Terms of Reference for Potential Study Agreement

*Please submit your proposal before **14 September 2023** to project@catalyticfinance.org*

This document serves to provide an overview of the underlying project relevant to the Subnational Climate Fund (SCF), context on data availability and goals of the mandate, as well as an estimated scope of work requested from the consultant. Final details of the mandate should be covered by the subsequent proposal submitted by the consultant.

1. The Subnational Climate Fund

The SCF is a blended finance impact fund formed to pursue attractive risk-adjusted returns for private investors while generating measurable and certified environmental and social impacts. The Fund is focused exclusively on pursuing investments in mid-size climate infrastructure with nature-based solutions in various developing countries across Latin America and the Caribbean, Africa, the Mediterranean, and Asia. The Fund is managed by Pegasus Capital Advisors, a commercial Private Equity impact fund manager and further benefits from a separate, grant-funded Technical Assistance facility managed by The International Union for the Conservation of Nature (IUCN) and implemented by R20, IUCN, and Gold Standard.

2. Context of the Potential Study Agreement

The SCF is considering a potential investment opportunity relating to the expansion to an existing waste processing plant in Cape Town, South Africa, comprising a Material Recovery Facility (MRF), Refuse Derived Fuel (RDF) production and a Waste-to-Energy plant to produce heat and power. The SCF's Technical Assistance Facility is commissioning various feasibility studies to support the company in the areas outlined below and is calling for proposals from qualified consultants.*

3. Scope of feasibility studies

	Study 1	**Study 2**	**Study 3**
Scope	Economic and technical feasibility assessment including waste characterization	Logistics and Traffic Study	Geotechnical investigation
Duration	3 - 6 months	3 months	4 months
Deliverable	1 Feasibility Report	1 Feasibility Report	1 Feasibility Report

*Please note that we prefer to allocate these three studies as a package to one qualified firm who either carries out all these services inhouse or who will use qualified subcontractors. Please see the detailed scope & qualification requirements for each study on the following pages.

Study 1: Full feasibility assessment of the project including waste characterization study

Scope of Work:

A technical and economic feasibility assessment of the project consisting of a Material Recovery Facility (MRF), RDF production and a Waste-to-Energy plant, which should include:

1. Technical Assessment:
- Infrastructure: Evaluate the existing facilities, equipment, and technologies for waste collection, sorting, recycling, and disposal.
- Capacity Analysis: Assess the capacity of the facilities in terms of waste processing and disposal relative to projected demand.
- Technology Review: Analyse the efficiency, effectiveness, and suitability of the chosen waste management technologies.
- Validate civil works design and costs.
- Assess quality of RDF according to the quality criteria outlined in the SCF's White Paper (this will be supplied to the consultant). Quality criteria for RDF include, for example: Ash content (Non-combustible fraction), Heating values (higher and lower calorific values), Water content, Physical properties such as grain size & shape and energy density, Biogenic content, Pollutant content (e.g. heavy metals), comparison of fuel characteristics from economic, processing and pollution point of view (e.g. processing requirements by off-taker, chlorine and sulphur content).

2. Economic Viability:
- Cost Structure: Break down the capital and operational costs associated with the project, including construction, equipment, labor, maintenance, and operating expenses.
- Revenue Generation: Analyze potential revenue streams, such as fees, RDF, heat and power, and sale of recyclables.
- Financial Projections: Provide financial forecasts, including revenue projections, operating expenses, net present value (NPV), internal rate of return (IRR), and payback period.
- Sensitivity Analysis: Assess the project's sensitivity to key variables like waste volume, pricing, and operating costs.

3. Market Analysis:
- Market Demand: Study the waste generation rates, demographics, and trends in the project area, also including the commercial waste sources targeted by the project.
- Identify market requirements for the commercialization of RDF and other outputs (organic fraction, recyclables).
- Competitor Analysis: Identify existing waste management service providers and their market share.
- Regulatory Landscape: Understand the relevant waste management regulations and permits required.

4. Risk Assessment:
- Operational Risks: Identify potential operational challenges that could impact the project's success.
- Market Risks: Evaluate the risks associated with changing waste generation rates, competition, and economic conditions.
- Regulatory Risks: Assess the regulatory risks and potential legal issues that might arise during the project's implementation.

