Offshore Production System Definition and Cost Study

This study includes a description of the offshore components for a seafloor production project at Solwara 1. It includes CAPEX / OPEX estimates for the offshore components but does not include an economic analysis

NAUTILUS
Minerals Inc.

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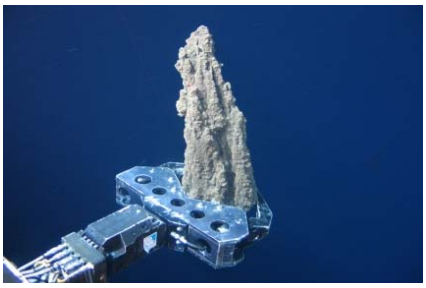

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Disclaimer

This study was prepared for Nautilus Minerals Inc. by SRK Consulting (Australasia) Pty Ltd. (SRK), Clough Limited (Clough) and Ausenco Services Pty Ltd. (Ausenco) (SRK, Clough and Ausenco collectively, the “Project Consultants”). This study is meant to be read as a whole, and sections should not be read or relied upon out of context. This study contains the expression of the professional opinion of the Project Consultants based on: (i) information available at the time of preparation, (ii) data supplied by outside sources, (iii) conclusions of other experts named in this study and (iv) the assumptions, conditions and qualifications in this study. The quality of the information, conclusions and estimates contained herein is based on industry standards for engineering and evaluation of a mineral project and is consistent with the levels of accuracy and / or contingency allowances stated. Clough has prepared the material in Sections 19.3.1 to 19.3.2.4 inclusive, 19.3.2.6, 19.5.1 to 19.5.4.9 inclusive, 19.6, 19.7.8, 19.7.10, 20.2.2 to 20.2.5 inclusive, 20.2.7 to 20.2.8 inclusive, 20.3.2, 20.3.4, 21.5.4 to 21.5.6 inclusive, 21.5.8, 22.3.2 to 22.3.4 inclusive and 22.3.6 of this study. Ausenco has prepared the material in Sections 16.6, 19.3.2.5, 19.5.5, 20.2.6, 20.3.3, 21.5.7, 21.5.9, 22.2 and 22.3.5 of this study except the DWP feed surge tank, the out of specification ore storage tank and the dewatered ore reserve dewatered storage tank (which fall under Section 19.5.2). Mineralurgy has prepared the material in Sections 16.1 to 16.5 inclusive and 21.4, Golders and Asociates prepared the Mineral Resource Estimates defined in Section 17 and SRK has prepared all remaining parts of this study. None of the Project Consultants takes responsibility or accepts any liability for the parts of this study that were prepared by the other Project Consultants.

List of Abbreviations

Abbreviation	Meaning
°C	degrees centigrade
AAS	Atomic Absorption Spectrometry
ABS	American Bureau of Shipping
Ag	Silver
AMM/AM	Auxiliary Mining Machine/Auxiliary Miner
ANZECC/ARMCANZ	Australian and New Zealand Environment and Conservation Council/Agriculture and Resource Management Council of Australia and New Zealand
Au	Gold
AUV	Autonomous Underwater Vehicle
AUX	Auxiliary Miner
As	Arsenic
Ba	Barium
bcm	bank cubic metre
BD	Bulk Density
Be	Berylium
BFA	Bench Face Angle
BH	Bench Height
Bi	Bismuth
BM	Bulk Miner
BSA	Bench Stack Angle
BSH	Bench Stack Height
BSL	Below Sea Level
C	Cohesion
Ca	Calcium
CAPEX	Capital Expenditure
Cd	Cadmium
CCR	Central Control Room
Co	Cobalt
Coffey	Coffey Natural Systems (Australia)
COG	Centre of Gravity
C&CO	Charter and Contract Operation
Cr	Chromium
CRM	Certified Reference Materials
CSA	Canadian Securities Administrators
CSIRO	Australian Commonwealth Scientific and Research Organisation
CTD	Conventional Tailings Disposal
Cu	Copper
CZ	Central Zone

Abbreviation	Meaning
dB	Decibels
DEC	Department of Environment and Conservation
DF	Diesel Fuel
DP	Dynamic Positioning
DPS	Dynamic Positioning System
DSTP	Deep Sea Tailings Placement
DTM	Digital Terrain Model
DWP	Dewatering Plant
DWT	Dead Weight Tonnes
E	East
EEZ	Economic Exclusive Zones
EIA	Environmental Impact Assessment
EIR	Environmental Inception Report
EIS	Environmental Impact Statement
EL	Exploration License
EM	Electromagnetic
EMP	Environmental Management Plan
EMS	Environmental Management System
EPCM	Engineering, Procurement and Construction Management
EPIRB	Emergency Position-Indicating Radio Beacon
E–W	East-west
Fe	Iron
FEED	Front End Engineering Design
FOB	Free on Board
FoS	Factor of Safety
FPSO	Floating Production, Storage and Offloading
GBI	Geotechnical Blockiness Index
GDM	Geotechnical Domain Model
GIS	Geographic Information System
GM	Gathering Machine
Golder Associates	Golder Associates Pty Ltd
GSBW	Geotechnical Safety Berm Width
ha	Hectare
Handymax	A naval architecture term for a bulk carrier, typically between 35,000 and 60,000 metric tonnes deadweight
Handysize	A naval architecture term for a bulk vessel with deadweight of about 15,000 to 35,000 metric tonnes.
HFO	Heavy Fuel Oil
Hg	Mercury
HLV	Heavy Lift Vessel
Hr	Hydraulic radius

Abbreviation	Meaning
IACS	International Association Classification Societies
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectrometry
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
IFC	International Finance Corporation
IFO	Intermediate Fuel Oil
IMO	International Maritime Organisation
IRA	Inter Ramp Angle
JORC Code	Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves prepared by the Joint Ore Reserves Committee of the Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Minerals Council of Australia (JORC), December 2004.
k	thousand
K	Potassium
kg	kilogram
kL	kilolitre
km	kilometre
km^2	square kilometre
kt	kilotonne
LARS	Launch and Recovery System
LBL	Long Base Line – refers to acoustic positioning arrays
LCG	Longitudinal Centre of Gravity
Li	Lithium
LOI	Letter of Intent
LOSA	Limiting Overall Slope Angle
m	Metre
M	Million
m RL	metres Reduced Level
m/s	metre per second
m^3	cubic metre
MSR	Marine Scientific Research
MST	Main Surge Tank
MARPOL	International Convention for the Prevention of Pollution from Ships
MDO	Marine Diesel Oil
mE	metres East
Mg	Magnesium
MGO	Marine Grade Oil
ML	Mining Lease
MLA	Mining Lease Application
MMAJ	Metal Mining Agency of Japan
mN	metres North
Mn	Manganese

Abbreviation	Meaning
Mo	Molybdenum
MODU	Mobile Offshore Drilling Unit
MOU	Mobile Offshore Unit
MRMR	Mining Rock Mass Rating
mS	metres South
Mt	Million tonnes
Mtpa	Million tonnes per annum
N	North
Na	Sodium
NATA	National Australian Testing Association
NE	Northeast
NGO	Non Government Organisations
Ni	Nickel
NPV	Net Present Value
NW	Northwest
ODP	Ocean Drilling Program
OFEM	Ocean Floor Electromagnetic
OFG	Ocean Floor Geophysics
OPEX	Operating Expenditure
OS	Oversize
P	Phosphorous
Pb	Lead
PGK	Papua New Guinea Kina
PMF	Probable Maximum Flood
PNG	Papua New Guinea
PNGPCL	PNG Ports Corporation Limited
POB	People on-board
ppm	Parts per million
Project	Solwara 1 Project
PSV	Production Support Vessel
Py	Pyrite
Q	Barton Q value
Q’	Modified Q value
QA/QC	Quality Assurance/Quality Control
RALS	Riser and Lifting System
RMR	Rock Mass Rating
ROM	Run of Mine
ROV	Remotely Operated Vehicle
RPM	Revolutions Per Minute
RQD	Rock Quality Designation

Abbreviation	Meaning
RTP	Riser Transfer Pipe
S	Sulphur
Sb	Antimony
SBW	Spill Berm Width
SE	Southeast
Se	Selenium
Si	Silicon
SME	Subsea Mining Equipment
SMS	Seafloor Massive Sulphide
SMT	Seafloor Mining Tool
SOLAS	International Convention for Safety of Life at Sea
SOPAC	South Pacific Applied Geoscience Commission
SPREP	Convention for the Protection of the Natural Resources and Environment of the South Pacific Region
Sr	Strontium
SR	Stripping Ratio
SRK	SRK Consulting (Australasia) Pty Ltd
SRM	Standard Reference Materials
S-SE	South-Southeast
SSLP	Subsea Slurry Lift Pump
Study	Offshore Production System Definition and Cost Study
SW	Southwest
t	Tonne
TCG	Transverse Centre of Gravity
Te	Tellurium
Ti	Titanium
TML	Transportable Moisture Limit
Tp	Peak wave period
Tpa	tonnes per annum
TPUSA	Technip USA Inc
TSF	Tailings Storage Facility
TTD	Thickened Tailings Disposal
µm	Micrometer
UNCLOS	United Nations Convention on the Law of the Sea
V	Vanadium
VCG	Vertical Centre of Gravity
VHMS	Volcanic-Hosted Massive Sulphide
VIV	Vortex induced vibration
VMS	Volcanogenic massive sulphide
v/v	volume / volume
W	West

Abbreviation	Meaning
W	Tungsten
WBS	Work Breakdown Structure
Weathervane	Refers to change in direction faced by a vessel or barge - moving in response to changes in wind direction
WHO	World Health Organisation
WHOI	Woods Hole Oceanographic Institute
W-NW	West-Northwest
Zn	Zinc

1. Executive Summary

1.1 Summary

This Offshore Production System Definition and Cost Study provides a summary review on the status of Nautilus Minerals Bismarck Sea exploration results and its production development plan up to delivery of ore to the port of Rabaul, PNG.

This study has been based on documentation generated by Nautilus and its consultants, contractors and suppliers and has been reviewed and compiled by:

- SRK Consulting.
- Clough Engineering.
- Ausenco.
- Mineralurgy
- Golder Associates

This report has been compiled to conform to the reporting requirements of *National Instrument 43-101 (Standards of Disclosure for Mineral Deposits)* and 43-101F1 guidelines provided by the Canadian Securities Administrators.

This study is preliminary in nature, that it includes inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorised as mineral reserves, and that there is no certainty that the output of this study will be realized. Mineral resources that are not mineral reserves do not have demonstrated economic viability.

1.2 Project Overview

Nautilus has located a number of Seafloor Massive Sulphide (SMS) deposits in the Bismarck Sea, within the Territorial Waters of Papua New Guinea. Nautilus' business model is based on the notion of ongoing resource accumulation and "aggregating" numerous high grade SMS systems and to sequentially develop them using a "floating" production system. The notion is in keeping with the land based Volcanic Hosted Massive Sulphide (VHMS) systems occurring in "camps" and has been supported by Nautilus' strong record of discovery of new SMS systems in the Bismarck Sea.

Nautilus' development plan is to commence with its Solwara 1 site located within Mining Lease Application MLA154, within Exploration License No. EL1196. As of December 2009, the indicated and inferred mineral resources attributed to the Solwara 1 deposit as calculated by Golder Associates (using a 4% Copper cut-off) is 870 kT and 1,300 kT respectively. Nautilus is continuing with an exploration and resource evaluation program with the expectation that Solwara 1 in MLA154 and its other Bismarck Sea tenement holdings will translate into an increased aggregated commercially viable reserve.

The Bismarck Sea Development Project will involve the extraction and recovery of SMS deposits in expected water depths of between 1,500 to 2,500 m.

The development comprises the following elements:

- Seafloor Mining Tools (SMTs).
- Riser and Lifting System (RALS).
- Production Support Vessel (PSV) with dewatering facilities.
- Ore transportation to the port of Rabaul.
- Ore storage at an onshore stockpile facility (outside scope of report).
- Load-out and transportation to a processing facility (outside scope of report).

- Concentration of ore (outside scope of report).
- Load-out and transportation of concentrate to the market (outside scope of report).

At the time of writing this report, Nautilus is in commercial discussions with external parties on PNG operations and on concentrate processing options and hence the last four items above are excluded from the scope of this report.

SMTs will be used to excavate the massive sulphide material from the seafloor. The excavated material will be pumped as slurry to the production support vessel via the RALS. The pumped slurry will be dewatered at surface and then be transferred to cargo barges for transportation to shore for stockpiling. The ore will subsequently be offloaded into bulk carriers for transportation to a concentrator treatment plant and then subsequent processing and delivery to the concentrate market.

A simplified process flow chart that illustrates the scope of the Solwara 1 project is shown in Figure 1-1.

1.3 Scope of Study

The purpose of the study is to:-

- Review and verify various preceding exploration results, studies, assessments, engineering designs and compile into a single report.
- Review and verify CAPEX / OPEX evaluations for the development project up to the delivery of ore on transportation barges to the port of Rabaul, (PNG) (i.e. before any stockpiling operations or delivery of ore to a concentrate processing plant).
- Form the basis of future NI 43-101 compliant reports on the entire development project.

1.4 Exploration

Nautilus Minerals Group (Nautilus) is exploring Exploration Licences (EL's) located in the Bismarck Sea, within the territorial waters of Papua New Guinea. These licences are either known to host, or are considered prospective for, Cu-Zn-Ag-Au SMS mineralisation.

Terrestrial volcanic-hosted massive sulphide (VHMS) deposits form a significant part of the world's reserves of copper, lead and zinc, as well as being significant producers of gold and silver. The similarities between SMS deposits and many ancient VHMS deposits have led to the conclusion by geologists that VHMS deposits originally formed as SMS deposits.

In Papua New Guinea, as of 31 December 2009, Nautilus has 45 EL's, 18 EL's applications and one Mining Lease application in the Bismarck Sea, PNG. On the 29 December 2009, Nautilus received the final Environmental Permit for the development of the Solwara 1 Project from the Department of Environment and Conservation (DEC) of Papua New Guinea for a term of 25 years, expiring in 2035. The Environmental Permit is a significant step towards the processing of Nautilus' Mining Lease Application (MLA154).

Nautilus has a track record of successful discovery of active and fossil polymetallic SMS systems, building a pipeline of exploration prospects within its offshore exploration tenements in the Bismarck Sea. In 2009, Nautilus completed a target generation and target testing program in the Bismarck Sea that identified and sampled nine new prospects, bringing the total number of prospects in the Bismarck Sea to 19. Seventeen of these prospects are SMS systems and 2 are sulphate rich hydrothermal systems with anomalous precious metals.

Nautilus uses subsea drilling equipment for scout, resource and metallurgical drilling operations on SMS deposits. Nautilus has drilled a total of 184 holes for 1,640 m total length over three separate drilling campaigns.

Nautilus is planning additional exploration work in the Bismarck Sea to further assess their tenement holdings and will focus on increasing its knowledge of SMS systems in the Bismarck Sea through additional drilling. This is intended to feed into the Exploration Project Pipeline to develop and maintain a suitable resource inventory.

Nautilus has developed 2D geophysical methods and is investigating 3D geophysical methods to assist mapping the size and shape of massive sulphide bodies. This will augment the data available through drilling. Nautilus has also been investigating the use of Autonomous Underwater Vehicles (AUV) in their exploration programs to improve the quality and efficiency of exploration data acquisition.

Given Nautilus' research and development initiatives to improve target generation and orebody delineation, as well as the proposed exploration in prospective areas, it is SRK's opinion that Nautilus' proposed activities are appropriate for exploring for new SMS deposits and adding to the current SMS resources.

SRK is of the view that the projects are sufficiently prospective to warrant exploration with the techniques and programs indicated to SRK during the assessment. In SRK's opinion the directors and staff of Nautilus have the appropriate technical and management expertise to manage the proposed exploration program.

1.5 Resource and Reserves

Following a drilling program in 2007, Golder Associates carried out a Mineral Resource estimate for the Solwara 1 deposit. The Mineral Resource (Lipton, 2008) estimate was carried out to conform to the principles of the National Instrument 43-101 and is reported to contain an Indicated Resource of 870 Kt at 6.8% Cu, 4.8 g/t Au, 23 g/t Ag and 0.4% Zn, and an Inferred Resource of 1,300 Kt at 7.5% Cu, 7.2 g/t Au, 37 g/t Ag and 0.8% Zn. The Indicated Resources are composed of seafloor massive sulphides while the Inferred Resources include lithified sediments and chimney material in addition to the seafloor massive sulphides. No resource estimates have been defined for any other prospect, and as such, these areas are considered speculative by nature, and involve varying degrees of moderate to high exploration and financial risk.

1.6 Process Metallurgy

The results of the mineralogical and metallurgical test work completed to date on Solwara 1 ore can be summarised as follows:

- Copper is present almost exclusively as the mineral chalcopyrite.
- Treatment by conventional grinding and flotation processing produced commercial copper concentrates grading 25 to 30% Cu.
- Chalcopyrite liberation is significant at a sizing of 80% -40 µm with the test flow sheet using a primary grind of 80% -55 µm and regrinding of rougher concentrate to 80% -25 µm.
- Copper recovery in the laboratory has been 85-90%.
- Arsenic is the only significant deleterious element in the ore with the main carrier being arsenopyrite, however, arsenic levels in concentrates from samples tested were well below typical penalty levels.
- Gold recovery to the copper concentrate is around 25%.
- Around 65-70% of the total gold content can be recovered into a pyrite concentrate.
- At least 80-90% of the gold reporting to the pyrite concentrate can be extracted by the conventional technologies of roasting / cyanidation or pressure oxidation / cyanidation. This would give a total 'gold recovery' to copper concentrate + bullion of 75 to 90%.
- The pyrite concentrate would average about 7—9 g/t Au and ~45% sulphur.
- The samples tested have Bond Ball Work Index values in the range of 10-12 kWh/t indicating a low to medium resistance to comminution.

These results have not been optimised but the following points have been noted.

- Copper flotation results are consistent for all samples tested.
- Tests had open circuit cleaning i.e. copper recoveries would be expected to be higher with closed circuit cleaning albeit at the risk of lower concentrate grade.
- Dilution with low grade materials or 'country rock' should not affect copper metallurgical performance.
- Copper concentrates are 'clean' and should not present any problems to custom copper smelters.
- Exposure of the materials tested for up to 8 weeks has not caused any major deterioration in metallurgical performance.
- Production of an auriferous pyrite concentrate will be necessary to get 'gold recovery' to copper concentrate + doré bullion to 75 to 90%.

The only attempt at making a zinc concentrate gave an encouraging result with a product high in precious metals that may be upgraded by the established technique of reverse flotation.

1.7 Solwara 1 Development Plan

1.7.1 General

Nautilus is progressing its plan for the Bismarck Sea Development Project on the basis of:

- Creating value from the Solwara 1 SMS deposit.
- Prioritising development work and cash spend on the offshore production system.
- Maximising use of existing technology and market leaders.
- Providing a flexible production system that can be relocated to other prospective Bismarck SMS deposits that may be commercially viable in their own right or as a part of an aggregated resource model.

1.7.2 Project Status

The Solwara 1 project is currently in an engineering phase.

Nautilus' development plan strategy has been to initially focus on the key / less developed elements of the production system associated with cutting and lifting produced ore from the seafloor to the surface. Based on this strategy and prior to project suspension, Nautilus had placed a number of key commitments on the long lead subsea and offshore project scopes.

In December 2008, during the downturn in the global financial market, Nautilus suspended the project which included the partial suspension of contracts / purchase orders associated with key technologies (SMTs, subsea lift pump and RALS design). Remaining key contracts / purchase orders were terminated for convenience with all contractual matters resolved and reported. Since that time, the project has continued engineering and commercial evaluation of the project.

Nautilus intends to re-sanction and recommence the project build subject to Nautilus Board approval.

1.7.3 Project Management Plan

Nautilus' delivery model is to maintain a small owners management team centred in Brisbane, Australia, supervising work packages either managed by EPCM contractors or equipment purchases provided by vendor design and construct packages. Each significant package is supervised by a dedicated Lead Engineer or Delivery Manager reporting to one of the two Project Managers (offshore production and materials handling / processing), supported by contracts, project controls (cost, planning, document control), technical (engineering), health, safety and environmental teams which report to the Project Director.

This structure provides the required resource flexibilities and expertise of contracting groups across the range of disciplines required to deliver this project, whilst ensuring packages interfaces are understood and managed by the Nautilus team. A vessel integration EPCM contractor will have particular responsibility for managing interfaces involved in transport, preparation and integration of the SME into the vessel (PSV).

1.7.4 Seafloor Mining Tools

The development of the SMTs is based on the consolidation of technologies that exist in the offshore (deepwater) oil and gas, trenching, marine dredging and onshore / offshore mining industries. Whilst the precise design of this equipment will be bespoke, each element of the equipment has an existing analogue within the above industries.

A contract is in place for the design and supply of the seafloor mining tools with Soil Machine Dynamics, a market leader in offshore / subsea trenching and remotely operated vehicles. Design of the equipment is ongoing.

The development of seafloor mining tools is considered technically feasible. The following key risk areas have been identified:

- Hyperbaric effect (ie. the effect of hydrostatic pressure on the cutting process).
- Production rate / equipment operability.
- Operations interfacing with riser and lift system.
- Waste material management.

Tests and studies have been undertaken on the impact of hyperbaric effect on cutting rates / energy which has been incorporated into the equipment design. Further studies and tests are planned, including in-situ (on seafloor) measurements from future drilling campaigns.

Project returns are sensitive to production rate which is ultimately driven by that of the seafloor mining tools. The impact of ore body variability, seafloor topography and equipment operability has been evaluated which led to a change in the number and types of machines. The modified mining configuration on the seafloor is analogous to onshore surface mining operations where multiple machines operate, each performing a specific task. Co-ordination and handling the three separate seafloor mining tools from the production support vessel will be critical and has been the subject of analysis by Nautilus contractors and consultants. As far as practicable, flexibility and higher instantaneous production rates have been incorporated into the designs to optimise over-all production rates.

Modifications in the seafloor mining tool designs offer simpler operating interfaces with the riser and lift system.

Waste material management associated with the relocation of subeconomic rock / sediment using the SMTs has not been finalised and is being developed during detailed design.

As design work is in progress, and due to the criticality of this equipment, periodical and ongoing reviews will be undertaken.

1.7.5 Riser and Lift System

The riser and lift system is a critical component to the project development plan. Components and technology of the system come from the well established offshore oil and gas (drilling and production) industry.

An EPCM contract is in place for the over-all system design with Technip, USA and a supply contract in place with GE Hydril for a subsea lift pump. Detailed design and equipment supply testwork is ongoing.

The development of the riser and lift system is considered technically feasible. The following key risk areas have been identified:

- Erosion rates.
- Subsea lift pump performance.

Engineering analysis has been undertaken on vertical riser erosion rates. This analysis has demonstrated that in the vertical riser, particles are centralised in the flow and do not cause unacceptable erosion. Bends will be sacrificial and regularly replaced as a result of erosion. Further verification work is in progress to confirm this outcome.

The selected subsea lift pump has not been previously utilised for pumping slurry with similar parameters as the Solwara 1 ore. The pump has been used for pumping drill cuttings. Testwork is in progress to test the subsea lift pump components with representative material for erosion, flow assurance and reliability performance. Results of testwork will be used in developing maintenance schedules.

1.7.6 Production Support Vessel

The production support vessel is similar to vessels that service the large markets of offshore (subsea) construction, drilling and production for the offshore oil and gas industry. A production support vessel has not yet been selected by the project.

The main technical requirements for a suitable PSV are:

- Adequate deck space.
- Accommodation for up to 140 persons.
- Dynamic positioning reliability.
- Adequate electrical power.

These requirements can be met from either barge or ship hulls so selection of a suitable PSV donor hull is not considered a significant technical risk. The benign location of Solwara 1 will mean that vessel motions and associated weather downtime will be minimal.

Delivery schedule and integration of the seafloor mining and production equipment are identified as the main risks associated with the PSV. Vessel selection will be based on existing hulls or new build delivery from market leading vessel owners which require minimal modification. An EPCM contractor will be selected to manage the over-all co-ordination and integration of equipment onto the vessel. This integration exercise is analogous to a vessel spread mobilisation which is a common activity in the offshore oil and gas industry.

1.7.7 Dewatering Plant

Dewatering plant process design is based on well known and well established technology from the mineral processing industry and hence corresponds to a reduced project technology risk in comparison to the seafloor mining equipment. However, as the DWP is a part of a single integrated production process design, it is a critical component of the development.

A design study for the DWP was performed originally by Parsons Brinkerhoff. A contract for the DWP detailed design and / or supply has not been placed at time of writing this report.

The development of a DWP onboard the PSV is considered technically feasible. The unit processes within the dewatering plant flow sheet and the equipment selected for the duty are generally consistent with normal design practice. The space constraints onboard the PSV add to the DWP design complexity to minimise its footprint.

The following key risks have been identified:

- Reduced design optimisation due to limited test material and TML definition.
- Slurry variability including ROM ore feed size and slurry temperature effects.
- Operations interfacing with seafloor riser and lift system.

Limited test material from the Solwara 1 site is available. Consequently, design is primarily based on assumed empirical parameters. Test work has been performed and further tests are in progress to finalise the DWP design envelopes.

As far as practicable, buffering capacity ahead of the DWP has been incorporated into the design to reduce the variability in its process feed. This includes:

- Specific seafloor cutting machines that provide greater control on cut particle size.
- Delinked seafloor cutting and gathering machines that provides a “buffer” of broken floor stocks between the cutting and gathering operations.
- Constant volumetric flow for the gathering machine which ultimately provides steady state DWP slurry flow rate.
- A surge tank between the riser and lift system and the DWP feed to modulate variability in slurry density.

Notwithstanding the above, checks associated with additional test work and subsea equipment design interface will be undertaken during the detailed design to confirm the Parson Brinckerhoff DWP design.

1.7.8 Ore Transport to the Port of Rabaul / Stockpiling

Ore (barge) transportation, handling, offloading and stockpiling are well established and well understood operations.

Studies on barging, stockpiling and handling of ore were performed by Parsons Brinckerhoff.

A number of options exist for the transportation barges from PSV to the port of Rabaul. A decision on contracting strategy has not been finalised at time of writing of this report although the cost base for this study has assumed purchase of existing second hand barges. The final decision will be made based on assessment of commercial and schedule benefits / constraints and project risk management of the various options.

Transportation, offloading and stockpiling of ore to and at the port of Rabaul is technically feasible. The following key risks have been identified:

- Reactivity of the ore.
- Limitations / restrictions of existing facilities at the port of Rabaul.

The reactivity of the ore can be managed with industry established practices. Final design will account for covers to manage TML and first in / first out rotation in the stockpiles.

There exists some limitations with the port facilities which are manageable with the use of mobile equipment and some capital works. The port of Rabaul is located in an earthquake risk zone. Work is ongoing to confirm the geotechnical foundation work required.

Commercial discussions with the port of Rabaul were ongoing at the time of writing this report, hence CAPEX / OPEX evaluations have been excluded from this report.

1.7.9 Concentrator

The concentrator process design is based on a flow sheet and unit operations that are well proven in base metals flotation plants.

The process metallurgy and design rely mainly on preliminary test work. Additional work is in progress to refine and optimise the design and associated costs.

At the time of writing this report, Nautilus has not concluded its concentrate facility development plan and is in commercial discussions with external parties on its processing options. Correspondingly, the concentrate facility definition is excluded from the scope of this report.

1.7.10 Mine Plan / Schedule

The Solwara 1 project mining and processing production rate is planned to commence at a rate of 1.2 Mtpa (dry equivalent) with the capacity to ultimately ramp up to 1.8Mtpa of dewatered ore delivered to the Rabaul Port.

The systems and plant will be designed and operated so that the steady state annual rate of production is limited by the Seafloor Mining Tools (SMTs) and where practicable, all plant and equipment downstream of the SMTs will not restrict production.

A mine plan has been developed for the Solwara 1 NI 43-101 resource estimate which achieves 2,000 kt of ore mined and gathered over 18 months. The daily production rate varies from 2,200 to 4,320 tonnes per day with the average production rate for the Solwara 1 production schedule being 3,450 tonnes per day or an average of 3,710 tonnes per day (1.35Mtpa) excluding site initiation and shut-down. Over the initial production period the copper equivalent grade varies from 5.5% to 12.3% with the average at 9.2%.

1.7.11 CAPEX / OPEX Estimates

The total capital cost for the system to deliver dewatered ore on board transportation barges to the port of Rabaul as defined by the basis of estimate (Section 20.1.1) including contingency (17.5%) is US$383 million.

The operating cost (excluding contingency) is estimated to be US$237,000 per day or approximately US$64 per tonne of mined ore transported to port of Rabaul (based on production rate of 1.35 Mtpa). Allowing for a 10% contingency, the above operating costs become $261,000 per day or approximately $70 per tonne.

1.7.12 Schedule

First ore is scheduled 30 months after project sanction.

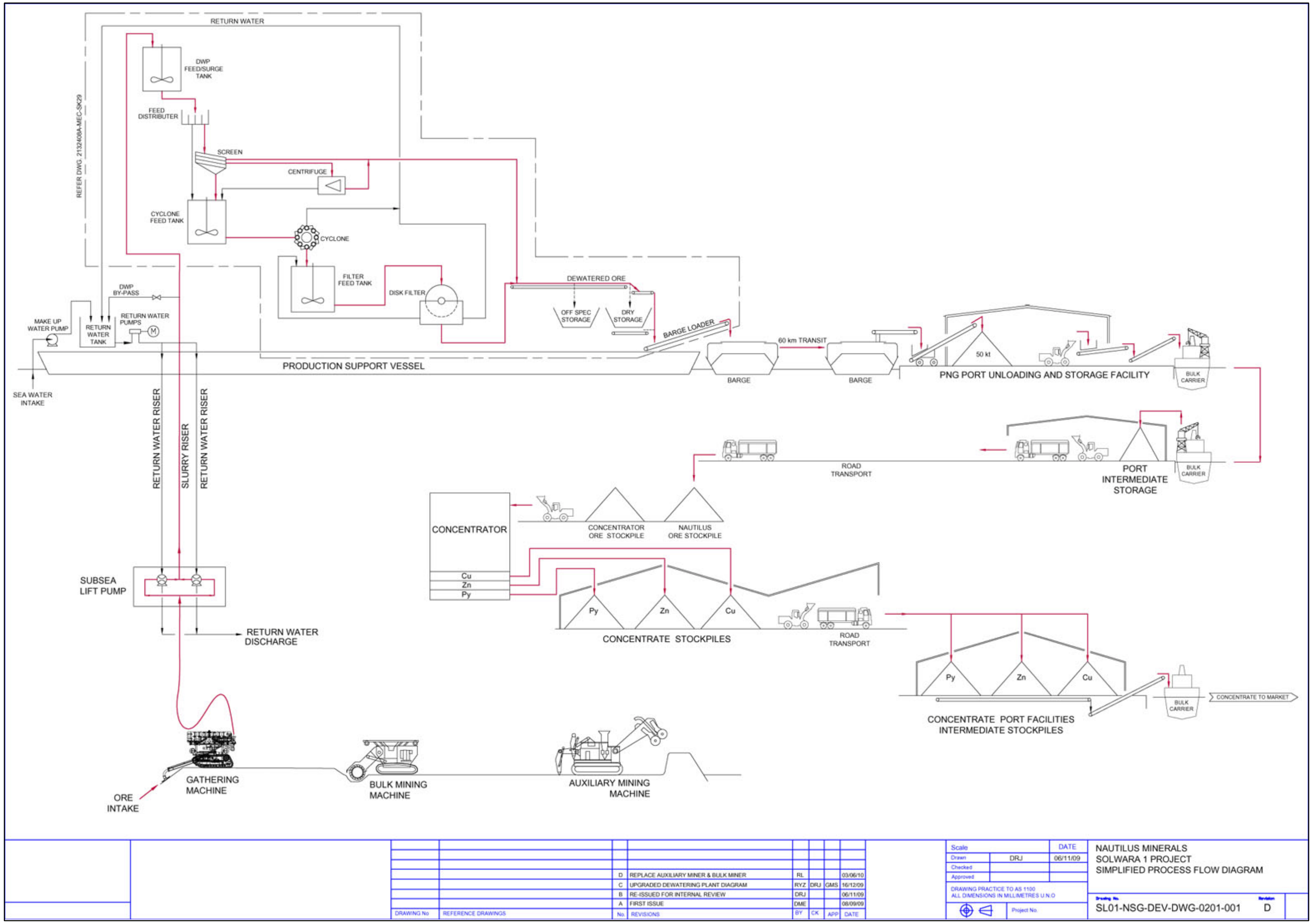

Figure 1-1: Solwara 1 Project Process Flow Chart

2. Introduction and Scope of Report

2.1 Project Overview

Nautilus has located a number of SMS deposits in the Bismarck Sea, within the Territorial Waters of Papua New Guinea. Nautilus' business model is based on the notion of ongoing resource accumulation and "aggregating" numerous high grade SMS systems using a "floating" mining production system. The notion is in keeping with the land based VHMS systems occurring in "camps" and has been supported by Nautilus' strong record of discovery of new SMS systems in the Bismarck Sea and Tonga.

Nautilus' development plan is to commence with its Solwara 1 site located within Mining Lease Application MLA154, within Exploration License No. EL1196. As of December 2009, the indicated and inferred mineral resources attributed to the Solwara 1 deposit as calculated by Golder Associates (using a 4% Copper cut-off) is 870 kT and 1,300 kT respectively. Nautilus is continuing with an exploration and resource evaluation program with the expectation that Solwara 1 in MLA154 and its other Bismarck Sea tenement holdings will translate into an increased aggregated commercially viable reserve.

Figure 2-1 shows the locations of the various SMS and sulphate deposits (notated Solwara 1 – 19) within the Bismarck Sea.

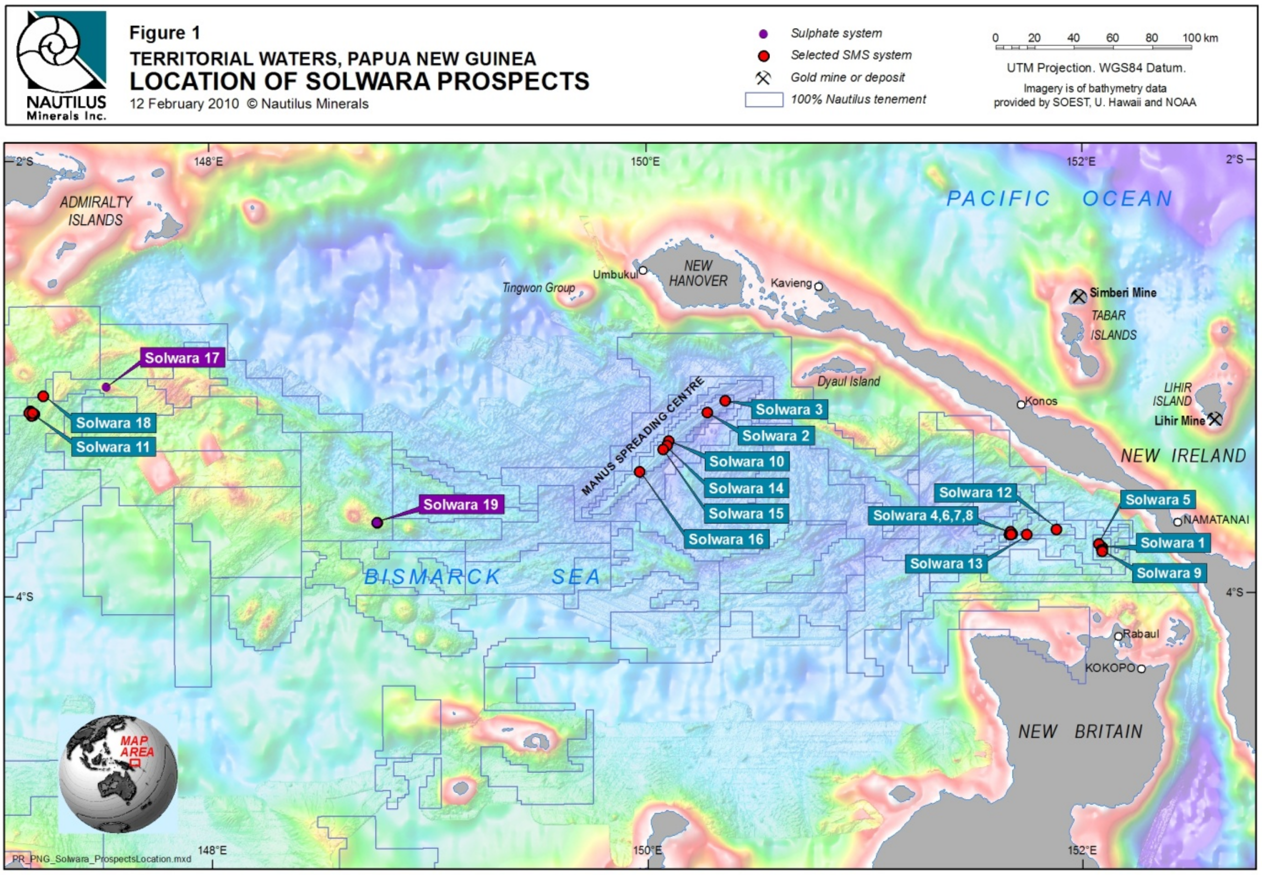

Figure 2-1: Bismarck Sea – SMS Deposit Locations

2.2 Mining Systems Overview

The Bismarck Sea Development Project will involve the extraction and recovery of sea floor massive sulphide (SMS) deposits in expected water depths of between 1,500 to 2,500 m.

The development project comprises the following elements:

- Seafloor Mining Tools (SMTs).
- Riser and Lifting System (RALS).
- Production Support Vessel (PSV) with dewatering facilities.
- Ore transportation to the port of Rabaul.
- Ore storage at an onshore stockpile facility.
- Load-out and transportation to processing facility.
- Concentration of ore.
- Load-out and transportation of concentrate to the market.

The last four of the above elements are outside the scope of this report.

Seafloor mining equipment will be used to excavate the material from the seafloor. The excavated material will be pumped as slurry to the production support vessel via a riser and lift system. The mined slurry will be dewatered at surface and then be transferred to cargo barges for transportation to shore for stockpiling. The ore will subsequently be offloaded into bulk carriers for transportation to a concentrator treatment plant and then subsequent processing and delivery to the concentrate market.

A diagrammatic representation of the mining process flow and material process elements (outside the scope of this report) is presented in Figure 2-2.

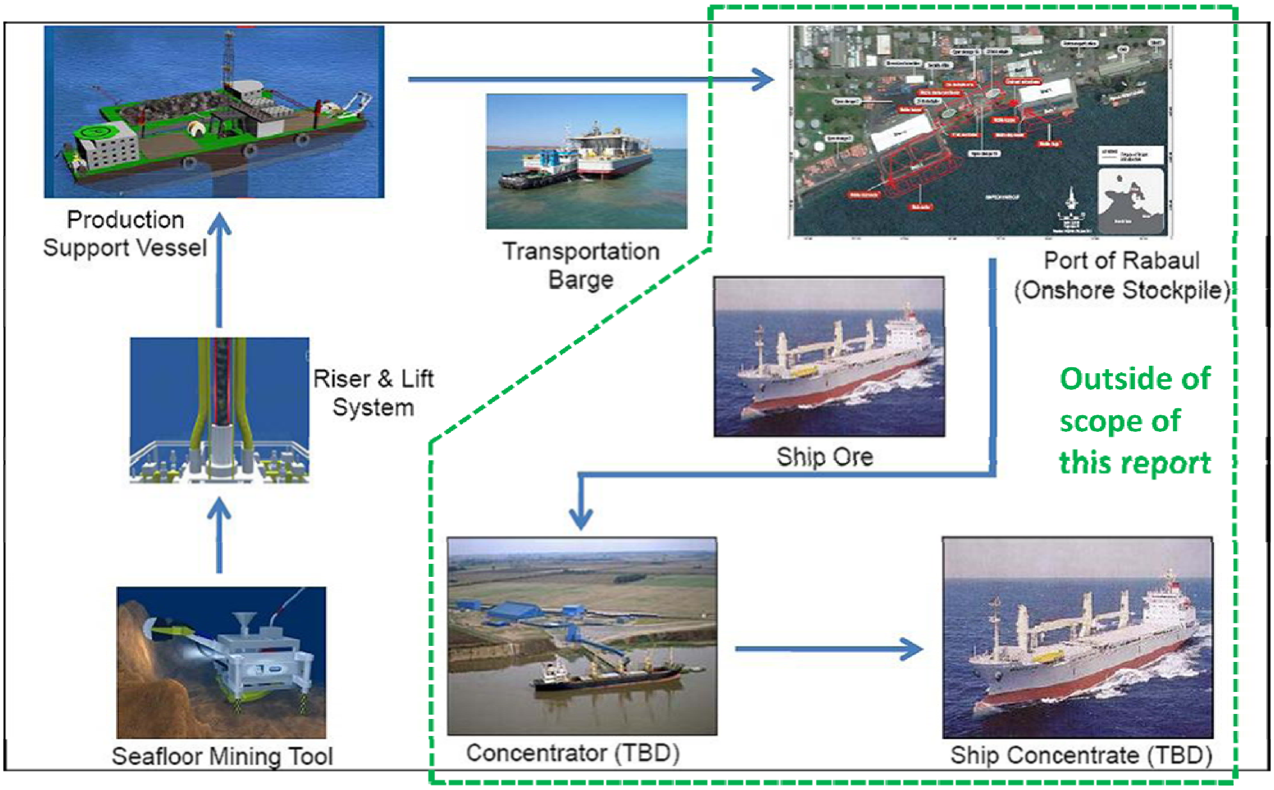

Figure 2-2: Seafloor Mining System Process Flow

2.3 Terms of Reference / Purpose of Report

The purpose of the study is to:

- Review and verify various preceding exploration results, studies, assessments, engineering designs and compile into a single report.
- Review and verify CAPEX / OPEX evaluations for the development project up to the delivery of ore on transportation barges to the port of Rabaul, (PNG) (i.e. before any stockpiling operations or delivery of ore to a concentrate processing plant).
- Form the basis of future NI 43-101 compliant reports on the entire development project.

2.3.1 Reporting Standard

Nautilus requires a report which complies with the following codes and jurisdictions:

- The JORC Code.
- The Valmin Code.
- National Instrument 43-101 of the Canadian Securities Administrators.
- The listing rules of the Toronto Stock Exchange and the London Alternate Investment Market.

National Instrument 43-101 (NI 43-101) is a rule developed by the Canadian Securities Administrators (CSA) and administered by the provincial securities commissions that governs how issuers disclose scientific and technical information about their mineral projects to the public. It covers oral statements as well as written documents and websites. It requires that all disclosure be based on advice by a "qualified person" and in some circumstances that the person be independent of the issuer and the property.

Reporting of any mined reserves or resources is required to conform to the CIM Standards on Minerals Resources, Definitions and Guidelines (National Instrument 43-101) which classifies blocks as Measured, Indicated and Inferred resources. This standard similar to those of the Joint Ore Reserve Committee (JORC) of the Australian Institution of Mining and Metallurgy.

2.4 Source of Information

Nautilus has made available documentation as detailed in Appendix 1.

2.5 Project Team

Mr Peter Chwastiak	Lead Mechanical / Equipment Engineer Offshore Oil and Gas	Clough Engineering
Mr Andrew See	Manager Studies - Queensland and Asian Operations	Ausenco
Mr Phil Jankowski	Principal Resource Consultant	SRK
Mr Peter Munro	Senior Principal Consulting Engineer	Mineralurgy
Mr Erich Heymann	Principal Environmental Consultant	SRK
Mr John Blackburn	Principal Mining Consultant	SRK
Mr Ian Lipton	Principal Geologist	Golder Associates

2.6 Background of the Project

Nautilus is focused on its exploration and developments plans for the recovery of high grade copper and gold in seafloor massive sulphide mineralisation. These mineralised belts, analogous to land based volcanic massive sulphide deposits, are typically located in back-arc basins near seafloor plate boundaries.

A considerable amount of exploration and development work has been undertaken to date by Nautilus and its Consultants / Contractors.

This work has been extensive and includes numerous exploration cruises as well as development work ranging from conceptual studies through to detailed design. Work has also been done by Marine Scientific Research (MSR) groups such as CSIRO, independent of Nautilus. The breadth and nature of this work can be understood by reviewing Appendix 1 which shows the list of more than 200 documents which record the details of the work undertaken.

Nautilus' exploration programmes have predominantly focused on the Bismarck Sea. Despite the infancy of the industry, Nautilus Minerals has been able to utilise existing technologies to achieve a very high success rate in generating and converting targets into high grade SMS mineralised discoveries. As of 31 December 2009, Nautilus Minerals has 17 SMS and 2 sulphate discoveries in its Bismarck Sea, PNG tenements.

The first deposit under development by the company is located at an approximate water depth of 1,600 m at Solwara 1, in the benign waters of the Bismarck Sea. This location lies within the territorial waters of Papua New Guinea. From 2006 to 2009 the company completed detailed environmental and geological studies at Solwara 1, culminating in a number of world firsts, including the first Environmental Permit granted for the extraction of seafloor massive sulphide deposits and the first NI 43-101 compliant SMS deposit resource statement.

As of December 2009, the indicated and inferred mineral resources of the Solwara 1 deposit as calculated by Golder Associates (using a 4% Copper cut-off) are 870 kT and 1,300 kT respectively. Nautilus is continuing with an exploration and resource evaluation program with the expectation that Solwara 1 in MLA154 and its other Bismarck Sea tenement holdings will translate into an increased aggregated commercially viable reserve.

In its development plans, Nautilus will rely on proven deepwater technologies from the oil and gas industry in the design of its mining system. Pipeline trenching units, workclass ROVs, deepwater production risers and drill cuttings removal systems will be adapted to develop the mining system. Key contractors used by Nautilus on this project have been selected for their deepwater experience and technical expertise.

2.7 Work Programme

This study has been prepared over a period of six months in late 2009 and early 2010. The inputs include work undertaken by Nautilus suppliers and consultants over a period in excess of 3 years (as demonstrated by Appendix 1) and compiled by SRK, Ausenco and Clough Engineering. The geological input has come principally from SRK, Golders and Nautilus, the environment input has come principally from Nautilus, Coffey and SRK, the mining input has come principally from Clough Engineering and Nautilus, and the processing input principally from Ausenco.

2.8 Statement of SRK Independence

Neither SRK nor any of the authors of this study have any material present or contingent interest in the outcome of this study, nor do they have any pecuniary or other interest that could be reasonably regarded as being capable of affecting their independence or that of SRK.

SRK has no beneficial interest in the outcome of the technical assessment being capable of affecting its independence.

SRK's fee for completing this study is based on its normal professional daily rates plus reimbursement of incidental expenses. The payment of that professional fee is not contingent upon the outcome of the study.

2.9 Warranties

Nautilus has represented to SRK that full disclosure has been made of all material information up to the 31 May 2010 and that, to the best of its knowledge and understanding, such information is complete, accurate and true.

3. Reliance on Other Experts

The opinions expressed in this study have been based on the information supplied to SRK by Nautilus. The opinions in this study are provided in response to a specific request from Nautilus. SRK has exercised all due care in reviewing the supplied information being Part A documents in Appendix 1. This study contains the expression of the professional opinion of the Project Consultants based on: (i) information available at the time of preparation, (ii) data supplied by outside sources, (iii) conclusions of other experts named in this study and (iv) the assumptions, conditions and qualifications in this study. The quality of the information, conclusions and estimates contained herein is based on industry standards for engineering and evaluation of a mineral project and is consistent with the levels of accuracy and / or contingency allowances stated.

Clough Engineering were requested by Nautilus to carry out a review / audit of existing documentation and to provide an overview of the proposed Offshore Mining Operation, to identify short falls or abnormalities in the proposed system and to make recommendations for improvements or further testing and design. This work was undertaken by Mr Peter Chwastiak of Clough Engineering who is a Qualified Person with regards to these areas.

Ausenco were requested by Nautilus to carry out a review / audit of existing documentation and to provide an overview of the proposed dewatering plant. This work was undertaken by Mr Andrew See of Ausenco who is a Qualified Person with regards to these areas.

4. Property Description and Location

4.1 Tenement Details

The Papua New Guinea *Mining Act 1992* is the principal policy and regulatory document governing the exploration, development, processing and transport of minerals PNG. It vests ownership of all minerals in or below the surface of land with the State of PNG and governs exploration and mining activities. The *Mining Act* allows exploration activities and mining of minerals to be undertaken on the seafloor within PNG territorial waters.

As of 31 December 2009, Nautilus' Bismarck Sea Project Area comprises 45 granted Exploration Licences (ELs), 18 Exploration Licence applications, and one Mining Lease application. The granted ELs cover 70,675 km^2 and the application areas cover 20,862 km^2 (Figure 4-1). The mining lease application (MLA 154) covers the Solwara 1, Solwara 5, Solwara 9a, Solwara 9b, North Zone, North Su and South Su seafloor massive sulphide (SMS) prospects (Figure 4-2). The mining lease application has an area of 59.11 km^2 and was registered by the PNG Mineral Resources Authority in September 2008.

The Solwara 1 Project Environmental Permit was granted on 29 December 2009.

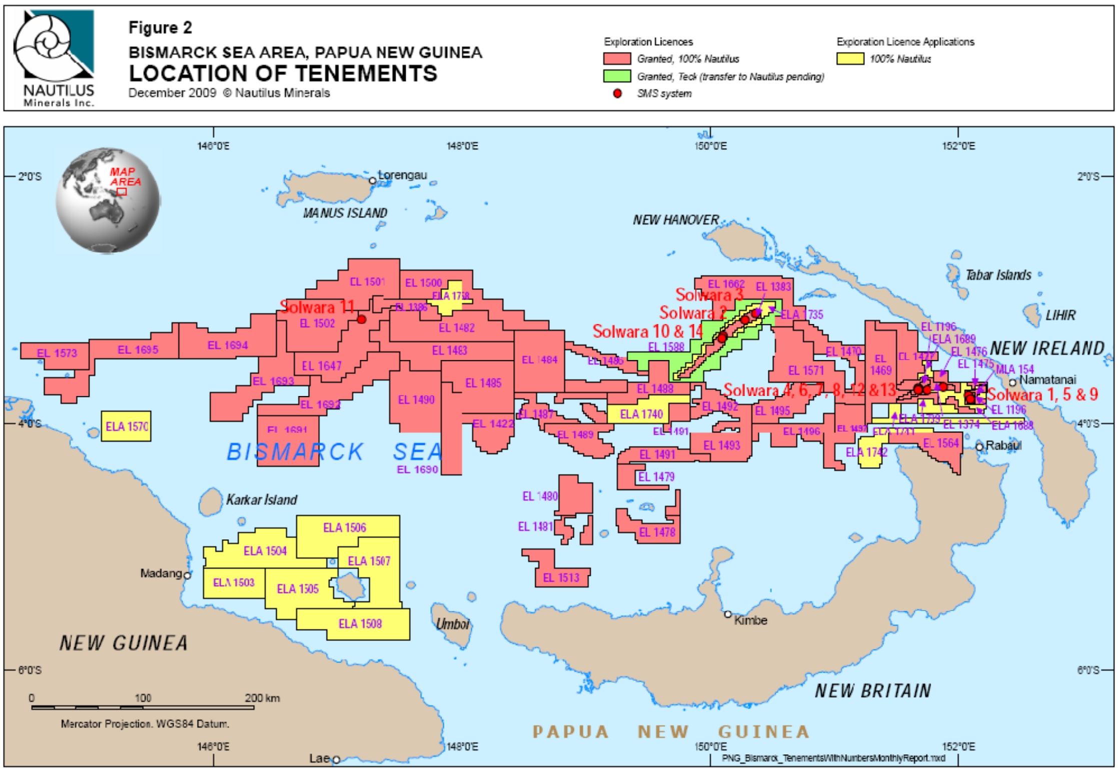

Figure 4-1: Nautilus tenements and tenement applications in the Bismarck SeaExploration Licences

4.2 Exploration Licences

An Exploration Licence (EL) is granted for a period of two years and is renewable for a further period of two years, with a 50% reduction in area at the end of the initial period. If the reduction reduces an EL to 30 sub-blocks or fewer, no further relinquishments are required. If the reduction reduces an EL to between 30 and 75 blocks, the holder may apply to the Mineral Resources Authority to waive or vary the requirement to make any further relinquishments. If the MRA is satisfied that special circumstances exist which justify retention of more than 30 sub-blocks, it may waive or vary those requirements, but the total area after such waiver or variation shall not exceed 75 sub-blocks. Successful renewal is dependent upon the holder having complied with the provisions of the Papua New Guinea Mining Act 1992. Nautilus has successfully applied to the Director of the Minerals Resources Authority to waive further relinquishments of EL1196, and has applied for another waiver in respect of EL 1476.

Under the *Mining Act 1992* an EL authorises the holder the exclusive occupancy for exploration purposes of the area identified in the EL. This includes the surface and any ground beneath the surface of the land and any offshore areas identified in the EL, being the seafloor underlying the territorial sea from the mean low water spring level of the sea to such depth as required for exploration or mining of minerals.

The EL permits the holder to extract, remove and dispose of such quantity of rock, earth, soil or minerals as may be permitted by the approved program subject to the requirements that all cores and drilling samples shall be preserved. The EL authorises the holder to do all other things necessary or expedient for the undertaking of exploration and confers to the holder priority to other parties when applying for mining rights.

4.3 Mining Leases

Mining Leases (MLs) are granted for an initial term not exceeding 20 years under the *Mining Act 1992*. The Minister may, after considering a recommendation from the Mineral Resources Authority Board, extend the term of the ML for a period or periods not exceeding 10 years, as the Minister determines.

Holders of MLs are authorised, in accordance with the *Mining (Safety) Act 1977* and any conditions to which the mining lease is subject to:

- Enter and occupy the ML for the purpose of mining the minerals on that land and carry on such operations and undertake such works as may be necessary or expedient for that purpose.
- Construct a treatment plant on that land and treat any mineral derived from mining operations, whether on that land or elsewhere, and construct any other facilities required for treatment including waste dumps and tailings dams.
- Take and remove rock, earth, soil and minerals from the land, with or without treatment.
- Take and divert water situated on or flowing through such land and use it for any purpose necessary for his mining or treatment operations subject to and in accordance with the Water Resources Act 1982.
- Do all other things necessary or expedient for the undertaking of mining or treatment operations on that land.

The holder of an ML is entitled to the exclusive occupancy for mining and mining purposes of the land in respect of which the ML was granted; and owns all minerals lawfully mined from that land.

4.4 Tenement Survey

Under the *Mining Act 1992*, an applicant for an ML tenement is to mark out each corner of the land over which the ML is sought by erecting a distinctively coloured post standing at least 1.2 m above the surface. In the case of MLA 154, four metal posts with coordinates marking the four corners of the ML were deployed.

Exploration Licences are not required to be surveyed under the *Mining Act 1992*. The tenements are identified using unique combinations of map, block and sub-block identifiers. Each sub-block measures one minute of longitude by one minute of latitude. The surface area of a sub block is therefore variable depending on its latitude.

4.5 State's Equity Interest Right

Pursuant to the Mining Act and title licence conditions, the State reserves the right to elect at any time, prior to the commencement of mining, to make a single purchase of up to 30% equitable interest in any mineral discovery arising from any licence, at a price pro rata to the accumulated exploration and development expenditure, and then to contribute to further exploration and development in relation to the lease on a pro rata basis. As at the date of this report, the State of PNG has not exercised this right in respect of any of Nautilus' tenements. The last time the State exercised this right was in respect of the Lihir Gold Project in 1996.

4.6 Royalty

The royalty payable to the State of PNG under the Papua New Guinea *Mining (Royalties) Act 1992* is 2% of the net smelter return on all minerals produced, and 0.25% for the Mining Resource Authority.

4.7 License Application Fees

A security deposit of PGK6,000 is lodged upon grant for each Exploration Licence in PNG. When a Mining Lease is granted, a security deposit of PGK48,000 applies.

4.8 Legal Requirements

Prior to commencing either onshore construction activities or seafloor mining operations, the Project has to be granted a Mining Lease and an Environmental Permit in accordance with the PNG *Mining Act 1992* and the *Environment Act 2000,* respectively. The application process requires, inter alia, the submission of a Mining Development Proposal and approval of an Environmental Permit.

Nautilus has in the first instance used local PNG legislation and requirements as reference standards; however where local requirements were inadequate or non-existent, Equator Principles and other internationally recognised standards and guidelines were used. Nautilus also took cognisance of international conventions and maritime law requirements.

4.9 Mining Act 1992

The Mining Act 1992 is presently the principal policy and regulatory document governing the mining industry in PNG. The Mining Act 1992 vests ownership of all minerals in or below the surface of land with the national government, and governs the exploration, development, processing and transport of minerals.

The Mining Act allows exploration activities and mining of minerals to be undertaken on the seafloor within PNG territorial waters. The Solwara 1 deposit falls into this category.

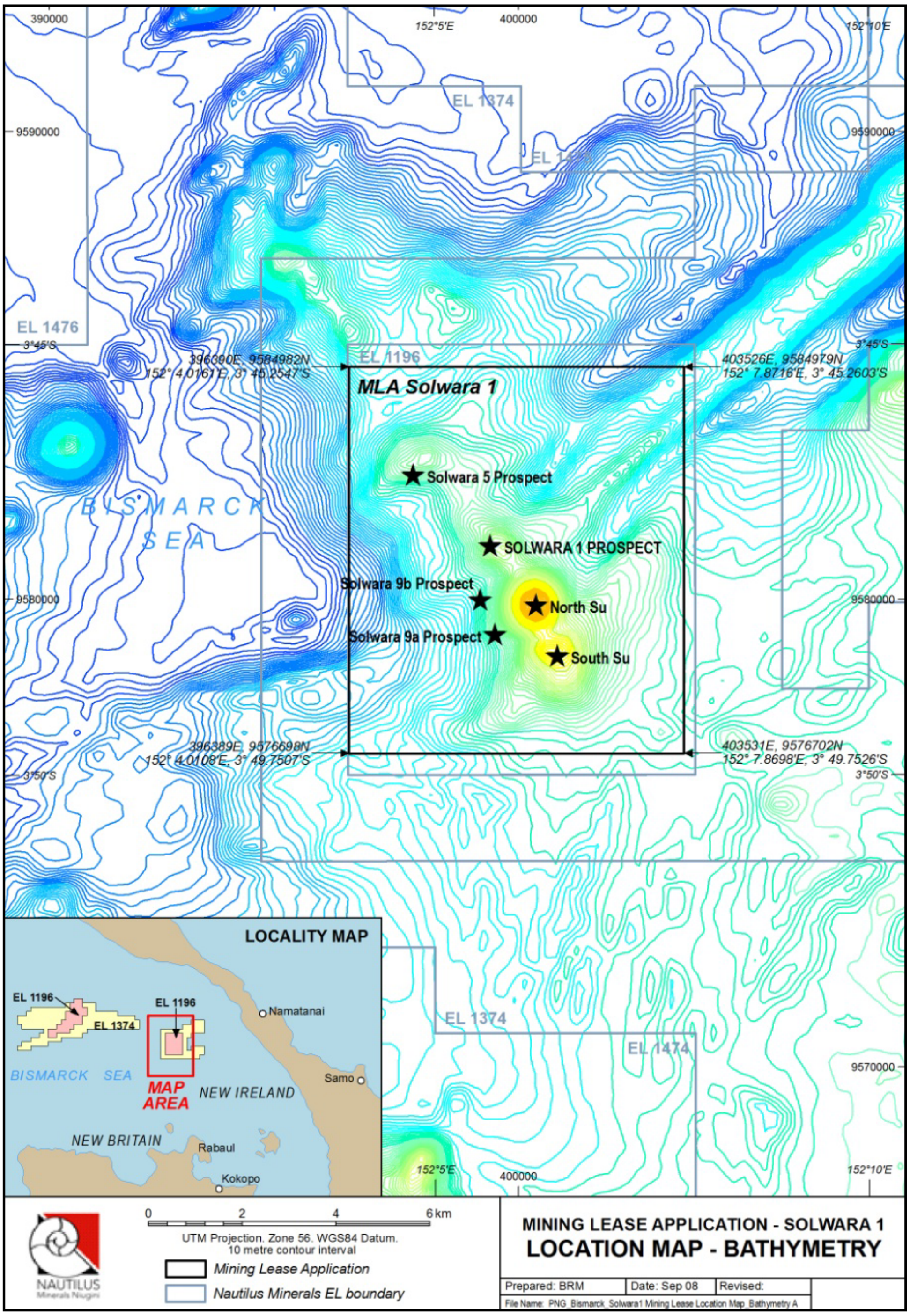

Figure 4-2: Nautilus registered Mining Lease Application (MLA154) in the Bismarck Sea

5. Accessibility, Climate, Local Resources, Infrastructure, Physiography and Environment

5.1 Location

The Solwara 1 deposit is situated in the Bismarck Sea within the New Ireland Province of PNG, at latitude 3.789° S, longitude 152.094° E. The site is about 50 km north of Rabaul (East New Britain Province) and about 40 km west of Namatanai (New Ireland Province). Solwara 1 is located approximately 30 km from the nearest coast. The proposed mining project is of relatively small scale and there is no need for large-scale site preparation or construction of complex facilities, and no direct landowner issues. The area proposed for mining is small, approximately 0.112 km^2 and the footprint at the sea surface is limited to the presence of a production support vessel and attendant support vessels.

Solwara 1 would be the first attempt in the world to mine an SMS deposit commercially. The mining area includes small areas of active mineralised chimney habitats with associated hydrothermal vent fauna colonies. Consistent with standard industry practice, compliance with environmental permit conditions is a fundamental requirement for the project.

5.2 Physiography

The Solwara 1 deposit occurs on a mound on a small ridge on the NW flank of the North Su volcanic centre at depths of ~1500 mBSL to ~1700 mBSL. The top of the deposit is characterised by the presence of sulphide-rich chimneys which can reach up to 15 m in height. Some of the chimneys are still active and are venting hydrothermal fluids, but for the most part the chimney fields are inactive. A thin veneer of unconsolidated sediments covers much of the mound.

The water depth increases beyond Solwara 1 to the north and west to 2000 mBSL. Within the Bismarck Sea, there are a number of seafloor mounds rising up to 500 m above the surrounding seafloor. The mounds are volcanic centres that are believed to be intermittently active, as indicated by thermal plumes and fresh volcanic rocks. The hydrothermal field containing Solwara 1 extends SE across the North Su and South Su seafloor volcanic domes. The summits of North Su and South Su are 1150 mBSL and 1320 mBSL respectively.

5.3 Climate

5.3.1 Temperature

The climate of the Bismarck Sea and surrounds is tropical, with mean maxima ranging from 31°C to 33 °C and mean minima about 23°C (Figure 5-1). There are two distinct monsoonal regimes, the NW Monsoon, which persists typically from about November to April and the SE Monsoon, which persists typically from about May to October. Rainfall is distributed throughout the year, but is heavier during the NW Monsoon. The project area is within 5 degrees of the equator and is not affected by tropical cyclones.

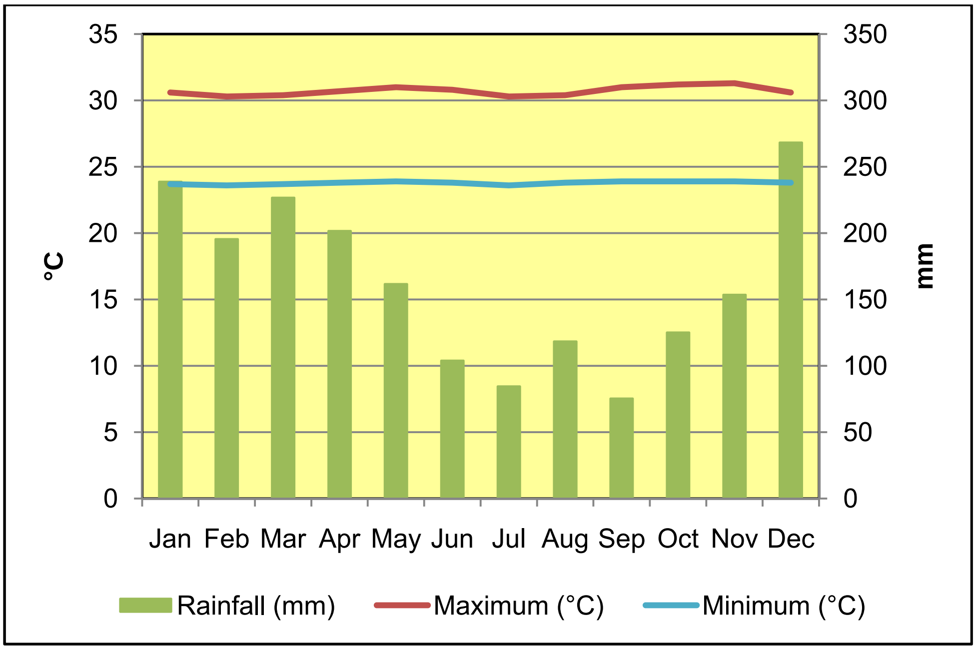

Figure 5-1: Average climate conditions for Rabaul, 1974-1994

Seawater temperatures for the Solwara 1 site remain warm throughout the year, with mean monthly sea surface temperatures ranging from a maximum of 30.1 °C (in November) to a minimum of 28.9°C (in August). Throughout the year, mean near-seafloor water temperatures remain virtually constant at ~3°C.

5.3.2 Wind

The conditions at the Solwara 1 site are generally benign with occasional strong to gale force winds from the W-NW (during the summer NW Monsoon) and from S-SE (during the winter SE Monsoon). Higher maximum winds occur during the summer NW Monsoon, with 10 minute mean speeds ranging from about 18.2 to 20.3 m/s. Higher mean wind speeds occurring during the winter SE Monsoon have 10 minute mean speeds ranging from about 6.8 to 7.4 m/s.

Ten minute mean wind speeds are typically the lightest in and around the transition months (April to May and October to December) between the two Monsoons, with mean speeds ranging from only about 4.7 to 5.6 m/s.

Reports of gale force winds (>17.5 m/s) over the Bismarck Sea are rare (<1% chance of occurrence). Most gale reports are due to very localised conditions, such as convective squalls or a big surge in the NW Monsoon due to a distant tropical cyclone.

Due to its close proximity to the equator and the considerable protection of the surrounding islands, tropical cyclones have historically not occurred within the Bismarck Sea.

5.4 Waves, Tides and Currents

The Solwara 1 location is situated in the Bismarck Sea about 50km north of Rabaul township, East New Britain Province and about 40km west of Namatanai, New Ireland Province. The site is well protected (with significantly limited fetches) to the arrival of significant seastates especially from the north through east through south to southwest directions. Fetches at Solwara 1 are only significant (i.e. ~700 to 1000 km) to the west (WSW – WNW). As a result, the waves at Solwara 1 location will be mostly locally generated wind waves (seas with Tp < 7 sec) roughly following the directions of the NW and SE Monsoons (i.e. from the W in summer and from the SE – SSE in winter), with only fairly minor contributions of swell waves (with Tp > 7 sec and up to 19.5 sec).

At Solwara 1, the strongest winds (> 14.5 m/s) are from the W – WNW during the NW Monsoon months of February to April and are from the ESE – SSE during the SE Monsoon months of June to September. However, the largest waves (> 3.0m) affecting Solwara 1 location are only from the W – WNW directions (where sufficient fetch exists) during the summer NW Monsoon months of December to April. During the SE Monsoon months of June to September, the largest waves are typically only just greater than 2.0m (due to limited fetch) and are from the SE – SSE directions.

The Solwara 1 site experiences a maximum spring tide range of around 0.8 m. The tides of the area are predominantly diurnal, with typically one high and one low each day. A summary of annual wave exceedence data against significant seastate is presented in Table 5-1.

Table 5-1: Annual wave exceedence data against significant seastate

% Exceedence	Significant Seastate - H_{sig} (m)
> 1%	2.69
> 5%	1.72
> 10%	1.33
> 30%	0.80

The ambient total steady currents for the Solwara 1 site are dominated by the reversing monsoonal drift and wind-driven currents for the mixed layer (up to ~150m) of the water column. The combined effect of the diurnal tides and drift currents dominate the majority of the water column from about 200 m depth to about 1300 m depth. The lower ~200 m of the water column (down to 1500 m depth) is more strongly tidally dominated.

5.5 Volcanic Activity

The Solwara 1 deposit lies on the NW flank of the active North Su submarine volcano. Rabaul is situated adjacent to the two volcanoes, Tavurvur and Vulcan. These volcanoes have been active in historical times.

As at 2010, Vulcan is largely dormant while Tavurvur has intermittent emissions of volcanic ash (of decreasing frequency). The Rabaul Observatory is manned to monitor trends in volcanic activity in the region.

5.6 Tectonics and Seismicity

PNG straddles several major tectonic plate boundaries and is part of the Pacific ‘Ring of Fire’. Modelling indicates that the India–Australia and Pacific plates are moving towards each other at a rate between 3 and 10 cm/yr. The movement of the plates has resulted in significant faulting and seismic activity, creating the potential for both shallow and large magnitude earthquakes on land and in the sea. The Solwara 1 site is located on volcanic rocks relating to the Bismarck Sea Seismic Lineation. The PNG earthquake loadings code indicates that the Solwara 1 site is located within Zone 2 (where Zone 1 is most unstable) and the Port of Rabaul component of the Project is located within Zone 1. The Global Seismic Hazard Assessment Program has assessed the Rabaul area as having a peak ground acceleration range of 4.0 g to 4.8 g (a very high hazard) for a return period of 475 years.

5.7 Environment Act 2000

The *Environment Act* 2000 defines the activities which require an Environmental Impact Assessment (“EIA”) process prior to the approval of an Environmental Permit. It sets out three levels of activities, ranging from Level 1 to Level 3 activities, where Level 3 activities are defined as those that may result in serious environmental harm. It also sets out the EIA process to be followed which commences with the registration with the Department of Environment and Conservation (“DEC”) of the intent to carry out preparatory work for an activity. After review DEC serves a notice, for Level 3 activities, to undertake an EIA process.

The first step in this process is to prepare and submit an Environmental Inception Report ("EIR") in accordance with Section 52 of the Environment Act 2000. Once the EIR is approved the proponent commences with the preparation of an Environmental Impact Statement ("EIS"). Once submitted the EIS is assessed by DEC and other parties and if approval is recommended DEC grants approval in principle, after which the Environmental Permit may be issued. In terms of Section 66 of the Environment Act 2000 a condition of the permit may be the preparation of an Environmental Management Plan ("EMP") based on the findings and mitigation measures contained in the EIS.

5.7.1 Key Environmental Regulations

- Environment (Council's Procedures) Regulation 2002.
- Environment (Prescribed Activities) Regulation 2002.
- Environment (Water Quality Criteria) Regulation 2002.
- Environment (Fees and Charges) Regulation 2002.

5.7.2 Other Relevant Legislation

- The Fauna (Protection and Control Amendment) Act 1974.
- The International Trade (Fauna and Flora) Act 1979.
- Dumping of Wastes at Sea Act 1979.
- Prevention of Pollution at Sea Act 1979.

5.7.3 International Standards and Conventions

- International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto ("MARPOL").
- United Nations Convention on the Law of the Sea ("UNCLOS") (1994).
- Convention for the Protection of the Natural Resources and Environment of the South Pacific Region ("SPREP") (1990).
- Kyoto Protocol to United Nations Framework Convention on Climate Change (1997).
- International Finance Corporation ("IFC") Performance Standards.
- IFC General EHS Guidelines.
- World Health Organisation ("WHO") Standards.
- Montreal Protocol on Ozone Depleting Substances.
- Convention on Biological Diversity (1993).

5.7.4 Nautilus Mandated Requirements

- Nautilus Environmental Policy.
- Nautilus Solwara 1 Project Design Premise.

5.7.5 Default or Voluntary Codes and Guidelines

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality Guidelines.
- Australian National Environment Protection (Ambient Air Quality) Measures.
- Equator Principles established by the World Bank.
- Lihir Gold Mine DEC standards.
- Lihir PNG Standards (reported in Lihir Responsible Environmental Management Fact Sheet 4).
- PNG Code of Conduct for Mining.

5.8 Environmental Impact Assessment (MLA 154)

5.8.1 Environmental Inception Report

On 5 October 2006, Nautilus submitted a ‘Notification of Preparatory Work’ to the DEC under the provisions of the Environment Act 2000 for the first phase of the Project. The activity was deemed to be a Level 3 activity and on 17 October 2006 DEC issued a ‘Notice to Undertake Environmental Impact Assessment’ to Nautilus to prepare and submit an EIR. The objectives of the EIR were to:

- Identify the potential environmental and social issues of developing the Project.
- Describe the scope of the EIS to address these issues.
- Initiate the formal process of stakeholder consultation.
- Enable DEC to review the proposed EIS scope and redress any shortcomings.

Nautilus submitted the EIR for the offshore component of the Project on 1 February 2007. DEC approved the EIR on 28 May 2007.

5.8.2 Environmental Impact Statement

The Solwara 1 Project is a ‘Level 3’ activity under the *Environment Act 2000*, (Section 53) which requires that an Environmental Impact Statement (EIS) be submitted to the Department of Environment and Conservation (DEC). Nautilus appointed Coffey Natural Systems (Australia) (“Coffey”) as the lead consultant for the EIA / EIS process.

In contrast to a typical land-based project, there are no direct landowner impacts, and the primary focus is on environmental issues. The Project environmental footprint is mainly that of a single mining ship (with attendant support vessels) and precision mining machinery operating on an area proposed for mining of approximately 11.2 Ha. One of the key environmental issues is the need to understand the biology of hydrothermal vent communities and the surrounding seafloor, and the potential impacts of mining on them.

It is proposed to discharge the water from dewatering close to its point of origin at depths between 25 to 50 m above the seafloor, and not at shallow or mid-water depths; this avoids any exposure or impacts on surface ecosystems. The processes of mining and dewatering will therefore not affect the pelagic tuna, tuna fisheries or near-shore coral reefs.

Potential impacts to surface pelagic animals result only from the presence of the surface vessels and their normal operations, including lighting, underwater noise and routine discharges (in compliance with relevant maritime acts and regulations). These impacts are similar to shipping generally and to the exploration surveys already completed.

In an effort to enhance scientific knowledge while meeting the needs of the EIA process, Nautilus engaged international scientific experts to design and conduct the following environmental studies for the Project:

- Macrofauna of hard seafloor areas (College of William and Mary, Duke University).
- Macrofauna and meiofauna of sediments (Scripps Institution of Oceanography).
- Abyssal meiofauna (Dr John Moverley and Coffey Natural Systems).
- Sediment geology (University of Toronto).
- Sediment geochemistry – elutriate and toxicity testing (CSIRO and Charles Darwin University).
- Biomass, biodiversity and bioaccumulation (Hydrobiology).
- Water quality (CSIRO and Coffey Natural Systems).
- Natural hazards (Rabaul Volcano Observatory).
- Oceanography (Coffey Natural Systems).
- Underwater acoustic modelling (Curtin University of Technology).
- Discharged water and sediment dispersion modelling (Asia-Pacific Applied Science Associates).

In addition, Nautilus provided oceanographic and deep sea sampling platforms (ROVs) to conduct this work.

The main objectives of the EIS were to understand the existing environment, potential impacts due to mining and how to mitigate significant impacts. The EIS discusses the issues and impacts associated with the Project in a range of spatial contexts such as the mining areas at Solwara 1, barge corridor and crew transfer routes and the project facilities to be used during operations at the Port of Rabaul.

Key sections of the EIS include:

- Executive summary and overview of proposal.
- Purpose of the development.
- Viability of the project.
- Overview of the policy, legal and administrative framework.
- Stakeholder consultation.
- Description of the proposed development activity.
- Development timetable.
- Physical, biological and social characteristics of the receiving environment.
- Socioeconomic Environment.
- Potential impacts of the project and mitigation and management measures.
- Accidental events and natural hazards.
- Waste minimisation, cleaner production and energy balance.
- Environmental management, monitoring and reporting.
- Other statutory decisions.

5.8.3 EIS Approval Status

In September 2009, the Department of Environment and Conservation granted an 'Approval in Principle' in for the Solwara 1 Environmental Impact Statement. The Approval in Principal was signed by the Minister and signalled the completion of internal and independent external reviews of the EIS by the DEC. The Solwara 1 Project Environmental Permit was granted on 29 December 2009 for a term of 25 years, expiring in 2035. The next steps for Nautilus are to prepare the draft project Environmental Management Plan (EMP) for submission and approval by the DEC 3 months prior to project commissioning.

5.9 Stakeholder Consultation

Unlike other mining projects in Papua New Guinea, is that there are no directly affected communities or landowners. The initial investigation into the characterisation of the social environment revealed that no customary land ownership exists at any of the proposed project locations.

Due to its offshore location, under PNG law the Solwara 1 deposit is therefore owned by the State of PNG; the proposed facilities at the Port of Rabaul occupy alienated land and is a pre-existing industrial facility.

Nevertheless, social awareness and general acceptance of the Project is important for its successful operation. To this end Nautilus currently maintains regular contact with regional stakeholders and government agencies through stakeholder awareness programs which aim to keep all parties informed of Project development progress and to understand any new concerns.

Nautilus has also followed a public consultation process which involved extensive interactions with stakeholder groups. Consultation with communities in New Ireland, East New Britain Provinces and other provinces, NGOs and the international scientific community has included formal meetings, presentations and workshops. Mining Warden's Hearings were carried out in a total of nine provinces and there has been ongoing regular consultation with PNG government departments. Key issues raised during the stakeholder consultation process, which were addressed in the EIS, included:

- Concerns regarding the possibility of Project activities setting off a natural disaster, such as a volcanic eruption, tsunami, etc.
- Concern regarding impacts to the biological life, in particular to surface pelagic fish, turtles, whales, sharks and reefs. Impacts to local fishing and 'shark calling'.
- Concern that the benefits would not reach the people or provincial governments directly impacted by the project.
- Fewer jobs for PNG nationals due to the project operations being carried out remotely.
- Local nationals won't be involved due to the need for international expertise, particularly at start-up.
- Government capacity to regulate the Project.

Local communities expressed most concern about the environmental impacts to surface organisms, in particular, pelagic fish such as tuna, whales, sharks, turtles and dolphins. In response, Nautilus engineered out impacts to surface waters from the discharge of mining waters, and designing a fully enclosed ore delivery system (a riser pipe). The only impact to surface waters will be the presence of the Production Support Vessel (PSV), supporting vessels and the riser pipe. In addition, Nautilus conducted education campaigns for communities, various levels of government departments and regulators. Nautilus used a number of media including radio, posters, brochures, newspaper articles, face-to-face meetings and workshops in both Tok Pisin and English (the official languages of PNG). Nautilus conducted 10 community awareness campaigns in 2009 (see Figure 5-2 for the locations of Nautilus engagements).

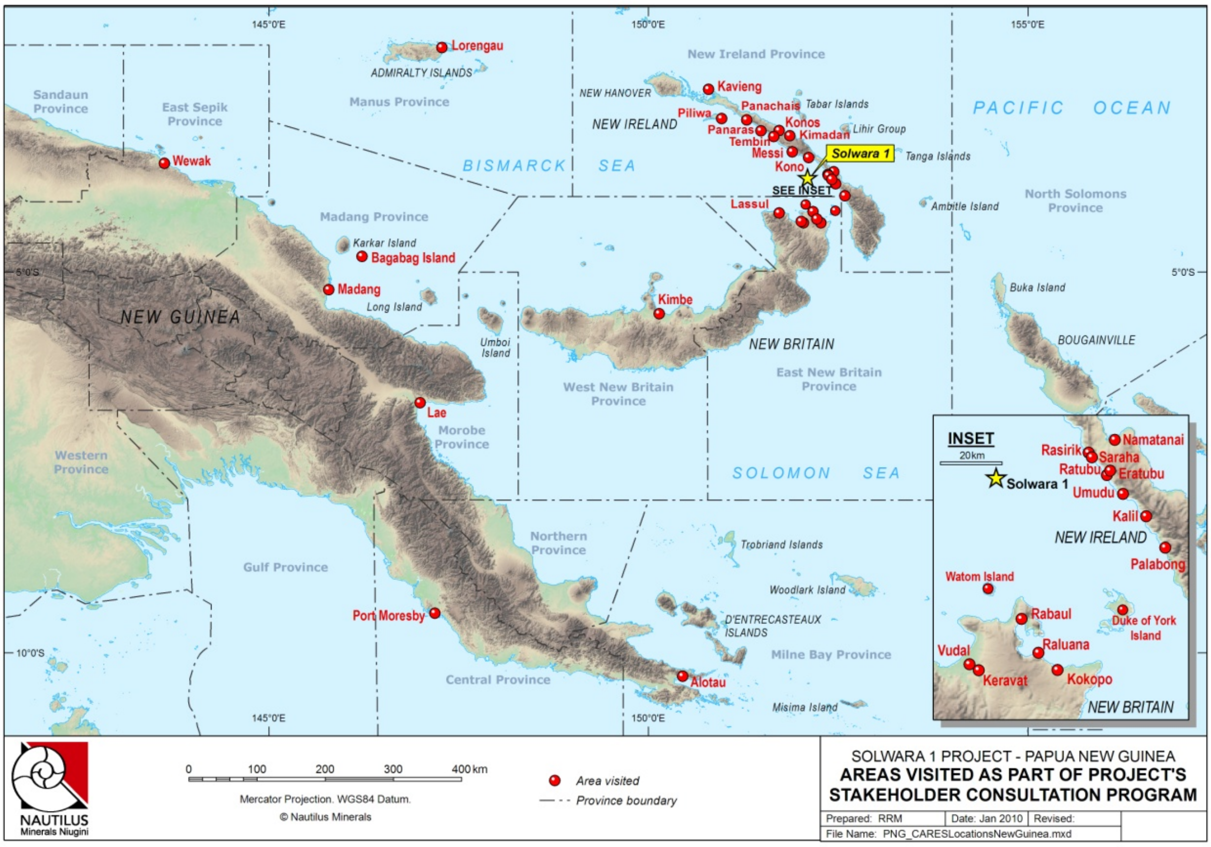

Figure 5-2: Areas visited as part of stakeholder consultation program

5.10 Specialist Studies Conducted

Nautilus gave independent experts the opportunity to participate throughout the EIA process. Nautilus held a workshop in March 2007 in Port Moresby to enable the early identification of perceived impacts from a broad spectrum of bodies and interested parties. These included local and international Non Government Organisations ("NGO"), local and international scientists, environmentalists, anthropologists, oceanographers, as well as DEC and the Department of Mines.

The specialist studies conducted by consultants, research bodies and universities during the EIS phase to determine or predict the potential impacts through observation and/or modelling focussed not only on the biological communities of both active and inactive hydrothermal vents, but also included physical, chemical and other biological baseline studies.

Specific specialist studies included:

- Benthic habitat assessment to characterise the seafloor areas adjacent to venting sites.
- Bioaccumulation to determine the potential for contaminants to accumulate via the food chain.
- Bioluminescence to predict the effect of mining activities on deep-sea species of fish.
- Existing resource utilisation to describe the nature of offshore commercial and subsistence fisheries, assess the potential impact on these fisheries and develop procedures to communicate with fishing vessels during construction and operation.
- Hazard and risk assessment to identify and characterise potential hazards and risks associated with construction and operation of the project, estimate the likelihood of the project activities setting off a hazard event, inform project design and operating procedures so that significant risks are reduced to be as low as is reasonably possible.

- Hydrodynamic modelling to determine the composition of the water to be discharged during the dewatering process, model the dispersion of discharged water at different depths, determine the most appropriate depth of discharge, determine the contours of concentrations of contaminants and mixing zone boundaries, assess compliance with ambient water quality standards.
- Hydrodynamic modelling of the seafloor to determine the potential generation and extent of the formation of plumes caused by the seafloor mining equipment, model plume dispersion at the seafloor.
- Macrofauna survey to determine species present at Solwara 1 and the taxonomic and genetic similarities with species, determination of species present at a reference site. Note: inactive and active sites were studied.
- Meteorology to gather all available meteorological and oceanographic data on the Bismarck Sea, use collected data and researched data to model currents within the Bismarck Sea.
- Noise, light and vibrations to determine the underwater noise and likely attenuation characteristics of the project vessels and mining equipment, assess the distances from source for noise to attenuate to threshold levels, manage potential interactions with cetaceans, describe likely fish attracting and other physical aspects of the presence of the vessel on surface and near surface swimming animals.
- Oceanography to obtain 12 months of full water column current profiles at Solwara1, use collected data and researched data to model currents within the Bismarck Sea.
- Sedimentation rates to determine the rate of sediment/particulate matter deposition over Solwara 1 and the reference site (South Su).
- Sediment geochemistry to determine baseline sediment geochemistry and composition surrounding Solwara 1 and the control site.
- Visual observation logging to record biological, geological, and water observations of the deep seafloor at Solwara 1 and the reference site.
- Waste management to develop a waste minimisation and management plan for the project.
- Water quality to determine the baseline water quality at and above Solwara 1 and South Su.

5.11 Potential Impacts

Marine life varies with the depth of water. At the Solwara 1 site the ocean may be divided into three broad zones:

- The 'Surface Mixed Layer' which is the upper water column between ~0 – 200 mBSL and contains mostly pelagic fish species including tuna, squid and sharks. Other animals known to exist in the area include dolphins, turtles and migrating whales.
- The 'Mesopelagic Zone' which is the mid water column between ~200 – 1000 mBSL and where amongst others squid and occasional short visits by, for example, tuna in search of prey and migrating whales may occur.
- The 'Bathypelagic Zone' which is the bottom water column, deeper than ~1000 m where animals typical of active hydrothermal vent sites, such as gastropods, shrimp, crabs, barnacles, etc occur. Away from venting, animals present include bamboo coral, stalked barnacles, hydroids and others. Other animals observed include octopus, swimming sea cucumbers, Chimera, deep sea fish species.

