Executive Summary

1 Introduction

M/s. Hutti Gold Mines Company Limited (HGML), Government of Karnataka Undertaking, has the unique distinction of being the only producer of primary gold in India. HGML has been active in the exploration, development and exploitation of gold deposits occurring in Karnataka. Till now over 86.26 tonnes of Gold has been produced and still the gold reserves estimated are around 10.21 million tonnes of 5.35 g/t. HGML has applied for mining lease over an extent of 62.72 Ha. (155 Acres) at Sy No. 93, 94 and 371 in Guddada Rangavana Halli Village in Chitradurga Taluk & District, Karnataka for mining of Gold, Silver and Copper. The Department of Mines & Geology, Government of Karnataka in their letter No: DMG: RPS: 197AML 1994, 2012-13 dated 19th April 2012 had advised for obtaining the various statutory clearances.

2.1 Project Description

2.2 Project Location

The proposed project is located in G.R.Halli Village, Chitradurga Taluk & District of Karnataka.

2.3 Size and Magnitude of the Project

The total mine area is located in 62.72 Ha (155 Acres) which consists of mainly two reefs East reef and West reef. The total mineable reserves in this area are 3, 44,001 tons. It is proposed to produce 97,009 tonnes of gold (Au) ore during the first five years of the plan period and later to that balance 2, 46,992 tonnes shall be mined in remaining years. Details of ore reserves are given in **Table 1**

Table 1

Details of Ore Reserves

Category	Mineable Reserves (T)	UNFC Code	Cut-off grade
Proved Mineral Reserves	3,44,001	111	1.0g/t Au
Pre-feasibility Mineral Resources (Blocked Reserves within subsequent levels)	1,42,702	221	
Inferred Mineral Resources	5,61,422	333	
Total Geological Mineral Resources	**10,48,125**	-	-

2.3 Need of the Project

The capacity of the proposed project is to produce 250 TPD of gold ore by underground mining from 62.72 Ha. The total cost of the project is Rs.9.46 Crores. The entire mining lease area falls in revenue - agriculture land. As a part of open scrub there are trees and bushes

are found in the North Eastern side of the lease area. The ultimate land use of the lease area is given in **Table 2**

Table 2

Present Land Use and Land use during Plan Period

Particulars	Present Land use			Land use pattern during Plan period		
	Ha	Acres	Sq.m	Ha	Acres	Sq.m
Old working pits	0.04	0.10	400	0.04	0.10	400
Main shaft	0.11	0.27	1100	0.50	1.24	5000
Adits	0.21	0.52	2100	0.30	0.74	3000
Trenches	0.06	0.15	600	0.06	0.15	600
Roads	0.60	1.48	6000	1.00	2.47	10000
Buildings/ Infrastructure	0.04	0.10	400	1.00	2.47	10000
Wind mill	0.50	1.24	5000	0.50	1.24	5000
Green belt	0.00	0.00	0	0.75	1.85	7500
Afforestation	0.00	0.00	0	10.00	24.70	100000
Total	**1.56**	**3.85**	**15600**	**14.15**	**34.95**	**141500**
Virgin area/ Area undisturbed	61.16	151.07	611600	48.57	119.97	485700
Total Lease area	**62.72**	**154.92**	**627200**	**62.72**	**154.92**	**627200**

2.4 Topography & Drainage

The G.R.Halli Gold Mine is a flat to undulating terrain surrounded by low relief hills associated with agricultural lands. The highest elevation of the area is 822m and the lowest elevation of the area is 744m above mean sea level.

The drainage in the area flows from north east to south west. There are few water courses within the lease area that drains the rainwater outside the lease. A small bund is seen within the lease area, which is constructed by villagers to harvest the rain water during monsoon.

2.5 Proposed Schedule

The life span of mine lease area is 14 years and during the first five years of mining plan period the mining shall be done at different levels, especially on level I (752.2mRL), level II (725.8mRL), level III (700mRL), level IV (675mRL), level V (650mRL), level VI (625mRL) and level VII (600mRL) within the proved mineral resource. The production pattern for first five years varies from 8000 to 22000 tonnes from Shafts, Winzes and Stope with a total of 97,009 tonnes. A total of 4440 tonnes are expected during first five years with an average ore to waste ratio of 1:0.05.

