

6.0 MONITORING PROGRAMMES

Several environmental and social monitoring programmes would be continued or initiated as Project operations commence to ensure mitigations (presented in **Section 5.0, Mitigation Measures**) to impacts (identified in **Section 4.0, Assessment of Impacts**) are effective. These programmes would be implemented in accordance with various plans that would receive reviews and approvals from the appropriate Ghanaian government entities. General descriptions of the various monitoring programmes and data collection efforts for the Project are described herein. A summary of the monitoring programmes and the period of monitoring is presented in **Table 6-1**.

6.1 ENVIRONMENTAL MONITORING

The various components of the Project environmental monitoring programme would be initiated as mine development proceeds and would continue until reclamation is successfully completed. Data collected during the monitoring programmes would be used to supplement data collected during baseline studies and ongoing monitoring programmes at the Project site. Ongoing monitoring of the environment would be an integral part of the Project, providing management with information which can be used to assess the need to employ corrective measures in case deviations are discovered. In addition, monitoring programmes would confirm the environmental sustainability of the Project and would generate data that can be used to demonstrate compliance with permits under which the Company would operate. Existing environmental monitoring programmes include:

- Air Quality,
- Meteorology and
- Water Resources (surface water, groundwater, stormwater).

These monitoring programmes would be continued into the pre-construction (initial) and construction phases of the project. Additional environmental monitoring programmes would be developed for the following as construction commences in conjunction with the Project:

- Seepage (from waste rock disposal areas and the tailings storage facility),
- Vegetation (for reclaimed areas, noxious weeds),
- Fauna and Aquatics (macroinvertebrate),
- Noise and Vibration,
- Erosion and Sedimentation (caused by site disturbance),
- Geochemistry (of waste rock and tailings) and
- Operational Parameters.

Specific environmental monitoring programmes for air quality, water resources and revegetation, as well as implementation of fluid management plans and external and internal audit programmes are described in this section. **Annex E** contains generalized descriptions of the proposed monitoring programmes for the Project. A site-specific Environmental

Monitoring Plan would be developed as a component of the Project Environmental Management Plan, as required by the EPA (see **Section 7.0, Provisional Environmental Management Plan**). The Environmental Monitoring Plan would provide specific details of these programmes, including reporting requirements, and would be reviewed and approved by EPA in accordance with Ghanaian regulatory requirements. The Environmental Monitoring Plan would be implemented following issuance of the Environmental Permit.

6.2 ENVIRONMENTAL STUDIES

This section describes environmental data the Company would collect to expand on or confirm information obtained during baseline studies and fill certain data gaps. Environmental data collected from these supplemental data collection efforts, along with ongoing monitoring programmes, would also be used to determine if modifications to the design of various components of the Company's proposed operation and/or closure plans are warranted.

6.2.1 GROUNDWATER STUDIES

The Company will install additional monitoring and test wells in and near the proposed open pit to provide access to verify water quality and determine the hydraulic characteristics of the various aquifers at the site. These data would be used to further establish baseline conditions and develop and/or refine conceptual and numeric groundwater flow models being developed for the pit area. The groundwater models would, in turn, be used to further quantify expected groundwater dewatering rates and quality associated with the mine development and be used as input to post-mine pit lake geochemistry evaluations (see below). The refined dewatering rate data would also be used by mine planners in optimizing their analyses of operational makeup water requirements and general water balance calculations. Such data are useful, for example, in determining if sufficient water can be derived from dewatering wells in the open pit area to negate the need to construct the water supply pipeline from the Pra River.

Data derived from the numeric groundwater flow model would also be used to confirm predictions of potential impacts on adjacent community and village water supply boreholes as well as assess the time required for equilibrium to be realized after mine dewatering activities cease. These assessments, in conjunction with ongoing groundwater monitoring, would assist the Company in determining the location of at-risk village and community wells with respect to realizing lowered water levels from mine pit dewatering and the probable timing of any impacts. Appropriate mitigations (e.g., construction of replacement supply wells) could then be scheduled accordingly (see **Section 5.0, Mitigation Measures**).

The numeric groundwater model for the Study Area would be updated and refined periodically as additional groundwater monitoring data are obtained to reflect actual measured site conditions. This tool will become an integral part of the monitoring plan, the output which would be incorporated into monitoring reports to the EPA.

6.2.2 ENVIRONMENTAL GEOCHEMISTRY

The Company has completed an evaluation and modelling exercise to predict water quality and hydrogeologic characteristics of the post-mine pit lake associated with the Project (Golder 2006). This analysis is based upon currently available geochemical and hydrogeologic data. The Company will update and refine this geochemical model as new water resources and geochemical data become available. Refinement of these analyses would consider new groundwater hydraulic and analytical data that would become available as the open pit area is further evaluated through installation of monitoring and test wells (see above) as well as new geochemical data generated through ongoing kinetic tests being conducted of the various types of waste rock. The expected quality of pit lake water would also be confirmed in this analysis using the ongoing geochemical characterization data collected during the first 12 years of operation.