Although the impacts to the seafloor, its hydrothermal chimneys and associated vent fauna, have been identified as the main defining environmental issue for this project, there may be impacts throughout all three zones. The process of impact assessment was approached through internal risk assessment of issues at each step of the process.

The results of this provided the initial assessment of potential hazards, impacts, mitigation strategies and severity of residual effects.

This was further developed at a workshop held in San Diego, USA in April 2008, where input was provided by an international team of scientists on appropriate mitigation measures aimed at protecting biodiversity of the Solwara 1 site. Several aspects may give rise to specific environmental impacts.

These include:

- Water use and discharge.
- Water quality.
- Noise and vibrations on the seafloor and at the surface.
- Sedimentation and dewatering.
- Acid mine drainage.
- Emissions to air.

5.11.1 Water Use and Discharge

Potable water on the production support vessel ("PSV") will be obtained by two 35 kL/day reverse osmosis desalination plants resulting in brine production of up to 82 kL/day. This brine will be discharged to the sea. The brine salinity will typically be double the salinity of the sea water, but is not expected to have any material impact. However pre-treatment requirements for the desalination plants such as chlorination, bromination, dechlorination, coagulation and filtration may lead to waste streams that may require treatment prior to discharge.

5.11.2 Water Quality

Impacts on water quality may occur due to accidental hydraulic fluid leaks, fuel spills during transfers at the site of the PSV, ore spills during transfer to barges and bulk ore carriers and in extreme cases due to accidental collisions resulting in loss of vessels. Unexpected equipment malfunctions could result in the loss of material in the Riser and Lifting System ("RALS"). The maximum amount of mined ore in the riser pipe at any one time is approximately 11 m^3, which could be lost to the seafloor. Any of these occurrences could cause localised impact to water quality near the seafloor or in surface waters, along with associated smothering of animals on the seafloor.

5.11.3 Noise

Transmission of noise from operating machinery through the water is an important consideration due to the presence of marine turtles and whales, both of which are protected by international conventions. It was identified that the most likely source of noise which may cause disturbance is from the vessel power generation, dynamic positioning system ("DPS") thrusters or Seafloor Mining Tool ("SMT"). Modelling indicated that noise levels will drop rapidly within the first 2 km, and more slowly thereafter. These sounds may be audible (e.g., to whales) at up to 600 km but at long ranges, the sounds will not be greatly above that of background ocean noise depending on sea surface conditions. This noise is similar to any DP vessel, of which a number have been operating in the Bismarck Sea.

The maximum distances for specific received level thresholds being exceeded show that it would not be until an animal approached closer than 1.1 km from the source that the levels would be greater than 140 dB. Harmful effect to whales is unlikely as literature suggests behavioural avoidance at levels generally between 130 to 140 dB. Masking of marine animal calls may occur if the mining vessel noise interrupts or prevents the listener from detecting the communicative signal. The operational noise associated with the DP (propulsion) system of the mining vessel is continuous over a wide frequency bandwidth. Animals may suffer signal-masking effects at similar ranges up to approximately 15 km.

5.11.4 Sedimentation and Dewatering

Prior to mining, pre-stripping of unconsolidated surface sediment will be required. It is anticipated that approximately 130,000 t of unconsolidated sediment and 115,000 t of competent waste rock will be moved within the mining zones. The unconsolidated sediment will be disposed of, and competent waste material side cast, at a number of locations adjacent to the mining area. While suspended sediment plumes may be created, no significant geochemical changes are expected to occur as the unconsolidated sediment and competent waste material will remain near the seafloor and will not be exposed to any increases in temperature or oxidation. Where practicable, relocation of low-grade material is to be conducted in such a way so as to minimise sediment re-suspension and plume generation. As such the intention is to discharge such material horizontally along the seafloor rather than into the water column to minimise plume formation and enhance the rate at which material settles to the seafloor. The waste water plumes from dewatering will be discharged such that it will not have an impact in the water column shallower than 1300 m. It is proposed to discharge the water from dewatering close to its point of origin at depths between 25 to 50 m above the seafloor, and not at shallow or mid-water depths.

Discharge plumes of the slurry waste water is therefore not expected to impact fish and other animals in the mid (~200 to 1000 m) and upper (0 to 200 m) water column. It is intended to keep exposure time of cold and un-oxygenated seawater recovered from the seafloor to surface to a minimum so as to not lead to an unacceptable change in oxygen or temperature levels when pumped back. Discharges from dewatering are not expected to have any adverse toxicity effects to seafloor ecosystems and will have negligible overall effects.

Potential impacts to surface pelagic animals are only from the presence of the surface vessels and their normal operations, including lighting, underwater noise and routine discharges (in compliance with relevant maritime acts and regulations). These impacts are similar to shipping generally and to the exploration surveys already completed.

5.11.5 Acid Mine Drainage

Onshore storage and handling at the Port of Rabaul of produced ore will be designed to minimise acid generation and deal with acid rock drainage. Where such generation and drainage cannot be eliminated, then a drainage treatment facility will be added to prevent any acidic water draining into the ocean.

5.11.6 Emissions to Air

Air emissions will consist of combustion emissions from the vessel power supply and the mining, transfer and processing power supply. Air emissions of most concern are carbon dioxide, carbon monoxide, nitrogen oxide and sulphur dioxide. It is expected that there will be no dust emissions from processing or transport activities due to the moisture content of the processed ore. Emissions to air from this Project should not have a direct impact on marine life.

5.12 Impact Mitigation

Nautilus proposes the following management and mitigation measures to minimise adverse environmental and socioeconomic impacts identified:

- The application of sound engineering design, deployment and operational practices for the SMT so as to minimise disturbance to the seafloor and the suspension of sediments.
- The adoption of a dewatering management strategy that will involve discharge at depths from which the material originated, thereby avoiding impacts to the water column.
- The retention of an unmined area at South Su and temporary reserve areas in Solwara 1 to aid in the recolonisation of the mined areas and conservation of biodiversity. Relocation of animals to already impacted areas is to be considered in addition to the placement of artificial substrates to enhance recolonisation.

- The adoption of lighting and noise strategies that will address surface and subsea operational and safety requirements and minimise the potential for the attraction of, and interaction with, marine animals.
- The adoption of a waste management strategy that will address the management of sewage, chemical and hazardous materials to minimise the potential for contamination of the water column.
- The adoption of appropriate water management strategies at the Port of Rabaul that will involve the containment and, possibly, treatment of surface runoff to ANZECC/ARMCANZ (2000) standards to avoid any impacts of acid drainage prior to any discharge to Simpson Harbour waters.
- Where practicable, the application of policies for the employment and training of the workforce that will maximise benefits to the local communities and minimise adverse social effects.
- The development of emergency response plans to mitigate the effects of natural disasters and unplanned events.

5.13 Environmental Management System

Nautilus states that it intends to manage the Project under the governance of an environmental management system ("EMS") which is envisaged to be developed in accordance with the international EMS standard, ISO 14001:2004 as adapted for use in Australia and New Zealand as AS/NZS ISO 14001:2004. This standard will provide Nautilus with the elements to implement, achieve, review and maintain the company's environment policy.

Details of the Project's proposed environmental monitoring program, including descriptions of the components to be monitored, frequency of monitoring and purpose, will be included in the detailed EMPs which are still to be submitted to the PNG regulatory authorities and will take into account any relevant conditions of approval set in the Environmental Permit.

The Project will provide the PNG regulatory authorities with compliance reports as stipulated in environment, water abstraction and waste discharge permits. Regulatory authority and internal assessments of EMP implementation will occur, with the schedule for such assessments and reporting to be determined in consultation with DEC.

Much of the proposed monitoring of the deep seafloor is anticipated to extend into more general scientific research, for which Nautilus will encourage publication through the normal scientific peer review process.

Incidents that occur as a result of an emergency, accident or malfunction or that cause or threaten serious adverse environmental impacts or are likely to adversely impinge on relations with local communities will be immediately reported to Project senior management in addition to the relevant PNG regulatory authorities.

5.14 Waste Management

The aim of waste management is to employ practices which avoid waste in the first instance, progressively moving through less preferable alternatives. If waste generation cannot be avoided the measures of most relevance to the Project are likely to be a combination of recycling, treatment and disposal. Management of solid, liquid and hazardous waste are the key issues of concern.

5.14.1 Non Hazardous Waste

General waste includes items such as timber, packaging, spent batteries, paint containers, aluminium cans, cable, cardboard and paper, plastic, printer cartridges and steel. The majority of waste is expected to be office waste and food waste. Office waste will be separated for recycling. Waste on the PSV will be disposed in accordance with International Maritime Organisation ("IMO") requirements and may include incineration. Not everything can be incinerated and items such as scrap steel, glass and batteries will be segregated for recycling or other waste disposal options.

5.14.2 Hazardous Waste

Hazardous waste includes waste oil, contaminated oil, hazardous chemical containers, medical waste and sharps. Small volumes are expected to be generated for all except waste oil.

There are three main liquid hazardous wastes likely to be generated on the PSV namely oily water, sewage and brine from the desalination plant. Nautilus states that the surface discharge of all wastewater from the support vessel will comply with international maritime standards such as MARPOL 73/78 Convention and the Protection of the Sea - Prevention of Pollution from Ships Act 1983 as well as with additional standards required by the PNG government.

5.15 Socioeconomic Environment

Consideration of social and economic impacts is an integral part of the assessment of the Solwara 1 Project under the Environment Act which requires that the likely social impacts of the proposed activity be set out in the EIS. The EIS addresses background requirements such as demographics, existing infrastructure, public health, social services availability and present economic status of the Project area. However as the Solwara 1 mining area is located offshore (where the workforce will also be accommodated) and owing to the fact that the onshore Project components will utilise an existing commercial facility the actual social impact assessment was confined to areas where:

- Employees will be recruited.
- Contractors and suppliers are located.
- Benefit streams, e.g., royalties and taxes, will be distributed.
- Offshore activities will take place, e.g. where fishing and marine traffic occur.

The main local areas are Kavieng and Rabaul. Kavieng which is both a trading and tourist destination is the capital of the New Ireland Province and is the largest town on the island. Rabaul is a township in East New Britain Province which used to be the provincial capital until it was destroyed by the falling ash from a volcanic eruption in 1994. However Rabaul remains a tourist destination popular for diving and snorkelling. The PNG Millennium Development Goals rank these two provinces performance against the PNG average and show that, in general these two provinces perform well above the national average.

There are no subsistence fisheries at Solwara 1 but some interaction between ore transport and support vessel activities to and from Solwara 1 and subsistence fisheries may occur closer to shore. Traditional activities, such as shark calling, were found to be important. Nautilus and its consultants are confident that the project activities will not impact shark calling, a traditional activity practised in New Ireland Province. Solwara 1 is located 30 km from shore and 1600 m below the surface of the sea, which is well away from coral reefs, fish and reef sharks. The effects of the project at the surface involve only the presence of a surface ship and barges. Cargo ships and other vessels already sail on the Bismarck Sea. So if these ships do not impact shark calling, neither should the presence of the ship proposed for mining.

Marine traffic in the Bismarck Sea includes national and local cargo and passenger traffic. Generally, routes are poorly defined and companies operate largely without charts or navigational aids. There are some smaller local transportation boats that move between New Ireland and East New Britain.

As the setting of the onshore components of the Project, on fully developed and alienated land an archaeological and cultural heritage survey was not conducted.

5.16 Conclusions

Nautilus notes that seafloor mining offers advantages over typical land-based mining from health, safety, environmental and social points of view. Nautilus states that benefits of seafloor mining include:

- Limited social disturbance as seafloor mining does not require the social dislocation common to land-based operations with the resulting impact on culture or disturbance of traditional lands.
- Little mining infrastructure as SMS deposits are located on the seafloor, mining production will be limited to a floating ship and a concentrator located close to shore. There will be no intensive land use requiring post-production restoration.
- Minimal overburden or stripping as the ore generally occurs directly on the seafloor and will not require large pre-strips or overburden removal.
- Minimal mining waste as only high-grade ore will be mined, resulting in a small ore footprint, with no requirement for waste rock dumps.
- Worker safety as the operation is remote, not requiring operators to be exposed to typically dangerous mining environments.

SRK notes the following in terms of this review:

- Nautilus and its subsidiaries have adopted best practice for the development of the environmental component of the project as evidenced by going beyond PNG requirements and incorporating environmental standards and guidelines from a cross-section of countries and organisations.
- The environmental consultants, notably Coffey and the specialist sub-consultants have produced a comprehensive EIS based on a comprehensive EIA process.
- The EIS has been approved.
- The Environmental Permit for the Solwara 1 Project was granted on 29 December 2009 from the Department of Environment and Conservation (DEC) of Papua New Guinea for a term of 25 years, expiring in 2035.
- Nautilus must now compile and submit an EMP based on the EIS and Environmental Permit requirements for approval.
- SRK expects the EMP which is still to be finalised and approved by the regulatory authorities to be of the same high standard as the current EIS documentation.
- Consultation with PNG regulatory authorities, local communities, NGO's and international experts has been comprehensive, inclusive and is of an ongoing nature.
- Nautilus accepts that there adverse environmental impacts associated with this Project, but has committed to minimise these impacts and manage the residual impacts in a responsible manner.
- Adverse social impacts are likely to be minimal.

6. History

The first discovery of submarine hydrothermal sulphides and black smokers in PNG was at what was to become the Solwara 2 project, when in 1985 the US research vessel *RV Moana Wave* photographed sea floor sulphides there. Since then, occurrences of submarine sulphides in the Bismarck Sea have been studied by Marine Science Research groups from many countries, including France, Germany, Canada, USA, Japan, Korea, UK and Australia.

As a result of detailed geological, geophysical and geochemical surveys by these research groups, extensive hydrothermal fields and SMS mineralisation have been identified. Results of these studies are documented in several reports that are listed in the reference section of this report. A brief and general summary of the research history of the property is provided here, mainly from Adamson (2003).

Research cruises have supplied detailed bathymetry of the Solwara 1, 2, 3 and 4 areas, and these have also been observed during manned submersible dives and numerous deep-tow video traverses. Dredging traverses were extensively employed during the various "PACMANUS" and "Binatang" research cruises, and it is estimated that, since 1991, Australia's Commonwealth Scientific and Industrial Research Organisation ("CSIRO") has acquired several tonnes of sulphide samples from the Solwara 4 and Solwara 1 hydrothermal fields. Basic descriptions of samples of dredge contents are recorded in the various cruise reports, which were compiled on board, prior to chemical analysis of the samples. Submersible and deep-tow video observations supplemented by the dredge reports have enabled researchers to compile and publish basic geological reconnaissance reports and maps of several of the hydrothermal fields.

Analytical data were generally reported several years after the research cruises. The largest research database is contained in Yeats, Parr and Binns (1998), which presents data from about 100 of the almost 500 samples collected between 1991 and 1997 at the Solwara 4 and Solwara 1 hydrothermal fields.

Detailed logs, core photos and some descriptive data are reported from Leg 193 of the Ocean Drilling Program, which was completed in December 2000 (ODP 193, 2000). A series of partially cored holes was drilled to investigate geological and geophysical conditions to depths of up to 370m below the seafloor in three of the active Solwara 4 fields.

During the German/UK Research Cruise "Condrill" (SO166) in late 2002, an initial phase of drilling to 5 m depth into the surface of the Solwara 4 hydrothermal fields was conducted using the drilling services of the British Geological Survey. Of the ten holes drilled, three recovered massive chalcopyrite mineralisation, and six recovered sphalerite-rich chimney material (Petersen *et al.*, 2003). All holes had significant recovery difficulties with recoveries < 30%.

Dredge samples were recovered during several research cruises (eg. Yeats, Parr and Binns, 1998; Binns, Parr and Waters, 1999) and included values of approximately 8% Cu, 18% Zn, 200ppm Ag and 11ppm Au based on analysis of 17 samples. Note that these values are from scientific reports and may be based on sulphide samples that were specifically selected for detailed analysis and scientific research on the formation and genesis of sea-floor massive sulphide systems. Therefore, the values only reflect the average of the samples selected and may not reflect the average value of the whole SMS deposit.

Table 6-1: Summary of selected research cruises in Nautilus PNG tenements

Research Cruises	Ship / Cruise	Dates	Area
CSIRO-led Cruises			
PACLARK I	RV Franklin	April 1986	Western Woodlark Sea
PACLARK II	RV Franklin: FR01/88	January 1988	Western Woodlark Sea and Goodenough Bay
PACLARK III	HMAS Cook	February 1988	Western Woodlark Sea
PACLARK IV/SUPACLARK	RV Akademik Mstislav Keldysh: Leg 1	April 1990	Western Woodlark Sea
PACMANUS/PACLARK V	RV Franklin: FR08/91	Sep-Oct 1991	Eastern Bismarck Sea
PACMANUS II	RV Franklin: FR05/93	June 1993	Eastern Bismarck Sea
PACMANUS III	RV Franklin: FR10/96	Nov-Dec 1996	Eastern Bismarck Sea
PACMANUS IV	RV Franklin: FR09/97	Oct-Nov 1997	Eastern Bismarck Sea
BINATANG	RV Franklin: FR03/00	Apr -May 2000	Eastern Bismarck Sea
SHAARC	RV Franklin: FR04/00	May 2000	Tabar-Lihir-Tangi-Feni Chain
ODP Leg 193	JOIDES Resolution	Nov 2000 – Jan 2001	Eastern Bismarck Sea
BISMARCK-SOLAVENTS 2002	RV Franklin: FR02/2002	March 2002	Western Bismarck Sea
BISMARCK-SOLAVENTS 2002	RV Franklin: FR03/2002	Mar-Apr 2002	Bougainville-Solomon's
Southern Bismarck Arc	RV Southern Surveyor	Jul-Aug 2007	West & south Bismarck Sea
Cruises with CSIRO participation			
Edison '94	*RV Sonne*: SO 94	Mar-Apr 1994	Lihir-Feni Chain and Eastern Manus Basin
ManusFlux	*Yokosuka*/Shinkai 6500: Y95-07	Oct-Nov 1995	Eastern Bismarck Sea (Solwara 4)
BioAccess 98	*Natsushima*/Shinkai 2000: NT98-13	Oct-Dec 1998	Eastern Bismarck Sea (Solwara 4)
KODOS '99	*RV Onnuri*	May 1999	Eastern Bismarck Sea
Dae Yang 2002 Leg 1	*RV Onnuri*	Aug-Sep 2002	Lihir Island and Eastern/Western Bismarck Sea
Other cruises			
Moana Wave (USA)	*RV Moana Wave*: MW8517-18	1985-86	Bismarck Sea, Woodlark Sea and Islands
OLGA I (German)	*RV Sonne*: SO 63	Jul-Sep 1989	Eastern Bismarck Sea
OLGA II (German)	*RV Sonne*: SO 68	Apr-Jun 1990	Eastern Bismarck Sea
21st Cruise	*RV Akademik Mstislav Keldysh*: Leg 3	May-Jun 1990	Eastern Bismarck Sea
Aquarius	*Hakuho-Maru*: KH90-33 Leg 2	Nov-Dec 1990	Eastern Bismarck Sea
MMAJ for SOPAC	*RV Hakurei-Maru* No 2	Aug-Oct 1992	Central Bismarck Sea
BioAccess 96	*Natsushima*/Shinkai 2000: NT96-14/15	Oct-Dec 1996	Eastern Bismarck Sea (Solwara 4)
ODP Leg 180	*JOIDES Resolution*	Jun-Aug 1998	Western Woodlark Sea
Edison II	*RV Sonne*: SO 133	Jul 1998	Lihir-Feni Chain
Manaute	*RV L'Atalante*/Nautile	Mar-Apr 2000	Central and Eastern Bismarck Sea
Condrill	*RV Sonne*: SO 166	Sep-Oct 2002	Solwara 4 and Conical Seamount
Bismarck Sea Survey 2005	*RV Onnuri*	Sep-Oct 2005	Central Bismarck Sea
WHOI	*RV Melville*	Jul – Aug 2006	Manus Basin
Jamstec	*Yokosuka*/Shinkai 6500	Sep 2006	Manus Basin
Woodlark Basin	*RV Sonne:* SO 203	Oct-Dec 2009	Solomon Sea

7. Geological Setting

The Manus Basin in the Bismarck Sea is an active back-arc basin bounded to the south by the active subduction zone of New Britain Trench and to the north by the inactive subduction zone of the Manus Trench, formed at the convergence zone between the Australian Plate to the south and the Pacific Plate to the north (Figure 7-1).

The Basin's major geological features include:

1) The rapidly opening (~10cm/yr) Manus Spreading Centre, which hosts the Solwara 2, 3, 10, 14, 15 and 16 prospects.

2) The Willaumez Spreading Centre, which includes the Willaumez Project, comprising Solwara 11, 17 and 18.

3) The rifted volcanic zone of the Eastern Manus Basin, which is bounded by two major W to NW transform faults (the Djaul and Weitin Faults), and characterised by basaltic to dacitic volcanism. The Eastern Manus Volcanic Zone (Figure 7-2) is in the Eastern Manus Basin, and hosts the Solwara 1, 4, 5, 6, 7, 8, 9, 12 and 13 prospects.

A series of prominent submarine volcanic edifices have been formed on the sea floor, extending in an en echelon configuration across the trend of the rift basin (Binns and Scott, 1993). These edifices are the sites of active hydrothermal venting and associated deposition of seafloor massive sulphide (SMS) deposits, such as those found at both Solwara 4 and Solwara 1. Nautilus has identified seventeen separate SMS prospects in the Manus Basin (Figure 7-3) and two sulphate prospects that collectively comprise the Solwara Project.

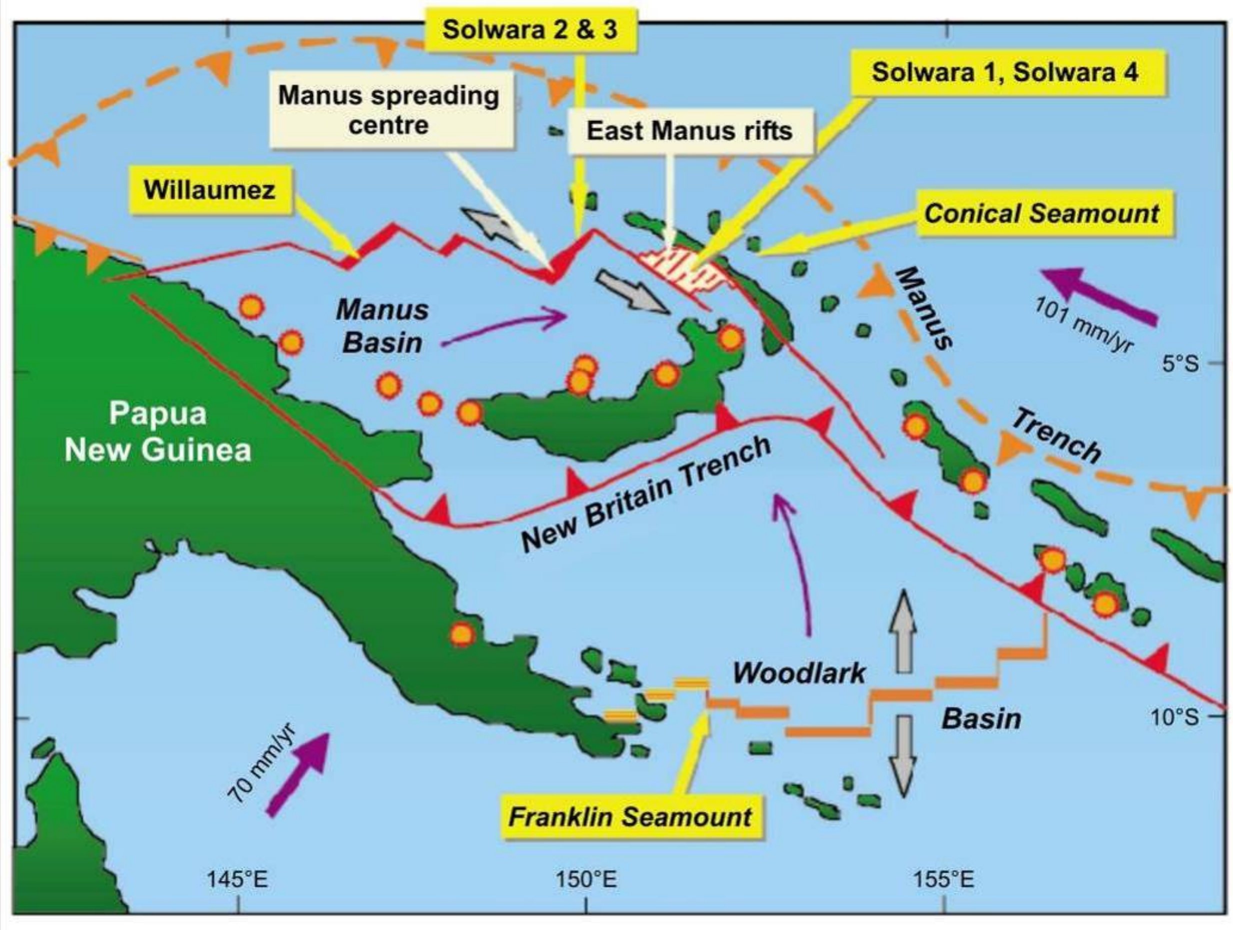

Figure 7-1: Major geological features and hydrothermal fields in eastern PNG

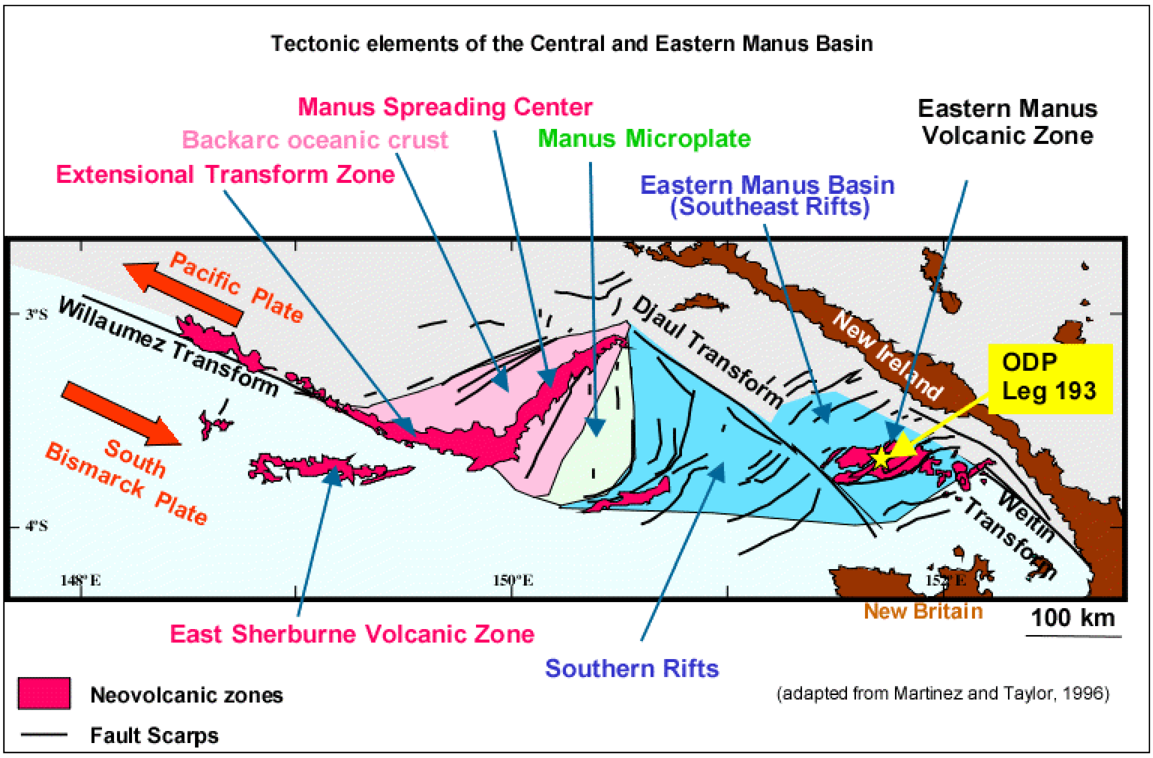

Figure 7-2: Tectonic features summary in Central and Eastern Manus Basin

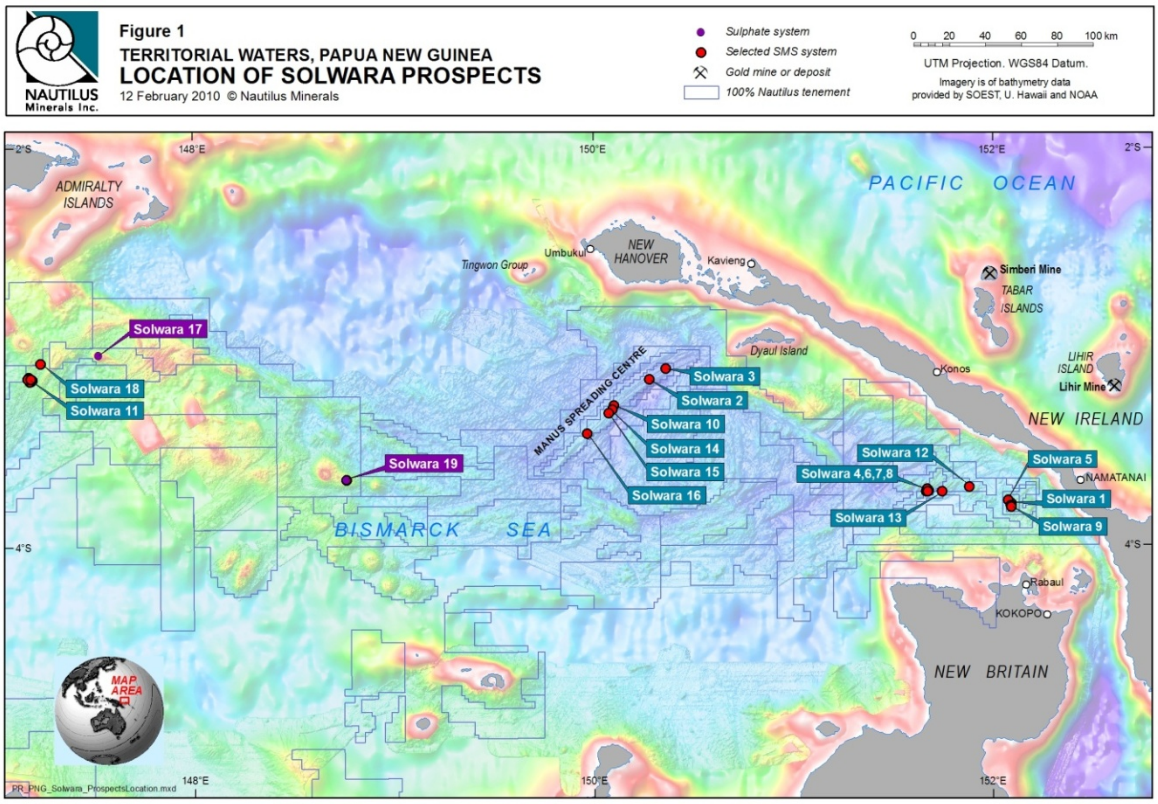

Figure 7-3: Location of SMS occurrences Solwara 1 to 19

Note: 17 and 19 are barite rich sulphate systems

7.1 Solwara 1

The hydrothermal field of the Solwara 1 Project was first discovered by the CSIRO during the 1996 “PACMANUS III” cruise on the *RV Franklin* in the far eastern sector of the Eastern Manus Basin. The detection of an intense particulate plume during the “PACMANUS II” cruise in 1993 led the researchers to the NNW-trending volcanic edifice (the Pual Ridge) that hosts Solwara 1, which is located on a deep (approx 1,700m BSL) platform of pelagic sediments. The Pual Ridge is 5 km long and is mainly basalt, with two major andesite-dacite domes (North Su and South Su). Solwara 1 is to the NNW of North Su, and lies at the intersection of an adjacent, NE-trending extensional rift structure (Bugave Ridge), which contains largely basaltic lavas (Figure 7-4). Dacites and andesites at North Su and South Su are extensively brecciated and altered, and carry widespread disseminations and stockworks of pyrite and other sulphides, as well as localised sulphide chimneys, mounds and sulphide breccias. Solwara 1 has exposures of both andesite and dacite lavas, and includes several large fields of chalcopyrite-rich massive sulphide chimneys and mounds. Sulphide chimney heights generally range from approximately 2 m to 10 m, with the tallest chimney approximately 18 m. The chimney fields are draped with finely laminated to coarsely-banded sulphidic sediments. The summits of North Su and South Su are 1,150 and 1,320m BSL respectively. The Solwara 1 field occurs at approximately 1,520m BSL.

The Solwara 1 Project was the target for exploration works by Placer Dome Inc. and continues to be evaluated by Nautilus. ROV dive videos and bathymetry show that sulphide mounds and chimney fields are generally surrounded by flatter areas, containing mound and chimney debris, sulphide crusts, algal mats, and unconsolidated sediments (Figure 7-5). Unconsolidated sediments consist of variably sulphidic mud and clay, as well as volcanic ash from recent terrestrial and/or nearby submarine eruptions. Approximately 500 chimneys and chimney clusters have been observed during previous ROV dives.

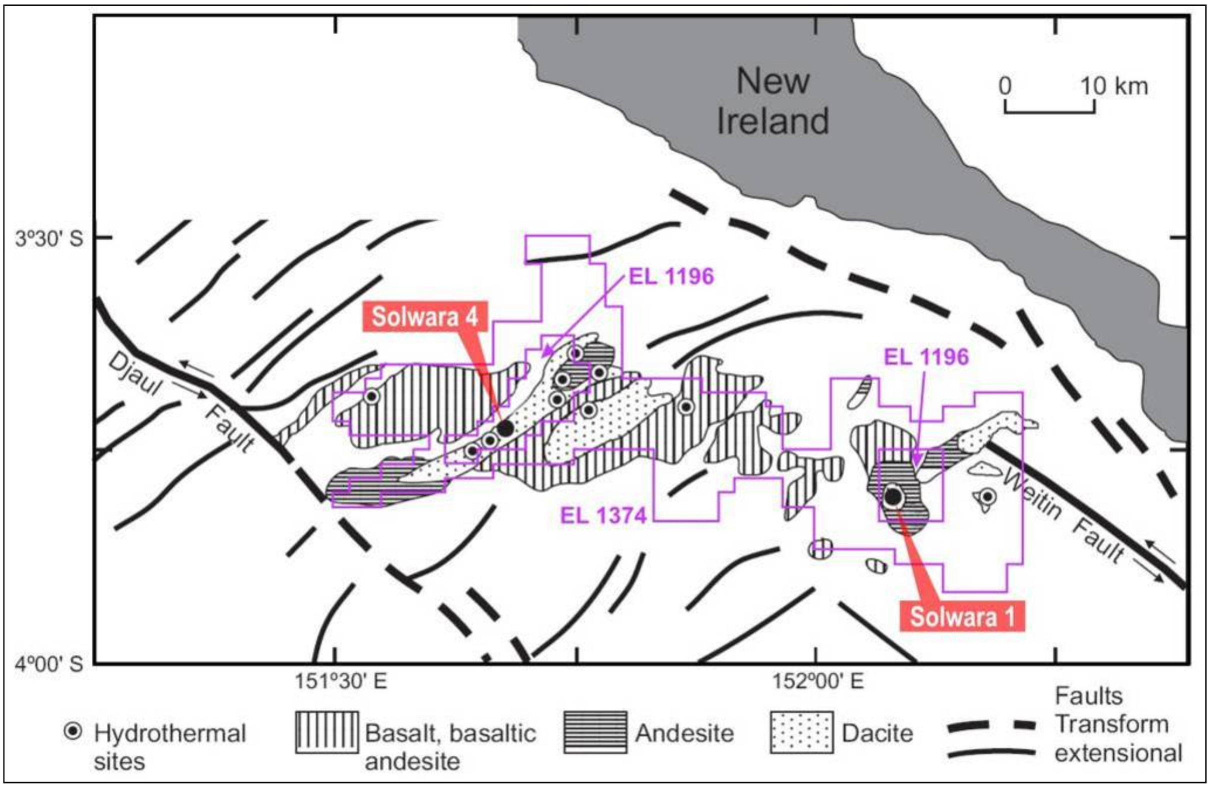

Figure 7-4: Schematic geology and locations of Solwara 1 and 4 with EL boundaries, adapted from Binns (2004)

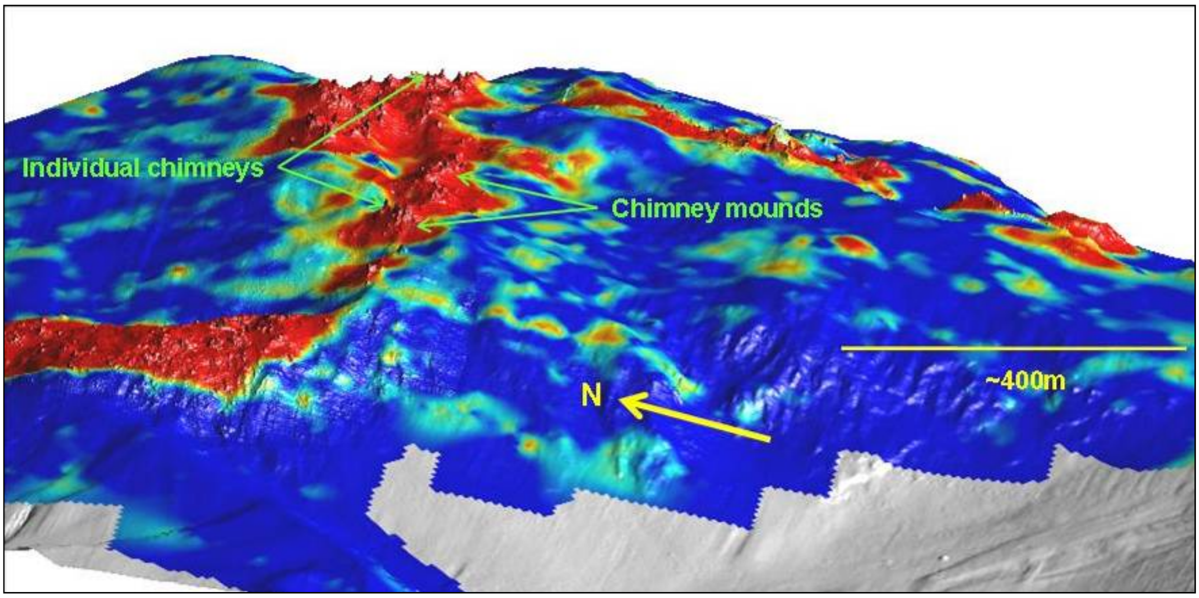

Figure 7-5: Oblique view of the Solwara 1 area seafloor showing Electromagnetic (EM) conductive areas in red

Note: The conductive zones correspond with areas of strong chalcopyrite mineralisation

7.2 Solwara 2 and 3 (EL 1383)

The Solwara 2 and 3 prospects include a group of several known SMS occurrences on the Manus Spreading Centre (Figure 7-1) which are also referenced as:

- Vienna Woods.
- Solwara 2a and 2b (formerly known as Tufar 2).
- Solwara 3a and 3b (formerly known as Tufar 3).

The Manus Spreading Centre covers a basaltic to andesitic back-arc spreading zone, and is one of the first discoveries of modern massive sulphide chimneys in a back arc basin setting. German researchers on the cruises OLGA I (SO63, 1989) and OLGA II (SO68, 1990) aboard the *RV Sonne* used a TV-guided grab sampler and accurate navigation with sea floor beacons to conduct an extensive survey of this area in order to locate extensive SMS fields. Four major fields were surveyed, and other sites of venting were noted without locations being given. All four venting sites lie on the central spreading ridge or valley. The largest is Solwara 2 proper (centred on 3°9.86'S, 150°16.78E), which was originally reported as having a strike length of 1,000 m. Tufar 2 is nearby but smaller with a reported strike length of 500 m. Tufar 3 to the northeast was described as being larger, but mostly containing Fe-Mn oxides, rather than sulphides (which in other areas has indicated an extinct field) with 'weathered' thin Mn oxide coatings. The researchers also reported indications from water sampling of hydrothermal activity and plumes at many places along the ridge but these were not followed up. At Vienna Woods, some chimneys are described as very high, up to 20 m high and 15 m across as individuals, with smaller chimneys surrounding them to distances of approximately 10-30 m. Reported results of geochemical analyses of 25 samples from Vienna Woods and Tufar 2, average 29.7% Zn, 2.18% Cu, 15.2% Fe (Tufar 1990, Tufar and Jullman 1991, Tufar 1992). Note that these average grades are from scientific reports and may be based on sulphide samples that were specifically selected for detailed analysis and scientific research on the formation and genesis of sea-floor massive sulphide systems. Therefore, the average grades stated only reflect the average of the samples selected and may not reflect the average value of the SMS deposit, although comparisons with samples acquired by Placer Dome Inc and Nautilus in 2005 and 2006 have shown that the scientific research sampling returns grades broadly similar to those intended for mineral exploration. Gold assays were not averaged but are reported to range from 1.3 g/t to 52.5 g/t Au (Tufar 1990, Tufar and Jullman 1991, Tufar 1992).

7.3 Solwara 4

The Solwara 4 prospect is a group of six known SMS occurrences:

- Solwara 4a (formerly known as Rogers Ruins).
- Solwara 4b (formerly known as Roman Ruins).
- Solwara 4c (formerly known as Satanic Mills).
- Solwara 4d (formerly known as Snowcap).
- Solwara 4e (formerly known as Fenway).
- Solwara 4f (formerly known as Tsukushi).

All of these occurrences (except Solwara 4e) were discovered in 1991 during the "PACMANUS I" marine science research cruise, a collaboration between CSIRO and the University of Toronto (Scott and Binns 1995). The active hydrothermal vents and associated sulphide mounds occur over an area of approximately 10 km2 (Figure 7-6) Solwara 4e was discovered during the Magellan 06 cruise in 2006.

The first interpretations based on video camera surveys were successfully confirmed via dredging, which produced sulphide material. During subsequent research campaigns (1993, 1996 and 1997) four individual hydrothermal fields (Solwara 4a, 4b, 4c and 4d) were identified along the crest of Pual Ridge (Figure 7-6), a volcanic ridge that formed from fissure eruptions of mostly andesite, dacite and rhyodacite lava eruptions along a NE-trending extensional fault at the centre of the East Manus Basin.

Pual Ridge is a narrow steep-sided volcanic edifice that is approximately 15km long and rises to 1,655m BSL from the surrounding basalt-basaltic andesite sea floor at ~ 2,200m BSL. Four high temperature (up to 276°C) black-grey smoker chimney fields (Solwara 4a, 4b, 4c and 4f) occur at fracture zones in relatively unaltered dacite lavas. Chimneys formed from venting hydrothermal fluids, and are composed dominantly of chalcopyrite and sphalerite, with barite and minor bornite. Solwara 4d shows extensive diffuse venting of low temperature fluids (up to 6°C) through extensively altered dacite-rhyodacite with disseminated pyrite and native sulphur at a small eruptive centre.

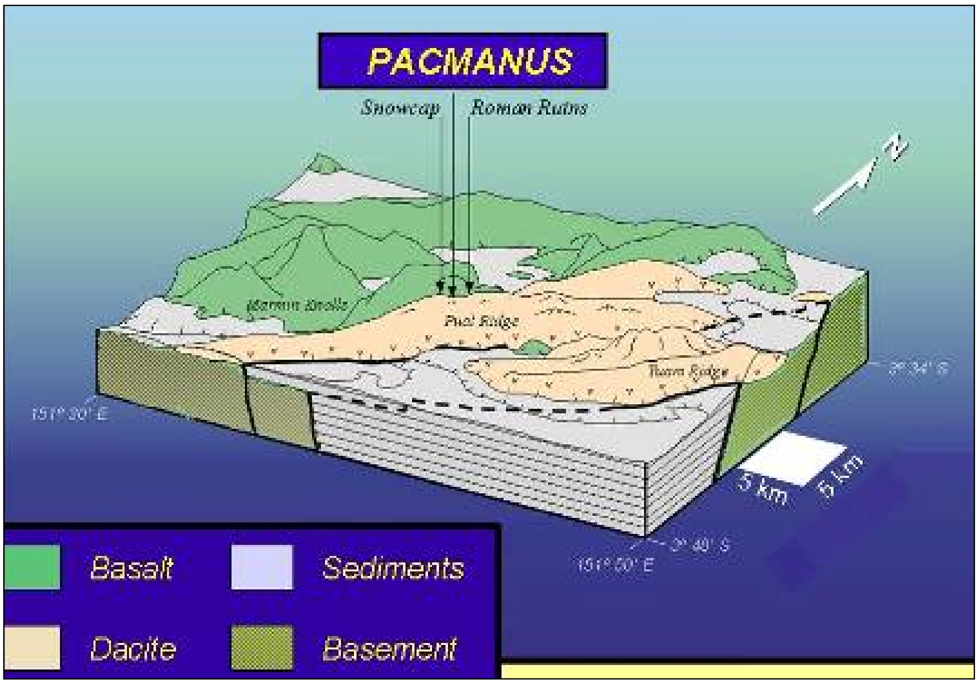

Figure 7-6: Schematic Solwara 4 sea floor topography, geology and major prospects

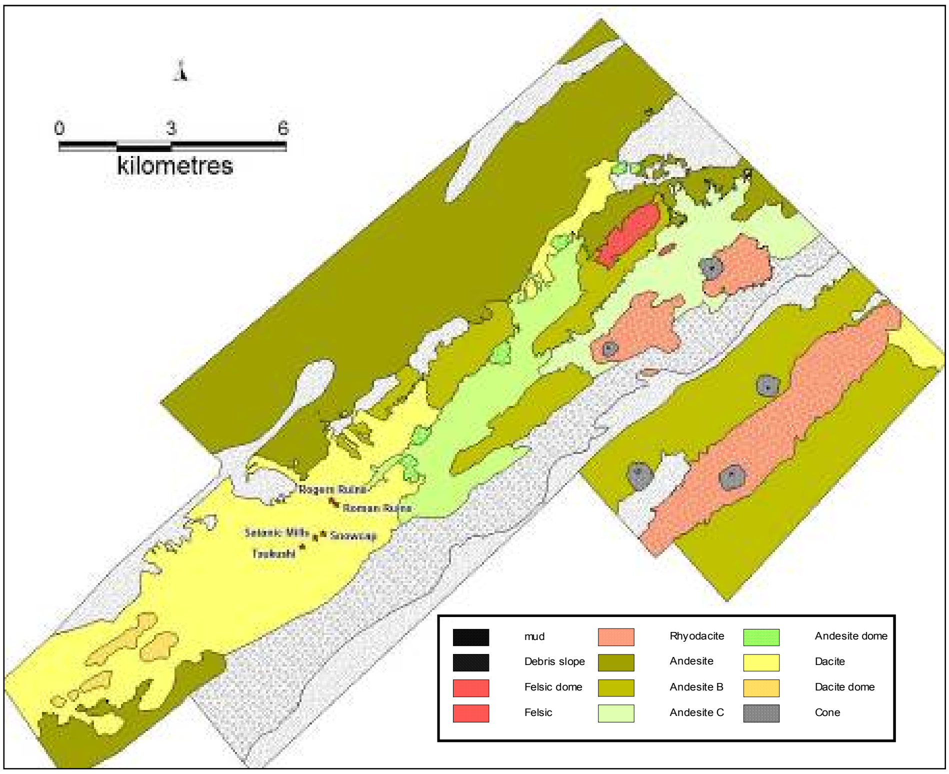

Figure 7-7: Schematic geology of the Solwara 4 with locations of hydrothermal fields

7.3.1 Solwara 4a

The most northerly site of the Solwara 4 prospects, Solwara 4a, is located at about 1,730 to 1,800 m BSL, on a very steep northwest slope of Pual Ridge with an area of approximately 100 m x 80 m (Figure 7-8). This hydrothermal vent field consists of numerous large (< 20 m) inactive sulphide chimneys and a few chimneys that are actively venting hydrothermal fluid. The process of SMS mound formation is well advanced here with chimney debris located among erect chimneys in addition to proximal developments of low mounds of Fe-Mn and manganiferous oxides.

7.3.2 Solwara 4b

The Solwara 4b Field is a relatively level site that occurs on the crest of Pual Ridge at depths of 1,690 to 1,710 m BSL. As with Solwara 4a, Solwara 4b consists of numerous sulphide chimneys that stand as high as 20 m in an area of 250 m x 150 m (Figure 7-8). Many chimneys are broken and some show later re-growth. Chimneys collected from Solwara 4b are composed predominantly of chalcopyrite and sphalerite, with subsidiary pyrite, bornite, tennantite, galena, and dufréynosite (Scott and Binns, 1995; Parr *et al.*, 1996). Barite is the principal gangue, but anhydrite substitutes in some samples. A scientific research drilling program was conducted at Solwara 4b in 2000 (Figure 7-9).

7.3.3 Solwara 4c

The Solwara 4c chimney field is located on the upper southeast slopes of the Pual Ridge, approximately 500m south of Solwara 4b. It is an area of scattered chimneys approximately 150m across that slopes south-eastward from 1,700 to 1,720 m BSL. Chimney structures are actively venting, resulting in a sulphide mound approximately 50 m in diameter with a halo of Fe-Mn oxide crusts. East of this field are north-south oriented fissures in dacite, encrusted with fauna, which are emitting clear fluid and are interpreted as juvenile vents that may develop into black smoker fields. Chimneys collected from Solwara 4d are composed predominantly of chalcopyrite and sphalerite, with subsidiary pyrite, bornite, tennantite, galena, and dufréynosite (Scott and Binns, 1995; Parr *et al.*, 1996). Barite is the principal gangue with anhydrite in some samples.

7.3.4 Solwara 4d

Solwara 4d is approximately 150m by 200m, at depths of 1,654 to 1,670 m BSL, bounded to the east by a NNE-striking fault scarp 60 to 80 m high. Unlike the other fields, it is venting low-temperature fluid (approximately 6°C). Outcrops of altered dacite-rhyodacite lava and hyaloclastite predominate, locally covered with patches of both sandy sediment and metalliferous hemipelagic ooze only millimetres thick. Typical alteration assemblages at Solwara 4c are dominated by cristobalite, with lesser natroalunite, diaspore, and illite-montmorillonite with traces of pyrite, marcasite, chalcopyrite, enargite, and native sulphur.

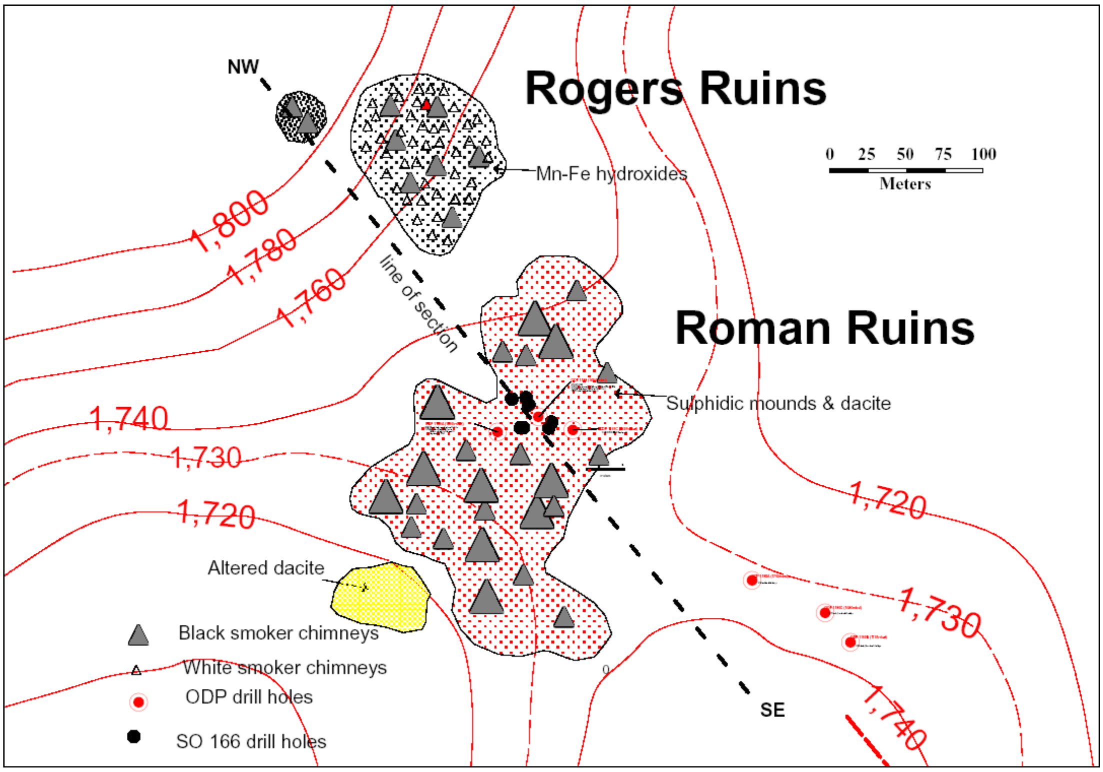

Figure 7-8: Plan of Solwara 4a (Rogers Ruins) and Solwara 4b (Roman Ruins)

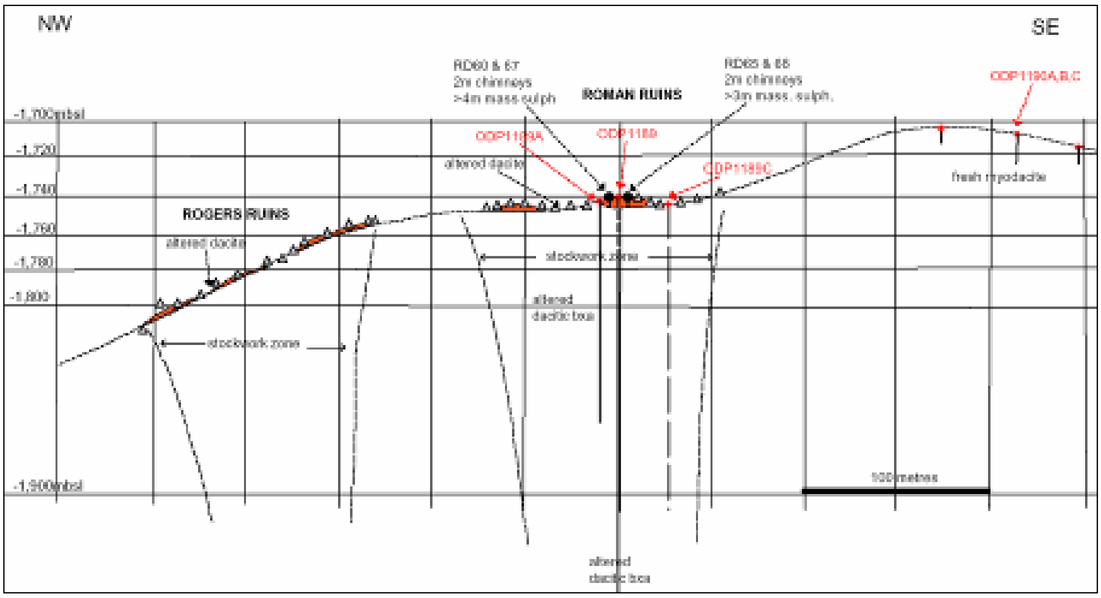

Figure 7-9: Solwara 4b section showing general geology and drillholes

Source: Adamson (2003)

7.3.5 Solwara 4e

Solwara 4e (1,680–1,686m BSL) at the far south-eastern end of Solwara 4 was discovered during the Magellan 2006 cruise aboard the RV *Melville*, operated by Woods Hole Oceanographic Institute (WHOI). The system comprises a 40m diameter two-tiered mound, with a large black smoker chimney complex. The entire mound is composed of chimney debris, massive anhydrite-sulphide rock and anhydrite sand. Diffuse venting of clear to grey to black smoker fluids takes place in numerous locations along the base and up the slope.

7.3.6 Solwara 4f

Solwara 4f (1,680–1,686 m BSL) at the south-western end of Solwara 4 and contains numerous actively venting chimneys as high as 30m. When first observed in 1993, and again in 1995, no chimneys were recorded. However, chimneys were discovered in 1996, and more large chimneys were present in 1998. Solwara 4f may in fact be a very young and developing SMS deposit.

7.4 Solwara 5

Solwara 5 is 2.5km NW of Solwara (White *et al.*, 2008). Numerous outcrops of felsic to intermediate-mafic volcanic rocks were identified in the area surrounding Solwara 5. The chimney area itself is approximately 250 m by 170 m. The chimney field is inactive and contains sparse small chimneys with significant sediment draped over them, obscuring the underlying geology. Only around 5 to 10% of the seafloor is outcropping chimneys, with most of the chimneys upstanding and only a few metres high.

7.5 Solwara 6

Solwara 6 is approximately 1.3km to the SE of Solwara 4b and was identified by the discovery of a hot water venting site. The field consists of standing and collapsed chimneys which appear to lie within a small bathymetry plateau or terrace (White *et al.*, 2008). The field is inactive, covering an area of approximately 50 m x 50 m, with the standing chimneys formed in clusters and individual chimneys up to several metres in height. The standing chimneys are surrounded by piles of collapsed chimney debris, and the chimney field is sediment covered.

7.6 Solwara 7

Solwara 7 is located approximately 200 m to the NE of Solwara 4a, on the NW flank of the Pual Ridge, and 440 m to the NW of Solwara 4b. The area is a highly active hydrothermal field with a strike length of 200 m and 20 to 25 m wide. The seafloor surrounding Solwara 7 is composed of the typical glassy volcanics of the Pual Ridge, which is largely felsic in composition. The area is characterised by a large variety of chimney styles, ranging from narrow, tall and fragile black smokers up to 18 m high, to collapsed and broken tree-trunk like formations, to classic bee-hive chimneys, to white anhydrite chimneys (White *et al.*, 2008). The chimneys occur in clusters of dozens of chimneys, and are surrounded by large mounds of collapsed chimney rubble forming piles at least 2 or 3 metres high in some places. A separate small pod of active chimneys named “Solwara 7 Extension” was also discovered approximately 220 m to the NW of Solwara 7. This small chimney cluster is only about 10m by 10m in size, but appears to be along the same structure that controls Solwara 7.

7.7 Solwara 8

Located approximately 750 m to the WSW of Solwara 6, Solwara 8 consists of both active and inactive chimneys, immediately adjacent to Solwara 4e and 4c. The local basement geology is predominantly glassy volcanics (interpreted to be felsic), with extensive sediment cover in places. Around several of the vent areas there are piles of chimney rubble. Collectively, these three sites (Solwara 8, Solwara 4e, 4c) comprise a discontinuous SSE to NNW trending chimney field of chimneys with an approximate strike distance of 580 m trending, with a width varying from 50 to 150 m (White *et al.*, 2008). 2008 ROV mapping suggests Solwara 8 and Solwara 4 are probably part of the same hydrothermal system.

7.8 Solwara 9

Solwara 9 consists of two separate areas, Solwara 9a and Solwara 9b, both located within 1.5 km of Solwara 1. They are approximately 22 0m and 180 m long respectively, with a width averaging 40 m. They lay approximately 1,680 m BSL on the south-west flank the North Su knoll. The chimney outcrops are surrounded by unconsolidated sediment and volcanic outcrops.

7.9 Solwara 10

Solwara 10 is located in EL1383 on the Manus Spreading Centre, about 24km southwest of Solwara 2. The SMS system is approximately 680 m along strike, with width varying from 30 to 270 m averaging around 110 m. It lies on the seafloor approximately 2,240 m BSL on the south flank of a small volcanic knoll. The SMS outcrop is surrounded by unconsolidated sediment and volcanic outcrops.

7.10 Solwara 11a to 11i

The Solwara 11 area lies in the western parts of the Bismarck Sea, to the south of Manus Island. The area is prospective for SMS deposits due to its combination of felsic volcanic activity, hydrothermal plume activity and known SMS occurrences. Solwara 11 lies along an under-explored structural extensional zone (the Willaumez Spreading Centre Extension Zone), interpreted to be a similar geological feature to the Manus Spreading Centre. It was first examined by the Metal Mining Agency of Japan (MMAJ) in 1992 with *RV Hakurei Maru No 2*, including a detailed multibeam map published in their atlas for the South Pacific Applied Geoscience Commission (SOPAC). MMAJ used a systematic gridding of sediment samples to look for metal enrichments. They located several inactive sites of ferruginous oxide deposit, (possible “weathered” sulphides) (Japan International Cooperation Agency 2000).

The French “MANAUTE” cruise in 2000 (aboard the *RV L’Atalante*) used a manganese detector on the manned submersible Nautile to record anomalies indicative of local hydrothermal activity. Ferruginous and Mn-Si oxides, barite, and “sulphides” (limited details given) were dredged from three underwater volcanoes (Auzende *et al.*, 2000).

In 2008 Teck, working under their earn-in option, discovered the Solwara 11 deposit on EL 1647. Solwara 11 comprises at least four sulphide-rich chimney fields (Solwara 11a, e, f, and i) with associated iron-manganese oxide and silica-iron zones (Solwara 11b, c, d, g, and h) covering an area of approximately 2.8 km by 2 km. Sulphide outcrops up to 10 m high were mapped by ROV; chimney fields are largely inactive except one where hot water was observed.

Solwara 11i was discovered in late 2009 and is located approximately 310 m to the SW of Solwara 11a (White *et al.*, 2010). This prospect is approximately 160 m by 90 m and consists of remnant chimney clusters both standing (up to 18 m tall) and collapsed. Three ROV traverses demonstrated that Solwara 11a and 11i are not joined.

7.11 Solwara 12

Solwara 12 occurs near the apex of a rise over 120 m high, located on the southeastern edge of the DESMOS Caldera at around 1850 m BSL to 1900 m BSL water depth (White *et al.*, 2010). The rise extends significantly beyond the observed sulphide chimney outcrops along two sediment covered ridges: one trending north; and the other trending west. The chimney field is around 200 m across with abundant sediment cover between chimneys, the extent of mineralisation beneath the sediment is unknown. The Solwara 12 outcropping chimneys are large (up to 15 m high).

7.12 Solwara 13

Solwara 13 occurs at the southwest end of the Yuam Ridge, in the eastern Manus Basin at around 2000 m BSL (White *et al.*, 2010). The chimney field is approximately 200 m x 150 m, comprising mainly inactive chimneys up to 20 m high; two areas of active venting were observed near the centre of the field. Large clusters of well cemented chimneys were observed in the central part of the field. The outer part of the chimney field is dominated by smaller, poorly indurated Fe-Mn oxide chimneys.

The chimney field is bounded by volcanic outcrops on all sides. XRF analysis of 2 scoop samples reveal that the Fe-Mn oxides do not contain significant copper, zinc or lead mineralisation.

7.13 Solwara 14

Solwara 14 lies approximately 1.8 km south of Solwara 10, in the Manus Spreading Centre at around 2240 mBSL (White *et al.*, 2010). The system comprises two sub-parallel NE trending lenses of strong sulphide development.

Solwara 14a is a linear zone of inactive chimney clusters approximately 150 m by up to 20 m wide. The chimneys are up to 14 m high. Some minor development of chimney mound was observed. Solwara 14b is slightly smaller and less continuous than Solwara 14a, and has active black smoker chimneys.

7.14 Solwara 15

Solwara 15 occurs on the Manus Spreading Centre, to the SW of Solwara 14 at around 2215 m water depth (White *et al.*, 2010). The system comprises a cluster of small, generally NE trending/elongated chimney occurrences scattered along about 1km of the main spreading ridge axis. Solwara 15a comprises one small area of chimneys on NE trend (~60 m long and 10 m wide). Two of the clusters are actively venting black smoke with abundant biology. Another area around 80 m long was mapped further east of this (Solwara 15b). Billowing black smokers occur in this area with abundant life. The chimneys are built on volcanic pillows and lobes close to fault scarps. No samples were collected from Solwara 15.

7.15 Solwara 16

Solwara 16 occurs in the southern part of the Manus Spreading Centre.approximately 20km SSW of Solwara 10 in the SW portion of the Manus Spreading Centre, at around 2160 m water depth (White *et al.*, 2010). The system comprises several small sulphide zones less than 50 m each in strike length over a 400 m long NE striking zone. When combined, the total strike length of the sulphide systems exceeds 100 m. Regionally, algal mats and hydrothermal indicators were observed in conjunction with the sulphides over a strike length approximately 4 km. A lack of sediment cover and proximity to the spreading axis suggest the system is relatively young. Six sulphide chimney samples were taken from Solwara 16.

7.16 Solwara 17

The Solwara 17 system is located approximately 60 km NE of Solwara 11 (White *et al.*, 2010), along a transform zone that links the two main spreading centres in the Willaumez area. The system is a 120 m x 75 m zone of outcropping chimneys, extensive algal mats and hydrothermal oxide coatings in relatively shallow waters (around 530 mBSL). The chimneys are quartz-rich or sulphate-rich hydrothermal precipitates; only minor sulphides were observed in hand specimen; hot water venting was observed in places.

The target was selected for investigation based on previously published reports from a French-Japanese cruise noting the presence of possible sphaleriate in dredge samples. An additional, smaller, shallower (~390 mBSL), active, chimney site was discovered approximately 1.1 km to the south west of Solwara 17.

7.17 Solwara 18

Solwara 18 is located within the Willuamez Spreading Centre Extended, approximately 10 km NNE of Solwara 11, at around 1310 m water depth (White *et al.*, 2010). This system comprises east-west elongated small inactive chimney clusters scattered over 80 m of strike length, hosted within a wider zone of hydrothermal indicators. The chimneys appear to be growing directly on volcanic pillows, and are only around 1 m height on average. The substrate is pillow basalt with no sediment cover.

7.18 Solwara 19

Solwara 19 occurs at around 1030 mBSL approximately 150 km WSW of Solwara 10. The system comprises a northerly trending zone of barite chimneys, outcropping for approximately 110 m along strike, situated on a mound ESE of a large caldera system (White *et al.*, 2010).

8. Deposit Types

8.1 Discovery and Global Distribution

More than 300 sites of hydrothermal activity and seafloor mineralisation are known (Hannington *et al.* 2005) (Figure 8-1), of which about 100 have high-temperature venting or polymetallic sulphide deposits. The existence of more can be inferred on the basis of hydrothermal plume studies (Baker *et al.*, 2003). These hydrothermal sites have been discovered principally by cooperative research and government institutions conducting basic research on Earth processes. Deposits of metalliferous mud and sulphides are formed at, or adjacent to, the vent site when the rising hot hydrothermal fluids mix with the cold ambient sea water on the sea floor.

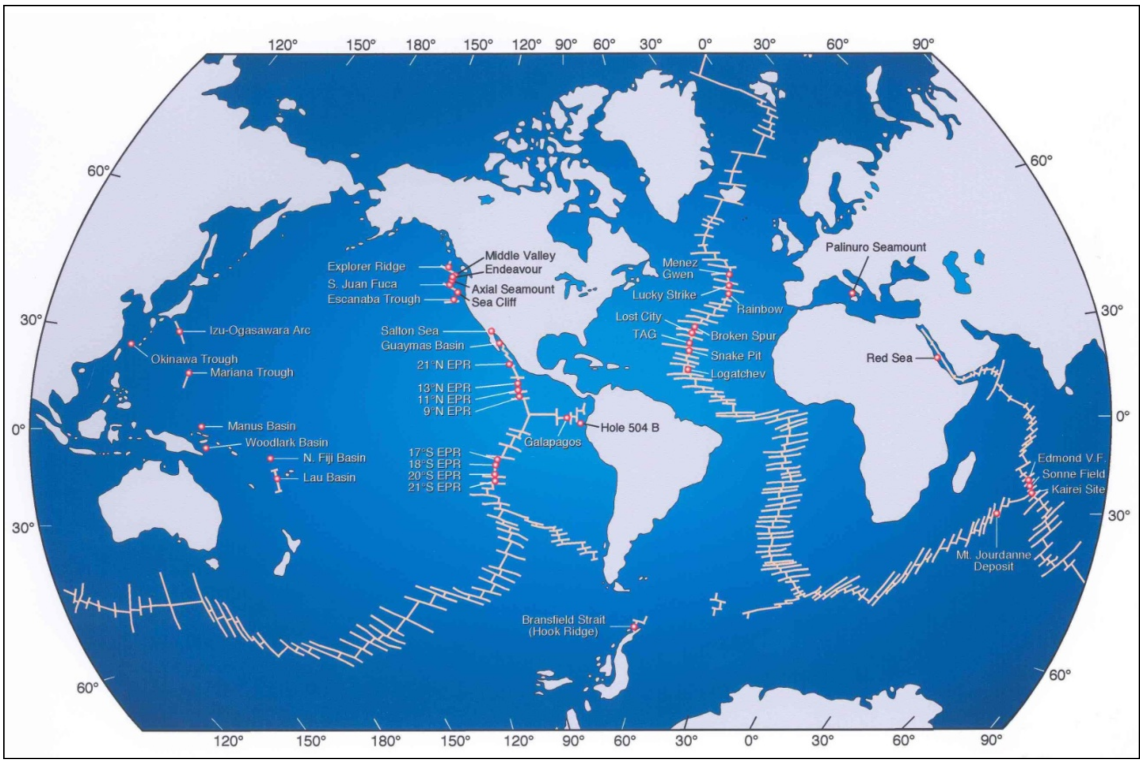

Figure 8-1: Known hydrothermal systems and polymetallic massive sulphides deposits

The Atlantis II Deep deposit is located in the Red Sea and is the largest known sea floor sulphide deposit. During the 1970s the Sudanese and Saudi Arabian governments contracted the German company Preussag to bulk sample and review the economics of mining the Atlantis II Deep deposit (Guney et al., 1984). Although there were some higher grade parts of the deposit, the overall grades of 0.45% Cu, 2.07% Zn, 39 g/t Ag and 0.5 g/t Au were considered to be uneconomic.

The first active 'black smoker' chimneys (and associated SMS deposits) were discovered in 1977 around the Galápagos Islands by the National Oceanic and Atmospheric Administration. They were observed using the submersible Alvin. Subsequently, numerous marine scientific research projects have discovered SMS systems throughout the oceans of the world. This period of rapid discovery was followed by exploration in western Pacific back-arc basins. One of the first discoveries of modern massive sulphide chimneys was in the Manus Basin back-arc in PNG (Both et al., 1986). Although not unlike their mid-ocean equivalents, subsequent research on back-arc SMS systems has shown them to be higher grade (Herzig, 1995). By drawing an analogy with ancient felsic-hosted VHMS deposits, further expeditions discovered SMS deposits in volcanically active back-arc rifts (Halbach et al., 1989; Binns and Scott, 1993) and within the calderas of submarine arc volcanoes (Iizasa et al., 1999; de Ronde et al., 2001). The 1991 discovery of actively forming massive sulphide chimneys with high base and precious metal contents in felsic volcanics at Pual Ridge (Solwara 4) demonstrated the potential of PNG to host high grade SMS deposits (Binns and Scott, 1993; Binns et al., 1995). In 1997, the PNG Government granted Nautilus the first two exploration licences for SMS deposits, covering the Solwara 1, 2, 3 and 4 areas.

Less than 15% of the known 82,000km of prospective sea floor environments worldwide have been carefully surveyed, with another ~6% in less detail (Baker et al., 2003). To date, academic research efforts have only focussed on the active hydrothermal fields and little is known about extinct or mature fields. The older fields are the priority target for Nautilus' exploration programmes as these areas contain deposits that are mature, and therefore more likely to be of a sufficient size for exploitation. The extinct fields are also less likely to support colonies of hydrothermal-specific marine life. There are likely to be many more extinct fields deposited over time (~100,000 years) on the sea floor than currently active fields, which are the main focus of researchers.

8.2 Characteristics of Terrestrial VHMS Deposits

Volcanic-Hosted Massive Sulphide (VHMS) deposits form a major part of the world's reserves of copper, lead and zinc, as well as being producers of gold and silver. Over 800 terrestrial (land based) VHMS deposits have already been identified around the world (Franklin *et al*., 2005). These deposits occur in rocks that range in age from the Archaean through to the Cainozoic, with notable examples being the deposits of the Iberian Pyrite Belt, Kidd Creek and the Noranda Camp in Canada, and Kuroko in Japan. VHMS are commonly found in clusters, often consisting of dozens of individual deposits around 1 to 10 Mt within a larger mining camp. A selection of VHMS deposits is tabulated in table 8.1 with a comparison of the Solwara 1 resource to some other VHMS deposits is shown in Figure 8.2.

- They are hosted in volcanic or volcano-sedimentary successions originally deposited under water.
- They are the same age as the host succession.
- The host rocks vary from coherent to clastic volcanic or sedimentary facies and range in composition from basalt through andesite and dacite to Rhyolite.
- Most deposits are hosted in thin volcaniclastic units (less than 100m thick) between major volcanic formations.
- The economic parts of the deposits typically comprise >80% sulphide minerals by volume, principally pyrite, sphalerite, chalcopyrite and galena.
- Massive sulphide lenses are commonly aligned parallel to volcanic strata.
- Stringer (or stockwork) sulphide zones commonly underlie the massive sulphides and may contain economic Cu grades.
- Metal contents and metal ratios vary considerably. Deposits may be Cu-rich, Au-rich, Cu-Zn-rich or polymetallic (Cu-Zn-Pb-Ag-Au) types.
- Ore metals within sulphide deposits are typically vertically zoned, from Cu at the stratigraphic base to Zn, Pb, Ag, Au and Ba towards the top. However, there are many exceptions to this zonation pattern.

The widely accepted genetic model for VHMS deposits is that they are formed at or just below the seafloor, in volcanically-active extensional settings, where convected seawater is drawn into the seafloor down extensional faults. Vent fluids are heated (>200°C) by underlying magmas, and leach metals from the underlying volcanic rock; this metal-rich fluid may also mix with magmatic fluids sourced from sub-volcanic intrusions. The reduced hydrothermal fluid is then driven upwards towards the seafloor via fault pathways, and expelled at or immediately below the seafloor surface. When in contact with cold seawater, the hydrothermal fluid cools rapidly and precipitates sulphides, sulphates and Fe-oxide minerals. Long lived precipitation eventually builds up a mound of metal-rich sulphide on or immediately beneath the seafloor.

Within a mining camp, VHMS deposits tend to be spatially clustered with multiple deposits, commonly forming at a single stratigraphic level. Deposits are localised at the prospect scale by the distribution of synvolcanic extension faults. These extension faults are active during the formation of the deposits and create the permeability required to allow transport of the upward-migrating metal-laden fluids to reach either the sea floor or the immediate sub-sea floor porous environments.

Table 8-1: Average grade and tonnage data * for selected VHMS groups

Area	Dominant metals	Number of deposits	Average Grade and Tonnage					
			Cu (%)	Zn (%)	Pb (%)	Ag (ppm)	Au (ppm)	Mt
Abitibi Belt, Canada	Cu-Zn	52	1.47	3.43	0.07	3.19	0.8	9.2
Norwegian Caledonides	Cu-Zn	38	1.41	1.53	0.05			3.5
Bathurst, N.B., Canada	Zn-Pb-Cu	29	0.56	5.43	2.17	62.0	0.50	8.7
Green Tuff Belt, Japan	Zn-Pb-Cu	25	1.63	3.86	0.92	95.1	0.90	5.8
Iberian Pyrite belt	Cu-Zn	85	0.80	2.00	0.70	26.0	0.50	20.8
Australian Palaeozoic	Cu-Zn	24	1.13	4.10	1.62	42.95	1.78	10.7

Modified after Lydon (1993) and Large (1992)
* This information does not relate to mineralisation on the properties that are the subject of this technical report

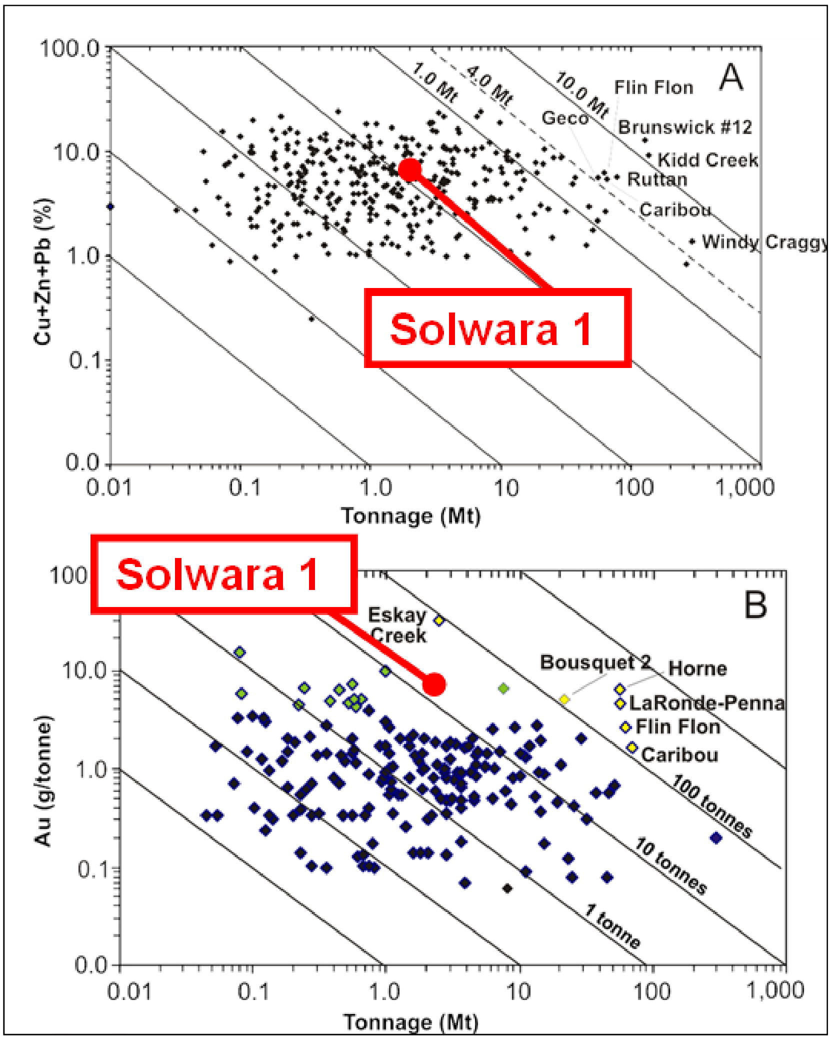

Figure 8-2: Comparison of Solwara 1 resource to Canadian VHMS deposits

8.3 Formation and Morphology of SMS Deposits

Modern day SMS deposits can be subdivided into three end member deposit styles, based on morphology (eg. Large, 1992):

- Lens and blanket deposits have a low aspect ratio with a dominant zinc-rich massive sulphide lens and subordinate stringer zone.
- Mound deposits have a high aspect ratio, narrow and elongate massive sulphide with a well developed stringer zone.
- Pipe and stringer deposits have cross-cutting massive sulphide pyrite-chalcopyrite pipe or stringer zones with little or no stratiform Zn rich sulphide lenses.

SMS deposits are commonly formed on the sea floor near plate margins in either:

- Divergent plate margins such as mid-ocean ridge spreading centres or spreading back arc basins.
- Convergent plate margins such as island arcs and back-arc spreading centres.
- Intra-plate oceanic islands.

SMS deposits are formed in geological settings where extensional fault systems facilitate the deep circulation of sea water in convection cells, formed by heat flow from submarine volcanic activity. Active sulphide deposition on the ocean floor (Figure 8-3) is confined to sites where hot (>200°C) rising hydrothermal vent fluids mix with cool (2°C) ambient ocean water. Through the accumulated precipitation of the sulphides at the vent site, chimney-like structures form. These chimneys consist of anhydrite and polymetallic sulphides. The combined processes of: 1) episodic flux of the hydrothermal vent fluid; 2) sea floor oxidation; and 3) seismic events contribute to the collapse of the old chimney structures and the initiation of new chimney structures. This cyclical process results in the formation of a sulphide mound on the sea floor. As the size of the mound increases, through prolonged hydrothermal activity, the mound permeability decreases to a point where precipitation, replacement and remobilisation of sulphides inside the mound can occur resulting in a concentration of minerals.

The obvious similarities (tectonic setting, mineralogy, metal zonation and alteration zonation) between SMS deposits and mound style VHMS deposits have led the research community to conclude the systems are analogous. To date research programs have mostly identified SMS deposits that appear to be analogues with the mound style of VHMS deposit, as these are forming on the sea floor surface and are readily detectable by bathymetry, camera tows, dredge sampling or ROV mapping and sampling. Any SMS analogues of the other two styles of VHMS deposits (pipe and stringer deposits and lens and blanket deposits) would be forming beneath the sea floor, and require geophysical, geochemical and drilling techniques to detect them rather than by direct observation.

VHMS deposits on land commonly form in clusters. This is likely to be similar for SMS deposits; however, many small (<1Mt) SMS deposits could be mined by moving floating infrastructure, whereas on land VHMS deposits of this size may individually be too small to justify development.

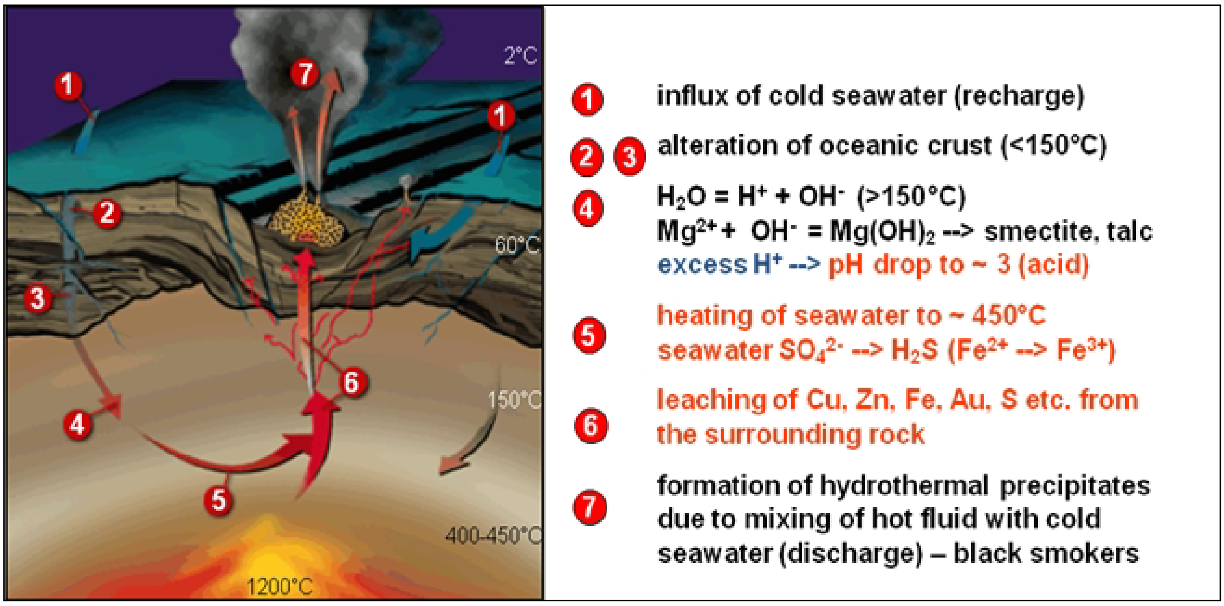

Figure 8-3: Schematics of development of modern mound-chimney SMS deposit

9. Mineralisation

Significant SMS mineralisation has been identified at 16 prospect areas within the Nautilus tenements: including the Solwara 1 to 14, Solwara 16 and Solwara 18 prospects (**Table 9-1**).

Samples from Solwara 17 and 19 were weakly anomalous in base metals and sulphate-rich. No samples from Solwara 15 were recovered and therefore sulphides have not yet been confirmed there.

This section includes results from previous studies and investigations, along with descriptions of mineralised zones, surrounding rock types and geological controls. The results of the scientific sampling are not compliant with NI-43101 reporting requirements, and are superseded by Nautilus' sampling results reported in Section 10. They are presented as historical background only.

Table 9-1: Average compositions of grab subsamples from the Solwara Project

Prospect	Cu %	Zn%	Au g/t	Ag g/t	Samples
Solwara 1	11.0	6.6	18.2	215	148 chimney samples
Solwara 2	1.1	23.8	10.6	340	68 chimney samples
Solwara 3	0.5	11.0	30.6	3375	2 chimney samples
Solwara 4	12.3	19.5	14.1	232	43 chimney samples
Solwara 5	5.5	7.7	13.9	263	13 chimney samples
Solwara 6	11.7	18.4	16.1	203	7 chimney samples
Solwara 7	3.7	15.6	10.9	261	11 chimney samples
Solwara 8	5.6	31.4	15.6	305	13 chimney samples
Solwara 9	6.3	10.6	19.9	296	17 chimney samples
Solwara 10	7.1	14.1	2.3	152	13 chimney samples
Solwara 11	1.5	15.1	1.3	198	21 chimney samples
Solwara 12	7	22.6	13.7	425	10 chimney samples
Solwara 13	9.1	30.7	4.7	546	7 chimney samples
Solwara 14	1.3	19.2	3.3	97	14 chimney samples
Solwara 16	2.1	18.6	2.8	105	6 chimney samples
Solwara 17	0.0	0.1	0.0	181	3 chimney samples
Solwara 18	0.3	19.6	0.2	110	2 chimney samples
Solwara 19	0.0	0.1	0.6	4	2 chimney samples

Note that some of these grades are from unverified third-party scientific reports and may be based on samples that were specifically selected for detailed analysis and scientific research. Therefore, the grades stated only reflect the grades of the samples selected and may not reflect the average grade of underlying mineralisation.

9.1 Solwara 1

The Solwara 1 deposit is a tabular flat lying zone of massive (>50%) to semi-massive (20-50%) sulphide mineralisation, lying on a on a volcanic ridge which rises 150 to 200 m above the surrounding seafloor. The slopes of the ridge are steep, up to 30 degrees. There are some flatter areas near the crests of the ridges where much of the deposit is located. The volcanic ridge is dominated by andesite to dacite rocks.