2.6 Shrinkage Stoping

The shrinkage stoping method is proposed at Hutti Gold Mines, GR Halli (Village), Karnataka. The shrinkage stoping is a method to excavate one slice of ore and filling back the same by waste rock. This fill forms the platform for workmen and machinery to work

on to excavate the next slice. The slices are taken from lower level to the upper level. Jackhammer will be used for drilling; blasting will be conducted by conventional explosives.

2.7 Transport of Ore

The blasted ore in the underground mine is transported to main underground bin by means of granby cars. The material dumped in the ore bins are hoisted up by the means of skips. Lorry transport is employed for transporting of ore from the main surface bin to the crusher plant at Ingaldhal Copper Mines, Chitradurga, which is about 18km away from the mine area.

2.8 Manpower

Around 174 persons will be employed in the present mine including skilled and semi skilled professionals. Large number of local personnel including land loosers would be mostly recruited in unskilled, semi skilled, office assistant categories etc.

2.9 Blasting

In the underground mine, drilling will be carried out by pneumatically operated jack hammers (mounted on air leg). The holes of 33mm diameter are drilled in two patterns i.e. the Wedge cut pattern and Burn cut pattern. Blasting is done electrically, using delay detonators (half second and mill second delay interval), Emulsion explosive of 25mm & 240mm dia cartridge of 140gm are used in combination of slurry explosives SDD (short delay detonators) and LDD (long delay detonators). The leads of the detonator of one face are connected in a series. These leads are connected to a blasting cable, whose other end is at a safe and secure place, away from the site of blasting. The blasting current is given from an electronic exploder capable of giving sufficient current to the full charge of the face.

2.10 Generation of Solid waste

During the course of mining through the development of haulage drives, cross cuts, development of ore bins etc., around 4440 tonnes of waste rock shall be generated during the five years of the mining plan period. Out of which 80% will be utilized for construction of roads and 20% of quantity shall be backfilled in the stopes and the rest will be hoisted to the surface and will be used as road ballets. Domestic solid waste will be generated from the admin building is around 40kg/day and which will be handover to the municipal authorities.

2.11 Energy and Water Requirement

Power required for mining activities is expected to be 500kv. The power will be supplied from Karnataka Electricity board. Diesel generator of 185kvA capacity will be provided as a backup during power failure. 26 KLD of water will be required to carry out the mining

activities like drilling and blasting, domestic usage and fire fighting. The water requirement for green belt is around 7KLD which will be met through the bore well during initial stage of mining and later the mine sump water will be used after appropriate treatment.

2.12 Mine seepage water

The total amount of water produced from the underground mine drain depends upon the area of the shaft and length of the shaft. The proposed mining lease area contains only one Main shaft with 3m *3.2m sizes and is expected to develop up to VII level in the mining plan period of 5 years. As the ground water table is present at 700mRL, the mining activity reaches ground water at III level, which is at a depth of 712-697mRL. The yield of water at site area is varies from 1 to 5 litres per second. The yield of water during mining activity is depends on the ground water recharge and availability of water in water table. The mine seepage water will be used for plant activities and remained amount of water if any will be stored in the overhead tank located at upstream of the mine for sedimentation of solids then it is supplied to the adjacent villagers through natural drain.

3 Baseline Status

The baseline data was collected for various environmental components to compute the impacts that are likely to be arising out of the mining activities covering an area of 10km radius from the proposed mine.

3.1 Meteorology (Climate)

Meteorological data was collected for the study area during the months of winter season (December, January, February (2014-15)). Wind Speed, Wind Direction, Temperature, and Relative Humidity were recorded on hourly basis during the study period.

Project area falls under the central dry zone of Karnataka. For the winter season the winds were predominantly recorded from E followed by NE, ENE and ESE. Calm conditions prevailed for 10.6% of the total time and the average wind speed for the season i.e. December -2014 to February-2015 is 2.33 m/sec. The average maximum temperature is 36.1^{0}C and minimum is 16.9^{0}C. The Humidity is highest in the month of August at 86 %.