5. Recommendations:

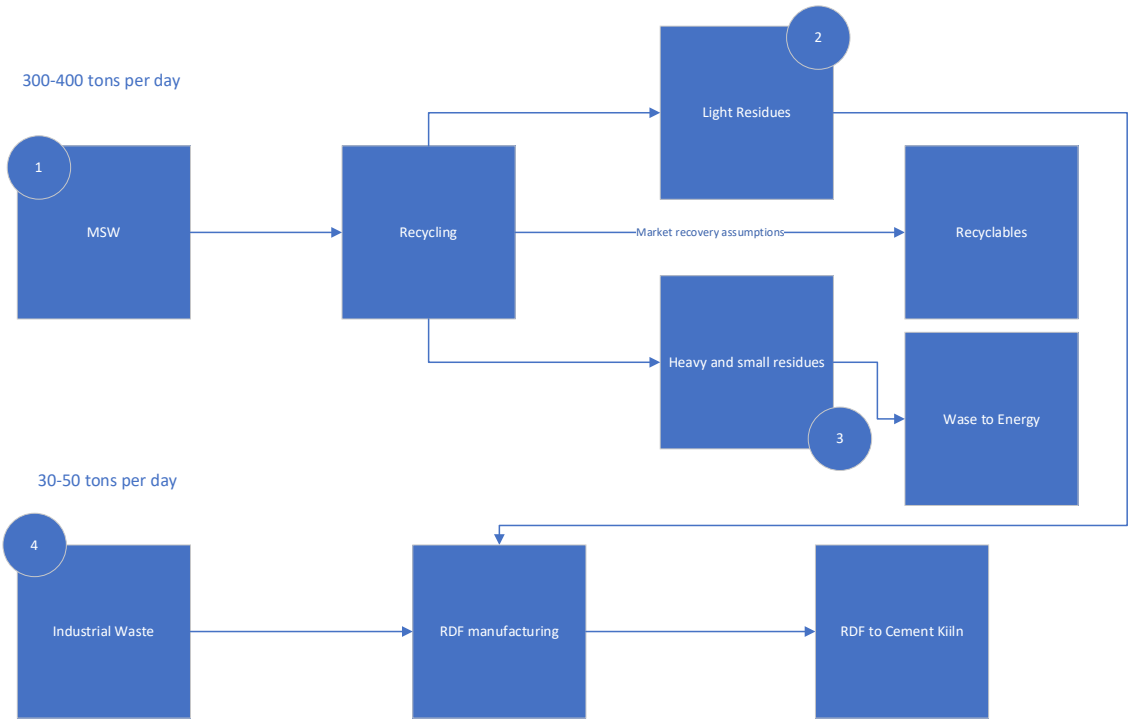
- Summarize the findings from the assessment and provide recommendations for mitigating risks (contingency plan), improving operational efficiency, and ensuring economic viability.

To conduct some of the above-mentioned assessments, a **waste characterization study** should be conducted by the consultant. In close collaboration with the project developer, the consultant is expected to:

1. Clearly define the purpose of the waste characterization study, such as understanding the composition, types and quantities of waste generated in the project area.

2. Specify the geographic area that the study will cover.

3. Waste streams to be analysed: The diagram below depicts the main points of interest in the waste processing plant and how it relates to RDF production and Waste to Energy. Only items 1 and 4 are required.



1. MSW sampled and characterised. Samples are analysed as per methodology.
2. **From the samples in 1 the light fraction will be estimated by the project (recyclable rates assumed from industry standards)**
3. **Similarly, the heavy fraction will be estimated by the project according to methodology to determine mass based on Anaergia fractional recoveries.**
4. Industrial wastes used and identified by the company, sampled, and announced.