Part of the Solwara 1 Project was surveyed by CSIRO on three marine science research cruises: PACMANUS III, PACMANUS IV and Binatang 2000. Each research cruise included deep-tow video traverses, dredge traverses and limited grab sampling. These cruises identified the hydrothermal venting at the North Su and South Su prospects and the chimney fields at Solwara 1, initially called Suzette. Nautilus' interpretations of recently acquired side-scan sonar data, provided by Placer Dome, defined the extent of the Solwara 1 SMS deposit.

The main area of the Solwara 1 deposit contains numerous hydrothermal vent structures ("chimneys"). Nautilus has sampled 148 of these chimneys (Table 9-1). The chimneys are formed dominantly of sulphide and lesser sulphate minerals including chalcopyrite, sphalerite, pyrite, barite and anhydrite.

The South Su field is approximately 2.5 km to the south of Solwara 1, and contains copper and gold-rich chimneys standing on an exhalative mound comprising massive pyrite-sphalerite-barite and sulphidic muds. The exhalative sea floor deposits are underlain by altered dacite consisting of high-sulphidation silica-pyrite-native sulphur-alunite alteration accompanied by disseminated and stockwork sulphide mineralisation. The stockwork appears to be exposed on southerly flanks of the dome where samples of altered brecciated dacite and brecciated silica-sulphide assemblages with up to 2.6% Cu and 0.8ppm Au, have been recovered by dredging (Binns *et al.*, 1997). Note that these grades are from a scientific Report and may be based on samples that were specifically selected for detailed analysis and scientific research on the formation and genesis of sea-floor massive sulphide systems. Therefore, the grades stated only reflect the grades of the samples selected and may not reflect the average value of the SMS deposit. Additionally, only the emergent black smoker chimneys were sampled; the grades of these are likely to be different from the underlying SMS mound deposit.

The North Su field is approximately 1.5 km to the south of Solwara 1, and is dominated by steep topography and appears to consist of jagged and sheet-like volcanic outcrops and hydrothermal exhalative mounds, crusts and volcaniclastic dominated zones. Previous deep-tow video surveys were relatively unsuccessful due to large amounts of suspended particulate matter possibly emitted from active hydrothermal vents. Dredged samples from the NW strike extents of North Su consist of dacite which is altered and is host to veined and disseminated pyrite (Binns, 2004).

The sub-surface geological sequence at Solwara 1 (Figure 9-2) has been determined by shallow diamond drilling. Mineralisation is believed to be associated with structures that have formed "feeder-zones" through the host volcanic package of high hydrothermal flux. Hydrothermal fluids have reacted with the volcanic rocks in and adjacent to these zones in a series of processes that have led to the formation of massive sulphides by replacement and vein/breccia infill. Three domains in the mineralisation system (excluding the chimneys found at surface), have been defined:

- Cemented sediment : a distinctive layer of pale to dark grey, fine to medium grained volcaniclastic sands from 0 up to 5.4 m thick, averaging 0.5 m thick. The sediments have been flooded by hydrothermal fluids that have precipitated a cement of opaline silica, sulphide and sulphate minerals. Rare fragments of sulphide-rich chimneys are entrained within this domain. Locally this unit is well mineralised containing significant chalcopyrite and sphalerite.
- Massive and semi-massive sulphide: this is the main mineralised domain, varying in thickness from 0 to at least 18 m (many holes terminated in massive sulphides). The zone consists mainly of pyrite and chalcopyrite with anhydrite or barite gangue; chalcopyrite commonly dominates closer to the surface, but in some drillholes it tends to diminish with depth where pyrite dominates. Pyrite is also seen to be the dominant sulphide on the south eastern side of the deposit. Anhydrite and barite occur in variable amounts throughout the sulphides or in veins and breccia matrix, particularly towards the base of the zone. Locally, the main sulphide zone can include patches of clay-rich altered volcanic material, and generally it grades into this material at depth.
- Altered volcanic rocks: the footwall to the mineralisation consists of altered volcanic rocks in which most of the primary minerals have been altered to clays or replaced (or veined) with anhydrite and disseminated pyrite. Short-wave infrared (SWIR) mineral analyser studies of alteration minerals in the footwall domain indicate zonation of alteration minerals, with smectites and opal dominant on the periphery of the system, and illite forming the dominant alteration mineral in the centre of the system. Rare pyrophyllite and kandite/dickite have been identified in some drillholes. These rocks are commonly weak and core recovery is generally low in this zone.

The results of drilling of the deposit in 2007 were used to estimate a resource for the deposit (see Section 11).

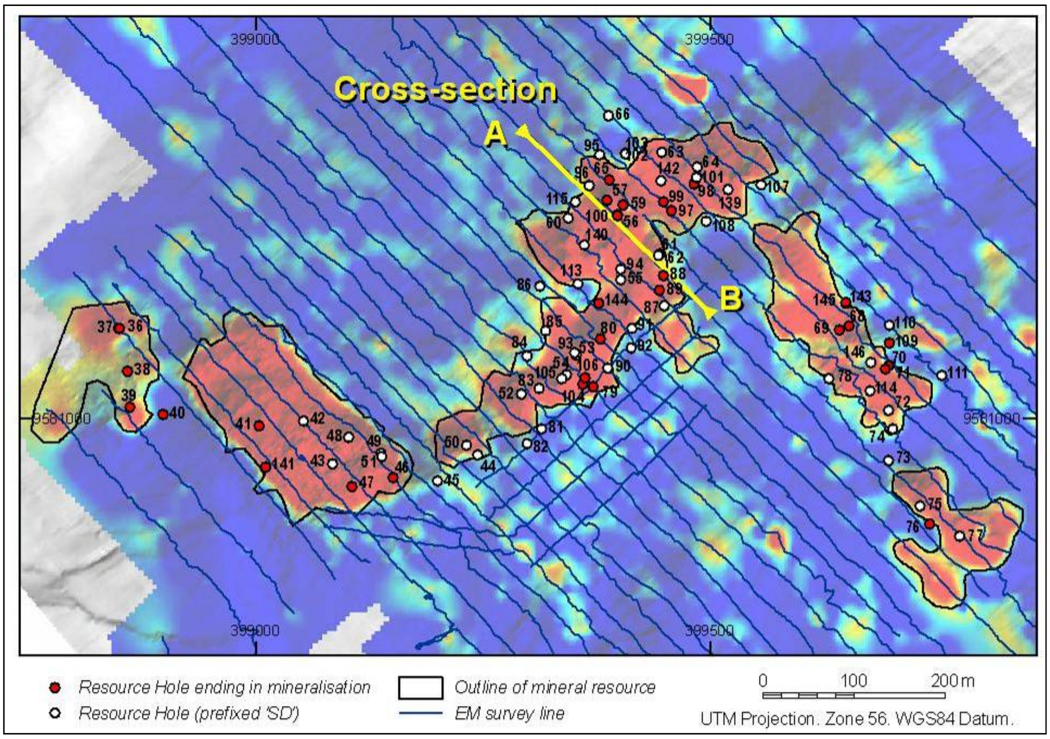

Figure 9-1: Distribution of resource drilling at Solwara 1

Source: Lipton (2008)

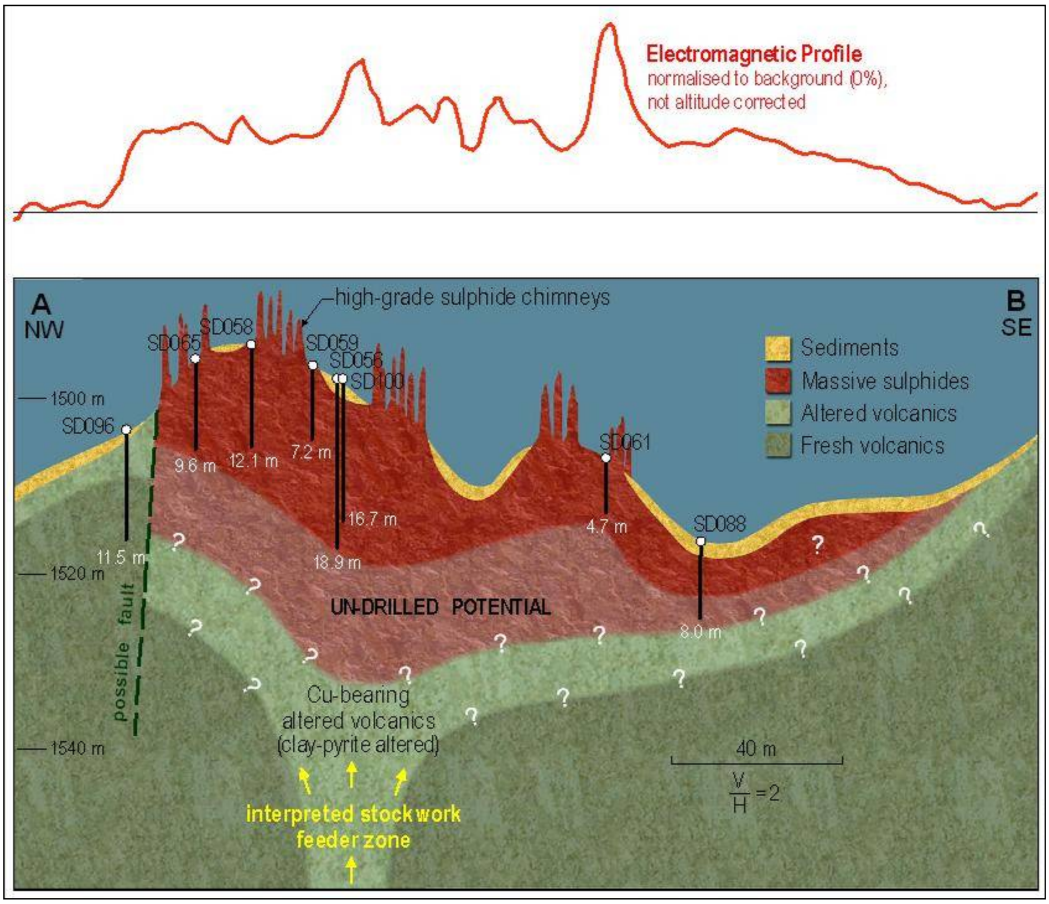

Figure 9-2: Schematic cross-section through the Solwara Deposit

Source: Lipton (2008)

9.2 Solwara 2 and 3

Solwara 2 is located on the Manus Spreading Centre. It comprises two chimney areas, Solwara 2a and 2b. Many of the chimneys in the Solwara 2a area are growing out of a volcanic substrate with little mound development.

In 1990, the OLGA-II cruise on the *RV Sonne* discovered two Zn-rich chimney clusters at Solwara 2 and one chimney area at Solwara 3. Using data from the OLGA-II cruise, a Russian team on the *RV Akademik Mstislav Keldysh* carried out one dive at Solwara 2 and one dive at Solwara 3, confirming the presence of several chimney clusters and collecting samples at 16 sites in the two areas. In 1995, French-Japanese teams carried out five dives by the *Shinkai-6500* in the Solwara 2 area, reporting chimneys scattered through an area of 400 m diameter with vent temperatures of up to 300°C. In 2006, the Magellan 2006 cruise of the *RV Melville* acquired detailed bathymetry, temperature and Eh data using the AUV *ABE* at the Solwara 2 and 3 sites and at an intermediate site named the Bronze Age Fort. The *ROV Jason* carried out seven dives in these areas.

Assays returned from chimney samples at the Solwara 2 and 3 sites are tabulated in **Table 9-1**. Note that some of these grades are from unverified third-party scientific reports and may be based on samples that were specifically selected for detailed analysis and scientific research on the formation and genesis of sea-floor massive sulphide systems. Therefore, the grades stated only reflect the grades of the samples selected and may not reflect the average grade of underlying mineralisation.

Solwara 2 is located on the Manus Spreading Centre. It comprises two chimney areas, Solwara 2a and 2b. Many of the chimneys in the Solwara 2a area are growing out of a volcanic substrate with little mound development.

In 1990, the OLGA-II cruise on the *RV Sonne* discovered two Zn-rich chimney clusters at Solwara 2 and one chimney area at Solwara 3. Hydrothermal activity at Solwara 2 is said to extend 100 m along strike. Using data from the OLGA-II cruise, a Russian team on the *RV Akademik Mstislav Keldysh* carried out one dive at Solwara 2 and one dive at Solwara 3, confirming the presence of several chimney clusters and collecting samples at 16 sites in the two areas. In 1995, French-Japanese teams carried out five dives by the *Shinkai-6500* in the Solwara 2 area, reporting chimneys scattered through an area of 400 m diameter with vent temperatures of up to 300°C. In 2006, the Magellan 2006 cruise of the *RV Melville* acquired detailed bathymetry, temperature and Eh data using the AUV *ABE* at the Solwara 2 and 3 sites and at an intermediate site named the Bronze Age Fort. The *ROV Jason* carried out seven dives in these areas.

At Solwara 2a and 2b, 63 samples chimney from the Magellan 2006 cruise averaged 1.3% Cu, 22.6% Zn, 10 g/t Au and 334 g/t Ag. At Solwara 3, two samples returned maxima of 16.3 % Zn, 0.73 % Cu, 8.58 % Pb, 30.6 g/t Au and 4,480 g/t Ag. Note that these values are from a scientific report and may be based on samples that were specifically selected for detailed analysis and scientific research on the formation and genesis of sea-floor massive sulphide systems. Therefore, the values stated only reflect the values of the samples selected and may not reflect the average value of the SMS deposit. Additionally, only the emergent black smoker chimneys were sampled; the grades of these are likely to be different from the underlying SMS mound deposit.

9.3 Solwara 4

In 2000 the Solwara 4 SMS systems on the Pual Ridge were extensively sampled by dredging and research drilling. The target of the drilling program was to collect geological and geophysical information on the alteration and extents of mineralisation beneath the hydrothermal vent locations. The drilling program (Leg 193 of the Ocean Drilling Program (“ODP”)) was conducted from the marine research vessel RV JOIDES Resolution (Table 6-1). It is important to note that, due to academic considerations, the drilling program was not engineered or designed to recover representative samples of sulphide mineralisation within 30 m of the seafloor, and the core recovery was inconsistent throughout the drillholes. Despite the lack of consistent core recovery, evidence of altered volcanics and stockwork mineralisation was discovered to extend down to 370m below the seafloor. A cross-section through the Solwara 4 prospect is shown in Figure 9-3.

Further drilling was undertaken in 2002. This research drill program ("Condrill", SO-166) on the RV Sonne consisted of ten holes drilled to 5 m. These drillholes were designed to target the near-seafloor extents of the SMS mineralisation within two of the Solwara 4 hydrothermal fields. Three drillholes intersected massive chalcopyrite mineralisation and six returned samples of sphalerite-bearing debris (chimney fragments) confirming the existence of the sulphide mound below the hydrothermal vents or chimneys.

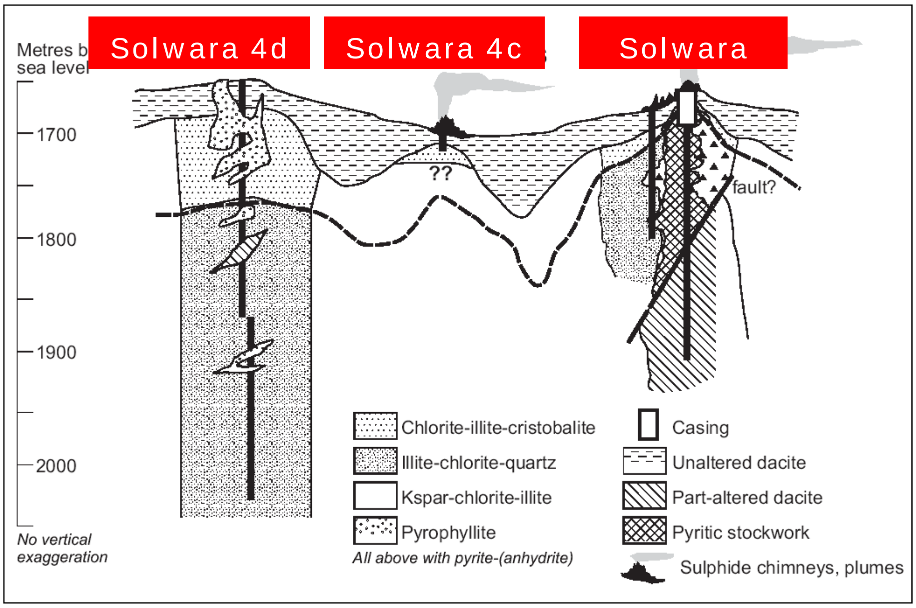

Figure 9-3: Schematic SW-NE cross-section along the crest of Pual Ridge Solwara 4

9.3.1 Solwara 4a

Dredging of black smoker chimneys at the Solwara 4a returned samples with high percentages of polymetallic sulphides. The average grades of eight chimney analyses were 7.3% Cu, 17.9% Zn, 250 g/t Ag, 11.3 g/t Au (Yeats *et al.*, 1998). These average grades are from a scientific Report and may be based on specifically selected sulphide samples; however the comparison of the results of the scientific sampling at Solwara 1 and Solwara 2 and the grab sampling suggests that these grade tenors are likely to be associated with significant SMS mineralisation.

9.3.2 Solwara 4b

This chimney field had two drillholes completed in 2000 as part of the ODP Leg 193 program. In the first hole, ODP 1189, sample was not returned until 31 m depth, and the remaining 210 m of the drillhole intersected altered dacite breccias and sulphide-silica-anhydrite stockwork mineralisation. The second hole, ODP 1189A, was drilled further away from the known extent of the mound and was not core sampled until 30 m depth. No significant massive sulphide mineralisation was intersected in this hole.

Dredging returned mineralised samples of sulphidic chimney (average of nine samples: 9.0% Cu, 18.8% Zn, 170g/t Ag, 12.3g/t Au; Yeats, Parr and Binns, 1998). Note that these average grades are from a scientific Report and may be based on sulphide samples that were specifically selected for detailed analysis and scientific research on the formation and genesis of sea-floor massive sulphide systems. Therefore, the average grades stated only reflect the average of the samples selected and may not reflect the average value of the SMS deposit.

A drilling program conducted as part of the 2002 "Condrill" (SO-166) marine science research cruise on the RV Sonne consisted of ten holes drilled to 5 m, which were designed to target the near-seafloor extents of the SMS mineralisation within two of the Solwara 4 hydrothermal fields. Three drillholes intersected massive chalcopyrite mineralisation and six returned samples of sphalerite-bearing debris (chimney fragments) confirming the existence of the sulphide mound below the hydrothermal vents or chimneys.

Assays of quarter core sections of core from all drillholes indicate high base and precious metal contents averaging 10.8g/t Au, 166g/t Ag, 18.2.% Zn, 4.1% Cu (S Petersen, pers comm).

These average grades are from a scientific Report and may be based on specifically selected sulphide samples; however the comparison of the results of the scientific sampling at Solwara 1 and Solwara 2 and the grab sampling suggest that these grade tenors are likely to be associated with significant SMS mineralisation.

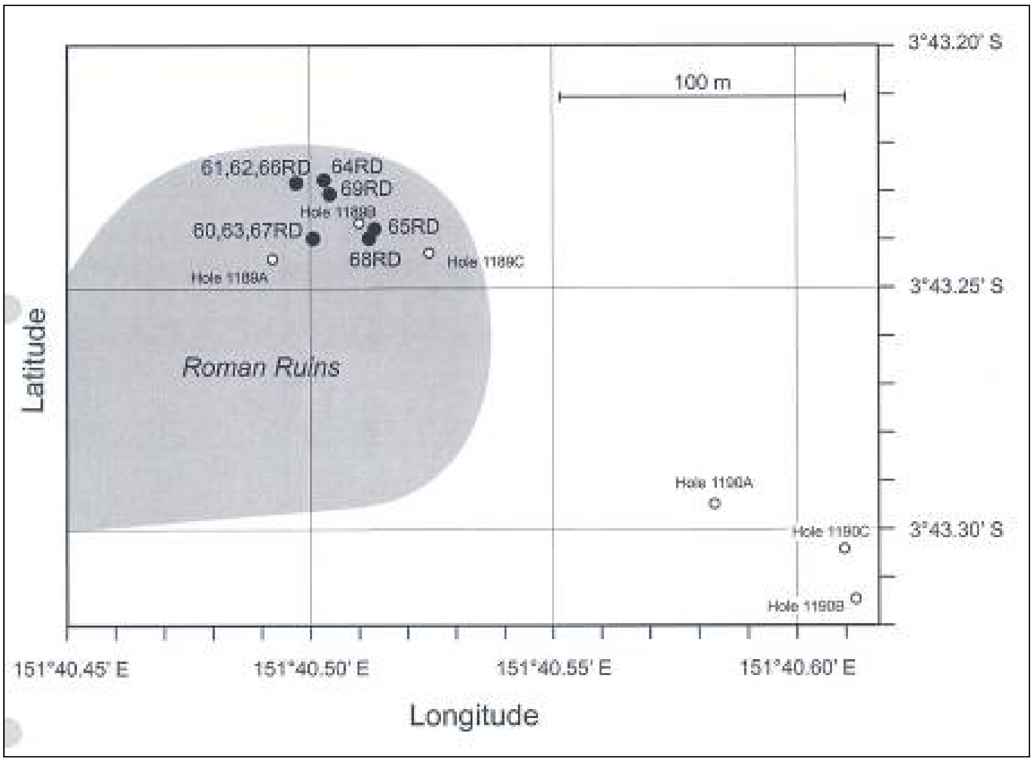

Figure 9-4: Schematic map of Condrill core hole locations at Roman Ruins

9.3.3 Solwara 4c

Dredge sampling of Solwara 4c indicated significant polymetallic sulphide mineralisation with average values from 48 samples of 13% Cu, 20.8% Zn, 164 g/t Ag and 14.4 g/t Au (Binns, 2004). A large grab sample of a black smoker chimney was recovered by dredging in 2004. A slab was cut from across the long axis of the chimney fragment, and 85 small core samples taken (Petersen, 2004). The average grades of these 85 samples are presented in Table 9-2.

Note that these average values are from a scientific report and may be based on sulphide samples that were specifically selected for detailed analysis and scientific research on the formation and genesis of sea-floor massive sulphide systems. Therefore, the average values stated only reflect the average of the samples selected and may not reflect the average value of the SMS deposit.

Table 9-2: Average results of 85 samples from Solwara 4c sulphide material

Au (ppm)	Ag (ppm)	Zn (%)	Cu (%)	Pb (%)
13.86	272.28	22.13	8.79	1.06

Figure 9-5: Massive sulphide black smoker chimney Solwara 4c

Figure 9-6: Slice through chimney with sample core holes

9.3.4 Solwara 4d

The Solwara 4d chimney field consists of two multi-spired complexes with patchy hydrothermal venting about half way up these 6-7 m tall structures. Smaller solitary spires in the area are all inactive. Some chimneys grow out of fissures in hard rock basement. Overall, venting activity is minor (Tivey *et al.*, 2006).

Three grab samples were recovered from Solwara 4d during the *RV Melville* cruise in 2006. Average assay grades returned from those samples were 17.1 % Cu, 29.6 % Zn, 34.5 ppm Au, and 390.7 ppm Ag. Note that these average grades are from a scientific report and may be based on sulphide samples that were specifically selected for detailed analysis and scientific research on the formation and genesis of sea-floor massive sulphide systems. Therefore, the average grades stated only reflect the average of the samples selected and may not reflect the average value of the SMS deposit.

9.3.5 Solwara 4e

The core of the Solwara 4e site is a 40 m diameter two-tiered mound, with a large black smoker chimney complex forming the upper tier. The entire mound is composed of chimney debris, massive anhydrite-sulphide rock and anhydrite sand. Diffuse venting of clear to grey to black smoker fluids takes place in numerous locations along the base and up the slope of the Solwara 4e mound. The area around the Solwara 4e mound also features hydrothermal activity in the form of extensive fields of diffuse venting, densely populated by crabs and mussel beds, as well as smaller chimney complexes, active and inactive, up the south and southeast facing slopes that bound the Solwara 4e site to the north. The southern slopes of Solwara 4e are covered with talus, mostly massive sulphide (Tivey *et al*., 2006).

Sixteen grab samples were recovered from Solwara 4e during the *RV Melville* cruise in 2006. Average assay grades returned from those samples were 9.6 % Cu, 12.6 % Zn, 8.9 ppm Au, and 158.6 ppm Ag. Note that these average grades are from a scientific report and may be based on sulphide samples that were specifically selected for detailed analysis and scientific research on the formation and genesis of sea-floor massive sulphide systems. Therefore, the average grades stated only reflect the average of the samples selected and may not reflect the average value of the SMS deposit.

9.3.6 Solwara 4f

The Solwara 4f chimney field is mostly inactive. It extends about 40 m E-W and comprises numerous structures that are simple, tall pillars with white conical tips. Minor diffuse fluids seep up through oxide stained cracks in the volcanic basement on which the chimneys stand. The sediment cover is generally light (Tivey *et al.*, 2006).

One grab sample was recovered from Solwara 4f during the *RV Melville* cruise in 2006. The sample returned assay grades of 0.8 % Cu, 62.2 % Zn, 68.5 ppm Au, and 262.0 ppm Ag. Note that these grades are from a scientific report and may be based on a sulphide sample that was specifically selected for detailed analysis and scientific research on the formation and genesis of sea-floor massive sulphide systems. Therefore, the value stated may not reflect the average value of the SMS deposit.

9.4 Solwara 5

Sampling across the Solwara 5 chimney field identified numerous chimneys with high grades of precious and base metals (**Table 9-1**). The chimneys commonly display a strong weathering rind up to several centimetres thick, and these rinds have much lower base metal concentrations. Chimneys are on average around 0.5 to 1 m high, which are significantly smaller than at Solwara 1. Most of the chimneys are Zn-rich, containing dull grey sphalerite, with a few of the chimneys sampled in the centre of the field, returning very high Cu. In total, 13 samples were taken (White *et al*., 2008).

9.5 Solwara 6

Sampling across the Solwara 6 chimney field identified numerous samples with high percentages of Cu, Zn and Au. The standing chimneys are thick in diameter (10’s of cm), several metres in height, have a weathered appearance, and are surrounded by similarly sized collapsed chimneys which form considerable rubble piles. A total of nine samples were taken from the Solwara 6 site, and assays reveal either zinc rich or copper rich samples (White *et al*., 2008).

9.6 Solwara 7

Solwara 7 is a very active chimney field with a huge variety of different chimney styles, ranging from tall and fragile black smokers to thick tree-trunk like formations. The chimneys occur in clusters of dozens of chimneys which are surrounded by large mounds of collapsed chimney rubble forming mounds several metres high in some places. Eleven samples were taken from the Solwara 7 site and high Au, Cu and Zn grades are reported, although Pb grades are generally lower (White et al., 2008).

9.7 Solwara 8

A total of thirty one samples were taken across the Solwara 8 chimney field, and assay results indicate that Solwara 8 has predominantly zinc-rich chimneys, although Au and Cu grades are also high in particular locations. In some of more heavily sedimented regions around the site, there were small mounds of what appeared to be old oxidized chimneys. However, these were not sampled due to their friable nature (White *et al*., 2008).

9.8 Solwara 9

Solwara 9 is on the south-west flank the North Su knoll at approximately 1,680 m BSL (Sant *et al.*, 2009). It comprises two zones, Solwara 9a and Solwara 9b approximately 220 m and 180 m long respectively with a width averaging 40 m. Solwara 9a consists of chimneys up to 17 m in height, some with minor black smoking vents; Solwara 9b consists of chimneys up to 10 m tall with rare grey-to-clear venting water. Seventeen chimney samples were collected by Nautilus and returned high precious and base metal grades (Table 9-1). The area surrounding the chimneys contained both sediment cover and blocky volcanic outcrop.

9.9 Solwara 10

Solwara 10 is located on the Manus Spreading Centre about 24 km SW of Solwara 2, at a depth of 2,240mBSL (Sant *et al*., 2009). It is situated on the flank of a knoll of volcanic with some lobate flows and zones of unconsolidated sedimentary cover. The deposit is approximately 680 m long and averages 110 m wide, and consists of chimneys up to 12 m tall with sulphide mound development of several metres thickness. No active venting has been observed. Thirteen chimney samples were collected by Nautilus and returned high base metal and elevated precious metal grades (Table 9-1).

9.10 Solwara 11

Solwara 11 consists of 9 separate pods of chimney clusters over an area of approximately 2.8 km x 2 km. Several of the pods comprise metal bearing chimney clusters including sulphide outcrops up to 10 m high protruding from a base of predominantly pillow basalts. These chimneys are generally Zn rich and there is no sulphide mound development. The chimney fields are largely inactive, although some minor hydrothermal venting has been observed. Two of the smaller pods lie on a separate structure over 1km to the west and contain iron-manganese oxides (Puzic, 2008; White *et al.*, 2010).

9.11 Solwara 12

A total of 10 samples were collected from Solwara 12, across the mapped chimney field. The results highlight very high Zn-Cu-Au-Ag-Pb assays. Three of the samples in the middle section of the system are high in Cu and show abundant chalcopyrite-bornite mineralisation. Zn-rich chimneys surround the copper-rich chimneys, and are comprised mainly of sphalerite mineralisation. Some of the Zn-rich chimneys are also rich in Pb. Both the Cu- and Zn-rich chimneys are highly anomalous in Ag and Au.

9.12 Solwara 13

Seven sulphide chimney samples were taken from Solwara 13. The results highlight very high Zn-Cu-Au-Ag-Pb assays. Three of the samples in the middle section of the system are high in Cu and show abundant chalcopyrite-bornite mineralisation. Zn-rich chimneys also occur in this filed, and are comprised mainly of sphalerite mineralisation. Some of the Zn-rich chimneys are also rich in Pb. Both the Cu- and Zn-rich chimneys are highly anomalous in Ag and Au (White *et al.*, 2010).

9.13 Solwara 14

Fourteen sulphide chimney samples were taken from Solwara 14a and 14b. The Cu and Zn rich chimney samples observed contain sphalerite- and chalcopyrite-rich sulphide mineralisation (White *et* al., 2010).

9.14 Solwara 15

No samples were collected from Solwara 15 due to operational problems, and its small size not justifying a return to this site at a later date. The chimneys at Solwara 15 appear to be sulphide rich of similar appearance to Solwara 14 (White *et al*., 2010).

9.15 Solwara 16

Six sulphide chimney samples were taken from Solwara 16. Mineralogical observations show them to consist of a matrix of sphalerite (40%) and pyrite (20%) euhedral crystals. Chalcopyrite (1-15%) occurs as either thin bands within sphalerite-pyrite zonations or as rims within minor, thin conduits and vugs. Sulphates were only observed in one sample as infill within minor vughs. Assay results for the six sulphide samples indicate high Zn and Cu. The samples also have anomalous precious metal grades (White *et al.*, 2010).

9.16 Solwara 17

Solwara 17 comprises a zone of oxidized outcropping sulphides, extensive algal mats and hydrothermal oxide coatings. The samples from Solwara 17 returned very low grades for all metals of interest except for Ag (White *et al*., 2010).

Mineralogical observations highlighted three chimney samples collected from the system are grouped into quartz rich (x1) and sulphate-rich (x2) hydrothermal precipitates. The quartz-rich material consists of very fine saccharoidal, intergrown, quartz crystals. The material is stained with Fe oxides except in a few 'fresh areas'. In some of the fresh areas fine sulphide growths within the quartz can be seen, probably pyrite (<1% abundance). The sulphate rich material is stained with both iron and manganese oxide coatings. Fresh material generally consists of a pale cream coloured mineral likely barite and/or anhydrite. Pyrite (4-30% abundance) is present as either aggregated masses in once cavities or as thin bands (1-2 mm). All the chimney samples collected from this system contained at least some pyrite but no copper, zinc or lead sulphides were observed.

9.17 Solwara 18

Solwara 18 comprises a zone outcropping sulphide-rich chimneys. Metal grades from the two samples collected at Solwara 18 are anomalous in Zn and Ag (White *et al.*, 2010). Mineralogical observations from these samples indicate the chimneys are sphalerite rich with Fe-Mn oxide crusts and porous internal mineral zonation.

Pyrite-silica banding is observed at the outer edges of the chimneys while silica banding is observed within the chimney centres. Major modal percentages include sphalerite (15-30%) and pyrite (15%). No chalcopyrite was visible in either of the samples.

9.18 Solwara 19

Solwara 19 comprises a small cluster (30 m by 50m) of sulphate rich chimneys. Samples show massive sulphate with minor Fe-Mn oxide coatings. Two chimney samples were assayed and both samples returned very low base metal grades, apart from one sample with 1.2 g/t Au (White *et al.*, 2010).

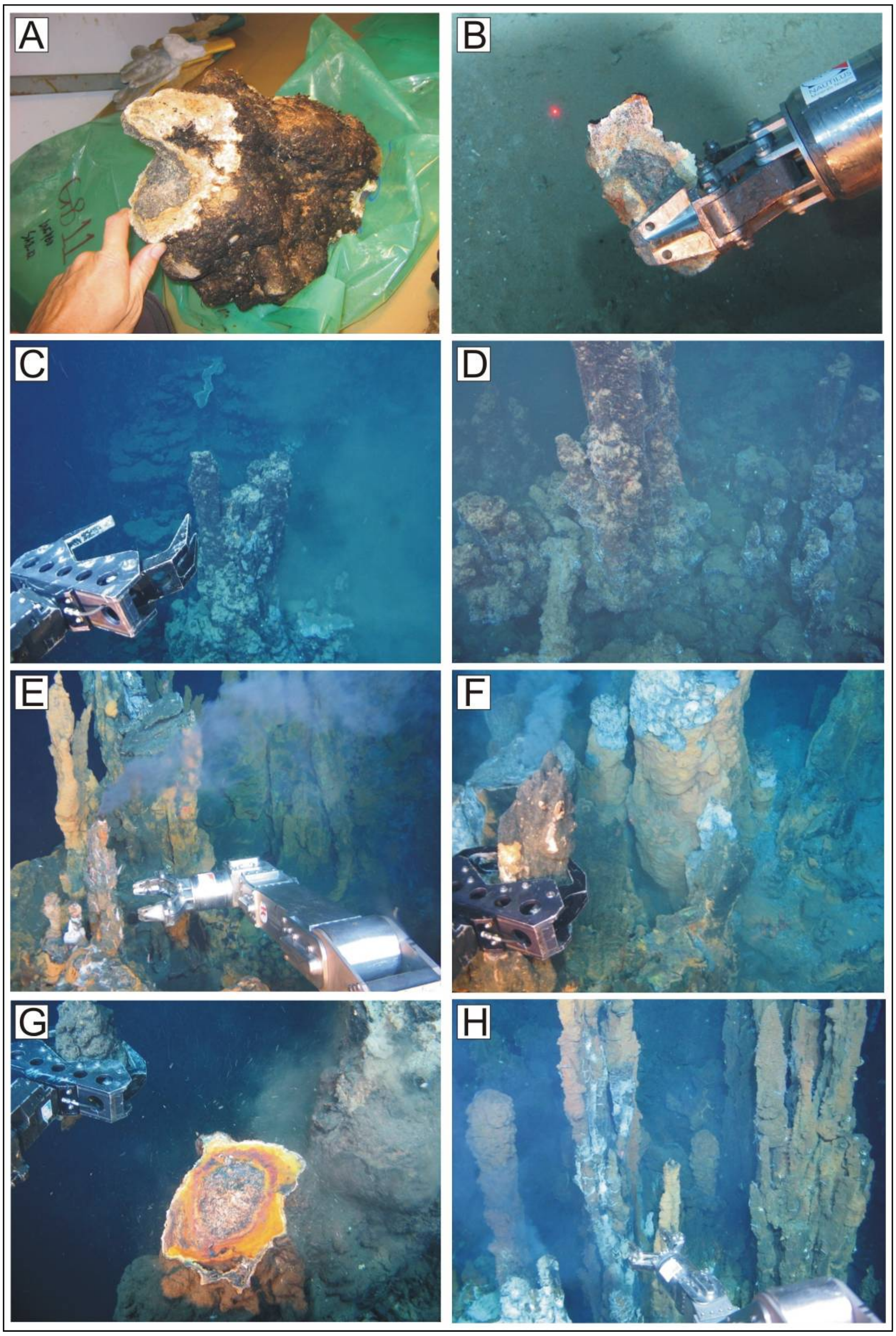

Figure 9-7: Examples of chimney fields sampled at Solwara sites 5 through 8

A & B = Solwara 5, C & D = Solwara 6, E & F = Solwara 7, G & H = Solwara 8

10. Exploration

10.1 Exploration Strategy

10.1.1 Overview

SMS deposits are formed where rising hot hydrothermal fluids mix with cold sea water at seafloor spreading centres, back-arc basins and along submarine volcanic arcs. The Bismarck Sea is a back-arc basin characterised by bimodal volcanics, which are common characteristics of terrestrial VHMS terranes. Nautilus applies the understanding of the formation of VHMS deposits to locate and map outcropping SMS systems in the Bismarck Sea.

Nautilus has a five step exploration strategy prior to development.

The steps are:

- Project Generation – Identify and secure title over the most prospective areas for SMS mineralisation.
- Target Generation – Identify and rank sufficient high quality targets to ensure new SMS systems can be discovered at a sufficient rate to provide continual growth options to Nautilus.
- Target Testing – Discover new SMS systems at a sufficient rate to provide continual growth options to Nautilus.
- Prospect Delineation – Focus resource evaluation work with mapping, sampling and geophysics.
- Resource Evaluation – Drilling, resource estimation, metallurgical test work and environmental impact statement.

At each stage of the process from 1 to 5, Nautilus assigns a prospectivity rank to each area to prioritise expenditure. This forms the “Project Pipeline’ (refer Figure 10-1).

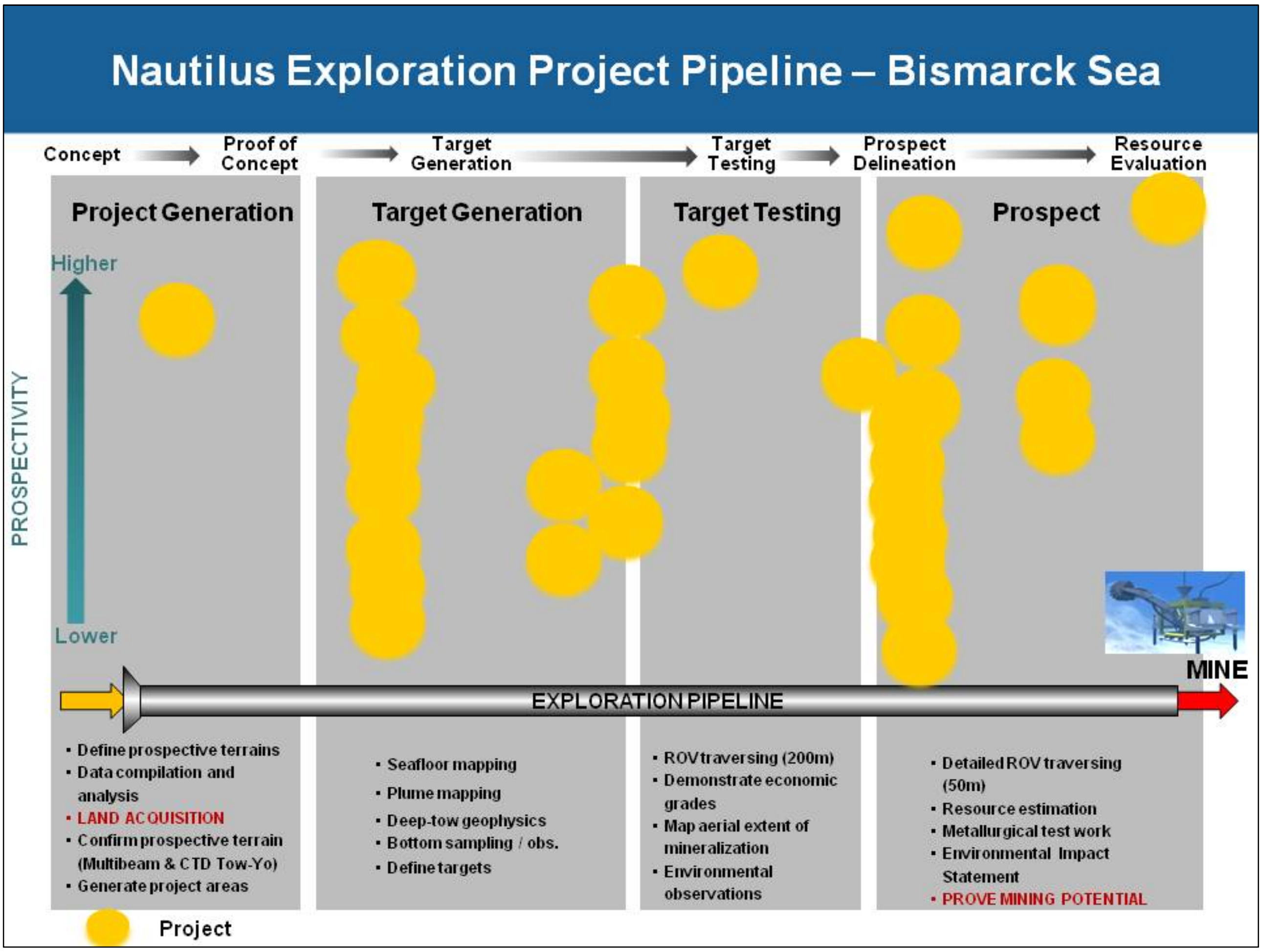

Figure 10-1: Nautilus Exploration Project Pipeline

10.1.2 Project Generation

Nautilus identifies features prospective for SMS within territorial waters and Economic Exclusive Zones (EEZ) of SW Pacific countries. These areas are under the jurisdiction of national exploration and mining laws, which avoids issues in international waters related to the lack of jurisdiction, lack of internationally ratified mining and exploration laws, and uncertain tenure status.

After identifying a prospective terrane, Nautilus conducts extensive literature searches of public-domain scientific reports and databases to identify historical research cruises that have occurred over the prospective areas. These cruises have largely been funded by international, governmental or scientific bodies, and have investigated several areas prospective for SMS deposits over the last 3 decades. Many features that are associated with the formation of SMS deposits were identified, including iron-oxide crusts, active hydrothermal vents, vent dispersion plumes in the water column, active volcanic complexes, as well as mapping the geology and structure of the seafloor. As part of these studies, samples of mineralised material have been recovered; although they are sampled for scientific research into mineralising processes and may not be in themselves representative of the grades of any mineralisation. Notwithstanding this, Nautilus has found these to be useful indicators of mineralisation, and follow-up dredging, grab sampling and scout drilling has returned values that are broadly similar in tenor to the values from the scientific programs. Based on the results of this research compilation, Nautilus applies for tenements covering the most prospective areas in territorial waters and associated Economic Exclusion Zones (EEZ).

10.1.3 Target Generation

Having secured tenure over prospective tenements, Nautilus generates larger project areas and smaller target areas for further consideration and investigation. SMS deposits are commonly present as raised sulphide mounds on the seafloor, with either fossil or active black smoker chimneys, which may be up to 20+ m in height.

Targets are identified by using regional geophysical and geochemical methods such as:

- Sidescan sonar.
- Multibeam bathymetry.
- Magnetics.
- 3D plume mapping (Eh, temperature, conductivity, turbidity).
- Water chemistry testing.

10.1.4 Target Testing

Possible SMS targets are confirmed by direct inspection by a Remotely Operated Vehicle (ROV) and physical sampling of seafloor rocks, which may use:

- ROV mapping using by video cameras on a systematic grid or traverse through the target area.
- Grab sampling from the ROV to select samples from the target area.
- Camera tows.

10.1.5 Prospect Delineation

Nautilus uses grid based mapping, sample collection, and ROV-based geophysical surveys such as electromagnetics and magnetics to define the approximate resource boundaries on the seafloor. These are used along with high-resolution bathymetry surveys.

10.1.6 Resource Evaluation

Nautilus progresses the best prospects to resource status by systematic resource drilling and sampling, followed by resource estimation. Detailed bathymetry and grid-based geophysics are used to define the resource boundaries, prior to drilling.

10.2 Exploration Potential

Of the 17 SMS systems identified to date in the Bismarck Sea, only Solwara 1 has been systematically drill tested. In early 2008, a NI43-101 compliant Mineral Resource was estimated for Solwara 1, based on the 2007 drilling programme. This drilling program did not drill the entire thickness of the SMS deposit due to drill rig limitations. Therefore further mineralisation potential is present immediately below the current Mineral Resource at many locations. Nautilus has constructed provisional thickness contours of the SMS deposit (Figure 10-2).

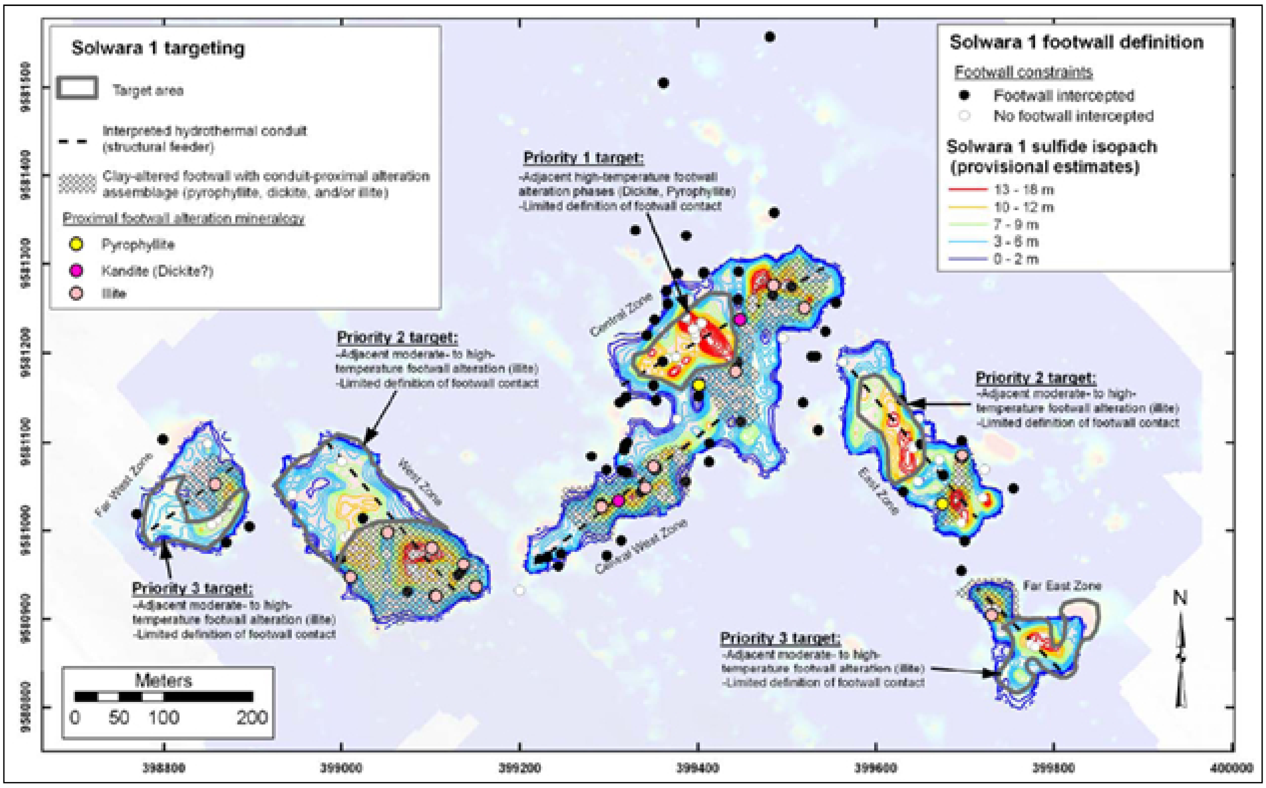

Figure 10-2: Solwara 1 exploration potential

In 2008, 22 extra drillholes were drilled within the bounds of MLA 154 at Solwara 1 and Solwara 5 to improve resource confidence, to test the Solwara 5 prospect for mineralisation at depth and to test selected electromagnetic anomalies around Solwara 1. This drilling resulted in the discovery of the North Zone near Solwara 1.

10.3 Exploration Success Rate

Previous marine scientific research and Nautilus' exploration have found systems which outcrop and are near hydrothermally active vents. This strategy has achieved a high rate of success in converting mineral exploration targets to mineralised prospects. Areas where hydrothermal activity is dormant or extinct have not yet been explored and these have further SMS potential.

Previous marine scientific research cruises and Nautilus' exploration programs have found several systems which outcrop that are proximal to hydrothermally active vents. The strategy to explore near areas of active hydrothermal and volcanic activity has achieved a high rate of success in converting mineral exploration targets to mineralised prospects. Areas where hydrothermal activity is dormant or extinct have not yet been explored and these have further SMS potential. Nautilus has had to date a high success rate, with the identification of one SMS occurrence for every four to five targets tested in the Bismarck Sea (Figure 10-3). The Bismarck Sea project areas have not been exhaustively explored and significant potential remains.

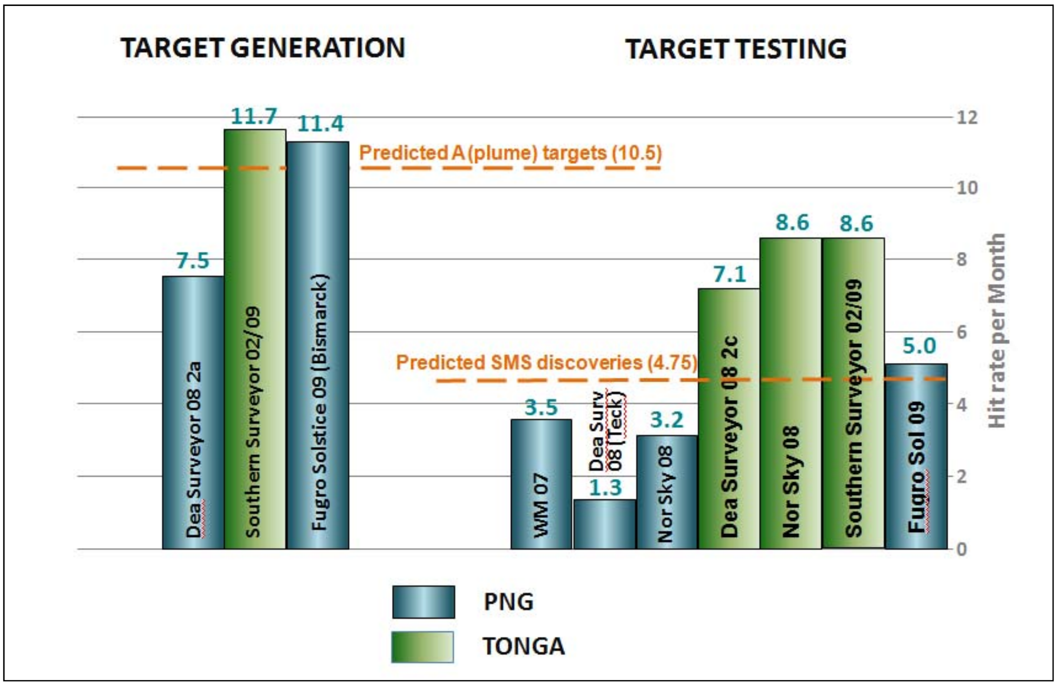

Figure 10-3: Nautilus 2008 and 2009 exploration success

10.4 Bismarck Sea Exploration Results

Since 2005 Nautilus Minerals and its partners, have commissioned nine exploration cruises to the Bismarck Sea. These cruises have contributed to the discovery and improved understanding of 16 SMS systems (Solwara 1 to 14, Solwara 16, Solwara 18); plus Solwara 17 and Solwara 19 from which only weakly anomalous sulphate samples were taken, and Solwara 15 where samples were not retrieved.

In 2005, the *MV Genesis* was used to: map the seafloor around Solwara 1 (SuSu Knolls) and Solwara 4 (Pacmanus); dredge up samples from the Solwara 1 deposit; and trial a range of geophysical techniques over the Solwara 1 mineralisation. This *MV Genesis* cruise provided: an excellent base-map from which to plan further exploration; confirmed the abundance of high grade mineralisation reported previously by academic researchers; and provided an understanding of the most applicable geophysical tools required for mapping SMS mineralisation.

In 2006, the *DP Hunter* was used to more systematically sample the Solwara 1 mineralisation and to test the thickness of the mineralisation by trialling a derrick-based drilling system. The *DP Hunter* ROV samples confirmed the surface distribution of high grade mineralisation at Solwara 1 and the drilling, (despite poor recoveries and difficulties keeping the holes open), confirmed mineralisation down to at least 18 m depth.

In 2006, the *RV Melville*, in collaboration with the Woods Hole Oceanographic Institute, was used to sample Solwara 2, Solwara 3 and Solwara 4; plus trial the ABE autonomous underwater vehicle and its geophysical payload over Solwara 1 and several other exploration targets. The *RV Melville* samples confirmed the widespread distribution of high-grade mineralisation across multiple settings in the Manus Basin. The data acquired using ABE demonstrated the high potential of AUVs to improve the efficiency of exploration programs.

In 2007, the *MV Aquila* was used to generate exploration targets over larger areas of prospective seafloor using a deep tow side scan system and various other exploration tools. The *MV Aquila* data generated numerous exploration targets and base-maps, which continue to contribute to Nautilus exploration effort.

In 2007, the *MV Wave Mercury* was used to: collect additional samples from Solwara 1 using an ROV; carry out drilling at Solwara to further test the depth extent of the deposit (see drilling section below); to test a variety of exploration targets across the Bismarck Sea; and to conduct the world's first commercial electromagnetic survey over an SMS system.

The *MV Wave Mercury* target testing resulted in the discovery of four new high-grade SMS systems (Solwara 5, Solwara 6, Solwara 7 and Solwara 8). The drilling program resulted in the world's first NI43-101-compliant resource estimate at Solwara 1. The electromagnetic system worked well, successfully delineating shallow, high-grade copper sulphide mineralisation at Solwara 1.

In 2008, the *MV Nor Sky* was used to collect additional samples, expand upon the electromagnetic surveys conducted at Solwara 1 and Solwara 4 and test more exploration targets by geological traversing. In addition, a number of scout drillholes where completed several prospects (see drilling section below). The *MV Nor Sky* work resulted in the discovery of two more high-grade SMS systems (Solwara 9 and Solwara 10) plus a new zone of mineralisation to the north of Solwara 1 (Far North Zone).

In 2008, the *MV Sepura* was used by exploration partner, Teck Resources, to map the previously unmapped seafloor of the Willaumez Rise and Willaumez Spreading Centre, west of the Manus Basin. The *MV Sepura* data enabled a reassessment of the prospectivity of this previously neglected area of the Bismarck Sea.

In 2008, the *MV Dea Surveyor* was used by Nautilus' then exploration partner, Teck Resources, to: trial a continuous water-column geochemistry technique to generate targets; and target testing work using the small ROV onboard. The *MV Dea Surveyor* water-column geochemical data proved successful in focusing the subsequent follow-up ROV exploration in the Willaumez area, resulting in the discovery of the high-grade Solwara 11 SMS system.

In 2009, the *MV Fugro Solstice* was used to: generate targets using the water-column geochemistry technique; test the targets using an ROV; and then delineate several SMS prospects with geophysical surveys using an ROV. The *MV Fugro Solstice* cruise resulted in the discovery of an additional five high-grade SMS discoveries (Solwara 12, Solwara 13, Solwara 14, Solwara 16 and Solwara 18); plus an SMS system which was not sampled (Solwara 15) and two other potential SMS prospects that cannot yet be classified as true SMS systems as surface grab samples consist of weakly anomalous sulphate (Solwara 17 and Solwara 19).

10.4.1 Solwara 1 Dredging March 2005 (*MV Genesis*)

An account of the dredge sampling at Solwara 1 can be found in Jankowski and Hodkiewicz (2006).

10.4.2 Solwara 1 Grab Sampling March 2006 (*DP Hunter*)

During the early 2006 cruise of the *DP Hunter*, the previously discovered Solwara 1 prospect was investigated. A total of 51 grab samples were taken from identified chimneys, both active black smokers and extinct chimneys. The position of each sample was recorded at the time of sampling. The sample assay results (**Table 10-1**)are broadly similar in grade tenor to the dredge sampling previously undertaken, with the average of each mound returning significant polymetallic grades.

Table 10-1: Assay results from Solwara 1 grab sampling, March 2006

Mound	Samples	Cu (%)	Zn (%)	Ag (ppm)	Au (ppm)
Binns	10	13.84	2.79	134	14.63
Full agar	6	5.20	3.49	123	14.24
Kowalczyk	13	10.93	5.30	125	19.47
Williamson	14	5.80	7.13	169	12.43
Others	8	9.94	4.13	103	12.41
All	**51**	**9.26**	**4.91**	**136**	**14.66**

10.4.3 Solwara 2 and 3 Grab Sampling July 2006 (*RV Melville*)

During the July 2006 Magellan 2006 cruise of the *RV Melville*, the previously discovered hydrothermal vent fields at Vienna Woods (Solwara 2), Tufar 2 (Solwara 3) and Tufar 3 and surrounding areas of EL1383 were investigated (Tivey *et al.*, 2006).

To define targets, ABE (the Autonomous Benthic Explorer) traversed parts of EL1383, both the known targets and surrounding areas; ABE has the ability to follow track lines with a repeatability of 10 m line-spacing or better.

ABE is equipped with the following sensors:

- SIMRAD SM2000 200 kHz multibeam sonar.
- Imagenex 675 kHz scanning sonar.
- 3-component Develco fluxgate magnetometer.
- 2 SeaBird 9/11+ Conductivity-Temperature-Depth sensor.
- SeaPoint optical backscatter sensor.
- digital still camera imaging system.
- Eh meter.

Targets were defined by either seafloor topography, water column temperature anomalies or Eh anomalies. At the 50-200 m flying height above seafloor, the seafloor topography corresponding to the model of sulphidic vent zones (high relief with narrow chimneys up to 20m high) was identified, as well as negative seawater Eh or positive temperature anomalies that may correspond to the dispersion plume of an active black smoker.

The targets defined were investigated by traverses by the ROV *Jason.* Chimney fields were discovered at the Solwara 2 and 3 prospects, and two unnamed areas 2 and 10km to the NE. A total of 68 grab samples were collected using the ROV sampling claw of the Jason and retrieved to the surface for description, sampling and analysis. The assay results of these samples are tabulated in **Table 10-2**; the sample locations are shown in Figure 10-4.

Table 10-2: Solwara 2 and 3 grab sampling results July 2006

Prospect	Number of Samples	Cu (%)	Pb (%)	Zn (%)	Ag (ppm)	Au (ppm)
Solwara 2	37	1.3	0.2	22.8	226	6.2
Solwara 3	26	1.3	1.1	22.4	488	15.4
NE areas	5	0.3	2.6	14.9	1476	13.6

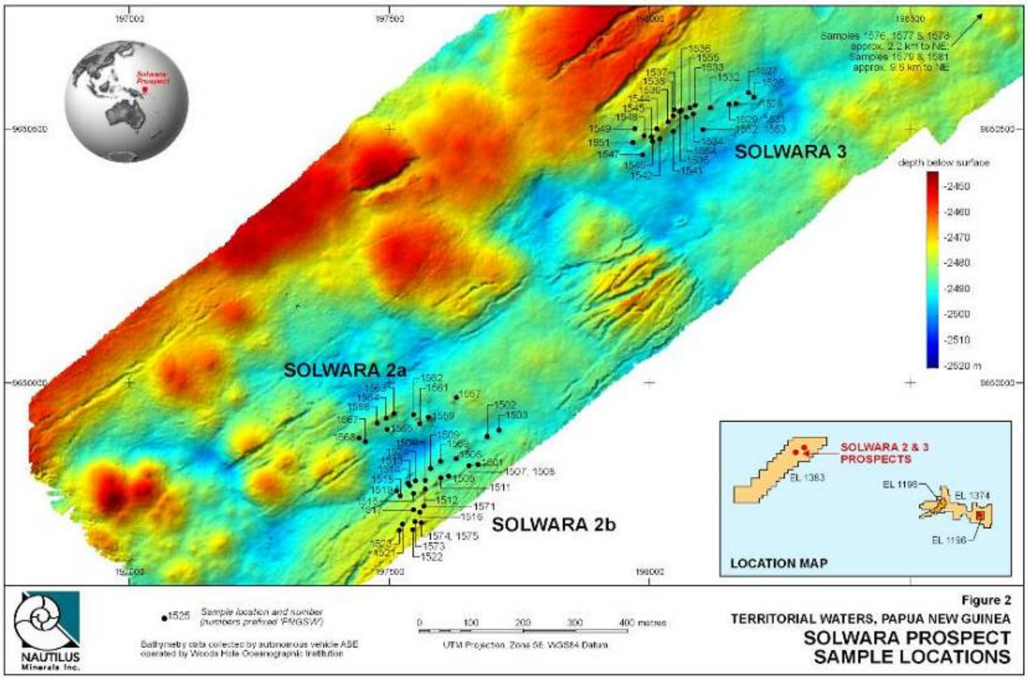

Figure 10-4: Sample location of Solwara 2 and 3 prospects, EL1383

10.4.4 Solwara 4 Grab Sampling August 2006 (*RV Melville*)

After the July 2006 sampling at Solwara 2, Solwara 3 and surrounding areas of EL1383, underwater mapping and ROV sampling were also carried out at the Solwara 4 prospect. Further sampling at Solwara 1 was also completed, and reported in Jankowski and Hodkiewicz (2006). A relatively small number of samples were acquired from each area at Solwara 4 (**Table 10-3**); the results confirm the broad grade tenor of previous scientific sampling as well as the prospectivity of the area (Tivey *et al.*, 2006).

Table 10-3: Solwara 4 grab sampling results, including duplicates, August 2006

Prospect	Number of Samples	Cu (%)	Pb (%)	Zn (%)	Ag (ppm)	Au (ppm)
Solwara 4a	3	15.1	0.8	25.9	584	5.4
Solwara 4b	6	5.2	2.3	26.9	310	14.8
Solwara 4c	6	25.4	0.4	11.6	121	21.1
Solwara 4d	3	7.3	1.5	46.1	451	2.5
Solwara 4e	14	10.6	0.4	18.4	221	8.9
Solwara 4f	1	0.8	0.2	62.2	251	66.5
NE Pual	1	6.6	0.3	41.1	396	19.0

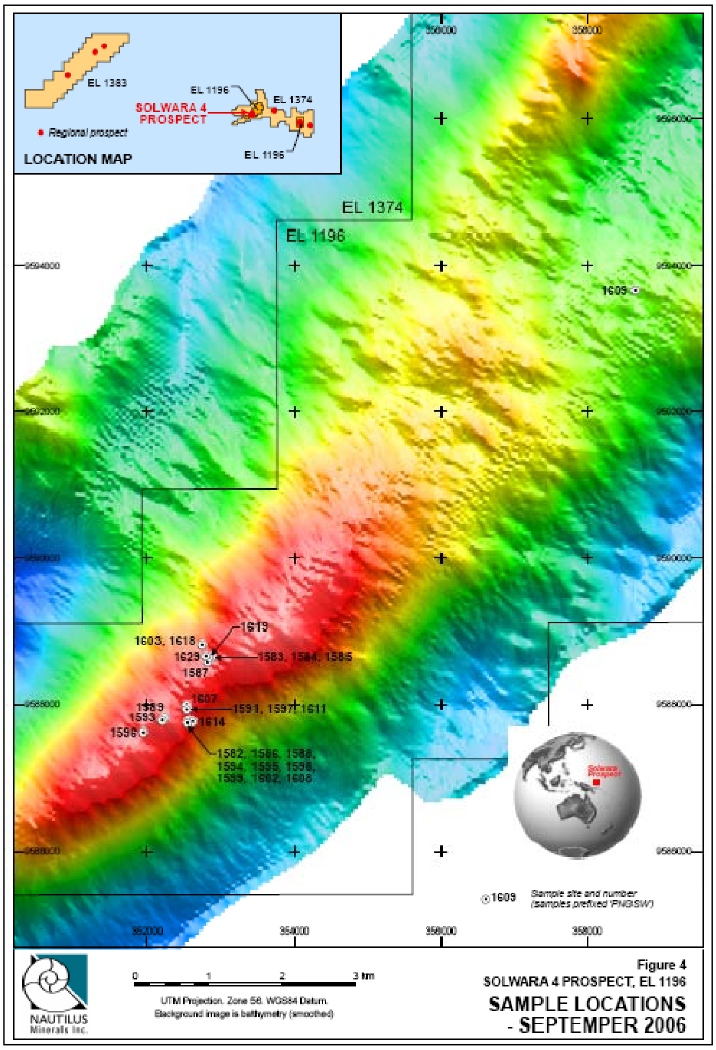

Figure 10-5: August 2006 grab sampling locations and bathymetry, Solwara 4

10.4.5 Solwara 1 and 5 through 8 Grab Sampling 2007 (*MV Wave Mercury*)

An underwater mapping and ROV sampling campaign was undertaken in 2007 (White *et al.*, 2008) across numerous targets identified from historic surveys. The program identified four new chimney fields. A total of 159 grab samples were collected from Solwara 1, 5, 6, 7 and 8; the average sample grades are presented in **Table 10-4**; sample statistics for each prospect are in **Table 10-5** to **Table 10-9**.

Surface samples from Solwara 1 were used for resource estimation and metallurgical testing. The samples collected at Solwara 1 were in addition to those sampled pre-2007 and reported in Jankowski and Hodkiewicz (2006).

Table 10-4: Average grades of 2007 grab samples from Solwara 1, 5, 6, 7 and 8

Area	Count	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Solwara 1	96	11.4	1.7	7.4	253	18.7
Solwara 5	12	6.0	1.6	8.3	282	14.6
Solwara 6	9	13.4	0.6	15.2	191	19.2
Solwara 7	11	3.7	1.2	15.6	261	10.9
Solwara 8	31	10.1	1.4	19.7	205	13.4

Table 10-5: Sample statistics of 2007 grab samples from Solwara 1

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	96	96	96	96	96
Minimum	0.04	0.03	0.03	14	0.01
Maximum	31.3	12.75	35.3	1230	56.3
Mean	11.44	1.68	7.38	253	18.72
Median	12.53	0.67	3.355	175	17.75
SD	8.53	2.76	9.29	243	12.48
CV	0.75	1.65	1.26	0.96	0.67

Table 10-6: Sample statistics of 2007 grab samples from Solwara 5

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	12	12	12	12	12
Minimum	0.08	0.10	0.46	99	0.01
Maximum	24.7	9.16	17.1	977	48.8
Mean	5.96	1.59	8.27	282	14.64
Median	0.16	0.85	7.36	203.5	10.68
SD	8.96	2.48	5.37	242	16.12
CV	1.50	1.56	0.65	0.86	1.10

Table 10-7: Sample statistics of 2007 grab samples from Solwara 6

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	9	9	9	9	9
Minimum	0.15	0.07	1.7	70	4.18
Maximum	34	1.65	34.3	345	55.7
Mean	13.37	0.57	15.15	191	19.16
Median	4.35	0.28	5.68	158	12.95
SD	14.58	0.56	14.19	88	15.39
CV	1.09	0.99	0.94	0.46	0.80

Table 10-8: Sample statistics of 2007 grab samples from Solwara 7

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	11	11	11	11	11
Minimum	0.005	0.04	0.02	0.5	0.02
Maximum	18.5	6.16	43.1	823	39.3
Mean	3.74	1.19	15.61	261	10.92
Median	0.28	0.68	12.1	162	4.84
SD	6.25	1.76	14.79	274	14.88
CV	1.67	1.48	0.95	1.05	1.36

Table 10-9: Sample statistics of 2007 grab samples from Solwara 8

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	31	30	31	31	31
Minimum	0.06	0.01	0.02	0.5	0.01
Maximum	34	7.78	50.7	702	64.8
Mean	10.05	1.37	19.68	205	13.39
Median	6.03	0.61	18.55	170	9.47
SD	10.10	1.90	14.75	171	14.83
CV	1.00	1.39	0.75	0.83	1.11

10.4.6 Solwara 1 Sampling Method Comparison

As a test of the usefulness of the varying sampling methods for identifying prospectivity, the average grades of the grab sampling from scientific cruises (Binns, 2004), February 2005 dredge sampling, and 2006, 2007 and 2008 grab sampling of Solwara 1 have been compared. Note that none of these three sampling methods is considered adequate for a resource estimate, and the scientific samples are potentially highly biased, given that they are very selectively sampled for scientific purposes only and not for estimating average grade of mineralisation. The core drilling has not been included in his comparison, as it is testing mineralisation in the SMS mound rather than the emergent black smoker chimneys.

The comparison (Table 10-10) shows that although there are differences in the average grades of the different types of sampling, all of them return broadly similar grade tenors.

Table 10-10: Comparison of Solwara 1 2005 to 2008 sampling campaigns

Sample Method	Samples	Cu (%)	Pb (%)	Zn (%)	Ag (ppm)	Au (ppm)
Scientific (pre-2005)	34	12.80		2.90		22.00
Dredge (2005)	45	10.80		3.65	224	13.70
Grab (2006)	51	9.26		4.91	136	14.66
Grab (2007)	96	11.40		7.40	253	18.70
Grab (2008)	9	12.06	0.65	4.04	165	23.47

10.4.7 Seafloor Mapping and Target Generation (*MV Aquila* 2007)

Nautilus used sidescan imaging techniques for seafloor mapping and targeting of SMS deposits in the Bismarck and Woodlark Seas of PNG in 2007. Sidescan imaging is analogous to black and white aerial photography as historically used by land explorers in outcropping areas. As such, a suitably resolved image of the seafloor enables the interpreter to recognize outcrop, important structural controls on mineralisation and even the rubble and chimneys associated with chimney fields themselves (Lowe, 2007). Any changes in texture and absorption can also assist with lithological mapping and relative dating and intensity of volcanic activity.

The primary objectives of the *MV Aquila* 2007 Cruise was to:

- Identify potential SMS sites.
- Undertake seafloor mapping and target generation of highest priority structural terrains in the Bismarck Sea.
- Upgrade the exploration potential of the Woodlark Sea.
- Make the exploration process efficient with respect to cost and manpower required.
- Demonstrate faster and cheaper discovery costs than land based exploration.

Approximately 415 targets were generated from the Aquila 2007 survey, and some of these were subsequently investigated as part of the Wave Mercury exploration program (documented in White *et al.*, 2008).

10.4.8 Solwara 1 and Solwara 5 EM Survey 2007 (MV *Wave Mercury*)

During the 2007 Bismarck Sea campaign, Nautilus successfully trialled and then deployed the Ocean Floor Geophysics's (OFG) Ocean Floor Electromagnetic (OFEM) system over Solwara 1 and Solwara 5. Both the Solwara 1 and Solwara 5 deposits returned strong EM anomalies. An account of this program is presented in Lipton (2008).

Figure 7-5 presents the conductive areas of the Solwara 1 2007 OFEM Survey, with respect to the bathymetry of the Solwara 1 mound, and together with the cross-section in Figure 9-2: illustrates how well the OFEM responded to the shallow copper-rich mineralisation as defined by the 2006 and 2007 drilling campaigns. Several lesser anomalies were detected away from the known sulphide accumulations. Drill testing is required to determine if they represent:

- Higher resistivity base metal mineralisation (lower sulphide concentration or less favourable sulphide texture).
- Similar massive sulphide mineralisation that is beneath shallow non-conductive overburden (volcanic or sediment).
- Instrument noise.

Despite uncertainties with regards to the exact nature of minor EM responses, it is clear that the technique detects accumulations of copper rich massive sulphide material, and can be considered an effective exploration tool for near surface copper-rich SMS mineralisation.

10.4.9 Solwara 1 and Solwara 4 EM Survey 2008 (*MV Nor Sky*)

In August and September 2008 a ROV-mounted electromagnetic (EM) survey was carried out over the Solwara 1 and Solwara 4 areas (figure 10-6) along with multibeam, forward looking sonar, hydrophone, sub bottom profiler and magnetometers (Solwara 4 only) (Sant *et al.*, 2009). ROV traverses on a regular grid were conducted across the prospective areas of interest. Approximately 372 km of traverses were completed. The Solwara 1 and 4 deposits returned strong EM anomalies; a highlight of this program was the discovery of Solwara 9 which was defined during the EM survey.

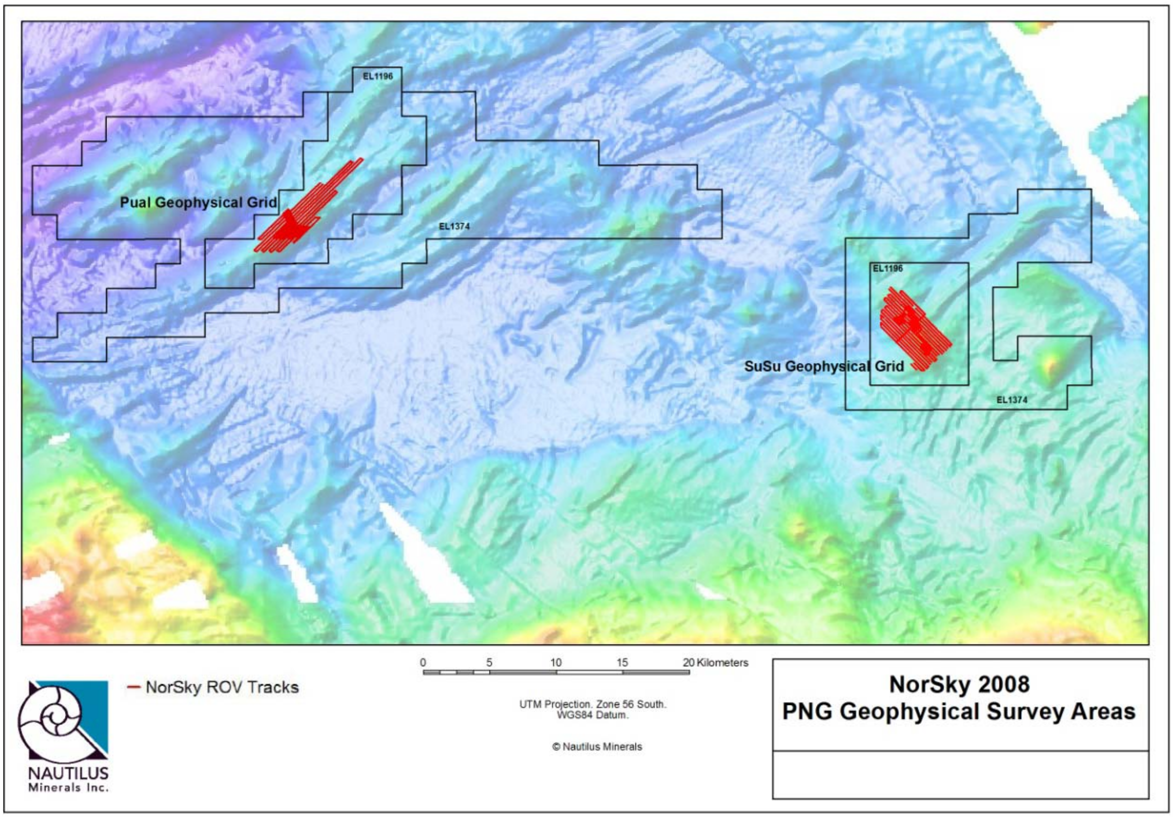

Figure 10-6: MV Nor Sky 2008 geophysical grid areas

10.4.10 Teck Bismarck Sea Target Generation 2008 (MV Sepura*)*

During April 2008 an extensive multibeam bathymetry and backscatter survey was completed by Teck using a pole mounted multibeam system. The cruise collected 10082 km^2 of data over previously unmapped seafloor in the Willaumez Spreading Centre and Willaumez Rise project areas in the West Bismarck Sea (Figure 10-7). The data collected enabled a reassessment of the prospectivity of these previously under-explored areas (Jansen, 2008).

10.4.11 Teck Bismarck Sea Plume Survey 2008 (*MV Dea Surveyor)*

In May and June 2008 Teck carried out an extensive plume hunting survey of the Bismarck Sea tenements (Puzic & Massoth, 2008). The plume survey used a towed underwater sensor array that measures water conductivity, temperature, pressure and turbidity. Approximately 1,540 line kilometres of survey were conducted within an area of 575 km by 160 km (Figure 10-7). This was the most complete assessment of plume activity within the Bismarck Sea up to mid 2007, and gave Nautilus several target areas for follow up. Solwara 10 and Solwara 11 were discovered by following up plume anomalies discovered during this cruise.

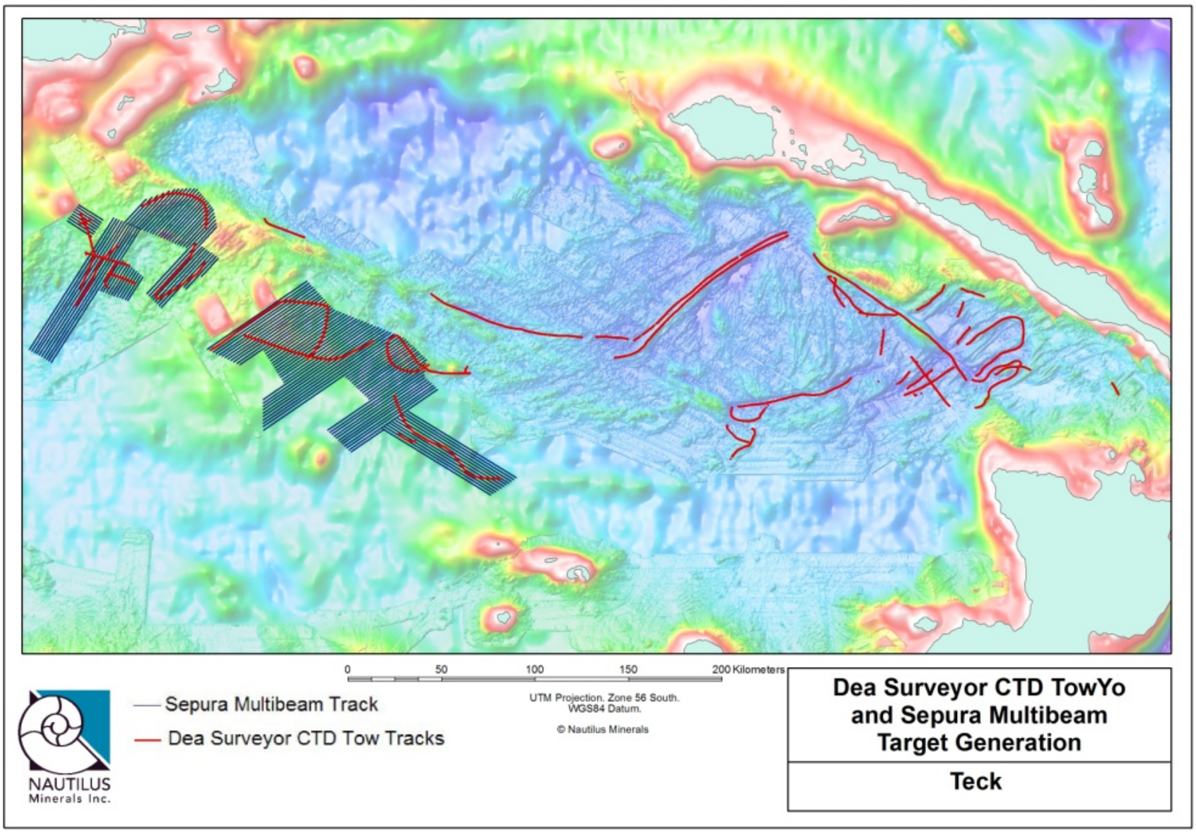

Figure 10-7: *MV Sepura* Multibeam Target Generation and *MV Dea Surveyor* CTD Tow Yo Lines

10.4.12 Solwara 1, 2a, 9 and 10 Grab Sampling 2008 (*MV Nor Sky*)

An underwater mapping and ROV sampling campaign was undertaken in 2008 across two newly identified SMS prospects, Solwara 9 and Solwara 10 (Sant et al., 2009). Samples were taken from fossil chimneys and are tabulated in Table 10-11 and Table 10-12. The previously identified prospects Solwara 1 and Solwara 2a were also revisited; grab sample results are tabulated in Table 10-13 and Table 10-14.

Table 10-11: Average grades of 2008 grab samples from Solwara 9

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	17	17	17	17	17
Minimum	0.07	0.34	1.71	55	3.11
Maximum	24.6	3.15	21.9	550	47.3
Mean	6.34	1.50	10.56	296	19.91
Median	1.40	1.07	11.45	258	15.20
SD	7.99	0.95	6.46	147.81	13.33
CV	1.26	0.63	0.61	0.50	0.67

Table 10-12: Average grades of 2008 grab samples from Solwara 10

Area	Cu (%)	Pb (%)	Zn (%)		
Count	13	13	11	13	13
Minimum	0.05	0.01	0.1	4	0.09
Maximum	21.6	0.72	28.1	734	10.15
Mean	7.09	0.13	7.45	152	2.31
Median	1.61	0.02	1.20	44	1.32
SD	7.99	0.22	9.87	228.3	3.13
CV	1.13	1.68	1.33	1.50	1.35

Table 10-13: Average grades of 2008 grab samples from Solwara 1

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	9	9	9	9	9
Minimum	0.1	0.1	0.06	106	10.5
Maximum	32.1	1.25	7.67	291	53
Mean	12.06	0.65	4.04	165	23.47
Median	12.35	0.50	4.13	150	19.15
SD	10.24	0.41	2.64	57.8	12.53
CV	0.85	0.63	0.65	0.35	0.53

Table 10-14: Average grades of 2008 grab samples from Solwara 2a

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	7	7	6	7	7
Minimum	0.03	0.04	0.27	10	0.34
Maximum	1.87	0.38	34.6	824	31.4
Mean	1.01	0.20	24.10	275	9.73
Median	0.86	0.14	29.15	147	6.29
SD	0.63	0.13	12.56	282.7	10.48
CV	0.62	0.65	0.52	1.03	1.08

10.4.13 Solwara 11 Grab Sampling 2008 0 – Teck Cominco Inc (MV Dea Surveyor)

An underwater mapping and ROV sampling campaign was undertaken by Teck 2008 at several target areas, including the newly-discovered Solwara 11 deposit in the Willaumez area (Puzic, 2008). Pieces of sulphide chimneys averaging 1.4 kg were collected by the ROV. Sample selection targeted material that was considered representative of the SMS system. Representative sub-samples for analysis were taken from the larger samples using either a hammer or rock saw. The results are tabulated in Table 10-15.

Table 10-15: Average grades of 2008 grab samples from Solwara 11

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	17	17	17	17	17
Minimum	0	0	0.1	6	0
Maximum	23.8	12.7	46.6	471	2.1
Mean	1.73	1.32	9.40	213	1.06
Median	0.20	0.50	3.80	236.	1.20
SD	5.70	3.04	13.26	155.1	0.71
CV	3.30	2.31	1.41	0.73	0.67

10.4.14 Bismarck Sea Target Generation 2009 (*MV Fugro Solstice*)

In August to October 2009 Nautilus Minerals carried out an extensive multibeam and plume hunting survey of the Bismarck Sea tenements (Figure 10-8) (White *et al.,* 2009). The plume survey used a towed underwater sensor array that measures water conductivity, temperature, depth, turbidity, and Eh. High resolution multibeam data was collected over a total area of 7,335 km^2 and 1143 line kilometres of plume surveying was completed. Water samples were collected using a Niskin bottle rosette and tested for pH and helium-3. The samples were also filtered onto membranes to collect particulates for multi-element analysis (Table 10-15). A total of 24 new water column anomalies were identified. Solwara 12, 13, 14, 15, 16 and 18 were discovered by following up these anomalies. Solwara 17 and 19 were also discovered during this cruise by following up other geomorphological targets.

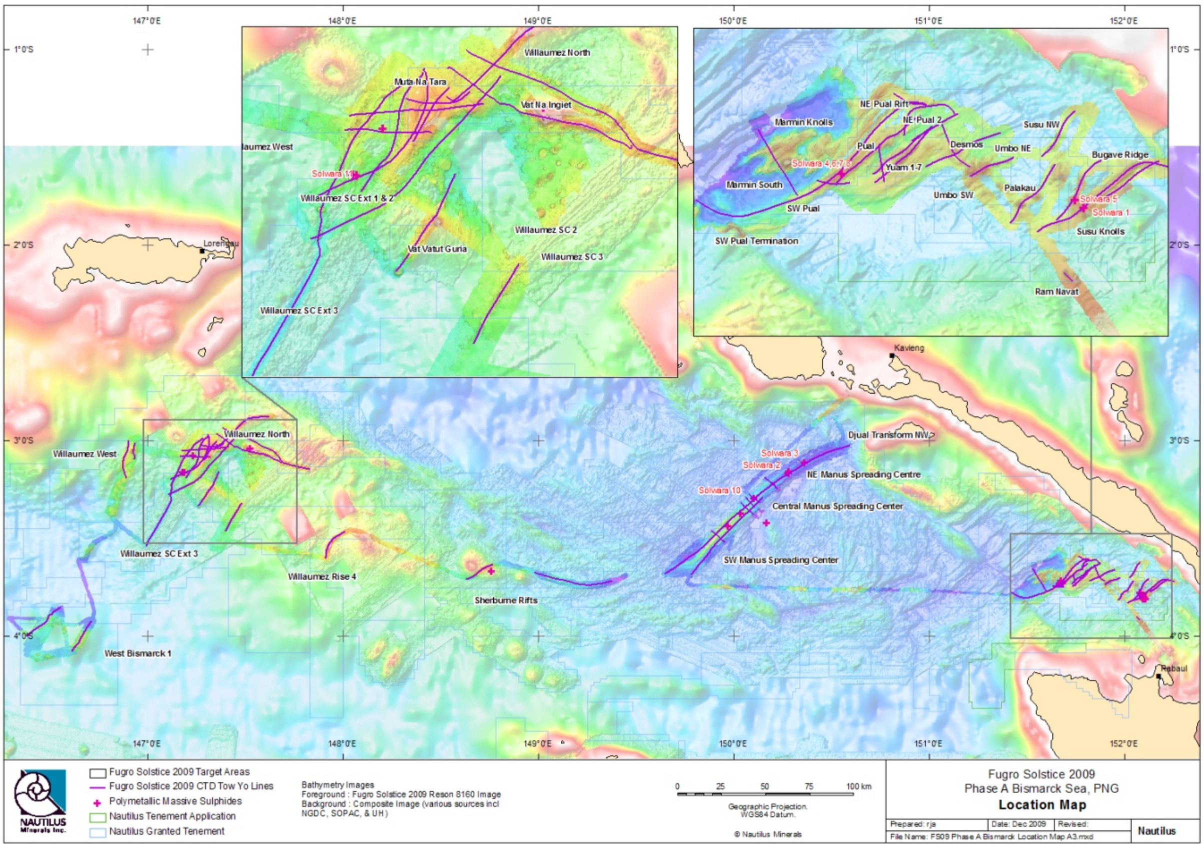

Figure 10-8: *MV Fugro Solstice* Multibeam Target Generation *and* CTD Tow Yo Lines

Table 10-16: 2009 Solwara water sample filtrate results

	Cu (nM/L)	Zn (nM/L)	(Fe nM/L)
Count	47	47	47
Minimum	0.147	0.117	6.199
Maximum	13.169	30.878	1041.240
Mean	1.335	3.006	187.564
Median	0.561	0.900	115.395
Standard Deviation	2.301	5.919	229.281
Coefficient of Variation	1.723	1.969	1.222

10.4.15 Solwara 11i to 14, 16 to 19 Grab Sampling 2009 (*MV Fugro Solstice*)

In late 2009, an underwater mapping and ROV sampling campaign was undertaken across nine newly identified SMS prospects, Solwara 11i and Solwara 12 to 19 (White *et al.,* 2010).