The Company is also conducting additional geochemical characterization of ore and waste rock samples obtained from the Proposed Mining Area. Composite samples of waste rock are being subjected to several types of tests, including: Synthetic Precipitation Leaching Procedure; Biological Acid Production Procedure; Potentially Acid Generating; and other kinetic tests. Results of these analyses would be used to confirm results of previous geochemical testing completed to date. Additional waste rock characterization sampling would be conducted for the life of the mine as required by the Company's internal standards to avoid unanticipated problems with Acid Rock Drainage. The overall expected quantity and quality of water predicted to seep from the base of the waste rock disposal facilities and Tailings Storage Facility would be confirmed using data derived from ongoing ore and waste rock characterization programmes (described in **Section 3.2, Geology and Minerals – Geochemical Characterization of Rock**) as applied using a geochemical modelling software package.

6.3 SOCIOECONOMIC MONITORING

The Company recognizes its commitment to restore and improve the livelihood and well-being of Project-affected People, households and communities such that they are at least as well off, if not better than before development of the Project. The Company is committed to design, develop and operate the Project in a manner that would protect the quality of life for local residents, improve living conditions, provide needed community infrastructure, enhance skills and employment opportunities, encourage business development and protect human health in the area. Many of the programmes to obtain these objectives have already commenced (see **Section 9.0, Consultation**) and others would be initiated prior to mine development. All programmes would be developed in concert with stakeholders.

The Company would implement a monitoring and evaluation process to accurately measure progress of each of the programmes listed below, which would be designed to meet objectives listed above. Monitoring would consist of: (1) internal monitoring by the Company as an integral part of the Newmont management scheme (see **Annex A-3**), (2) external monitoring by Company-appointed consultants, working with the impacted communities and (3) participatory monitoring with Community representation to the extent possible. Monitoring activities would include audits and conventional sample verification surveys. The programmes include:

- Resettlement and Relocation of Local Communities
 - Resettlement Action Plan
 - Livelihood Replacement Programme
 - Vulnerables Programme
- Local Infrastructure Pressures
 - Influx Management Plan
- Employment, Training and Educational Opportunities
 - Employment and Operational Skill Training Plan
 - Influx Management Plan
- Local Economic Opportunities and Business Development
 - Small and Micro Business Plan
 - Akyem Linkages Programme
- Community Health and Safety
 - Community Health and Safety Plan
- On-going Public Consultation and Disclosure
 - Grievance Management
 - Issues tracking and feedback

The results of this monitoring would be captured and analysed using the established Akyem Information Management System. Results of internal and external audits of these various programmes and the degree to which the various policies and plans are implemented successfully would be presented in audit reports, to be issued routinely to the EPA and other entities, as requested.

6.4 POST-CLOSURE MONITORING

Procedures for short- and long-term monitoring of the Proposed Mining Area after closure would be established to ensure that mining activities do not affect surrounding areas. This will be a continuation of the operational monitoring programme. Specifics of the post-closure monitoring programme would be reviewed and approved by the EPA as part of the Project Closure and Decommissioning Plan. The types of monitoring to be conducted in the post-closure phase of the Project would be agreed upon with the EPA and the overall monitoring plan would be updated as mining and reclamation activities progress. An environmental report would be submitted at a frequency prescribed by EPA to satisfy regulatory requirements.

In concept, short-term monitoring in the post-closure phase of the Project would include groundwater and surface water resources (including runoff), pit lake quality and rate of recovery, fugitive dust, revegetation success, open pit condition and stability and Waste Rock Disposal Facility and Tailings Storage Facility effluent quantity and quality. Short-term monitoring would be performed on a monthly basis during active closure and reclamation of facilities and continue for three years or until monitoring data and observations indicate

stable conditions. Water resource samples (groundwater, surface water, pit lake water, runoff and Waste Rock Facility and Tailings Storage Facility effluent) would be analyzed for a parameter list to be developed in concert with the EPA but would likely include, at a minimum, several metals. Air monitoring stations would be maintained from the operational phase and sampled for fugitive dust. Revegetation would be inspected for soil stability and erosion, biodiversity, effective vegetative cover and growth and compared to a set of agreed-upon reclamation success criteria.

Long-term monitoring would consist of a combination of observations, measurements and sample collection and analysis for water and air quality on a less intensive schedule (quarterly or bi-annually). The proposed long-term schedule for water resources and air sampling and site observations would be agreed upon with the EPA and would be reflective of improvement in site conditions.

Short-term monitoring of the human environment would be performed regularly (e.g., bi-annually) for a three year period to verify operational monitoring conditions following completion of reclamation of the Proposed Mining Area. Post-closure monitoring would include an evaluation of the status of reclaimed land and its agricultural use, physical infrastructure (buildings and utilities) turned over to the local community by the Company and the economy of the local communities.

Long-term monitoring would be performed annually for a period of time following completion of the short-term monitoring plan and would consist of a combination of quantitative and qualitative surveys to collect and analyze data against baseline and short-term monitoring programmes. This proposed schedule for post-closure monitoring would be evaluated as reclamation and closure activities near completion as well as near the end of the long-term post-closure monitoring period to ensure goals and objectives have been met.