5. Methodology: Describe the methods and techniques that will be used to collect and analyze waste samples, including sampling locations, sampling frequency, and sample size. The minimum scope for the waste characterization study is as follows (these specifications were provided by the EPC provider):

    a. Sampling of statistically significant amounts of MSW (min 150 kg per sample) for a 400 tons per day RDF and Waste to Energy plant.
    b. Use ASTM STP1656-9S For MSW Characterisation and Sampling (or suggest suitable alternative).
    c. Take and process 10 RDF feed material samples for analysis as per the ASTM specification (currently on site as it is utilised by the project in the pilot unit).
    d. Use ASTM E829-16 RDF Sampling and Analysis (or suggest suitable alternative).
    e. Ensure that for the MSW characterisation and analysis, the parameters set out in Annexure 1 and Annexure 2 below are included if not already included in the ASTM standards.
    f. During waste characterisation all relevant health and safety requirements will be adhered to and waste shall be quartered and samples will not be selected through selective picking.
    g. Suggest various market related recycling rates for recyclables from a dirty MRF.
    h. Chemical analysis as per W2E plant feed specification and RDF input feedstock.
    i. Compositions and heating values of fractions coming from the MRF.
    j. The waste to energy plant will supply the waste and the appropriate areas for waste characterisation in Athlone. All other labour, consumables, and laboratory work are to be part of the scope. In the Consultant's proposal, the amount of waste required, the number of samples, the duration of each trial and the area required should be clearly identified.

6. Data Collection: Explain how data will be collected, whether through field surveys, waste audits, interviews, or a combination of methods.

7. Data Analysis: Detail the process for analyzing the collected data, including statistical methods, categorization of waste types, and determination of waste composition percentages.

8. Stakeholder Engagement: If the study involves engaging with stakeholders, outline the approach for involving local communities, waste management agencies, government bodies, or other relevant groups.

9. Quality Assurance: Describe the measures that will be taken to ensure the accuracy and reliability of the study, including quality control procedures and validation processes.

Qualifications: The work is to be undertaken by a qualified expert with experience in the assessment, design and management of projects dealing with waste sorting, waste incineration, or RDF production, and with experience in conducting waste characterization studies.

Timeline: Work is expected to commence immediately after the consultant is appointed and to be completed within 3 to 6 months after signing the service contract.

Study 2: Logistics and Traffic Study

Scope of Work: The consultant is expected to provide the following assessment:

- Evaluate traffic flow for waste deliveries, residuals removal, and RDF removal and the waste flow from Cape Town Biogas (CTB) to the company.
- Consider traffic suggestions for site entry gates and internal roads.
- Evaluate impact on the feeder road to the facility considering the traffic generated by the Cape Town Biogas facility and the Waste Mart current operations.

Various layouts of the facility are already available: Annexure 4 shows the preliminary internal layout. Figure 1 below shows the site location and the light blue line shows the road connection through the Athlone Industrial suburb to the main road where the first traffic light is located.

Figure 1: Site Location

Qualifications: The work is to be undertaken by a qualified expert with experience in the evaluation of traffic flows for waste management projects and with good knowledge of the local project context.

Timeline: Work is expected to commence immediately after the consultant is appointed and to be completed within 3 months after signing the service contract.

Study 3: Geotechnical Investigation

Scope of Work: The consultant is expected to provide the following assessment:

- Investigate the soil and dig test pits with testing and inputs for foundation design for the waste-to-energy plant construction. The specification is given in Annexure 3 and the layout in Annexure 4.

Qualifications: The work is to be undertaken by a qualified expert with experience in conducting geotechnical investigations for waste-to-energy plants or similar infrastructure projects.

Timeline: Work is expected to commence immediately after the consultant is appointed and to be completed within 4 months after signing the service contract.

4. Deliverables

For each study, the consultant(s) should provide a final report consisting of the following elements:

- Executive Summary
- A table of acronyms
- Main report
- Bibliography
- All lab analyses and subcontractor reports as referenced annexures
- Follow the SCF's template for TA studies
- Word Format

Regular progress update meetings are to be conducted among the consultant, the project developer and Catalytic. Some interim reports are expected from the consultant which will be outlined in the service contract with Catalytic and be used as milestones for payment. The final report is expected to go through a reviewing and amendment process in writing and through online video meetings.

5. Form of Proposal & Requirements

Please prepare a brief proposal for the performance of this work, including the scope of work, project team and qualifications, and estimated costs. Proposals can be submitted either for the entire work package (single source) covering all the studies, or for individual studies, depending on the skillset of the consultant(s).