3.2 Air Quality

Around 11 Ambient Air Quality Monitoring locations were monitored for SO_2, NO_x and Particulate Matter (PM) <2.5µm and <10µm in the study area.

- Range of 98th percentile of PM <2.5µm is 16.1 to 24.1µg/m^3 and the range of PM<10µm is between 49.0to 68.2 µg/m^3.
- Range of 98th percentile of SO_2 is 13.4 to 20.4µg/m^3 and the range for NO_x is between 15.9 to 24.2µg/m^3

- O_3 values were in the range of 14.2 to 22.3µg/m^3.

The observed air pollutants were within the limits as per NAAQ standards.

3.3 Water Quality Status

Around 10 ground and 2 surface water samples were collected to assess the water quality. The ground water samples were drawn from bore wells of villages being used for domestic needs. Surface water samples were taken from lakes.

Ground Water

- The pH is varying from 7.11 to 8.11, indicating within acceptable limits.
- TDS levels are varying from 384 mg/l to 2136 mg/l, indicating that one sample is below the acceptable limit, 8 samples were above the acceptable limit but within the permissible limit and one sample is above the permissible limit.
- Chloride levels are ranging from 79 mg/l to a maximum of 623 mg/l which are within permissible limits.
- Hardness is varying from 252 mg/l to 1461 mg/l. Hardness in 6 samples were above the acceptable limit but within the permissible limit and 4 samples were above the permissible limit.
- The fluoride levels are in the range of 1.0 mg/l to 1.68 mg/l indicating 9 samples are within the permissible limit and one sample is above the permissible limit.

Surface Water

- pH was varying between 7.40 to 7.71.
- The total dissolved solids were in the range of 278 mg/l to 324 mg/l
- The chlorides were in the range of 75 mg/l to 80 mg/l
- The hardness is varying between 155 mg/l to 185 mg/l.
- Fluoride content was in range of 0.23 mg/l to 0.26 mg/l

Analysis of groundwater samples were found to be within acceptable limit, but hardness and dissolved solids in most of the samples seem were above permissible limits. Surface water samples in the study area are meeting Class A norms as per IS: 2296-1982.

3.4 Noise Quality

Baseline noise levels were monitored at 11 locations, using continuous noise measurement device. Day levels were monitored during 6 AM to 10 PM and the night levels during 10 PM to 6 AM. The day equivalents are ranging between 52.6 to 60.4dB (A) whereas the night equivalents were in the range of 41.4 to 44.2 dB (A). From the results it can be seen that the Day equivalents and the Night equivalents were within the Ambient Noise standards of residential areas except in one sample (Chitradurga), where the day equivalent is above the residential area standards.

3.5 Soil Quality

Around 11 sampling locations were selected to assess the existing soil conditions representing various land use and geological features. The results are:

- pH values are varying from 7.85 to 8.93 indicating that the 9 samples are falling in normal to saline class and 2 samples are falling in tending to become alkaline class.
- Electrical conductivity is varying from 63 to 242 µs/cm indicating Normal category, soils and do not indicate any hazard to soil, agriculture and ecological balance.
- The Organic Carbon is varying from 0.36 – 0.86 % indicating 5 samples are in low range, 5 samples are in medium range and 1 sample is showing high range of carbon.
- Available Nitrogen is varying from 252 to 348 kg/Ha indicating 3 samples are falling in low range and remaining 8 samples are falling in medium range.
- Available Phosphorus is varying from 6.1 to 22.6 kg/Ha, which indicates that 3 samples are falling in low range and 8 samples are falling in medium range.
- Available Potassium in the study area is varying between 58.9 to 110 kg/Ha which indicates that indicates that all samples are falling in low range.

3.6 Flora & Fauna

Ecological survey was done to understand baseline ecological status, important floristic elements, fauna structure. Secondary data was collected from Forest Working Plan and Gazetteers.