10.4.15.1 Solwara 11i Grab Sampling (*MV Fugro Solstice*)

Two chimney samples were collected from Solwara 11i (refer toFigure 10-9). Both samples were of high grade zinc mineralisation.

Table 10-17: Average grades of 2009 grab samples from Solwara 11

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	2	2	2	2	2
Minimum	0.677	0.366	25.400	90	0.98
Maximum	0.692	0.453	52.000	133	2.18
Mean	0.685	0.410	38.700	112	1.58

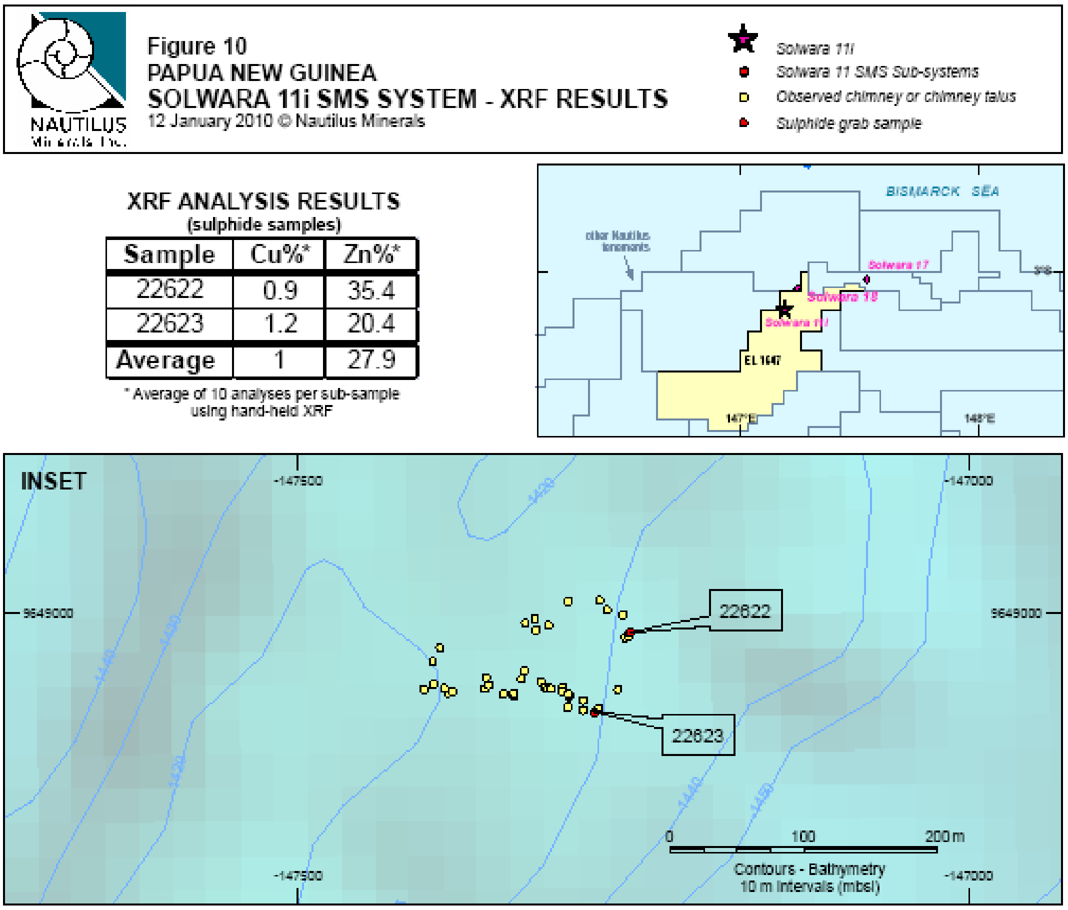

Figure 10-9: *MV Fugro Solstice* 2009 Grab Samples – Solwara 11i

10.4.15.2 Solwara 12

A total of 10 chimney samples were collected from Solwara 12 (Table 10-18, Figure 10-10). The chimney samples are massive sulphide, either sphalerite-rich zinc types, or bornite-chalcopyrite rich copper types and are very high in Zn-Cu-Au-Ag-Pb. The assay results for are summarised in Table 10-18. Three of the samples in the middle section of the system are high in Cu with abundant chalcopyrite-bornite mineralisation. Zn-rich chimneys surround the copper-rich chimneys, and are comprised mainly of sphalerite mineralisation. Some of the Zn-rich chimneys are also rich in Pb; both the Cu- and Zn-rich chimneys are highly anomalous in Ag and Au.

Table 10-18: Average grades of 2009 grab samples from Solwara 12

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	10	10	10	10	10
Minimum	0.006	0.095	3.420	186	0.00
Maximum	32.400	12.700	52.000	682	39.70
Mean	6.998	3.543	22.617	425	13.69

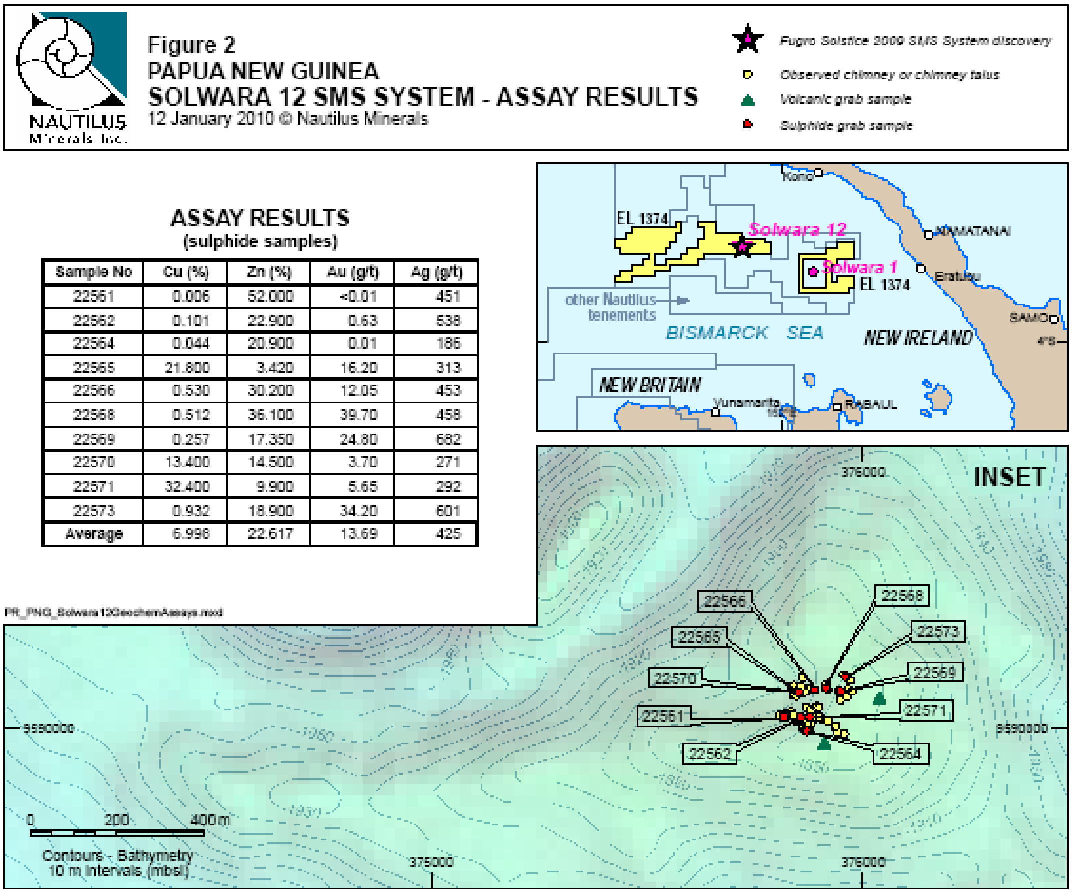

Figure 10-10: *MV Fugro Solstice* 2009 Grab Samples – Solwara 12

10.4.15.3 Solwara 13

Seven chimney samples were collected from Solwara 13. The results highlight very high Zn-Cu-Au-Ag-Pb assays (**Table 10-19**). Three of the samples in the middle section of the system are high in Cu (up to 28.0%) and show abundant chalcopyrite-bornite mineralisation. Zn-rich chimneys (up to 52.6%) also occur in this filed, and are comprised mainly of sphalerite mineralisation. Some of the Zn-rich chimneys are also rich in Pb (up to 11.45%). Both the Cu and Zn-rich chimneys are highly anomalous in Ag (up to 1550 g/t) and Au (up to 9.23 g/t).

Table 10-19: Average grades of 2009 grab samples from Solwara 13

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	7	7	7	7	7
Minimum	0.131	0.211	7.580	105	0.03
Maximum	28.000	11.450	52.600	1550	9.23
Mean	9.136	3.267	30.726	546	4.72

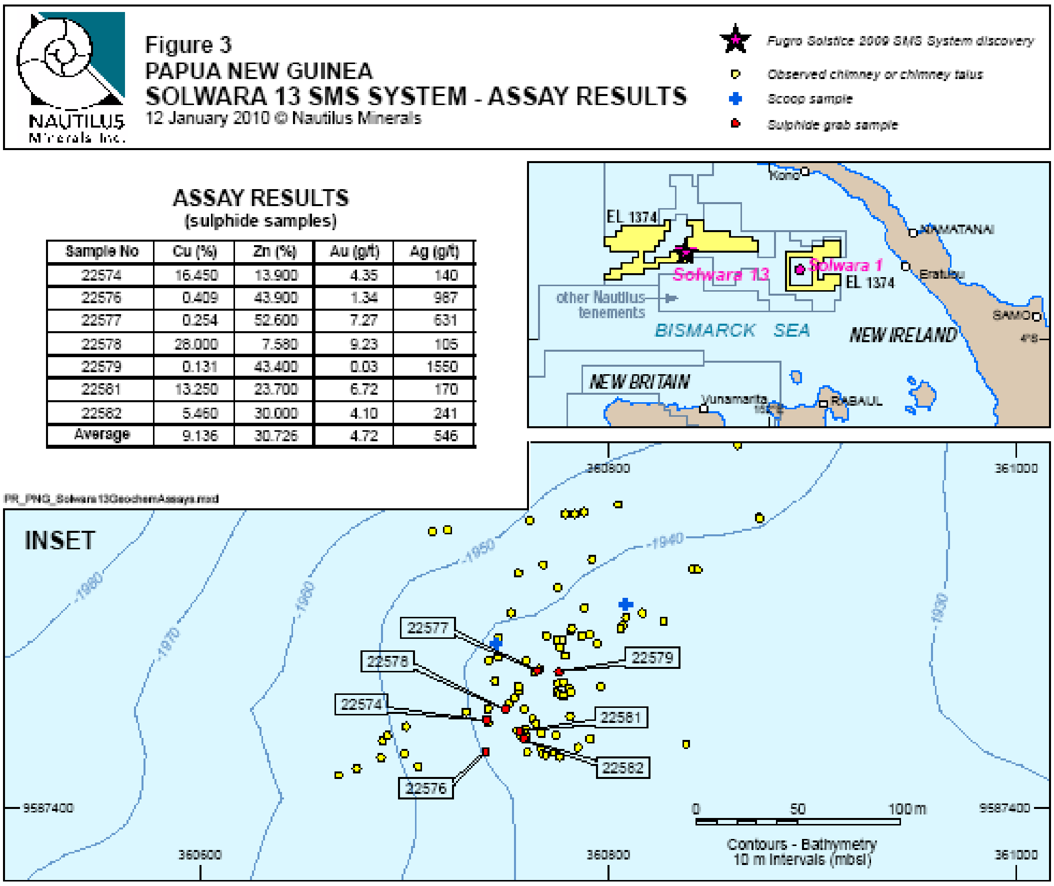

Figure 10-11: ***MV Fugro Solstice*** **2009 Grab Samples – Solwara 13**

10.4.15.4 Solwara 14

A total of 14 sulphide samples were collected from Solwara 14a and 14b. Assay results returned significant base and precious metal grades (Table 10-20).

Table 10-20: Average grades of 2009 grab samples from Solwara 14

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	14	14	14	14	14
Minimum	0.077	0.015	3.220	29	1.10
Maximum	7.010	0.107	41.100	184	6.28
Mean	1.399	0.039	19.194	97	3.32

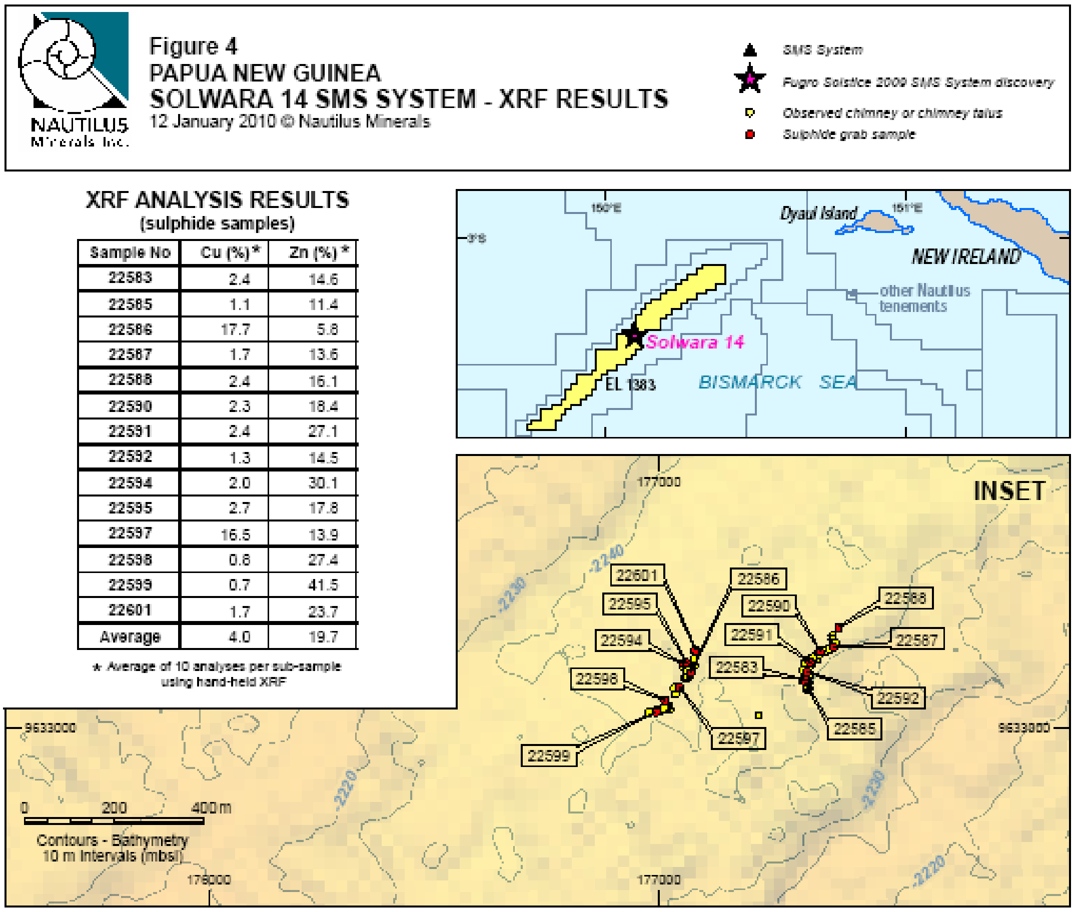

Figure 10-12: ***MV Fugro Solstice*** **2009 Grab Samples – Solwara 14**

10.4.15.5 Solwara 15

No samples were recovered from this occurrence due to operational issues.

10.4.15.6 Solwara 16

Six samples were recovered from Solwara 16. Assay results for the six sulphide samples indicate high Zn and Cu. The samples also have significant precious metal grades with assay results (Table 10-21).

Table 10-21: Average grades of 2009 grab samples from Solwara 16

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	6	6	6	6	6
Minimum	0.151	0.012	5.630	38	1.13
Maximum	9.400	0.063	32.800	172	5.12
Mean	2.142	0.033	18.572	105	2.82

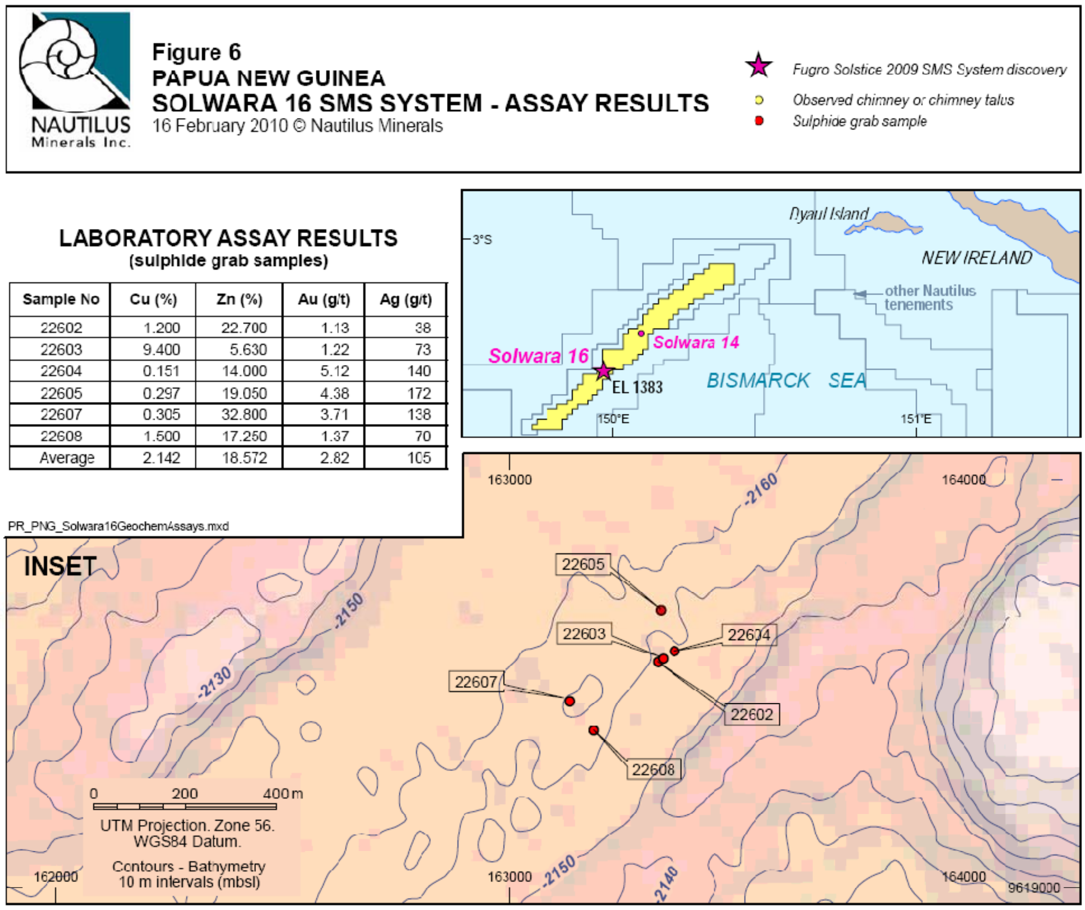

Figure 10-13: *MV Fugro Solstice* 2009 Grab Samples – Solwara 16

10.4.15.7 Solwara 17

Three chimney samples were collected from Solwara 17 which returned very low grades for all metals of interest except for Ag (Table 10-22, Figure 10-14.).

Table 10-22: Average grades of 2009 grab samples from Solwara 17

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	3	3	3	3	3
Minimum	0.007	0.315	0.098	0.00	22
Maximum	0.036	0.525	0.231	0.10	292
Mean	0.025	0.417	0.148	0.04	181

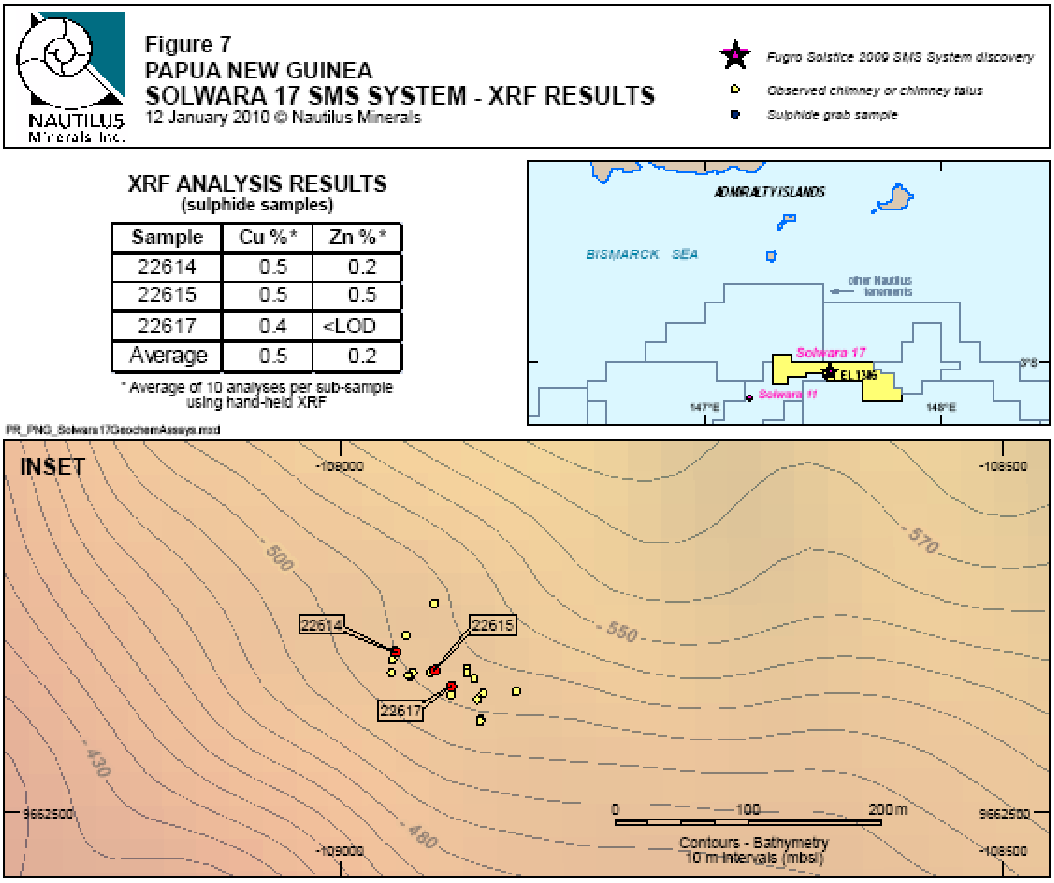

Figure 10-14: *MV Fugro Solstice* 2009 Grab Samples – Solwara 17

10.4.15.8 Solwara 18

Metal grades from the two samples collected at Solwara 18 are anomalous in Zn and Ag (Table 10-23; Figure 10-15).

Table 10-23: Average grades of 2009 grab samples from Solwara 18

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	2	2	2	2	2
Minimum	0.108	1.050	14.100	85	0.18
Maximum	0.499	1.365	25.000	134	0.19
Mean	0.304	1.208	19.550	110	0.19

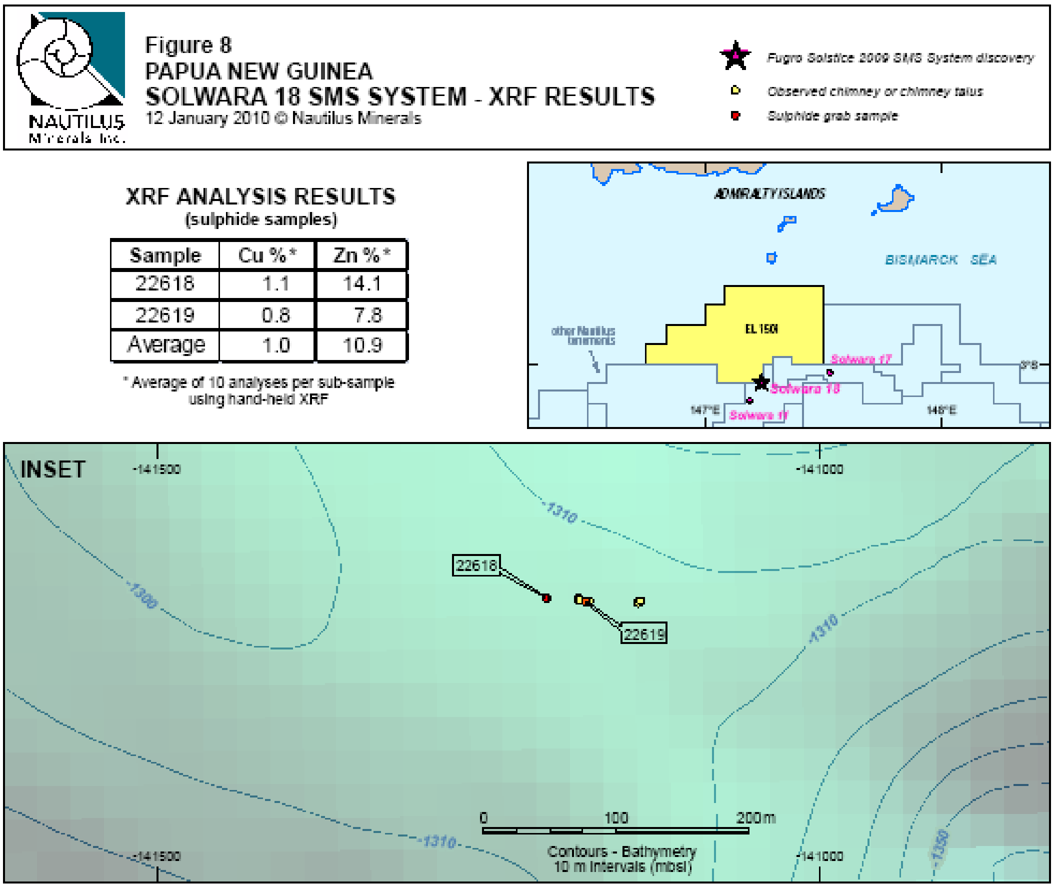

Figure 10-15: *MV Fugro Solstice* 2009 Grab Samples – Solwara 18

10.4.15.9 Solwara 19

Two chimney samples were assayed from Solwara 19. Both samples returned very low base metal values, apart from one sample with 1.2 g/t Au.

Table 10-24: Average grades of 2009 grab samples from Solwara 19

Area	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)
Count	2	2	2	2	2
Minimum	0.002	0.002	0.000	0.08	1
Maximum	0.018	0.037	0.250	1.20	6
Mean	0.010	0.020	0.125	0.64	4

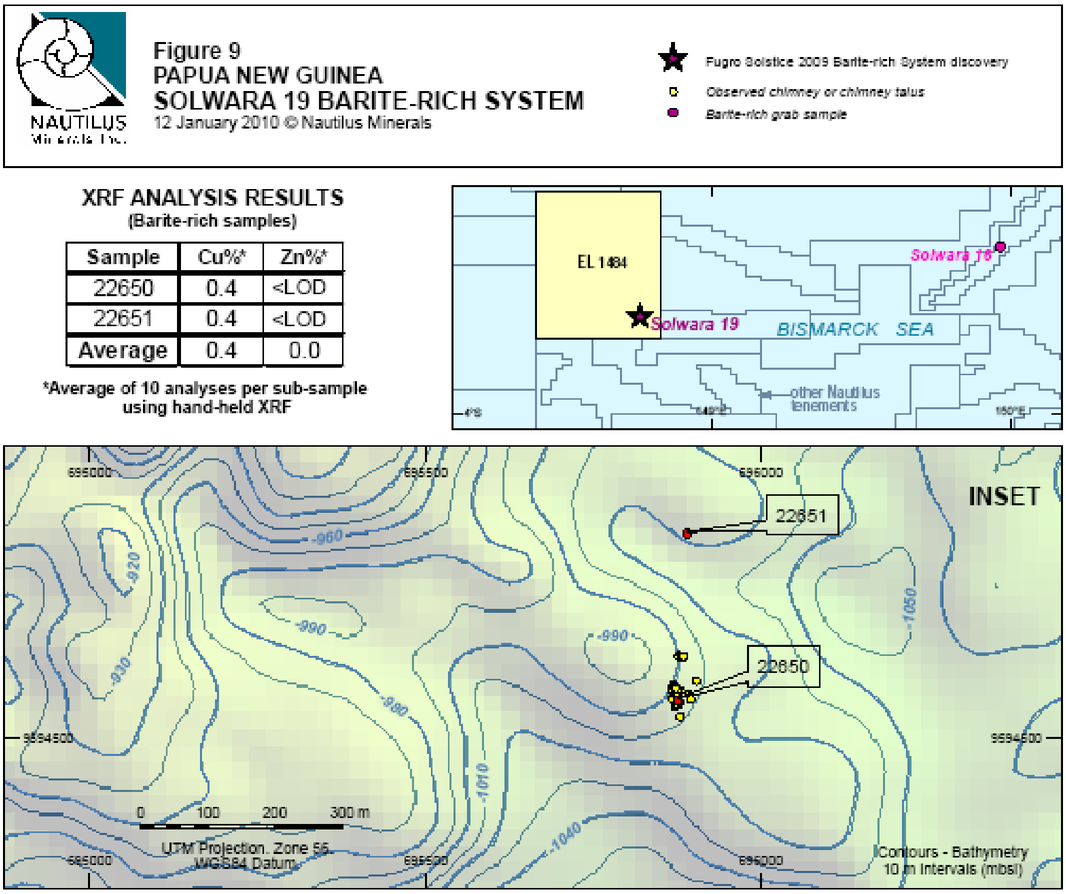

Figure 10-16: *MV Fugro Solstice* 2009 Grab Samples – Solwara 19

10.4.16 Solwara 12 Sediment Cores Sampling 2009 (*MV Fugro Solstice*)

Late in 2009 a trial sediment push core program was completed (White et al., 2010). A 1.2 m long metal tube was pushed into the sediment cover around Solwara 12 and two other targets in order to better understand the lateral and vertical metal dispersion patterns. The sediment cores were sampled at 1 to 2 cm intervals down the retrieved core sample. S ome compaction of the sediment occurred when the cores were pushed into the sediment cover therefore the retrieved samples were considerably less than 1.2 m long. The 1-2 cm length samples were split and sub-sampled for analysis for a range of elements.

10.4.16.1 Solwara 12

Four sediment core samples were collected from around Solwara 12. Two samples sites are located within the mapped chimney area of Solwara 12. An additional two sample sites are located approximately 200 and 600 m outside the mapped chimney area. At each sample site a push sediment core and sediment scoop sample were taken. Depth penetrations of 70 to 80 cm were achieved. All samples showed some degree of compression after extraction from the corer. The maximum recovery was 50 cm, with compression ranging from 10 to 45 percent. Assay results show highly anomalous base and precious metals from the sediment overlying Solwara 12. The metal grades significantly decrease outwards from the Solwara 12 system, but still include some layers that are well above normal background levels in Ag, Cu, Pb and Zn.

10.4.16.2 Sherburne 1 Area

One sediment core was collected from the Sherburne 1 target area in the Willaumez project. The assay results returned only low metal grades around background levels.

10.4.16.3 Willaumez Rise 9

Two successful sediment core samples were collected from the Willaumez Rise 9 target area in the Willaumez project. The assay results returned only low metal grades around background levels.

10.4.17 Solwara Geophysics and Prospect Delineation 2009 (*MV Fugro Solstice*)

Sixteen days of the MV Fugro Solstice 2009 cruise were used to conduct geophysical surveys over Solwara prospects including Solwara 11, 10, 14, 13, 12, 5 and 1. Electromagnetics, magnetics and detailed MBES was conducted at a local prospect scale, to gain detailed data in preparation for drilling in 2010 (White *et al.*, 2010).

Dedicated high resolution multibeam bathymetry surveys were conducted over Solwara 11, 10, 14, 13, 12 and 5. Data from Solwara 11, 10, 14, and 5 is yet to be processed (as of January 2010). The processed bathymetry collected at Solwara 12 and 13 is shown in Figure 10-17 and Figure 10-18. Dedicated Ocean Floor Electromagnetic surveys were carried out at Solwara 1, 5 and 12 (Figure 10-19 to Figure 10-21).

Conductive responses at each location are interpreted as due to high copper content in the seafloor. Magnetic data was also collected throughout each of these surveys, and the data reveals several key structural and alteration features, as well as anomalies directly associated with Solwara 1 and Solwara 12 (Figure 10-22).

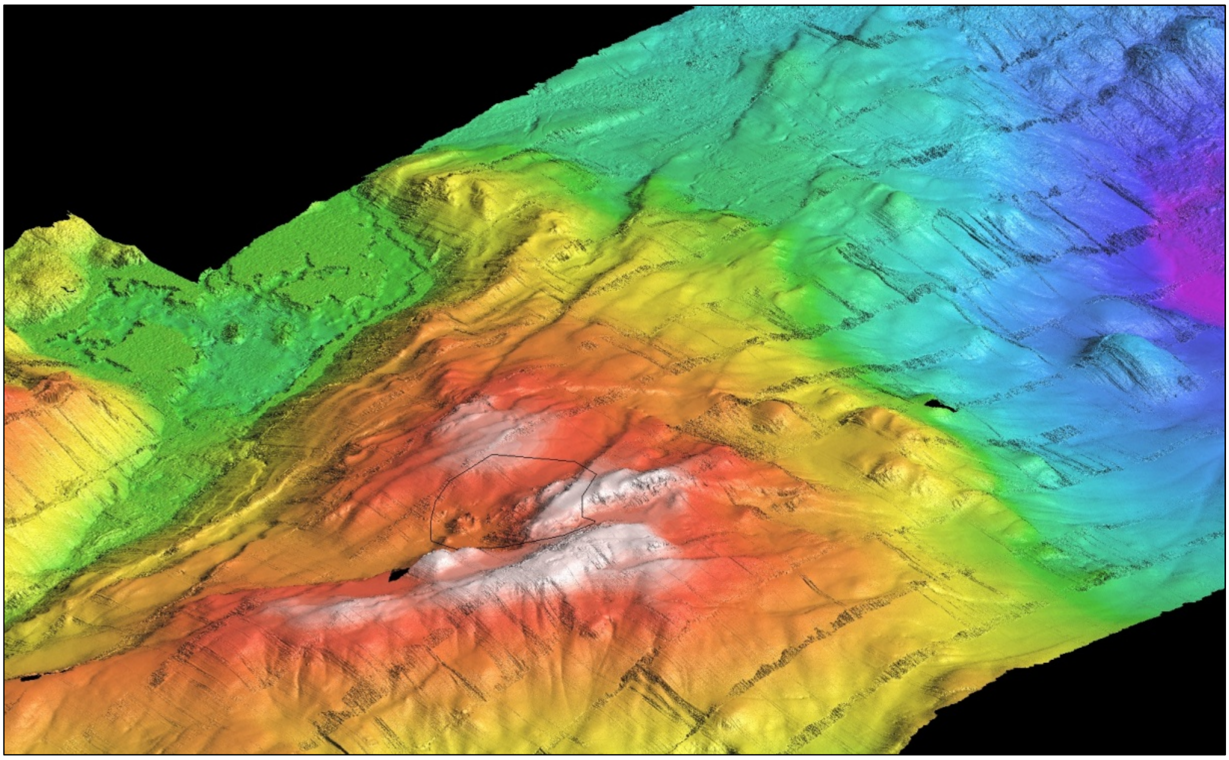

Figure 10-17: Solwara 12 High Resolution Bathymetry

Note: Surface extent of Solwara 12 is shown in black.

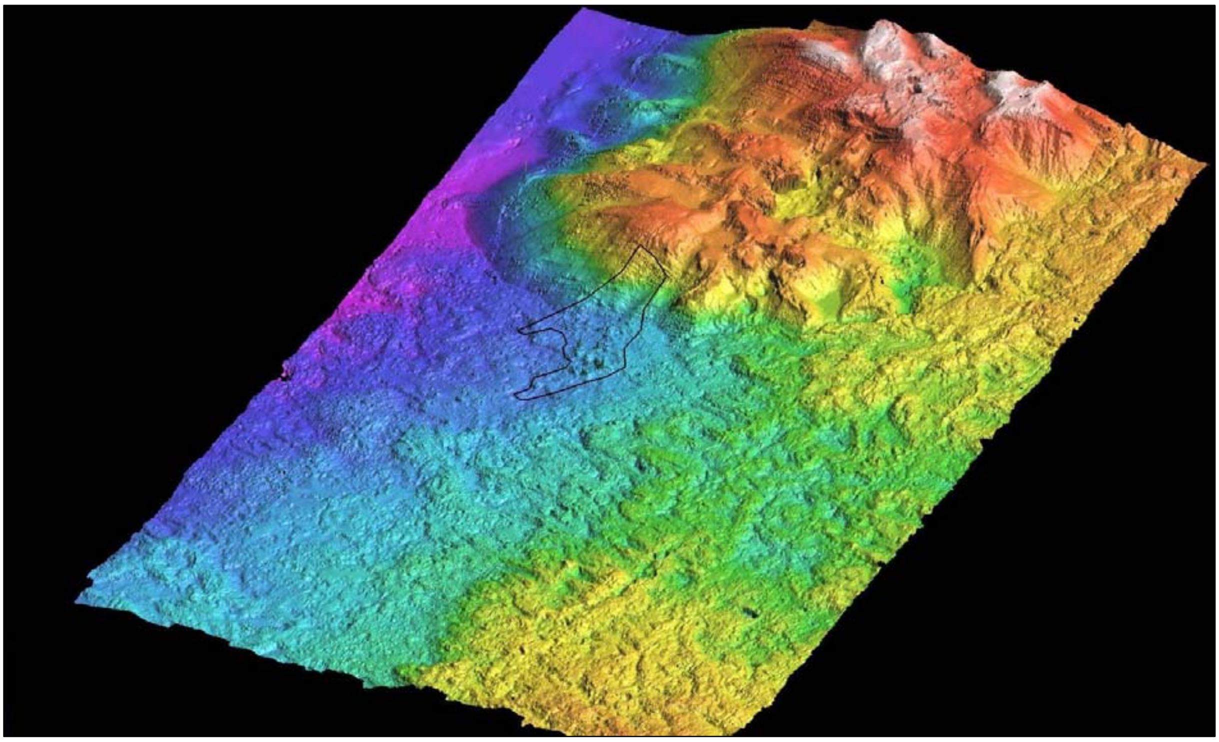

Figure 10-18: Solwara 13 High Resolution Bathymetry

Note: Surface extent of Solwara 13 is shown in black.

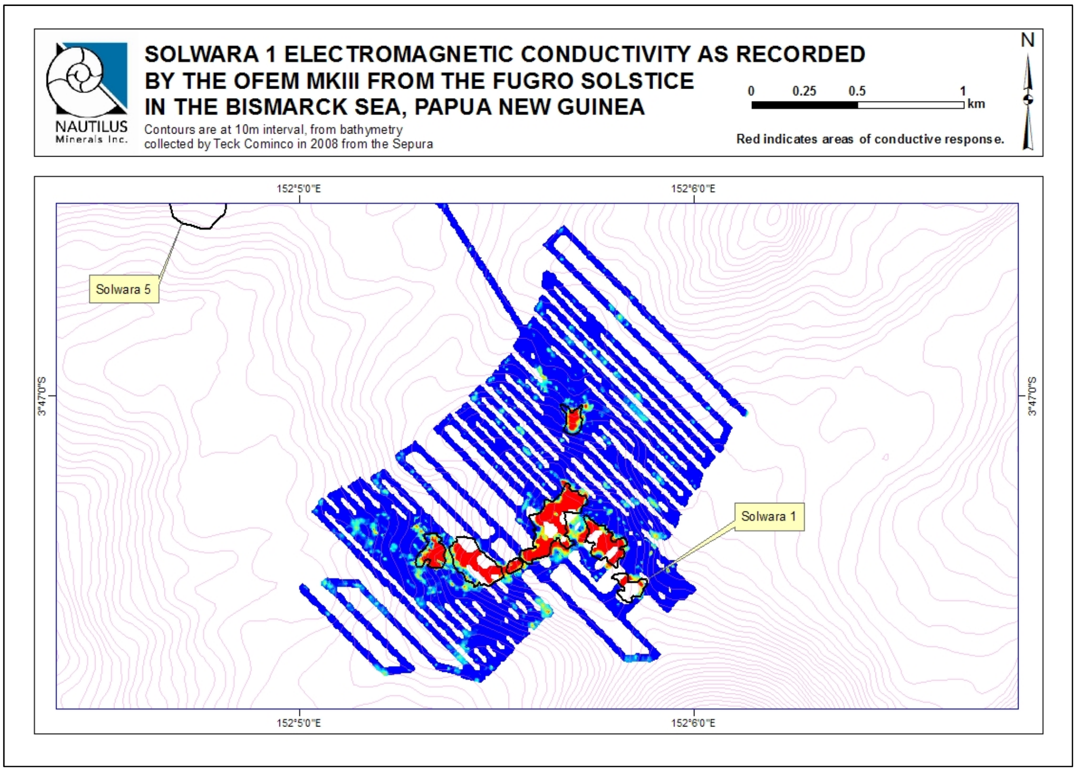

Figure 10-19: Solwara 1 OFEM MkIII Electromagnetic Conductivity Response

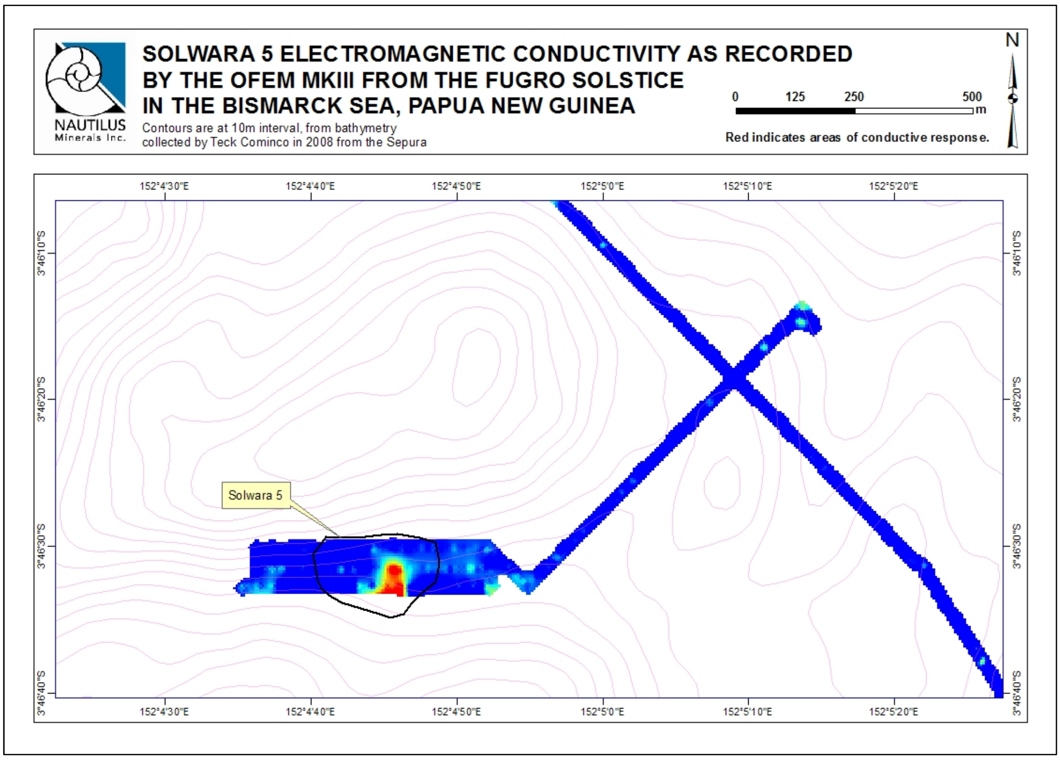

Figure 10-20: Solwara 5 OFEM MkIII Electromagnetic Conductivity Response

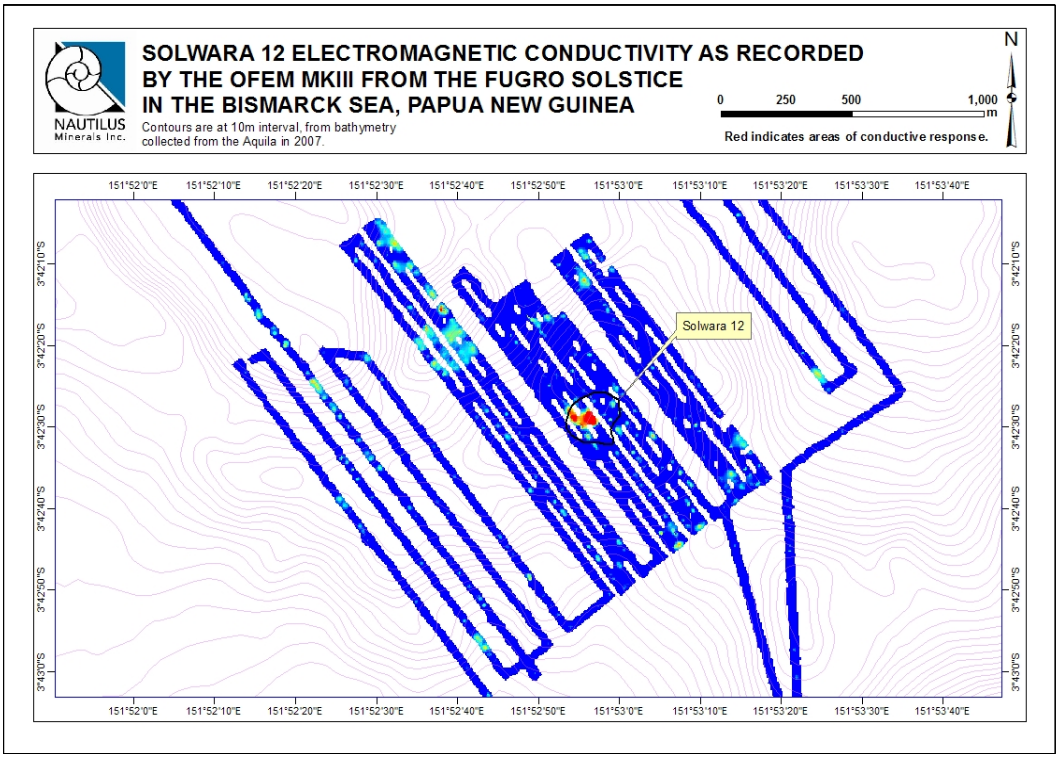

Figure 10-21: Solwara 12 OFEM MkIII Electromagnetic Conductivity Response

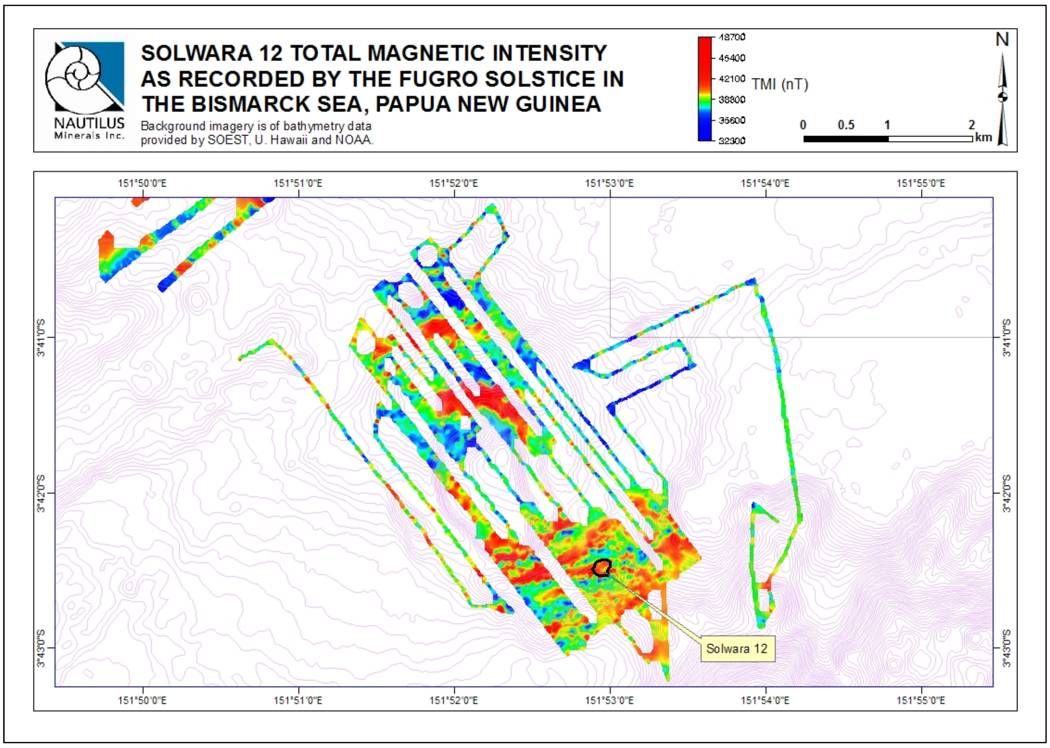

Figure 10-22: Desmos Caldera Solwara 12 – Total magnetic field intensity

11. Drilling

11.1 Overview

To date, Nautilus Minerals has drilled a total of 184 holes of 1,640 m total length over the following three drilling campaigns:

- 2006 Scout Drilling (*DP Hunter*).
- 2007 Mineral Resource and Metallurgical Drilling (*MV Wave Mercury*).
- 2008 Scout Drilling (*MV Nor Sky*).

Of the 19 mineralised systems identified to date in the Bismarck Sea, only Solwara 1 has been systematically drill tested. The 2007 sea floor drilling program at Solwara 1 was designed for resource estimation, within the limited depth capability of the drilling equipment used (maximum 20m). This drilling program was supported by electromagnetic data acquired using an electromagnetic system designed and built by Ocean Floor Geophysics Inc., a partly Nautilus-owned company, set up to provide seafloor geophysical services to the SMS exploration industry.

11.2 February 2006 Scout Drilling (DP *Hunter*)

Forty-two diamond drillholes for a total of 380.95m were drilled in February 2006 by a Seacore R100 Marine Drill mounted on the *DP* Hunter. Several holes were drilled in to each major hydrothermal mound in Solwara 1, at locations chosen for ease of drilling. All drillholes were drilled vertically. Core recovery averaged approximately 41%. The results of the 2006 drilling program were used in the development of a geological model for Solwara 1, but were not used in the 2007 resource estimate. A detailed account of the results from this program is provided in Jankowski and Hodkiewicz (2006).

11.3 2007 Mineral Resource and Metallurgical Drilling (*MV Wave Mercury*)

In 2007, Nautilus completed a 111 hole drilling program from the *MV Wave Mercury* using ROVs lowered onto the seafloor. The following summarises the drilling for 2007 based on documentation by Lipton (2008), and a visit to the *Wave Mercury* by Bruce Sommerville of SRK.

Drilling was carried out using two custom-built submersible drilling rigs mounted on remote operated vehicles (ROVs) as shown in Figure 11-1. Each rig consisted of a conventional core barrel and drill rod system designed to produce core of 52 mm diameter. The core barrels and drill rods were stored on board each drill rig in a carousel. Each rod and core barrel was 2.0 m in length, and the core barrels each had a 1.75 m core recovery capability. The configuration of the carousel and rods allowed a maximum drilling depth of about 20 m. The drilling operations were managed by Canyon Drilling Inc (Canyon). All operations were remotely controlled by Canyon drilling crews onboard the *Wave Mercury* via an umbilical cable. A live video link (Figure 11-2) was available to drill crews and geologist on board.

Drillers record the drilling information on a drill record sheet as follows:

- Run Number.
- Barrel Number. The barrel number is engraved onto each barrel (Figure 11-3).
- Split tube (Y/N).
- Start and end depths.
- Any comments. The comments include how hard the ground is.
- Drillers log sheets also include recovery information; however this is added by the geologists upon removing the core from the core barrels

Core recovery was variable during the 2007 drilling program but there was a significant improvement in recovery compared to the 2006 drill program.

Total core recovery averaged approximately 60% and Lipton (2008) reports that core recovery averaged 73% in the massive sulphide zone. However some holes still returned very poor recoveries of less than 30%.

Figure 11-1: Submersible drilling rig (ROV T203)

Figure 11-2: Submarine drilling video capture of ROV T203

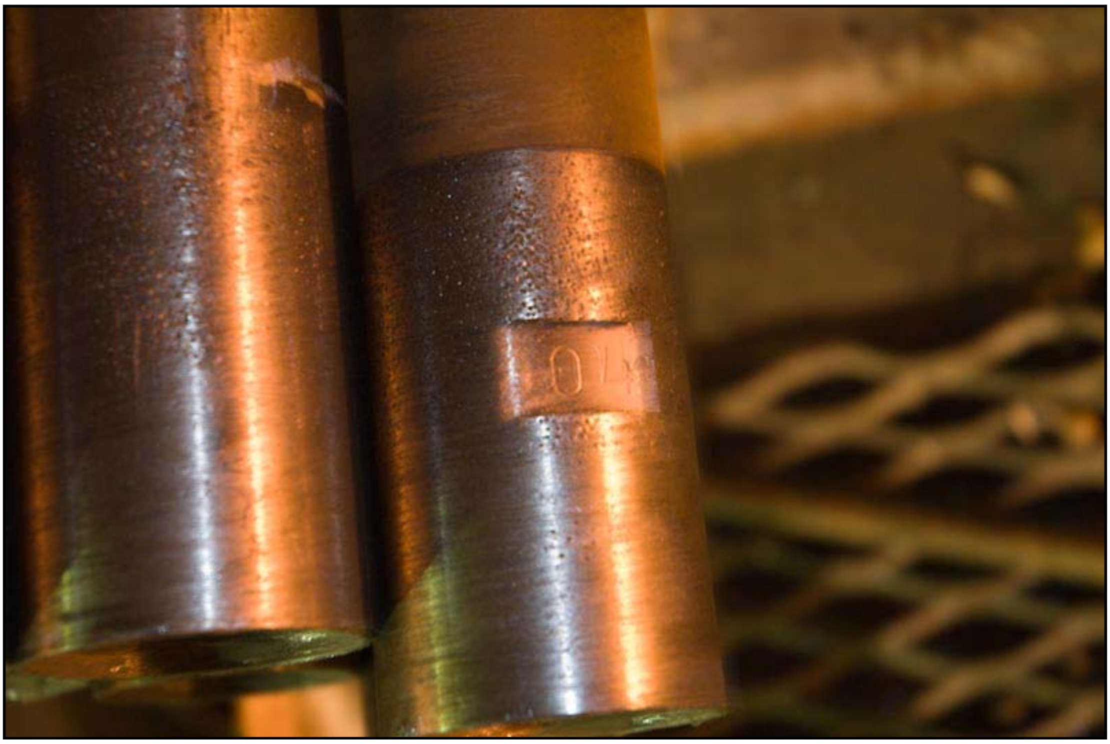

Figure 11-3: Numbered Core Barrels

11.4 2008 Scout Drilling (*MV Nor Sky*)

11.4.1 Introduction

In 2008, the same drilling technology as used in 2007 was used for a scout drilling program. Thirty-one holes for a total of 176.03m were drilled at Solwara 1, Solwara 4 and 8, Solwara 5 and Solwara 10 (Table 11-1, Figure 11-4).

The 2008 drilling program was designed to test a number of relatively weak electromagnetic anomalies or sulphide outcrops identified by ROV dives in 2007 and 2008. Each dive of the drill program was generally designed to complete two short scout holes, with around 8 to 9 m of rods available for each hole if ground conditions allowed.

Overall core recovery during 2008 was 41%, which is significantly lower than the recovery in 2007 (approximately 60%). The lower recovery may have resulted from the large number of sites tested, alternating very soft and hard material, and the highly fractured nature of the near surface material. Operator inexperience also contributed to poor recoveries given the short nature of the program relative to 2007, when recovery improved with operator experience (White *et al.*, 2009).

All holes were logged and sampled in the same manner as in 2007 and samples were analysed at ALS Chemex in Brisbane.

Significant intersections were selected to enclose individual mineralised samples of drill-core with grades greater than 3% Cu, 9% Zn, 3 g/t Au or 100g/t Ag. Zones of core loss bounded by mineralised samples, and interpreted from drilling data to be the result of poor drilling performance (as opposed to a change in material type) is allocated the average grade of the samples above and below the core loss, before length-weighted average grades for the significant interval are calculated separately for Cu, Zn, Au and Ag. If the overall recovery for the interval was less than 50% the interval is flagged as having low recovery with a warning that the calculated grades may not be representative of the entire interval.

Table 11-1: Summary of 2008 scout drilling

Prospect	Holes	Metres
Solwara 1	18	120.57
Solwara 4 and 8	4	18.43
Solwara 5	4	17.77
Solwara 10	5	19.26

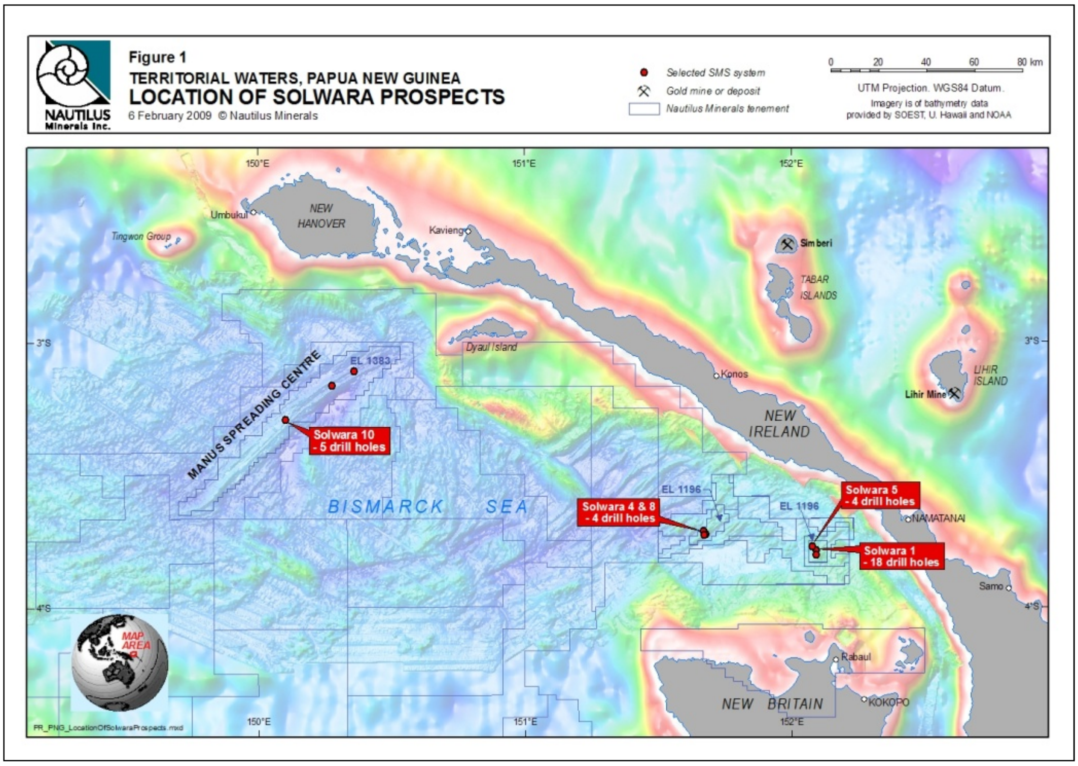

Figure 11-4: Solwara 2008 drill program summary

11.4.2 Solwara 1

Three holes for 24.33m were drilled at a newly discovered zone 250 m north of the Inferred Resource. Overall recovery was poor for the drillholes, and sampling was limited to the limited intervals of good recovery. All three holes ended in sulphide mineralisation (**Table 11-2**). The drilling also indicates that high-grade mineralisation does exist locally under volcanic rock as well as sediment cover.

Table 11-2: Solwara 1 North Zone 2008 drilling significant intersections

Hole	From (m)	To (m)	Interval (m)	Recovery (%)	Cu (%)	Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)	Comments
SD148	1.45	2.01	0.56	100%	1.16	1.54	17.00	19.49	380	Semi-massive sulphide
SD148	5.32	7.00	1.68	40%	8.08	0.10	0.37	4.64	15	Massive sulphide; end of hole
SD149	1.12	2.05	0.93	100%	12.88	0.16	4.36	20.56	121	Massive sulphide
SD149	3.96	4.08	0.12	100%	11.95	0.04	0.21	3.87	22	Massive sulphide; end of hole
SD162	7.12	8.39	1.27	100%	9.07	0.14	2.48	16.84	124	Massive sulphide; end of hole

Eight holes for 96.24m were drilled at Solwara 1 at the margins of the existing Inferred Resource. The thicknesses and grades (Table 11-3) were broadly in line with what was expected from the previous drilling. The two holes without significant intersections (SD157 and SD158) were drilled just outside the resource boundary to test for possible extensions. The resource has not been re-estimated with these new holes.

Table 11-3: Solwara 1 Resource Area 2008 drilling significant intersections

Hole	From (m)	To (m)	Interval (m)	Recovery (%)	Cu (%)	Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)	Comments
SD151	0.26	9.25	8.99	45%	3.35	0.05	0.07	3.64	19	Massive and semi-massive sulphide; end of hole
SD152	1.31	8.48	7.17	85%	13.21	0.07	0.65	11.41	40	Massive sulphide and hydrothermally altered clay-rich volcanic; rock end of hole
SD154	1.37	5.24	3.87	54%	10.23	0.06	0.22	7.88	36	Massive sulphide
SD155	0.70	1.12	0.42	100%	22.8	0.02	0.07	5.25	45	Massive sulphide
SD156	1.05	2.05	1.00	100%	11.45	0.06	0.22	19.81	58	Massive sulphide
SD157										No significant Intersections
SD158										No significant Intersections
SD161	2.88	3.50	0.62	100%	12.6	0.37	0.8	12.5	34	Massive sulphide; end of hole

Five other drillholes (SD 147, 150, 153, 159, and 164) were drilled to test weak EM anomalies near the Inferred Resource, however failed to intersect any sulphide mineralisation or anomalous material.

11.4.3 Solwara 5

Four holes for 17.77m were drilled at Solwara 5 targeting a small EM anomaly co-incident with a chimney field. All four holes intersected high grade copper or zinc mineralisation (**Table 11-4**) both in massive sulphide and in the overlying sediment cover. Three of the four holes ended in mineralisation, which is open both at depth and laterally.

Table 11-4: Solwara 5 2008 drilling significant intersections

Hole	From (m)	To (m)	Interval (m)	Recovery (%)	Cu (%)	Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)	Comments
SD_S5_001	1.22	1.71	0.49	100%	24.3	0.07	0.76	7.14	37	Massive sulphide end of hole
SD_S5_002	1.08	2.95	1.87	100%	20.25	0.08	0.95	7.38	56	Volcanic breccia with sulphide matrix
SD_S5_002	8.87	9.02	0.15	100%	7.42	0.02	0.05	1.27	14	End of hole
SD_S5_003	0.71	2.31	1.60	100%	1.35	0.42	5.9	9.57	120	Clay; Lithified clastic sediment; end of hole
SD_S5_004	0.19	3.54	3.35	27%	3.92	0.32	3.76	14.47	157	Massive sulphide; fresh and partly altered volcanic rock

11.4.4 Solwara 10

Five holes for 19.26m were drilled at Solwara 10, where zinc rich chimneys had been observed over a strike length of 680 m. The EM response over the prospect is generally weak and irregular. Four drillholes intersected zinc-rich mineralisation and one hole intersected copper-rich mineralisation. All holes contained elevated gold and silver.

The Solwara 10 mineralisation is different from the Solwara 1 mineralisation, being dominated by zinc sulphides rather than copper sulphides. Some of the mineralisation drilled occurs in veins and breccias, rather than massive sulphide.

Table 11-5: Solwara 10 2008 drilling significant intersections

Hole	From (m)	To (m)	Interval (m)	Recovery (%)	Cu (%)	Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)	Comments
SD_S10_001	0.33	1.65	1.32	100%	1.68	0.15	49.81	3.21	209	Massive and semi-massive sulphide; end of hole
SD_S10_002	0.91	2.03	1.12	100%	1.54	0.16	29.2	2.77	166	Massive sulphide; partly altered volcanic rock
SD_S10_002	3.91	4.21	0.3	100%	4.5	0.02	6.31	0.22	30	Hydrothermally altered clay-rich volcanic rock
SD_S10_003	0.3	0.8	0.5	100%	0.31	0.1	29.5	1.4	145	Massive sulphide
SD_S10_005	0.73	1.22	0.49	100%	0.51	0.1	24	0.35	62	Volcanic breccia with sulphide matrix; altered volcanic rock

11.4.5 Solwara 4 and 8

Four holes for 18.43 m were drilled in the Solwara 4 and 8 areas, where local low-order EM anomalies were defined. Drilling returned mixed results, with highest assay grades of 25.2% Cu, 13.4% Zn and 27.0 g/t Au.

Table 11-6: Solwara 4 and 8 2008 drilling significant intersections

Hole	From (m)	To (m)	Interval (m)	Recovery (%)	Cu (%)	Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)	Comments
SD_S4_002	0.78	1.25	0.47	100%	25.2	0.11	1.7	5.19	45	Massive sulphide
SD_S4_003	2.14	4.1	1.96	33%	5.2	0.18	10.07	15.93	121	Massive sulphide

12. Sampling Method and Approach

12.1 2005, 2006 and 2007 Grab Sampling

Detailed descriptions of dredging (March 2005; *MV Genesis*) and grab sampling (March 2006; *DP Hunter*, July 2006; *RV Melville*) campaigns, are presented in Jankowski and Hodkiewicz (2006). The same procedures were followed during the 2007 exploration program on the *RV Wave Mercury* (White *et al.*, 2007).

12.2 2007 and 2008 Mineral Resource and Metallurgical Drilling (*MV Wave Mercury and MV Nor Sky*)

The core sampling and logging procedures used during the 2007 resource and metallurgical sampling program are described in Lipton (2008). The 2007 drilling program was designed to test the inferred location of the deposit initially on a 50m by 50m grid, with subsequent infill to a 25 m by 25 m grid. The rugged terrain, particularly near the chimney mounds, prevented the location of the drillholes on a regular grid. However, over much of the deposit a final drillholes spacing of approximately 30m was achieved.

Core handling and logging used the following procedures:

- Each core is barrel is removed from the carousel and put into barrel racks.
- Barrels are opened in the order that is recorded on the geologist log sheet. The geologists and the driller confirm that the correct barrel is being opened.
- After the core is removed from the barrel, the core is photographed, before being handled any further. At this stage, the core is measured and recoveries on the drillers log sheet are recorded by the geologists.
- Core is placed in core trays, by geologists. Core trays have been numbered and checked by the senior geologist before core transfer takes place. At this stage, the geologists add the core blocks and a measured length of foam is to the core tray to signify core loss. For the first barrel, the core loss marker was placed at the start of the hole. For subsequent samples, the loss maker was placed at the end of the core run.
- Core barrels and equipment are cleaned by the drillers as the geologist measure and handle the recovered core.
- It was clear that the process of putting core into the core trays was carried out with great care and diligence by the geologists and the drill crew. Appropriate procedures have been followed.
- Geologists mark the core to define the different geological and ore type intervals (Figure 12-1). These geological boundaries are then used as sample boundaries. In the case of geological units longer than 1.3m, several samples were taken within the same geological interval.
- Sample numbers and sampling breaks are clearly marked by geologist.
- Holes are analysed using a hand held Niton XRF. Each sample interval is measured at least 10 times to provide a realistic average grade. XRF data is not added to the acQuire database, but is stored in Excel spreadsheets.
- Data are entered into the acQuire database on a lap top computer. The database provides data entry validation in terms of the logging code used. Other data entry validation measures includes unique sample ID's and no over lapping intervals. No sample (NS) log codes are used for lost core.
- Core is photographed by the geologists before sampling. An example from hole SD 112 is shown in (Figure 12-1).
- Drill logs are reviewed and approved by a senior geologist.

Sub-sampling of core for chemical assay was not observed. Inspection of the core stored on board clearly shows that sub-sampling is via half core. When taken, the duplicate comprises of the remaining half core. Foam markers are added to the core tray to mark the half core position, as shown in Figure 12-3. Other features of the drilling, for example lost core and cave in material, are also clearly marked.

Figure 12-1: Drillcore mark up (hole SD 130) before sampling

Figure 12-2: Core photos for hole SD 112 before (left) and after sample mark up (right)

Source: Photos from Nautilus

Figure 12-3: Drill storage after sampling (Hole SD068) showing half core duplicate

12.2.1 2007 Drillhole Logging Procedures

Lipton (2008) details the logging procedures used during the 2007 sampling program. This section, together with Section 13 of this report, summarises these procedures.

Geologists identify each unique geological interval within the core and details of the lithological types and mineralogy are entered into acQuire via a data entry screen on a tablet PC. The system allows for validation of logging intervals and codes at the time of logging to ensure consistency between geologists. Log codes and descriptions are shown in **Table 13-1**.

12.3 2008 Solwara and Exploration Grab Sampling (*MV Nor Sky*)

ROV grab sampling is intended to collect a set of mineralised chimney samples to characterise the tenor of the chimney fields; it is not possible to sample any underlying mineralisation in the sulphidic mounds without drilling equipment.

The samples are taken using hydraulic-operated arms on the ROV. These arms are capable of picking up and manipulating loose objects, as well as grasping and breaking off parts of standing chimneys. The samples are placed either in the 'Geobox' or the chimney cage. The 'Geobox' comprises nine numbered compartments, each approximately 25 cm x 25 cm x 30 cm, mounted on a slide out platform on the front of the ROV (Figure 12-4).. The chimney cage (Figure 12-6) contains eight plastic garbage bins, is lowered on a separate line to the ROV and can hold larger samples than the 'Geobox', up to 250 kg each.

Sample locations are chosen by the geologist supervising the ROV dive. Mineralised samples may be taken either from standing chimneys or chimney debris; samples of non-mineralised volcanic rock are also taken to improve geological understanding of the target area. Sample numbers area assigned at the time of sampling from a pre-printed set of sample number tags. Sample numbers and descriptions are loaded directly into Nautilus' acQuire database during sampling.

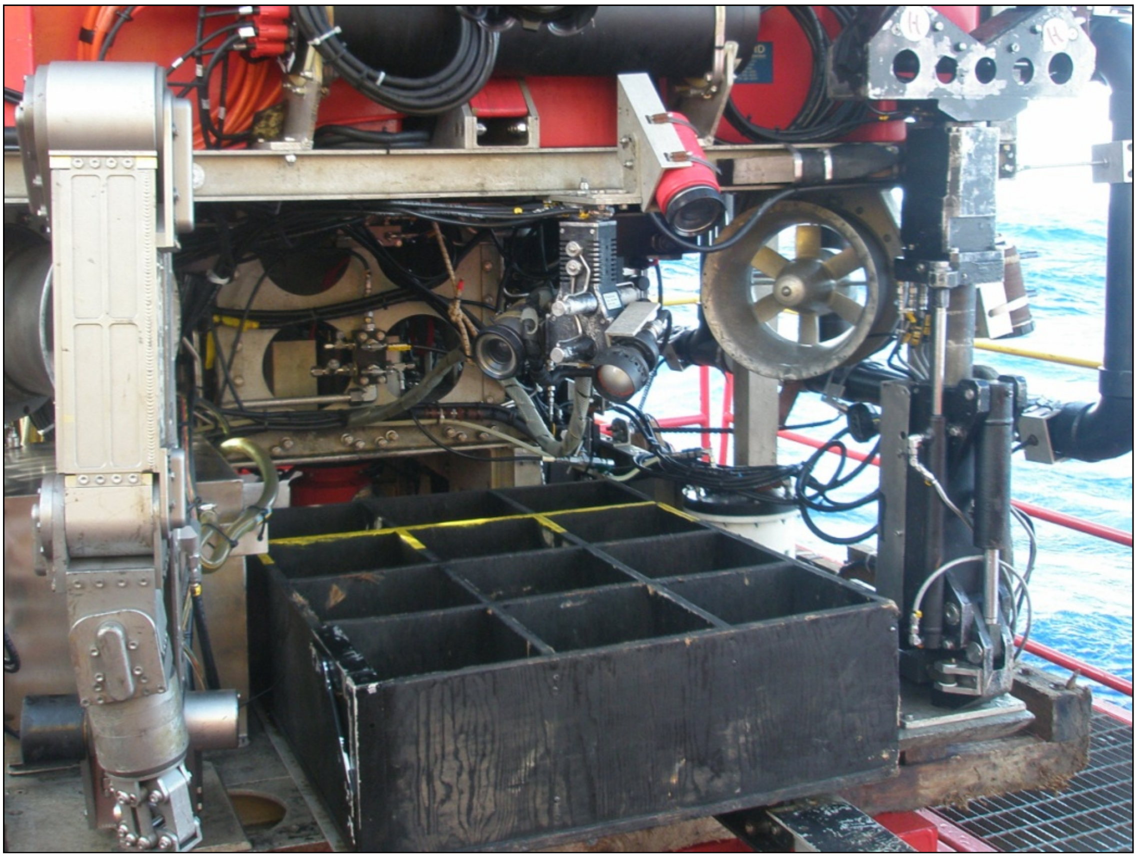

Figure 12-4: 'Geobox' used to hold samples on the front of the ROV

Figure 12-5: Chimney sample 20060 (Tahi Moana 1) being loaded into the 'Geobox'

Figure 12-6: Chimney sample cage

12.4 2008 Teck Exploration Grab Sampling (*MV Dea Surveyor*)

MV Dea Surveyor was equipped with a Phoenix Remora 6000 series 25hp observation ROV, equipped with forward looking sonar, low-light video, and dual 6 function manipulators. Two high resolution cameras, one digital video, and one14-208 digital and high powered HMI lights were fitted.

All of video footage from the ROV operations on the seafloor were captured onto hard drive; corresponding geological logging was also recorded by the VirtualSoft system and exported to a GIS format. Sampling philiosophy was similar to that used in the Nautilus programs.

12.5 2009 Exploration Grab Sampling (*Fugro Solstice*)

ROV grab sampling is intended to collect a set of mineralised chimney samples to characterise the tenor of the chimney fields; it is not possible to sample any underlying mineralisation in the sulphidic mounds without drilling equipment.

The samples are taken using hydraulic-operated arms on the ROV. These arms are capable of picking up and manipulating loose objects, as well as grasping and breaking off parts of standing chimneys. The samples are placed either in the Geobox' or the chimney cage. The 'Geobox' comprises 10 numbered compartments, each approximately 30xcm x 30 cm x 30 cm, mounted on a slide out platform on the front of the ROV. The chimney cage contains 10 plastic garbage bins, and is lowered on a separate line to the ROV position, and can hold larger samples than the 'Geobox', up to 250 kg each.

Sample locations are chosen by the geologist supervising the ROV dive. Mineralised samples may be taken either from standing chimneys or chimney debris; samples of non-mineralised volcanic rock are also taken to improve geological understanding of the target area. Sample numbers area assigned at the time of sampling from a pre-printed set of sample number tags. Sample numbers and descriptions are loaded directly into Nautilus' acQuire database during sampling.

13. Sample Preparation, Analyses and Security

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Core handling and logging used the following procedures:

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- Core barrels and equipment are cleaned by the drillers as the geologist measure and handle the recovered core.
- It was clear that the process of putting core into the core trays was carried out with great care and diligence by the geologists and the drill crew. Appropriate procedures have been followed.
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- Sample numbers and sampling breaks are clearly marked by geologist.
- Holes are analysed using a hand held Niton XRF. Each sample interval is measured at least 10 times to provide a realistic average grade. XRF data is not added to the acQuire database, but is stored in Excel spreadsheets.
- Data are entered into the acQuire database on a lap top computer. The database provides data entry validation in terms of the logging code used. Other data entry validation measures includes unique sample ID's and no over lapping intervals. No sample (NS) log codes are used for lost core.
- Core is photographed by the geologists before sampling. An example from hole SD 112 is shown in (Figure 13-2).
- Drill logs are reviewed and approved by a senior geologist.

Sub-sampling of core for chemical assay was not observed. Inspection of the core stored on board clearly shows that sub-sampling is via half core. When taken, the duplicate comprises of the remaining half core. Foam markers are added to the core tray to mark the half core position, (Figure 13-3).

Other features of the drilling, for example lost core and cave in material, are also clearly marked.

Figure 13-1: Drillcore mark up (hole SD 130) before sampling

Figure 13-2: Core photos for hole SD 112 before (left) and after sample mark up (right)

Source: Photos from Nautilus Minerals Inc.

Figure 13-3: Drill storage after sampling (Hole SD068) showing half core duplicate

13.2.1 2007 Drillhole Logging Procedures

Lipton (2008) details the logging procedures used during the 2007 sampling program. This section summarises these procedures.

Geologists identify each unique geological interval within the core and details of the lithological types and mineralogy are entered into acQuire via a data entry screen on a tablet PC. The system allows for validation of logging intervals and codes at the time of logging to ensure consistency between geologists. Log codes and descriptions are shown in**Table 13-1**.

Table 13-1: Lithological codes and descriptions

Lithology	Code
Massive sulphide	HMS
Semi-massive sulphide	HSM
Sulphate-Sulphide	HSS
Fe-(Mn)-(Si) Oxides	HFE
Mn-(Fe)-(Si) Oxides	HMN
Hydrothermally altered clay-rich rock	HSI
Anhydrite- barite rock	HAB
Anhydrite	HAN
Other hydrothermal rocks	H_Other
Fresh volcanic	VF
Partly-altered volcanic	VPA
Altered volcanic	VA
Mineralized volcanic breccia	VBM
V_Other	V_Other
Lithified clastic sediment	SLI

Lithology	Code
Volcaniclastic Sand	SVC
Sand - undifferentiated	SND
Silt	SLT
Clay	SCY
S_Other	S_Other
Core Loss	CL
Cavity	CAV

13.3 2008 Solwara and Exploration Grab Sampling (*MV Nor Sky*)

ROV grab sampling is intended to collect a set of mineralised chimney samples to characterise the tenor of the chimney fields; it is not possible to sample any underlying mineralisation in the sulphidic mounds without drilling equipment.

The samples are taken using hydraulic-operated arms on the ROV. These arms are capable of picking up and manipulating loose objects, as well as grasping and breaking off parts of standing chimneys. The samples are placed either in the 'Geobox' or the chimney cage. The 'Geobox' comprises nine numbered compartments, each approximately 25cm by 25cm by 30cm, mounted on a slide out platform on the front of the ROV (Figure 13-4).

The chimney cage (Figure 13-6) contains eight plastic garbage bins, is lowered on a separate line to the ROV and can hold larger samples than the 'Geobox', up to 250kg each.

Sample locations are chosen by the geologist supervising the ROV dive. Mineralised samples may be taken either from standing chimneys or chimney debris; samples of non-mineralised volcanic rock are also taken to improve geological understanding of the target area. Sample numbers area assigned at the time of sampling from a pre-printed set of sample number tags. Sample numbers and descriptions are loaded directly into Nautilus' acQuire database during sampling.

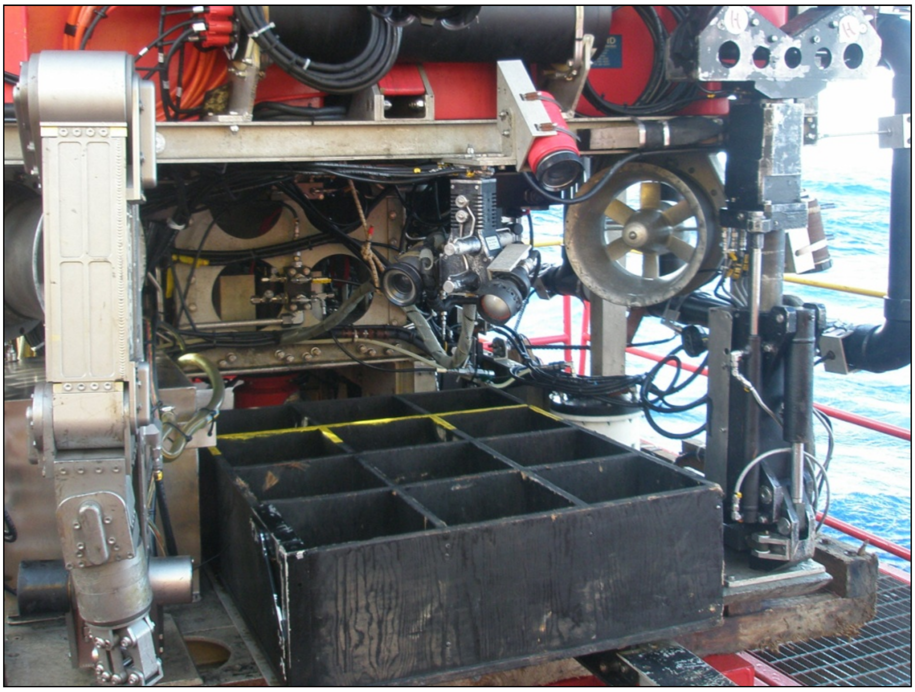

Figure 13-4: 'Geobox' used to hold samples on the front of the ROV

Figure 13-5: Chimney sample 20060 (Tahi Moana 1) being loaded into the 'Geobox'

Figure 13-6: Chimney sample cage

13.4 2008 Teck Exploration Grab Sampling (*MV Dea Surveyor*)

MV Dea Surveyor was equipped with a Phoenix Remora 6000 series 25hp work class ROV, equipped with equipped with forward looking sonar, low-light video, and dual 6 function manipulators. Two high resolution cameras, one digital video, and one14-208 digital and high powered HMI lights were fitted.

All of video footage from the ROV operations on the seafloor was captured onto hard drive; corresponding geological logging was also recorded by the Virtual Soft system and exported to a GIS format. Sampling philosophy was similar to that used in the Nautilus programs.

13.5 2009 Solwara and Exploration Grab Sampling (*MV Fugro* Solstice)

ROV grab sampling procedures for the 2009 *MV Fugro Solstice* campaign were similar to the 2008 *MV Nor Sky* program (Section 13.3).

13.6 2009 Water Sampling (*MV Fugro Solstice*)

A rosette containing twelve 5L Niskin bottles for collecting water samples was mounted on the frame of the tow-yo carousel or sled (Figure 13-7). Observers on the vessel triggered the bottles remotely, either to capture samples within plume anomalies or to define background grades for a region. Processing of water samples included some or all of the following:

- Small water samples were sealed in copper tubes for subsequent helium analysis at NOAA.
- pH measurements were completed onboard.
- Water was filtered to collect particulates for geochemical analysis at ALS Chemex in Brisbane.

On recovery of the CTD sled, the water bottles were sub-sampled for ^3He, pH, particulate matter (all potentially indicators of hydrothermal activity). For ^3He, samples were drawn into 60cm sections of 1.6 cm diameter Cu tubing from which all air had been flushed. The tubes were cold-weld sealed into two 25 cm sub-sections and stored for shipment to the NOAA He Laboratory in Newport, OR, USA where helium isotopes and abundances are measured using a 21-cm-radius mass ratioing mass spectrometer with a 1σ precision of 0.2% for $^3He/^4He$ ratios and an accuracy of 1% for the absolute He concentration.

pH samples were drawn into 60 mL plastic bottles, being careful to displace all air bubbles and overflowing at least three bottle volumes before sealing with fluid-displacing screw caps. Buffers and samples were allowed to come to thermal equilibrium in a bucket of water (~40 minutes) before being measured with a combination pH electrode and temperature thermister for quantification. Replicate precision was ±0.005 pH units and the detection limit for anomalies in pH was -0.01 to – 0.02 pH units.

After sub-sampling for He and pH, selected water samples were filtered for particulate matter on 47 mm diameter, 0.4 µm pore diameter polycarbonate membranes using vacuum filtration. In order to filter about 7L of plume water (a target volume established by historical determinations) duplicate water samples were tripped at all depths intended for filtration. The particulate samples were rinsed with purified water adjusted to pH ~ 7.5 to remove residual sea salt, then stored in plastic petri-slides for transport to the ALS Laboratory Group in Brisbane for quantification by digestion-ICP/AES.