1) **Scope of Work:** The scope of work should include a description of the specific activities that will be performed in order to accomplish the required tasks stated in Section 3. This should include any proposed site visits/reconnaissance, documents to be reviewed, interviews, etc. If the Consultant feels that additional tasks or components within a required task are suggested or warranted, these should be stated and delineated as "Optional Tasks".
2) **Project team and qualifications:**
   This should include the name of the principal staff members and any sub-contractors, and a brief description of their role within the project team. Qualifications of staff should include relevant technical capabilities, full CVs, specific previous experience similar to this assignment, specific in-country experience and knowledge.
3) **Estimated costs:**
   A total time and cost estimate (not to be exceeded), in US Dollars, must be provided for the required scope of work. A breakdown of the estimated costs by task must also be presented in tabular format and should include Direct Labour Costs (number of hours or days per staff and their associated unit costs) and Indirect Labour Costs (i.e. travel, sub-contractors, etc.). Please note that R20 as a foundation under Swiss law is exempt from VAT for international services such as this. Your financial proposal should therefore not include VAT.
   Conflicts of interest:
   As part of the proposal, the Consultant shall also confirm that they do not have a conflict of interest and that they are in a position to provide an adequate, accurate and objective review.

6. Submission

Please submit your proposal before **14 September 2023** to **project@catalyticfinance.org**

ANNEXURES

ANNEXURE – 1 – WASTE (MSW) ANALYSIS

The Fuel Analysis shall be done w.r.t the following constituents.

1. Date of waste analysed :
2. Low (Net) Calorific value (kcal/kg) :
3. Design range of LHV (kcal/kg) :
4. Bulk Density (kg/m³) :
5. Weight considered for analysis (kgs) :
6. Waste View Analysis (% by weight) (As received basis):

Sl.No	Material (As received basis)	% by Wt.	Value
a.	Kitchen waste (Organic)	(%)	
b.	Plastic/ synthetics	(%)	
c.	Paper	(%)	
d.	Wood	(%)	
e.	Garden waste	(%)	
f.	Inert material (Glass, metal)	(%)	
g.	Fine fraction (mainly inert)	(%)	

7. Ultimate Analysis (% by weight) (As received basis):

Sl.No	Ultimate Analysis (As received basis)	% by Wt.	Value
a.	Carbon	(%)	
b.	Hydrogen	(%)	
c.	Nitrogen	(%)	
d.	Sulphur	(%)	
e.	Ash content*	(%)	
f.	Total moisture*	(%)	
g.	Oxygen	(%)	
h.	Chlorine	(%)	
i.	Phosphorous	(%)	
j.	Florine	(%)	
	Total	(%)	100

- * Design range to be mentioned (Min/Max)

ANNEXURE – 2 – ASH ANALYSIS

This specification is for carrying out analysis of Ash Components for the waste, which shall be fired the boiler. This analysis is important as the design Features and Performance of the Boiler and ash handling system are dependent on characteristics of the ash.

1. Ash Properties:

a.	Initial deformation Temperature	°C	
b.	Ash Softening temperature	°C	
c.	Hemispherical temperature	°C	
d.	Fluid Temperature	°C	
e.	Ash resistivity		
f.	Bulk Density	(Kg/m^3)	

2. Elemental Ash analysis (% by weight):

a.	Silica (SiO_2)	(%)	
b.	Alumina (Al_2O_3)	(%)	
c.	Iron oxide (Fe_2O_3)	(%)	
d.	Titanium dioxide (TiO_2)	(%)	
e.	Calcium oxide (CaO)	(%)	
f.	Magnesium oxide (MgO)	(%)	
g.	Sodium oxide (Na_2O)	(%)	
h.	Potassium oxide (K_2O)	(%)	
i.	Manganese oxide (MnO)	(%)	
j.	Sulphur Trioxide (SO_3)	(%)	
k.	Phosphorous Pentaoxide (P_2O_5)	(%)	
l.	Nickel Oxide (NiO)	(%)	
m.	Vanadium Pentoxide (V_2O_5)	(%)	
n.	Chlorides	(%)	
	Total	(%)	100

ANNEXURE 3

TECHNICAL SPECIFICATION FOR SOIL INVESTIGATION STUDY

1.0 INTENT:

The intent of this specification is for carrying out Soil investigation at the site which is essential to design economical and adequate foundations for the heavy and small equipment and structures of the proposed 4.5 MW Waste to Energy based Power Plant.

The following types of structures are envisaged at the site for which suitable foundations are to be designed later by the Owner based on the recommendations of the report to be submitted by the Contractor.