The dominant tree species found in the area are *Buchanania lanzan*, *Anogeissus latifolia*, *Wrightia tomentosa*, *Grewia orbiculata*. Few climbers and twiners like *Celastrus paniculata*, *Cocculus hirsutus*, *Aristolochia indica*, and *Asparagus racemosus* are also observed. Shrubs like *Calotropis procera*, *Calotropis gigantea*, *Cassia auriculata*, *Tecoma stans*, *Dodonaea viscosa*, *Gardenia gummifera*, *Clerodendrum serratum* etc., are a part of this type of vegetation. The grasses species like *Andropogon pumilus*, *Apluda mutica*, *Brachiaria eruciformis*, *Chrysopogon fulvus*, *Cymbopogan martini*, *Cynodon dactylon*, *Heteropogon contortus* etc. are present in the study area.

There is no national park, wildlife sanctuary, biosphere reserve within 10km of the study area. The project site does not have any species which fall under the Schedule I of The Indian Wildlife (Protection) Act, 1972 or under threatened category of The IUCN Red List of Threatened Species.

3.7 Socio Economics

Sample survey was done to collect qualitative information about the socio economic environment of the area. The Study area is mostly inhabited by economically weaker

section people. Lack of amenities such as roads, drinking water, dwellings, lavatories, and education, employment, medical and electricity facilities was evident during the site visit.

Though agriculture is the main occupation in the studied villages, it has provided employment opportunities to only 50-60% of the families. The remaining population is depending on the other type of employment opportunities mainly as laborers.

4 Anticipated Environmental Impacts and Mitigation Measures

4.1 Impact on Air Quality

The Predicted maximum Ground level concentration of 24 Hour average of particulate matter concentration is superimposed on the maximum baseline concentration obtained during the study period to estimate the post project scenario, which would prevail at the post operational phase. As the proposed project is an underground mine, there will be only less emissions during mining and the emission rates will be more during transportation of ore from the mine to plant crushers at Ingaldhal.

The predicted incremental rise of particulate matter is 1.14µg/m^3. The overall post project scenario along with existing baseline concentration of particulate matter is found to be70.94 µg/m^3, against the NAAQ standards of 80µg/m^3.

4.1.1 Mitigation Measures

- Wet drilling method will be employed while carrying out the mining to decrease the dust generation.
- The underground workings of the mine will be well ventilated by adequate ventilation arrangements. The requirements and standards specified in this regard by Director General of Mines Safety (DGMS) would be adhered.
- Effective water spraying arrangements will be done in underground working places, at haulage junctions, ore loading bunkers at pithead on surface, at main haul roads within the mine, approach roads to the mine and other transfer points.
- Enclosures at ore transfer points and watering of roads at regular intervals.
- Water sprinkling will be carried out by both fixed and mobile sprinklers on internal transport road, transfer points, critical areas, loading and unloading points.
- Periodic maintenance of machinery and vehicles etc.
- All the vehicles carrying raw materials will be covered with tarpaulin/plastic sheet; unloading and loading activity will be stopped during windy period.

4.2 Impact on water quality

The total water requirement for the mining activities will be 26KLD. This will be met by bore wells in the starting stage of mining and once the mining activity touches the

ground water table the mine seepage water will be used for the same after appropriate treatment.

Waste water generated from the machines and workshops will be treated in O&G trap and domestic effluents will be treated in STP/ Soak pit. Treated water is used for greenbelt development to the maximum extent along with dust suppression.

4.2.1 Mitigation Measures

- The mine seepage water, which may contain ore fines needs sedimentation before discharge into the natural water course/ open land. The treatment facilities such as sedimentation, filtration and chlorination (as per the end use) will be provided for mine seepage water.
- Rain water harvesting structures will be constructed to collect the rooftop rainwater from the admin buildings. The water which is drained into the mine workings during rainy season will be collected and the collected water will be stored in overhead tank after appropriate treatment and the same will be utilized for mining activities and if remains it will be given to villagers for agriculture purpose.
- The excess mine seepage water is proposed to be pumped into overhead tank and from this it will be discharged into nearby natural streams which will be used by local villagers for agricultural purpose. This also augments recharge of the ground water regime. Hence negligible impacts will be felt due to mine water discharge.