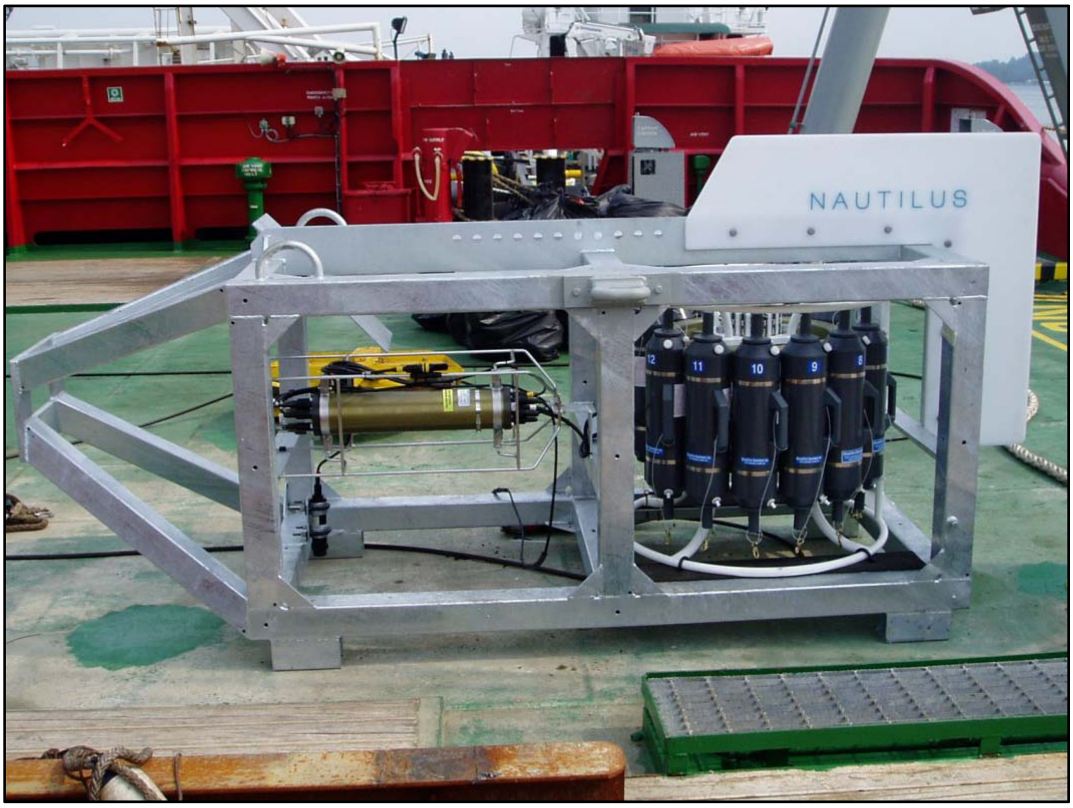

Figure 13-7: CTD sled with water bottles mounted inside the main frame

13.7 Sample Preparation, Analyses and Security

13.7.1 Sample Retrieval

Samples are brought to the surface in the 'Geobox 'or chimney cage. When on deck, each individual sample is put into pre-numbered sample bags, and transferred to a refrigerated container (reefer). Samples are stored in the reefer until sampled.

13.7.2 Sample Preparation

Samples stored in the reefer are brought out to be processed one at a time on the deck. All samples are photographed and weighed. A pneumatic hammer is used to take a sample of approximately 6kg from the base of each chimney sample, taking a slice across the complete cross-section.

If a duplicate sample is to be taken (1 in 10 samples), this is taken as a slice of the complete cross-section across the chimney next to the original sample.

13.8 Handheld XRF

13.8.1 Introduction

A Niton XLT592 handheld XRF unit is used onboard to analyse samples. These analyses are only suitable as a general indication of the tenor of base metal mineralisation and are not suitable for use in resource estimation, because:

- The instrument only measure grades from the surface and near-surface part of a specimen.
- The specimen has not been crushed or pulverised to create a representative subsample.
- Readings are not corrected for matrix effects.

Nevertheless, despite these limitations the XRF tool does produce readings that are sufficiently accurate for identification of mineralisation and management of the exploration program.

13.8.2 Procedures

Ten readings by the XRF unit are taken on each sub-sample of collected chimney material (Figure 13–8). The sample number, prospect name and operator details are entered into the XRF unit, and then downloaded along with the readings to Nautilus' acQuire database system.

During 2009, a range of standard materials provided by the manufacturer of the XRF unit were measured during each batch of work.

Figure 13-8: Niton handheld XRF measuring cut face of chimney sample

Table 13-2: Niton handheld XRF elements and detection limits

Element	Detection Limit
Cu	1%
Pb	1%
Zn	1%
Fe	4%

13.9 Sample Preparation

13.9.1 Dredging – March 2005 (*MV Genesis*)

Dredging runs recovered samples ranging from less than 1kg to over 250 kg, most of which was mud and grit. From each dredge run, all fragments greater than approximately 25 mm was collected and cut by diamond saw to produce a composite sample, or samples, for analysis, with the remainder retained as a reference or to be used for later metallurgical test work. For the smaller pieces, approximately half was included in the composite; larger pieces were quartered. Only dredging runs where sulphides from the SMS deposits had been recovered were sampled.

The samples were bagged into individual numbered calico bags lined with plastic bags, which were packed in plastic polyweave sacks and plastic drums for transport by commercial freight forwarders to the commercial assay laboratory. Small amounts of the remaining sample (generally no more than 100 g) were taken for scientific research purposes by the independent researchers on the cruises. The remainder was bagged in the same way as the dispatched assay samples and stored by Nautilus in a storage facility in Brisbane, Australia.

The sample preparation flowsheet is:

- Samples are received.
- Samples are sorted, received weights are captured, samples are placed on drying racks and put in oven.
- Sample numbers and analysis required are entered into the system generating barcode labels and worksheets.
- After drying, samples are coarse crushed then fine crushed. A quartz flush is also crushed between each sample and retained.
- Samples over 3.4 kg are split, the coarse residue is stored in a plastic bag, the analytical split is placed in an alfoil tray.
- Samples are pulverized in sequence and the retained quartz flush is also pulverized between each sample.

13.9.2 Grab Sampling – March 2006 (*DP Hunter*), July 2006 (*RV Melville*)

The grab sampling returned to the surface irregular sample sizes, ranging from 2 kg to 250 kg. These grab samples were sub-sampled by cutting a slice of about 1 kg to 6 kg through the rock, generally perpendicular to the long axis of the chimney to adequately represent the zonation of the chimneys, which tend to be Cu-rich in the core and Zn-rich on the outside.

The submitted samples were bagged into individual numbered calico bags lined with plastic bags, which were packed in plastic polyweave sacks for transport by commercial freight forwarders to the commercial assay laboratory. Small amounts of the remaining sample (generally no more than 100 g) were taken for scientific research purposes by the independent researchers on the cruises. The remainder was bagged in the same way as the dispatched assay samples and stored by Nautilus in a storage facility in Brisbane, Australia.

13.9.3 Grab Sampling – 2007 (*MV Wave Mercury*)

Sample preparation for the grab samples collected during the 2007 program followed that of the 2006 campaign (see Section 13.9.3). In 2007, the chimney samples were sliced radially with a power saw, to obtain a sample approximately 3 cm thick through the full width of the chimney.

13.9.4 Grab Sampling – 2008 (*MV Nor Sky*)

After a study on sample variability from chimneys collected in 2007 (Pitard 2007) sub-samples from chimney samples collected in 2008 were taken from the base of the returned chimney by jack-hammer or geologist's hammer. Sub-samples for analysis were packed in heavy-duty plastic bags together with a pre-printed, plasticised sample-number tag.

Duplicate samples were inserted at a rate of 1 per 10 primary samples by taking an additional sub-sample from the original grab sample.

Blank samples were inserted at a rate of 1 per 10 primary samples. Builder's sand sourced from Brisbane, Australia, was used as the blank material.

Commercial certified reference material (CRMs) was inserted at a rate of 1 per 10 primary samples. CRMs were selected arbitrarily from a range of material supplied by Geostats or OREAS.

13.9.5 Grab Sampling – 2009 (*MV Fugro Solstice*)

Sample preparation for the grab samples collected during the 2009 program followed that of the 2008 campaign. Duplicate samples were inserted at a rate of 1 per 15 primary samples by taking an additional sub-sample from the original grab sample.

One low-grade base-metal certified reference material (CRM) and one low-grade gold CRM were inserted at a rate of 1 per 15 primary samples to act as quantified blanks within the sample sequence. Both low-grade CRMs were supplied by Geostats; the low-grade base metal CRM was GBM998-5 and the low-grade gold CRM was GLG907-1. The Low-grade material was produced from a barren basaltic rock.

One base-metal CRM and one gold CRM were inserted at a rate of 1 per 15 primary samples. Available CRMs were selected to cover a low to high grade material produced from sulphide ore-types. CRMs were selected arbitrarily from a range of material supplied by Geostats.

13.9.6 2007 Mineral Resource and Metallurgical Drilling (*MV Wave Mercury*)

Geochemical sampling of drillcore was carried out by Nautilus personnel after the on-board geotechnical testwork had been completed and the geotechnical test residues returned to the core trays. The drillcore was cut longitudinally in half with a diamond saw, unless the core was very soft in which case a chisel or knife was used.

Each sample was placed in a labelled plastic sample bag and a sample ticket was stapled to the bag for reference. For odd numbered holes the right hand half of the core (looking up the core tray) was sampled, for even numbered holes the left hand half of the core was sampled.

Duplicate core samples were collected at a rate of 1 for every 10 regular samples. The duplicate sample interval was replaced in the core tray with a rectangular bar of polystyrene foam cut to the length of the duplicate sample and marked with the word "Duplicate" and the duplicate sample number.

Each sample was packed into labelled green plastic bags and vacuum sealed. Samples are stored in refrigerated shipping containers. Core is added to the refrigerated units immediately after the handling of core into the core trays. Samples are only removed from the refrigerated units for logging and geotechnical tests.

Core and chimney samples from the 2007 program were analysed by ALS Laboratory Group in laboratories in Brisbane and Townsville. The laboratories are NATA certified. The samples were dried and crushed to 70% passing 2 mm in a jaw crusher. A rotary splitter was used to split 1 kg which was then pulverised in a ring mill to better than 85% passing 75 µm.

13.10 Sample Analysis

13.10.1 2006 Programmes

Samples from the March 2006 dredge programme, the February 2006 grab sampling and scout drilling program, and the July 2006 grab sampling program were assayed by ALS Chemex in Brisbane, Australia. Other assay results have been collated from numerous sources, in the most part scientific papers and no information on analytical methods or laboratories is available.

A suite of 32 elements was analysed by ALS Chemex in Brisbane, Australia. This facility has ISO 9001:2000 registration and is accredited by NATA (National Australian Testing Association). Atomic Absorption Spectrometry (AAS) was used for Au; Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) was used for Te; Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES) was used for all other elements.

13.10.2 2007 to 2009 Programmes

Samples from the 2007 to 2009 programs were assayed by ALS Chemex in Brisbane and Townsville. Cu, Ag, Pb and Zn were measured by ore-grade analysis using inductively coupled plasma atomic emission spectrophotometry (ICPAES) following an aqua regia digest. A number of stabilising compounds are used in the digestion to keep Cu, Zn, Pb and Ag in solution at high concentrations. Au was assayed by fire assay using a 30g charge and an AAS finish. Due to the high sulphide content, the fire assay charges were reduced for many samples. Al, As, Be, Bi, Ca, Cd, Co, Cr, Fe, K, Mg, Mn, Mo, Na, Ni, P, S, Sb, Sr, Ti, V, W, Hg, Se, Te and Li were analysed by ICPAES after a four acid digest; Ba was analysed by XRF.

ALS uses an extensive set of quality control procedures, including the use of blanks, duplicates and certified reference materials to monitor the quality of the sample preparation and analyses, and protocols for reanalysis of batches if results are unsatisfactory. Nautilus carried out its own quality control procedures, including the insertion of duplicates, blanks, certified reference materials (CRM) and matrix-matched secondary reference material.

Table 13-3: Elements, detection limits and analytical methods ALS Chemex

Element	Detection Limit	Units	Method
Au	0.01	ppm	AAS
Ag	1	ppm	ICP-AES
Cu	0.01	%	ICP-AES
Pb	0.01	%	ICP-AES
Zn	0.01	%	ICP-AES
Al	0.01	%	ICP-AES
As	2	ppm	ICP-AES
Ba	10	ppm	ICP-AES
Be	0.5	ppm	ICP-AES
Bi	2	ppm	ICP-AES
Ca	0.01	%	ICP-AES
Cd	0.5	ppm	ICP-AES
Co	1	ppm	ICP-AES
Cr	1	ppm	ICP-AES
Fe	0.01	%	ICP-AES
Ga	10		ICP-AES
Hg	1	ppm	ICP-AES
K	0.01	%	ICP-AES
Mg	0.01	%	ICP-AES
Mn	5	ppm	ICP-AES
Mo	1	ppm	ICP-AES
Na	0.01	%	ICP-AES
Ni	1	ppm	ICP-AES
P	10	ppm	ICP-AES
S	0.01	%	ICP-AES
Sb	2	ppm	ICP-AES
Se		ppm	ICP-AES
Si	0.01	%	ICP-AES
Sr	1	ppm	ICP-AES
Te	0/01	ppm	ICP-MS
Ti	0.01	%	ICP-AES
V	1	ppm	ICP-AES
W	10	ppm	ICP-AES

13.10.3 Metal Analysis of Particulate Matter Filtered from Niskin Water Samples

Water samples of between 2-10 litres were filtered through a filter pad which collected very fine particulate matter that was floating in the water column anomaly detected by the real time sensors on the CTD unit. This filter pad is sent to ALS Chemex Environmental Laboratory in Brisbane for analysis. The filter pad and particulate matter are dissolved together in aqua regia and analysed through solution on an ICP-MS. A suite of 26 elements commonly associated with SMS systems was assayed.

13.11 Bulk Density

Measurements of dry bulk density were determined on samples of drillcore and chimneys, as described in detail by Lipton (2008). Average bulk densities in each geological unit are listed in Table 13.4. Lipton (2008) reports that three density measures were used including water Archimedean, Water Displacement and calliper methods from the drillcore. Lipton (2008) has compared various methods of density measurements to confirm the suitability of the methods used.

Table 13-4: Dry bulk density grades assigned to stratigraphic domains

Zone	Domain code	Dry bulk density (t/m^3)
UCS	200	1.2
LS	300	2.4
MS	400	3.0
Basement (altered volcanics)	500	2.2
Chimney	600	2.2

Source: Lipton (2008)

13.12 Sample Security

Security tags were applied to all shipping containers (plastic drums or polyweave sacks). Holes were drilled through the lids and sides of each drum at two diametrically opposite points. Security tags were then applied so that lids could not be opened without the removal of the tags. For the polyweave sacks, the security tags were used to close the neck of the sack. Upon receipt at ALS Chemex Laboratories in Brisbane, all original signed security tags were found to be in place and there was no evidence that the samples had been tampered with. Security tags were removed; samples were inspected and prepared for quarantine heat treatment on site at ALS Chemex. Following quarantine, samples were further processed onsite at ALS Chemex under standard laboratory security procedures.

Since the 2007 program, samples for dispatch have been placed into individually numbered plastic boxes with lids attached by tape and cable-tiles, including two cable-ties with unique embossed security numbers. The sample boxes and secure ID tags were numbered and photographed prior to handover to agent or courier. Details of the samples in each box are sent to the assay laboratory. The assay laboratory is required to report the condition of the box and that the security tags are in place.

In SRK's opinion, the sampling methodology, sample preparation, sample analysis and sample security procedures used for the sampling programs are appropriately designed and were implemented correctly.

14. Data Verification

The following sections exclude the 2009 program details. At the time of compiling this report, assay results were still pending for most of this program. SRK has however reviewed the quality controls used in the 2009 program, and is satisfied the 2009 procedures were undertaken to a similar high standard as in past programs.

14.1 Quality Assurance / Quality Control

Nautilus implemented an assay QA/QC program of repeats, duplicates, blanks, and commercially available Certified Reference Materials (CRM). During 2007 and 2008 QA/QC material was inserted into sample dispatches at the rate of 4 QAQC samples per 10 primary samples. During 2009 ROV programs QA/QC material was inserted into sample dispatches at the rate of 5 QA/QC samples per 15 primary samples.

14.2 Pulp Repeats

Selected pulp samples from grab samples were reassayed during 2008 using the same method as the original sample aliquot, to test the pulp homogeneity, digestion and assay process. Eleven grab samples from the Solwara group of deposits were reassayed for multiple elements. The results (Table 14-1; Table 14-2) show no statistical biases and the scatterplots (Figure 14-1, Figure 14-2, Figure 14-3, Figure 14-4) do not identify any obvious errors.

Table 14-1: Grab sample pulp repeats Cu, Pb and Zn results

	Original Cu	Repeat Cu	Original Pb	Repeat Pb	Original Zn	Repeat Zn
Count	11	11	11	11	11	11
Minimum	0.01	0.01	0.005	0.005	0.02	0.02
Maximum	29.4	30.2	2.33	2.39	36.2	37
Mean	9.57	9.58	0.88	0.90	11.26	11.31
Median	9.39	9.54	1.03	1.05	6.62	6.77
Standard Deviation	9.80	9.92	0.74	0.77	13.27	13.36
Coefficient of Variation	1.02	1.04	0.84	0.86	1.18	1.18

Table 14-2: Grab sample pulp repeats Au and Ag results

	Original Au	Repeat Au	Original Ag	Repeat Ag
Count	11	11	11	11
Minimum	0.03	0.02	0.5	0.5
Maximum	35.8	34.9	345	342
Mean	11.67	11.77	170.64	171.00
Median	12.0	12.4	189	187
Standard Deviation	11.05	10.97	118.52	119.09
Coefficient of Variation	0.95	0.93	0.69	0.70

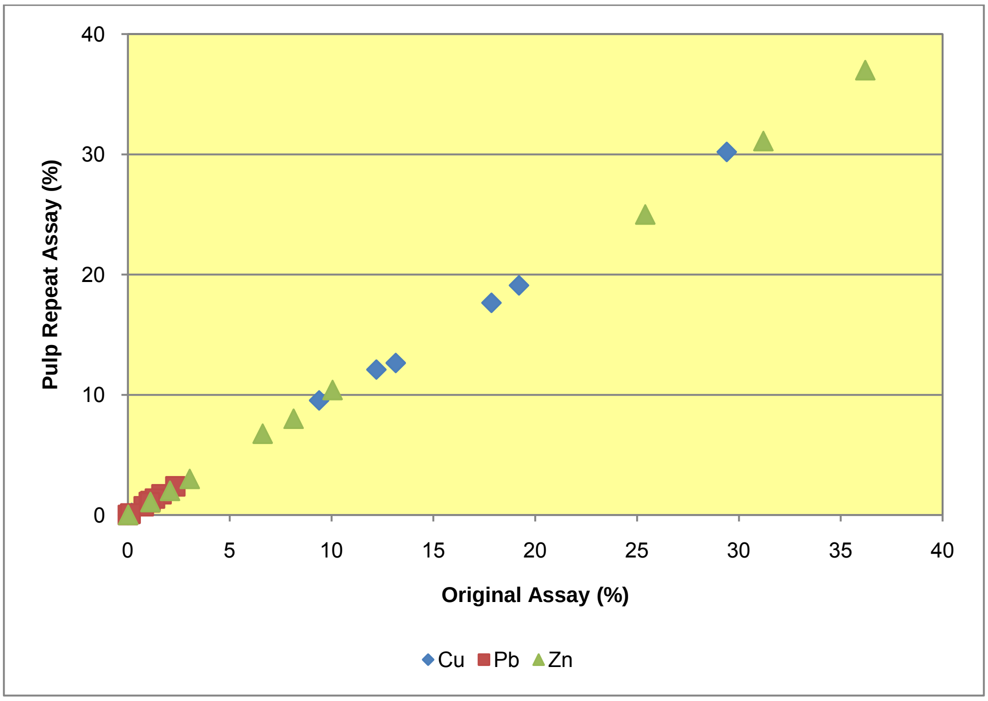

Figure 14-1: Original and pulp repeat Cu, Pb and Zn assays, Solwara grab samples

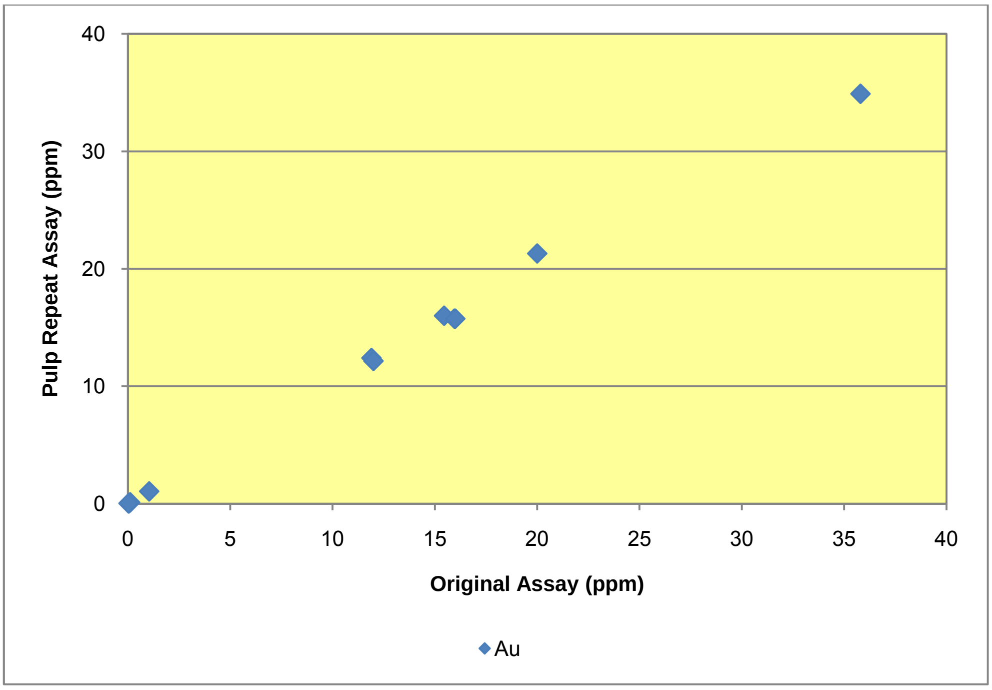

Figure 14-2: Original and pulp repeat Au, Solwara grab samples

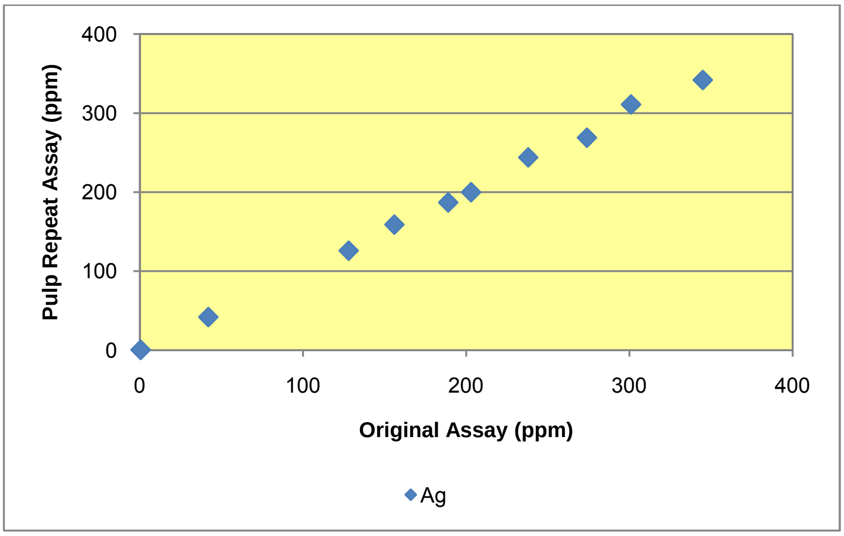

Figure 14-3: Original and pulp repeat Ag, Solwara grab samples

Fifty-six pulps from Solwara 1 drillholes were reassayed during 2008, using the same method as the original samples. The repeat results (Table 14-3) show no obvious bias in the statistics, and a very good correspondence on the scatterplot (Figure 14-4) except for one sample with an original value of 13.5ppm and a repeat of 3.89 ppm.

Table 14-3: Drillhole pulp repeats Au results

	Original	Repeat
Count	56	56
Minimum	0.01	0.01
Maximum	37.9	38.9
Mean	7.41	7.26
Median	4.9	4.62
Standard Deviation	7.82	8.04
Coefficient of Variation	1.05	1.11

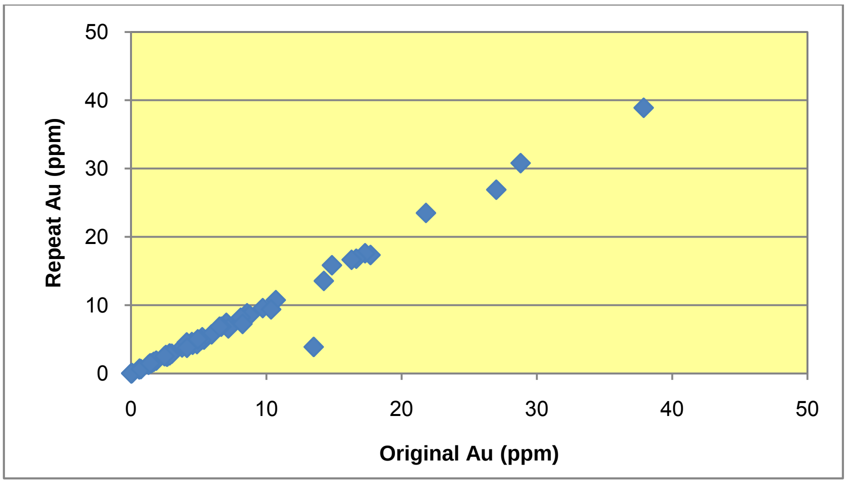

Figure 14-4: Original and pulp repeat Au assays, Solwara 1 drillholes

14.3 Coarse Repeats

Coarse repeats were taken during 2008 at the assay laboratory from stored coarse-rejects. The results are tabulated in Table 14-4 and Table 14-5. These show that the repeat assays are very similar to the original, suggesting that the original split is representative of the sample crushed.

Table 14-4: Grab sample coarse repeats Cu, Pb and Zn results

	Original Cu	Repeat Cu	Original Pb	Repeat Pb	Original Zn	Repeat Zn
Count	9	9	9	9	9	9
Minimum	0.08	0.09	0.1	0.09	1.14	1.16
Maximum	30	30.2	1.9	1.95	34.5	33.6
Mean	10.78	10.73	0.71	0.68	12.1	11.67
Median	8.09	8.08	0.67	0.54	5.43	5.19
Standard Deviation	10.58	10.67	0.52	0.55	11.60	11.12
Coefficient of Variation	0.98	0.99	0.73	0.80	0.96	0.95

Table 14-5: Grab sample coarse repeats Au and Ag results

	Original Au	Repeat Au	Original Ag	Repeat Ag
Count	9	9	9	9
Minimum	57	55	0.08	0.1
Maximum	320	331	50.1	47.5
Mean	189.56	186.89	19.24	18.76
Median	158	164	18.7	19.2
Standard Deviation	77.77	80.47	15.38	14.63
Coefficient of Variation	0.41	0.43	0.80	0.78

14.4 Field Duplicates

A total of 78 duplicate samples were obtained by collecting the second half of the core from the core trays of holes drilled during 2007 and 2008. Each duplicate sample was submitted in the same batch as the original sample. Fifty-six duplicate samples of chimneys were obtained by collecting a second slice of chimney from adjacent to the original slice. Results are tabulated in Table 14-6 to Table 14-9. These show that the duplicate grades are similar to the original grades; this suggests that the samples taken are representative of the material sampled.

Table 14-6: Grab sample field duplicate repeats Cu, Pb and Zn results

	Original Cu	Repeat Cu	Original Pb	Repeat Pb	Original Zn	Repeat Zn
Count	56	56	56	56	56	56
Minimum	0.02	0.01	0.01	0.005	0.02	0.01
Maximum	31.3	30.8	8.54	10.25	34.5	37.5
Mean	8.99	8.38	1.47	1.52	7.47	7.32
Median	5.7	6.42	0.485	0.56	3.51	3.68
Standard Deviation	8.87	8.22	2.30	2.62	9.16	8.91
Coefficient of Variation	0.99	0.98	1.57	1.73	1.23	1.22

Table 14-7: Grab sample field duplicate repeats Au and Ag results

	Original Au	Repeat Au	Original Ag	Repeat Ag
Count	62	62	56	56
Minimum	1	0.5	0.01	0.01
Maximum	884	857	64.8	62.1
Mean	196.49	204.50	15.58	15.86
Median	138	134	13.55	15.35
Standard Deviation	209.85	211.47	14.78	13.51
Coefficient of Variation	1.07	1.03	0.95	0.85

Table 14-8: Drillhole field duplicate repeats Cu, Pb and Zn results

	Original Cu	Repeat Cu	Original Pb	Repeat Pb	Original Zn	Repeat Zn
Count	78	78	78	78	78	78
Minimum	0.01	0.01	0.005	0.005	0.005	0.005
Maximum	19.95	20.3	1.08	2.69	5.52	11.65
Mean	6.79	5.30	0.11	0.11	0.57	0.47
Median	5.015	2.765	0.04	0.055	0.13	0.05
Standard Deviation	5.72	5.64	0.19	0.31	1.03	1.42
Coefficient of Variation	0.84	1.06	1.72	2.73	1.80	3.05

Table 14-9: Drillhole field duplicate repeats Au and Ag results

	Original Au	Repeat Au	Original Ag	Repeat Ag
Count	78	78	78	78
Minimum	0.5	0.5	0.02	0.005
Maximum	136	335	24.8	25.7
Mean	26.71	26.62	5.82	5.49
Median	15.5	8	3.78	3.885
Standard Deviation	31.11	50.72	5.55	5.70
Coefficient of Variation	1.16	1.91	0.95	1.04

14.5 Blanks

Sample blanks submitted during 2007 and 2008 consisted of ordinary silicate sand. Assay of the blanks showed below detection limit grades for Cu, Pb, Zn, Ag and Au. During the sampling programme, approximately 500g was placed in a normal sample bag with a sample number in the ordinary sequence and submitted to the laboratory. Analysis of the results (Table 14-10 and Table 14-11) shows that there has been some low level contamination in the laboratory; the mean grades are about 1% of the average tenor of the Nautilus samples, suggesting that there is a 1% between-sample contamination. This contamination may occur in the laboratory during the sample preparation process. This level is not high enough to materially alter the interpretation of the assay results; however it should be followed up by a review of laboratory procedures.

During the 2009 grab sampling program very low-grade CRM material was used in place of the blank.

Table 14-10: Grab sample blanks results

	Cu	Pb	Zn	Ag	Au
Count	23	23	23	33	23
Minimum	0.01	0.005	0.005	0.5	0.01
Maximum	0.45	0.04	0.4	11.1	0.39
Mean	0.08	0.01	0.05	2.37	0.10
Median	0.03	0.01	0.02	1.4	0.04
Standard Deviation	0.10	0.01	0.08	2.54	0.12
Coefficient of Variation	1.32	0.76	1.58	1.07	1.12

Table 14-11: Drillhole sample blanks results

	Cu	Pb	Zn	Ag	Au
Count	107	107	107	109	46
Minimum	0.005	0.005	0.005	0.5	0.01
Maximum	0.43	0.01	0.02	6	0.27
Mean	0.02	0.01	0.01	1.12	0.03
Median	0.01	0.005	0.005	0.5	0.01
Standard Deviation	0.06	0.00	0.00	1.13	0.05
Coefficient of Variation	2.50	0.20	0.44	1.02	1.67

14.6 Certified Reference Materials

Commercially prepared Certified Reference Materials (CRMs) are used to control the accuracy of the assaying process. Sixteen different CRMs are used (Table 14-12) with base metal or precious metal grades similar to mineralised grades.

Table 14-12: Reference Materials ppm values and 95% Confidence Intervals

CRM	Source	Cu	Pb	Zn	Ag	Au
GBM304-11	Geostats Pty Ltd	104,011±897	1648±27	109±9		
GBM304-16		22,721±259	728±18	718±22		
GBM305-15		262,422				
GBM906-13		21,682±217	108±6	3036±59	3.74±0.33	
GBM906-16		106,807±1267	239±16	4783±179		
GBMS304-2		14,325±87.14	820 ±7.84	57±1.19	5.1±0.11	6.04± 0.05
GBMS304-4		9,698±20.39	271 2.6	149 2	0.8±0.05	5.67±0.05
G308-8						2.45±0.12
G907-6						7.25±0.29
GBM998-5		0.0056±0.0007	0.0008±0.0006	0.0084±0.004		
GLG907-1						0.00387±0.00309
OREAS-10Pb	Ore Research & Exploration Pty Ltd					7.15±1.0
OREAS-24P		52	2.9	114	1	
OREAS61d						
OREAS62d					8.37	10.5
OREAS_62Pb					21.5	11.3

14.7 Standard Reference Materials

During 2007 Nautilus produced two Standard Reference Materials ("SRMs") from a composite of approximately 100kg of pulverised sulphidic rejects of Solwara 1 chimney samples from the *DP Hunter* cruise (SRM NUSC) or drillcore samples from the 2006 drilling program (SRM NUSD). HRL Testing in Albion, Australia prepared the composite by:

- Stage crushing.
- Pulverising to 90% passing 75µm.
- Blending.
- 60g aliquots taken using a scoop.

Aliquots were submitted to five Australian laboratories to determine the average grades of the material. The laboratories were ALS Laboratories, Brisbane, Amdel Laboratories of Thebarton, UltraTrace Laboratories of Canning Vale, Becquerel Laboratories of Malaga and Standard and Reference Laboratories, also of Malaga. The first four laboratories analysed 5 samples. Standard and Reference Laboratories analysed a single sample. Different assay methods were used by the various laboratories (Table 14-13). Nautilus compiled the results of the analyses. Results that were considered biased or unacceptably variable were discarded; the averages of the remaining results were taken as the reference value. The reference grades for these (NUSC and NUSD) are tabulated in Table 14-14.

Table 14-13: Assay methods used for Standard Reference Material

Laboratory	Samples	4AD, ICP-OES	FA	NAA	Wet Chemistry	HBr-Br
ALS	5	Cu, Zn, Pb	Au			
Amdel	5	Cu, Zn, Pb	Au			
UltraTrace	5	Cu, Zn, Pb	Au			
Becquerel	5	Cu, Pb		Zn, Ag, Au		
Standard & Reference	1		Ag, Au		Cu, Zn	Pb

The average value received of the standards (Table 14-15) corresponds well with the certified grades; except for one of the low level Pb (NUSC); this suggests that the lead assays may be biased high.

Table 14-14: Standard material grades and average of assays received

Standard	Count	Cu Value	Cu Average	Pb Value	Pb Average	Zn Value	Zn Average	Ag Value	Ag Average	Au Value	Au Average
NUSC	34	10.67	10.67	0.25	0.49	2.66	2.63	186	184.74	19.4	19.71
NUSD	108	5.11	5.12	0.23	0.23	1.71	1.72	44	42.87	5.91	5.90

Note: Base metals in %, precious metals in ppm

Analysis of the NUSC and NUSD SRMs during 2008 indicated oxidation of the material and the SRMs have since been replaced in the QAQC process by relevant CRMs produced commercially from sulphidic-matrix material.

15. Adjacent Properties

15.1 Neptune Minerals plc

Neptune Minerals plc ("Neptune") is engaged in exploration for SMS deposits in Papua New Guinea. Neptune was granted two exploration licences in PNG in October 2007: EL 1541 and EL1542, totalling 495 km^2, which are adjacent to Nautilus' tenement holdings in the Bismarck Sea. Neptune also held tenements offshore and the east of New Ireland, Papua New Guinea in 2009.

15.2 Bismarck Mining Pty Ltd

Bismarck Mining is a Sydney-based private company, with a registered office in Melbourne. As of November 2009 Bismarck Mining held seven exploration licences in the Bismarck Sea adjacent to Nautilus' tenements and tenement applications. Renewal applications for all of these tenements were submitted over reduced areas in 2009.

16. Mineral Processing and Metallurgical Testing

This section is a summary by Ausenco of reports by Mineralurgy Pty Ltd. It details the mineral processing and metallurgical testing campaigns completed during development of the Solwara 1 Project.

During development of the Solwara 1 Project a series of sampling and testing programs were completed. These comprised:

- 1998 testing of five samples from different areas of various Solwara deposits.
- 2005 testing of a single composite sample from the Solwara 1 deposit.
- 2007-2008 testing of core from 24 drillholes and 2 composite surface (chimney) samples from the Solwara 1 deposit.

16.1 1998 Testing

In 1998, Rio Tinto Exploration's Research and Technology Development conducted bench assay and pilot tests on five Manus Basin samples supplied by CSIRO (Rio Tinto, 1998). Three samples were from Solwara 4a, one was from the Solwara 3 prospect, and one from the Solwara 1 prospect.

Test work carried out by Rio Tinto included staged crushing, assay, and rougher flotation. The tests flagged no unusual process issues and achieved a recovery of 90% of zinc and copper to respective bulk concentrates. The test work on these SMS composites showed their flotation characteristics to be similar to terrestrial volcanic-hosted massive sulphide (VHMS) ores.

The sample preparation flow sheet was:

- Five rock samples ranging up to 2 kg in mass were used.
- Samples were crushed to 100% passing 3 mm.
- Further crushing was completed to achieve a particle size distribution where the majority of mass was between 38 and 212 µm, which is an ideal floatation size range.
- A sub-sample of samples BB4 and BB8 (both Solwara 4a) were selected for testing; a composite of equal parts by weight of all five samples (including those from Solwara 4a) was also prepared.

The +38 -53 µm and +150 -212 µm fractions were prepared for mineralogical characterisation. Mineral liberation was quantified using a Kontron mineral image analyser.

Assay results for two of the samples are:

- BB4 0.45% Cu, 41.4% Zn, 2.29% Fe, 16.6% Ba, 25.8% S.
- BB8 8.02% Cu, 23.6% Zn, 11.9% Fe, 17.3% Ba, 28.3% S.

Three flotation tests were performed focusing on maximising the recovery of copper and zinc to their respective sulphide concentrates.

Mineral liberation for both sphalerite and chalcopyrite were determined. Sphalerite liberation ranged from 74% to 83% in BB4 to 79 to 87% in BB8. Chalcopyrite liberation ranged from 34% to 43% in BB4, the lower copper and zinc ore, and from 80% to 89% in BB8.

Greater than 90% recovery of Cu and Zn to sulphide concentrates was achieved by rougher flotation. Given the recovery from the rougher sample, no cleaner flotation tests to achieve maximum concentrate grade were performed. The test work indicates a copper flotation pH of 6.5.

16.2 2005 Testing

A composite sample of mineralisation from the Solwara 1 prospect was tested by Placer Dome Inc. in 2005 (Jiang & Aylmore, 2006). The sample consisted largely of chalcopyrite, pyrite, and barite. Minor quantities of marcasite, sphalerite, galena, rutile and quartz were also present, with trace amounts of tennantite, anglesite/cerussite, bornite, covellite, Fe-oxides, and carbonates.

Bulk flotation recovered 97% of the Cu, 93% of the Ag, 90% of the Pb, 96% of the Zn and 75% of the Au present. This concentrate assayed 26.64% Cu, 3.38% Pb, 4.92% Zn, 440g/t As and 15.51g/t Au. Separation of individual copper, lead and zinc mineral components by sequential flotation and differential flotation approaches was not successful. However mineralogical results indicate that liberation and separation of minerals containing lead and zinc should be possible at a finer grind size. The sample was compared to other terrestrial massive sulphide ores (Osborne, Australia; Duck Pond Mine, Canada; and Brunswick, Canada). The metallurgical characteristics of the concentrate produced from the seafloor sulphide were similar to these mining operations.

16.3 2007 Testing

Taylor (2007) defined eight ore types, based on logging of a selection of 29 out of the total of 111 resource drillholes drilled in 2007 (Table 16-1). Metallurgical samples of each of these ore types were then composited from 24 new core holes drilled specifically for metallurgical testing. These holes were located as close as possible to resource drillholes and designed to produce proportions of each ore type representative of its abundance in the deposit. Two composite chimney metallurgical samples were also collected, one zinc-rich and one zinc-poor. Sample locations of the drillhole and chimney metallurgical samples are shown in Figure 16-1 and Figure 16-2 respectively.

The metallurgical samples were cleaned in fresh water, dried, vacuum sealed, placed in a nitrogen purged container and shipped to the AMMTEC Limited laboratory in Perth, Australia. The samples were dispatched as whole core.

Table 16-1: 2007 Drillhole metallurgical samples with ore type descriptions

Sample	Material Type Description	Sample Mass (kg)
1	Chalcopyrite-pyrite -sphalerite mineralisation as veins, blebs, clasts, breccias and disseminations within sedimentary units above the massive sulphide horizon	132
2	Vuggy and porous chalcopyrite-pyrite mineralisation within the massive sulphide horizon	322
3	Dense massive sulphide (chalcopyrite-pyrite), rare vugs; can be banded. Main part of massive sulphide horizon	137
4	Brecciated massive to semi-massive sulphide, chalcopyrite-pyrite	313
5	Dominant anhydrite/barite overprint, veins within altered footwall volcanics pyrite-chalcopyrite Transition zone between massive sulphide horizon and footwall.	74
6	Chalcopyrite-pyrite mineralisation with anhydrite overprint and veins within altered footwall volcanic rocks. Transition zone between massive sulphide horizon and footwall.	24
7	Altered brecciated footwall volcanics with disseminated and vein pyrite-chalcopyrite	87
8	Altered basaltic volcanics brecciated with blebs and disseminated pyrite-chalcopyrite	23

Note: cpy – chalcopyrite, py – pyrite, -spl – sphalerite

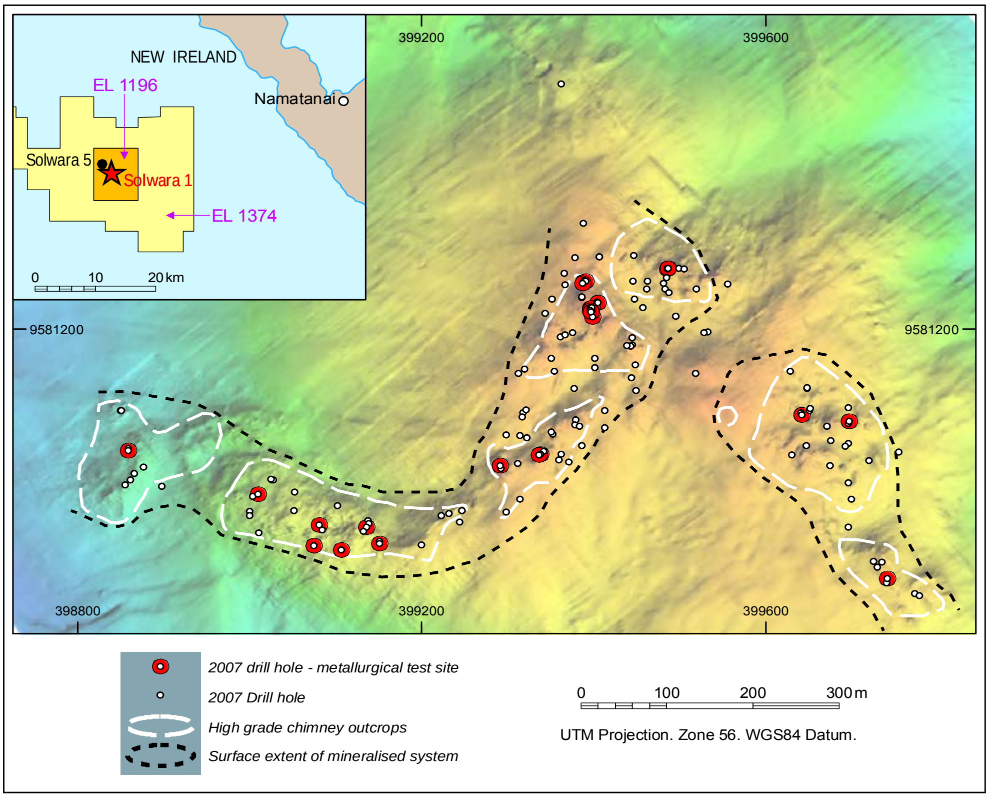

Figure 16-1: Location of the metallurgical test samples from drillholes

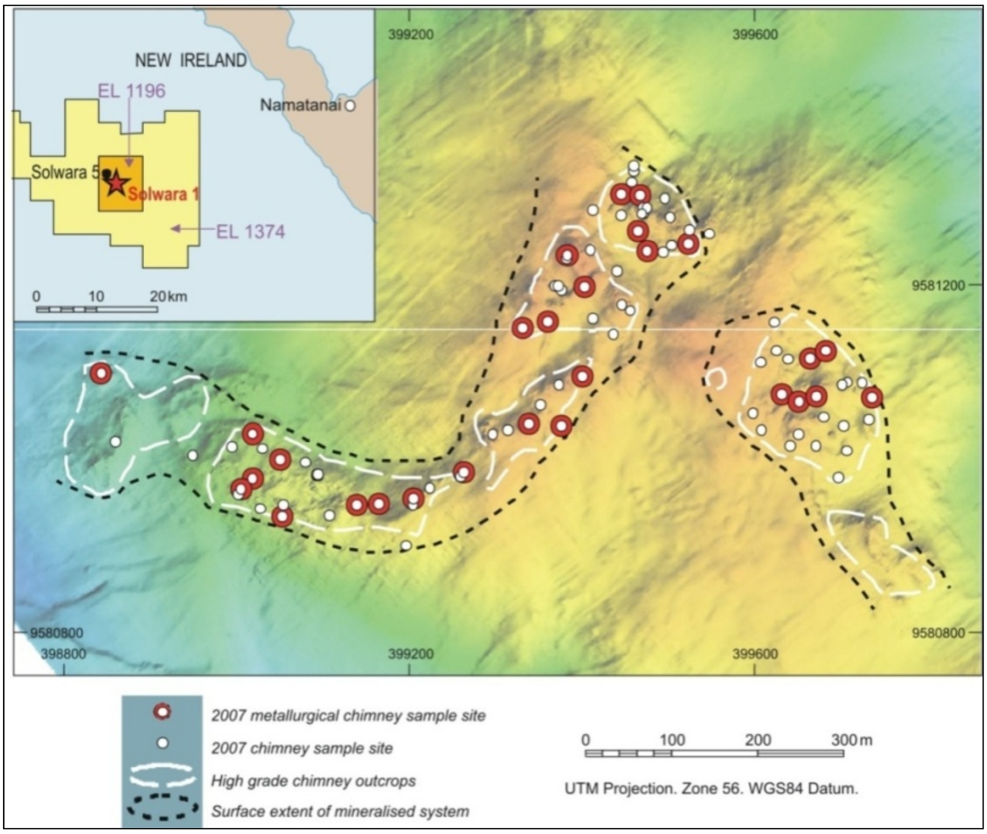

Figure 16-2: Location of the metallurgical test sample from chimneys

16.4 2008 Testing

Further metallurgical test work was performed by AMMTEC and G&T Metallurgical Services under the supervision of Mineralurgy Pty Ltd in 2008 (Munro & Johnson, 2008). The emphasis of this work was on producing a saleable Cu concentrate with payable precious metals rather than a Zn concentrate, as Zn-rich material is a relatively minor proportion of the Solwara 1 resource.

Mineralogical studies showed that the dominant Cu-bearing mineral is chalcopyrite, with lesser amounts of bornite, chalcocite and covellite. There is a very low content of the Cu-As-bearing phases of tetrahedrite, tennantite and enargite, indicating that any copper concentrate should not contain unacceptably high As. Arsenopyrite contents of up to 1% have been recorded. Testwork has shown it does not report to the copper concentrate.

Pyrite is the dominant gangue mineral and the pyrite:chalcopyrite mass ratio is around 2:1, which is favourable for flotation separation. The test work average to date shows that a saleable Cu concentrate of 25% to 30% Cu can be produced by conventional grinding and flotation. Copper recovery is 85% to 90% and gold recovery to copper concentrate is around 25%, with about 80% of the remaining gold able to be recovered into a pyrite concentrate.

The Bond Ball Work Index ranges from 10 to 12 kWh/t, which is a moderate value for mineral processing.

Testing of samples of low grade material from the footwall of the SMS gave similar recoveries of copper as the ore-grade samples. This suggests that the inclusion of any mining dilution in the ore stream should not adversely affect copper processing.

Saleability of the pyrite concentrate has not yet been finalised, although test work has demonstrated that its treatment is technically viable using existing methods and technologies.

16.5 Mineral Processing Design Basis

The objective of the metallurgical test programs completed to date has been to put the processing of Solwara 1 material in the context of the characteristics of other Volcanogenic Massive Sulphide (VMS) deposits ie. to show that its submarine occurrence does not directly impact on processing.

While there has been a significant sampling program undertaken by Nautilus Minerals, it is not yet clear if individual samples are representative of the variability within the orebody.

Variability samples were also tested to examine whether each sample had clear similarities in its properties to those of the composite example of that ore type (as used for metallurgical design). The examination concluded the composites were suitable for conceptual flow sheet development.

The results of the mineralogical and metallurgical test work to date can be summarised as follows:

- Treatment by conventional grinding and flotation processing produced copper concentrates grading 25 to 30% Cu.
- Copper recovery in the laboratory has been 85-90%.
- Gold recovery to the copper concentrate is around 25%.
- Copper is present almost exclusively as chalcopyrite.
- Chalcopyrite liberation is significant at a sizing of 80%-40 µm with the test flow sheet using a primary grind of 80%-55 µm and regrinding of rougher concentrate to 80%-25 µm.
- Arsenic is the only significant deleterious element in the ore, with the main carrier being arsenopyrite, however, arsenic levels in concentrates from samples tested were all below typical penalty levels.
- Around 65-70% of the gold not reporting to the tailing can be recovered into a pyrite concentrate.

- At least 80-90% of the gold reporting to the pyrite concentrate can be extracted by the conventional technologies of roasting / cyanidation or pressure oxidation / cyanidation. This would give a total 'gold recovery' to copper concentrate + bullion of 75 to 90%.
- The pyrite concentrate averages about 7—9 g/t Au and ~45% sulphur.
- Melnikovite or 'primitive pyrite', which accounts for around 15% of the pyrite, has a gold content of ~44 g/t Au compared with crystalline pyrite at ~4 g/t Au i.e. an order of magnitude higher.
- The samples tested have Bond Ball Work Index values in the range of 10-12 kWh/t indicating a low to medium resistance to comminution.

These results have not been optimised but the following important points should be noted:

- Copper flotation results are consistent for all samples tested.
- Dilution with low grade materials or 'country rock' should not affect copper metallurgical performance.
- Copper concentrates are 'clean' and should not present any problems to custom copper smelters.
- Exposure of the materials tested for up to 8 weeks has not caused any major deterioration in metallurgical performance.
- Production of an auriferous pyrite concentrate will be necessary to get 'gold recovery' to copper concentrate and doré bullion to 75 to 90%.
- The only attempt at making a zinc concentrate gave an encouraging result, with a product high in precious metals that may be upgraded by the established technique of reverse flotation.

Characterisation tests were also done. These did not show any significant issues affecting copper flotation performance. Accordingly, copper concentrates were produced by a conventional laboratory batch flotation technique. Copper concentrate grades were all above 25% Cu, with the main diluent being pyrite. Taking a target concentrate grade of 28% Cu indicates that the expected copper recovery will be 85 to 90%. All the copper concentrates have gold contents above 1 g/t Au, with a recovery of ~25%. The copper flotation performances on each ore sample were achieved with essentially the same conditions. Locked cycle flotation tests and pilot scale work are in progress. Testing of diluents (e.g. transition, footwall) suggests these will not deleteriously affect flotation performance.

Production of pyrite concentrates from copper flotation tailings reduced gold lost into the flotation tailings to less than 10%. Testing suggests that gold remaining after production of a copper concentrate is 'refractory' because of its intimate association with pyrite. Preliminary tests suggest a bulk pyrite concentrate will contain 4 to 15 g/t Au, with pressure oxidation and cyanidation giving 95-99% gold extraction after 98-99% sulphur oxidation. Analysis found the gold content of the melnikovite component (at 44 g/t Au) is an order of magnitude greater than that of the crystalline pyrite which (at 4 g/t Au).

The resource contains a minor amount of zinc rich ore. A single test was completed that resulted in 71% zinc recovery to concentrate grading 43% zinc. It is expected that this result could be improved upon but any zinc concentrate is expected to be lead-rich and contain high amounts of gold and silver. Such a product is more suited for treatment by an Imperial Smelting Furnace smelter rather than the conventional roast-leach-electrowinning plants.

16.6 Mineral Processing Plant Description

Processing option studies have been undertaken by Ausenco for a new build processing plant (in PNG) and for toll treatment using an existing facility. Mineral processing is outside the scope of this report. However, below is a summary of the technical work undertaken in those studies including the associated design criteria, assumptions and constraints which may be considered in any processing evaluation.

The Solwara 1 operation will mine a volcanogenic massive sulphide deposit located on the sea floor, off PNG. VMS deposits are a well known group of poly-metallic base metal sulphide deposits. These ore types are routinely treated by conventional minerals processing technology. The operation is initially proposed to process ~1.3 Mtpa of ore to produce ~0.4 Mtpa of copper concentrate and up to ~0.7 Mtpa of auriferous pyrite concentrate. In subsequent years, the treatment rate ramps up to ~1.8 Mtpa of ore.

16.6.1 Concentrator Flowsheet Description

This section outlines the conceptual design for a new concentrator treating the Solwara 1 ore and producing a copper and a pyrite concentrate.

The concentrator facility would be comprised of the following areas:

- Ore handling, storage and reclaim.
- Grinding and classification.
- Copper flotation.
- Pyrite flotation.
- Concentrate thickening.
- Concentrate filtration and storage.
- Tailings handling and disposal.
- Reagents handling.
- Water supply.
- Air supply.
- Utilities.

Run-of-mine (ROM) ore is received at the concentrator ore unloading wharf. Ore is off-loaded onto a transfer conveyor. The transfer conveyor delivers the ore to an open radial stockpile. A front-end loader recovers ore from the ROM stockpile and continuously feeds a mill feed hopper.

The grinding circuit and downstream plant is scheduled to operate 24 hours per day, 7 days per week with availability above 90%. The circuit consists of a single-stage low-aspect SAG mill in closed circuit with cyclones.

The copper flotation circuit consists of a rougher flotation bank, regrind mill for rougher concentrate followed by three stages of cleaning in separate banks of tank cells. The first cleaner bank is operated in open circuit.

The pyrite flotation circuit consists of a conditioning tank, rougher flotation bank, two-stage cleaning of rougher concentrate in separate banks of tank cells, cleaner scavenger bank and regrind mill for cleaner scavenger concentrate.

Copper and iron concentrations of streams within the flotation circuit are monitored by on-stream analysis to optimise concentrate grades and recoveries.

Copper and pyrite concentrates are initially dewatered using separate high-rate thickeners. Thickened copper and pyrite concentrates are dewatered by dedicated single pressure filters to achieve product moistures of approximately 9.5% for shipment. Dewatered concentrate discharging from each filter is stored in covered stockpiles until transported off site. The concentrates are reclaimed from the stockpiles by front-end loaders to a conveyor feed hopper.

Flotation tailings from the pyrite flotation circuit are pumped to a tailings storage facility (TSF) or alternatively to a deep sea tailings placement (DSTP) facility. Flotation tailings contain a high proportion of sulphides and as a result are deposited sub-aqueously. A cover of water is maintained over the tailings to minimise oxidation and acid generation. Water from the tailings storage facility is returned to the process water tank in the plant via a floating reclaim pump barge.

A covered storage area for reagents is located adjacent to the main reagents mixing area. The reagents mixing area incorporates concrete bunds for containing reagent tank spillage. The concentrator facility stores, mixes and distributes the following reagents: hydrated lime; flotation collectors and frother; copper sulphate; flocculant; steel grinding balls; and ceramic regrind media.

Decant water is pumped from the TSF to the process water tank via a floating pontoon pump. Raw water is used as make-up to the process water supply as required.

Dedicated process and raw water tanks provide short-term storage requirements at the plant. Process water is reticulated around the plant for use. The raw water tank is also used to feed the gland water system and has a dedicated fire water reserve.

Raw water is treated in a potable water treatment facility and stored in a potable water tank at the plant site.

High pressure air compressors supply compressed air to the plant for general use. Dedicated high pressure air compressors also supply air for the concentrate filters air drying cycle. Low pressure blowers deliver low pressure air to the flotation cells.

17. Mineral Resource and Mineral Reserve Estimates

17.1 Solwara 1 Resource Estimate

The Mineral Resource for the Solwara 1 deposit was estimated by Ian Lipton of Golder Associates Pty Ltd (Golder) following the 2007 data collection program. This estimate was reported in a Technical Report pursuant to NI43-101 (Lipton, 2008); this report is available on the SEDAR website. Mr Ian Lipton is the Qualified Person for the estimate, which is summarised in Table 17-1.

Table 17-1: Mineral Resources for Solwara 1 (Lipton 2008)

Classification	Domain	Tonnes	Cu (%)	Au (g/t)	Ag (g/t)	Zn (%)
Indicated	Massive sulphide	870,000	6.8	4.8	23	0.4
Inferred	Chimney	80,000	11	17	170	6
Inferred	Lithified sediment	2,000	4.5	5.2	36	0.6
Inferred	Massive sulphide	1,200,000	7.3	6.5	28	0.4
Indicated	**Total**	**870,000**	**6.8**	**4.8**	**23**	**0.4**
Inferred	**Total**	**1,300,00**	**7.5**	**7.2**	**37**	**0.8**

Lipton (2008) considers that the following risks and uncertainties may materially influence the resource estimate:

- A significant number of drillholes (44%) ended in massive sulphide material. In such instances, and where no adjacent drillhole information was available from which the true thickness could be reasonably interpreted, the base of the drillhole was interpreted to be the base of the massive sulphides. The massive sulphide resource is therefore open at depth in some areas.
- Although a few drillhole intercepts in the basement zone exceeded the cut-off grade, material in this zone was excluded from the resource estimate, as these widely spaced drillhole intercepts were erratic and their grade correlation was unclear.
- Drillhole intercepts in the unconsolidated sediment suggested that this zone contains some material above cut-off grade. Whilst this may be likely in the form of chimney rubble or interstitial sulphide precipitation, this material has been excluded from the resource estimate.
- No drillholes were located on top of the exposed chimney mounds, consequently, the block grade estimates for interpreted massive sulphide material below these mounds is based on holes drilled adjacent to these mounds. It is possible that the massive sulphide material beneath the chimney mounds may have a different mineralogical composition being closer to the interpreted source of the mineralising fluid.
- Average core loss of around 30% could result in estimation bias if the core loss was preferentially related to low or high grade material. Closed-spaced (<5m) drilling for metallurgical samples suggests that the probability of such preferential core loss is low.
- Significant lateral extrapolation of massive sulphide mineralisation to the boundaries of the EM anomaly was supported by all holes drilled in 2007. However, a large proportion of the Inferred Resource relies on this EM anomaly in areas that have not been tested by drilling. The EM provides no information on base metal grades. Furthermore, it is not possible to determine the thickness of the conductor sulphide material from the EM data, thus, the interpreted thickness of massive sulphide in areas distant to drilling is of low confidence. The EM anomaly is open at the western end of the deposit.
- The higher-grade chimney mounds have only essentially been surface sampled by breaking off protruding chimney pieces. The interpreted depth of the chimney mounds is based on an automated algorithm that produces a truncated bathymetry that is considered geologically reasonable. However, until these mounds are tested by drilling, their grade, density and depth should be considered of low confidence. If the chimney mound/massive sulphide interface is not correctly positioned then the risk to the contained metal is considered to be low to moderate as the higher-grade/lower density chimney material would most likely be substituted by lower grade/higher density massive sulphide material.

- The Mineral Resource for Solwara 1 has not yet been re-estimated using the 2008 Drilling results. Nautilus intends to re-estimate the resource after completion of a more substantial drilling program with a drilling rig capable of drilling to at least 40 m depth.

18. Other Relevant Data and Information

18.1 Further Drilling

Nautilus plan to aggregate numerous SMS systems using the proposed floating mining production system. Terrestial VHMS systems occur in camps, and Nautilus' mineralisation discoveries within the Bismarck Sea suggests this is also the case for the Solwara SMS systems. Up until the 31st December 2009, Nautilus has been able to identify seventeen significant SMS systems within the Bismarck Sea, and further discoveries are likely.

Nautilus' discovery rates for new SMS systems reinforces this notion of aggregation, however unlike terrestrial VHMS mineralisation, Nautilus plans to access multiple high grade systems by simply picking up its mining equipment and then moving to the new permitted site, without the need for expensive shaft or open pit access and supporting infrastructure.

Nautilus is currently planning an exploration drilling program designed to further understand the resources at its Solwara 1 system and within MLA154 (North Zone, Solwara 5, and potential under thin sediment cover), and to provide additional knowledge at selected SMS deposits in the Bismarck Sea Project Area. Nautilus is seeking to improve on the efficiency of the drill rig used during the 2007 and 2008 drilling campaigns and is currently assessing options for a seafloor drilling rig capable of increased productivity, better landing capability, improved core recovery and improved drilling capability (at least 40 m downhole).

Nautilus is planning additional exploration work in the Bismarck Sea in 2011 to further assess their tenement holdings and will focus on increasing its knowledge of SMS systems in the Bismarck Sea through additional drilling. This is intended to feed into the Exploration Project Pipeline to develop and maintain a suitable resource inventory.

19. Project Development Plan

19.1 Execution Overview

Nautilus development plan is to commence production at its Solwara 1 site located within Mining Lease Application MLA154, Bismarck Sea, New Ireland Province, Papua New Guinea (PNG) (refer Figure 19-1). The Solwara 1 Project will involve mining sea floor massive sulphide (SMS) deposits in approximately 1,500 m – 1,700 m water depth at a rate of 1.2 to 1.8 million tonnes per annum.

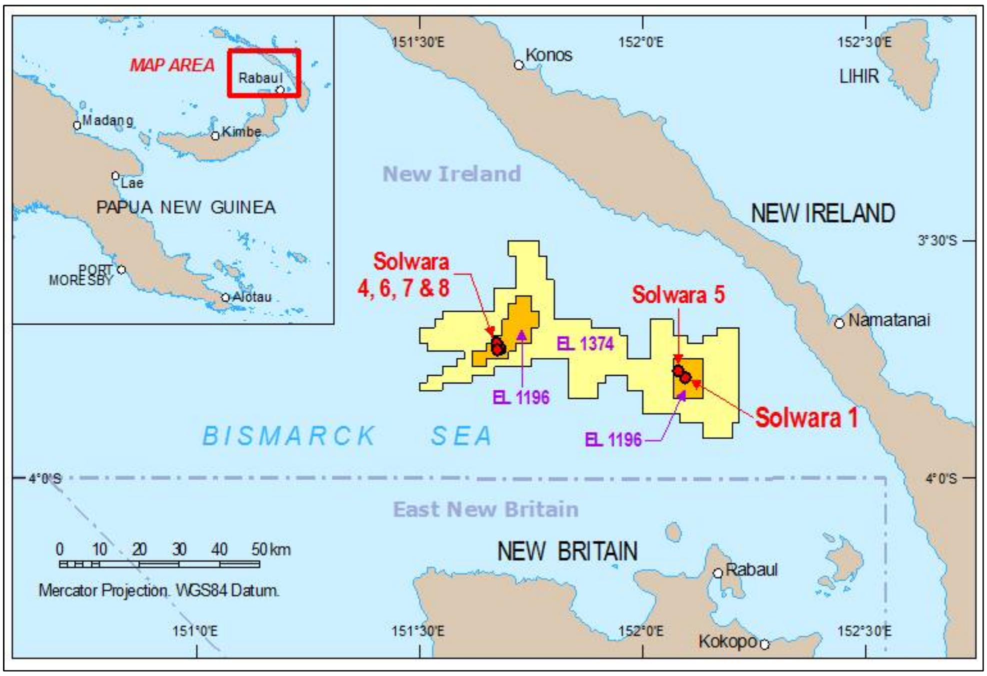

Figure 19-1: Solwara 1 Location

The development project comprises the following elements:

- Production Support Vessel (PSV).
- Seafloor Mining Tools (SMTs).
- Riser and Lift System (RALS).
- Dewatering Plant (onboard PSV).
- Ore transportation to the port of Rabaul.
- Storage at an onshore stockpile facility (see note).
- Load-out and transportation to processing facility (see note).
- Concentration of ore product (see note).
- Transportation of concentrate to the market (see note).

Note: At the time of writing this report, Nautilus is in commercial discussions with external parties on PNG port operations and on concentrate processing options and hence the last four items above are excluded from the scope of this report.

Seafloor mining tools (SMTs) will be used to excavate the material from the seafloor in benches. The excavated material will be pumped as slurry to the production support vessel via a riser and lift system. The mined product will be dewatered at surface and then be transferred to cargo barges for transportation to shore for stockpiling. The ore will subsequently be loaded into bulk carriers for transportation to a mineral concentrator for subsequent processing and delivery to the customer concentrate smelter market.

A diagrammatic representation of the production process flow and associated process flow diagram are presented in Figure 19-2 and Figure 19-3. The onshore stockpiling, the shipping of ore to the concentrator, the processing operations in the concentrator and the shipping of the concentrate are outside the scope of this report.

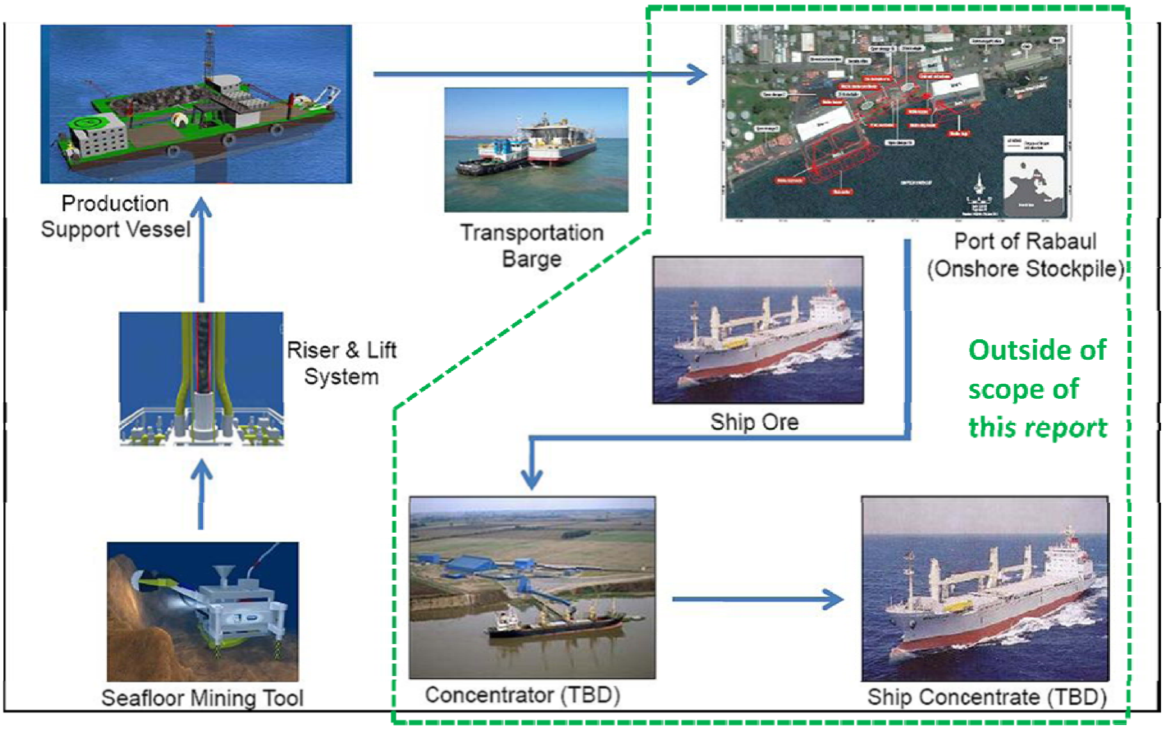

Figure 19-2: Seafloor Mining System Process Flow

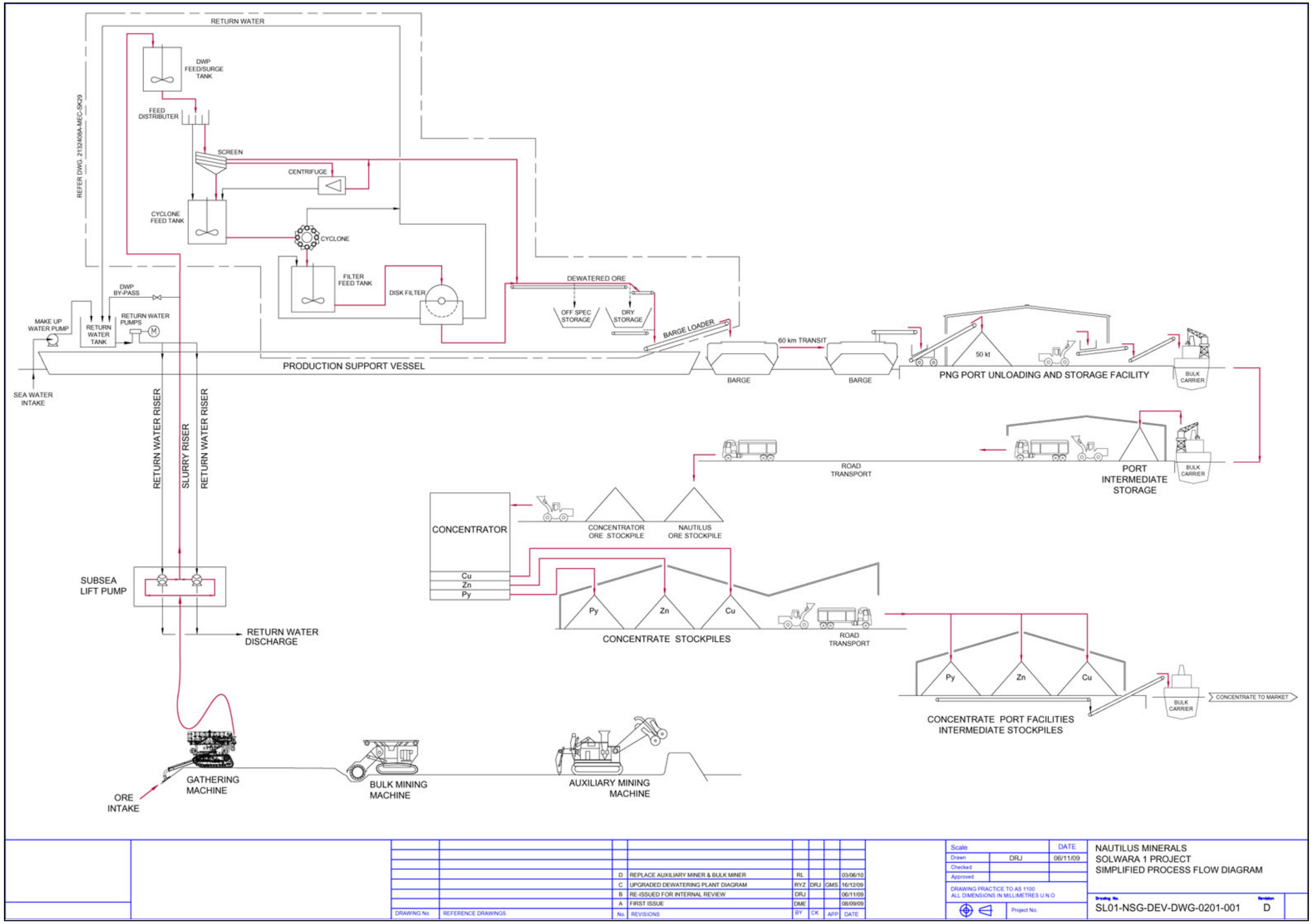

Figure 19-3: Solwara 1 Project – Simplified Process Flow Diagram

19.2 Project Delivery Plan

19.2.1 Nautilus Project Execution Philosophy

Nautilus' delivery model is to maintain a small owners management team centred in Brisbane, Australia, supervising either work packages managed by EPCM contractors or equipment purchases provided by vendor design and construct packages. Each significant package is supervised by a dedicated Lead Engineer or Delivery Manager reporting to one of the two Project Managers (onshore and offshore) who report to the Project Director.

This structure provides the required resource flexibilities and expertise of contracting groups across the range of disciplines required to deliver this project, whilst ensuring package interfaces are understood and managed by the Nautilus team. The vessel integration EPCM will have particular responsibility for managing interfaces involved in transport, preparation and integration of the SME into the vessel (PSV).

The Project Team consists of Health and Safety, Environment, Engineering Systems, Projects Controls, Procurement, and Contracts, all of whom report to a Project Director. In turn the Project Director and the Operations Departments report to the Chief Operating Officer who reports to the CEO.

Work under contract will be competitively tendered. Award will generally be on a value for money / best technical risk basis within overall project delivery schedule. Fixed and firm prices will be sought where possible, with rates based contracting (target price, capped profit and bonus/malus schemes adopted to manage schedule risk). All such contracts will use Nautilus Minerals' standard contract documents.

Particular focus will be placed on technically capable world class groups.

19.2.2 Project Status

The Solwara 1 project is currently in a suspension phase. Nautilus had previously sanctioned the project and had placed commitments with the following companies:-

- Soil Machine Dynamics (SMD - Newcastle UK) for the seafloor mining tools design and construct contract (awarded December 2007).
- Technip (USA) Inc for the riser and lift system engineer, procure and construct management (EPCM) contract (awarded May 2008)
- GE Hydril (USA) Distribution Inc for the subsea lift pump design and construct purchase order (awarded June 2008).
- GE Vetco Grey Inc for the riser supply purchase order (awarded June 2008)
- LeTourneau Technologies Inc for the riser deployment / recovery system and surface "mud" charge pumps purchase order (awarded Sep 2008).
- North Sea Shipping As for the production support vessel charter heads of agreement (awarded June 2008).

Following the downturn in the global financial market, Nautilus suspended the project in December 2008 and terminated for convenience the contracts / purchase orders associated with GE Vetco Grey, LeTourneau Industries and North Sea Shipping. The remaining contracts / purchase orders of SMD, Technip and Hydril were partially suspended. Since that time, the project has continued engineering and commercial evaluation of key aspects of the project.

Nautilus intends to re-sanction and recommence the project build subject to Nautilus Board approvals.

The sections that follow describe the method of project delivery following project re-start-up.

19.2.3 Seafloor Mining Tools (SMTs)

The SMTs supply is a lump sum design and build contract (awarded to Soil Machine Dynamics (SMD) in UK). SMD is responsible for design, procurement, manufacture and assembly of three seafloor mining tools to meet the requirements of a functional specification.

SMD has a dedicated team in place for the development including design, procurement and build/assembly of the Seafloor Mining Tools (SMTs).

19.2.4 Riser and Lift System (RALS)

The Riser and Lift System has been let as an EPCM contract to Technip of Houston, USA. Technip are a reimbursable (target price) contractor with responsibility to design, specify, procure and deliver the complete system, including the RTP, the SSLP, lift riser, the seawater return and associated handling systems.

Technip will engage a number of specialist vendors on behalf of Nautilus to deliver the work under (largely) fixed price contracts. The target price scope includes delivery to a suitable integration facility in South East Asia. Technip and the various vendors will provide specialist personnel to assist in the equipment integration phase, mobilisation and set-up.

19.2.5 Dewatering Plant

The dewatering plant supply will be managed by a Nautilus Project Engineer. The process design will be performed by external consultants with a subsequent award of a fixed-price design and construct contract for the delivery of the DWP. Construction, inspection and integration of this package will be managed by the vessel integration EPCM.

19.2.6 Production Support Vessel (PSV)

Nautilus is considering a number of potential vessel options for the PSV. The PSV will likely be chartered and is the basis of the estimate provided in section 20 however ownership or equity by Nautilus would also be considered.

Nautilus will agree a basic conversion specification with the vessel owner / supplier to provide a unit capable of receiving the production equipment onboard the vessel at a suitable yard location to be sourced by an Integration Contractor. The vessel owner will be responsible for delivery of the unit to the agreed specification at the integration yard. The vessel charter will likely be based on the principles of a BIMCO Supply-time charter party with a BIMCO Crewman contract for provision of marine crew and services.

19.2.7 Vessel Conversion and Seafloor Mining Equipment (SME) Integration Phase

Nautilus intends to engage an EPCM contractor to manage these aspects of the work on its behalf, on a reimbursable, target price basis. The elected contractor will either manage the direct conversion work or represent Nautilus' interest and the interfaces between Nautilus, contractors/vendors and the vessel owner / supplier.

SME Integration works will be identified in a discrete Scope of Work document that will be used as the basis for tendering this service to appropriately qualified engineering and project management contractors.

The work under contract will be managed by the SME Integration EPCM in accordance with a company approved project execution plan.

19.2.8 Barging / Port of Rabaul

A Project Engineer will overview the establishment of an ore barging service and will manage the implementation of the port service agreement.

19.2.9 Mobilisation and Start-up

In addition to the direct SME Integration activities, the SME Integration EPCM will have an involvement in the subsequent mobilisation, transit to site and start-up activities. In such a case, during the initial start-up and transition to steady state mining operations, it is envisaged that Nautilus mining team would be onboard and form an integrated team with the SME Integration contractor personnel. The integration contractor would manage specialist personnel for the various SME vendors and supervise initial deployments and operation of the equipment to commission the system.

19.2.10 Project Schedule

First ore is scheduled 30 months after the project sanction. A level 1 project schedule is presented in Figure 19-4.

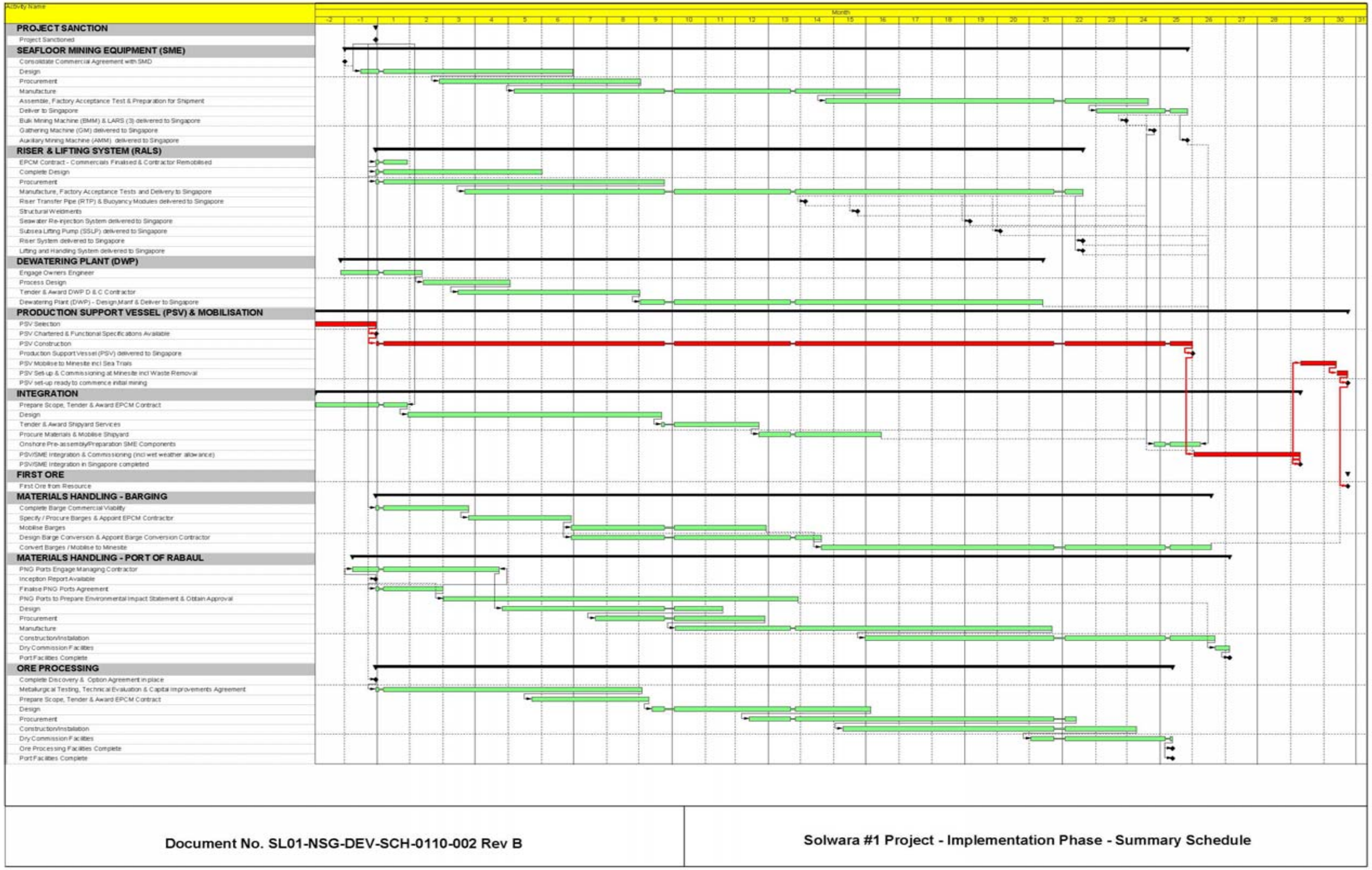

Figure 19-4: Level 1 Project Schedule

19.3 Operating Philosophy

19.3.1 Overview

The Solwara 1 project mining and processing production rate is planned to commence at a rate of 1.2Mtpa (dry equivalent) ultimately ramping up to 1.8Mtpa of dewatered ore delivered to the Rabaul Port. The systems and plant will be designed and operated so that the steady state annual rate of production is limited by the Seafloor Mining Tools (SMTs) and where practicable, all plant and equipment downstream of the SMTs will not restrict production.

Specifically the project will be designed and operated to achieve the following goals:

1 Maximise project NPV.

2 Be readily relocatable for application on other Bismarck Sea SMS deposits.

3 Minimise the application of new technology.

4 Minimise development and operational risk.

5 Maximise workforce and third party safety.

6 Minimise sparing through commonality of design and supply.

7 Minimise project environmental impact and conform to operating permit requirements.

8 Conform to, or where appropriate exceed, all local laws and regulations.

9 Maximise local sourcing and employment based on availability and competitiveness.

19.3.2 Production Support Vessel / Seafloor Mining Equipment

19.3.2.1 Overview

The Production Support Vessel (PSV) and associated mining equipment perform the following key operations:

- Seafloor cutting and gathering.
- Ore (slurry) recovery to surface.
- Slurry dewatering.
- Ore discharge to transportation barges.

During production operations, two seafloor mining tools will excavate ore from the seafloor. Cut and gathered ore will be pumped by a Gathering Machine (GM) as slurry via a flexible Riser Transfer Pipe (RTP) to a Riser and List System (RALS). The RALS includes a Subsea Slurry Lift Pump (SSLP) connected to a vertical riser assembly suspended beneath the PSV through which the slurry is pumped to surface.

On deck of the PSV, the slurry passes through a Dewatering Plant (DWP) and the dewatered ore discharged to a transportation barge moored alongside. Water discharged from the DWP is pumped back to the seafloor through the vertical riser assembly and provide the hydraulic power to operate the SSLP. Discharge of the return water to the seafloor avoids release and mixing of the cold seafloor seawater with the warm surface seawater.

Given the high fixed costs involved with PSV operations, the principal operating philosophy for the PSV and associated production equipment is to maximise seafloor production of commercially viable ore. Seafloor operations will be defined by an extraction plan that will focus on maximising NPV by prioritising grade and maximising production within operational constraints.

A diagrammatic representation of the overall offshore production system is presented in Figure 19-5.

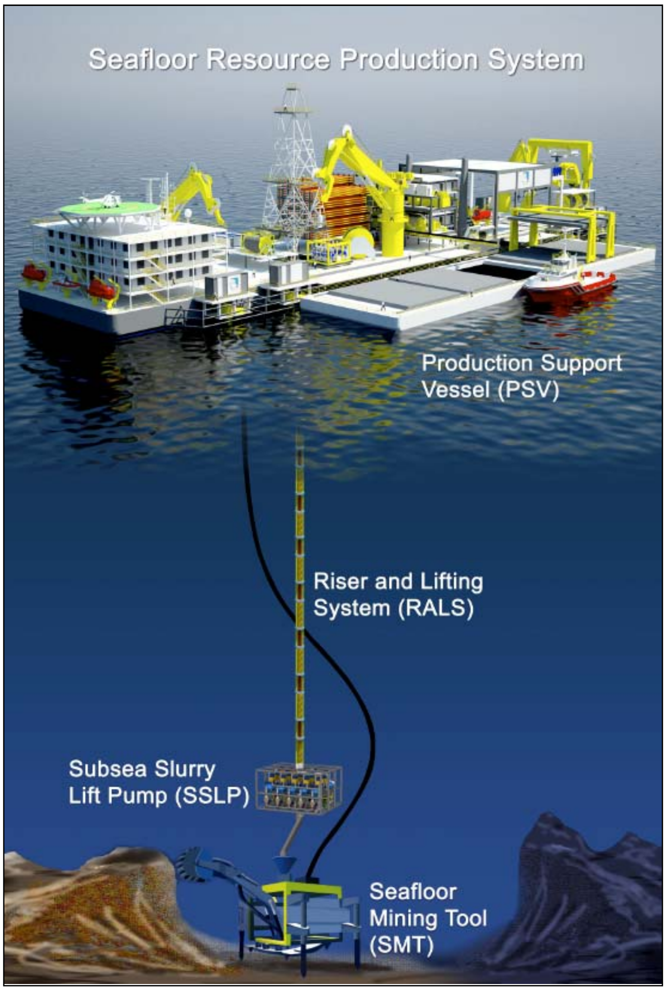

Figure 19-5: Seafloor Resource Production System

(Diagrammatic – not to scale and one SMT shown for simplicity)

19.3.2.2 Production Support Vessel

The Production Support Vessel (PSV) will maintain its position over the seafloor mine site using dynamic positioning and support surface and subsea operations to cut, gather, pump / lift, dewater, and discharge ore to shuttle barges.