1.1 Block Foundations for Equipment's.

1.2 Framed RCC structure with solid mat and deck slab on frame for Turbo generator with dynamic loads.

1.3 Cable trenches & drains.

1.4 Circular Slid raft for Chimney Foundations.

1.5 Piles/Foundations for SSG supporting structure.

1.6 Electrical resistivity of Soil to size the underground earth pit / earth mat

Soil Investigation and recommendations shall be conducted by keeping in view of above , and shall be in accordance with the following specifications.

2.0 SCOPE OF WORK:

2.1 FIELD INVESTIGATIONS:

2.1.1 Field visit of the Contractor to familiarize themselves about site condition (Pl see clause 4 .0 below).

2.1.2 The depth of bore may be restricted to 20.0 m or at a depth where 'N' value is greater than 50 whichever occurs earlier.

2.1.3 Collection of disturbed and undisturbed soil samples at every 1.5M intervals/change of strata, rock cores for conducting laboratory tests.

2.1.4 Direct undisturbed soil sample testing by open trial pit. The excavation trial pit and side protection during the test and backfilling shall be carried out by the contractor.

2.1.5 The Standard Penetration Tests (SPT) shall be performed at regular intervals and the following details considered for carrying out SPT shall be furnished by the agency.

2.1.6 Bore hole identification number.

2.1.7 Type and diameter of drilling.

2.1.8 Depth at which SPT was conducted.

2.1.9 Penetration record and N value.

2.1.10 Water table information.

2.1.11 Description, identification and depth of different strata encountered.

2.1.12 Core recovery data, level of bore hole termination etc.,

2.1.13 Soil Electrical resistivity test shall be performed.

2.1.14 Cyclic plate load test shall be carried out using reaction loading for loading the test plates.

2.2 Laboratory testing:

Conducting all the following laboratory tests on the soil and rock samples collected from the site.

2.2.1 Tests to be conducted on representative disturbed samples:

2.2.1.1 Moisture content

2.2.1.2 Specific Gravity

2.2.1.3 Grain Size Analysis

2.2.1.4 Atterberg's Limits

2.2.1.5 Proctor densities

2.2.1.6 PH value, Sulphate Content & Chloride content

2.2.1.7 California Bearing Ratio Test

2.2.2 Tests to be conducted on representative undisturbed samples:

2.2.2.1 Consolidation test

2.2.2.2 Undrained triaxial shear test

2.2.2.3 Unconfined compression test

2.2.3 Tests to be conducted on rock samples:

2.2.3.1 Compressive Strength

2.2.3.2 Moisture absorption

2.2.3.3 Density & Specific Gravity

2.2.3.4 Modulus of Elasticity

2.3.0 Chemical analysis of soil, and subsoil water for presence of chlorides and sulphates and such detrimental salts harmful for foundation.

2.4.0 All the above Tests 2.1 & 2.2 shall be carried out in accordance with the relevant latest specified standards, the work should conform to British Standards or American Society of Testing Material (ASTM) Specifications. All measurements shall be in the metric system.

3.0 SUBMISSION OF TEST REPORTS:

Reports covering the detailed test results for Field and Laboratory tests shall be submitted in hard copies and Soft Copy. The reports shall cover the following:

3.1 Appraisal of the data and analysis of the estimated bearing capacities, (safe and

ultimate) settlement behavior, swelling potential of foundations for the different strata existing at different locations.

3.2 Recommendations regarding the type of foundations to be provided for different structures based on range of loading.

3.3 Recommendations of allowable bearing capacities/ Safe bearing capacities (SBC) at different levels and at different locations.

3.4 Any special recommendations regarding equipment foundations including the recommendation for type of road pavement structure, prediction of the settlement of them and recommendations for the depth of soil embankment for them to be provided.

3.5 Recommendations regarding filling, utilization of fill material, excavated at site and the degree of compaction required for safe durable existence of the foundations.

3.6 Level of water table.

3.7 Relevant cross-sectional drawings of soil profile & results of analysis in tabular and graphical forms, plot plan showing the location of the tests conducted (sketch indicating the same will be given by Owner later before start of the investigation)

3.8 If pile foundations are envisaged the following data for various sections shapes (ie., I section, rectangular section circular section) with various sizes in each of piles:

a. The allowable load carrying capacity of the pile in compression, tension and horizontal directions for various depths of piles recommended. The structural configuration of the piles namely size reinforcement used, grade of concrete etc., should also be made available for the given load capacity.

b. The depth of the piles recommended for various categories of structures as explained under "1.0 Intent" above.

c. The type of pile construction recommended for the works (bored- cast at site or pre-cast & Driven or auger–press spun pile or under-reamed).