4.3 Impact on Noise Environment

As the mining operations are carried out in underground, there will not be any significant impact on the existing noise levels. The increase in the noise levels in underground mine are limited to the work place. The major noise generating sources in the plant during operational phase will be drilling and blasting of ore, transportation and from the DG sets during power failure. The expected noise levels in the mine are 50-55 dB (A) which is well within the industrial area standards of 75dB (A).

4.3.1 Mitigation Measures

- Effective noise enclosures will be provided to attenuate the noise level. All the mining machines and equipments will be maintained and lubricated as per maintenance schedule.
- Fixed equipments such as pumps, compressors, fans, etc where practicable is located in positions where noise effects to residents in the vicinity are minimized.
- In the high noise intensity working areas/ zones, earmuffs or earplugs or any other suitable personal protective equipment would be provided to the workmen.

- Regular noise level monitoring would be done periodically for taking corrective action, wherever required.
- Green belt will be developed around the mine site, office buildings and all along the internal road to create a barrier or screen between the source and the receiver so that the noise is absorbed and the exposure level is minimized.
- It is therefore expected with these measures the exposure level will be within the permissible limits.

4.4 Impact on Land Use

The entire mining lease area falls in revenue and agriculture land and it is dry deciduous. There are some trees and bushes are found in the North Eastern side of the lease area. As underground mining will be practised, so there will not be any major land alteration is expected. Out of 62.72 Ha of lease area only 0.8 Ha of land is used for shafts and adits, hence most of the lease area will be untouched or virgin area.

4.4.1 Mitigation Measures

- The mining of ore will be carried out for only 5 years initially, though the life of mine is 14 years.
- Only 0.8Ha of land area is disturbed for mining and other allied activities during the plan period.
- During this mining plan period green belt will be developed near the mining activities and all along the road. Along with this afforestation will be carried out in 10Ha of land area in stage wise (2Ha in each year of the plan period).
- All the voids created during extraction of ore will be backfilled by the waste rock. The waste dumps created in the initial stage of the mine are reclaimed and the area will be used for green belt development.
- At the end of plan period all the mine openings will be properly sealed and fenced to prevent entry of humans or animals in the mine workings.

4.5 Impact due to Solid Waste

As the mining activity in the proposed area will be carried out by underground mining method so there will not be any stripping/removal of top soil. During the course of mining i.e. development of haulage drives, cross cuts, development of ore bins etc., around 4440 tonnes of waste rock shall be generated during the five years of the mining plan period. A small quantity of domestic waste will be generated from the workers residence and which will be handover to municipal authorities.

4.5.1 Solid Waste Management

- The waste rock generated will be used as a platform for workers while digging into deeper levels of the mine.

- Out of total waste rock generated, 80% will be utilized for construction of roads and 20% of quantity shall be filled slice wise in stoped out area.
- A strong wall shall be constructed with cement masonry to act as a safety barrier leaving the holes for seepage of water.
- The domestic solid waste generated from the workers residence will be segregated. The bio degradable waste will be used for composting and non bio degradable waste will be handover to authorised dealers.
- The sludge that will be generated from mobile STP will be used as manure for green belt development.

4.6 Greenbelt Development

Plantation will be initiated from first year of mining around the facilities wherever space is available. A thick plantation is proposed to be provided and maintained along the roads. The plantation is designed within the natural constraints of the site and species selection will reflect the flora known to be resistant to the local conditions. HGML maintains a well-established group of people to carry on the afforestation program over the mining areas and in the residential colonies of the company. Around 11,300 plants will be planted in the 5years of mining plan period.

4.7 Improvement in Socio Economic Environment

- The mine is located in the rural village of Chitradurga district where the economic and social level of the people is not satisfactory.
- The main occupation of the people is agriculture which is dependent on mainly rainfall of the area.
- The proposed mining activity will provide employment to nearly 600 people in both direct and indirect way.
- The company has a well laid corporate social responsibility plan which will provide/ full fill the basic needs of the villagers. There will be change in the social and economic conditions of the people due to the proposed project.
- Around Rs.9 lakhs, which is 1% of the total project cost will be allocated for CSR's activities until the production of mine and later 2-3% of every year company's profit will be used for the same.