The PSV will be capable of discharging ore to transportation barges from either side.

The PSV will support continuous mining production operations simultaneously with:

- Offshore bunkering.
- Offshore transfer of provision supply.
- Offshore waste management / disposal.
- Fresh water making.
- Offshore crew change out.
- MEDIVAC transfer capability.
- Equipment and maintenance sparing transfer and storage.

The primary basis for crew change-out will be crew boat from Port of Rabaul. Helicopter facilities will be provided for emergency evacuation purposes.

19.3.2.3 Seafloor Mining Tools

The seafloor mining tools comprise of the following three separate machine types:

- Auxiliary Miner (AUX) whose purpose will be to initiate mining operations and prepare an adequate landing area for the Bulk Miner (BM) and Gathering Machine (GM). The Auxiliary Miner will also remove edge sections of benches which cannot be accessed or efficiently mined by the Bulk Miner.
- Bulk Miner will be a high production cutting machine to cut the majority of a bench once adequate working area has been prepared by the Auxiliary Miner
- Gathering Machine will gather the cut material and pump as a slurry to the RALS via the flexible RTP

The generalised mining sequence is:

a. Remove unconsolidated sediment using GM.
b. Prepare level area using AUX.
c. Gather ore with GM.
d. Fragment the ore using the BM to leave a bench of 0.5m – 1.0m in height.
e. Gather fragmented ore using GM.
f. Repeat steps 4 and 5 until remnant edges are 4 m high.
g. Trim edges using AUX.
h. Supplement mining rate with AUX when under utilised.
i. Continue the top down mining sequence to mine subsequent benches per steps 4 – 8 above to the depth of the commercially viable resource.

The seafloor mining equipment will be operated as two interdependent systems – cutting and gathering, with broken floor stocks providing a buffer between them. Control systems on board the PSV will look to optimize each of these systems whilst ensuring sufficient separation between machines, umbilicals and lift wires to ensure continuous cutting operation.

Equipment redundancy and reliability will be the fundamental design requirement to minimize operational downtime associated with maintenance and / or breakdown. Operation and maintenance schedules will be co-ordinated to maximize use of equipment non-productive time for maintenance purposes.

<u>Cutting</u>

- Production rate will be driven by the cutting machines (AUX / BM). Co-ordination of the machines will be subject to ore grade, over-all production rate, operational and maintenance constraints. Machines will be sequenced to maximize production whilst minimising the risk of undue machine wear and tear which would be likely to create unscheduled stoppages.
- Excavated particle size will be controlled by the AUX / BM cutter type, pick arrangement, rotation speed and rate of machine advancement. Over-size particles can be re-worked on subsequent bench mining operations.
- Cutting system parameters (cutter rotation speed, cut depth, advancement speed) will initially be manually controlled / set by the Operators and incorporate automatic controls to prevent stalling of cutting operations. With time it will be the intention to maximise the automation of mining. Control system will have capability to incorporate automatic feedback control integrated into the mine model such that operating parameters (eg. cutting rate, recovered grade, rock hardness and particle size) “learned” from overlying benches can be automatically used to control the mining of subsequent benches. Additionally, digging lines for the BM and turns can be undertaken manually or using automated routines.
- Cutter design and operation will look to minimise fines production to the extent reasonably possible.
- Cutter design, pick selection and machine operation will seek to optimise NPV by ensuring appropriate cut rock size distribution, minimising cutting energy and maximising seafloor cutting campaign length.

Gathering

- Where practicable, the gathering machine will not limit the over-all production rate.
- Over-all gathering machine parameters (flow rate / GM advancement speed / suction head control) will be controlled and/or set by operators.
- The gathering system will be operated at constant flow rate.
- Within practical limits and while maintaining the required production rate, the GM gathering system operation will minimise the variability of slurry inlet density.
- An inlet grizzly (or similar) will be used on the GM inlet to prevent over-size particles being introduced into the slurry system. The system will be designed so that this grizzly screen size can be changed by retrieving the GM to the PSV deck.
- The gathering machine pump and control systems will maintain integrity of slurry flow and account for anticipated variability in the inlet slurry conditions. As a minimum, the pump / gathering system will incorporate automatic slurry inlet dilution / bypass valves to prevent loss of flow integrity associated with:
  - Excessive instantaneous slurry inlet density
  - Gathering inlet blockage
- The GM design will consider a back flow system to assist in clearing any slurry system blockages within the GM.
- It is anticipated that gathering utilisation will average 50 – 60%.

19.3.2.4 Riser and Lift System

The Riser and Lift System (RALS) will perform the following functions:

- Receive ore slurry from the Gathering Machine (GM) and pump it vertically up the riser system to the dewatering plant inlet on the deck of the PSV.
- Send the return water to the seafloor.

The Riser and Lift System comprises of:

- Vertical slurry riser complete with connectors and accessories.
- Return water risers complete with connectors and accessories.
- Subsea Slurry Lift Pump (SSLP).
- Riser Transfer Pipe (RTP) from GM to SSLP.
- Riser / SSLP deployment and recovery system.

The principal operating philosophies for the RALS are:

- Where practicable, the riser and lift system will not limit the over-all system production rate
- The RALS will pump the return water (from DWP discharge) to the SSLP where it will be vented in the most environmentally appropriate manner.
- The RALS slurry flow rate will be controlled to match the GM slurry flow rate.
- The RALS will accommodate variability in slurry density delivered from the gathering machine.
- The overall slurry load / density in the RALS will be controlled manually by the Gathering Machine Operator assisted by the RALS control system providing integrated average RALS slurry density information to the operator (with time this function should be automated).
- To prevent blockage of the riser, the system will incorporate an automatic dump valve in the event slurry flow drops below its critical flow rate.
- To prevent blockage in the GM and RTP, the SSLP will incorporate a bypass to allow continued operation and / or flushing of the GM and RTP when there is reduced or no flow in the vertical riser.

- The RALS surface piping system will incorporate a DWP bypass (to the return water make-up tank) to accommodate RALS / GM water circulation during DWP shut-down and / or during start-up operations.
- A surge tank (MST) on the RALS outlet will moderate the variability of the RALS discharge slurry entering the DWP. To accommodate DWP unplanned shut-down, the RALS outlet surge tank latent capacity will be sufficient to enable flushing of the seafloor GM and RALS.
- The volume of this MST will be sufficient to accommodate the volume of slurry in the RALS ahead of the MST in the case of any DWP failure. In the case of a DWP unplanned shut-down, the GM will disengage the seafloor and continue pumping seawater, the slurry in the RALS will be discharged to the MST until seawater is discharged to surface, at which time the DWP by pass will be engaged. A decision will then be made to idle or shut down the RALS depending upon the expected DWP down time. Design and operation of the RALS discharge to the MST is required to accommodate potential gas desorption from the ore slurry as it is discharged.
- RALS utilisation will follow GM utilisation, and apart from scheduled SSLP quarterly maintenance should not impact on system availability.

19.3.2.5 Dewatering Plant

The dewatering plant will dewater the run of mine (ROM) slurry to below the transportable moisture limit (TML) while minimising any material losses. Engineering development of the dewatering plant is currently at concept level.

The dewatering process will produce three streams of dewatered solids:

Stream 1 – Screen	Using twin deck screens. Oversize from the top deck is delivered directly to the product stream. Oversize from the lower deck is delivered to the centrifuge circuit; screen undersize is delivered to the filter circuit.
Stream 2 – Centrifuge	Oversize from the lower deck is discharged to the centrifuge circuit. Solids are delivered to the product stream and return water to the filtration stream.
Stream 3 – Filtration	Centrate from centrifuges and undersize from screens followed by hydro-cycloning and filtration using disc filters. Underflow from the cyclones and filter return are delivered to the make-up water tank to be returned to the SSLP.

The principal operating philosophies for the DWP are:

- Where practicable (and not cost prohibitive), the DWP will not limit the over-all system production rate
- The DWP slurry throughput (flow rate) will match the delivery flow rate of RALS and seafloor gathering machine.
- The DWP will be able to accommodate variability in the inlet slurry density and particle size distribution.
- The PSV will accommodate a separate storage bin with re-feed capability for out of specification dewatered ore.
- The DWP will discharge dewatered ore directly to a transportation barge.
- The PSV will accommodate a separate storage bin to store onboard approximately 1 day’s production capacity).
- DWP utilisation will follow GM utilisation, and its maintenance should not impact on system availability. The system design and operation will minimise surface residence time for return water to minimise water heating and oxygenation.

19.3.2.6 Offshore Production Control

Control of the offshore production process will use a combination of:

- Management systems / plans.
- Stand-alone plant / equipment control systems.
- Integrated control systems.

The principal offshore production system control philosophies are:

- Over-all offshore production management will be controlled from a Central Control Room (CCR) onboard the PSV.
- Controls for operating the following plant / equipment will be located in the CCR:
  - Seafloor gathering machine (GM).
  - RALS pumping system.
  - Dewatering plant operations.
  - Ore discharge to the shuttle barges.
- PSV positional control / manoeuvring will be performed from the vessel bridge. Relative position of the GM, BM and AUX will be monitored on the bridge by a surveyor to ensure equipment separations are maintained by verbal commands to the machine operators. Positional data will be relayed to the CCR for operator reference.
- Controls for operating the following plant / equipment will be located in stand-alone deck control cabins adjacent to the associated launch and recovery systems:
  - Auxiliary Miner.
  - Bulk Miner.
- Key operating and production parameters of all production plant / equipment will be displayed in the CCR.
- Equipment / plant operated remotely from the CCR will have feeds / displays of key operating parameters from other production plant and equipment.

19.3.3 Onshore Logistics / Ore Handling – PNG

19.3.3.1 Logistics Management

Where possible, Nautilus will use existing available local capabilities or assist in local business development to support its operations. The Port of Rabaul, PNG will be used for onshore ore handling, stockpiling and load-out operations.

The Rabaul port will be also be used for storage of spares, equipment and supplies. Materials will be sourced from approved suppliers.

Due to lack of onshore fuel storage tanks, bunkers will be transferred directly to the PSV fuel storage tanks. Bunkers for the supply vessels / transportation barges will be transferred from the PSV fuel storage tanks.

19.3.3.2 Barge Loading / Transportation / Discharge

Powered or unpowered barges assisted by tug/s (where required) will receive and transport dewatered ore from the PSV to the Port of Rabaul.

The dewatered ore from the dewatering system will be delivered to a mechanical offloading system and then onto shuttle barges for offloading the ore to an onshore covered storage area.

The principal operating philosophies for the transportation barges are:

- To accommodate 24 hour / day ore discharge and transportation operations.
- Minimise ore production / ore transfer downtime associated with moorings and barge motions.
- Allow for barge loading on both sides of the PSV.
- Maintain ore moisture content <TML.
- Enable discharge of ore at Port Rabaul.
- Enable clean out of ore storage tanks.
- Accommodate the reactivity of the Solwara 1 ore.

19.3.3.3 Stockpiling / Storage / Load-out

Unloading, stockpiling and load-out of ore onto transportation vessels is planned to be undertaken at the port of Rabaul as part of a port service agreement established with the PNG Ports Corporation. Commercial discussions were ongoing at the time of writing this report and hence are excluded from the commercial evaluation of this report. However, an indicative plan for the operations is provided herein for reference.

The onshore storage and load-out facilities at the Port of Rabaul stockpile will receive ore from the offshore site via transportation barges and stockpile for subsequent load-out onto bulk carriers for transportation to a concentrator site or direct delivery to smelters. The Solwara 1 materials handling requirements must consider existing port traffic and operations and integrate its requirements.

Ore will be unloaded from barges using self unloading gear to mobile transfer conveyors, front end loaders and stacker to fabric covered stockpiles of nominal 50,000t capacity. Reclaim will utilise front end loaders, loading to mobile transfer conveyors which load a mobile ship loader.

General operational criteria include but are not limited to:

- First in first out policy to be adhered to where possible, that is, the ore that has been unloaded first is the preferred ore to be loaded onto the export vessel first (wherever possible).
- All materials handling equipment must have covers to assist maintaining TML prior to loading.
- Ore can be unloaded either onto an intermediate storage position or directly onto the stockpile.
- Port activities will be undertaken 24 hours a day, 365 days a year to accommodate the overall production rate.

The port is owned and operated by PNG ports. Agreements between Nautilus and PNG ports need to ensure that Nautilus is provided with the requisite performance to ensure that production, safety environment and quality targets are met.

19.4 System Design Premise

19.4.1 Regulations / Codes / Standards

The Solwara 1 Project will comply with the following PNG Acts and Regulations:

- Mining Act 1992.
- Environment Act 2000.
- Papua New Guinea Maritime Safety Authority – Marine Orders.
- Papua New Guinea Maritime Safety Authority – Navigation Act.

The seafloor mining industry is an emerging industry that currently contains few existing codes, or standards specifically written for the design and certification of the equipment. In absence of this and in order to set high standards in building a sustainable industry, codes and standards associated with the offshore oil and gas industry will be used as guidelines for the design and verification of the seafloor mining system equipment. However, deviations from such codes / standards will be considered where appropriate.

For onshore operations and facilities, Australian standards (or international equivalent) will be used.

19.4.2 Key Design Parameters

19.4.2.1 Production Rate

The design production rate for the mining system components is 1.8Mtpa (dry equivalent). Major production components will be designed for this rate.

The production rate is planned to commence at an initial start up rate of 1.2Mtpa (dry equivalent) to ultimately ramp up to 1.8Mtpa in the longer term.

19.4.2.2 Design Life

Based on an assumed Solwara 1 mine life of 3 – 5 years and an assumed aggregated mine life of 10 years from Bismarck Sea SMS systems, the Solwara 1 design mine life will be 5 years and the mining system / infrastructure operating life will be 10 years.

To accommodate potential future mining operation life extensions, the design life of some component equipment may extend beyond the operating life. Conversely, reduced design life for specific equipment or subsystem may be elected on the basis where periodical replacement or site specific application is considered more cost effective.

19.4.2.3 Solwara 1 Seafloor Site

The current extent of the Solwara 1 mine site is located latitude 3.79 degrees South, longitude 152.09 degrees East and has an approximate size of 1,200m x 600m. Figure 19-6 shows the existing bathymetric contours and resource outline.

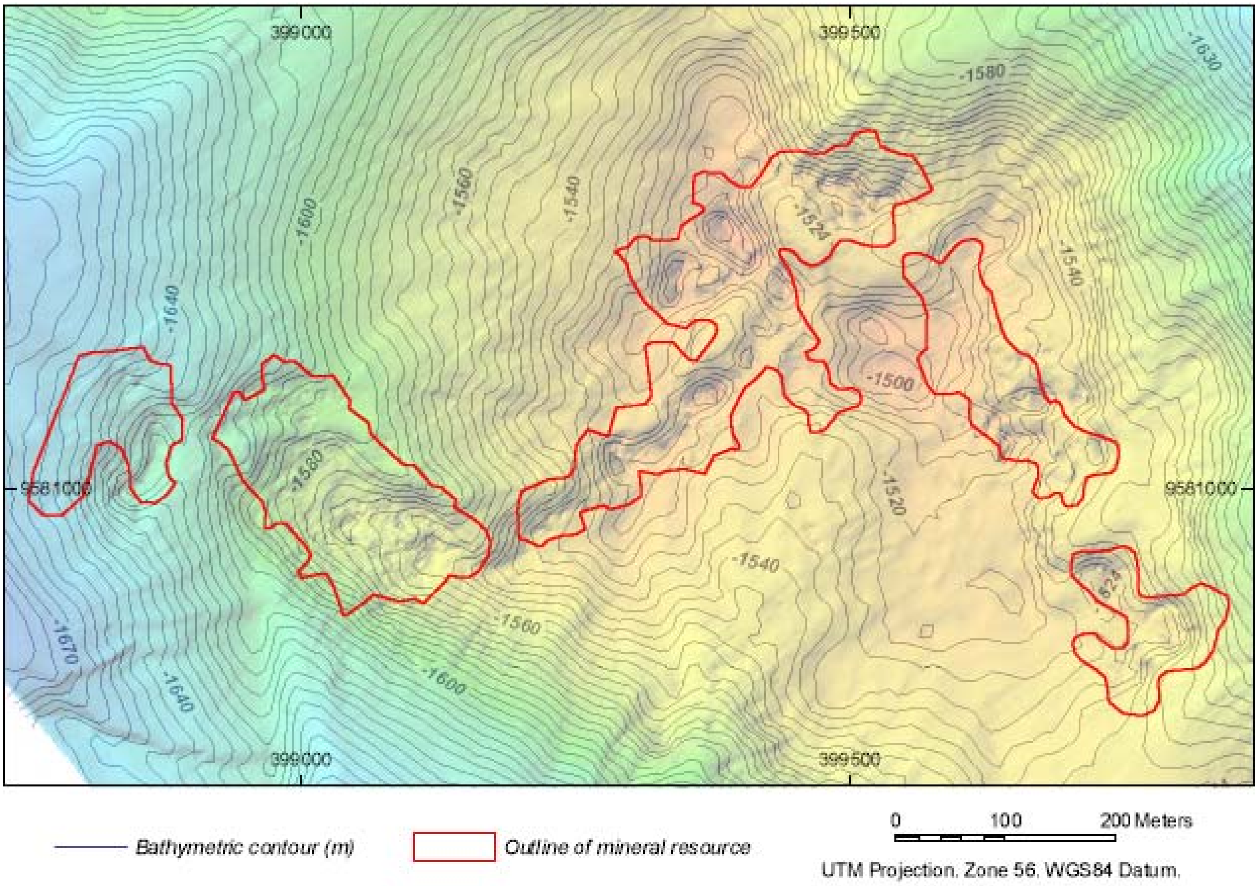

Figure 19-6: Bathymetric Contours and Resource Outline (as of 2007 drilling program)

19.4.2.4 Water Depth

The Solwara 1 deposit occurs on a small ridge on the NW flank of the North Su volcanic centre. The water depth across the Solwara 1 mine site ranges nominally from 1,500m to 1,660m. The water depth increases beyond Solwara 1 in the N, NW and W directions.

The design water depth for the Solwara 1 project is 1,800m. However, to facilitate future developments and flexibility of operations, equipment that will be expensive to upgrade in the future will be initially designed for 2,500m water depth.

19.4.2.5 Environmental / Metocean Data

The climate of the Bismarck Sea and surrounds is tropical, with high temperatures and high rainfall throughout the year. The Solwara 1 site in the Bismarck Sea lies at ~4 degrees south of the equator and is well outside of the tropical cyclone belt.

There are two distinct monsoonal regimes, the Northwest Monsoon, which persists typically from about November to April (summer) and the Southeast Monsoon (Trade Winds), which persists typically from about May to October (winter). The Solwara 1 location is well protected (with significantly limited fetches) to the arrival of significant seastates from especially the north through east through south to southwest directions. Fetches at Solwara 1 are only significant (i.e. ~700 to 1000km) to the west (WSW – WNW). As a result, the waves at Solwara 1 location will be mostly locally generated wind waves.

A summary of annual wave exceedence data against significant seastate is presented in Table 19-1.

Table 19-1: Solwara 1 Seastate Exceedence Summary

% Exceedence	Significant Seastate - Hsig (m)
> 1%	2.69
> 5%	1.72
> 10%	1.33
> 30%	0.80

Solwara 1 will experience a maximum spring tide range of only around 0.8m. The tides of the area are predominantly diurnal (occasionally mixed), with typically one high and one low each day.

19.4.2.6 Geotechnical Data

The Solwara 1 deposit is a strata bound zone of massive and semi-massive sulphide mineralisation that occurs on a subsea volcanic mound which extends about 150 to 200 m above the surrounding seafloor. The sub-surface geological sequence at Solwara 1, from the top down, may be summarised as:

- Unconsolidated sediments. These typically comprise of dark grey clays and silts ranging in thickness from 0 to 2.7 m, with an average of about 1.4 m.
- Lithified sedimentary rocks. These typically comprise a layer of pale to dark grey, lithified volcanic sandstone varying from 0 - 5.4 m thick. The lower parts of this layer are locally weakly lithified.
- Massive and semi-massive sulphide rocks. This is the main ore horizon and it varies in thickness from 0 – 18+ m in the holes drilled to date. Many holes terminated in massive or semi-massive sulphides and from these holes it may be inferred that the massive sulphide zone is greater than 18 m thick in some locations. It consists mainly of pyrite and chalcopyrite, with variable amounts of anhydrite and barite. Locally, the interval may include patches of clay-rich altered volcanic material, and vugs.
- Altered volcanic rocks. The footwall to the mineralisation commonly consists of altered volcanic rocks in which most of the primary minerals have been altered to clays. These rocks are weak and core recovery is commonly low to very low in this zone.

A cross-section of the deposit through the central zone is shown in Figure 19-7.

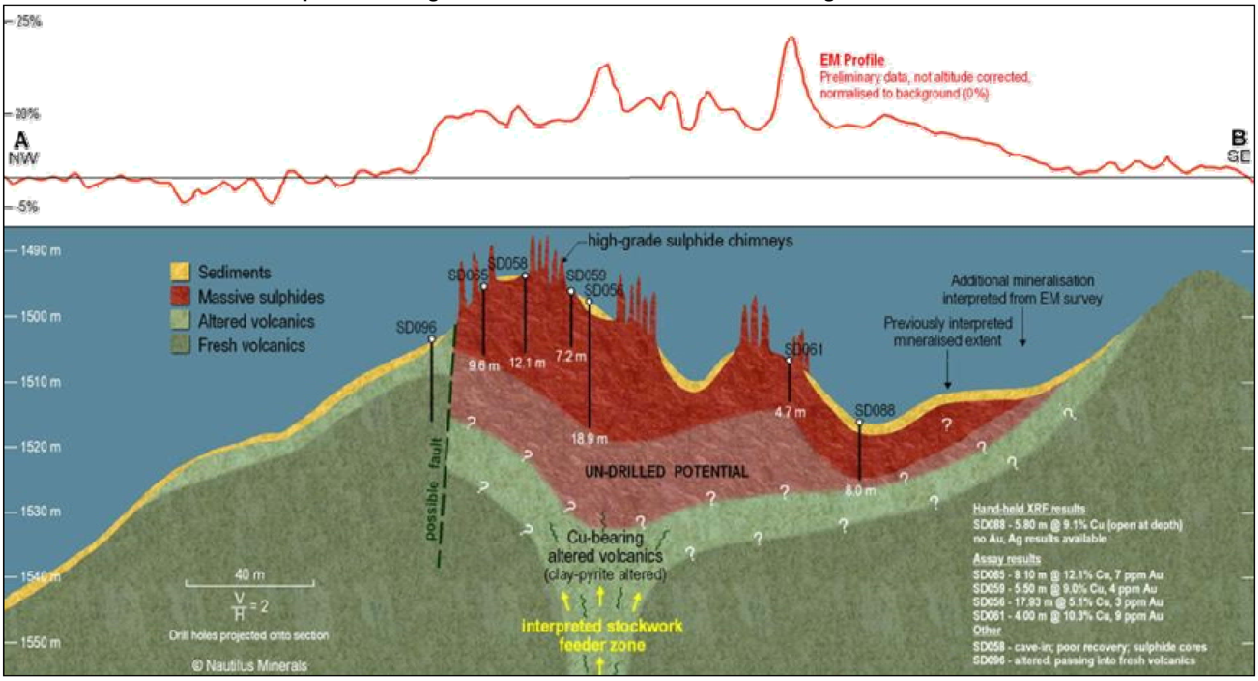

Figure 19-7: Solwara 1 Ore Body Cross-Section

Key geotechnical data design parameters are summarised in Table 19-2.

Table 19-2: Key Geotechnical Design Basis

Parameter	Value
Unconfined compressive strength (ex-situ) - Minimum - Maximum - Average	 0 MPa 65 MPa 18 MPa
Average specific cutting energy (in-situ)	17.3 MJ/m^3
Bulk Specific Gravity - Range - Average	 2.0 – 4.4 3.2
Mined Particle Specific Gravity - Range - Average	 2.2 – 5.0 3.3

The seafloor mining machines, pumping, dewatering and handling equipment is designed to the following parameters:

Table 19-3: Slurry Key Design Parameters

Parameter	Value	Notes
Nominal slurry pumping rate	1,000 m3/hr	Based on gathering machine utilisation of circa 50% - 60% and is to be considered maximum DWP flow rate at 12% slurry volumetric density
Nominal volumetric slurry density	12%	
Instantaneous min / max volumetric slurry density	0% / 20%	
Excavated / slurry particle size	D100 < 50mm D80 < 25mm	

19.5 Production System / Equipment Description

19.5.1 System Overview

The approach taken by Nautilus has been to work with a range of consultants and suppliers experienced in offshore works, subsea equipment (predominantly from the oil and gas industry) and dewatering process plant.

The key Consultants / Contractors Nautilus have engaged on the project to date by Nautilus are summarised in Table 19-4.

Table 19-4: Key Contractors / Suppliers Engaged on Project

Scope	Consultant / Supplier	Contract Type
Seafloor mining tools	Soil Machine Dynamics (UK)	Design and construct
Riser and lift system	Technip Houston	EPCM
Subsea Lift Pump	GE Hydril (Houston, USA)	Design and construct
Dewatering Plant Conceptual Design	Parsons Brinckerhoff, reviewed by Ausenco	Conceptual design
Rabaul Port Facilities	Parsons Brinckerhoff	Conceptual design

Note: A further number of Contractors / Suppliers had been engaged on the project for vessel and RALS component supply which were subsequently terminated on commercial and / or contractual purposes.

A description of the equipment as developed with Nautilus' Contractors / Suppliers is summarised in the following sections.

19.5.2 Production Support Vessel

19.5.2.1 General Description

The PSV will remain on location for the duration of mining at Solwara 1 and will support all mining, recovery, dewatering and offshore loading activities to enable safe and efficient mining of the SMS deposits.

Station holding capability for the vessel will be dynamic positioning.

The vessel hull / type is yet to be selected and will be sourced from the commercial vessel market.

Vessels under consideration include:

- Barge.
- Heavy lift transportation vessel.
- Bulk carrier.

Both charter and purchase options will be considered and the ultimate selection will be determined against criteria intended to yield superior commercial result for the project and the region.

The general philosophy for the production spread will be to modularise all equipment and where possible, pre-commission all components ahead of final load-out onto the ship. The aim will be to reduce ship interference and reduce the time required for commissioning.

The vessel will be delivered with a large clear aft deck with adequate room to fit the mining spread. The vessel will also incorporate the following three production storage tanks:-

- Slurry Main Surge Tank (MST) located after the RALS outlet to modulate the instantaneous variation in the slurry density prior to feeding into the DWP.

- A dewatered ore out of specification bin for storage and re-feed of dewatered ore that does not meet transportation specifications.
- A dewatered ore storage bin to store onboard approximately 1 day's production capacity.

The vessel will require accommodation for up to 140 personnel and be fitted with a moon pool for riser deployment / recovery.

Figure 19-8 presents a typical lay-out of the PSV.

Operationally, the Production Support Vessel (PSV) is ultimately similar to many hundreds of vessels involved in oil and gas, the dredging or transportation industries where its purpose is to ultimately supply a large deck space and a stable platform from which operations are controlled, undertaken and supported.

The benign location of the Bismarck Sea allows the vessel selection to be made from a broad market.

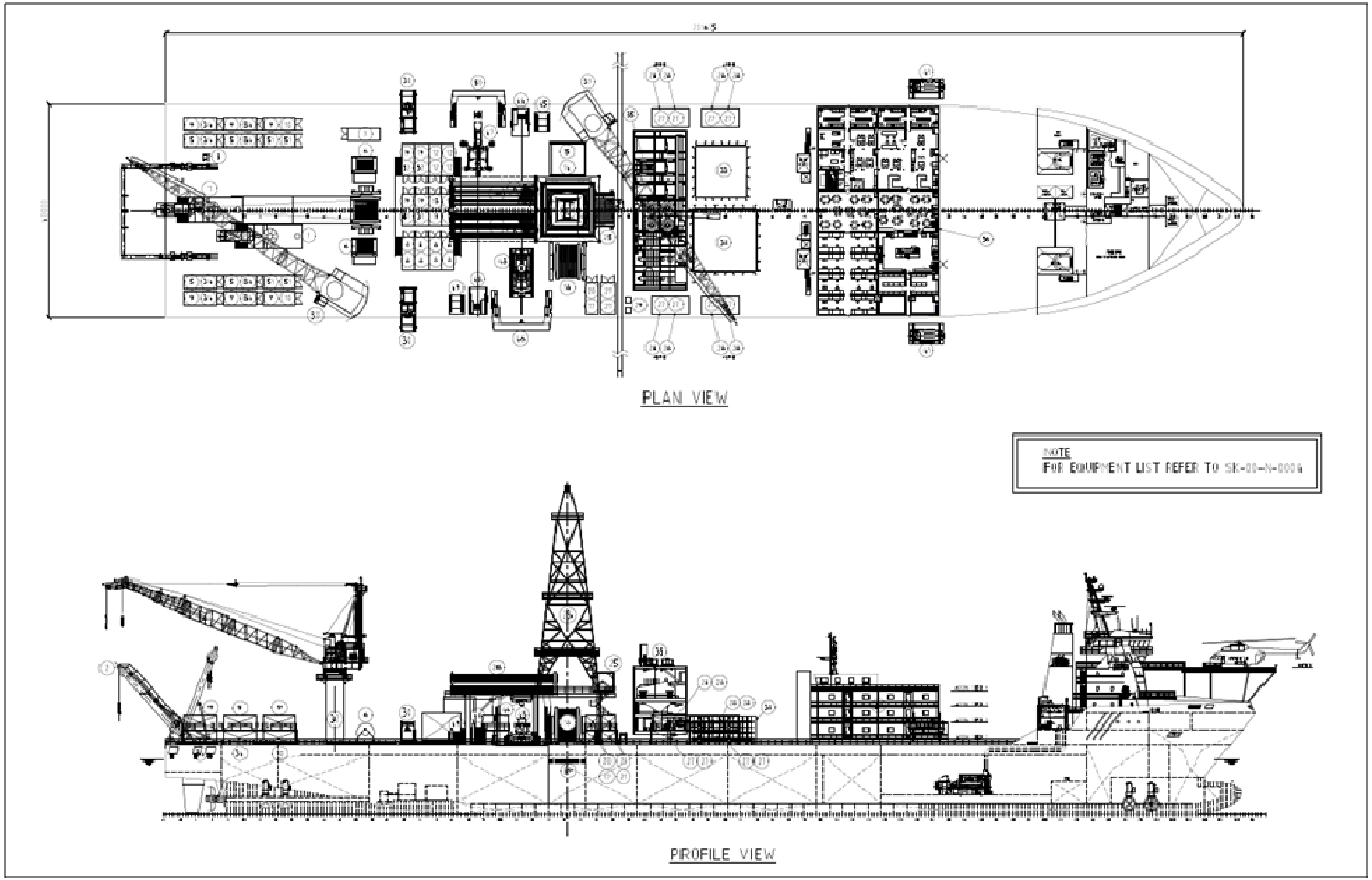

Figure 19-8: **Production Support Vessel General Arrangement**

19.5.2.2 PSV Conversion

The present vessel layouts have as much of the subsea and topsides equipment as possible located above the main deck to reduce the mobilisation times for the SME integration.

However there will be underdeck stiffening in way of equipment foundations, seawater feed pumps, piping, electrical cabling and deck penetrations etc that will be installed into the vessel hull. Many of these items will be affected by Vessel Class regulations and their location and design will have to be reviewed and approved by Class.

It is therefore the intent that as many of these items be incorporated into the vessel hull during the vessel construction or conversion by the owner before delivery for SME integration.

If the hull modifications and equipment are installed prior to the vessel arriving at the integration yard, then the SME integration will be straight forward and any potential problems with Vessel Class will be eliminated.

19.5.2.3 Vessel Positioning System

Station holding capability for the vessel will be dynamic positioning.

Dynamic positioning is used widely in the offshore industry on deep water drilling ships, diving support vessels, deep water pipe lay vessels, construction vessels and exploration activities which require a stable yet manoeuvrable platform to undertake work. Dynamic positioning (DP) systems consists of several electric or diesel powered thruster propellers that are controlled by a computer system that uses Global Positioning System (GPS) as a reference. The computer system varies the output from each thruster to hold a vessel to within a few metres of the required location. The dynamic positioning system rating will be DP2 which has the required level of redundancy consistent with such open water operations.

The Production Support Vessel will hold position over the mine site during mining operations. The vessel will also need to change position to reposition the various mining machines from one mining face to another and to be able to weathervane to optimise the motions of shuttle barges when moored alongside for materials off loading.

Fuel consumption associated with dynamic positioning is a primary cost for the PSV. The Solwara 1 project however has the benefit of being located in the benign Bismarck Sea and hence has low wind, wave and current loading (and hence lower fuel consumption) by comparison to other offshore locations. Furthermore, fuel consumption can be optimised though power supply design and operational controls (ie. altering vessel heading relative to environmental conditions).

19.5.2.4 Power Generation

Onboard power generation is required to support the following primary consumers:

- Production Operations.
- Dynamic positioning thrusters.
- Ship hotel services.
- Auxiliary ship systems.

An electrical load analysis has been performed for a 170m x 40 m DP barge which indicates approximately 22MW of electrical power is required to run the vessel in the peak load condition, assuming design generator loading is limited to around 90%. It is assumed that in 10 year return weather conditions the mining equipment is not required to be operational. In the one year return weather conditions the ship is required to continue mining operations.

Table 19-5: Electrical Power Demand for Various Operating Conditions

Item	Max Load (kW)	Average Conditions		1 yr Return Worst Case		10 yr Return Worst Case	
		Weather vaning		Weather vaning		Weather vaning	
		DF	(kW)	DF	(kW)	DF	(kW)
Mining Equipment	13,800	1	13,800	1	13,800	0	0
Thruster 1	1,500	0.3	450	0.6	900	1	1,500
Thruster 2	1,500	0.3	450	0.6	900	1	1,500
Thruster 3	1,500	0.3	450	0.6	900	1	1,500
Thruster 4	1,500	0.3	450	0.6	900	1	1,500
Thruster 5	1,500	0.3	450	0.6	900	1	1,500
Thruster 6	1,500	0.3	450	0.6	900	1	1,500
Thruster 7	1,500	0.3	450	0.6	900	1	1,500
Thruster 8	1,500	0.3	450	0.6	900	1	1,500
Ship Services	1,100	1	1,100	1	1,100	1	1,100
Total Power Demand			18,500		22,100		13,100

19.5.3 Seafloor Mining Tools

19.5.3.1 Overview

A seafloor mining configuration that utilises three distinct machine designs is being pursued. The drivers for this are similar to equipment optimisation on land based mining projects where the machine flexibility required to establish and “clean” benches is in conflict with the optimisation required to maximise machine productivity.

The current approach for the seafloor mining system is analogous to many surface mining systems, where it is common for a more flexible and mobile machine to prepare the site which is usually followed by a separate, dedicated high production system. Surface ore collection can be either integrated (simple conveyor to dump trucks) or laid in wind-rows behind the production machine for another collection system to follow behind.

Soil Machine Dynamics Ltd (SMD) in the UK has been awarded the contract to design and supply the seafloor mining tools. SMD is a leading manufacturer of bespoke and specialist heavy duty seafloor trenching and cutting machines, as well as being one of the largest volume manufacturers of remotely operated vehicles (ROV) to the oil & gas, defense and scientific sectors, having delivered over 200 subsea systems to clients worldwide.

Because of the topography of the mine site with its relatively steep slopes (up to 20 deg) and the numerous chimneys that cover the mine sites, three different subsea mining machines, namely the Auxiliary Miner, the Bulk Miner and the Gathering Machine will be utilised to extract the ore from the seafloor. Each of the machines is configured differently and performs different mining tasks.

19.5.3.2 Auxiliary Miner

The Auxiliary Miner (AUX) is a track mounted machine of approximately 150 tonnes that will be used to clear a flat landing area for the main Bulk Miner (BM), remove bench edges and areas that cannot be readily accessed by the BM. The purpose of the auxiliary machine is to:-

- access and prepare level landing / working areas for the Bulk Miner (BM).
- assist with levelling and grinding up chimneys.
- be capable of cutting a bench height of up to 4m, even on a slope.

- clear bench edges and / or footwall interfaces not readily accessible by the BMs.
- clean up the mine-site at completion of mining

The AUX is a multi-function machine which has the mobility to access, or to create access to any part of the unprepared mine-site. The exception to this is the larger chimneys which need leveling before their base material becomes accessible. The AUX must have the flexibility and cutting ability, to land on the seafloor and prepare access to (ie. cut an access ramp up to the top of the mine) and level areas in which the BM can effectively be landed.

When initiating a new site at Solwara 1, the Auxiliary Miner is the first machine to deployed, where it clears the high-points to make a landing pad large enough for the BM to commence main production work. After clearing a suitable pad, it is lifted on its main recovery wire and replaced on another high-point of the mine where it repeats the preparation phase. In general, the terrain is too awkward to land on 'peaks', therefore the AUX is landed as near to them as possible and cuts a ramp up to the peak area, generating its own access-way.

The AUX incorporates a rock cutter head (about 600kW) on an articulated arm which can slew or raise/lower in front of the machine to access up to a 4m high bench.

The secondary function of the AUX is to tidy up edges / footwalls etc that are not accessible by the BM due to proximity to edges and the relative inflexibility of the BM (concerns over slope stability) or constraints at the footwall with regards to excavation of non-ore bearing material.

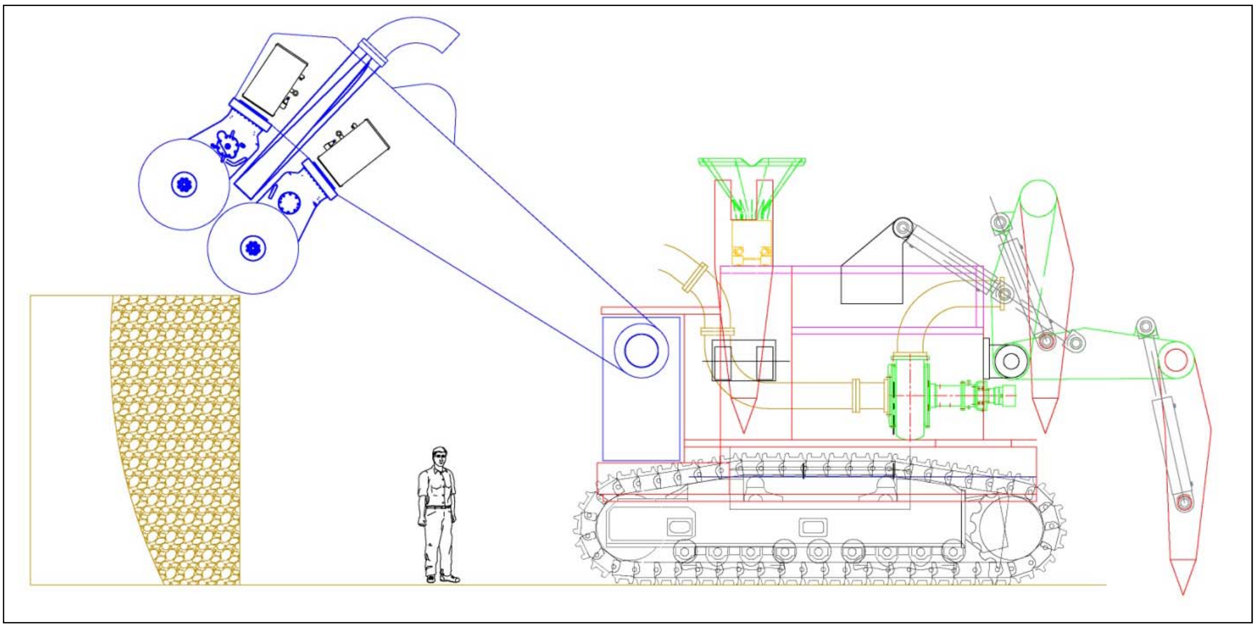

Figure 19-9: Auxiliary Miner

The AUX is expected to be approximately 13.5m long x 5.2m high x 7m wide, with a total power requirement of about 1.6MW and an in air weight of approximately 150 tonnes. The minimum working area for the AUX is expected to be some 25 m by 30 m.

The AUX is a tracked system with spuds to provide additional traction as required.

The rock cutting head will be mounted on an articulated hydraulic arm consisting of slew pivot and boom. The arm provides a very versatile mounting for the cutter and allows a large volume of rock to be cut without moving the AUX itself. Although somewhat different in application, an articulated boom mounted cutter has been used on 250 tonne diamond mining machines as shown in Figure 19-10.

Figure 19-10: 250 tonne Diamond Mining Machine with slewing arm

The material generated from the cutting head will be transported past the boom and slew pivot using a centrifugal suction / delivery pump and deposited behind the vehicle.

The proposed seafloor mining will require the AUX to undertake a variety of tasks which include:

- Cut a bench up to 4 m high and 10 m width.
- Cut a ramp up or down 20 degree.
- Manage a 10 degree cross fall slope.
- Work on cut / flattened material.

19.5.3.3 Bulk Miner

The Bulk Miner (BM) is a large track mounted cutting machine of approximately 250 tonnes (in air) that will undertake the bulk of the cutting operations.

The purpose of the Bulk Miner is to:

- Cut / grind the bulk of the ore-body in the most efficient and practical way it can.
- Reduce the mined material on-bottom to the size distribution to suit the topsides recovery process.

The BM's primary design parameter is to deliver maximum cutting power continuously into the mine rock-surface. The BM cuts/grinds/sizes the mineral but does not gather any material.

The BM is a heavy, tracked machine that is based on onshore surface-miner/road-miner machines that use a wide-cutting drum shearer head with carbide tipped picks.

Figure 19-11: Onshore Road Miner Cutting Head

The cutter makes relatively small cuts or chips at each individual pick to generate small cuttings suitable for transportation as slurry.

When an area is prepared (approx 25m x 35m) and the AUX has moved on, the BM is landed on the prepared site. The BM is a heavy tracked low and wide chassis with a full machine-width cutter drum mounted at the end. The arrangement is based on a surface-miner/road-miner layout Fig 19-11. A low-slung chassis keeps the centre of gravity close to the ground and close to the cutter, enabling maximum power delivery (about 900 kW) via the cutter into the rock. Machine weight is expected to be about 250 tonnes in air and total power is expected to be about 2MW.

The BM drives along the prepared site cutting a nominal 4m wide swathe. Ore is cut and ground in one pass to a depth between 300mm and 1,000mm, depending on hardness.

The BM follows a plan developing strips of cut ore until the site is fully cut to a single pass of cutter depth, then the gathering by separate machine begins while following behind. To maintain production, the BM is relocated by lifting wire to the next area prepared by the AM.

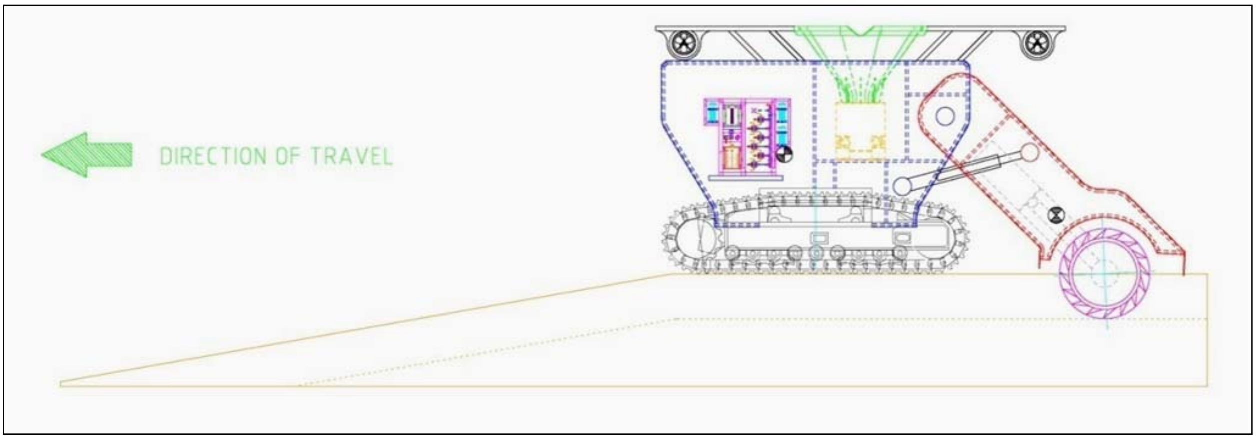

Figure 19-12: Bulk Miner

Development of a three machine excavation system based on existing cutting technology and equipment will maximise seafloor production.

Testing and evaluation on the impact of hyperbaric effect of cutting has been undertaken to assess the effect of the seafloor hydrostatic pressure on the required rock cutting energy. These studies have demonstrated that a hyperbaric effect does exist and is influenced by rock parameters such as brittleness, permeability and porosity. This work has shown that the hyperbaric effect increases the over-all cutting energy in the SMS deposit by approximately 70% and in some rock types, there is no impact. The hyperbaric effect has been accounted for in the seafloor mining tool designs.

The design and build of the vehicle chassis will utilise existing subsea vehicle technology already developed and used by SMD on their subsea pipe trenching machines.

19.5.3.4 Gathering Machine

The gathering machine's primary function is to gather the cut ore from the seafloor and pump it to the SSLP via the RTP where it is pumped to the PSV via the main riser pipe.

The Gathering Machine is approximately 8.5m long x 7.7m wide x 6.4m high with an in air weight of approximately 100 tonnes that will move on 1 pair of tracks and be electrically powered from the surface. Fitting the vehicle with buoyancy and thrusters is under consideration to reduce it's in water weight to approximately 10 tonnes to enable the vehicle to "fly" through the water as well as drive on its tracks. Evaluation of a buoyant or non-buoyant gathering machine configuration is in progress.

The layout of the GM chassis is similar to a trenching ROV. The top of the machine may have syntactic buoyancy modules, while the lower part of the chassis has two tracks for locomotion on the seafloor. Within the chassis is a series of large centrifugal pumps to draw in the ore and deliver to the riser.

Once the GM has landed on its tracks on the seafloor, it engages the Riser Transfer Pipe (jumper hose), sets up pump-flow in concert with the riser lift pumps and moves forward with a suction-auger head reaching in front to vacuum up the ground ore.

Once a bench has been gathered, the GM relocates to the next area mined by the BM, or collects material left by the AUX in preparing another part of the mine.

The set up of the GM has the additional advantage in that it can readily clear large quantities of unconsolidated sediment, known to be around Solwara 1. These are pumped offsite to suitable seafloor storage locations down-current and down-slope from the mine.

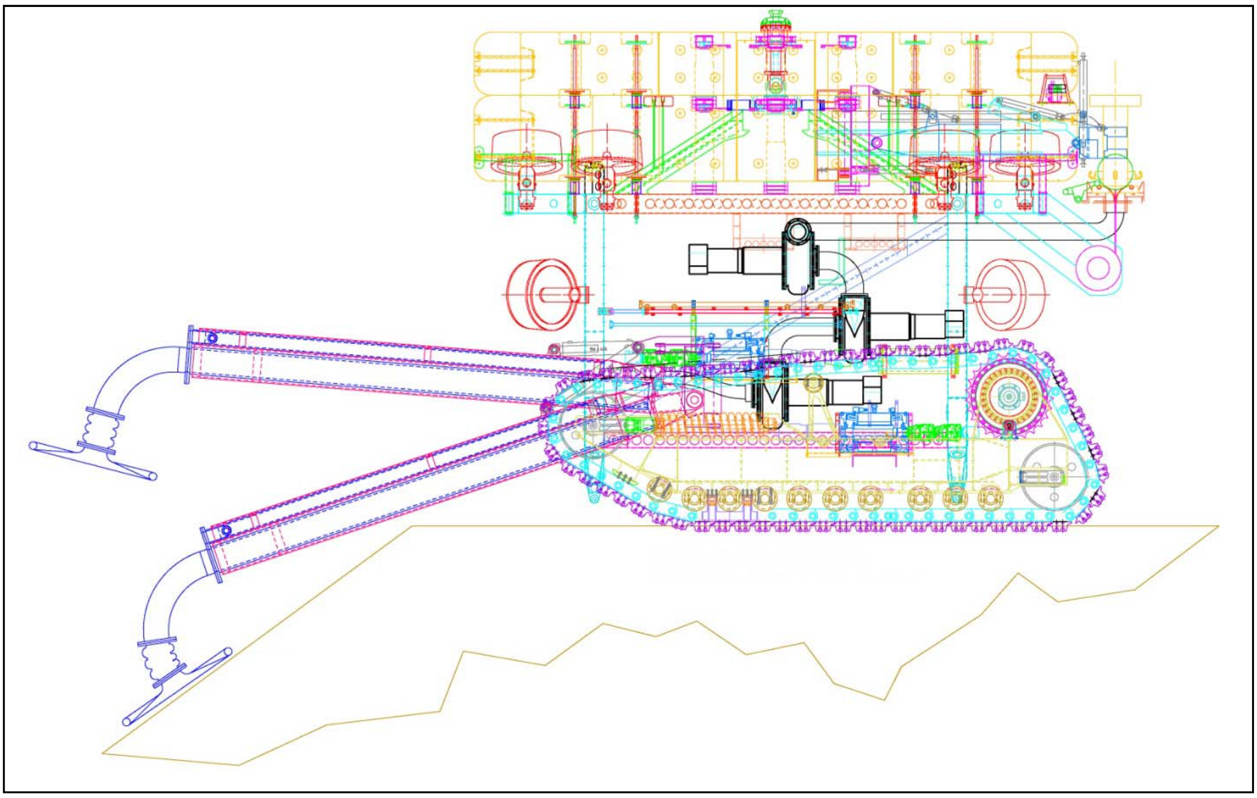

Figure 19-13: Gathering Machine

For normal gathering, the vehicle is fitted with an auger device that channels the ore to the inlet of a large centrifugal dredge pump as the vehicle traverse the mine site. The GM will also be fitted with a secondary suction head on a sweeping boom.

The ability of the auger to convey the mined ore to the pump inlet is seen as a key element to the success of the vehicle. Prototype trials of the auger will be carried out before building the final auger to ensure that it works correctly and can deliver the required production.

The SSLP will be positioned 35 m to 75 m above the seafloor and that the minimum pressure required at the inlet to the Subsea Lift Pump is approximately 5 bar (75psi).

The total system head for the gathering machine centrifugal pumping is estimated by Technip in the order of 18 bar. This discharge pressure will require centrifugal pumps in series to achieve this pressure.

The remainder of the vehicle is based on other machines that have been built by SMD and will be subject to normal Factory Acceptance Tests and integrated wet testing.

19.5.3.5 Vehicle Launch and Recovery Systems

The launch and recovery systems for each vehicle will consist of an articulated A-frame and deployment winch. The A-frames will pick the machines up from the deck and launch them out over the side so they can be lowered to the sea floor using their deployment winches.

A-frame deployment systems are widely used offshore for deploying large subsea machines and equipment and are a proven design.

Figure 19-14: Typical Large A-frame

The deployment winch used to lower the machines to sea floor will be either electric or hydraulic powered single drum winch or traction winch.

Single drum winches have been widely used offshore for many years however as water depths and line tensions have increased, traction winches are becoming more widely used and are possibly more suited to this particular application.

19.5.4 Riser and Lift System

19.5.4.1 Overview

The purpose of the Riser and Lift System (RALS) is to lift the mineral ore particles mined from SMS deposits to the PSV, using a Subsea Lift Pump (SSLP) and a vertical riser system suspended from the PSV.

The ore particles mined by the Subsea Mining Tools are collected using the Gathering Machine and the seawater /ore slurry pumped into the positive displacement SSLP at the base of the riser, where it is pumped to the surface.

Once at the surface, the slurry passes through a dewatering process. The solids are transferred to a transport barge for shipment to shore and the (filtered and cleaned) return water is topped up with additional seawater as required and pumped down to the SSLP, where it is used to drive the positive-displacement chambers of the SSLP prior to being discharged into the sea close to the depth at which it was originally collected.

Much of the RALS and components have been taken directly from the offshore oil and gas industry where these items are field proven in similar applications.

The RALS can be broken down into the following major sub components:

- Riser Transfer Pipe (RTP).
- Subsea Lift Pump (SSLP).

- Main vertical slurry riser, connectors, flexjoint and accessories.
- Return water riser, connectors and accessories.
- Surface pressure seawater supply system ("mud" pumps).

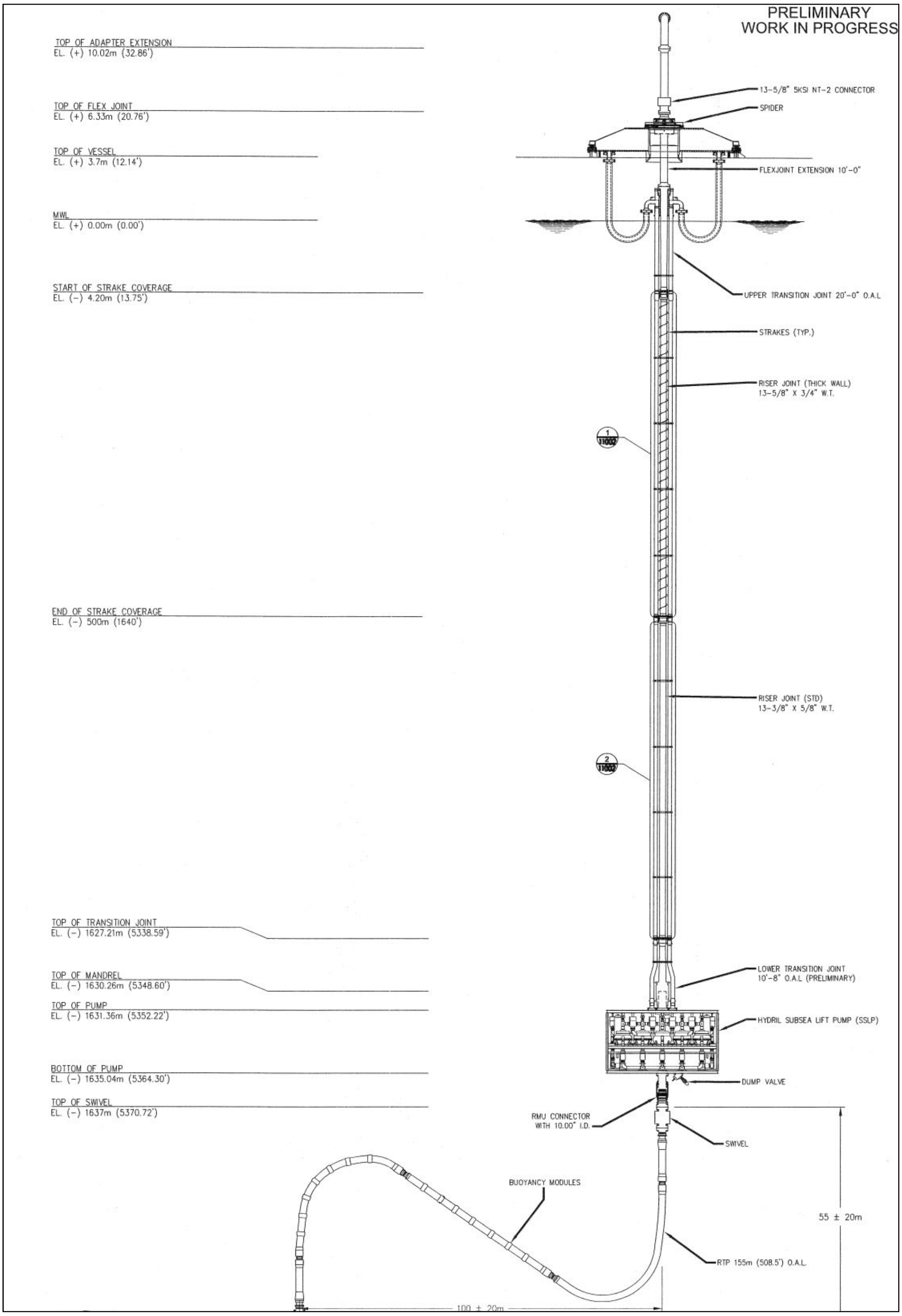

Figure 19-15: **Overall Layout of RALS (excluding Derrick and Draw works)**

19.5.4.2 Riser Transfer Pipe

The RTP is a nominal 280mm ID flexible hose 150 to 200 m long that is used to connect the SSLP to the Gathering Machine. The seawater/ore slurry is pumped through the RTP from the Gathering Machine to the SSLP.

The hose will be made up in sections approximately 20 m long bolted together using Grayloc Hub connectors.

To keep the RTP from dragging on the seafloor syntactic buoyancy modules are to be provided continuously from the Gathering Machine end to about 2/3 of the RTP length to form the RTP into an “S” wave configuration.

The RTP configuration is analogous to dynamic subsea flow lines and risers that are extensively used in the offshore industry to connect subsea wellheads to Floating Production, Storage and Offloading (FPSO) facilities.

The RTP’s service conditions are similar to that of the dredging and diamond mining industries which are subject to erosion from the ore slurry. Liner material will be selected to maximise service life. The RTP configuration, complete with subsea remote connectors, will enable change out in the field.

If necessary, a breakaway coupling between the RTP and the Gathering Machine can be utilised that will allow the RTP to break away from the Gathering Machine if the PSV were to suffer a DP runoff. Such breakaway couplings are widely used on FPSO offloading hoses that allow the offloading hose to breakaway if overstressed during off loading operations with tankers.

19.5.4.3 Subsea Lift Pump

The Subsea Lift Pump (SSLP) to be supplied by GE Hydril is suspended at the bottom of the riser and receives slurry from the Gathering Machine via the RTP. The SSLP subsequently pumps the slurry to the PSV. The pump assembly comprises two pump modules, each module containing five positive displacement pump chambers driven by pressurised return water delivered from the PSV to the pump via the riser assembly. The use of multiple pump chambers provides a consistent pressure / flow regime and also provides a high degree of redundancy.

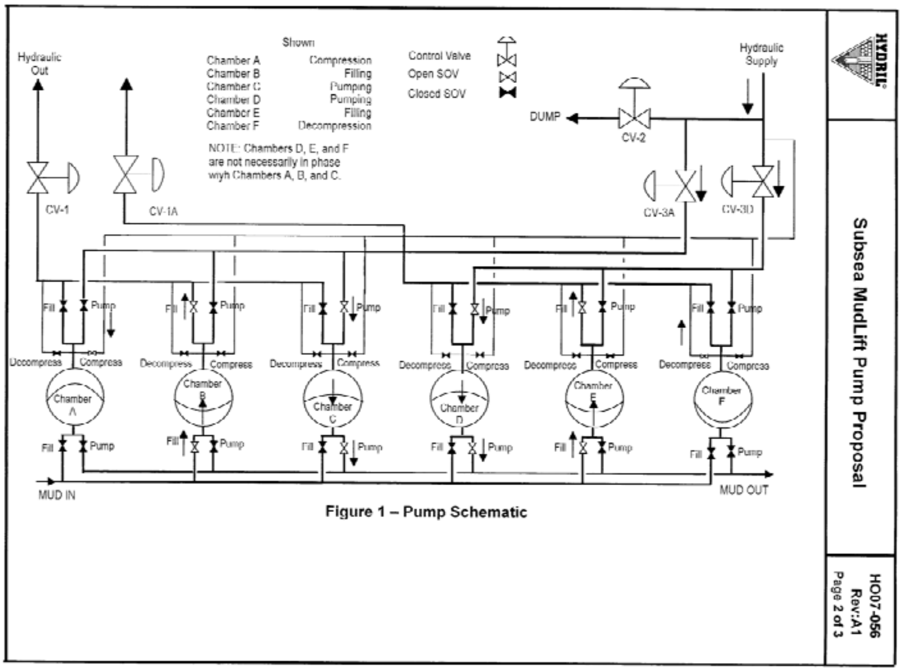

Figure 19-16: Typical Arrangement of Subsea Lift Pump Module

The SSLP is expected to weigh approximately 129 tonnes in air and measure 5.2 m x 6.4 m x 3.7 m high.

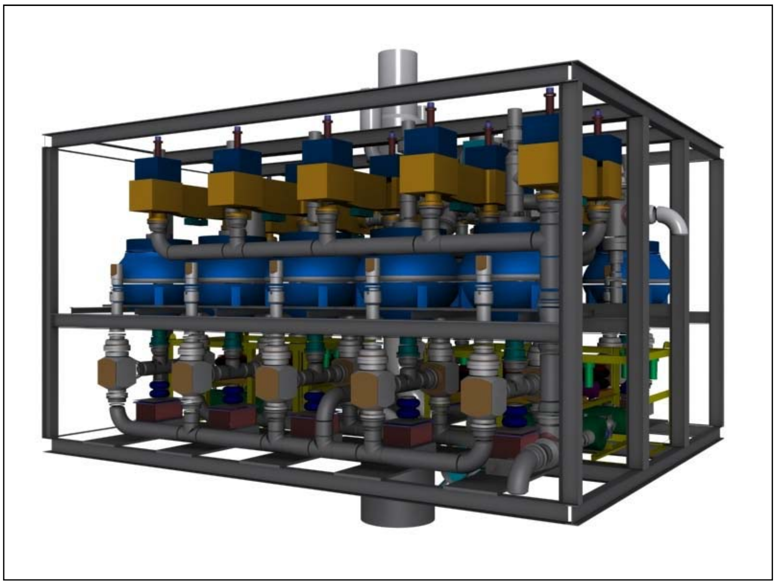

Figure 19-17: 3D Artist Impression of Subsea Lift Pump

Documentation reviewed shows that the development of the SSLP started with the identification of the mud lift pump system developed for a dual gradient drilling joint industry project from 1996-2001 as a method of pumping fluids that could contain significant amounts of solids from the seafloor to the surface. A prototype pump was built and successfully tested during the drilling of a test well offshore in 1,000' (305 m) of water in the Gulf of Mexico. The sub-components or sub-assemblies of the SSLP are rated and have been tested to 2,500m water depth.

Figure 19-18: Prototype Pump Under Test

On previous applications, the subsea pump was originally designed to operate using electrically-driven hydraulic pumps at the seafloor driving the PD pump chambers. On these earlier projects, concerns were expressed on personnel safety while running up to five high voltage (13,000 volt) umbilicals in the moon pool area. As a result, the system was redesigned to be powered by seawater supplied from the surface through a conduit to the pump located on the seafloor.

The main benefit of moving the pump's power supply to the surface is that all the seawater power generating components (pumps, motors) are at the surface. If a seawater pump or motor fails, it can be repaired or replaced without having to pull the subsea portion of the pumping system. If the system is designed with redundant or parallel seawater supply pumps, the slurry pumping process can continue at a reduced rate until the seawater supply component is repaired. For application on the Solwara 1 project, utilising return seawater (from the DWP) to power the SSLP has the added benefit returning this water to the depth from which it originated and avoids mixing of water from seafloor with the warm surface water.

The pump design features a pump chamber that uses an elastomeric diaphragm as a barrier element between the seawater power fluid and the slurry being pumped. This diaphragm never experiences differential pressure across it but rather merely provides a barrier between the seawater (hydraulic power) and the slurry being pumped.

The required design life for the pump chamber's elastomeric element has to exceed 1,000,000 cycles (116 days of continuous operation) at which time the intention is to retrieve the pump to the surface for replacement of the diaphragms. The actual life of the diaphragm has not been determined as no operational failures were experienced during the field trials.

The prototype pump utilized specially designed solids-tolerant valves to handle the inlet/outlet control on the process and seawater sides. These are hydraulically actuated valves with clear flow paths, allowing large solids to pass. Hydraulic actuation allows the valve stem to shear any solids that may be preventing closure of the valve at the appropriate time. According to information available this valve design showed virtually no wear after 1,000,000 qualification cycles, equating to approximately 116 days of continuous operation.

The overall layout and design philosophy of the SSLP is well thought out. Slurry pumping tests will be undertaken to confirm correct operation of valves and pump chambers as well as assess erosion rates to optimise maintenance programs in operation.

19.5.4.4 Main Vertical Riser

The 1700m long riser assembly consists of a main 13 5/8" (OD) central pipe string to support the SSLP and convey the mined ore slurry to the PSV and two 8 5/8" (OD) pipe stings supported off the main pipe string to supply the high pressure return seawater to drive the SSLP. Two umbilicals for controlling the SSLP are also attached to the central riser bundle.

The riser assembly is made up of 62 feet (18.9m) long joints that are connected together using fatigue resistant connectors.

The main features of the riser are:

- Main riser Pipe (0 to –500 m): 13 5/8" OD x ¾" wall API5L X80 seamless pipe.
- Main riser Pipe (-500 to –1700 m): 13 5/8" OD x 5/8" wall API5L X80 seamless pipe.
- Water injection lines: 8 5/8" OD x ½" wall API5L X65 seamless pipe.

The weight of the riser string with SSLP in air, in water (not operating) and in water (operating, 12% slurry) is 694 tonnes, 546 tonnes, and 591 tonnes, respectively.

The riser design is based directly on existing technology that is being used extensively in the offshore drilling industry.

Figure 19-19: Typical Offshore Drilling Riser

The documentation reviewed shows that considerable stress, fatigue and corrosion analysis has been carried out and shows that the present design configuration is acceptable.

Erosion rates have been considered in the riser design and erosion rate modelling is ongoing. Work to date supports the calculated erosion rates for the pipe.

19.5.4.5 "Flexjoint"

The complete riser assembly will be supported in the centre of the PSV moon pool using a "Flexjoint", (refer Figure 19-20) that will support the weight of the SSLP and riser and allow the PSV to roll and pitch without overstressing the riser.

Companies such as "Oilstates" have been manufacturing "Flexjoints" for several years and they are widely used in the offshore oil and gas industry for connecting steel catenary risers (pipes) to moored offshore vessels.

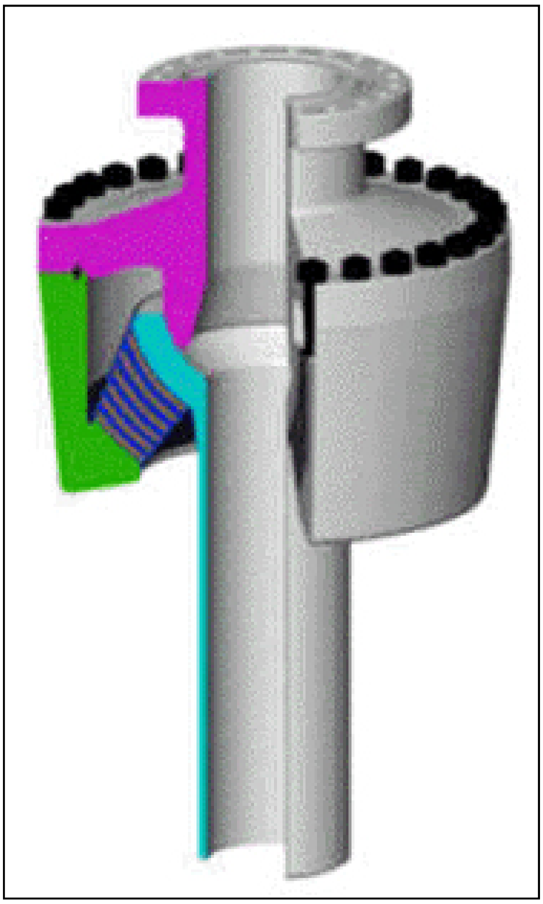

Figure 19-20: Typical "Flexjoint"

19.5.4.6 Riser Connectors

The riser joints will be connected together using proven fatigue resistant riser connectors commonly available in the oil and gas industry for making up production risers and drilling conductors.

To simplify assembly and disassembly of the riser, the connectors (Figure 19-21) do not require turning of the riser to make them up.

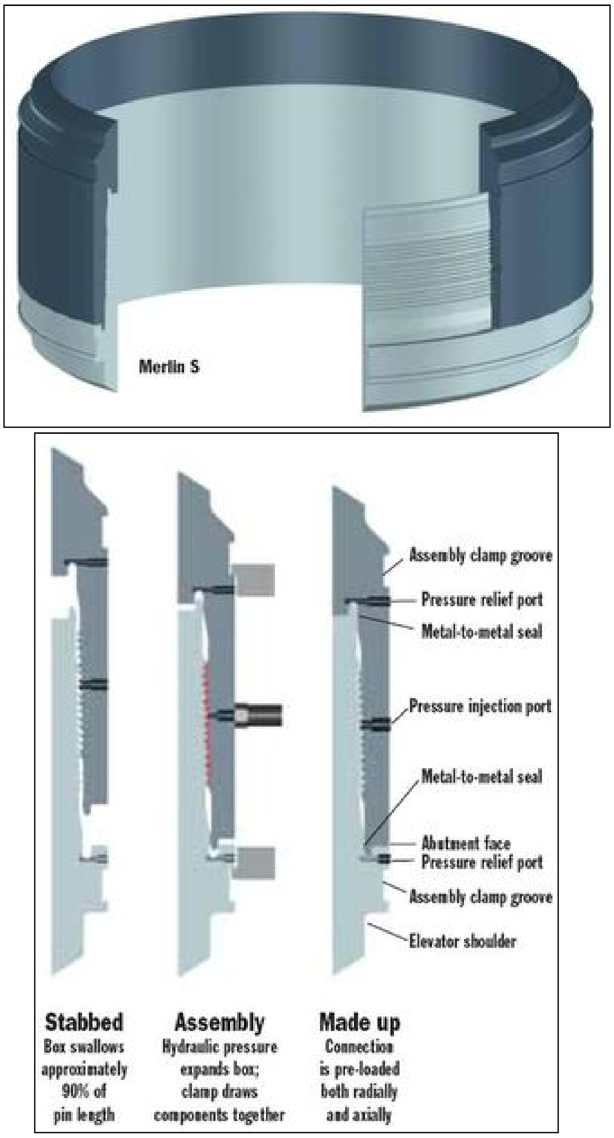

Figure 19-21: Typical Riser Connector

19.5.4.7 Riser Strakes

The Riser will be provided with helical strakes in areas identified as having a strong current typically the upper 500 m. The addition of strakes prevents vortex induced vibration (VIV) in the riser and subsequent increased fatigue to the system. Strakes are commonly used both onshore and offshore for eliminating VIV induced by water and air flowing around long thin pipes such as drilling conductors and power station chimneys etc. Figure 19-22 and Figure 19-23 illustrate non-straked and straked joints.

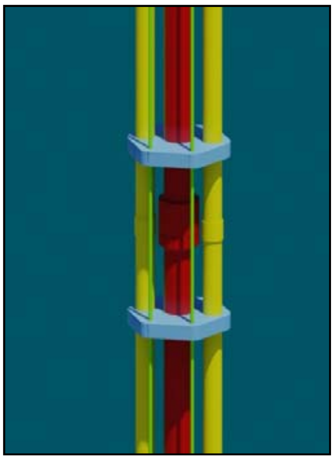

Figure 19-22: Non-straked Joint

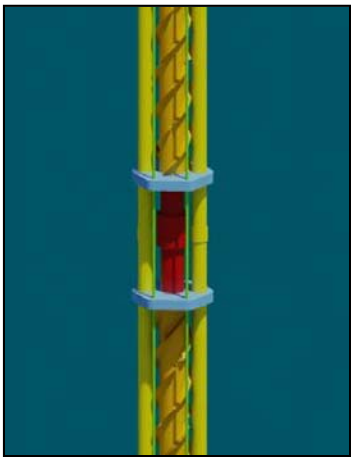

Figure 19-23: Straked Joint

19.5.4.8 Surface High Pressure Pump System

The subsea lift pump is to be powered using high pressure return seawater supplied from surface pumps on the PSV. Calculations indicate that 1,000 m^3/hr at 79 bar of sea water will be required to power the SSLP in 1700 m of water.

The ore/slurry is pumped to the surface by the SSLP and dewatered. The return water from the dewatering process is pumped back down to provide hydraulic power the SSLP. Some additional seawater is added to the return water to make up the ore and water lost during dewatering.

The complete High Pressure Seawater Supply System consists of:

- Settling header tank.
- Seawater make up pumps.
- Seawater charge pumps.
- HP triplex mud pumps.

Note: The surface triplex pumps are sometimes referred to as “mud “pumps as they are typically used in the drilling industry to pump drill mud.

Header Tank

A one atmosphere tank mounted on the main deck that will receive and mix return water from the dewatering skid with make-up water from the seawater make-up pumps. Water from the tank will be used to feed the high pressure mud pumps.

Seawater Feed Pumps

Low pressure centrifugal pumps that will be located in the hull of the PSV and will draw water through the vessel sea chest and pump it into the header tank.

Seawater Charge Pumps

Low pressure centrifugal pumps located on the main deck that will supply feed water to the high pressure mud pumps at slightly above atmospheric pressure to eliminate the possibility of cavitations in the high pressure pump.

High Pressure Triplex Mud Pump

Standard offshore triplex positive displacement pumps that are used extensively in offshore drilling to pump drilling mud and cement (Figure 19-24) will be used to power the SSLP.

Up to eight 1,600 HP triplex pumps in total will be installed on the Production Support Vessel with six in operation at any one time so that pumps can be cycled out for regular maintenance.

Figure 19-24: Typical Triplex Positive Displacement Pump

19.5.4.9 Derrick and Draw Works

The riser and lift system derrick will be based around a conventional 750tonne capacity bolted beam leg drilling derrick complete with crown block, travelling block guide dolly, travelling block, and 750 tonne rated draw works (Figure 19-25). Other derrick equipment will include a deadline anchor and load cell, ladders, platforms, stabbing board and lighting. All equipment will be commercially available catalogue items taken from reputable manufacturers.

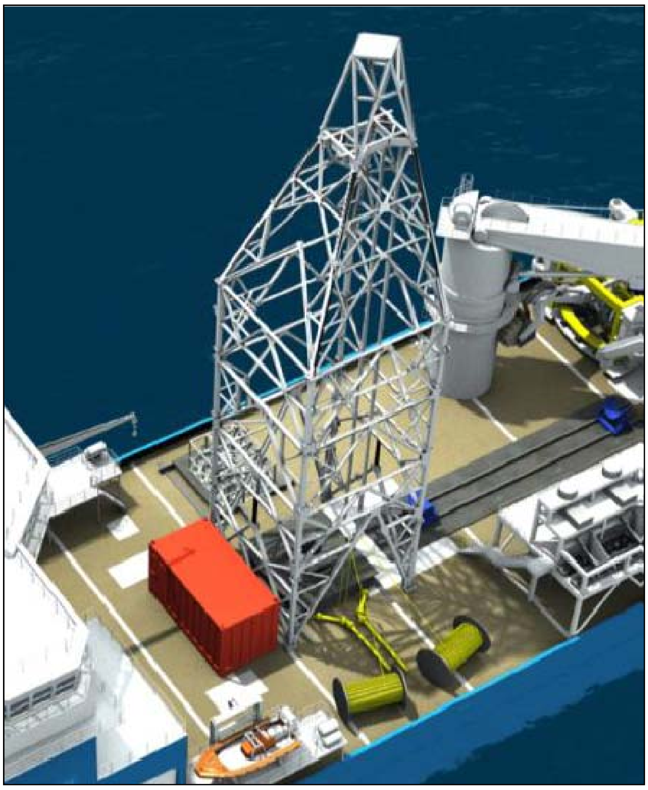

Figure 19-25: 3D Artists Impression of Derrick Installed on PSV

The main features of the derrick are:

- Footprint 12m x 12 m (39' x 39') centres.
- Height 40 m (120').
- Safe Working Load 750 short tons.
- Travelling block complete with dolly and elevators.
- 4500HP draw works.
- Skid base to transport SSLP in and out of derrick.

19.5.5 Dewatering Plant

19.5.5.1 Introduction

This section has been prepared by Ausenco Minerals to describe the processing operations relating to the Solwara 1 ship-based ore dewatering plant. Engineering development for the dewatering plant is currently to concept level. Detailed material property testing is in progress which will be used for detailed design.

The mined ore is pumped to the PSV by the riser and lift system as a slurry. The dewatering plant is used to reduce the water content. After dewatering, the ore is delivered for offloading to shuttle barges. The dewatering plant is required to dewater run of mine (ROM) ore to below the transportable moisture limit (TML).

The dewatering plant typically receives ROM ore slurry from the RALS outlet surge tank containing ~12%v/v solids to produce a product with ~8%v/v moisture. To achieve this, the dewatering plant produces three streams of dewatered solids:

- +5 mm sands as a coarse screen oversize (via vibrating screens).
- -5 mm +0.5 mm fines (via vibrating screen oversize subsequently dewatered by a centrifuge).

- -0.5 mm + 0.008mm filter cake (via desliming cyclone underflow subsequently dewatered by filters).

The three streams will be combined on a common discharge conveyor and discharged to shuttle barges. Prior to discharge each product will be measured for tonnage and moisture content (and samples are taken for grade control).

The following sections detail the dewatering plant:

- process design.
- design philosophy.
- flow sheet.
- operating philosophy.

19.5.5.2 Process Design

Process design is constrained by product specifications, primarily the transportable moisture limit (TML).

The TML is the permitted upper bound moisture content of a bulk solid granular material, defining the highest moisture content for safe marine transport of that material.

An assessment of the transport requirements for transhipment of Solwara 1 ore concluded that, due to potential variability in TML, testing for TML must be undertaken on the production support vessel. Hence the design includes continuous monitoring of moisture content and benchmarks this with on-site TML testing.

ROM ore is supplied to the dewatering plant as slurry containing -50mm particles. TML tests for sands and slimes are well documented and utilised in the industry. However, TML tests for coarse +3mm size fractions mixed with fines are not clearly defined by the industry. Hence, some care will be required during detailed design to clearly understand the shipping requirements.

As suitable sample stocks are limited, limited work has been completed to assess TMLs. Hence, the conceptual design for the dewatering plant is based largely on assumed empirical parameters.

Dewatering plant design assumptions are summarised as follows:

- a surge tank upstream of and separate to the DWP (at outlet of RALS) reduces fluctuations in the plant feed, improving stability of the plant operation and product quality and consistency.
- variations in feed rate and character will either be minimised or can be mitigated without additional equipment.
- ore will readily dewater on screens.
- TML for the -0.5mm product will be consistent with existing operations shipping similar materials.
- TML for the -50mm +0.5mm product will be similar to that of the -0.5mm product.

19.5.5.3 Design Philosophy

The functional requirements of the dewatering plant are to:

- Dewater run of mine (ROM) to below the transportable moisture limit (TML) whilst optimising mass recovery.
- Measure product mass flow.
- Provide sampling for grade control of seafloor mining and downstream process operations.
- Load the ore on to shuttle barges.
- Return excess water and entrained solids to the return water disposal system.

To effect these functional requirements, the dewatering system’s principal design parameters are as shown in Table 19-6.

Table 19-6: Dewatering Plant Principal Design Parameters

Item	Criteria
ROM ore slurry maximum delivery rate	~1,000 m³/h at 12% nominal (average) v/v solids and instantaneous minimum / maximum range of 0-20% v/v solids
Utilisation	50% - 60% utilisation
Produced particle size requirement	99% passing 50 mm & 80% passing 4 -24 mm
Specific Gravity of ROM ore	3.0 to 4.3 t/m³
Slurry temperature (DWP feed)	6 to 7°C
Dewatered product residual moisture content	< TML (nominally 8-9%)
Residual solid particle size in return water	99% passing 8 µm & 80% passing 6 µm

ROM ore is pumped to the Production Support Vessel (PSV) on surface via the RALS as a slurry of seawater and ore.

The seawater enters the RALS at 2 to 4 °C and is heated to 6 to 7 °C on rising through warmer surface waters. On delivery to the surge tank it is expected to have a viscosity of ~1.5 cP, whereas at 25°C it would be 1 cP. This higher viscosity adversely affects the performance of dewatering plant equipment, in particular the hydrocyclones and filters.

The design of the dewatering plant flow sheet allows for some flexibility and adjustment, eg:

- standby equipment is provided for each unit operation to maximise plant availability and maintainability and provide additional capacity for variations in ROM ore character and flow.
- coarse screen aperture can be changed to provide bias to either permit more feed (i.e. with a larger screen aperture) to the centrifuge to improve screen capacity or less feed (i.e. with a smaller screen aperture) to reduce centrifuge wear.
- hydrocyclones can be modified to increase the cut size if either slime losses are lower than filter operating costs or if filter or cyclone operation is limiting plant throughput.

The design philosophy adopted utilises industry standard equipment and includes a throughput design margin. This margin makes allowance for: the anticipated variations in feed character; the limited amount of design data currently available; current expectations regarding the difficulties associated with gathering detailed mine planning data and the effect of operating on a ship in open sea.

19.5.5.4 Flow Sheet

The flow sheet adopted is to: remove the coarse size fractions (-50 +5 mm, and -5 +0.5 mm respectively) by screening; remove the bulk of the water and the -0.008 mm slimes from the -0.5 mm undersize using hydro-cyclones; and then dewater the deslimed fines using filters.

This produces three product size fractions -50 +5 mm, -5 +0.5 mm, and -0.5 +0.008 mm that when combined meet the TML requirements for the shuttle barges. This flow sheet is summarised in Figure 19-26.

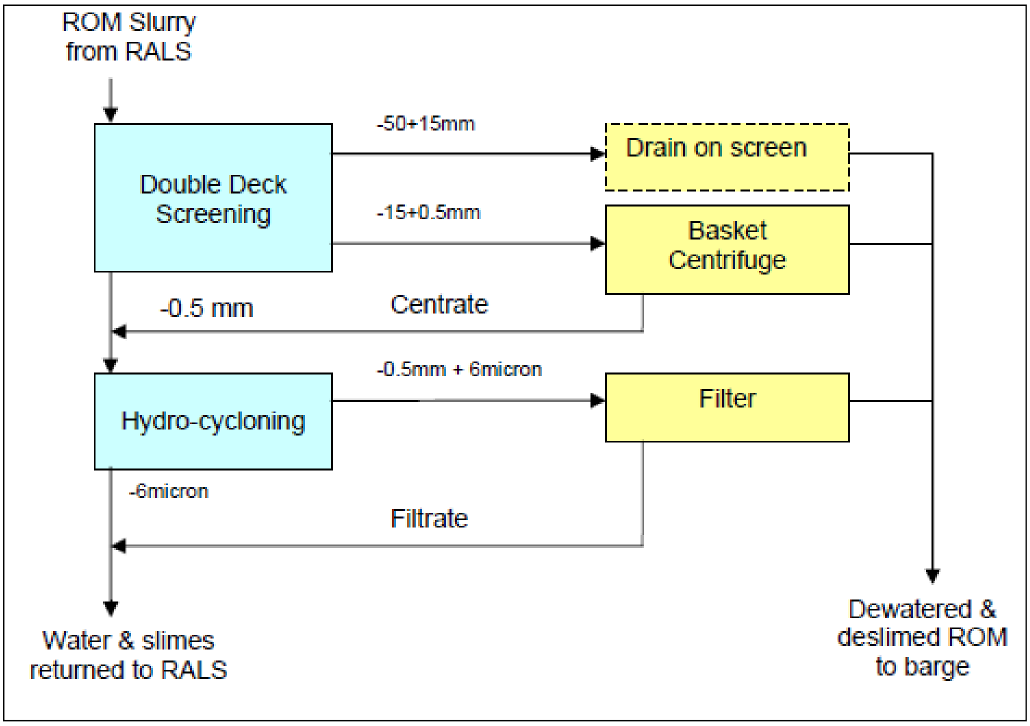

Figure 19-26: 3D Dewatering Plant Flow Sheet Schematic

Hence, the dewatering plant is comprised of the following areas:

- screen feed.
- screens.
- wedge wire basket centrifuge.
- hydrocyclones.
- filters.
- tanks.
- conveyors.
- slurry pumps.
- instrumentation, control and sampling.

19.5.5.5 Screen Feed

The screen feed system design will be based on a steady volumetric flow and a slurry inlet density moderated by the RALS outlet surge tank upstream of the DWP The screen feed system will comprise of splitters to distribute the flow across the screens. The type of equipment will be selected so as to not be adversely affected by the high settling velocity of the large particles in the feed.

Current expectations are that gathering operations will result in a relatively constant volumetric slurry flow rate that contains variable solids content i.e. with large variations in feed solids flow, typically with:

- a maximum feed solids flow rate of 395 t/h.
- a maximum instantaneous feed slurry solids content of ~20 %v/v (although this will be modulated via surge tank).
- feed solids flow rate changes of up to 50 t/h per minute.
- periods of no solids flow i.e. the RALS discharging water only to the dewatering plant.

19.5.5.6 Screening

Screens have been selected as the initial size separation as they are reasonably tolerant to variations in slurry solids content and require only a small footprint. The function of the screens is to separate the feed solids into three size fractions, with most of the water reporting with the finest fraction. The design cut sizes are 5 mm and 0.5 mm. The current design uses two duty double-deck flat screens as duty units with a stand-by screen used during maintenance or for reserve capacity.

19.5.5.7 Wedge-Wire Basket Centrifuge

Centrifuges have been selected to dewater the -5 +0.5 mm size fraction as they are reasonably tolerant to variations in feed rate; and require only a small footprint. The function of the centrifuge is to dewater the coarse fraction so that, when combined with the mid-size sands and fines filter cake, the co-deposited mixture will meet TML requirements.

Wedge-wire basket centrifuges are used to dewater coal and salt in the same size range as will be retained on the DWP screens' bottom decks. Equipment vendors advise their use for dewatering mineral ores has not been documented. As such, the use of centrifuges entails an identified (but manageable) risk in regard to process performance and maintenance wear life. The proposed design is based on assumed empirical performance estimates. The design and equipment specification should be revised on completion of equipment performance and TML test work.

19.5.5.8 Hydrocyclones

The function of the hydrocyclones is to reduce the volume of water that will report to the filters with the fines fraction. This equipment provides a flexible and low cost means of removing a significant portion of the water delivered by the RALS. However, the water removed contains entrained slimes. These slimes contain metal values and therefore represent a revenue loss.