3.9 The character and genesis of soil and the procedure adopted for investigating them.

3.10 The recommendations regarding the type of cement to be used and protection works recommended for the foundations in case of soil aggressiveness.

3.11 Discussions leading to recommended type of foundation for the given type of structure and economical for the given condition.

3.12 Interim report (two) copies shall be submitted when demanded by the Owner.

3.13 Any other special information of significance encountered during investigation and likely to have an impact on the design and construction of foundations.

4.0 SPECIFIC INFORMATION TO CONTRACTOR:

4.1 Site visit by contractor prior to bidding

a) The contractor has to note that the location where investigation to be conducted is located in an undeveloped plot. The contractor is advised to visit the site and familiarize themselves about the site conditions before bidding.

b) The rates quoted by the contractor shall be inclusive of all the arrangements and means for deployment of his plants, tools and personnel to conduct the tests at the said location

and no extra amount shall be paid to the contractor on what so ever account later.

4.2 Time period for investigation.

Time is the essence of this contract. The Contractor has to indicate in his offer the earliest time required to mobilize, investigate, test and submit reports for all the locations.

5.0 GENERAL:

5.1 Site map for soil investigation (that will be submitted before start of work) shall be referred for location of various tests.

5.2 The investigator shall arrange for all necessary labour, tools and tackles, storing materials, equipment and instruments necessary for carrying out detailed soil investigation work.

6.0 TEST REQUIREMENT:

Sl. No.	Description of Test	Quantity
1	Boreholes	Refer attached "Layout"
2	Cyclic Plate Load Test	
3	Soil Electrical Resistivity Test	
4	California Bearing Test	

Annex 3 - Technical specification for soil investigation study (p. 5/6)

6.0 SCHEDULE OF QUANTITIES AND RATES

Sl. No	Description of item	Unit	Qty	Unit Rate	Total Amount
1	Mobilize, demobilize, set up at each location and shift between locations, tools and personnel for the entire work	Lot			
2	Bore hole in all types of soil, rock including fixing of casing pipes etc. at required locations a) In soil b) In rock	 M M			
3	Conducting SPT at every 1.5 m deep or change of strata as deemed necessary (rate per test)	Each			
4	Conduction of lab tests for sample collected. a) Atterberg Limits b) Natural moisture content c) Dry and Bulk density d) Specific gravity and Voids ratio e) Grain size analysis f) Tri-axial tests Drained Un-drained g) Consolidation tests h) CBR tests Soaked Un-soaked i) Standard Proctor tests j) Chemical analysis Soil Water k) Swell Pressure test l) Permeability test m) Direct Shear test	Each			
5	Collection of undisturbed samples from bore holes as required	For Each Bore hole			
6	Cyclic Plate load test	Each set			
7	Electrical resistivity	Each set			
8	California Bearing Test	Each set			
9	Report preparation & submission	Lot	6 copies		

NOTES:

1. The Contractor shall quote firm unit rate for various items of work. The quantities of various items mentioned in this specification, drawing and schedule are approximate. The quoted rates shall remain firm even if the quantities vary. The payment shall be made only on the actual quantity of work done duly certified by the Owner.

2. Details of all the items in this schedule shall be read in conjunction with the corresponding specification, drawings and other tender documents.

3. Items of works in this schedule, which are not covered in the specifications, shall be executed strictly as per the instructions of the Owner.