5 Mining Technology

Shrinkage stoping method is the best suited technology with the prevailing geo mining conditions in this mine. In Shrinkage stoping the ore is generally mined in horizontal slices, starting from the bottom and advancing in the up dip direction. The hanging wall and footwall are supported by broken ore left in the mined out stope. This broken ore serves as the working platform for the operators in the stope, and sufficient ore is drawn out at the bottom, following blasting, to provide suitable headroom for the operators.

6 Environmental Monitoring Programme

6.1 Constructional Phase

The proposed project envisages construction of admin building, workshop and compressor shed. The constructional activities are expected to last for a short period and would involve Clearing of vegetation, Mobilisation of constructional material and equipments. Dust suppression will be done by regular sprinkling of water and providing mobile STP for treating waste water at the site.

6.2 Operational Phase

During operational stage of mine continuous air emissions (Particulate Matter emissions) and wastewater generation are expected. The following attributes will be regularly monitored based on the nature of industry and activities:

- Source emissions and ambient air quality;
- Groundwater Levels, ground water quality and Soil quality;
- Water and wastewater quality (water quality, effluent & sewage quality etc);
- Solid waste characterisation;
- Noise levels in and around the proposed project (equipment and machinery noise levels, occupational exposures and ambient noise levels); and
- Ecological preservation and afforestation.

7 Risk and Hazards

The proposed mining activities are subjected to various risks like dust from drilling, mine gas release, inundation and subsidence. Along with these there is possibility of accidents during material transport from underground to surface and from surface ore bin to beneficiation plant. A proper risk management plan will be proposed to avoid any kind of accident/ disaster.

8 Project Benefits

During primary data collection in the study area it has been noticed that there are good number of unemployed local youth in the surrounding villages, an action plan will be proposed to train the local employable youth, so that after relevant training they will be employed in the proposed project based on the requirement of different stages. An amount of Rs.9 lakhs which is around 1% of capital cost of the project (Rs.9.46 Crores) will be allocated towards CSR activities.

9 Environmental Management Plan

In order to keep a watch on the local environmental conditions (air quality, water quality and noise levels) monitoring shall be done regularly every year by taking measurements near the mine and residential areas preferably close to some of the earlier stations so as to keep a comparative check with respect to the base line data. Continuous air quality

monitoring on 24 hours sampling basis should be done for two days per week and analytical checks made for PM_{10}, $PM_{2.5}$, SO_2 and NO_x. For effective management of the environment, it is envisaged to have an organizational set-up under the administrative supervision of the mines management where responsibilities can be delegated to technical personnel like Mining Engineer, Geologist/ Chemist and Horticulturist with regard to specific aspects of environment management plan.

9.1 Budget provision for EMP implementation and monitoring

The feasibility report of proposed mine includes a financial assessment of the cost of development of the mine and its operation. Sufficient fund allocation has been made towards environmental management and monitoring by way of direct capital.

Table 3

EMP Implementation and Monitoring Cost (Rs.)

S. No.	Particulars	Capital Cost (Rs)	Recurring Cost (Rs)
1	Pollution Control	1750000	100000
2	Pollution Monitoring	705000	100000
3	Occupational Health	710000	100000
4	Reclamation	375000	50000
Total		**35,40,000**	**3,50,000**
Total cost of the Project is 9.46 Crores and 3.7% of it is allocated towards EMP Afforestation will be taken up in a phased manner at the rate of 2Ha/year and the cost for the same is 10 lakhs per year.			

10 Conclusion

It can be concluded from overall assessment of the impacts, in terms of positive and negative effects on various environmental components, that the mining activities will not have any adverse effect on the surrounding environment.

To mitigate any impacts due to the mining activities, a well planned EMP and a detailed post project monitoring system is provided for continuous monitoring and immediate rectification at site. Due to the mining activities, socio economic conditions in and around the project site are expected to improve substantially.