Using current empirical assumptions, a hydrocyclone cut point of 6 to 8 μm has been assessed as the likely operating point that balances costs, operability and metal loss. If there is insufficient value in the fine material above this cut size to cover the costs of its recovery, a higher cut size may be viable. If a higher cut size is viable then fewer, larger cyclones can be used. This will result in lower costs and a reduced propensity for blockages.

19.5.5.9 Filtration

The function of the filters is to produce a dewatered -0.5 mm fines fraction so that when combined with the coarse fraction and mid-size sands the co-deposited mixture will meet TML requirements.

As assessment of TML is incomplete, filter selection has not been finalised. Initial expectations are that vacuum disc filters using sintered ceramic filter media will be suitable. However preliminary TML test work has given results atypical for these ore types that suggest pressure filters could be required. As such, confirmatory test work should be undertaken prior to finalisation of the filter design and specification.

Pending the outcome of confirmatory TML test work, the following filter packages are being considered:

- 2 vacuum disc filters with ceramic media e.g. Ceramec CC-60 filters.
- 2 pressure filters e.g. Hoesch FFP 1516 70/70 M40 PP/TPV filters.
- The current cost estimate is based on the vacuum disc filters with ceramic media.

19.5.5.10 Tanks

The circuit contains three slurry tanks.

The cyclone feed tank receives the screen underflow and centrifuge centrate. It functions as a pump hopper and supplies four cyclone feed pumps. The tank will be agitated to maintain solids in suspension. During periods of low flow a facility is provided to recycle cyclone overflow back to the tank.

The filter feed tank is supplied by cyclone underflow. Excess slurry supplied to the filters is also returned to the filter feed tank. It functions as a pump hopper and supplies two filter feed pumps. The tank will be agitated to maintain solids in suspension.

The centrate tank receives centrate from the centrifuges for pumping to the cyclone feed tank. It functions as a pump hopper and supplies two centrate transfer pumps. The tank does not require agitation.

19.5.5.11 Conveyors

All conveyors are standardised to a 600 mm wide belt and are designed to operate at slow speeds (~1 m/s). Deep troughs are provided to minimise spillage.

On stream belt weigh scales and moisture meters are installed for process monitoring and control.

19.5.5.12 Slurry Pumps

Industry standard slurry and water pumps have been selected for the required duties. Standby units are provided for all duties. Variable speed drives are employed on the cyclone feed and filter feed pumps.

19.5.5.13 Instrumentation, Control and Sampling

The instrument and control system provides the means to sequence plant start-up and shut-down, and to monitor and maintain stable operation. The system monitors and logs the throughput and moisture of the feed and the three product size fractions. Due to the limited space, shortness of the conveyors and motion of the PSV, the preferred type of belt weightometer is nucleonic. These are contained in a frame that spans the conveyor. On-belt moisture monitors using microwave technology are housed in similar frames to the weightometers. On-belt elemental analysis (Prompt Gamma Neutron Activation System or similar) is also installed for grade control purposes. Sample of the product are gathered for TML testing and elemental analysis.

19.5.5.14 Operating Philosophy

Ore is loaded onto barges moored adjacent to the Production Support Vessel (PSV). The PSV will be able to accommodate barges on both sides of the vessel. Barges will deliver ore to Rabaul at a rate of approximately one barge per day.

A RALS outlet surge tank ahead of the DWP will feed the RALS discharge slurry to the DWP to moderate the variability of the RALS discharge slurry density.

Dual side barge loading will enable continued operation of the dewatering plant as an empty barge will be moored to the PSV prior to the loaded barge being disconnected. A dewatered storage compartment downstream of the DWP onboard the PSV will provide contingency storage in the event weather conditions or barge schedule prevents this dual barge loading option.

Maintenance will be scheduled around periods when the plant is not utilised ie. when seafloor gathering machine is not operating.

The plant has been designed with some reserve capacity.

The GM-RALS controls the feed rate to the dewatering plant. Given the use of positive displacement RALS pumps, the volumetric feed rate to the DWP is expected to be relatively constant.

However, the solids content of the feed slurry and its size distribution are expected to vary significantly. The control system will be programmed to manage foreseeable variations during start-up, shut-down and continuous operation. The control system will provide alarms if the system deviates outside the programmed range.

Key flows, slurry densities and product moisture will be monitored continuously by instruments. The speed and power draw of pumps will also be instrumented. This data will form the input to the control and monitoring system. This system facilitates automated operation of the plant and monitoring of product moisture. Additional on-stream elemental analysis of the product is employed for grade control.

In addition to the instrumentation, product samples will be taken periodically for laboratory analysis eg. size distribution, grade and TML requirement. This independent verification is required for shipping and ore purchasing and processing contracts and to check the calibration of the instrumentation on-board the PSV.

19.6 Transportation to Port Rabaul / Stockpiling

19.6.1 Introduction

Run-of-mine (ROM) ore will initially be mined at approximately 1.2 Mtpa and ultimately ramp up to 1.8 Mtpa. The ore will be dewatered through the dewatering plant (DWP) on the Production Support Vessel (PSV) at Solwara 1 site and transported via a barge-tug operation to the Port of Rabaul in Papua New Guinea (PNG), where handysize ships (~25,000 DWT) will be loaded for onward transportation to a concentrator plant.

Conceptual designs for Solwara 1 port and shipping requirements within PNG have been developed based on limited site information. Additional work is required to confirm the assumptions used in the concept studies and develop the design. Concept design development comprises the following areas:

- barging from the PSV to the Port of Rabaul.
- materials handling and ship loading at the Port of Rabaul.
- ore transportation from the Port of Rabaul to market.

19.6.2 Barging from PSV to Port of Rabaul

Ore mined at the Solwara 1 deposit will be dewatered through the DWP on the PSV and transported to the Port of Rabaul, prior to shipping to a concentrator facility.

Dewatered ore from the dewatering system will be delivered to a mechanical offloading system and then transferred onto shuttle barges for transportation and offloading of the ore to an onshore covered storage area.

At the Port of Rabaul there is limited access to fixed unloading equipment so mobile equipment has also been considered for barge unloading; however, it would require a purpose-built docking facility. Hence geared barges are seen as the most cost-effective method for transport of ore from the PSV to the Port of Rabaul.

Powered or unpowered barges (assisted by tug/s) will be used for ore transportation. A number of available options for commercial operation of the barging transport system are being considered, such as:

Charter and Contract Operation (C&CO), where tenders are received from various barging contractors for the supply and operation of the barging vessels on a charter basis;

Purchase and Contract Operation (P&CO), in which the project procures the barges, with equipment operation and servicing being supplied by a third party; and

Owner Self Perform (OSP) of both the procurement and the operations of the transport barges.

To determine the optimum delivery strategy, three key issues are identified: schedule; performance risk; and cost.

Based on schedule and cost, it was concluded that all of the proposed delivery strategies are acceptable options, providing that used equipment is available to suit project requirements. The assessment also noted that the options which pose the greatest potential for performance risk are those options requiring procurement. A decision on contracting strategy has not been finalised and at time of writing of this report, Nautilus had a number of options that could support a P&CO or OSP model. The final decision will be made based on assessment of commercial and schedule benefits / constraints and project risk management.

For the purposes of capital and operating cost estimating, a P&CO strategy has been adopted utilising contract operation of purchased second-hand barges and tugs.

19.6.3 Port of Rabaul Materials Handling and Ship Loading

Unloading, stockpiling and load-out of ore onto transportation vessels is planned to be undertaken at the port of Rabaul as part of a port service agreement established with the PNG Ports Corporation. Commercial discussions relating to this scope were ongoing at the time of writing this report and hence are excluded from the commercial evaluation of this report. However, an indicative plan for the operations is provided herein for reference.

The onshore storage and load-out facilities at the Port of Rabaul stockpile will receive ore from the offshore site via transportation barges and stockpile for subsequent load-out onto bulk carriers for transportation to a concentrator site or direct delivery to smelters. The Solwara 1 materials handling requirements will consider existing port traffic and operations and integrate its requirements.

Ore will be unloaded from barges using self unloading gear to mobile transfer conveyors, front end loaders and stacker to fabric covered stockpiles of nominal 50,000t capacity. Reclaim will utilise front end loaders, loading to mobile transfer conveyors which load a mobile ship loader. Barge unloading and ship loading will be undertaken 24 hours a day, 365 days a year to accommodate the over-all production rate.

Expected barge frequency is about one every 24 hrs and expected ship frequency is one every week.

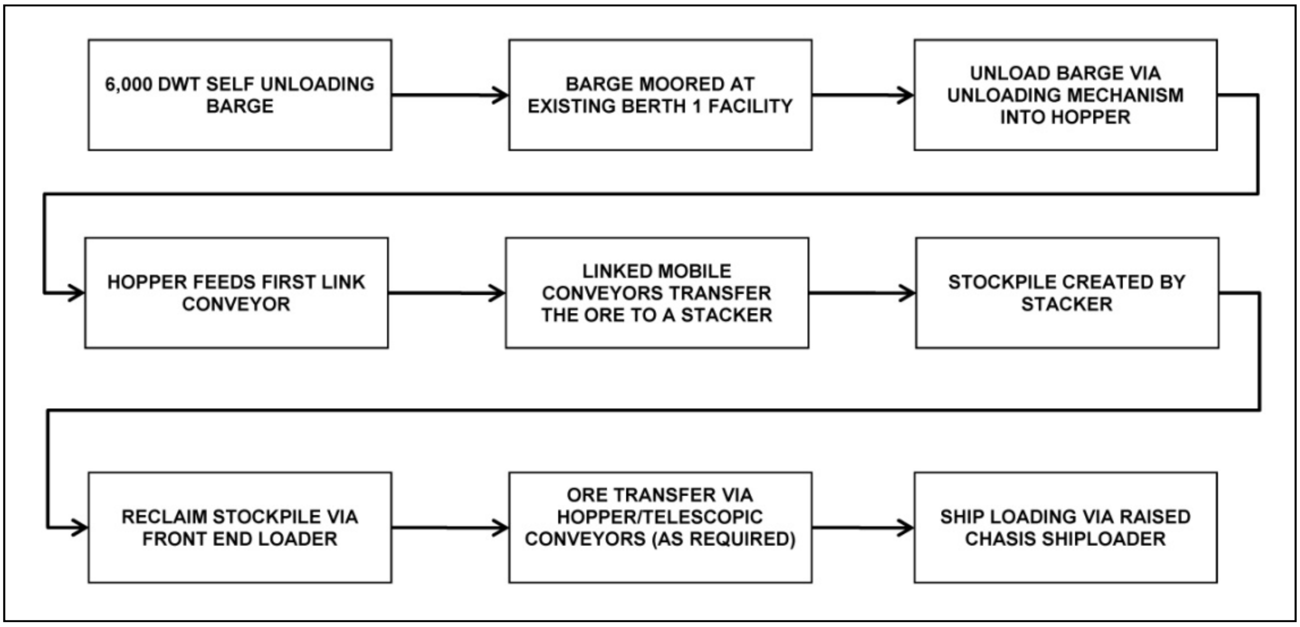

Figure 19-27: Port of Rabaul – Ore Handling Flowsheet

General operational and design criteria include but are not limited to:

- First in first out policy to be adhered to where possible that is, the ore that has been unloaded first is the preferred ore to be loaded onto the export vessel first (wherever possible).
- Ore can be either unloaded onto an intermediate storage position or unloaded directly onto the stockpile.
- Barge loading / unloading will continue through rain consequently all materials handling equipment will have covers.
- Preference to maximise the use of mobile equipment as compared to fixed capital.
- Short-term design life in the order of 3 years as Nautilus intends to consider more permanent facilities for its long term operations in PNG.
- Storage capacity is 50,000 tonnes.
- Design to limit water ingress (i.e. the stockpile will be covered) to minimise oxidation, acid drainage, windage and comply with Transportable Moisture Limit (TML) restrictions.

There are limited existing facilities at the Port of Rabaul for unloading Solwara 1 ore. An assessment of available facilities concluded that ore coming from the PSV would be best unloaded at Berth 1 (refer Figure 19-27). Existing shed facilities at the port are not suitable for stockpiling use. The most favourable ore stockpile location is between existing sheds and will have covers to minimise water take-up.

A basic port / stockpile arrangement has been selected and is based on barge unloading at Berth 1 (refer Figure 19-28), two covered stockpiles (or compacted hard stand) and ship loading at Berth 2. Options exist for different ore handling operations and will be finalised during detailed design phase. In the interim and for reference, below is a description of the anticipated handling operations.

- Barge berthing at the port (Berth1).
- Ore unloading by self unloading barge.
- Ore transfer to the storage stockpiles via mobile conveyors , front end loaders and stackers via an intermediate storage location.
- Ore stockpiling.
- Ship berthing at the port (Berth 2).
- Stockpile reclaim and ship loading via front end loaders, mobile (telescopic) conveyors and a mobile stacker.

For vessel berthing, there are two existing reinforced concrete berths at the Port of Rabaul.

Berth 1	The smaller berth, with a depth of 7.9 m, is used predominantly for fuel tankers and cruise vessels. Some container ships are also loaded and unloaded at this berth if Berth 2 is not available for use.
Berth 2	With a depth of 10.2 m, is used predominately for container vessels from both overseas and local PNG coastal ports.

Additional ships, predominately fishing vessels, are anchored in the harbour from time to time. These vessels may come in to port for fuel and water when a berth is available. Assessments of the recent shipping log records show that the existing berths have sufficient reserve capacity for the proposed operation.

The economics associated with shipping volumes and Rabaul port facilities constrain vessel size to Handy-size vessels (~25,000 DWT). These have a vessel draft suited to the proposed export wharf in Rabaul.

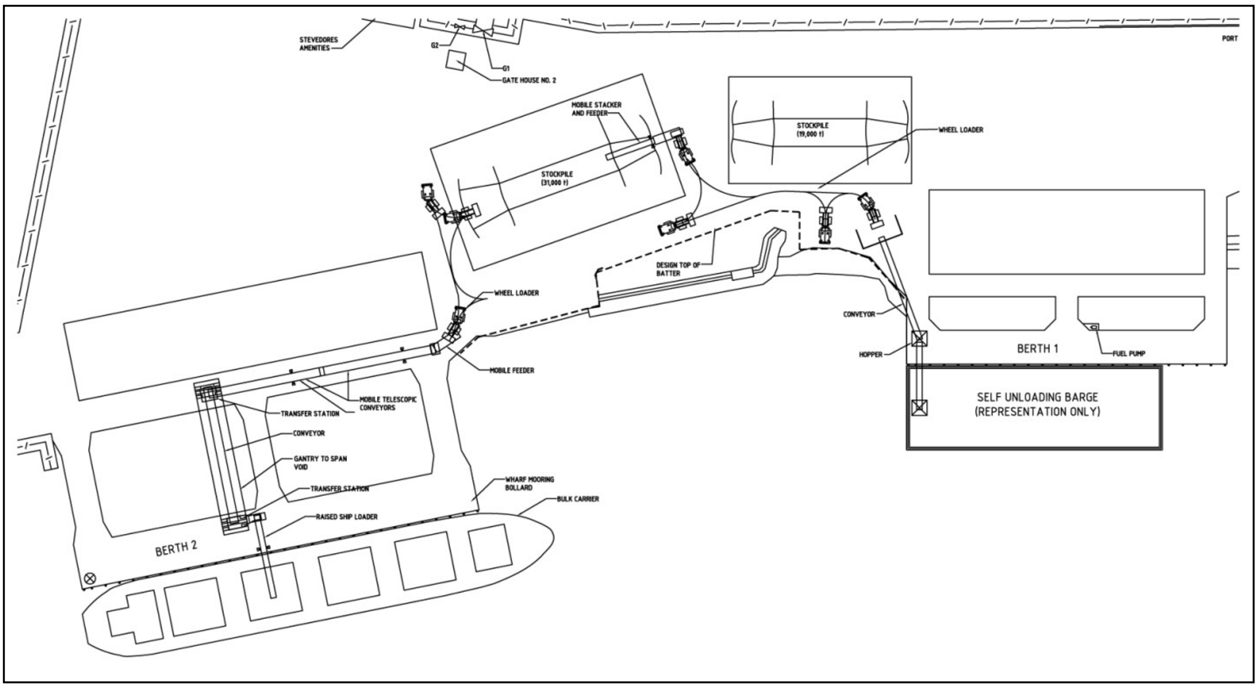

Figure 19-28: Port Rabaul Layout

19.7 Mine Plan / Production Schedule

19.7.1 Introduction

The purpose of this section is to provide a mine plan and mine schedule for the current Solwara 1 resource estimate (Section 17). Correspondingly, this mine plan and mine schedule is not definitive but reflects an initial estimate based on the current resource estimate. Given that approximately 40% of exploration holes drilled on Solwara 1 ended in mineralisation, there is a likelihood that the resource estimate will increase with further drilling campaigns, which would require subsequent revisions of this mine plan / schedule.

Furthermore the schedule is based on knowledge of mining equipment under development with productivity comparisons taken from onshore mining and subsea trenching operations. The schedule makes estimates of a ramp up period and does not take into account future developments or feed-back improvements that could follow from an initial mining period.

The mine plan in this study is preliminary in nature, that it includes inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorised as mineral reserves, and that there is no certainty that the output of the study will be realized.

Mineral resources that are not mineral reserves do not have demonstrated economic viability.

19.7.2 System Overview

The mine plan has been developed to maximise the Net Present Value (NPV) from the Solwara 1 deposit. Mining equipment is in the design development phase and the functional specification has been developed to meet the requirements of the mine plan.

Mining will follow a standard open mining approach with machines designed for each of the main functions:

- Site establishment – Auxiliary Miner and Gathering Machine.
- Cut – Bulk Miner and Auxiliary Miner.
- Gather and transport – Gathering Machine and Riser and Lift System.
- Clean-up – Auxiliary Miner.

Fragmentation of the ore will be by mechanical cutting using drum and pick technology developed for the mining and dredging industry. The mining equipment will use tracks as the main mode of locomotion over the seafloor and mining benches. Site establishment work, using the Auxiliary Miner, requires spud stabilisation when excavating ramps with gradients up to 20˚. Gathering of the cut ore is achieved using mechanical gathering to a suction mouth, with the ore then pumped to the Subsea Lift Pump.

Based on the current resource estimate (refer section 17), mining is scheduled to take 567 days to recover 1.957 Mt of ore with grades of 6.18% Cu, 5.25 g/t Au and 25.64 g/t Ag.

19.7.3 Resource Properties

The resource Block Model forms the foundation for developing the mining model. Golder Associates developed the resource block model with the following critical properties:

19.7.3.1 Metal Content

The resource model included copper (Cu %), gold (Au g/t), silver (Ag g/t), zinc (Zn %) and lead (Pb %).

19.7.3.2 Ore Domain

Table 19-7: Ore Domain

Domain	Domain Code
Unconsolidated Sediments	200
Lithified Sediments	300
Massive Sulphides	400
Basement Volcanics	500
Chimneys	600

19.7.3.3 Ore Class

Table 19-8: Ore Class

Class	Class Code
Measured	1
Indicated	2
Inferred	3
Unclassified	4

19.7.3.4 Model Parameter

NHole: Number of holes used for Kriging estimate ; KVar: Kriging Variance. The parameters for the Resource block model are given in Table 19-9.

Table 19-9: Solwara 1 Geological Model Parameters

Parameter	X Easting	Y Northing	Z RL
Parent Block size (m)	10	10	0.5
Sub-block (m)	N/A	N/A	N/A
Model origin	398 700	9 580 750	-1750
Model Limit	399 850	9 581 450	-1470
Extent (m)	1,150	700	280
Number of Parent Blocks	115	70	560

19.7.3.5 Ore Type

Rock within the Solwara 1 deposit has been categorised by both lithology and ore type. Ore type categories were selected on the basis they would exhibit noticeably different geotechnical, geomechanical and metallurgical characteristics. The ore types that make up 96% of the deposit existing within the massive sulphide and the description and modelled quantity are shown in Table 19-10.

Table 19-10: Ore Type Categories

Ore Type	Description	Estimated
2	Vuggy and porous mineralisation within the massive sulphide	65%
3	Dense massive sulphide, rare vughs, can be banded	26%
4	Brecciated massive to semi-massive sulphide	9%

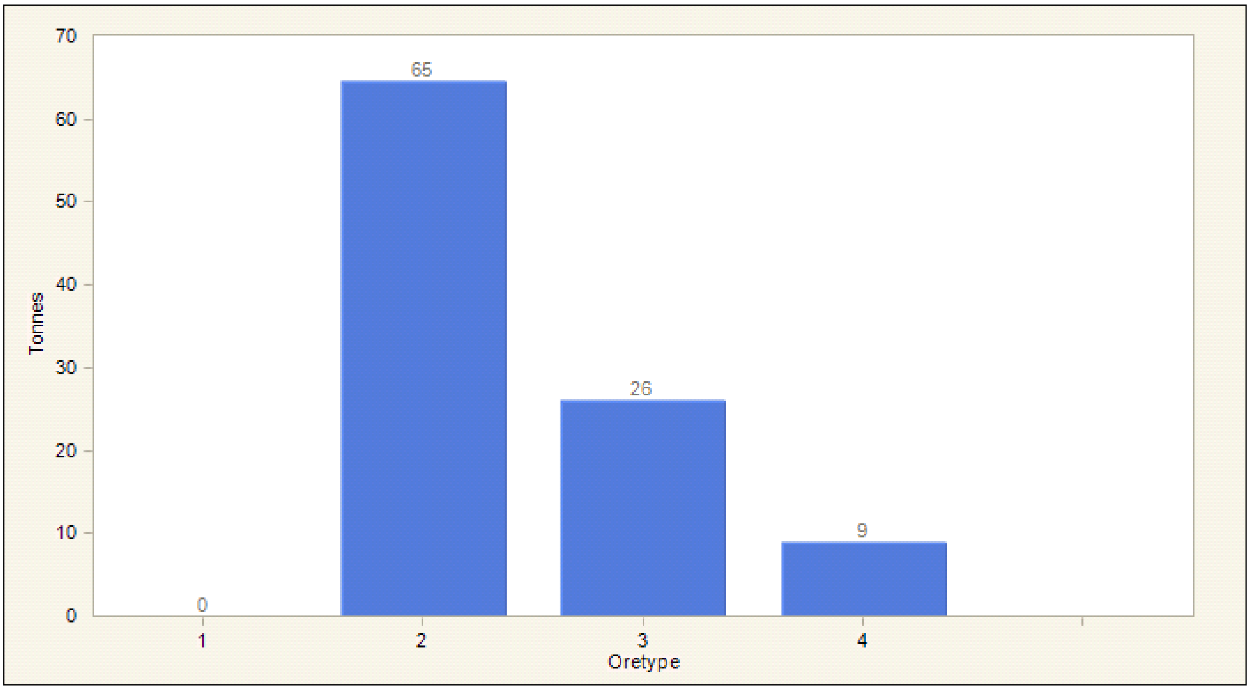

Figure 19-29: Ore Type Distribution

19.7.4 Mining Production Model

The flowchart below shows the process for development of the Mine Production Model. The following section details the main tasks.

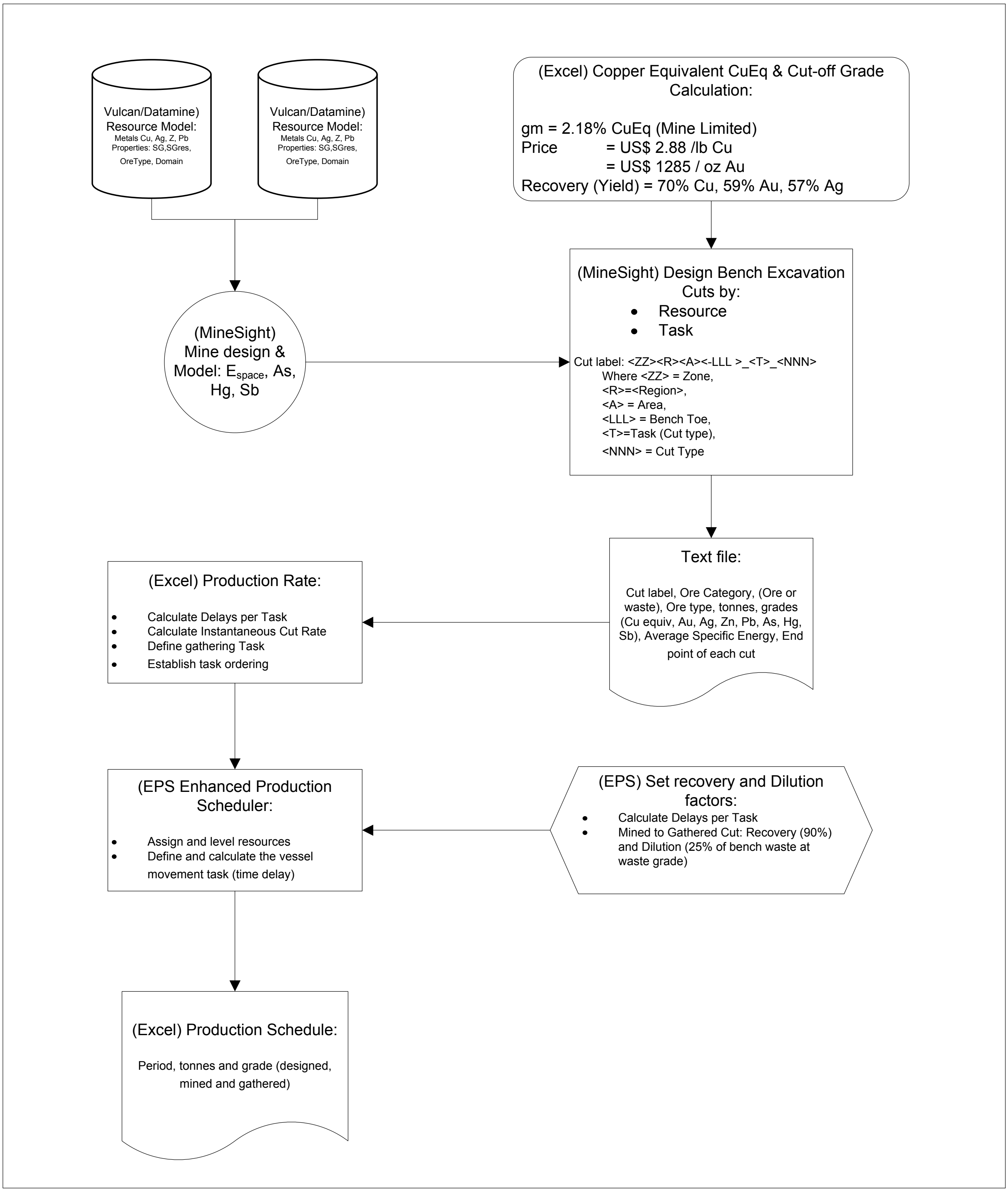

Figure 19-30: Mine Production Model

19.7.5 Solwara 1 Mine Areas

Solwara 1 has been divided into 5 mining areas based on 2007 drilling campaign with separate designs and mining sequences developed for each area. The areas are shown in Figure 19-31 and designated as:

- Far West Zone (FWZ) – Blue area.
- West Zone (WZ) – Red Area.
- Central Zone (CZ) – Orange Area.
- East Zone (EZ) – Yellow Area.
- Far East Zone (FEZ) – Green Area.

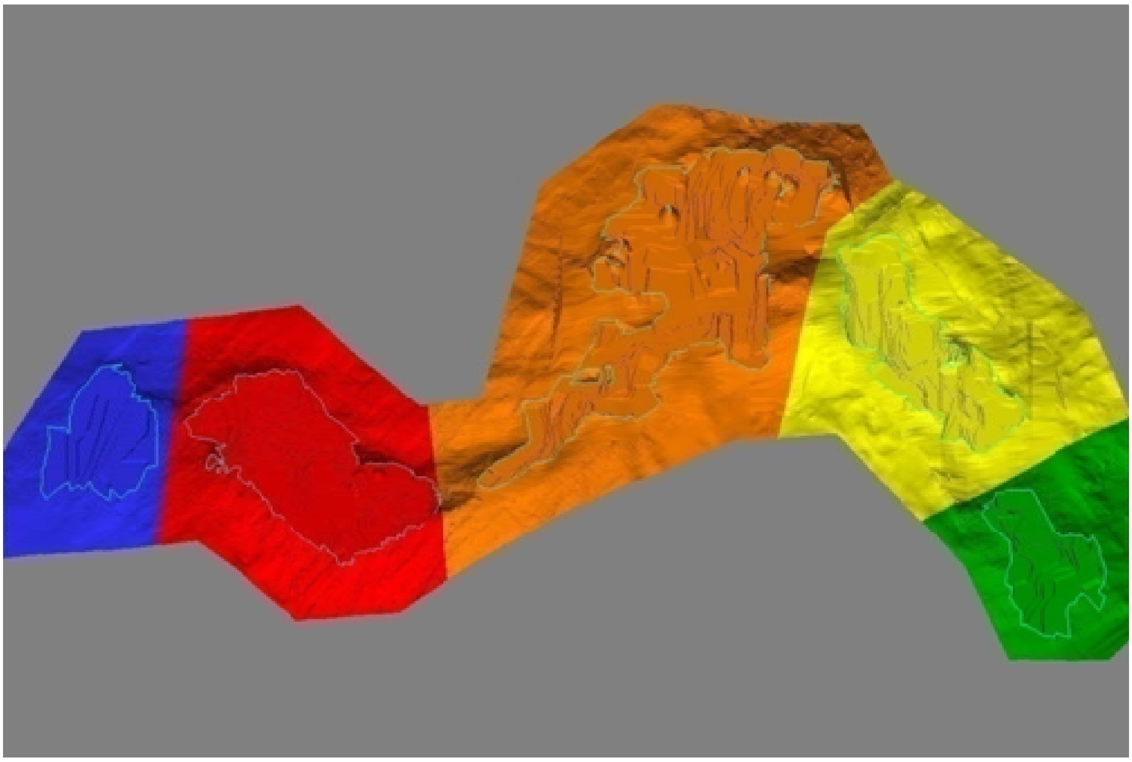

Figure 19-31: Solwara 1 Zones

Table 19-11 shows the summary ore, waste and unconsolidated sediment (US) quantities (no dilution or mining losses are shown), as well as ore grades.

Table 19-11: Solwara 1 Zone Mine Plan Estimates

Zone	Category	Tonnes	CuEq (%)	Cu (%)	Au (g/t)	Ag (g/t)	Pb (%)	Zn (%)	SR
Central	Ore	812,817	9.50	6.73	4.89	24.97	0.09	0.04	-
	US	41,853	-	-	-	-	-	-	0.10
	Waste	41,106	-	-	-	-	-	-	0.05
East	Ore	340,323	8.93	5.27	6.52	25.95	0.07	0.45	-
	US	31,796	-	-	-	-	-	-	0.22
	Waste	42,503	-	-	-	-	-	-	0.12
Far East	Ore	114,729	6.69	4.14	4.56	17.16	0.07	0.45	-
	US	8,018	-	-	-	-	-	-	0.56
	Waste	56,396	-	-	-	-	-	-	0.49
West	Ore	469,007	9.31	6.41	5.09	29.75	0.10	0.63	-
	US	25,313	-	-	-	-	-	-	0.07
	Waste	8,565	-	-	-	-	-	-	0.02
Far West	Ore	128,018	16.84	10.551	11.17	48.63	0.15	0.08	-
	US	22,560	-	-	-	-	-	-	0.24
	Waste	8,022	-	-	-	-	-	-	0.06
Total	Ore	1,864,894	9.68	6.49	5.65	27.49	0.09	0.52	-
	US	129,540	-	-	-	-	-	-	0.15
	Waste	156,592	-	-	-	-	-	-	0.08

19.7.6 Cut-off Grade Calculation

Mine Limited and Treatment limited cut-off grades were calculated using costs from the preliminary Project Financial Model as follows:

- $g_m = h \ / \ (p - k)y$
- $g_h = \{h + (f + F) / H\} / (p-k)y$

Where:

- gm = Mine Limited cut-off grade
- gh = Treatment Limited cut-off grade
- p = price
- k = Marketing variable cost
- y = yield recovery %
- h = Treatment variable cost ($/t)
- f = Treatment fixed cost
- F = Estimated opportunity Cost
- H = Treatment Capacity

Yield Recovery was calculated as shown in Table 19-12.

Table 19-12: Yield Recovery Calculation

Parameter	Copper	Gold
Met Recovery	90.0%	65.0%
Royalty	2.25%	2.25%
Dewatering & Payable rate	4.10%	4.10%
TC/RC charges	13.60%	
Yield Recovery	70.1%	58.7%

Treatment is defined as any part of the material flow that deals with ore only, this includes the Riser Transfer Pipe, Subsea Lift Pimp, Riser, Dewatering, barging, Stockpiling, transhipment of ore, processing, transhipment of concentrate, port facilities and transport and smelting.

The opportunity cost was calculated from a draft schedule using a discount rate of 25%.

- gm = 2.18 % CuEq
- gh = 4.00 % CuEq

Mine Planning assumes the project will be mine limited.

19.7.6.1 Open Pit Optimisation

For mine planning purposes the Golder Associates Vulcan resource model was converted to MineSight regular block model. A number of changes were made to this model to prepare for Lerchs-Grossman pit optimisation. The following fields were created in the model:

- VALPB: The Total Block Value.
- VALPT: The Block value per tonne.
- IPER: The Period the Block is mined.
- SLOPE: The slope domain the block is assigned.
- DEST: The destination of the block material.

The seafloor pit optimisation was done using the MineSight Economic Planning software, developed by Mintec Inc of Tuscon, USA. Mining ,Treatment costs and Metallurgical Recoveries are based upon a preliminary project financial model.

A number of open pit optimisation cases were run to test sensitivity to commodity price, recovery and costs. The following observations were made after analysing the optimisations results:

- The final pit design is not sensitive to copper price above $1.00 /lb. The NPV changes due to revenue changes but the quantity to be mined remains near constant.
- Copper price only affect the narrow ore zones down slope at the peripheries of the mining zones due to footwall striping required to access this ore.
- The NPV decreases as inter-ramp slope angles drop below 55 degrees.
- The NPV improves with decreasing bench height due to ability to ‘follow’ the sloping footwall.

The final pit design extracts the massive sulphide that can be effectively accessed with the Bulk Miner and Auxiliary Miner, without mining into the clay altered footwall.

19.7.7 Production Rate Calculation

19.7.7.1 Overview

Nautilus Minerals in concert with SMD and the University of Delft have developed a proprietary subsea rock cutting model based on the rock hardness, fracturing and water confining pressure. The analysis is based on geotechnical data collected during the Wave Mercury campaign in 2007 which was supervised and documented by Golder Associates (2008).

Geotechnical testing of the massive sulphide, during the 2007 drilling program, was carried out on board the vessel shortly after recovery from the seafloor.

Bias of the strength measurement was introduced due to:

- Development of micro-fracturing during depressurisation.
- Invalid failure types, during strength testing, being ignored.
- Strength tests requiring intact pieces of core.

Laboratory test work to determine another likely bias due to the development of micro-fracturing during depressurisation show actual in-situ strengths can be between 1.4 and 2 times those measured after recovery from the seafloor. Test results were adjusted to account for this bias.

Logging of the core to record the Structural Category and the number of invalid failure type during testing provides an indication as to the likely bias of the strength test results due to only competent core being used.

Table 19-13: Valid & Invalid Geotechnical Testing

Item	UCS	BTS	Point Load (radial)	Point Load (axial)
Tests	63	57	74	78
Valid Tests	38	31	43	65
% Valid Test	60%	54%	58%	83%

Table 19-14 shows the percentage of core logged as competent and the percentage of the strength tests that were considered valid, for each ore type. The strength test measurements, for each ore type, represent the percentage of total core available as shown in column '% test Represent' . Core that could not be tested due to the degree of fracturing, or failed during the test due to invalid failure type, would have a lower strength than the core that was tested. No Allowance for the bias of the strength measurements is incorporated in the production rate model and the production rate can be considered conservative.

Table 19-14: Core Structure & %Valid Tests by Ore Type

Ore Type	% Competent Core	% Valid UCS	% Valid BTS	% Valid PLTradial	% Valid PLTaxial	% Valid Strength Tests	% Test Represent
Ore Type 2	78.0%	61.5%	50.0%	55.6%	88.6%	66.4%	51.8%
Ore Type 3	84.9%	42.9%	66.7%	70.0%	87.5%	67.9 %	57.6%
Ore Type 4	89.6%	70.8%	59.1%	64.5%	83.3%	70.1 %	62.8%

19.7.7.2 Cutting Machine Type and Method of Operation

The two cutting machines are:

1. Auxiliary Miner: The cutting system is twin transverse counter rotating drum cutters.

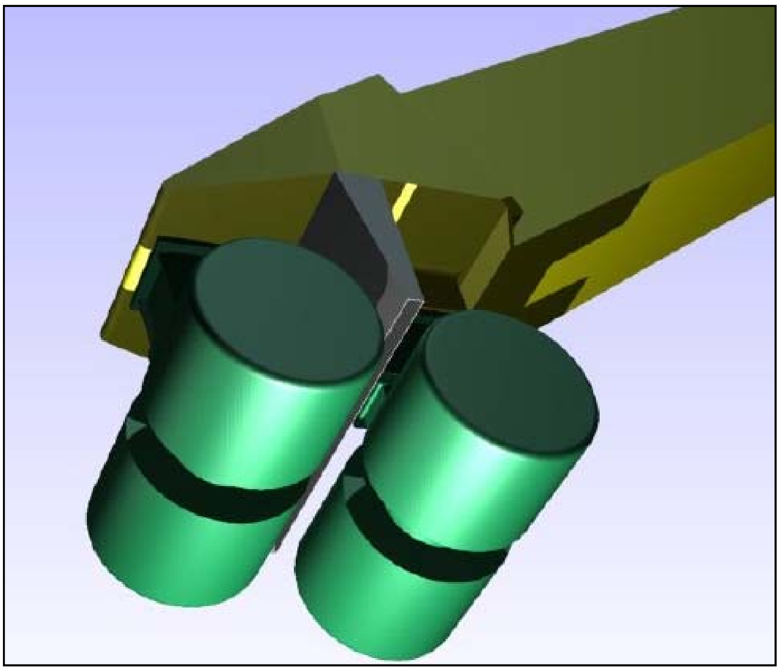

Figure 19-32: Auxiliary Miner Cutter Type

2. Bulk Miner: The cutting system is a single drum cutting in an undercut mode or overcut mode. Overcut mode is shown below for the Vermeer Road Miner.

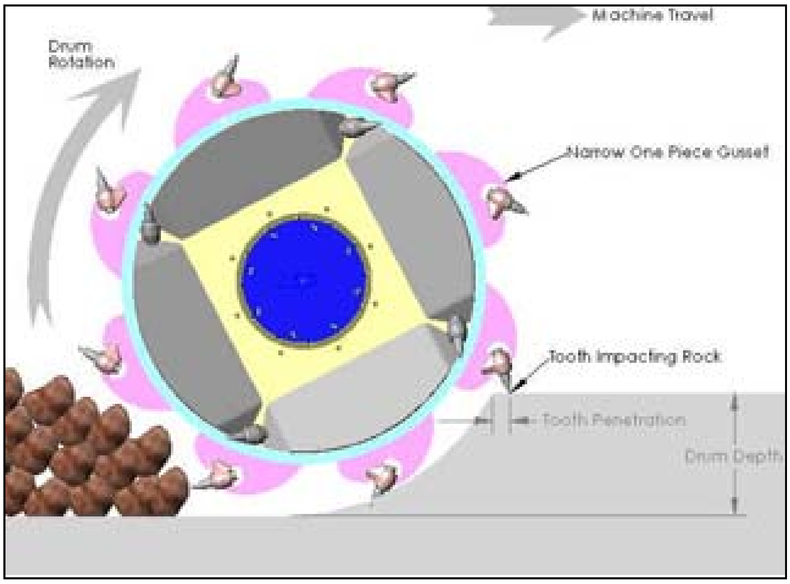

Figure 19-33: Bulk Miner Cutter Type

19.7.7.3 Pick Type and Condition

Specific Energy models are based on utilising Vosta T4 radial pick, which is a self sharpening chisel pick used in the dredging industry. Figure 19-34 shows Vosta T4 picks mounted on a dredge cutter head.

Figure 19-34: Available force that can be applied to the rock through the pick

The Bulk Miner is designed to deliver 900 KW of power to the rock through the picks, for a 30mm cut depth and velocity of 1.6 m/s the force applied will be 56 tonnes-f. The drum lacing determines the number of picks in contact with the rock, with a maximum of about 7 tonnes per pick.

The Auxiliary Miner is designed to deliver 600 KW of power to the rock through the picks.

19.7.7.4 Cut depth and velocity

Cut depth is expected to be a maximum of 50mm. The cut depth times velocity will be between 0.02 and 0.06.

19.7.7.5 Density

Conversion from a volume production rate to a tonne production rate requires multiplication with the 'in-situ' dry density of the rock mass being mined. Analysis of the dry density distribution from the 2007 drill program geotechnical test work is shown:

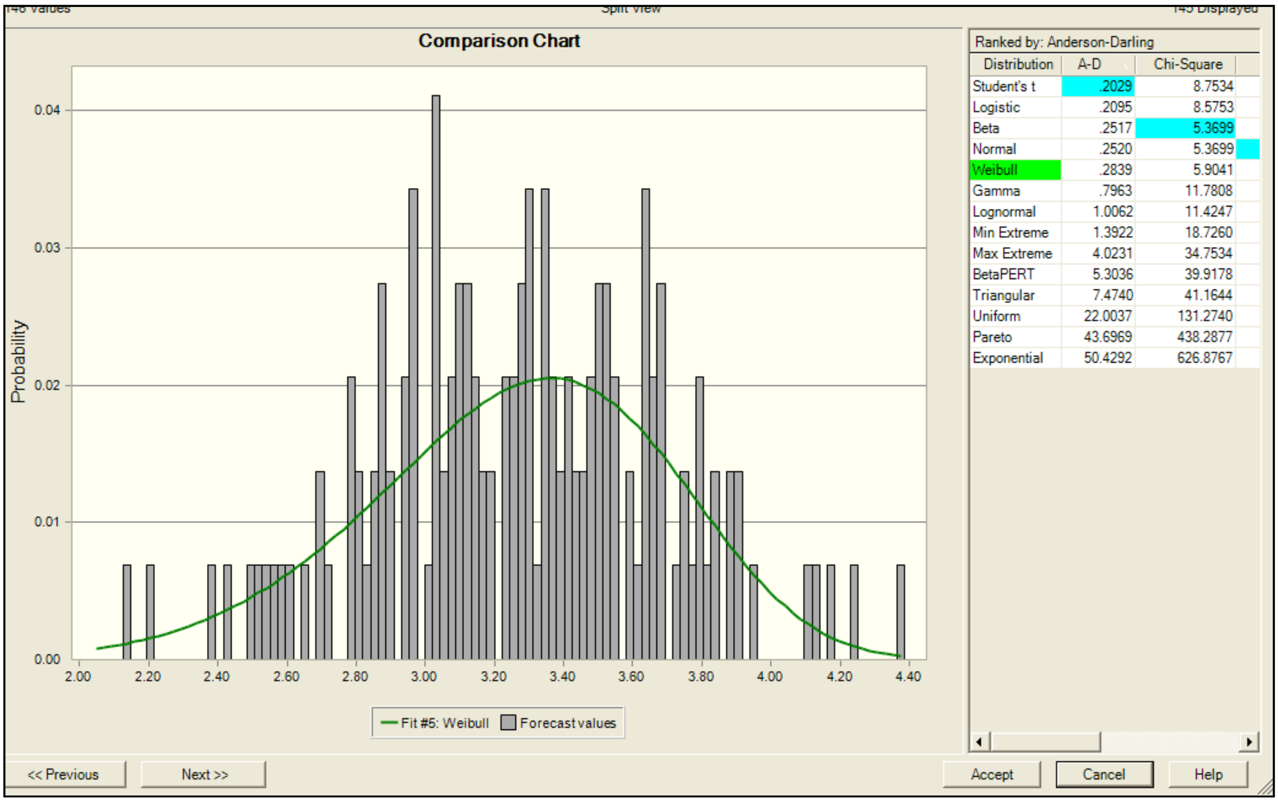

Figure 19-35: Density Distribution

Density has been assigned to each block within the Mining Block Model.

19.7.7.6 Operating Efficiency

19.7.7.6.1 Collection Efficiency

Collection efficiency (mining recovery) is estimated as follows:

- Design Cut to Mined Cut: 90%.
- Mined Cut to Gathered Cut : 90%.

These allow for ore lost from fines within the mining plume and from the edges of each bench which settle outside the accessible mining zone.

Dilution of the ore collected, from below cut-off grade material, has been calculated at 25% of the waste within each cut. The dilution grade is assumed to be the grade calculated for the waste.

19.7.7.6.2 Operating Hours per Day

Allowance is made for start-up of mining operations using a ramp up curve. The ramp up has been assumed to be linear from 30% to 100% efficiency over 26 weeks.

Riser and lift system maintenance has been assumed to take 7 days each 100 days.

19.7.7.7 Gathering Rate

The gathering machine collects the fragmented rock, from the stockpile on the bench or designated stockpile area, and pumps to the Subsea Lift Pump (SSLP). The design basis for the gathering machine is 1,000m^3/hr at a 12% slurry concentration by volume which equates to 120 cubic metres of solid per hour. The average specific gravity of the slurry solid is assumed to be 3.3 tonnes per cubic metre hence the schedule gathering rate has been set at 396 tonnes per hour.

19.7.8 PSV Operations / Mining Operability

Deploying and operating multiple remote operated vehicles simultaneously off the one support vessel is not new to the offshore oil and gas industry. The key to success is to have good acoustic positioning systems and surveyors to ensure that the operators know exactly where the vehicles are at all times to ensure that they do not crash into each other or manoeuvre around each other and tangle their umbilicals.

In deep water, multiple vehicles or objects hanging of a vessel tend to all move in the direction of the current and do not normally tend to become entangled. A system of “traffic” control will be employed to ensure that the machines have permissible “zones of operation” and operators are aware of when other machines are operating in proximity to their respective operating zones.

Producing an effective Production Support Vessel layout for the mining operations presents some challenges. The following points outline the main requirements:

- Each of the three types of subsea mining machines and each of the two ROV’s require dedicated launch and recovery system with maximum separation between each unit to reduce the risk of interference.
- Large fleeting distances between each LARS and the winches for the umbilical and deployment wires are required.
- The RALS requires a moon pool and derrick with a connection to the Gathering Machine subsea via the RTP.
- Preferably each LARS is a considerable distance from the DP thrusters to avoid wake interference when deploying or recovering.
- The cranes need to have maximum coverage to support maintenance work.
- The dewatering, offloading system and hopper are best located close to the RALS to simplify transport of the ore through the system.
- The accommodation and power modules require significant amount of deck space.
- COG should be kept low where possible to improve stability.

The deck layout for the PSV to accommodate all three seafloor mining tools is shown in Figure **19-8**.
Based on the selected deck layout, a mining operability review was undertaken based on the following assumptions:

- There will be one shuttle barge continuously alongside the Production Support Vessel (PSV).
- There are no environmental restrictions in mining several discrete sites within the central zone in parallel.
- The Bulk Miner and Auxiliary Miner can be suspended on their lift wires above the seafloor and moved from one site to another by moving the PSV.
- The Bulk Miner can be lifted and moved from one site to another with the Auxiliary Miner on the seafloor and vice versa.
- RTP is suspended from the SSLP in a modified lazy S that ensures the pipe is not horizontal at any point and does not place adverse load on the Gathering Machine
- Site layout, machine locations and tethers are managed with the use of sonar array.

From the preliminary operability work completed, it concluded that mining operations are feasible from a single vessel. This was done by considering the operating envelope of each SMT with respect to the PSV and the initial production stage or step. Figure 19-36 provides a typical diagram of the operating envelopes for the three seafloor machines deployed from the PSV. This plot demonstrates the large areas where the machines can operate and can enable large seafloor separation of the machines.

With careful planning of the mine operations, separation can be maintained between the mining machines and ROV’s to allow several machines to operate simultaneously at different work fronts.

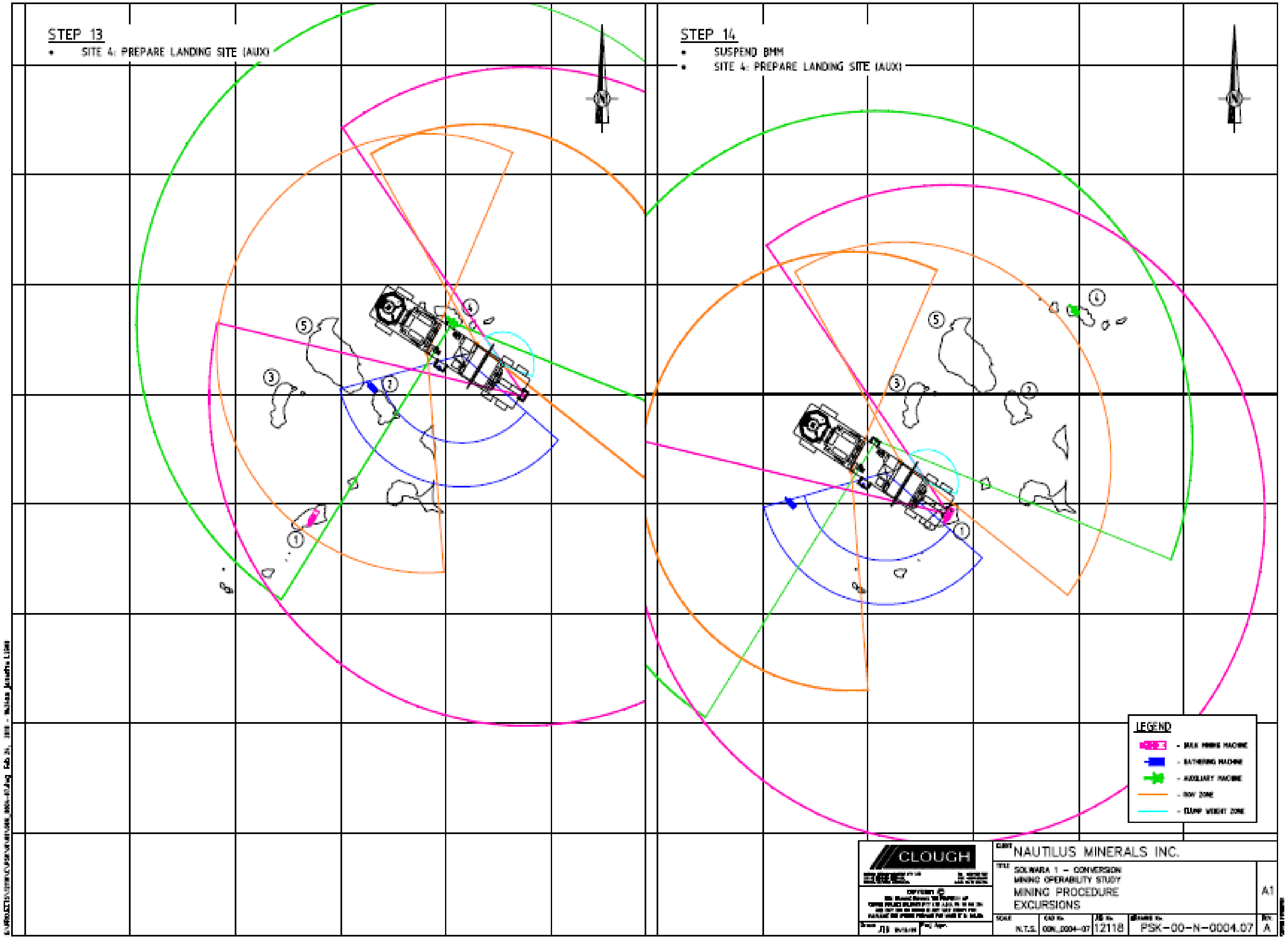

Figure 19-36: Seafloor Mining Equipment Operating Envelopes

19.7.9 Mine Schedule

19.7.9.1 Basis of Schedule

Criteria that control the development of the mining schedule have been defined as:

Auxiliary Miner

- Maximum ramp slope = 20° up and down
- Maximum cross fall slope = 10°
- Maximum bench height = 6 metres
- Design bench height = 4 metres
- Cut Width = 10 metres at the toe
- Mode of traction = tracks with spud assist
- Maximum travel speed = 600 m/hr
- Production rate = 42% of BM by bench
- Maximum Instantaneous Dig Rate = 504 bcm/hr

Bulk Miner

- Maximum slope = 10° cut down, tram up
- Maximum cross fall slope = 10°
- Maximum cut depth = 1.0 m
- Design cut depth = 0.5 m
- Design cut width = 4.0 m
- Mode of traction = tracks
- Maximum travel speed = 600 m/hr
- Production rate = calculated
- Maximum Instantaneous Dig Rate = 1,200 bcm/hr
- Minimum Mining Bench Area = 800 square metres. (defined by area to effectively operate AUX for Trimming bench edge)

Gathering Machine

- Design Gathering depth = 0.7 m
- Instantaneous Gathering Rate = 9,504 tpd
- Operating Window = 25 metres vertical zones (restrict operation into 25 m blocks to reduce riser sections addition and removal delays)

19.7.9.2 Description of Mining Tasks

The mining sequence is broken down to the following tasks:

1 Remove the unconsolidated sediment overlaying the ore body.

2 Level the chimneys.

3 Prepare a mining bench suitable for the bulk miner – AUX Prep Cuts.

4 Cut a 0.5m bench with the optimum parallel straight cuts – BM Production Cuts.

5 Trim perpendicular to the production cuts – BM Trim Cuts.

6 Relocate the BM to the next mining area.

7 Gather the 0.5 bench – GM Main Collection.

8 Relocate the BM back to the bench.

9 Repeat 4 to 8 until an additional BM Production cut can be competed (this varies from 2 to 8 benches).

10 Trim the bench edge – AUX Trim Cut.

11 Gather the AUX Trim Cut – GM Trim Collection.

12 While doing steps 4-9 use the AUX to boost production by mining 4 metre benches – AUX Production Cuts.

19.7.9.3 Removal of Unconsolidated Sediment

Unconsolidated sediment overlays much of the deposit, ranging in thickness typically from 0 to 2.7m and up to 6.0 m in localised troughs. With an angle of repose of about 15 degrees it accumulates in depressions throughout the deposit. The estimated density is 1.2 t/m^3, consisting of silt/sand particles in a sea-water matrix. Removal of the sediment is planned to be undertaken using the gathering machine. The gathering machine is designed to have a manually operated rigid suction hose, which will agitate the sediment and pump it outside the ore zone. There are estimated to be 129,540 cubic metres of unconsolidated sediment overlaying the ore body. The total theoretical time required to remove all unconsolidated sediment is 408 hours, as calculated in Table 19-5.

Table 19-15: Unconsolidated Sediment Pumping Time Calculation

Pump rate	**4,000**	**gpm**
	908	**cubic metres / hour**
Slurry Concentration	35%	percent
Pumped Solids	317.8	cubic metres / hour
Solid Volume	129,540	cubic metres
Pumping Hours	408	hrs

The slurry will be discharged at the designated tip heads for each mining zone.

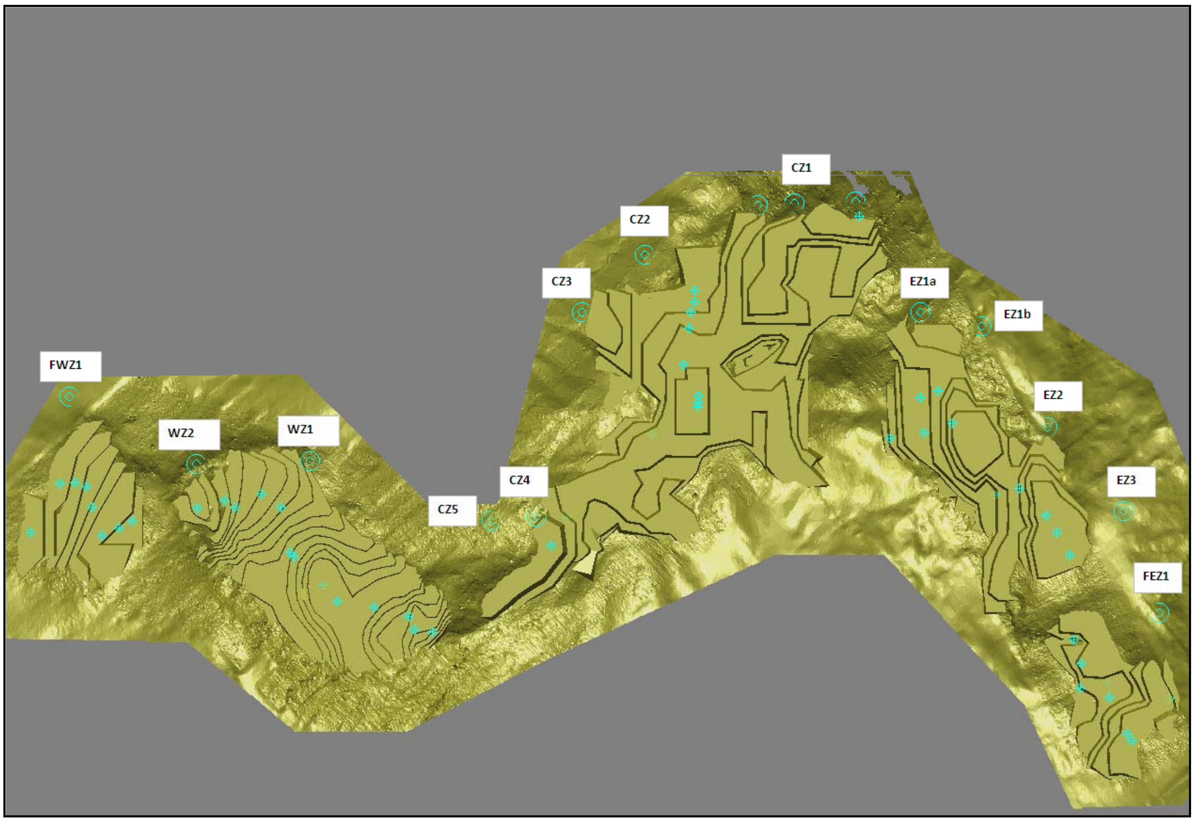

Figure 19-37: Unconsolidated Sediment Tip Head Location

Removal of unconsolidated sediment will be done progressively, as required for chimney removal and mining activities.

19.7.9.4 Level Chimneys

Chimneys will be cut down prior to commencing mining in an area. The chimneys will be left in place to be fragmented with the Auxiliary and Bulk Miners.

19.7.9.5 Prepare Bulk Miner Bench

Effective operation of the bulk miner requires a level bench of sufficient area to manoeuvre. It has been estimated an area greater than 750 m2 would provide for efficient bulk miner operations. The Auxiliary Miner will develop ramp access to the top of each distinct mining area and commence cutting down the mound, in 4.0 metre high benches, until the minimum bench area is excavated. Material excavated will be pumped to a stockpile located within 100 m from the excavation to ensure loose material does not accumulate on the slope forming the edge of the bench.

Discharge from the stockpile hose is controlled through a diffuser to minimise fines loss. Positioning and maintenance of the discharge point is controlled by ROV.

19.7.9.6 Bulk Miner Production and Trim Cuts

The bulk miner is designed to cut benches up to a depth of 1m, all scheduling has assumed an optimum 0.5 metre cut depth. Bench excavation is generally in straight lines, although cutting in a curved path can be achieved with a turning radius greater than 180 m.. Cut-lines are designed so that they are orientated to maximise the length of bulk miner cuts. The designed cut lines maximise the use of the bulk miner and ensure the tracks are always more than 2.0 m from the bench edge. The edges of each bench are either hard boundaries (bathymetry) or soft boundaries (footwall) and the safety margin maintained to prevent potential instability.

Bulk miner cuts are split into three types:

- Production, the Bulk Miner commences cutting from the start of a cut line, by moving parallel from the previous cut (unless the 1st cut), until the tracks are no less than 2 m from the end of the cut line
- Production trim, the Bulk Miner turns 180 degrees and completes the production cut, then moves parallel 4.0 m to the next cut. Should the Bulk Miner have a cutter drum at each end of the machine then the 180 degree turn is not required and the Production trim cut completed by engaging the alternate drum.
- Bulk Miner Trims, the Bulk Miner cuts along the cut lines perpendicular to the production cuts that are greater than 2.0 m in length.

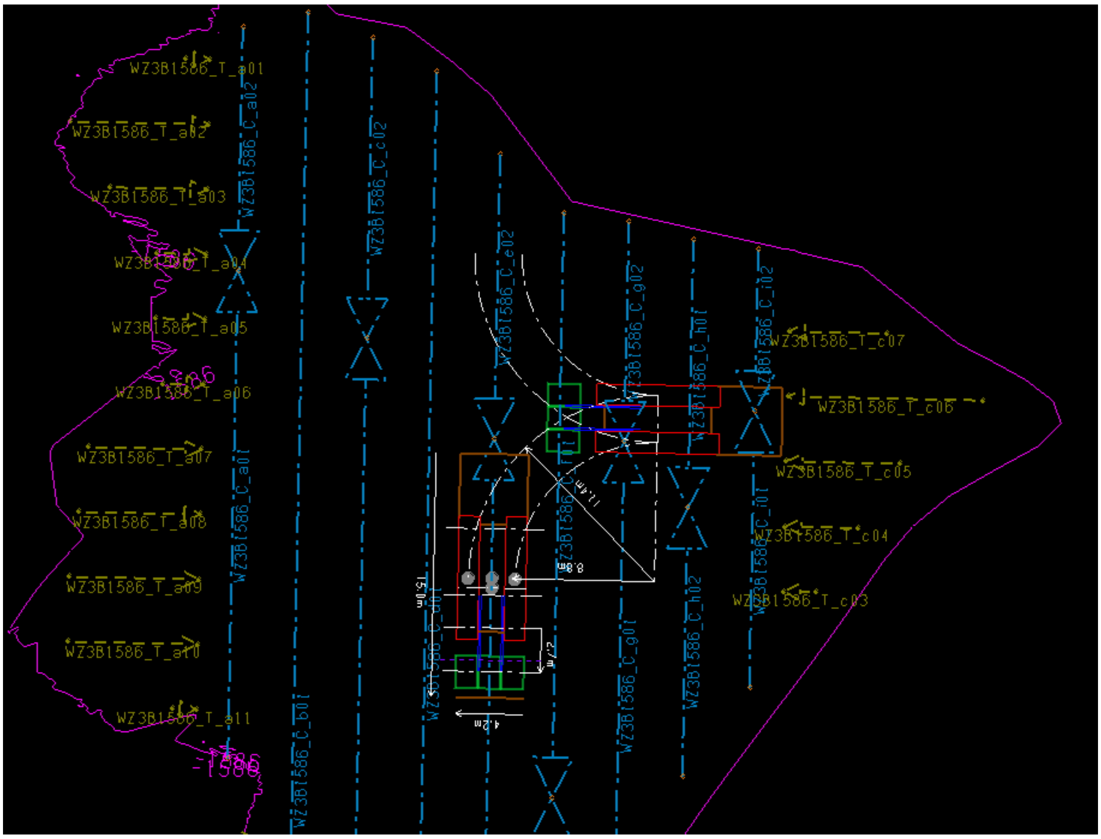

Figure 19-38: Typical Bulk Miner Production Cuts

Figure 19-38 shows the cut lines designed for the Bulk Miner: Production cuts in blue show the direction of cut. BM Trim cuts are shown in brown.

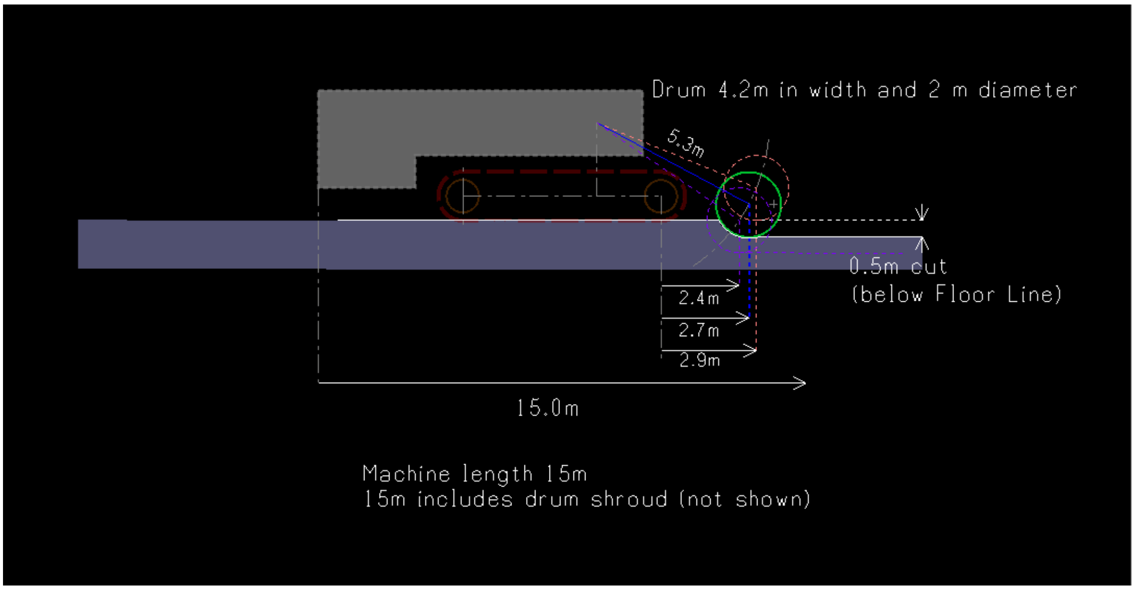

Figure 19-39: Bulk Miner Production Cuts

Figure 19-39 shows the dimension relevant for determining the start and end of the cut lines.

Control of the size distribution of the cut ore is achieved by varying the cut depth and advance rate of the miner.

Ore cut by the bulk miner is left on the bench. Fines dispersion will be minimised with cowlings around the cutting drum.

19.7.9.7 Gathering Machine Collection

The gathering machine is scheduled to collect a 8.0 m wide path through a stockpile in up to 1.0 m lifts.

19.7.9.8 Auxiliary Miner Trim Cuts

The safety margin around the edge of each bench results in material not being accessible for excavation by the bulk miner. Excavation continues using the same cut lines, with the unexcavated edge height increasing, until it is feasible to establish an additional BM production cut, or the maximum unexcavated height of 4.0 m is reached. The bench is then levelled and all edges removed using the auxiliary miner. Bulk miner production then continues with the added cut line and modified trim cuts.

19.7.9.9 Auxiliary Miner Production Cuts

The AUX is used to mine 4.0 metre benches in designated areas when being under-utilised for support of the BM operation. Areas allocated to the auxiliary miner are within the operating window defined by the maximum vertical excursion of the GM and the maximum pumping head for stockpiling. This results in the AUX mining benches being no more than 45 m below the BM mining bench and ore being pumped to a prepared stockpile area no more than 25 m lower than the BM mining bench. The height operating envelope moves up or down is 18 m by removing or adding a riser pipe section.

19.7.9.10 Equipment Schedule

Equipment hours have been classified as shown in Figure 19-40.

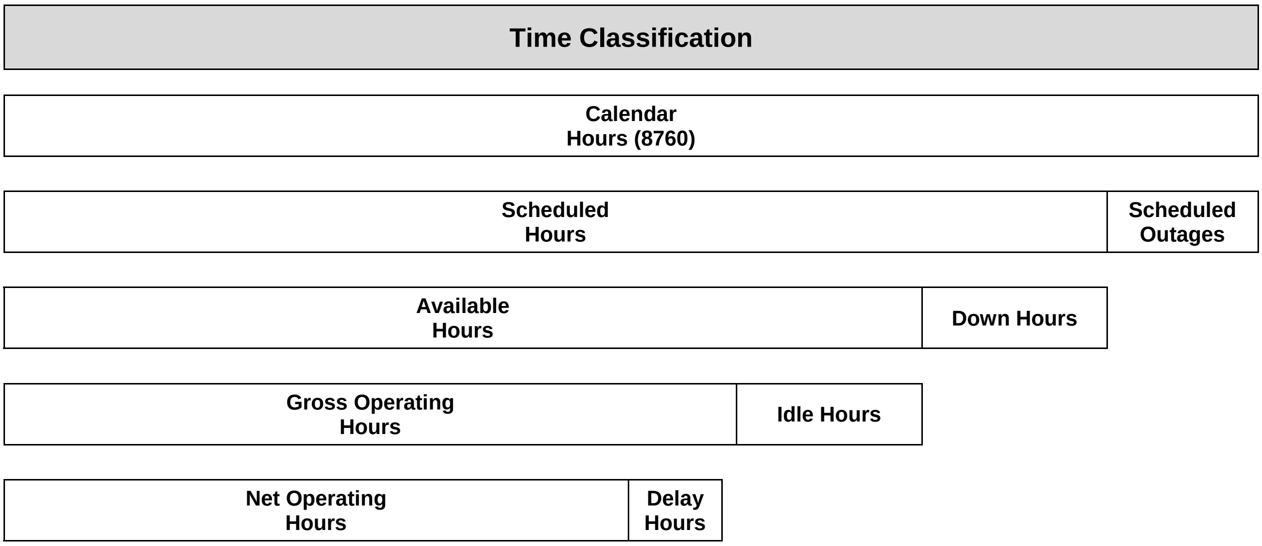

Figure 19-40: Equipment Time Classification

Scheduled Outages are defined as any downtime scheduled for the entire mining spread, this includes RALS maintenance, vessel maintenance and ramp-up downtime allowances.

Down hours have been scheduled at 24 hours every 3.5 days for the cutting machines and 24 hours every 6.5 days for the gathering machine.

Idle hours are non-productive time in the schedule waiting for a previous task to be completed by another piece of the equipment spread.

Delay hours are the times required to manoeuvre on a bench and relocate the equipment from a work place directly to the next work place.

In aggregate, Net Operating hours are the difference between Calendar Hours and the sum of (Delay hours + Idle hours + Downtime hours + Scheduled Outage hours).

Using the above time definitions, the individual time classifications for the three SMTs were determined and are shown in Table 19-16 along with the resulting equipment availability, utilisation and efficiency where:

- System Availability (scheduled hours / calendar hours) corresponds to percentage of calendar time that is available for the overall seafloor mining equipment after considering vessel and RALS maintenance.
- Mining Equipment Availability (machine available hours / calendar hours)) corresponds to percentage of time available for the individual seafloor mining equipment after accounting for vessel, RALS and mining tool maintenance / downtime).
- Mining Equipment Utilisation (Gross Operating Hours / Available Hours) corresponds to percentage of its available time that it is required to operate.
- Mining Equipment Efficiency (Net Operating Hours / Gross Operating Hours) corresponds to percentage of operating time that directly translates to cutting or gathering production.

Table 19-16: Seafloor Equipment Time Classification

Parameter	AM	BM	GM
Calendar Hours	13,608	13,608	13,608
Scheduled Outage Hours	2,216	2,216	2,216
Scheduled Hours	11,392	11,392	11,392
Downtime Hours	2,073	2,073	1,344
Available Hours	9,318	9,318	10,047
Idle Hours	4,963	3,828	3,220
Gross Operating Hours	4,355	5,491	6,826
Delay Time Hours	225	1,156	538
Net Operating Hours	4,130	4,335	6,288
System Availability	84%	84%	84%
Mining Equipment Availability	68%	68%	74%
Mining Equipment Utilisation	47%	59%	68%
Mining Equipment Efficiency	95%	79%	92%

19.7.9.11 Ore Production Schedule – Solwara 1

Making allowance for all the above items, an ore production schedule was developed for the Solwara 1 deposit. The summary production schedule for Solwara 1 is shown in Figure 19-41 and in tabular form in Table 19-17 and Table 19-18.

The daily production rate varies from 2,200 to 4,319 tonnes per day with the average production rate for the Solwara 1 production schedule being 3,452 tonnes per day or an average of 3,714 tonnes per day excluding site initiation and shut-down. Over the initial production period the copper equivalent grade varies from 5.5% to 12.3% with the average at 9.2%.

The individual equipment items were scheduled as seen for example for the Central Zone in Figure 19-42, Figure 19-43 and Figure 19-44.

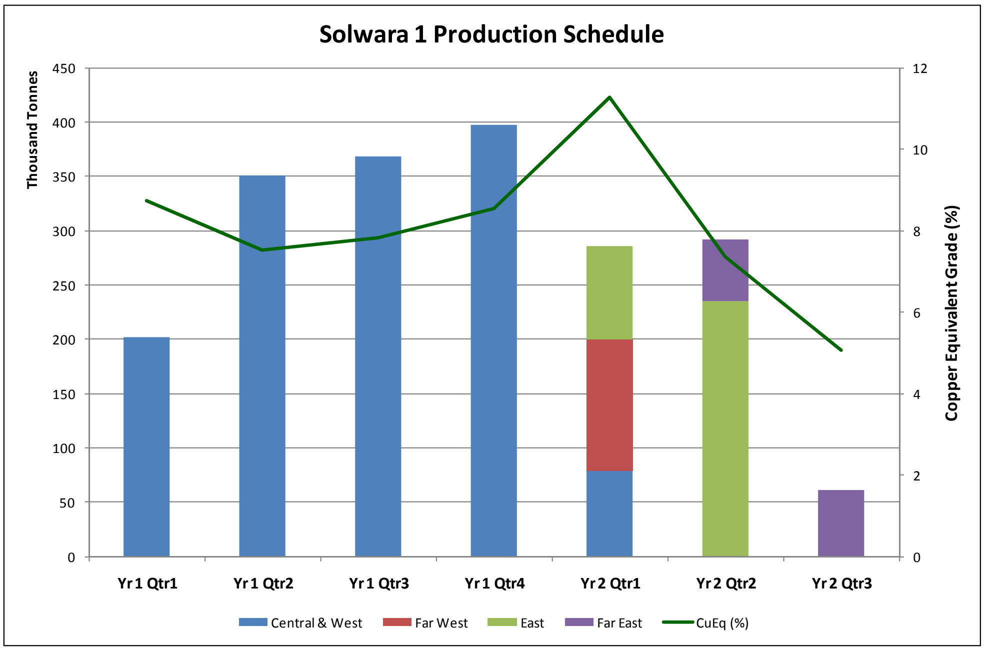

Figure 19-41: Solwara 1 Ore Production Schedule

Table 19-17: Summary Ore Production – Solwara 1

Zone	Item	Yr 1 Qtr 1	Yr 1 Qtr 2	Yr 1 Qtr 3	Yr 1 Qtr 4	Yr 2 Qtr 1	Yr 2 Qtr 2	Yr 2 Qtr 3	Total
Central & West	Tonnes gathered	202,099	350,660	368,472	397,364	79,434			1,398,029
	CuEq (%)	9.62	8.21	8.63	9.39	9.16			8.91
	Cu (%)	6.76	5.97	6.01	6.63	5.99			6.28
	Au (g/t)	5.02	3.94	4.64	4.85	5.57			4.63
	Ag (g/t)	29.46	20.61	22.55	26.65	30.47			24.68
	Zn (%)	0.60	0.33	0.39	0.51	0.61			0.45
	Pb (%)	0.12	0.08	0.08	0.08	0.1			0.08
Far West	Tonnes gathered					120,707			120,707
	CuEq (%)					16.40			16.49
	Cu (%)					10.28			10.28
	Au (g/t)					10.87			10.87
	Ag (g/t)					47.80			47.80
	Zn (%)					0.80			0.80
	Pb (%)					0.15			0.15
East	Tonnes gathered					85,554	235,495		321,049
	CuEq (%)					9.49	8.33		8.64
	Cu (%)					5.11	5.09		5.10
	Au (g/t)					7.87	5.75		6.31
	Ag (g/t)					22.22	26.3		25.21
	Zn (%)					0.34	0.48		0.44
	Pb (%)					0.07	0.06		0.06
Far East	Tonnes gathered						56,046	61,209	117,225
	CuEq (%)						6.50	5.48	5.97
	Cu (%)						3.99	3.41	3.69
	Au (g/t)						4.46	3.70	4.06
	Ag (g/t)						17.82	13.21	15.41
	Zn (%)						0.48	0.35	0.41
	Pb (%)						0.08	0.08	0.07
Total	Tonnes gathered	**202,099**	**350,660**	**368,472**	**397,364**	**285,695**	**291,541**	**61,209**	**1,957,040**
	CuEq (%)	9.62	8.21	8.63	9.39	12.32	7.98	5.48	9.15
	Cu (%)	6.76	5.97	6.01	6.63	7.54	4.88	3.41	6.18
	Au (g/t)	5.02	3.94	4.64	4.85	8.5	5.50	3.70	5.26
	Ag (g/t)	29.46	20.61	22.55	26.65	35.32	26.47	13.21	25.64
	Zn (%)	0.60	0.33	0.39	0.51	0.61	0.48	0.35	0.47
	Pb (%)	0.12	0.08	0.08	0.08	0.11	0.07	0.08	0.08
Days		91	91	92	92	90	91	20	567
Tonnes per day		**2,221**	**3,853**	**4,005**	**4,319**	**3,174**	**3,204**	**3,060**	**3,452**

Table 19-18: Summary Ore Production – Solwara 1 (Excluding Start-up / Shut-down)

	Yr1 Qtr 2	Yr1 Qtr 3	Yr1 Qtr 4	Yr2 Qtr 1	Yr2 Qtr 2	Totals / Avge
Tonnes Gathered	350,660	368,472	397,364	285,685	291,541	1,693,732
Days	91	92	92	90	91	456
Tonnes per day	3,853	4,005	4,319	3,174	3,204	3,714

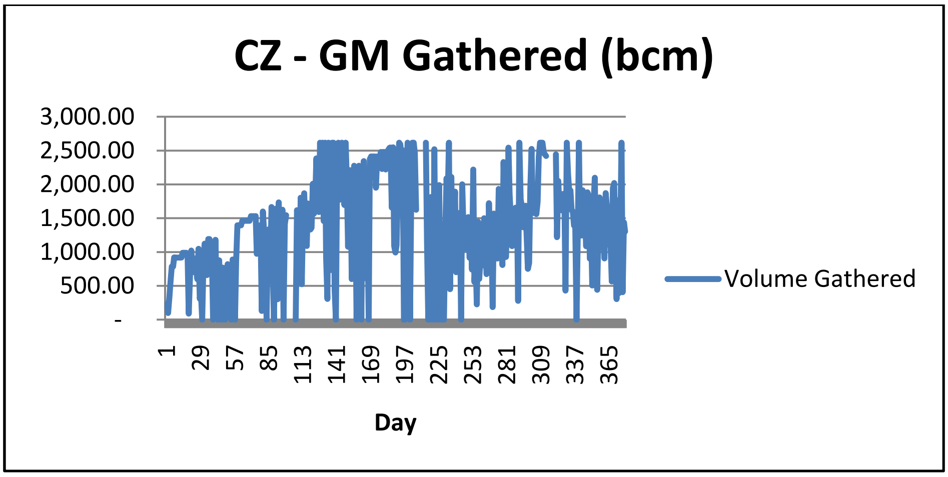

Figure 19-42: Gathering Machine Schedule

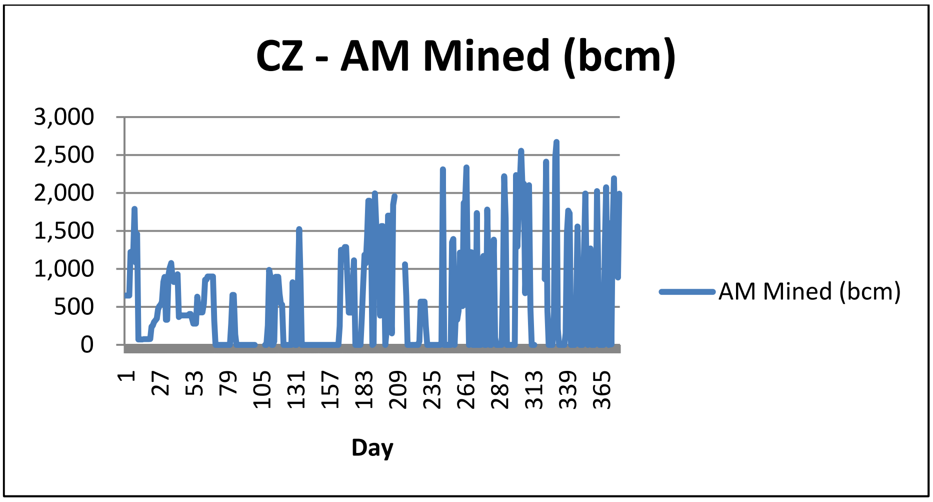

Figure 19-43: Auxiliary Miner Schedule

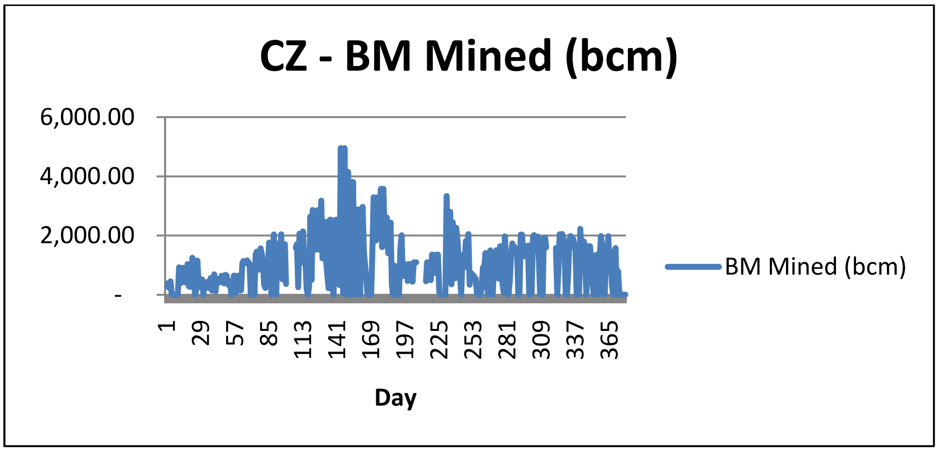

Figure 19-44: Bulk Miner Schedule

19.7.10 PSV Crew Organisation

The crew on the PSV will be divided into three sections:

1. Marine Crew.
2. Mining Equipment General Maintenance.
3. Mining Equipment Operations.

The organisation chart for each of these areas is shown in Figure 19-45.

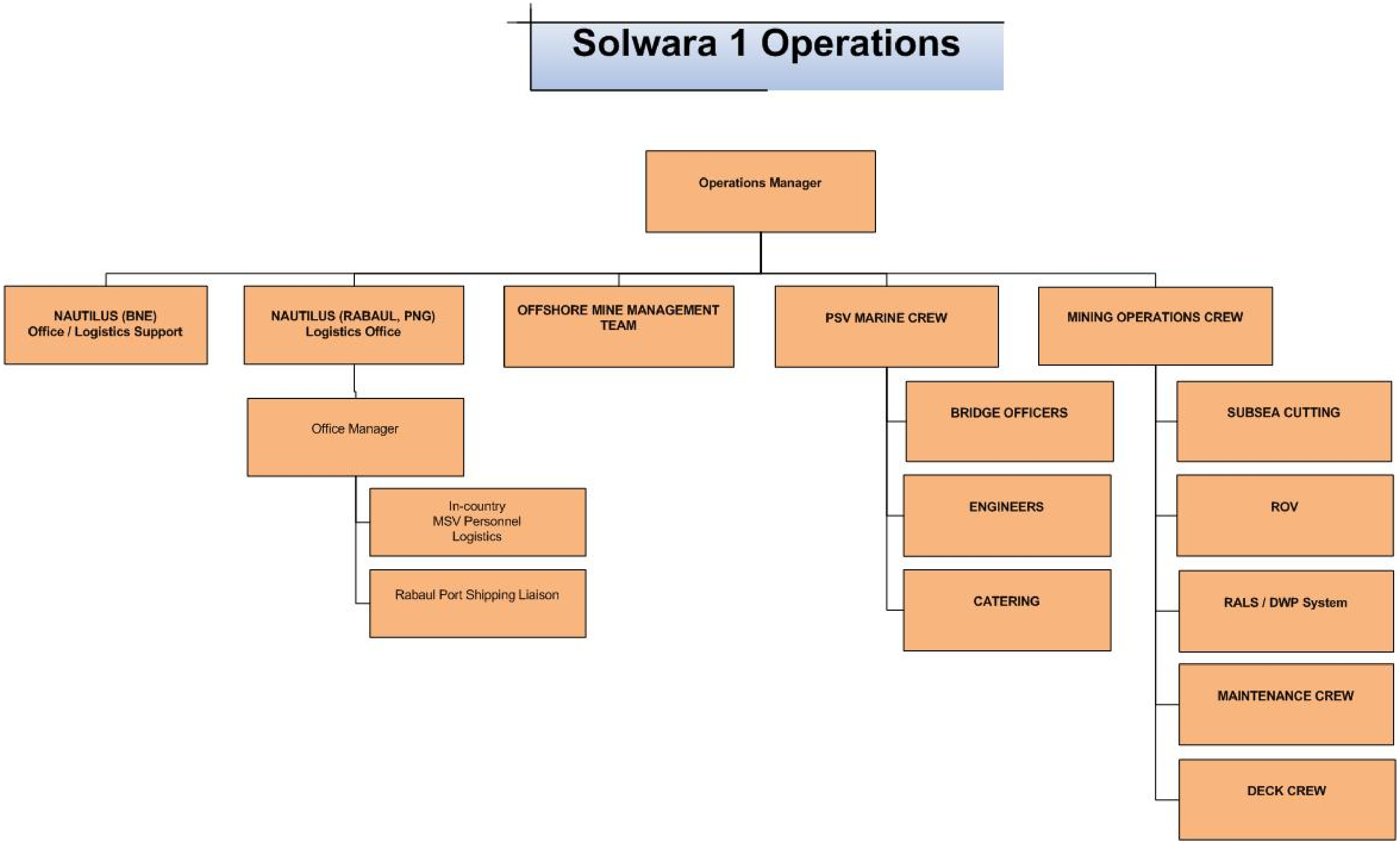

Figure 19-45: Solwara 1 Operations Organisation Chart

Initially during start-up and commissioning phase of the offshore mining, the PSV crew will be supplemented with additional and temporary expatriate personnel typically from the offshore oil and gas construction industry. Over time, these additional personnel will be phased out as the Nautilus operational team is trained and familiarises itself with the equipment and operations. The long term steady state crew onboard the PSV totals 121 people shown in Table 19-19 which corresponds to number of personnel to perform the 24 hour operations (ie. 2 shifts) onboard the vessel with crew working a four week on-four week off rotation.