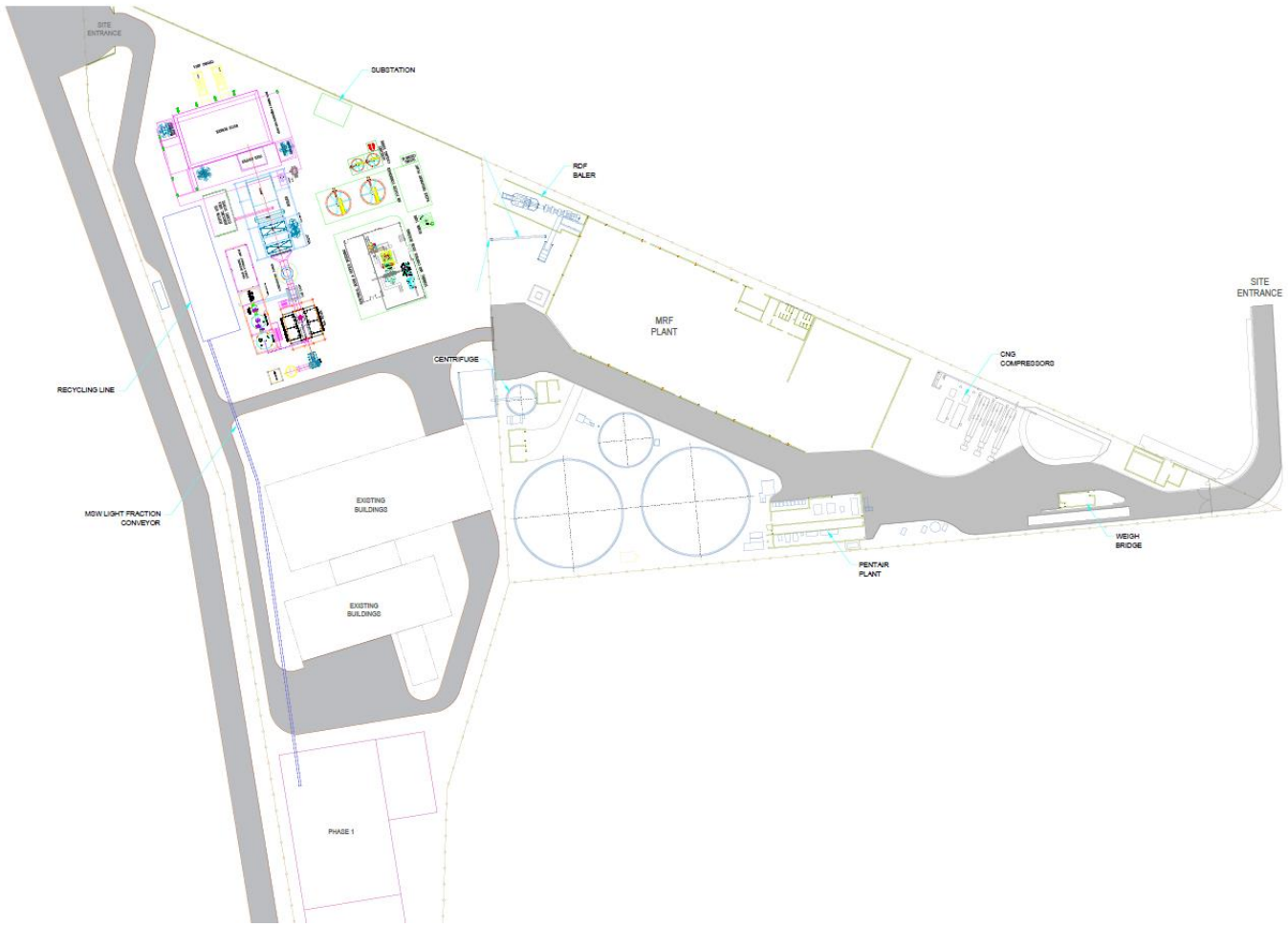
4. Rates shall be quoted both in figures and in words in clear legible writing. No overwriting is allowed. All scoring and cancellations should be countersigned by the Contractor. In case of illegibility, the interpretation of Owner shall be final. All entries shall be in English language.

5. Unless specifically mentioned otherwise in the Contract, the Contractor shall quote for the complete cost and the quoted unit rates shall include for provision of all necessary equipment, consumables, power, temporary works, levies, taxes, insurance, royalties, establishment, temporary roads, contingencies, overheads and profits as well as qualified and experienced personnel for completion of work in all respects and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work according to the contract.

6. In the interpretations of the various specifications, Owner's decision is final and binding.

7. Rates shall include provision for preparation and submission of 3 copies of Draft Report and 6 copies of Final Report after incorporating comments by Owner.

ANNEX 4 – Layout (1/2)



ANNEX 4 – Layout (2/2)