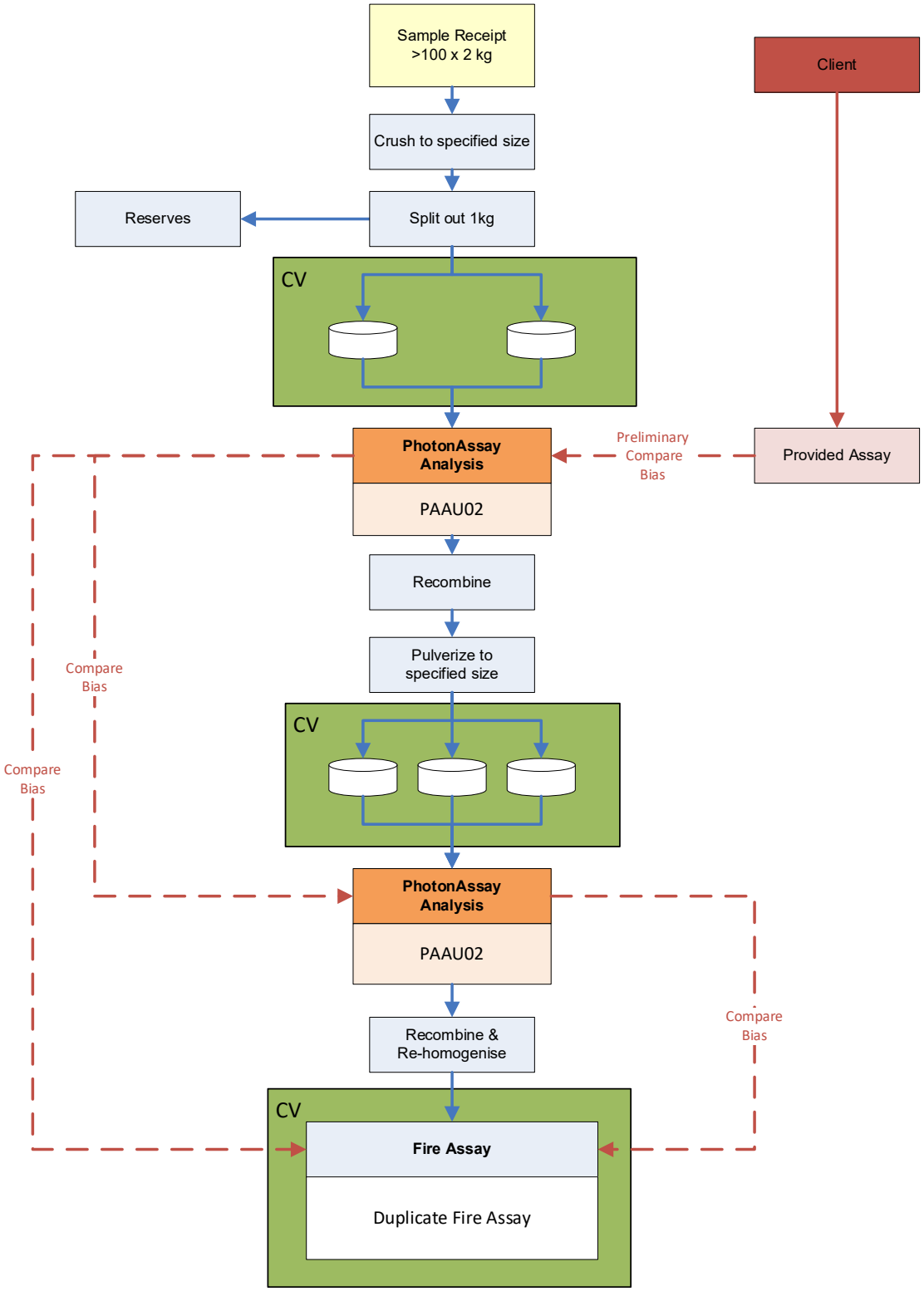
Defining Success

The principal measure of success is demonstrated when observed differences are consistent with the client's stated DQOs and are assessed as immaterial to the intended decision. Statistical analyses provide supporting evidence for this assessment and are interpreted within the context of the client's DQOs, materiality criteria and decision scale. Detailed statistical methodologies and interpretation criteria are provided in TN-302

Appendix A: Transitional Study Flowsheet Layer 2



Appendix B: Heterogeneity Study Flowsheet Layer 3



References

Dominy, S.C.; Graham, J.C.; Esbensen, K.H.; Purevgerel, S. (2024). *Application of PhotonAssay™ to coarse-gold mineralization: The importance of rig to assay optimization*. Sampling Science & Technology, 1, 2–30.

Sterk, R., Nessler, J., van de Ven, M., Knorsch, M., & Woestenburg, D. (2026). PhotonAssay™ — Techniques and Workflows to Establish Fitness For Purpose.