Table 19-19: PSV Personnel Summary

Area	Number Personnel
Vessel Marine Operations	30
Mining Operations	54
Mining Maintenance	31
Medical & HSE	2
Vendor Representatives	4
Total	**121**

Details of each of these sub groups of the total crew are shown in Table 19-20.

Table 19-20: PSV Personnel – Vessel Marine Operations

Personnel	Number	Responsibilities
Vessel Master	1	Managing all marine operations and the safety of vessel and all on board
Chief Mate (Deck Officer)	1	Second in command to the master
2nd Mate / DP Operators	3	Navigator / Operation of vessel DP
Vessel Administrator	1	Day to day vessel administration
Chief Engineer	1	PSV Marine Plant Maintenance
2nd Engineer	2	PSV Marine Plant Maintenance
3rd Engineer	2	PSV Marine Plant Maintenance
Electrical Officer	2	PSV Marine Plant Maintenance
Crane Operators	2	Crane Operations and some rigging duties
Integrated Ratings	2	General marine duties
Chief Steward	1	Supervising all catering and accommodation services
Chief Cook	2	Supervising cooks and day to day galley operations
Assistant Cook	4	Preparing meals
Laundryman / Stewards	6	Laundry and general housekeeping duties
Sub-Total	**30**	**Vessel Marine Operations Crew**

Table 19-21: PSV Personnel – Mining Operations

Mining operations	Number	Responsibilities
Offshore Mine Manager (OMM)	1	Overall control and managing of all the day to day mining operations on the PSV
Mine Superintendent	2	Second in command to the Offshore Mine Manager
Mine Planning Superintendent	1	Overall mine planning management
Mining Equipment Supervisor	2	Supervising of the machine operators and administration duties
Auxiliary Machine Pilot	4	Operating and maintaining machine
Bulk Miner Pilot	4	Operating and maintaining machine
Gathering Machine Pilot	4	Operating and maintaining machine
Subsea Mining Machine Technicians	4	Maintenance of all mining subsea machines
ROV Supervisor	2	Managing all day-to-day ROV operations and administration issues
ROV Pilot	4	Operating and maintaining ROV
ROV Pilot / Technician	8	Operating and maintaining ROV
Mining Engineer	1	Monitors the mining operations and advises OMM on mining progress
Ore Grade Control Officer / Environmental Scientist	2	Monitors ore grade and advises Mining Engineer
Subsea Controller	2	Monitors subsea equipment and vessel positions
Survey Supervisor / Superintendent	3	Supervising survey operations and administration duties
Surveyor / Technician	4	Operating survey equipment
RALS / Dewatering System Supervisor	2	Supervising the day to day running of the RALS and dewatering system
RALS/ Dewatering Operators / Technicians	4	Operating the RALS and dewatering system
Sub-Total	**54**	**Mining Operations Crew**

Table 19-22: PSV Personnel – Mining Maintenance

Mining Equipment / Maintenance Crew	Number	Responsibilities
Maintenance Superintendent	1	Responsible for maintaining and repairing all non specialist mining equipment
Mechanics / Technicians	8	Carrying out general maintenance on mining equipment
Electricians / Instrumentation Technicians	8	Carrying out general maintenance on mining equipment
Fitter / Welder	2	Carrying out general maintenance on mining equipment
Deck Foreman	2	Supervising riggers, roustabouts and mooring operations
Rigger / Roustabout	8	Deck / mooring operations. Riser deployment and recovery.
Storeman	2	Issuing and maintaining mining equipment spare parts and consumables
Sub-Total	**31**	**Mining Equipment Maintenance Crew**

Table 19-23: PSV Personnel – Medical and HSE

Medical & HSE Crew	Number	Responsibilities
QHSE Advisor	1	Managing and implementing company health, safety and environmental policies
Medic	1	Attending to medical issues with the PSV crew
Sub-Total	**2**	**Medic & HSE**

Table 19-24: PSV Personnel – Vendor Representatives

Vendor Reps	Number	Responsibilities
Vendor (SMT)	2	Provide specialist technical support and assistance for SMT equipment
Vendor (RALS)	2	Provide specialist technical support and assistance for RALS equipment
Sub-Total	**4**	**Vendor Representatives Crew**

20. Commercial Evaluation

20.1 Basis of Evaluation

20.1.1 Scope of Estimate

The following elements of the Solwara 1 Seafloor Mining Development Project are included in CAPEX estimate:

a. Seafloor Mining Tools (SMTs) – compromising separate machines:

- Auxiliary Mining Machine (AUX) – suitable for preparation of landing areas for Bulk Mining Machine and clearing difficult to access areas impractical or unsafe to be accessed by
- Bulk Mining Machine (BM) to cut rock and stockpile on the seafloor benches for subsequent collection by
- Gathering Machine (GM) feeding to the:
    - Riser and Lift System (RALS).
    - Production Support Vessel (PSV) with Dewatering Plant (DWP) and ore transfer facilities .
    - Shuttle barges for transfer of ore from vessel to onshore.

b. Onshore stockpiling and load in/load out facility at Rabaul.

The following items are excluded from the CAPEX and OPEX estimates:

- Ore unloading, stockpiling and load-out onto transportation vessels at the Port of Rabaul.
- Shipping from load out facility to concentrate processing plant.
- Concentrator facility and / or charges.
- Shipping from concentrator facility to smelter clients.
- Expended (sunk) costs prior to 31 December 2009.
- Escalation over project life.
- PSV / transportation barge dry docking costs (for maintaining class obligations) during life of mine operations.
- Site demobilisation costs.

OPEX estimates of cost per tonne are based on an average production rate of 3,714 tonnes per day (1.35 Mtpa) of produced dry ore based on production schedule determined in Section 19.7.

20.1.2 Currency Exchange Rates

The functional currency for the estimate is USD.

The following exchange rates were used in converting any foreign currencies into USD.

By way of explanation: 1 AUD = 0.90 USD

Table 20-1: Currency Exchange Rates

Currency Exchange Rates	
USD	1.00
AUD	0.90
CAD	0.95
EUR	1.49
GBP	1.65
PGK	0.39
SGD	0.70

20.1.3 Estimate Description

20.1.3.1 Seafloor Mining Equipment

The Subsea Mining Equipment (SME) estimate is based on the SMD contract value plus an allowance to cover for the scope changes from two machine to three machine configuration.

Spares and freight to SE Asia for integration in to the vessel are included in the costs.

20.1.3.2 Riser and Lift System

The overall RALS estimate is based on a combination of actual purchase orders placed or Vendor quotes including the major packages as summarised in Table 20-2.

Table 20-2: RALS Contractors / Suppliers

RTP	Technip
Subsea Lift Pump	GE Hydril
Riser	Vetco Gray [1]
Lifting and Handling	Le Tourneau Technologies Inc [1]

Note[1]:- Purchase orders associated with Vetco Gray and Le Tourneau Technologies were terminated in December 2008.

The above packages include allowances spares and freight.

The EPCM costs are based on Technip's target price. The target price is based on forecasted man-hours that have been extended at the contract man-hour rates. The EPCM costs include an allowance for profit.

20.1.3.3 Dewatering Plant

Equipment prices based on vendor quotes obtained by PB in 2008 and reviewed by Ausenco.

Estimate for fabrication and assembly was based on a preliminary design by Parsons Brinckerhoff (PB) and reviewed by Clough Engineering. Structural steel costs are based on estimated tonnage, and it is assumed that fabrication and modularisation of the DWP will be carried out at an existing quayside module fabrication yard in SE Asia. Current SE Asia module yard rates are used in the estimate.

Estimates for disciplines such as piping, E&I and general services were factored from equipment costs by applying industry norms and reviewed by Clough Engineering.

Freight and spares have been calculated as a factor on the total direct costs norms and reviewed by Clough Engineering.

EPCM costs are based on an assumed organogram that identifies the various roles. Current market rates, obtained from independent market research, have been used in calculating the overall costs for each of the roles.

An allowance for Vendor reps has also been included in the estimate.

20.1.3.4 Production Support Vessel

The PSV pricing is based on a charter vessel to an agreed specification. The vessel owner will build as per requirements and deliver it to Singapore for the fit-out of deck equipment and commissioning by a vessel integration EPCM contractor engaged by Nautilus.

The daily charter rate is based on budget day rates provided by the three shortlisted vessel owners.

The PSV mobilisation is based on the following activities and durations:

- China – Singapore (14 days).
- Singapore – Sea Trial location (4 days).
- Sea Trial location – PNG site (15 days).
- PNG Site set up – 10 days.

Mobilisation cost for personnel to Singapore and PNG are based on the project organogram. Current flight, accommodation and transport costs were applied as applicable. It's assumed that a skeleton staff of 44 people will mobilise out of Singapore onto the PSV. The remaining personnel will fly to PNG and be transported to the PSV on a crew boat.

Costs associated with integration of the seafloor mining equipment onto the PSV have been based on the following:-

- Charter costs during integration (80 days alongside in Singapore).
- Purchase of additional major vessel deck equipment (cranes, power distribution system).
- Pre-assembly in the shipyard prior to arrival of PSV.
- Installation of seafloor mining equipment onto the vessel including hook-up of all disciplines.
- Commissioning and Testing.

The sources for the data are from in-house data, quotes from vendors or previous purchase orders.

Fuel costs during operations is based on HFO at $523/t.

20.1.3.5 Barging / Materials Handling

The cost for three self-propelled shuttle barges, used for transporting ore between the PSV and the on-shore materials facility are also included under this section. The cost of the barges are based on a conditional offer for the purchase of three coal barges, together with the estimated costs for modifying these barges to Nautilus' preferred design. Mobilisation costs from SE Asia to PNG are also included in the estimated costs.

20.1.3.6 Project Services

The estimate for project services has been divided into the following main sections:

- Development Team Costs.
- Production Team.
- Studies / Testing.

Cost for the development team include all Nautilus resources as defined by a project organisation chart in various aspects of project management. Monthly rates were benchmarked against independent market research data and are inclusive of all direct and indirect costs. Indirect costs include allowances for superannuation, leave and bonus entitlements.

Production team costs include for all operations staff that are required to be trained and integrated during the execution phase to ensure their readiness for the operations phase. In general the following mobilisation strategy has been followed:

- Management type staff - 6 months prior to commissioning.
- Operators - 3-months prior to commissioning.
- Remaining operations staff - 1 month prior to commissioning.

The methodology in building up individual rates is as per the development team. The operations team comprise expats and PNG nationals.

The estimates for continuing studies and test work are based on a combination of Nautilus estimates and quotes/proposals from consultants.

20.2 CAPEX Estimate

20.2.1 Capital Costs Summary

The total capital cost for the system to deliver dewatered ore free on board a transportation vessel at the Rabaul port as defined by the basis of estimate (Section 20.1.1) including contingency is US 383 million. The summary of this cost is shown in Table 20-3.

Table 20-3: Capital Cost Summary

	Description	**Amount US$ (millions)**
Mining	Subsea Mining Equipment	84.1
	Riser and Lift System	101.1
	Dewatering Plant	24.0
	Production Support Vessel Mobilisation	6.5
	Integration and Testing	59.7
	Barges	10.8
Other	Project Services	32.2
	Owners Costs	7.4
	Capex Sub-Total	325.8
	Contingency (17.5%) – see note	57.0
Total Initial Capital Estimate (to Rabaul Port)		**383**

Note: The 17.5% contingency corresponds to a weighted contingency that accounts for the varying levels of cost maturity within the development project. Costs estimated from existing or terminated contracts have lower proportional cost contingency compared to scope elements not previously or yet to be awarded.

20.2.2 Mining Capital Costs Summary

20.2.2.1 Subsea Mining Equipment

The capital costs for the Subsea Mining Equipment are summarised in Table 20-4.

Table 20-4: Subsea Mining Equipment Costs

Item	Cost (US$M)
Subsea Mining Tools and Handling systems	76.2
Initial Spares	6.6
Freight and Insurance	1.3
Total	**84.1**

The above estimate is based on a fixed price contract with Soil Machine Dynamics with allowances for increased scope from two to three seafloor mining tools. The capital cost estimate is based on a new equipment build.

20.2.3 Riser and Lift System

The capital costs for the Riser and Lift System are summarised in Table 20-5.

Table 20-5: Riser and Lift System Costs

Item	Cost (US$M)
RTP	3.9
Subsea Pump	30.8
Riser	14.8
Lifting and Hoisting System	16.7
Indirects	34.9
Total	**101.1**

The above costs are based on a target price contract with Technip to provide engineering procurement and construction management services for the Riser and Lift System. Further engineering studies in 2009 have provided further support for the estimate. The capital cost estimate is based on a new equipment build.

20.2.4 Mining Production Support VesselMobilisations

The current estimate assumes that the Mining Production Support Vessel is chartered and requires minimal additional structural steelwork to accommodate the SME during integration. Therefore the capital costs for the Production Support Vessel relate to the mobilisation costs associated with taking the vessel from its port of “handover” to the integration port and then from the integration port to the mine site in PNG.

20.2.5 Integration and Testing

The capital costs for the Integration and Testing are summarised in Table 20-6.

Table 20-6: Integration and Testing Costs

Item	Cost (US$M)
Vessel costs including modifications	8.7
Additional equipment, steel work and materials	30.5
Assembly, Installation and Testing	4.5
Indirects including EPCM management and freight	16.0
Total	**59.7**

The integration and mobilisation costs include the charter costs while the equipment is being integrated, additional equipment required on the vessel including the Seafloor Mining Tools, dewatering plant, power distribution system and Riser and Lift System on to the vessel.

EPCM management cost are based on a small core team of 8 core people working full time on the project assisted by additional contractors personal and Nautilus personal on a part time basis as required.

20.2.6 Dewatering Plant Equipment Costs Summary

This section has been prepared by Ausenco Minerals based on review of Parsons Brinckerhoff work to outline the capital cost estimates for Solwara 1 dewatering plant equipment.

The direct capital costs of equipment for the dewatering plant are summarised in Table 20-7.

Table 20-7: Dewatering Plant Equipment Direct Costs

Item	Cost (US$M)
Screen	1.9
Centrifuge	0.56
Cyclone Circuit	2.6
Filtration	2.7
Barge Loading	1.3
Controls	1.7
General Services	0.62
Tankage	0.59
Total	**12.0**

The base date of the estimate is 3rd quarter of calendar year 2009. The capital cost estimate has been prepared in US dollars.

The capital cost estimate is based on new equipment and does not provide any allowance for escalation.

These costs were developed from preliminary engineering estimates performed in 2008 and reviewed by Ausenco.

All of the above items, have an additional allowance of 10% on the base equipment costs to account for material selection and design features suitable for a marine environment. These costs are assessed to have an accuracy of ± (30% - 40%) commensurate with the level of engineering development. This accuracy reflects the limited samples available for testwork due to the unusual deposit location, the difficulties with predicting the plant feed size distribution generated from the unique approach to mining required and the lack of comparable plants from which to extrapolate plant performance.

Costs associated with the supply and installation of structural steel, platework, pipework, electrical; assembly and installation for mechanical, instrumentation and control equipment are provided in section 20.2.8. The above costs exclude spares, first fills and indirect costs such as engineering, procurement and construction management (EPCM), and vendor representatives. Other exclusions are all duties, taxes and other government charges, escalation, variation in foreign exchange rates, Owner's Costs including development costs, pre-production operations costs, and contingency.

20.2.7 Dewatering Plant Fabrication and Assembly Costs

This section has been prepared by Clough Engineering based on Nautilus, Parsons Brinckerhoff and Ausenco information to outline the capital cost estimates for the fabrication and assembly of the Solwara 1 dewatering plant equipment.

The direct capital costs of equipment for the dewatering plant are summarised in Table 20-8.

Table 20-8: Dewatering Plant Equipment Supply and Installation Costs

Item	Cost (US$M)
Structural Steel	1.5
Assembly and installation	6.3
Indirects	4.2
Total (rounded to appropriate significant figures)	**12.0**

The base date of the estimate is 3rd quarter of calendar year 2009. The capital cost estimate has been prepared in US dollars.

20.2.8 Ore Transport to Rabaul

The CAPEX estimate for barging from the PSV to the Port of Rabaul is based on the purchase of second-hand self-propelled coal barges from South East Asia with refurbishment and upgrade cost allowances.

Estimates for standard mobile materials handling equipment onboard the barge have been obtained from vendors where possible.

The estimate for the purchase, refurbishment and procurement of three self-propelled barges is presented in Table 20-9.

Table 20-9: Port of Rabaul Capital Costs

Item	Cost (US$M)
Barges / Procurement / Upgrade	8.8
Material / Handling Equipment	2.0
Total	**10.8**

20.3 OPEX Estimate

20.3.1 Operating Costs Summary

The daily operating costs of the Solwara 1 Project for delivery of ore to the port of Rabaul is estimated to be US$237,000 (excluding contingency) or approximately US$64 per tonne mined ore per day. The summary of this cost is shown in Table 20–10. Allowing for a 10% contingency, the above operating costs become US $261,000 per day or approximately $70 per tonne.

Table 20-10: Operating Cost Summary

Description	Total Daily Cost (US$)	Unit Mined Cost US$ per tonne
Production Support Vessel	144,796	39.15
Seafloor Mining Equipment	20,130	5.44
Workclass ROV's	20,910	5.65
RALS	23,184	6.27
Support Services	15,235	4.12
Barging	12,694	3.43
Sub-Total Operating Costs to Run of Mine at Rabaul	236,949	64.06
Contingency (10%)	23,695	6.41
Total Operating Costs to Run of Mine at Rabaul	260,644	70.47

20.3.2 Mining Operating Costs

The daily operating cost for the mining production support vessel (PSV) has been determined by the following categories:

- Vessel Charter (for the PSV and the ROVs).
- Labour (wages, food, flights, accommodation and transport).
- Fuel. (Fuel costs based on use of HFO)
- Spares, Consumables and Miscellaneous .

20.3.2.1 Vessel Charter Costs.

The vessel charter costs include the provision of a vessel and basic marine crew to operate the vessel. The cost estimate is based on current market rates for a dynamically positioned barge on a long-term charter.

20.3.2.2 Labour Costs

Labour costs include all costs for wages, food, flights, accommodation and transport.

Allowance has been made for higher operating costs in the first six months of operation because of a greater proportion of expatriates in the workforce required for establishment of production and training of local personnel. The estimate is based on the weighted average cost of labour over the life of the project taking into account the higher expected labour costs in the first six months of operations.

20.3.2.3 Contingency Costs

An allowance of 10% for contingency costs was made.

20.3.2.4 Operating Cost Summary

The total daily mining cost over the life of the project is shown in Table 20-11.

Table 20-11: Operating Cost Summary

Operating Cost Type	US$ per day
PSV Charter	75,000
ROV Charter	9,200
Fuel (PSV / Barges)	30,622
Spares & Consumables	21,854
Labour (PSV / Barges)	100,273
Contingency	23,695
Total	**260,644**

20.3.3 Dewatering Plant Operating Costs Summary

This section has been prepared by Ausenco Minerals to document its review of the DWP direct operating and maintenance labour spares and consumables component of Nautilus Minerals' operating cost estimate. Excluded are power and general and administration costs, the latter including but not limited to management and technical support personnel, accommodation and catering for personnel. SRK acknowledge that these (as well as the DWP operating costs) are in the PSV operating costs included in Table 20-11.

The operating cost summary for the dewatering plant is presented in Table 20-12.

Table 20-12: Dewatering Plant Operating Costs

Item	Annual Cost (US$M)
Dewatering Plant Operators	1.24
Dewatering Plant Maintenance	0.29
Dewatering Spares and Consumables	1.2
PNG Customs Duty RALS & Dewatering	0.093
Total	**2.8**

The base date of the estimate is the third quarter of calendar year 2009 (CY2009Q3). The estimate does not provide any allowance for escalation.

This estimate has been supplied by Nautilus Minerals in United States dollars and is considered to be to a precision of ±20-25%. It reflects a steady-state operation of the dewatering plant. It is expected that the operating costs will be higher for the initial operation.

The selection and number of dewatering plant operators and maintenance personnel has been determined by Nautilus Minerals and reviewed by Ausenco based on market rates utilising a mix of expatriates and PNG nationals for these positions.

The daily rate of US$1,900 for the dewatering spares and consumables has been derived from Nautilus Minerals' in-house data. These represent approximately 5.6% per year of the direct costs.

The allowance for PNG customs duty to cover both the RALS and dewatering plant is based on a daily rate of US$255 supplied by Nautilus Minerals.

20.3.4 Barge Transportation of Ore

Ore transportation barges are considered in the development plan to be procured and operated by Nautilus. Operating costs include:

- Fuel
- Personnel
- Maintenance
- Class charges / insurances

Operating costs for the ore transportation by barges are estimated to be US$3.43/t ore.

21. Interpretation and Conclusions

This study is preliminary in nature, that it includes inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorised as mineral reserves, and that there is no certainty that the output of the study will be realized.

Mineral resources that are not mineral reserves do not have demonstrated economic viability.

21.1 Exploration

Nautilus Minerals Group (Nautilus) is exploring mineral exploration tenements located in the Bismarck Sea, Papua New Guinea. These tenements are either known to host, or are considered prospective for, Cu-Zn-Ag-Au seafloor massive sulphide (SMS) mineralisation.

At present, more than 300 sites of hydrothermal activity and seafloor mineralization are known globally.

Terrestrial volcanic-hosted massive sulphide (VHMS) deposits form a significant part of the world's reserves of copper, lead and zinc, as well as being significant producers of gold and silver. Notable examples include the deposits of Iberian Pyrite Belt in Spain and Portugal; Hellyer in western Tasmania, Australia; Kidd Creek and Noranda in Canada and Kuroko in Japan. The similarities between SMS deposits and many ancient VHMS deposits have led to the conclusion by geologists that VHMS deposits originally formed as SMS deposits.

In Papua New Guinea, as of 31 December 2009, Nautilus has 45 granted Exploration Licences (EL), 18 Exploration Licence applications and one Mining Lease application in the Bismarck Sea, PNG. On the 29 December 2009, Nautilus received the final Environmental Permit for the development of the Solwara 1 Project from the Department of Environment and Conservation (DEC) of Papua New Guinea for a term of 25 years, expiring in 2035. The Environmental Permit is a significant step towards the processing of Nautilus' Mining Lease Application (MLA154).

The exploration techniques used by Nautilus are appropriate and reasonable for defining the nature and extent of Cu-Zn-Au-Ag mineralisation in the SMS systems on the exploration tenements. The exploration sequence is:

1 Location of active and fossilised spreading centres and rift zones in PNG territorial waters.

2 Preliminary compilation of historic research data generated from over 25 years of offshore activity in the PNG territorial waters.

3 Direct detection of SMS mineralisation, using:

- Water geochemistry and plume sensors
- side-scan sonar/bathymetry/sub-bottom profiling and mapping using video cameras
- deep-tow magnetic, electrical, electromagnetic and other geophysical methods
- dredging and direct sampling with an ROV

4 Core drilling, in order to determine the in-situ continuity of thickness and grade of massive sulphide mineralisation.

In 2009, Nautilus completed a target generation and target testing program in the Bismarck Sea that identified and sampled nine new prospects, bringing the total number of prospects in the Bismarck Sea to 19. Seventeen of these prospects are SMS systems and 2 are sulphate rich hydrothermal systems with anomalous precious metals. One prospect was not sampled due to operational issues. High resolution bathymetry and geophysical data were acquired over selected Bismarck Sea prospects to aid in the planning of a further exploration and core drilling operations.

SRK completed five site visits of certain Nautilus PNG tenements between 2005 and 2008, and reviewed remote data gathering and sampling methods.

Based on recent exploration, Nautilus is able to demonstrate a track record of success with respect to the discovery of active and fossil SMS systems containing Cu-Zn-Au-Ag mineralisation. Nautilus has built a pipeline of exploration prospects within its offshore exploration tenements in Papua New Guinea.

SRK is of the view that the projects are sufficiently prospective to warrant exploration with the techniques and programs indicated to SRK during the assessment. In SRK's opinion the directors and staff of Nautilus have the appropriate technical and management expertise to manage the proposed exploration program.

For this independent geological assessment, SRK has:

- Reviewed previous exploration works and technical literature.
- Conducted site visits to some of the granted tenements in PNG.
- Independently verified sampling procedures, sample integrity and sample security.
- Reviewed various company reports as appropriate.
- Reviewed the proposed exploration program for 2010.

21.2 Drilling

Nautilus in conjunction with the offshore exploration contracting market has utilised subsea drilling equipment for scout and resource / metallurgical drilling operations on SMS deposits. Nautilus has drilled a total of 184 holes for 1,640 m total length in three separate drilling campaigns.

Nautilus has proposed an exploration program to further assess their tenement holdings. This program is focused on increasing its knowledge of SMS systems in the Bismarck Sea through additional drilling. This drilling has the potential to increase resources at Solwara 1, as 44% of the 2007 drillholes ended in mineralisation. The current resource has not been modelled past the end of the drillholes.

21.3 Resource and Reserves

Following a drilling program in 2007, Golder carried out a Mineral Resource estimate for the Solwara 1 deposit. The Mineral Resource (Lipton, 2008) estimate was carried out to conform to the principles of the National Instrument 43-101 and is reported to contain an Indicated Resource of 870 Kt at 6.8% Cu, 4.8 g/t Au, 23 g/t Ag and 0.4% Zn, and an Inferred Resource of 1,300 Kt at 7.5% Cu, 7.2 g/t Au, 37 g/t Ag and 0.8% Zn. The Indicated Resources are composed of sea floor massive sulphides while the Inferred Resources include lithified sediments and chimney material in addition to the seafloor massive sulphides. No resource estimates have been defined for any other prospect, and as such, these areas are considered speculative by nature, and involve varying degrees of moderate to high exploration and financial risk.

21.4 Process Metallurgy

The results of the mineralogical and metallurgical test work completed to date on Solwara 1 ore can be summarised as follows:

- Copper is present almost exclusively as the mineral chalcopyrite.
- Treatment by conventional grinding and flotation processing produced commercial copper concentrates grading 25 to 30% Cu.
- Chalcopyrite liberation is significant at a sizing of 80% -40 μm with the test flow sheet using a primary grind of 80% -55 μm and regrinding of rougher concentrate to 80% -25 μm.
- Copper recovery in the laboratory has been 85-90%.
- Arsenic is the only significant deleterious element in the ore with the main carrier being arsenopyrite, however, arsenic levels in concentrates from samples tested were well below typical penalty levels.
- Gold recovery to the copper concentrate is around 25%.

- Around 65-70% of the total gold can be recovered into a pyrite concentrate.
- At least 80-90% of the gold reporting to the pyrite concentrate can be extracted by the conventional technologies of roasting / cyanidation or pressure oxidation / cyanidation. This would give a total 'gold recovery' to copper concentrate + bullion of 75 to 90%.
- The pyrite concentrate averages about 7-9 g/t Au and ~45% sulphur.
- Melnikovite or 'primitive pyrite', which accounts for around 15% of the pyrite, has a gold content of ~44 g/t Au compared with crystalline pyrite at ~4 g/t Au ie. an order of magnitude higher.
- The samples tested have Bond Ball Work Index values in the range of 10-12 kWh/t indicating a low to medium resistance to comminution.

These results have not been optimised but the following points have been noted:

- Copper flotation results are consistent for all samples tested.
- Tests had open circuit cleaning i.e. copper recoveries would be expected to be higher with closed circuit cleaning albeit at the risk of lower concentrate grade.
- Dilution with low grade materials or 'country rock' should not affect copper metallurgical performance.
- Copper concentrates are 'clean' and should not present any problems to custom copper smelters.
- Exposure of the materials tested for up to 8 weeks has not caused any major deterioration in metallurgical performance.
- Production of an auriferous pyrite concentrate will be necessary to get 'gold recovery' to copper concentrate + doré bullion to 75 to 90%.

The only attempt at making a zinc concentrate gave an encouraging result with a product high in precious metals that may be upgraded by the established technique of reverse flotation

21.5 Solwara 1 Development Plan

21.5.1 General

Nautilus is progressing its plan for the Bismarck Sea Development Project on the basis of:

- creating value from the Solwara 1 SMS deposit.
- prioritising development work and cash spend on the offshore production system.
- maximising use of existing technology and market leaders.
- providing a flexible production system that can be relocated to other prospective Bismarck SMS deposits that are commercially viable in their own right or as a part of an aggregated resource model.

The development project comprises the following elements:

- Seafloor Mining Tools (SMTs).
- Riser and Lift System (RALS).
- Production Support Vessel (PSV) with dewatering facilities.
- Ore transportation to the Port of Rabaul.
- Ore storage at an onshore stockpile facility.
- Load-out and transportation to a processing facility.
- Concentration of ore.
- Load-out and transportation of concentrate to the market.

Note: At the time of writing this report, Nautilus is in commercial discussions with external parties on the Port of Rabaul operations and on concentrate processing options and hence the last four items above are excluded from the scope of this report.

21.5.2 Project Management Plan

Nautilus' delivery model is to maintain a small owners management team centred in Brisbane, Australia, supervising work packages either managed by EPCM contractors or equipment purchases provided by Vendor design and construct packages. Each significant package is supervised by a dedicated Lead Engineer or Delivery Manager reporting to one of the two Project Managers (onshore and offshore), supported by contracts, project controls (cost, planning, document control), technical (engineering), health, safety and environmental teams which report to the Project Director.

This structure provides the required resource flexibilities and expertise of contracting groups across the range of disciplines required to deliver this project, whilst ensuring packages interfaces are understood and managed by the Nautilus team. The vessel integration EPCM will have particular responsibility for managing interfaces involved in transport, preparation and integration of the SME into the vessel (PSV).

21.5.3 Development Plan Status

The Solwara 1 project is currently in an engineering phase.

Nautilus' development plan strategy has been to initially focus on the key / less developed elements of the production system associated with getting produced ore from the seafloor to the surface. Based on this strategy and prior to project suspension, Nautilus had placed a number of key commitments on the long lead subsea and offshore project scopes.

In December 2008, during the downturn in the global financial market, Nautilus suspended the project which included the partial suspension of contracts / purchase orders associated with key technologies (seafloor mining tools, subsea lift pump and RALS design). Remaining key contracts / purchase orders were terminated for convenience. Since that time, the project has continued engineering and commercial evaluation of the project.

Nautilus intends to re-sanction and recommence the project build subject to Nautilus Board approvals.

21.5.4 Seafloor Mining Tools

The development of the SMTs is based on the consolidation of technologies that exist in the offshore (deepwater) oil and gas, trenching, marine dredging and onshore / offshore mining industries. Whilst the precise design of this equipment will be bespoke, each element of the equipment has an existing analogue within the above industries.

A contract is in place for the design and supply of the seafloor mining tools with Soil Machine Dynamics, a market leader in offshore / subsea trenching and remotely operated vehicles. Design of the equipment is ongoing.

The development of seafloor mining tools is considered technically feasible. The following key risk areas have been identified:

- Hyperbaric effect.
- Production rate / equipment operability.
- Operations interfacing with riser and lift system .
- Waste material management.

Tests and studies have been undertaken on the impact of hyperbaric effect on cutting rates / energy which has been incorporated into the equipment design. Further studies and tests are planned, including further in-situ (on seafloor) measurements from future drilling campaigns.

Project economics are sensitive to production rate which is ultimately driven by that of the seafloor mining tools. The impact of ore body variability, seafloor topography and equipment operability has been evaluated which lead to change in the number and types of machines. The modified mining tool designs and configuration on the seafloor is analogous to onshore surface mining operations.

Co-ordination and handling the three separate seafloor mining tools from the production support vessel will be critical. As far as practicable, flexibility and higher instantaneous production rates have been incorporated into the designs to optimise over-all production rates.

Modifications in the seafloor mining tool designs has simplified the operating interfaces with the riser and lift system.

Waste material management associated with the relocation of subeconomic rock / sediment using the cutting machines has not been finalised and is being developed during detailed design.

As design work is in progress, and due to the criticality of this equipment, periodical and ongoing reviews will be essential. Recommendations associated with these further reviews are presented in Section 22.

21.5.5 Riser and Lift System

The riser and lift system is a critical component within the project development plan. Components and technology of the system come from the well established offshore oil and gas (drilling and production) industry.

An EPCM contract is in place for the over-all system design with Technip, USA and a supply contract in place with GE Hydril for a subsea slurry lift pump. Detailed design and equipment supply testwork is ongoing.

The development of the riser and lift system is considered technically feasible. The following key risk areas have been identified:

- Erosion rates
- Subsea lift pump performance

Engineering analysis has been undertaken on vertical riser erosion rates. This analysis has demonstrated that in the vertical riser, particles are centralised in the flow and do not cause unacceptable erosion. Further verification work is in progress to confirm this outcome.

The selected subsea lift pump has not been previously utilised for pumping slurry with similar parameters as the Solwara 1 ore. The pump has been used for pumping drill cuttings. Testwork is in progress to test the subsea lift pump components with representative material for erosion, flow assurance and reliability performance. Results of testwork will be used in developing maintenance schedules.

21.5.6 Production Support Vessel

The production support vessel is similar to vessels that service the large markets of offshore (subsea) construction, drilling and production for the offshore oil and gas industry. A production support vessel has not yet been selected by the project. The main technical requirements for a suitable PSV are:

- adequate deck space.
- accommodation for up to 140 persons.
- dynamic positioning reliability.
- adequate electrical power.
- simplicity of SME integration.

These requirements can be met from either barge or ship hulls so selection of a suitable PSV donor hull is not considered a significant technical risk. The benign location of Solwara 1 will mean that vessel motions and associated weather downtime will be minimal.

Delivery schedule and integration of the seafloor mining and production equipment are identified as the main risks associated with the PSV. Vessel selection will be based on existing hulls or new build delivery from market leading vessel owners which require minimal modifications and structural additions. An EPCM contractor will be selected to manage the over-all co-ordination and integration of equipment onto the vessel. This integration exercise is analogous to a vessel spread mobilisation which is a common activity in the offshore oil and gas industry.

21.5.7 Dewatering Plant

Dewatering plant process design is based on well known and well established technology from the mineral processing industry and hence corresponds to a reduced project technology risk in comparison to the seafloor mining equipment. However, as the DWP is a part of a single integrated production process design, it is a critical component of the development project.

A design study for the DWP was performed originally by Parsons Brinkerhoff. A contract for the DWP detailed design and / or supply has not been placed at time of this report.

The development of a DWP onboard the PSV is considered technically feasible. The unit processes within the dewatering plant flow sheet and the equipment selected for the duty are generally consistent with normal design practice. The space constraints onboard the PSV adds to the DWP design complexity to minimise its footprint.

The following key risks have been identified:

- Reduced design optimisation due to limited test material and TML definition.
- Slurry variability including ROM ore feed size and slurry temperature effects.
- Operations interfacing with seafloor riser and lift system.

Limited test material from the Solwara 1 site is available. Consequently, design is primarily based on assumed empirical parameters. Selective use of test work has been performed and further tests are in progress to finalise the DWP design envelopes.

As far as practicable, buffering capacity ahead of the DWP has been incorporated into the RALS design to reduce the variability in its process feed. This includes:

- Specific seafloor cutting machines that provides greater control on cut particle size.
- Delinked seafloor cutting and gathering machine that provides a “buffer” between the cutting and gathering operations.
- Constant volumetric flow for the gathering machine which ultimately provides steady state DWP slurry flow rate.
- A surge tank at the riser and lift system outlet discharging to the DWP feed to modulate variability in slurry density.

Notwithstanding the above, checks associated with additional test work and subsea equipment design interface will be undertaken during the detailed design to confirm the Parson Brinckerhoff DWP design.

21.5.8 Ore Transport to Port of Rabaul / Stockpiling

Ore (barge) transportation, handling, offloading and stockpiling are well established and well understood operations.

Studies on barging, stockpiling and handling of ore were performed by Parsons Brinckerhoff.

A number of options exist for the transportation barges from PSV to the port of Rabaul. A decision on contracting strategy has not been finalised at time of writing of this report although the cost base for this report has assumed purchase of existing second-hand barges. The final decision will be made based on assessment of commercial and schedule benefits / constraints and project risk management of the various options.

Transportation, offloading and stockpiling of ore to and at the port of Rabaul has not been finalised and is subject to further evaluations and commercial agreements. The following key risks have been identified:

- Reactivity of the ore
- Limitations / restrictions of existing facilities at the port of Rabaul

The reactivity of the ore can be managed with industry established practices. Final design will account for covers to manage TML and first in / first out rotation in the stockpiles.

There exists some limitations with the port facilities which are manageable with the use of mobile equipment and some capital works. The port of Rabaul is located in an earthquake risk zone. Work is ongoing to confirm the geotechnical foundation work required.

21.5.9 Concentrator

The concentrator process design is based on a flow sheet and unit operations that are well proven in base metals flotation plants.

The process metallurgy and design rely mainly on preliminary test work. Additional work is in progress to refine and optimise the design and associated costs.

At the time of writing this report, Nautilus has not concluded its concentrate facility development plan and is in commercial discussions with external parties on its processing options. Correspondingly, the concentrate facility definition is excluded from the scope of this report.

21.5.10 Mine Plan / Schedule

The Solwara 1 project mining and processing production rate is planned to commence at a rate of 1.2Mtpa (dry equivalent) with the capacity to ultimately ramp up to 1.8Mtpa of dewatered ore delivered to the Rabaul Port. The systems and plant will be designed and operated so that the steady state annual rate of production is limited by the Seafloor Mining Tools (SMTs) and where practicable, all plant and equipment downstream of the SMTs will not restrict production.

A mine plan has been developed for the Solwara 1 NI 43-101 resource estimate which achieves 2,000 kt of ore mined and gathered over 18 months.

The daily production rate varies from 2,200 to 4,320 tonnes per day with the average production rate for the Solwara 1 production schedule being 3,450 tonnes per day or an average of 3,715 tonnes per day (1.35Mtpa) excluding site initiation and shut-down. Over the initial production period the cupper equivalent grade varies from 5.5% to 12.3% with the average at 9.2%.

21.5.11 CAPEX / OPEX Estimates

The total capital cost for the system to deliver dewatered ore free on board a transportation barge vessel to the Rabaul port as defined by the basis of estimate (section 20.1.1) including contingency (17.5%) is US$383 million.

The daily operating costs of the Solwara 1 Project for delivery of ore to the port of Rabaul is estimated to be US$237,000 (excluding contingency) or approximately US$64 per tonne mined ore per day. The summary of this cost is shown in Table 20-10. Allowing for a 10% contingency, the above operating costs become US $261,000 per day or approximately $70 per tonne.

21.5.12 Schedule

First ore is scheduled 30 months after project sanction.

22. Recommendations

22.1 Exploration

It is recommended Nautilus develop improved drilling depth, core recovery and drilling efficiency and undertake further drilling to gain improved understanding of its prospect resources in the Bismarck Sea

This recommendation is consistent with Nautilus' plans of additional exploration work in the Bismarck Sea to continue developing its prospects pipeline as a part of a sustainable exploration "cycle" to develop and maintain a suitable resource inventory. Nautilus has proposed an exploration program to further assess their tenement holdings and will primarily focus on increasing its knowledge of SMS systems in the Bismarck Sea through additional drilling. This drilling has the potential to increase the resource at Solwara 1, as 44% of the 2007 drillholes ended in mineralisation.

Improvements in drilling capability will focus on:

- Increased drilling depth (down to 40 m).
- Improved core recovery.
- Improved drilling cycle time.

The minimum cost for the above improvements in drilling capability is $US 6.3 million.

Nautilus is investigating 3D geophysical methods to assist mapping the size and shape of massive sulphide bodies. This will augment the data available through drilling.

Nautilus has been investigating the inclusion of Autonomous Underwater Vehicles (AUV) in their exploration process to improve the quality and efficiency of exploration data acquisition. This may offer an opportunity for Nautilus to demonstrate a further step-change improvement in converting the next generation of targets needed in Papua New Guinea to SMS systems.

Given Nautilus' research and development initiatives to improve target generation and ore-body delineation, as well as the proposed exploration in prospective areas, it is SRK's opinion that Nautilus' proposed activities are appropriate for exploring for new SMS deposits and adding to the current SMS resources.

22.2 Metallurgy

It is recommended Nautilus undertake and continue its further metallurgical testing.

To date the metallurgical test work done for the project has emphasised demonstrating 'proof of concept' that commercial grade mineral concentrates can be produced rather than generating detailed data for design of a concentrator to treat the Solwara 1 ore.

The following metallurgical work is in progress to enable finalisation and optimisation of processing design. This test work will focus on the following 6 elements:

- variability assessment.
- materials handling.
- dewatering plant engineering design.
- process optimisation.
- concentrator engineering design.
- pyrite processing option.

Variability assessment test work will be to improve understanding of process variability as a function of ore body to generate a base line variability assessment on comminution and flotation processes. Outcome will be to assess operating range required for concentrator design, provide input to forecast metallurgical performance and cash flow forecasting.

Material handling test work to provide data on ore reactivity for handling and stockpile engineering design to be based on ore specific characteristics such as potential for ore oxidation.

Dewatering design test work will provide data to allow engineering design to be based on ore specific characteristics to confirm equipment selection and assess performance envelope.

Concentrator design test work will provide data to allow the engineering design of the concentrator to be based on ore specific characteristics covering areas of comminution, flotation and filtration.

Pyrite process testwork will focus on process development to separate high grade Au pyrite from low grade Au pyrite.

22.3 Project Development Plan

22.3.1 General

All costs to implement the recommended project activates in section 22.3 (and 22.2) are included in the development program and therefore the capital cost presented in section 20.2. No additional capital is required for these recommendations.

22.3.2 Seafloor Mining Tools

Following is a summary of recommendations associated with the seafloor mining tools:

- Continue work on defining method of waste material management of cut material on the seafloor. This should also include management of material cut by the Auxiliary Miner.
- Review launch and recovery design, in particular:
  - Review requirement for heave compensation system given the Bismarck Sea is benign. Review should also consider existence and impact of harmonic motion during deployment and recovery.
  - Consider alternate winch equipment (such as traction winches) which may increase deployment wire rope life and hence decrease frequency of wire rope change out.
- Continue evaluation and optimisation of simultaneous seafloor mining tools operations. Evaluation should include review of:
  - survey methods involving real time monitoring of seafloor mining tools and their tethers / recovery wires to avoid interference.
  - impact / risk of rotation of SMT's during deployment and recovery.
- As the seafloor mining tools do represent new equipment, testing programs should be as extensive as practicable and be phased over the entire design, build and commissioning phases to the project.
- Continue work on defining the Gathering Machine slurry pumping system and associated erosion rates.

22.3.3 Riser and Lift System

Following is a summary of recommendations associated with the Riser and Lift System:

- Continue work on testing of the subsea lift pump to validate design for erosion, slurry pumping operability and design life.
- Evaluate existence and any impact of slurry pumping induced vibration in the vertical riser.

22.3.4 Production Support Vessel

Following is a summary of recommendations associated with the Production Support Vessel:

- Review controls philosophy for entire seafloor mining and production process, in particular determine best level of integration of equipment controls systems.
- Review / compare fuel availability and cost benefit in PNG for HFO / MDO.
- Select a vessel that can accommodate the SME integration with minimal structural modifications and additions.

22.3.5 Dewatering Plant

Following is a summary of recommendations associated with the dewatering plant:

- Transportable Moisture Limit
  - Process design estimates of moisture content on each size fraction to be validated via screen, centrifuge and filter laboratory tests.
  - Uncrushed drill core be used to compile a representative size distribution for determining a combined size fraction TML.
- DWP design to account for slurry parameter uncertainty and limited test work results by ensuring flexibility in equipment selection and sizing.
- Riser and lift system including the surge tank design upstream of the DWP needs to account for DWP emergency shut-down and subsequent re-start process. The design of the feed system should be reviewed periodically as development of the SMT-RALS system progresses.

22.3.6 Ore Transport to Port of Rabaul / Stockpiling

Following is a summary of recommendations associated with the ore transport and stockpiling at the port of Rabaul:

- Finalise port of Rabaul service agreement for ore handling operations.
- Ongoing design and project work should continue to review, assess and finalise.
  - Barge selection.
  - Port utilisation and upgrade requirements.
  - Stockpiling operations / handling.
  - Port structures and mobile offloading equipment selection.
- Where adequate samples and test work exist, finalise definition of TML. If inadequate test samples exist, allow for TML variability in the barge design and handling / stockpiling operations.
- Initial geotechnical survey has been completed and current hardstand design has been based on that information. A further detailed geotechnical suitability survey of site to be conducted to confirm the design.

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24. Date and Signatures

The following Qualified Persons statements are shown in this section:

- Phil Jankowski
- Peter Chwastiak
- Andrew See
- Peter Munro
- John Blackburn
- Erich Heymann
- Ian Lipton

24.1 Phil Jankowski

SRK Consulting (Australasia) Pty Ltd
Tel: +61 8 9288 2000
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Email: pjankowski@srk.com.au

CERTIFICATE OF QUALIFIED PERSON

To accompany the report entitled "Offshore Production System Definition and Cost Study Nautilus Minerals Inc. Document No: SL01-NSG-XSR-RPT-7105-001" dated 21st June 2010.

I, Philip Edward Jankowski, do hereby certify that:

1 I am a graduate from the Australian National University with a Bachelor of Science degree in Geology in 1986 and a Graduate Diploma in 1988; and a graduate from the University of Western Australia with a Master of Science degree in Geology in 2000.

2 I have continually practiced my profession since 1988.

3 I am a Member of The Australasian Institute of Mining and Metallurgy and a Chartered Professional.

4 I am a Principal Consultant with SRK (Australasia) Pty Ltd, a firm of consulting geologists and engineers which has been practicing in this profession since 1974. I hold office at 10 Richardson Street, West Perth, WA 6005, Australia.

5 I have 21 years' mining industry experience, including mine geology and exploration roles and, I have worked as a geologist in open pit and underground gold mines and as a resource geologist.

6 I have read the definition of "qualified person" as set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfil the requirements to be a qualified person for the purpose of NI 43-101.

7 I completed a site visit which consisted of a five day trip on the RV Melville (24 to 30 July 2006) and witnessed ROV sampling.

8 I have no personal knowledge, as of the date of this Certificate, of any material fact or change, which is not reflected in this report, the omission to disclose that would make this report misleading.

9 Neither I, nor any affiliated entity of mine is at present, or under an agreement, arrangement or understanding expects to become, an insider, associate, affiliated entity or employee of Nautilus Minerals Incorporated, and/or any associated or affiliated entities.

10 Neither I nor any affiliated persons or entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nautilus Minerals Incorporated, or any associated or affiliated companies.

11 I am independent of Nautilus Minerals Incorporated, in accordance with the application of Section 1.5 of NI 43-101.

12 My prior involvement with the Exploration Tenements that are the subject of this report is limited to the preparation of four NI43-101 Technical reports, all commissioned by Nautilus Minerals Incorporated.

13 I have read the NI 43-101 and Form 43-101F1, and have prepared the technical report in compliance with NI 43-101 and Form 43-101F1.

14 I am responsible for Sections 4, 6 to 15 inclusive, 17 to 18 inclusive, 21.1 to 21.3 inclusive and 22.1 of this Report.

15 To the best of my information, knowledge and belief, the sections as defined in 14 above contain all scientific and technical information to make the preliminary assessment not misleading.

16 I consent to the filing of this report with the relevant securities commission, stock exchange and other regulatory authorities as may be determined, including general publication in hardcopy and electronic formats to shareholders and to the public.

Dated this 21st day of June 2010

Phil Jankowski

Principal Consultant (Resource Evaluation)

24.2 Peter Chwastiak

Clough Limited
Tel: +61 8 9281 9664
Fax: +61 8 9481 8202
Email: peter.chwastiak@clough.com.au

CERTIFICATE OF QUALIFIED PERSON

To accompany the report entitled "Offshore Production System Definition and Cost Study Nautilus Minerals Inc. Document No: SL01-NSG-XSR-RPT-7105-001" dated 21st June 2010.

I, Peter John Chwastiak, do hereby certify that:

1. I am a graduate from the West Australian Institute of Technology with a Bachelor of Mechanical Engineering .
2. I have continually practiced my profession since 1986.
3. I am a Member of The Institute of Engineers Australia .
4. I am a Lead Mechanical / Equipment Engineer – Offshore Oil and Gas, with Clough Limited, a firm of consulting engineers which has been practicing in this profession since 1919. I hold office at 251 Mount Street, Perth, WA 6000, Australia.
5. I have 24 years' oil and gas industry experience, including offshore construction vessel conversions, remote operated vehicle design and operation and deepwater lowering systems design and operation, I have also spent time on offshore drilling rigs installing and operating riser installation and tensioning systems. .
6. I have read the definition of "qualified person" as set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfil the requirements to be a qualified person for the purpose of NI 43-101.
7. I have not completed a site visit as it was not required given the nature of the site (on the seafloor) and the nature of my scope.
8. I have no personal knowledge, as of the date of this Certificate, of any material fact or change, which is not reflected in this report, the omission to disclose that would make this report misleading.
9. Neither I, nor any affiliated entity of mine is at present, or under an agreement, arrangement or understanding expects to become, an insider, associate, affiliated entity or employee of Nautilus Minerals Incorporated, and/or any associated or affiliated entities.
10. Neither I nor any affiliated persons or entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nautilus Minerals Incorporated, or any associated or affiliated companies.
11. I am independent of Nautilus Minerals Incorporated, in accordance with the application of Section 1.5 of NI 43-101.
12. I have not had any involvement with the Exploration Tenements that are the subject of this Report, prior to the review commissioned by Nautilus Minerals Incorporated.
13. I have read the NI 43-101 and Form 43-101F1, and have prepared the technical report in compliance with NI 43-101 and Form 43-101F1.
14. I am responsible for Sections 19.3.1 to 19.3.2.4 inclusive, 19.3.2.6, 19.5.1 to 19.5.4.9 inclusive, 19.6, 19.7.8, 19.7.10, 20.2.2 to 20.2.5 inclusive, 20.2.7 to 20.2.8 inclusive, 20.3.2, 20.3.4, 21.5.4 to 21.5.6 inclusive, 21.5.8, 22.3.2 to 22.3.4 inclusive and 22.3.6 of this report.
15. To the best of my information, knowledge and belief, the sections as defined in 14 above contain all scientific and technical information to make the preliminary assessment not misleading.
16. I consent to the filing of this report with the relevant securities commission, stock exchange and other regulatory authorities as may be determined, including general publication in hardcopy and electronic formats to shareholders and to the public.

Dated this 21st day of June 2010

Peter Chwastiak

Lead Mechanical / Equipment Engineer

24.3 Andrew See

Ausenco Services Pty Ltd
Tel: +61 7 3169 7000
Fax: +61 7 3169 7001
Email: andrew.see@ausenco.com

CERTIFICATE OF QUALIFIED PERSON

To accompany the report entitled "Offshore Production System Definition and Cost Study Nautilus Minerals Inc. Document No: SL01-NSG-XSR-RPT-7105-001" dated 21st June 2010.

I, Andrew See, do hereby certify that:

1. I graduated with a BSc in Physical and Inorganic Chemistry from the University of Western Australia in 1981. In addition I have obtained a BSc(Hons) degree in Mineral Science from Murdoch University in 1982..
2. I have continually practiced my profession since 1983.
3. I am a Member of The Australasian Institute of Mining and Metallurgy.
4. I am a Manager Studies - Eastern Region with Ausenco Services Pty Ltd, a firm of consulting metallurgists and engineers which has been practicing in this profession since 1991. I hold office at 144 Montague Road, South Brisbane, Queensland, 4101, Australia.
5. I have worked as a metallurgist for a total of 26 years since graduation, predominantly in base metals and gold mineral processing, in operations and project development.
6. I have read the definition of "qualified person" as set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfil the requirements to be a qualified person for the purpose of NI 43-101.
7. I have not completed a site visit as it was not required given the nature of the site (on the seafloor) and the nature of my scope.
8. I have no personal knowledge, as of the date of this Certificate, of any material fact or change to the matters within the scope defined in 14 below, which is not reflected in this report, the omission to disclose that would make this report misleading.
9. Neither I, nor any affiliated entity of mine is at present, or under an agreement, arrangement or understanding expects to become, an insider, associate, affiliated entity or employee of Nautilus Minerals Incorporated, and/or any associated or affiliated entities.
10. Neither I nor any affiliated persons or entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nautilus Minerals Incorporated, or any associated or affiliated companies.
11. I am independent of Nautilus Minerals Incorporated, in accordance with the application of Section 1.5 of NI 43-101.
12. I have not had any involvement with the Exploration Tenements that are the subject of this Report, prior to the review commissioned by Nautilus Minerals Incorporated.
13. I have read the NI 43-101 and Form 43-101F1, and have prepared the technical report in compliance with NI 43-101 and Form 43-101F1.
14. I am responsible for Sections 16.6, 19.3.2.5, 19.5.5, 20.2.6, 20.3.3, 21.5.7, 21.5.9, 22.2 and 22.3.5 of this report, except the DWP feed surge tank, the out of specification ore storage tank and the dewatered ore reserve dry storage tank, (which fall under Section 19.5.2).
15. To the best of my information, knowledge and belief, the sections as defined in 14 above contain all scientific and technical information to make the preliminary assessment not misleading.
16. I consent to the filing of this report with the relevant securities commission, stock exchange and other regulatory authorities as may be determined, including general publication in hardcopy and electronic formats to shareholders and to the public.

Dated this 21st day of June 2010

Andrew See

Manager Studies - Queensland and Asian Operations

24.4 Peter Munro

Mineralurgy Pty Ltd
Tel: +61-7-3870-7024
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CERTIFICATE OF QUALIFIED PERSON

To accompany the report entitled "Offshore Production System Definition and Cost Study Nautilus Minerals Inc. Document No: SL01-NSG-XSR-RPT-7105-001" dated 21st June 2010.

I, Peter Munro, do hereby certify that:

1. I graduated with a BAppSc in Applied Chemistry from the University of Adelaide in 1970. In addition I have obtained a BEcon degree in 1975 and a BComm degree in 1979 from The University of Queensland.
2. I have continually practiced my profession since 1970.
3. I am a Member of The Australasian Institute of Mining and Metallurgy; Member of The Institution of Engineers, Australia; Member of the Institution of Materials, Minerals and Mining (U.K.); Member of the Society of Mining, Metallurgy and Exploration (USA); Member of the Canadian Institute of Mining, Metallurgy and Petroleum and Member of the Southern African Institute of Mining and Metallurgy.
4. I am a Senior Principal Consulting Engineer with Mineralurgy Pty Ltd, a firm of consultants to the mining, metallurgical and process industries which has been practicing in this profession since 2000. I hold office at Unit 2, 42 Morrow Street, Taringa, Queensland, 4068, Australia.
5. I have worked as a metallurgist for a total of 40 years since graduation, predominantly in base metals and gold mineral processing operations, process development and project development.
6. I have read the definition of "qualified person" as set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfil the requirements to be a qualified person for the purpose of NI 43-101.
7. I have not completed a site visit as it was not required given the nature of the site (on the seafloor) and the nature of my scope.
8. I have no personal knowledge, as of the date of this Certificate, of any material fact or change, which is not reflected in this report, the omission to disclose that would make this report misleading.
9. Neither I, nor any affiliated entity of mine is at present, or under an agreement, arrangement or understanding expects to become, an insider, associate, affiliated entity or employee of Nautilus Minerals Incorporated, and/or any associated or affiliated entities.
10. Neither I nor any affiliated persons or entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nautilus Minerals Incorporated, or any associated or affiliated companies.
11. I am independent of Nautilus Minerals Incorporated, in accordance with the application of Section 1.5 of NI 43-101.
12. I have been involved in directing metallurgical test work on materials from the Exploration Tenements that are the subject of this Report, prior to the review commissioned by Nautilus Minerals Incorporated.
13. I have read the NI 43-101 and Form 43-101F1, and have prepared the technical report in compliance with NI 43-101 and Form 43-101F1.
14. I am responsible for Sections16.1 to 16.5 inclusive and 21.4 inclusive of this Report.
15. To the best of my information, knowledge and belief, the sections as defined in 14 above contain all scientific and technical information to make the preliminary assessment not misleading.
16. I consent to the filing of this report with the relevant securities commission, stock exchange and other regulatory authorities as may be determined, including general publication in hardcopy and electronic formats to shareholders and to the public.

Dated this 21st day of June 2010.

Peter Munro

Senior Principal Consulting Engineer

24.5 Erich Heymann

SRK Consulting (Australasia) Pty Ltd
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CERTIFICATE OF QUALIFIED PERSON

To accompany the report entitled "Offshore Production System Definition and Cost Study Nautilus Minerals Inc. Document No: SL01-NSG-XSR-RPT-7105-001" dated 21st June 2010.

I, Erich Ferdinand Heymann, do hereby certify that:

1. I am a graduate from the University of Stellenbosch, South Africa with a Bachelor of Engineering degree in Chemical Engineering – Extractive Metallurgy in 1983 and a graduate from the University of Stellenbosch School of Business with a Masters in Business Administration in 1995.
2. I have continually practiced my profession since 1984.
3. I am a Member of the South African Institute of Chemical Engineers, the South African Institute of Mining and Metallurgy and am registered as a Professional Engineer by the Engineering Council of South Africa.
4. I am a Principal Consultant with SRK (Australasia) Pty Ltd, a firm of consulting geologists and engineers which has been practicing in this profession since 1974. I hold office at Level 2, 44 Market Street, Sydney, NSW 2000, Australia.
5. I have 26 years' processing, oil and mining industry experience, including corporate environmental management and consulting roles,
6. I have read the definition of "qualified person" as set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfil the requirements to be a qualified person for the purpose of NI 43-101.
7. I have not completed a site visit as it was not required given the nature of the site (on the seafloor) and the nature of my scope..
8. I have no personal knowledge, as of the date of this Certificate, of any material fact or change, which is not reflected in this report, the omission to disclose that would make this report misleading.
9. Neither I, nor any affiliated entity of mine is at present, or under an agreement, arrangement or understanding expects to become, an insider, associate, affiliated entity or employee of Nautilus Minerals Incorporated, and/or any associated or affiliated entities.
10. Neither I nor any affiliated persons or entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nautilus Minerals Incorporated, or any associated or affiliated companies.
11. I am independent of Nautilus Minerals Incorporated, in accordance with the application of Section 1.5 of NI 43-101.
12. I have not had any involvement with the Exploration Tenements that are the subject of this Report, prior to the review commissioned by Nautilus Minerals Incorporated.
13. I have read the NI 43-101 and Form 43-101F1, and have prepared the technical report in compliance with NI 43-101 and Form 43-101F1.
14. I am responsible for Chapter 5 inclusive of this Report.
15. To the best of my information, knowledge and belief, the sections as defined in 14 above contain all scientific and technical information to make the preliminary assessment not misleading.
16. I consent to the filing of this report with the relevant securities commission, stock exchange and other regulatory authorities as may be determined, including general publication in hardcopy and electronic formats to shareholders and to the public.

Dated this 21st day of June 2010

Erich Heymann

Principal Consultant (Environmental)

24.6 John Blackburn

SRK Consulting (Australasia) Pty Ltd
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Email: jblackburn@srk.com.au

CERTIFICATE OF QUALIFIED PERSON

To accompany the report entitled “Offshore Production System Definition and Cost Study Nautilus Minerals Inc. Document No: SL01-NSG-XSR-RPT-7105-001” dated 21st June 2010.

I, John Lockhart Blackburn, do hereby certify that:

1. I am a graduate from the University of Melbourne with a Bachelor of Engineering (Mining) degree in 1973 and a graduate from Deakin University / APESMSA with a Master of Business Administration (Technology Management) in 2000.
2. I have continually practiced my profession since 1973.
3. I am a Member of The Australasian Institute of Mining and Metallurgy.
4. I am a Principal Consultant (Underground Mining) with SRK (Australasia) Pty Ltd,, a firm of consulting metallurgists and engineers which has been practicing in this profession since 1974. I hold office at 10 Richardson Street, West Perth, WA 6005, Australia.
5. I have 35 years’ mining industry experience, including underground, mine planning and scheduling, cons and consulting roles. I have worked as a mining engineer in open pit coal and underground nickel and gold mines and as a consultant engineer in variety of roles.
6. I have read the definition of “qualified person” as set out in National Instrument 43-101 (“NI 43-101”) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfil the requirements to be a qualified person for the purpose of NI 43-101.
7. I have not completed a site visit as it was not required given the nature of the site (on the seafloor) and the nature of my scope.
8. I have no personal knowledge, as of the date of this Certificate, of any material fact or change, which is not reflected in this report, the omission to disclose that would make this report misleading.
9. Neither I, nor any affiliated entity of mine is at present, or under an agreement, arrangement or understanding expects to become, an insider, associate, affiliated entity or employee of Nautilus Minerals Incorporated, and/or any associated or affiliated entities.
10. Neither I nor any affiliated persons or entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nautilus Minerals Incorporated, or any associated or affiliated companies.
11. I am independent of Nautilus Minerals Incorporated, in accordance with the application of Section 1.5 of NI 43-101.
12. I have not had any involvement with the Exploration Tenements that are the subject of this Report, prior to the review commissioned by Nautilus Minerals Incorporated.
13. I have read the NI 43-101 and Form 43-101F1, and have prepared the technical report in compliance with NI 43-101 and Form 43-101F1.
14. I have collated this report and am responsible for Sections 1 to 3 inclusive, 19.1 to 19.2 inclusive, 19.4, 19.7.1 to 19.7.5 inclusive, 19.7.7, 20.1, 20.2.1, 20.3.1, 21.5.1 to 21.5.3 inclusive and 21.5.10 to 21.5.12 inclusive, and 22.3.1 of this report.
15. To the best of my information, knowledge and belief, the sections as defined in 14 above contain all scientific and technical information to make the preliminary assessment not misleading.
16. I consent to the filing of this report with the relevant securities commission, stock exchange and other regulatory authorities as may be determined, including general publication in hardcopy and electronic formats to shareholders and to the public.

Dated this 21st day of June 2010

John Blackburn

Principal Consultant (Underground Mining)

24.7 Ian Lipton

Golder Associates Pty. Ltd.
611 Coronation Drive, Toowong, Queensland, 4066, Australia
Tel: +61-7-3721-5400,
Email: ilipton@golder.com.au

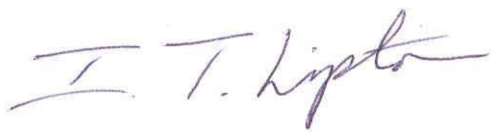
CERTIFICATE OF QUALIFIED PERSON

To accompany the report entitled "Offshore Production System Definition and Cost Study Nautilus Minerals Inc. Document No: SL01-NSG-XSR-RPT-7105-001" dated 21st June 2010.

I, Ian Thomas Lipton, BSc (Hons), FAusIMM, do hereby certify that:

1. I am a Principal Geologist with Golder Associates Pty Ltd, and have been so since November 2001.
2. I graduated with a degree in BSc (Hons) Geological Sciences from the University of Birmingham, UK in 1981.
3. I have worked as a geologist for a total of 29 years since my graduation from university.
4. I am a Fellow of the Australasian Institute of Mining and Metallurgy.
5. I have read the definitions of "qualified person" set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience,
6. I fulfil the requirements to be a "qualified person" for the purposes of NI 43-101.
7. I am responsible for Section 17 of this Report. Section 17 refers to a technical report titled 'Mineral Resource Estimate, Solwara 1 Project, Bismarck Sea, Papua New Guinea' and dated 1st February 2008, for which I am responsible, except Item 19, and with reliance on other experts as noted in Section 4.
8. I visited the Solwara 1 property between 10 – 24 June 2007, 22 – 29 July 2007 and 5 – 12 September 2007.
9. I am not aware of any material fact or material change with respect to the subject matter of the Report that is not reflected in the Section 17 of this report, and that the omission to disclose would make the report misleading.
10. I am independent of Nautilus Minerals Inc applying all of the tests in Section 1.4 of National Instrument 43-101.
11. I have read National Instrument 43-101 and Form 43-101F1 and the Technical Report has been prepared in compliance with that instrument and form.
12. I consent to the filing of this report with any stock exchange and other regulatory authority and any publication by them for regulatory purposes, including electronic publication in the public company files on their websites accessible by the public, of this Report.

Dated this 21st day of June 2010



Ian Thomas Lipton, FAusIMM, BSc (Hons)

Chief Geologist

Appendices

Appendix 1: Nautilus Project Documentation

Table A: Level 1 - Principal Documents

Company	Document Name	Document Number
SRK Consulting	03_02_13_IndependentAssessmentofSMS_NautilusTenementsinPNG_SRK2006.pdf	
SRK Consulting	NAT004 Nautilus 2008 Exploration NI43-101 Report Rev16.pdf	
KPMG	Nautilus Final tenement management report.pdf	
Technip USA Inc	RALS FEED Submission	
Ausenco Services Pty Ltd	Solwara 1 Project Process Review (Draft Report)	1820RPT001
Parsons Brinckerhoff	Dewatering Study	
Parsons Brinckerhoff	Dewatering Study 'Proposed Dewatering module Process Flow Diagram and Flow Rate Chart'	2132408A-MEC-SK29 (A)
Parsons Brinckerhoff	Dewatering Study 'Proposed Dewatering Module General Power Requirements – Single Line Diagram Sheet 1'	2132408A-ELE-SK01(A)-DRJ-A
Parsons Brinckerhoff	Dewatering Study 'Proposed Dewatering Module Provisional P&ID	2132408A-MEC-SK24 (B)
Parsons Brinckerhoff	Dewatering Study 'Proposed Dewatering Module General Arrangement 30m x 10m Option	2132408A-MEC-SK31(A)
Parsons Brinckerhoff	Dewatering Study 'Proposed Dewatering Module General Power Requirements – Single Line Diagram Sheet 2'	2132408A-ELE-SK02(A)-drj-A
Clough Pty Ltd	MSV Feasibility Assessment Report	SL01-NSG-XCL-RPT-7810-001
Parsons Brinckerhoff	SMS Deposit Phase 1 Shipping Study	
Meyrick & Associates	Nautilus Minerals - Solwara 1 Project: Ore Shipping Study – Optimisation of Shipping Scheme	

Company	Document Name	Document Number
Golder Associates Pty Ltd	Mineral Resource Estimate, Solwara 1 Project, Bismarck Sea PNG for Nautilus Minerals Inc. Canadian N143-101 form F1	Project 06631025-039
Golder Associates Pty Ltd	Review of Solwara Data, Bismark Sea, PNG. Electronic copy submitted to Nautilus.	06631025-001
AMMTEC Limited	Metallurgical Testwork on Samples from the Solwara1 Project for Nautilus Minerals-Phase 1A	Project A10988
AMMTEC Limited	Size by Size Elemental Analysis	Project A10988
AMMTEC Limited	Flotation Flowsheet, Reagent Scheme & Results	Project A10988
AMMTEC Limited	QEMSCAN Solwara 1 April 2008 AMTEC.pdf	
Mineralurgy Pty Ltd	Quantitative Mineralogical Data Review	SL01-NMN-XMI-RPT-5000-001
HRL Testing	Technical Memo 404 – Sample Preparation and Transportable Moisture Limit	
Core Laboratories Australia Pty Ltd	Solwara 1 Core Analysis	
G&T Metallurgical Services Ltd, Canada	Mineralogical Assessment & Implications for Flotation Process Design - Nautilus Minerals Solwara Project	KM2275
G&T Metallurgical Services Ltd, Canada	Ore Mineralogy & the implications for flotation process design	KM2111
Mineralurgy Pty Ltd	Solwara 1 Ore Processing Update	2007-014 Solwara
Mineralurgy Pty Ltd	Concentrators for Processing Solwara 1 by P. Munro	2007-014 Solwara
Mineralurgy Pty Ltd	SOLWARA 1 ORE PROCESSING UPDATE	SL01-NMN-XMI-RPT-5000-002

Company	Document Name	Document Number
Environmental Geochemistry International (EGI)	Acid Forming Characteristics of SMS ore	Document no. 2046/838
Golder Associates Pty Ltd	Solwara 1 SMS Deposit Geotechnical Review, Manus Basin PNG	025-06631025-R1
Coffey Int.	Environmental Impact Statement – Solwara 1	
Neil S. Seldon & Associates Limited	Study - Marketing & Key Revenue Assumptions for Copper Concentrates	
Nautilus Minerals	Solwara 1 Project Design Premise	SL01-ENG-SP-1000-0001
Nautilus Minerals	Solwara 1 Project Simplified Process Flow Diagram	SL01-NSG-DEV-DWG-0201-001 Rev B
Nautilus Minerals	Solwara 1 Project Simplified Process Flow Diagram	SL01-NSG-DEV-DWG-0201-001 Rev C
Nautilus Minerals	Operating Philosophy	SL01-NSG-DEV-SPC-0200-001
Nautilus Minerals	SMT Functional Specification: Schedule 3	SL01-6L-SP-001-0001
Nautilus Minerals	SMT Scope of Work: Schedule 4	SL01-6L-SC-001-0001
Soil Machine Dynamics	SMT Revised Preliminary Design Package (Drawings / Description)	
Nautilus Minerals	RALS Contract Schedule 4 – Scope of Work	SL01-6L-CN-003-001
Nautilus Minerals	RALS Contract Schedule 3 – Functional Specification	SL01-6L-CN-003-001
Technip USA Inc	RALS Basis of Design	GF011858000SP368004002

Company	Document Name	Document Number
Technip USA Inc	Static Flow Analysis for RALS	GF011858000RT368009014
Technip USA Inc	Riser System General Arrangement	GF011858000DW364611001
Technip USA Inc	Riser Wave Motion Fatigue Analysis	GFO11858-000-RT-3680-09006 Rev 0
Ausenco	Lassul Bay Contentrator Scoping Study Report	1930-RPT-0001 Rev A Daft - (SL01-NMN-XAU-RPT-5000-001)
	Input Data Riser Analysis	GF011858-000-RT-3680-09015

Table B: Level 2 – Support / Backup as Required

Company	Document / Data Set Name	Document Number
CSIRO	CSIRO_Bismarck_Sea_Geochronology_FINAL.pdf	
Geological Exploration Services (Howard	Solwara 1 Geology_draft2.doc; plus Figures 1 to 17	
U of T - Steve Scott	A08-0989 - UofT-Nautilus - Solwara 1 Project.pdf; SGH FINAL Report to Nautilus 200708.pdf; Solwara_1_sed_core_sites_sulphide_zones_bathy.pdf; Solwara_1_sed_core_sites_sulphide_zones_EM.pdf	
Elitsa Hrischeva Sed Core	Nautilus report, text.doc; Nautilus report, figures.pdf	
Ocean Deep Drilling Program	ODP 193 (Manus) Anhydrite composition.pdf	
Solid Geology (Steve King)	East Manus Key Geol Interp Maps SK 2007 x 2	
Solid Geology (Steve King)	PNG Geology Maps Steve King 2007 x 18	

Company	Document / Data Set Name	Document Number
Solid Geology (Steve King)	Bismarck Woodlark Report Steve King 2007 x 2; Bismarck Woodlark Report Steve King 2007 x 10 report enclosures; Bismarck Woodlark Report Steve King 2007 x 24 pdf figures	
Nautilus	Luk Luk Exploration Program 2007 - Full Report.pdf	
Nautilus	Nautilus Exec Summary Bismarck.doc	
Nautilus	Southern Surveyor - Woodlark and Bismarck Seas July-Aug 2007 .doc	
Teck	Sepura2008_Cruise Report.pdf	
Nautilus	Nor Sky 2008 PNG Geology Report.docx	
Nautilus	Nor Sky 2008 PNG drill cruise report.pdf	
Teck	Cruise 2a PNG PLUME RECON Report_FINAL with Appendices.pdf	
Teck	Teck Cruise 2c Tonga ROV August 2008 final report with Appendices_draft1.pdf	
G&T Metallurgical Services	Final_Report_MetSamples_KM2275.pdf	
Mineralurgy Pty Ltd	Draft Solwara 1 Ore Processing Executive Summary Version 1 - Munro 09-05-2008.doc	
PacAu (Fiji) Limited_Geoff Taylor	Solwara memo.doc	
PacAu (Fiji) Limited_Geoff Taylor	Solwara ore types and metallurgical drill holes.doc; OreTypesAppendix.pdf	
PacAu (Fiji) Limited_Geoff Taylor	Solwara ore types photos.doc	

Company	Document / Data Set Name	Document Number
Nautilus Miinerals	Solwara 1 - Project Feasibility Study	
Hatch/Technip Alliances	Option Studies & Project Valuation Analysis Solwara 1 Project	H326888-00000-G-PR-0004
Hatch/Technip Alliances	Solwara 1 project - Hydrologic report	H326888-00000-C-PR-0001
Centre for Earthquake Research in Australia	Review of "Disaster Risk Assessment - Report for East New Britain Province" (Papua New Guinea) for the Natural Hazards of Earthquake, Tsunami and Volcano, in relation to the proposed "Nautilus Project"	CERA/CONHATCH/REV GRA REPORT/JR SEP 07
Rabaul Volcanic Observatory	Solwara 1 Project Operations at Rabaul - Risk Assessment: Intro to the harbour & the volcanoes - PowerPoint presentation	
RPS MetoOcean Pty Ltd	Final Metocean Design Criteria Study for Solwara 1 Location in the Bismarck Sea	Job No. J2672.002, Report No. R1381
Soil Machine Dynamics	Execution Plan	C916 V1P1
Technip USA Inc	Project Execution Plan (schd 6)	GF011858-000-PP-01100
Technip USA Inc	Subsea Slurry pump specification	GF011858-000-SP-368005001
Technip USA Inc	Riser Pipe Sizing	GF011858000CN363009001
Technip USA Inc	Main riser pipe sizing	GF011858000RT368009008
Technip USA Inc	Riser Temperature Study	GF011858000RT368009016
Technip USA Inc	State of The Art Technical Review Of Deepsea Mining System	GF011858000RT368004002
Technip USA Inc	Corrosion Analysis of Vertical Riser Water Injection Lines	GF011858-000-RT-368006003

Company	Document / Data Set Name	Document Number
Technip USA Inc	RTP equipment specification	SL1-CN-003-SP-3511-08001 / GF011858-000-SP-08001
Technip USA Inc	RALS Process Flow Diagram Slurry Transportation Diagram	GF011858000DW368011004
Nautilus Minerals	MSA - Vessel Specification	
Nautilus Singapore	Seafloor Mining System	-
Nautilus Singapore	SME Residual Value Assessment	SL01-NSG-DEV-RPT-0410-001 Rev 0
Nautilus Singapore	Subsea Mining Tools Functional Spec	SL01-NSG-DEV-SPC-1010-001 Rev A
Parsons Brinckerhoff	DWP Equipment List	MasterEquipmentList_1i - 23-May-08
Parsons Brinckerhoff	Equipment Weight Take-off	Equipment Weight - Rev 18-Jun-08.pdf

Table C: Level 3 – Historical Documents

Company	Document / Data Set Name	Document Number
AGR Drilling	Progress Report, AGR Feasibility Study: Deepwater Mining Pump and Riser System	Proposal T07003 (AGR Drilling)
Technip (for Placer Dome)	Riser and Jumper Analysis Report	Techip (for Placer Dome) Doc. No 303868-000-RT-3680-0001
2H Offshore	Technical Proposal - RALS FEED Submission	2081-PRP-0004-1/GD
Technip/Placer Dome	Placer Dome, Deep Water Mining Project, Dewatering System Study	Document is work product of Technip Offshore, Inc (TOI). Technip Doc No. 303868-000RT-3690-0001

Company	Document / Data Set Name	Document Number
Tideway	MSV FEED Submission (ORIGINAL)	T-AU-07.071/005-L.hbo
Clough Engineering	MSV FEED Submission	Requisition No. SOL01/002
Global Maritime	Concept Mooring Design Report	SL01-NSG-XGM-RPT-3205-001 Rev 1
Global Maritime	Drilled and Grouted Pile Design and Moorinig Installation CAPEX Study	SL01-NSG-XGM-RPT-3205-002 Rev 1
Parsons Brinckerhoff	Solwara 1 Development Dewatering Module Delivery Strategy	
Parsons Brinckerhoff	Solwara 1 Development Rabaul Berth 1 and 2 Structural Assessment	
Parsons Brinckerhoff	Solwara 1 Development Equipment Selection and Delivery Assessment	
Parsons Brinckerhoff	Solwara 1 Development Transportable Moisture Limit	
Parsons Brinckerhoff	Solwara 1 Development Process Design Criteria	
Parsons Brinckerhoff	Solwara 1 Development Barge Unloading Operations Assessment	
Parsons Brinckerhoff	Solwara 1 Development Stockpile Management	
Parsons Brinckerhoff	PORT OF RABUAL STOCKPILE DETAIL PLAN PORT OF RABUAL UNLOADING OPTION 6.1.1.1.2.3 LOADING OPTION 6.1.3.5.5 SITE PLAN PORT OF RABUAL UNLOADING OPTION 6.1.1.1.2.3 LOADING OPTION 6.1.3.5.5 MATERIALS HANDLING CONCEPT LAYOUT B&W SHIP LOADER RAISED CHASSIS & GANTRY	2132408A-CIV-SK01 2132408A-MEC-SK17 2132408A-MEC-SK18 2132408A-MEC-SK28

Company	Document / Data Set Name	Document Number
Parsons Brinckerhoff	Solwara 1 Development Dewatering Facility Functional Description	
Soil Machine Dynamics	SMT Preliminary Design	C916 V1P14
Soil Machine Dynamics	Cutter Drive Power Calculations	C916-6-03-DN017 Iss 1
Soil Machine Dynamics	Evans Model for Specif Energy Cutting	C916-6-03-DN018
Soil Machine Dynamics	Vessel Motion/PAHC Performance	T07-021-232-11_01
Soil Machine Dynamics - Daltares	SMS Properties	n/a
Soil Machine Dynamics - Daltares	Limestone Analogue_Hyperbaric Trials	n/a
Soil Machine Dynamics - Daltares	Hyperbaric Tests - Hoek Cell	Z4539 part 2A
Technip USA Inc	Subsea Pump and Riser Test Requirements	GF011858-000-SP-368005002
Technip USA Inc	Riser System - Running and Retrieval Procedure	GF011858-000-RT-368005041
Technip USA Inc	Riser and Lifting System Equipment and Running Tool Specification	GF011858-000-SP-3680-06001
Technip USA Inc	Flexjoint for riser suspension specification	GF011858-000-SP-3680-06002
Technip USA Inc	Riser Spider Specification for Nautilus Solwara 1 Riser Hang-Off System	GF011858-000-SP-3680-06003

Company	Document / Data Set Name	Document Number
Technip USA Inc	RTP To SMT Connector Options	GF011858-000-RT-3680-08002
Technip USA Inc	Surface Transfer Pipe (STP) Equipment Specification	GF011858-000-SP-3500-08003
Technip USA Inc	Water Injection Hose Equipment Specification	SL1-CN-003-SP-3511-08002
Technip USA Inc	Typical Riser Joint Section	GF011858000DW364611002
Technip USA Inc	Riser Transfer Pipe	GF011858000DW3646 11003
Technip USA Inc	Upper Transition Joint	GF011858000DW3646 11004
Technip USA Inc	Water Injection Hose Concept	GF011858000DW3646 11005
Technip USA Inc	Flexjoint Concept	GF011858000DW3646 11006
Technip USA Inc	Flexjoint and Upper Transition Joint Assembly	GF011858000DW3646 11007
Technip USA Inc	Rig Handling System Deck Layout	GF011858000DW3680 11003
Technip USA Inc	RALS Sequence Sheets 1 Through 8	GF011858000DW3680 11009
Technip USA Inc	General Arrangement RALS Equipment PreInstalltion Sheets 1 Through 7	GF011858000DW3800 11003
Technip USA Inc	General Arrangement RALS Equipment Sheets 1 Through 3	GF011858000DW3800 11004
Technip USA Inc	SSLP Installation Through Moonpool Sheets 1 Through 3	GF011858000DW3800 11005

Company	Document / Data Set Name	Document Number
Technip USA Inc	Transport Skid Loading Sequence Sheets 1 Through 2	GF011858000DW3800 11006
Technip USA Inc	Riser Hangoff Structure Sheets 1 Through 3	GF011858000DW3810 11001
Technip USA Inc	Riser Bolster	GF011858000DW3810 11002
Technip USA Inc	Transportation Skid Sheets 1 Through 2	GF011858000DW3810 11003
Technip USA Inc	RTP Hangoff Structure	GF011858000DW3810 11004
Technip USA Inc	Spelter Socket Hangoff Insert	GF011858000DW3810 11005
Technip USA Inc	RTP Hangoff Insert	GF011858000DW3810 11006
Technip USA Inc	Work Platform	GF011858000DW3810 11007
Technip USA Inc	Vessel Transport Skid Rails Sheets 1 Through 2	GF011858000DW3810 11008
Technip USA Inc	Swivel Joint Hangoff Concept	GF011858000DW3810 11009
Technip USA Inc	Subsea Frame Sheets 1 Through 4	GF011858000DW3810 11010
Technip USA Inc	Subsea Pump Deployment Through The Moonpool Sheets 1 Through 14	GF011858000DW5711 11001
Technip USA Inc	RALS Installation Over The side of MSV Method Sheets 1 Through 15	GF011858000DW5711 11002
Technip USA Inc	Pump On MSV Layout Sheets 1 Through 4	GF011858000DW5750 11001

Company	Document / Data Set Name	Document Number
Technip USA Inc	Rig Handling System Deck Layout	GF011858000DW5750 11002
Technip USA Inc	Goose Neck and Water Injection Hose Layout	GF011858000DW5750 11003
Technip USA Inc	R.A.L.S. Process Flow Diagram Legand Sheets 1 Through 3	1 SL01CN003PFD0010 11001
Technip USA Inc	Topside Structural Interface Sheets 1 Through 2	GF011858000SK3819 11001
Technip USA Inc	Topside Piping Interface Sheets 1 Through 2	GF011858000SK3819 11002
Technip USA Inc	Rig and Hoisting Interface Main Deck Sheets 1 Through 2	GF011858000SK3819 11003
Technip USA Inc	Rig and Hoisting Interface Tween Deck Sheets 1 Through 2	GF011858000SK3819 11004
Technip USA Inc	Rig and Hoisting Interface Tank Top Sheets 1 Through 2	GF011858000SK3819 11005
Technip USA Inc	Electrical Interface Sheets 1 Through 2	GF011858000SK3819 11006
Technip USA Inc	SSLP Retrieval Motion Compensation & LockOff Method Option 1 Sheets 1 Through 6	GF011858000SK5765 11001
Technip USA Inc	SSLP Retrieval Bottom Founded Method Option 2 Sheets 1 Through 4	GF011858000SK576511002
Technip USA Inc	SSLP Retrieval Suspended Method Option 3 Sheets 1 Through 4	GF011858000SK576511003
Technip USA Inc	Subsea Slurry Lift Pump Interface Subsea Package Sheets 1 Through 2	GF011858000SK578011001
Technip USA Inc	Riser Transfer Pipe Interface Subsea Package Sheets 1 Through 2	GF011858000SK578011002

Company	Document / Data Set Name	Document Number
Technip USA Inc	Riser Transfer Pipe Interface Subsea Package Sheets 1 Through 2	GF011858000SK578011003
Technip USA Inc	Flexibles Interface Subsea Sheets 1 Through 2	GF011858000SK578011004
Technip USA Inc	Flexibles Interface Subsea and Topside Sheets 1and Topside Sheets 1 Through 2	GF011858000SK578011005
Technip USA Inc	SSLP Subsea Interface Sheets 1 Through 2	GF011858000SK578011006
Technip USA Inc	Subsea Riser Interface Sheets 1 Through 2	GF011858000SK578011007
Houlder Limited	Vessel RAOs for Operating Condition	B/356/001/2218 - Rev 0

Table D: Level 4 – Financial Spreadsheets / Data

Project Phase	Scope	Company	Document / Data Set Name	Document Number	Original Location - softcopy	SRK Handover	Clough Handover	Ausenco Handover
Solwara	**Financial**	Nautilus Minerals	Estimating Matrix - 231009	Estimating Matrix - 231009	Sharepoint	6-Nov-09		
			Solwara 1 CAPEX	Solwara 1 CAPEX 2009-02.4 Vessel Chartered Option – DP2 + Stickbuilt.xlsx	Sharepoint	6-Nov-09		
			OPEX 2009	Opex 2009-04 Charted Combi Lift Deck Carrier.xlsx	Sharepoint	6-Nov-09		
			WBS – Implementation Phase	Rev J	Sharepoint	6-Nov-09		

Project Phase	Scope	Company	Document / Data Set Name	Document Number	Original Location - softcopy	SRK Handover	Clough Handover	Ausenco Handover

			Financial Model		Hardcopy scanned	6-Nov-09		
			Mining Schedule			25-Nov-09		
			Solwara 1 Capex	2009-02 7 Vessel Chartered option - Clough			14-Dec-09	
			Solwara 1 Capex	2009-02 7 Vessel Chartered option - SRK		14-Dec-09		
			Solwara 1 Capex	2009-02 7 Vessel Chartered option - Ausenco				15-Dec-09
			Solwara 1 Opex	2009-07 Chartered Combi Lift Deck Carrier + Hellyer.xlsx		18-12-09	18-12-09	18-12-09